BACKHOE LOADER WORKSHOP MANUAL

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GENERAL INFORMATION

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GENERAL INFORMATION

BHA0001IA

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Service Techniques

General

The words 'front', 'rear', 'right-hand' and 'left-hand' used in this manual refer to the different parts of the machine as viewed from the Operator's seat, when facing the steering wheel.

Clean the exterior of all components before starting any type of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhauled components being more reliable and efficient in operation.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to O-rings and cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and also there is no risk to the personal safety of the user.

When replacing component parts, use the correct tool for the job.

Cleaning

⚠ **Caution:**

- **Care should be exercised to avoid skin rashes, fire hazards, and inhalation of vapours when using solvent type cleaners.**

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and agitated until all old lubricant and foreign material is dissolved and the parts are thoroughly cleaned.

Bearings

Remove bearings from cleaning fluid and strike flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. **Do not spin bearings when drying** . Bearings may be rotated slowly by hand to facilitate the drying process.

Housings

⚠ **Caution:**

- **Care should be exercised to avoid inhalation of vapours and skin rashes when using alkali cleaners.**

Thoroughly clean interior and exterior of housings, bearing caps, etc. Cast parts may be cleaned in hot solution tanks with mild alkali solutions, provided these parts do not have ground or polished surfaces.

Parts should remain in the solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water.

Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with a steam cleaner. All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft lint—free absorbent wiping rags, free of abrasive materials such as metal filings, contaminated oil or lapping compound.

Inspection

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

Bearings

Carefully inspect all rollers, cages and cups for wear, chipping, or nicks to determine fitness of bearings for further use. **Do not replace a bearing cone or cup individually** without replacing the mating cup or cone at the same time. After inspection, lubricate the bearings with suitable clean oil and wrap in clean lint—free cloth or paper to protect them until installed.

Oil Seals, Gaskets, Etc.

Replace O-rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or O-rings, regardless of condition. Always lubricate new seals and O-rings with suitable clean oil before installation.

Replacement of spring-load oil seals, O-rings, metal sealing rings, gaskets and snap rings is more economical when the unit is disassembled than premature overhaul to replace these parts at a future time.

Further loss of lubricant through a worn oil seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching or curling under the lips of seals seriously reduces their efficiency.

When assembling new metal type sealing rings, these should be lubricated with a light grease to stabilise rings in their grooves for ease of assembly of mating members.

Gears and Shafts

Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth show spots where case hardening is worn through or cracked, replaced with new gear. Small nicks may be removed with a suitable hone. Inspect shafts and quills to make certain they are not sprung, bent or spline-twisted, and that shafts are not bent.

Housings, Covers, Etc.

Inspect housings, covers and bearing cups to ensure that they are thoroughly clean and that mating surfaces, bearing bores, etc. are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions that would cause subsequent oil leaks or failures.

Hoses and Tubes

Always replace hoses and tubes if the cone end or the end connections on the hose are damaged.

When installing a new hose, loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

After hose replacement to a moving component, check the hose does not foul by moving the component through the complete range of travel.

Make sure any hose which has been installed is not kinked or twisted.

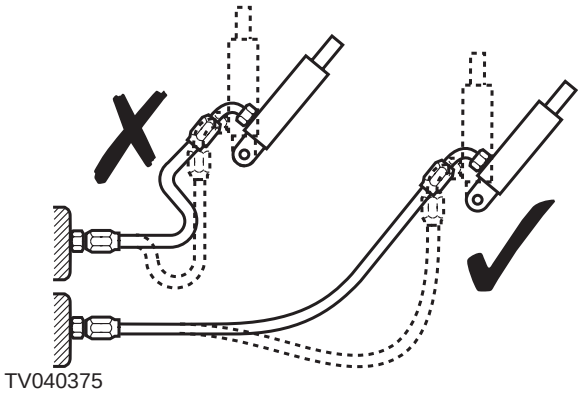
Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the component being served. Connectors which show signs of movement from the original swagged position have failed and will ultimately separate completely.

A hose with a chafed outer cover will allow water to enter. Concealed corrosion of the wire reinforcement will subsequently occur along the hose length with resultant hose failure.

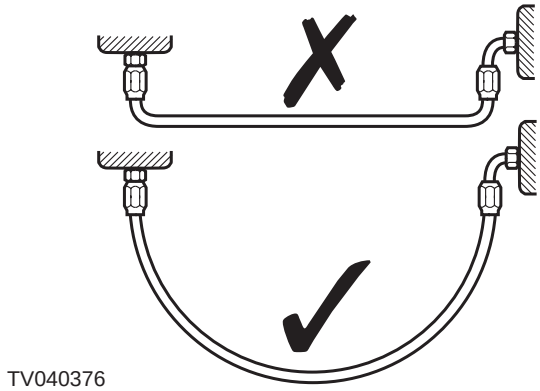
Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure will soon occur.

Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which can result in oil restriction, a reduction in the speed of operation and ultimately hose failure.

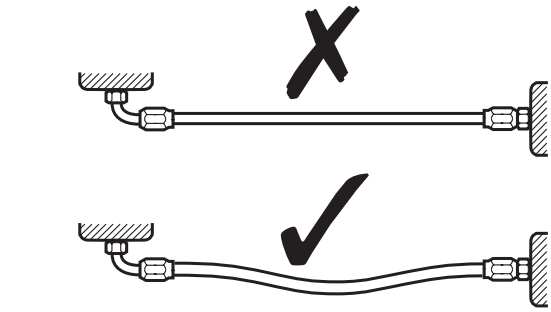
Free moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.



TV040375

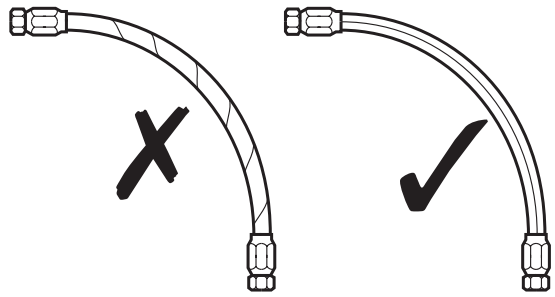


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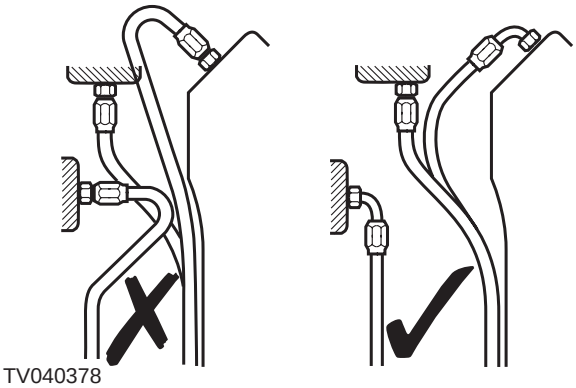


TV040377

Installing Flexible Hoses



TV040374



TV040378

VIN Definition

Item	Digit	Description/Values	Example
Manufacturer ID	S	Registered with BSI	S
	M		M
	F		F
Product Variants	X	**H** =Terex/TCE, **G** =Fermec	H
Transmission	X	**4** =4 Speed Synchro Shuttle, **3** =3 Speed Syncro Shuttle, **6** =4 Speed Power Shift, **5** =3 Speed Power Shift	5
Drive	X	**4** =4WD, **2** =2WD	4
Digging Length	X	**S** =4.5 Std, **T** =4.5 Ext, **L** =4.9 Std, **E** =4.9 Ext, **N** =None	T
Operator Compartment	X	**C** =Cab, **R** =ROPS	C
Loader Element Function	X	**0** =Mechanical, **N** =None	0
Production Year	X	BSA U175 Model Year, **1** =2001, **2** =2002, **3** =2003, **4** =2004 etc..	4
Chassis Type	X	See Table 1 Below	C
Engine Type	X	**F** =68.5 kW, **G** =74.5kW	G
Digging Element Function	X	**M** =Mechanical, **N** =None	M
Serial Number	X	Machine Serial Number	3, 6, 5, 7

Table 1 — Chassis Type

Digit	Type
A	2WS/Base/Sideshift (820)
B	2WS/Base/Centre Mount (820)
C	2WS/Main/Side Shift (860)
D	2WS/Main/Centre Mount (860)
E	4WS/Side Shift (970)
F	4WS/Centre Mount (970)

For additional information, refer to the Operator's Manual.

Fluids and Lubricants

Specifications

System	Temperatures		Viscosity	Specifications	Capacities (Litres)	Notes
	From	To				
Engine Turbocharged – 1100 Series 820/860/970	-40°C	+40°C	0W – 40	EMA DHD-1 or CH-4 API CH-4 ACEA E3 or E5	7.3	If sulphur content in fuel is above 0.2% of mass (2000ppm), change oil and filter every 250 hours)
	-30°C	+40°C	5W – 40			
	-10°C	+50°C	15W – 40			
Transmission Synchro Shuttle 820/860	ALL		10W	ATF	22 (Total System)	Check oil level with engine running at idle. Clean suction strainer at oil change
Transmission Powershift 860/970	ALL		10W	ATF	23 (Total System)	Check oil level with engine running at idle: Approved oils: ATF Elfmatic G3 Esso D (21611)
Front Axle 820/860	ALL		80W – 90	API GL5 MIL-L-2105D	6.5 + 1 + 1	As Alternative: Agip Rotra Multi THT Esso Torque Fluid 62 Mobil Fluid 422 or 424
Front Axle 970	ALL		80W – 90	API GL5 MIL-L-2105D	7.5 + 1 + 1	As Alternative: Agip Rotra Multi THT Esso Torque Fluid 62 Mobil Fluid 422 or 424
Rear Axle 820/860	ALL		80W	API GL4 M1135	14.5 + 1.5 + 1.5	Approved oils: Agip Rotra Multi THT Esso Torque Fluid 62 Mobil Fluid 422 or 424
Rear Axle 970	ALL		80W	API GL4 M1135	14.5 + 1.5 + 1.5	Approved oils: Agip Rotra Multi THT Esso Torque Fluid 62 Mobil Fluid 422 or 424
Hydraulics	Up to +30°C		ISO VG 46	DIN 51524	143 (Total System)	Tank Capacity = 85 Litre
	Up to +50°C		ISO VG 68			
Greasing – General	ALL		EP-NLGI	Grade 2		EP-Lithium based
Greasing - Backhoe swing	ALL		EP–NLGI	Grade 2		EP-Lithium based with Molybdenum disulphide (MoS2)

Greasing - Propeller Shafts	ALL	EP–NLGI	Grade 2		EP-Lithium based with Molybdenum disulphide (MoS2)
Greasing - Dive Shafts U.J					
Greasing - Axle(s) King Pins					
Coolant	Up to -33°C		BS 6580-1992 ASTM D3306	16 (Total System)	Antifreeze=33%
	Up to -50°C				Antifreeze=50%
Fuel	ALL			130	Cetane: Minimum 45 Sulphar content: Maximum 0.2% (of mass)
Air Conditioning			CFC 134 A	1200 gr (Initial Charge)	Recharge=900 – 1000gr

Service Schedule

System	Service Schedule (Hours)					
	10	50	250	500	1000	Yearly
Engine Turbocharged – 1100 Series 820/860/970	C			R		
Filter 2654403				R		
Transmission Synchro Shuttle 820/860		C			R	
Filter 6190810M1				R		
Transmission Powershift 860/970		C			R	
Filter 6193480M91					R	
Front Axle 820/860			C		R	
Front Axle 970			C		R	
Rear Axle 820/860			C		R	
Rear Axle 970			C		R	
Hydraulics		C			R	
Filter 3515328 M92					R	
Greasing – General	G					
Greasing - Backhoe swing	G					
Greasing - Propeller Shafts		G				
Greasing - Dive Shafts U.J			G			
Greasing - Axle(s) King Pins	G					
Coolant	C					C
Fuel					D (Tank)	
Filter 26560201				R		
Air Conditioning						C
C=Check, D=Drain, G=Grease, R=Replace						
NOTE: Synchro Shuttle Transmission oil level is checked with the engine running at idle and hot oil. **NOTE:** Distance from the flat on top of dipstick to the 'H' and 'L' marks 929mm respectively. Total length 952mm.						

Sealing and Locking Fluids

Type	Description
Loctite 242	Medium strength thread lock
Loctite 243	Medium strength oil tolerant sealant
Loctite 270	Maximum strength stud lock
Loctite 496	Instant Adhesive
Loctite 510	High temperature flange sealant
Loctite 542	Fine thread sealant
Loctite 638	Maximum strength retaining compound
Loctite 648	High strength/rapid cure retaining compound

General Specifications

Engine

Engine	Low Power (820)	High Power (860 – 970)
Make	Perkins	
Model	1104C–44T	
Bore and Stroke	105x127mm	
Capacity	4400 cc	
Compression Ratio	16.5:1	
Firing Order	1 3 4 2	
Type	2164/2200	2166/2200
Build List (With Air Con)	RG38043	RG38044
Build List (Without Air Con)	RG38100	RG38099
Power @ 2200rpm	68.5kW (92 HP)	74.5kW (100 HP)
Torque @ 1400rpm	395Nm	415Nm
Turbocharger	Garrett GT 25, with wastegate	
Perkins P/N	2674A226	
Wastegate beginning to operate pressure	1.0 +/- 0.05bar	
Injection Pump	Delphi	
Model	DP210	
Type	1398/2644H013	1405/2644H023
Setting Code	XR/2/2350	DT/2/2350
Perkins Type	9320A212G	9320A342G
Perkins P/N	2644H002	2644H003
Injection Advance	0.5° BTDC	
Timing	Pin Timed 0° ATDC	
Speed at which cut off starts under full load	2200 +/- 25rpm	
Maximum No Load Speed	2350 +/- 25rpm	
Idle Speed	700 – 1200rpm	

Injectors	Delphi
Type	LJBX6921101
Perkins P/N (Nozzle)	2645K611
Opening Pressure	290 +/- 8bar
Colour Code	Yellow
Fuel Feed Pump Pressure	0.1 – 0.7bar
Valve Lash (Cold) – Inlet	0.20mm
Valve Lash (Cold) – Exhaust	0.45mm
Valve Arrangement	IE IE IE IE
Cold Start System	Glow Plugs (4)
Make	Beru
Perkins P/N	2666A016
Initial Current	30A Immediately Reduced to 21A
After 8 sec	14A
After 20 sec	10A
After 60 sec	9A
Cold Start Sensor	Normally Open
Perkins P/N	2848A127
Closes at	50 +/- 3°C
Re–opens at	40 +/- 3°C
Radiator Cap Pressure	110kPa
Thermostat	Wax Element By-pass Blanking
Perkins P/N	2485C041P
Nominal Temperature Stamped on Thermostat	82°C
Start to Open Temperature	79 – 84°C
Fully Open Temperature	93°C
Minimum Valve Lift Fully Open	10mm
Lubrication	Rotor Pump
Minimum Oil Pressure at Max rpm	3.0bar

Transmission

Transmission	Synchro Shuttle	Power Shift
Make	Turner	Dana
Model	COM-T4-2032	121-4FT 16000-22
Fermec P/N	6108873M91	6108875M91
Torque Converter Stall Ratio	3.01:1	2.60:1
Pump Pressure	18.0bar	20.5 – 23.5bar
Clutch Pressure	16bar	20.5 – 23.0bar
Torque Converter Working Pressure	–	4.9 – 5.0bar
Torque Converter Safety Valve Pressure	6.5 – 7.5bar	9.0bar
Solenoid Pressure	–	9.5bar
860 Transmission Control Unit	–	4503428
970 Transmission Control Unit	–	4503427
Lubrication Pressure	1.5 – 3.0bar	0.4 – 0.5bar

Brakes

Brakes	Oil Immersed Disk Type in the Rear Axle
Booster	Transmission Pressure Activated
Boost ratio	2.60:1
Master Cylinders Diameter	31.75mm (1 1/4”)
Master cylinder seals	Specific for Mineral Oil
Brake Disks	
Friction Discs (820–860)	2 Each Side
Friction Disks (970)	3 Each Side
Brake Piston Seals	Specific for Mineral Oil

Axles

Axles	Synchro Shuttle	Power Shift
Make	Carraro	
820 Front Axle – Type	26.18LP	–
Carraro P/N	148092	–
Fermec P/N	6109000M91	–
820 Rear Axle – Type	28.43M	–
Carraro P/N	146157	–
Fermec P/N	6109183M91	–
860 Front Axle – Type	26.18LP	–
Carraro P/N	148093	–
Fermec P/N	6109144M91	–
860 Rear Axle – Type	28.43M	–
Carraro P/N	146157	–
Fermec P/N	6109183M91	–
860 Front Axle – Type	–	26.28LP
Carraro P/N	–	1480648
Fermec P/N	–	6109145M91
860 Rear Axle – Type	–	28.43M
Carraro P/N	–	143739
Fermec P/N	–	6109184M91
970 Front Axle – Type	–	26.28LP
Carraro P/N	–	148930
Fermec P/N	–	6109146M91
970 Rear Axle – Type	–	26.43LP
Carraro P/N	–	148405
Fermec P/N	–	6109185M91

Steering

Steering Orbitrol	Closed Center Type
Make	Rexroth
Dispaced Oil per Revolution	160cc
MRV Setting Pressure	175bar (170min – 178max)
Antishock Valves Opening Pressure	240bar +/-5
MRV Adjustment	+1 Turn=+26.6bar
Antishock Valves Adjustment	+1 Turn=+105bar
Special Tool for Adjusting MRV / Rexroth P/N	E35/:36064
Special Tool for Adjusting AS Valves / Rexroth P/N	E35/:36949

Hydraulics

Hydraulics	820	860 – 970
Tandem Gear Pump Make	Commercial	
Pump 1 Flow	80 l/min	80 l/min
Pump 2 Flow	62 l/min	80 l/min
Pump 1 Pressure	225bar (225min – 232max)	225bar (225min – 232max)
Pump 1 Pressure	207bar (207min – 214max)	207bar (207min – 214max)
Control Valves	Closed Center Type and Inlet Compensator	
Make	Rexroth	
Loader Control Valve Type	SX14 – 3 Spool	
Backhoe Control Valve Type	SX14 – 7 Spool	
Spool Leakage Oil Flow @ 100bar	11cc/min	
Compensator Pressure (Engine @ 1800rpm)	20bar (20min – 21max)	
Spool Stroke	+/- 8.0mm	
Tie Rod Nuts Tightening Torque	42Nm +/-4	
Ride Control System Gas	Nitrogen	
Gas Charge Pressure	25bar	

Electrics

System Voltage	12V Negative Ground
Battery Capacity (Single)	105Ah
Battery Capacity (Double)	70Ah
Alternator	14V
Make	Denso
Type	A115i
Capacity (Without Air Con)	75A
Perkins P/N	2871A302
Capacity (With Air Con)	100A
Perkins (P/N)	2871A304
Starter Motor	
Make	Denso
Type	P95RL
Power	3kW
Hydraulic Control Valve	
Clamp Solenoid Resistance	7.6Ω at 20°C

Industrial Equipment

Extendable Dipper	
Top Bolt Torque	920Nm +/- 120
Bottom Bolt Torque	140Nm +/- 5
Clearance between Inner and Outer Member	Less than 1.0mm

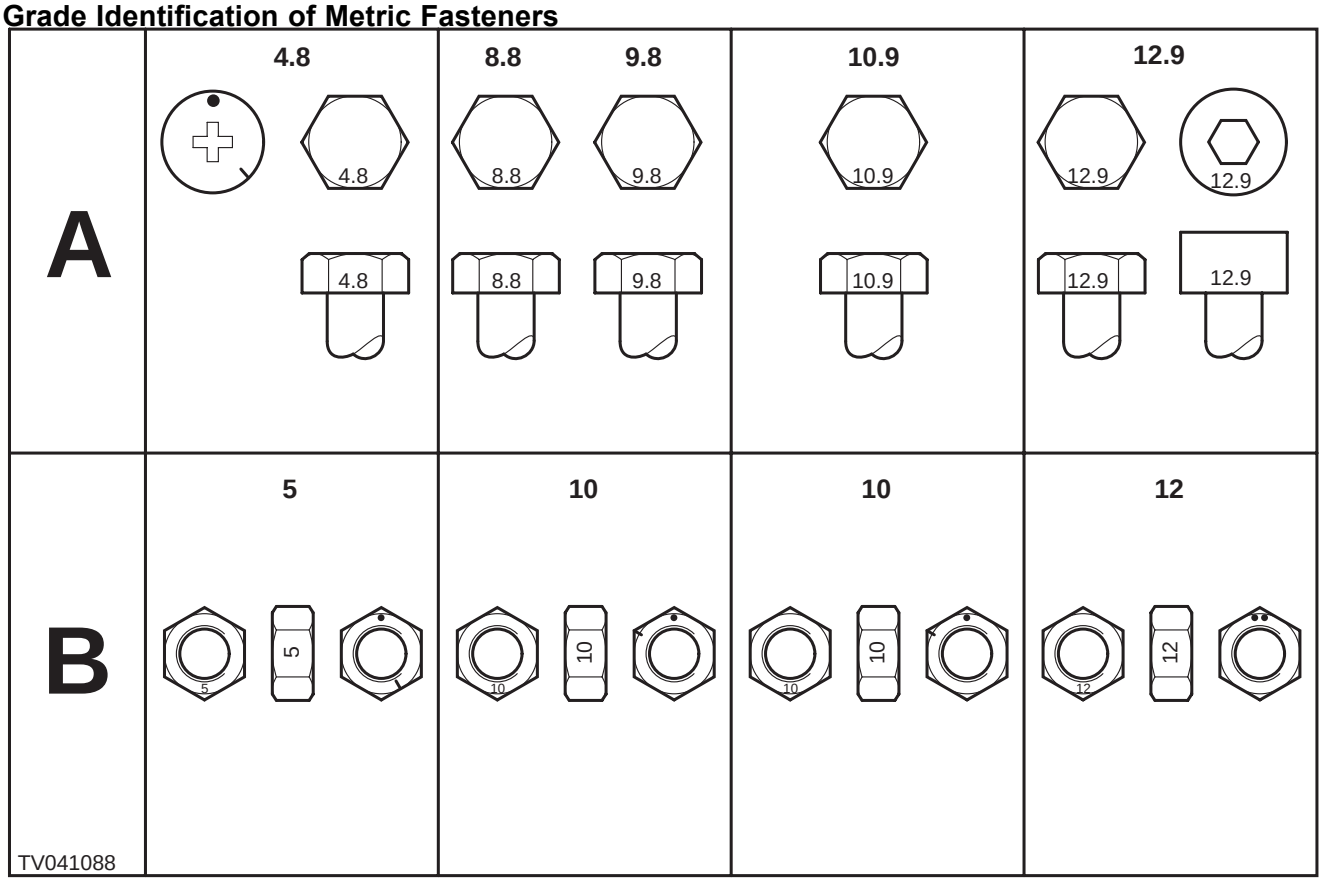
Stall Speeds

	820	860 SX	860 PS	970
	RPM			
Max Engine RPM No Load	2350 +/- 25	2350 +/- 25	2350 +/- 25	2350 +/- 25
Stall against Hydraulics @ 225bar	2300 +/- 25	2300 +/- 25	2300 +/- 25	2300 +/- 25
Stall against Transmission	2150 +/- 25	2200 +/- 25	2200 +/- 25	2200 +/- 25
Stall against Transmission and Hydraulics	1575 +/- 25	1625 +/- 25	2000 +/- 25	2000 +/- 25
Stall against Transmission, Hydraulics and Steering	1575 +/- 25	1625 +/- 25	2000 +/- 25	2000 +/- 25

Torque Values

Use the following torques when specifications are not given in the procedures.

Grade Identification of Metric Fasteners



A — Grade and head markings of Retaining Bolts and Cap Screws
B — Grade and head markings of Retaining Nuts

Torque Values For Metric Fasteners (Zinc Coated)

These torque values are applicable to threaded fasteners assembled with coarse and fine threaded retaining nuts, threaded holes with or without flat washers or lock washers, full height weld nuts.

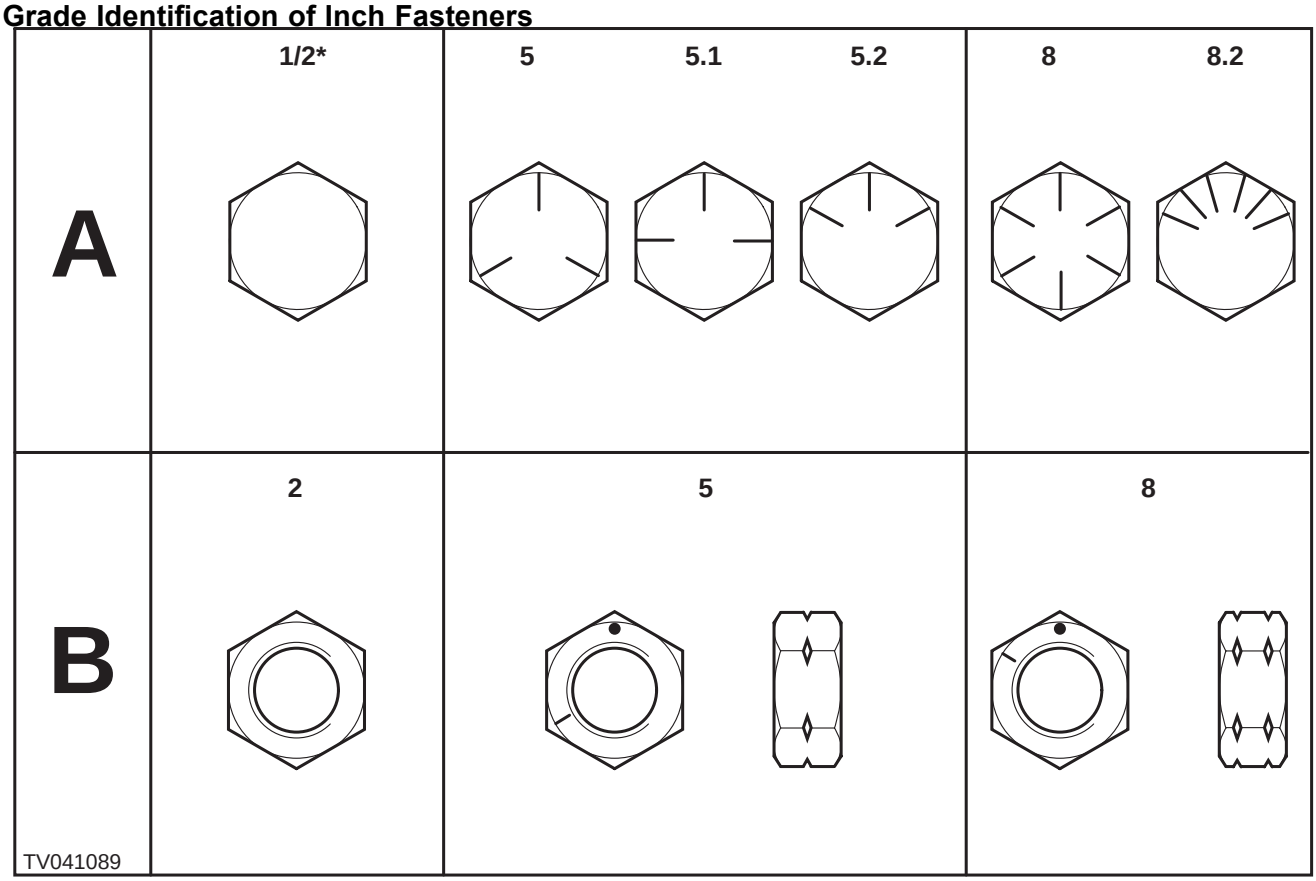
Size	Grade of Metric Fasteners							
	4.6		8.8		10.9		12.9	
	Nm	Lb.ft	Nm	Lb.ft	Nm	Lb.ft	Nm	Lb.ft
M3	0.5	0.5	1	1	2	1	2	1
M4	1	1	4	3	5	4	6	4
M5	2	1	7	5	10	7	12	9
M6	5	4	12	9	17	13	20	15
M8	11	8	30	22	41	30	48	35
M10	22	16	60	44	84	62	97	72
M12	38	28	105	77	140	103	162	119
M16	97	72	230	170	350	258	406	299
M20	185	136	490	361	700	516	812	599
M24	320	236	840	620	1150	848	1334	984
M30	630	465	1600	1180	2450	1807	2096	1546
M36	1100	811	2900	2139	4200	3098	3594	2651

Torque Values For Metric Fasteners

These torque values are applicable to threaded fasteners assembled with zinc coated and waxed lock nuts, phosphate coated retaining nuts or bolts, reduced height “jam” nuts, reduced height weld nuts.

Size	Grade of Metric Fasteners							
	4.6		8.8		10.9		12.9	
	Nm	Lb.ft	Nm	Lb.ft	Nm	Lb.ft	Nm	Lb.ft
M3	0.5	0.5	1	1	1.5	1	2	1
M4	1	1	3	2	4	3	5	4
M5	2	1	6	4	8	6	9	7
M6	4	3	10	7	14	10	16	12
M8	9	7	24	18	33	24	38	28
M10	18	13	48	35	67	49	78	151
M12	30	22	84	62	115	85	133	98
M16	78	58	185	136	280	207	325	240
M20	150	111	395	291	560	413	650	479
M24	260	192	670	494	920	679	1067	787
M30	500	369	1300	959	1950	1438	2262	1668
M36	880	649	2300	1696	3350	2471	3886	2866

Grade Identification of Inch Fasteners



A — S.A.E. Grade and head markings of Retaining Bolts

B — S.A.E. Grade and head markings of Retaining Nuts

* — Grade 2 applies for hex cap screw (not hex bolts) up to 152mm (6 inches) long. Grade 1 applies for hex cap screws over 152mm (6 inches) long, and for all other types of retaining bolts and screws of any length.

Note:

- Grades 1 and 2 have no markings.

Torque Values For Inch Fasteners (Zinc Coated)
These torque values are applicable to threaded fasteners assembled with coarse and fine threaded retaining nuts, threaded holes with or without flat washers or lock washers, full height weld nuts.

Size	Grade of Inch Fasteners					
	S.A.E. 1		S.A.E. 5		S.A.E. 8	
	Nm	Lb.ft	Nm	Lb.ft	Nm	Lb.ft
1/4	7	5	13	10	19	14
5/16	14	10	26	19	37	27
3/8	26	19	46	34	65	48
7/16	41	30	75	55	105	77
1/2	63	46	115	85	160	118
5/8	125	92	230	170	325	240
3/4	220	162	405	299	575	424
7/8	360	266	660	487	930	686
1	540	398	980	723	1400	1033
1 1/8	560	413	1220	900	1950	1438
1 1/4	790	583	1750	1291	2800	2065
1 1/2	1400	1033	3000	2213	4750	3504

Torque Values For Inch Fasteners
These torque values are applicable to threaded fasteners assembled with zinc coated and waxed lock nuts, phosphate coated retaining nuts or bolts, reduced height “jam” nuts, reduced height weld nuts.

Size	Grade of Inch Fasteners					
	S.A.E. 1		S.A.E. 5		S.A.E. 8	
	Nm	Lb.ft	Nm	Lb.ft	Nm	Lb.ft
1/4	6	4	10	7	16	12
5/16	11	8	21	15	30	22
3/8	21	15	37	27	52	38
7/16	33	24	60	44	84	62
1/2	50	37	92	68	125	92
5/8	100	74	185	136	260	192
3/4	175	129	325	240	460	339
7/8	290	214	530	391	745	550
1	435	321	785	579	1120	826
1 1/8	450	332	970	715	1560	1151
1 1/4	630	465	1400	1033	2240	1652
1 1/2	1130	833	2400	1770	3800	2803

Torque Values For JIC Hydraulic Hose Fittings

Hex. Size A/F		Termination Dash Size	Thread Size UNF	Machines Built With "Gates/Global" Hydraulic Hoses		Machines Built With "Manuli" Hydraulic Hoses	
mm	inch			Nm	Lb.ft	Nm	Lb.ft
—	9/16	04	7/16"-20	14	10	15	11
—	5/8	05	1/2"-20	18	13	20	15
—	11/16	06	9/16"-18	22	16	35	26
—	7/8	08	3/4"-16	41	30	50	37
24	—	10	7/8"-14	60	44	80	59
—	1	10	7/8"-14	60	44	80	59
27	—	10	7/8"-14	60	44	80	59
—	1 1/4	12	1 1/16"-12	90	66	100	74
—	1 1/2	16	1 5/16"-12	130	96	150	111

Torque Values For O-Ring Face Seal (ORFS) Hydraulic Fittings

Termination Dash Size	Inch Size	Thread Size UNF	Torque Value	
			Nm	Lb.ft
04	1/4	9/16–18	15	11
06	3/8	11/16–16	26	19
08	1/2	13/16–16	45	33
10	5/8	1–14	65	48
12	3/4	1 3/16–12	92	68
16	1	1 7/16–12	130	96
20	1 1/4	1 11/16–12	180	133
24	1 1/2	2–12	215	159

Torque Values For Split Flange Retaining Bolts

Size	Torque Value	
	Nm	Lb.ft
5/16–18	24	18
3/8–16	45	33
7/16–14	54	40
1/2–13	81	60
5/8–11	197	145

Torque Values For Dryseal Pipe (NPTF or Equivalent) Steel Fittings

Size Inch	Torque Value	
	Nm	Lb.ft
1/8	25	18
1/4	45	33
3/8	70	52
1/2	125	92
3/4	180	132
1	240	177
1 1/4	280	206

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GENERAL SAFETY

BHA0002IA

General Safety Considerations

Throughout this workshop manual you will see various WARNINGS, CAUTIONS and NOTES. Always read and obey the instructions in these wherever they appear.

⚠ Warning:

- **Warning is used to indicate that failure to follow this instruction may result in personal injury.**

⚠ Caution:

- **Caution is used to indicate that failure to follow this instruction may result in damage to machine or the equipment being used.**

Note:

- Note is used to provide the technician with additional essential information required to carry out a complete and satisfactory repair.

Before carrying out any maintenance on this machine, always carry out the following:

1. Park the machine on flat, level ground.
2. Lower the loader and backhoe attachments until they are resting on the ground.
3. Stop the engine and remove the starter switch key.
4. Engage the parking brake.
5. Lock the loader attachment controls (if equipped).
6. Block the wheels to prevent any machine movement. If a procedure requires the loader attachment to be raised (e.g. working on the engine), install the loader attachment control strut.
7. Removing the isolator key from the switch is recommended, especially when carrying out work on the electrical system.

Read and obey the following before carrying out a repair:

- Do not carry out any maintenance operations until you have read and understood the instructions and warnings given in the manual.
- Always wear suitable clothing when working on the machine.
- Always wear suitable eye protection when using a tool which might project metal particles. Use a hammer with a soft face, such as copper for installing pins.
- Unauthorized modifications of the machine can cause serious injury. Do not carry out any unauthorized modification on the machine. Any modification carried out must be in conformity with the machines technical specifications and must conform to current safety regulations.
- Do not carry out any welding operation without prior authorization.
- Some of the machines components are subject to type approvals. It is mandatory when replacing these components to ensure they are in conformity with regulations. Always use genuine parts.
- Hydraulic fluid, diesel fuel or grease under pressure which penetrates the skin can cause serious injury. Take the necessary safety precautions (protective clothing and face and hand protection) to prevent such risks. In addition, before handling these products, read the manufacturers specific instructions for their use. If hydraulic fluid, diesel fuel or grease penetrates the skin, seek medical attention immediately.
- When carrying out an authorized welding operation on the machine, disconnect the alternator plug and connect the welding set earth lead to the component on which the welding is to be carried out. Never connect the earth lead to a hydraulic system component.
- When checking tyre pressures or during an inflation operation, never stay facing the tyre but always facing the tread surface. Always use an inflation cage when the wheel is removed from the machine. keep all other persons away from the area. Never weld near a tyre. It is essential to remove the tyre before any welding operation.
- Take the necessary safety precautions to protect your face when using compressed air.
- The machines structure is in conformity with the 'FOPS' and 'ROPS' protection standards. Any modification (drilling, welding etc.) may cause that conformity to be invalidated.
- Always follow the specified repair and maintenance procedures outlined in this manual.
- Never carry out any repairs to the machine while someone is sitting in the operator seat, unless they are assisting in the procedure being carried out.
- Do not perform any repair on the machine while the engine is running, unless stated. Stop the engine and make sure all pressure is released from hydraulic circuits before removing any caps, covers, valves etc.
- Always use lifting equipment of appropriate capacity to lift or move heavy components.
- When performing a repair, disconnect the battery(s) and label the controls to warn the machine is being worked on. Block the machine and any implements which may be in the raised position.
- Only operate the machine or attachments when in the Operator's seat, do not attempt to operate the controls from outside of the cab.
- Do not wear rings, wristwatches, jewellery, unbuttoned or flapping clothing such as ties, torn clothes, scarves, open jackets or shirts with open zips which could become caught on moving parts. Use approved safety clothing such as anti-slipping footwear, gloves, safety goggles, hard hat etc.
- Lift and handle all heavy components using suitable lifting equipment of adequate capacity. Make sure that parts are supported by appropriate

slings and hooks. Use lifting eyes provided for this purpose.
- Never run the engine in confined spaces which are not equipped with adequate ventilation for exhaust gas recirculation.
- Never bring your head, body, arms, legs, feet, hands or fingers near fans or rotating belts.
- Always loosen the radiator cap very slowly before removing to allow pressure in the system to dissipate. Coolant should be topped up only when the engine is stopped.
- Do not fill the fuel tank when the engine is running.
- Never adjust the fuel injection pump when the machine is running.
- Never lubricate the machine when the engine is running.
- Fluid coming out from a very small port may be invisible and strong enough to penetrate the skin. Never use your hands to check for leaks, always use a piece of cardboard or wood for this purpose.

Precautions During Work
- Do not walk or stop under raised loads or machine parts supported by hydraulic cylinders or ropes only.
- Always keep the machine handrails and access steps free of oil, grease or dirt to prevent falls or slips.
- When entering or leaving the cab, always face the machine. Never turn your back.
- When carrying out operations at hazardous heights (greater than three metres from the ground), always use type-approved safety belts or fall preventing devices.
- Do not enter or leave the machine when the engine is running.
- Allow the engine to cool before servicing.
- Do not work on the machine when under or between the wheels when the engine is running. If work is required while in this position, stop the engine, apply the parking brake and chock the wheels to prevent accidental movement of the machine.
- Do not carry out any maintenance or repairs without adequate lighting.
- Do not connect wet plugs or sockets.
- Signs or safety decals should never be removed, obscured or unreadable.
- Always stop the engine and disconnect the battery before maintenance or service.
- Do not lubricate or clean any components while still moving.
- Before carrying out operations on hydraulic lines under pressure, always make sure the line has been depressurized and does not contain hot fluid.
- Do not carry out any repairs to the fuel system with the engine running.
- Handle all flammable or dangerous substances with care.
- Make sure that no tool, cloth or other objects have been left within compartments with moving parts or in which suction and cooling air circulates.
- After work , never leave the machine in a potentially dangerous state.

Fire Prevention
Engine fuel can cause an explosion or fire:
- Never fill with fuel when the engine is running.
- Do not smoke during re-fuelling.
- Take all necessary safety measures when welding, grinding or when working near a naked flame.
- Use a non flammable product for cleaning parts.

A spark or flame can cause the hydrogen in the battery to explode. To prevent any risk of explosion, obey the following instructions:
- Remove the battery isolator key (optional).
- When disconnecting the battery cables, always disconnect the negative (-) cable first.
- To connect the battery cables, always connect the negative (-) cable last.
- Never short circuit the battery terminals with metal objects.
- Do not weld, grind or smoke near a battery.
- The electrical system or engine exhaust may produce sparks. Before using the machine in an area which may contain inflammable vapours, make sure there is adequate ventilation.
- Clean the machine and remove all debris and material which may catch fire.
- Check for leaks. Replace damaged hoses, pipes and unions. Clean the machine after any repair work before operating.

Burn Prevention
- Battery electrolyte causes severe burns. The battery contains sulphuric acid. Avoid any contact with skin, eyes or clothing. If contact is EXTERNAL, rinse with water. If contact is INTERNAL, drink large quantities of water or milk. Seek medical assistance immediately. If contact is with in the EYES, rinse with water for 15 minutes. Seek medical assistance immediately.
- When the electrolyte of a battery is frozen, it can explode if you attempt to charge the battery or if you try to start the engine using a booster battery. Always keep the battery charged to prevent the electrolyte freezing.
- Batteries produce explosive gases. Keep all flames, sparks, and cigarettes away. Provide adequate ventilation when charging a battery or using a battery in an enclosed space. Always protect your eyes when working near a battery.
- Boiling coolant solution can spray out if the radiator cap is removed while the system is still hot. To remove the cap, allow the system to cool down, turn the cap to the first notch and wait until there is no more pressure. Then remove the cap.

Personal Safety Considerations
Wearing wrong clothes or carelessness in dress can cause accidents. Make sure to wear suitable clothing when servicing the machine.

Some jobs require special protective equipment, always use protective equipment when required.

Skin Protection
Used oil may cause skin cancer. Follow work practises that minimize the amount of skin exposed and length of time used oil remains on the skin.

Eye Protection
Eye injury may cause loss of vision. Always wear suitable eye protection when chiselling, grinding, welding, painting or working on any pressurized fuel or oil system.

Breathing Protection
Fumes, dust and paint spray may be harmful. Always wear suitable breathing apparatus when these are present.

Hearing Protection
Loud noises may damage hearing and the greater the exposure the greater the damage. If the noise level is excessive, wear suitable ear protection.

Lifting Protection
Avoid injury by correct handling of components. Make sure you are capable of lifting the object, if in doubt seek assistance.

Hand Protection
It is advisable to use a protective cream before work to prevent irritation and skin contamination. After work, clean hands with soap and water. Solvents such as mineral spirit and kerosene may harm the skin.

Foot Protection
Substantial or protective foot wear with reinforced toe caps will protect feet from falling objects. Oil resistant soles will assist in avoiding slippage.

Special Clothing
For certain work it may be necessary to wear flame or acid resistant clothing.

Equipment Safety Considerations

Machine Guards
Before using any machines, make sure the machine guards are in position and are serviceable. These guards prevent anything from coming into contact with any moving parts and prevent injury from any flying debris.

Lifting Devices
Make sure lifting equipment such as chains, slings, hooks and eyes are thoroughly inspected for damage before use. If in any doubt about the weight capacity required, use stronger equipment than is necessary.

Compressed Air
The pressure from a compressed air line can often exceed 100PSI (690 kPa). This is safe to use but incorrect use may cause injury.
Do not use compressed air to blow dust, filings or dirt from the area being worked in unless the correct nozzle is fitted.

Hand Tools
Injuries may result from using defective tools. Always use the correct tools for the job, use of incorrect tools mat result in damage to the machine or personal injury.
When removing or installing hardened pins, use a copper or brass drift. Do not use a hard faced hammer.
When carrying out a repair procedure, always use the Special Tools recommended.

General Considerations

Solvents
Use cleaning fluids and solvents that are known to be safe. Certain types of fluids may cause damage to components such as seals and may cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and individual parts and will not affect the personal safety of the user.

Fire
Fire has no respect for persons or property. The destruction a fire may cause is not always fully realized. Always be on guard against fire hazards.
Do not smoke when working on the machine.
Work cleanly and dispose of waste material into suitable containers.
Identify the location of the nearest fire extinguisher and know how to operate it.
In the event of a fire, do not panic, warn those near and raise the alarm.
Do not use a naked flame near the fuel tank, battery or any other components.

First Aid
Dirt, grease and fine dust may settle on the skin and clothing. If a cut, burn or abrasion is left unattended, infection may occur. Seek medical attention immediately.

Cleanliness
Cleanliness of the hydraulic system is essential for optimum performance. When carrying out service and repairs, plug all hose ends and connections to prevent contamination.
Clean the exterior of all components before carrying out any repairs. Dirt and abrasive dust can reduce the efficiency and working life of a component. Use of a high pressure washer or steam cleaner is recommended.

ACCESSORIES

A01
SECTION

REMOVAL AND INSTALLATION — STANDARD LOADER BUCKET FROM A QUICK ATTACH UNIT A01–01–1
REMOVAL AND INSTALLATION — MULTI PURPOSE LOADER BUCKET FROM A QUICK ATTACH UNIT A01–01–3
REMOVAL AND INSTALLATION — QUICK ATTACH LOADER UNIT A01–01–5
REMOVAL AND INSTALLATION — QUICK ATTACH LOADER UNIT HYDRAULIC CYLINDER A01–01–9
SPECIFICATIONS — ACCESSORIES A01–01–11
DESCRIPTION AND OPERATION — HOSE BURST VALVES A01–02–1
REMOVAL AND INSTALLATION — LOADER BEAM HYDRAULIC CYLINDERS BURST VALVES ... A01–02–3
REMOVAL AND INSTALLATION — LOADER BUCKET CROWD HYDRAULIC CYLINDER BURST VALVE A01–02–5
REMOVAL AND INSTALLATION — BACKHOE DIPPER ARM CYLINDER BURST VALVE A01–02–9
REMOVAL AND INSTALLATION — BACKHOE BOOM CYLINDER BURST VALVE A01–02–11
SPECIFICATIONS — HOSE BURST VALVES A01–02–13

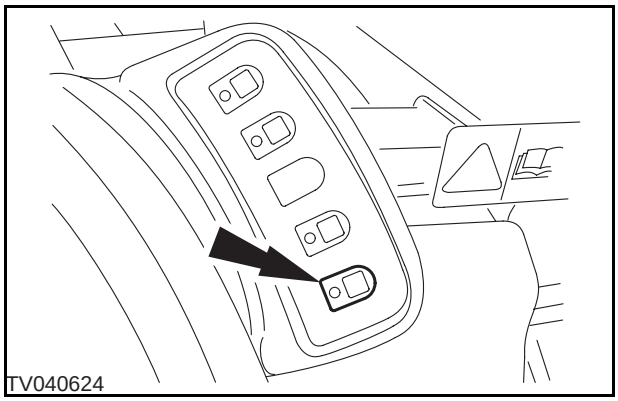
REMOVAL AND INSTALLATION — STANDARD LOADER BUCKET FROM A QUICK ATTACH UNIT

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Operation: **Removing and Installing the Standard Loader Bucket from a Quick Attach Unit**	*Job Code:* **01 08 13 xx**		
None	Standard tools		

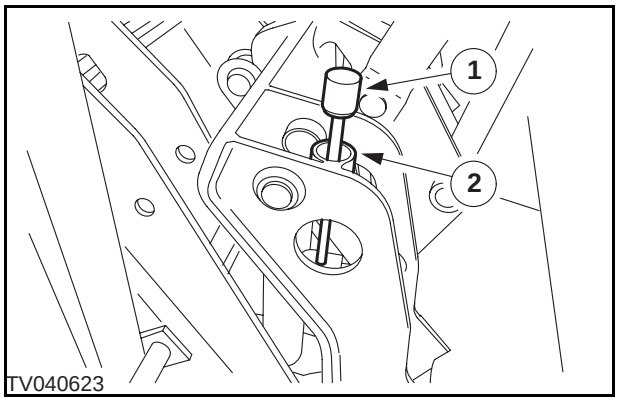
Removal

1. Park the machine on firm level ground.
2. Position the loader bucket flat on the ground.
3. Press and hold the loader quick attach switch down to unlock the loader quick attach.


TV040624

4. Operate the loader auxiliary service lever until the loader bucket retaining pins are fully retracted.

   Note:
   - The Indicator (1) raised clear of the tube (2).



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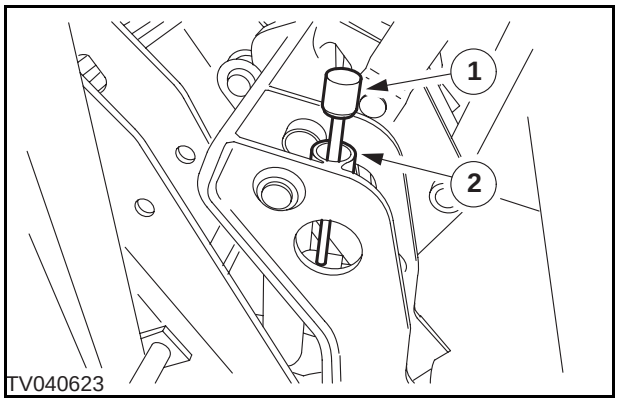
5. Carefully reverse the machine away from the loader bucket whilst crowding forward to disengage the quick attach hook from the loader bucket retaining pins.

Installation

1. To install, reverse the removal procedure.

Note:

- Make sure the top of the indicator (1) is flush with the top of the tube (2).



REMOVAL AND INSTALLATION — MULTI PURPOSE LOADER BUCKET FROM A QUICK ATTACH UNIT

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Operation: **Removing and Installing the Multi Purpose Loader Bucket from a Quick Attach Unit**	*Job Code:* **01 09 13 xx**		
None	Standard tools		

Removal

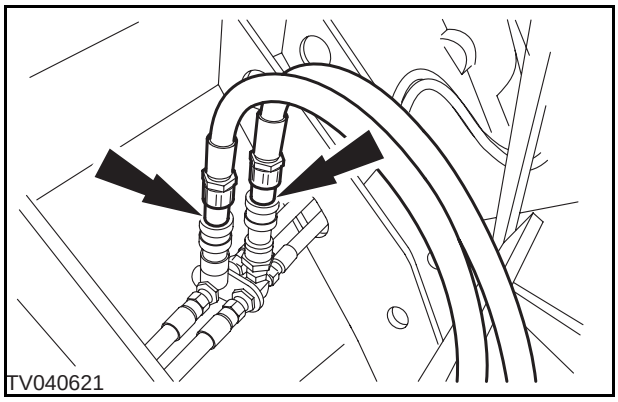
Note:
- Make a note of the position of the hydraulic hoses prior to disconnection to aid installation.

Note:
- Install blanking plugs to avoid contamination.

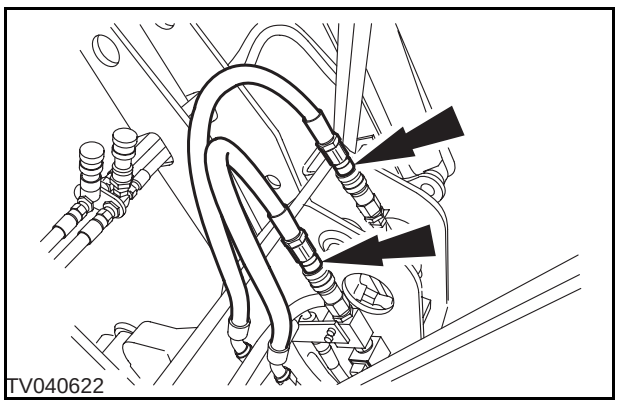
1. Park the machine on firm level ground.
2. Position the loader bucket flat on the ground.
3. Place the forks in the stowed position and secure them using the pins (if equipped).
4. Release the pressure from the hydraulic system. For additional information, refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .

Note:
- Make sure the connections are clean and free from obstructions.

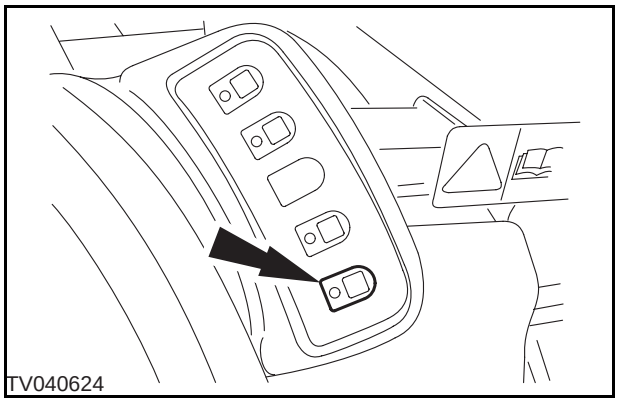
5. Disconnect the hydraulic hoses from the loader bucket.


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6. Connect the hydraulic hoses to the quick attach control valve connectors.

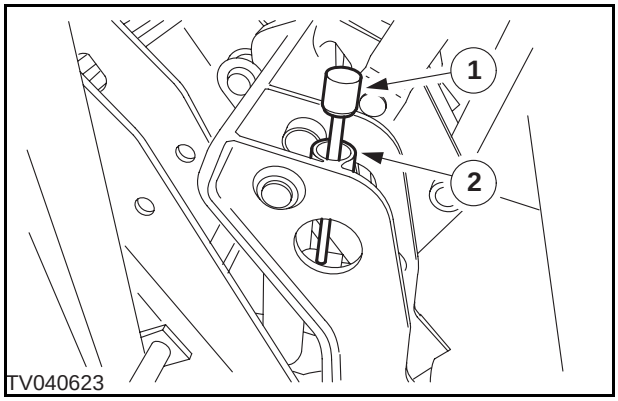

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7. Start the engine, press and hold the quick attach switch down to unlock the loader quick attach.



8. Operate the loader auxiliary service lever until the loader bucket retaining pins are fully retracted.

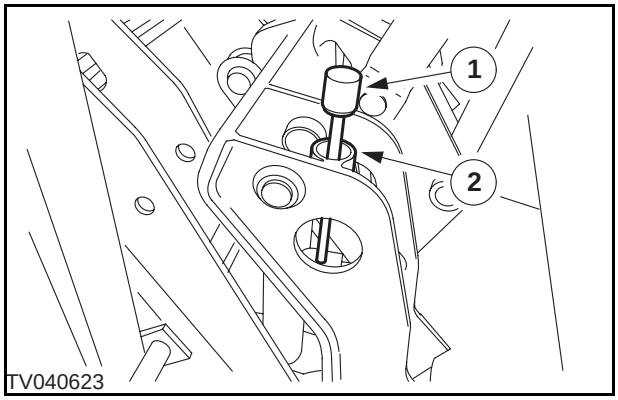
   Note:
   - The Indicator (1) raised clear of the tube (2).



9. Carefully reverse the machine away from the loader bucket whilst crowding forward to disengage the quick attach hook from the loader bucket retaining pins.

Installation

1. To install, reverse the removal procedure.
2. Make sure the top of the indicator (1) is flush with the top of the tube (2).



REMOVAL AND INSTALLATION — QUICK ATTACH LOADER UNIT

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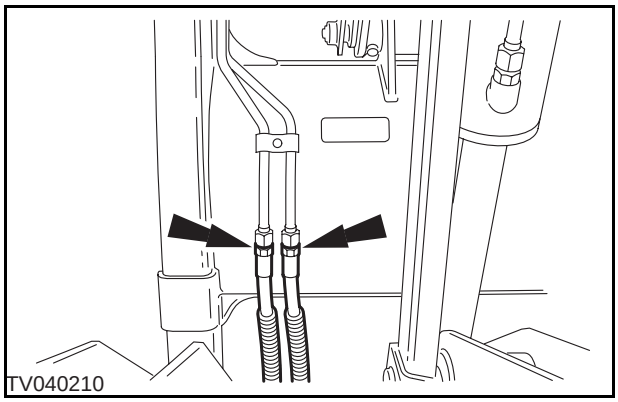
Operation: **Removing and Installing the Quick Attach Loader Unit**	*Job Code:* **01 10 13 xx**		
Suitable Lifting Equipment	Standard tools		

Removal

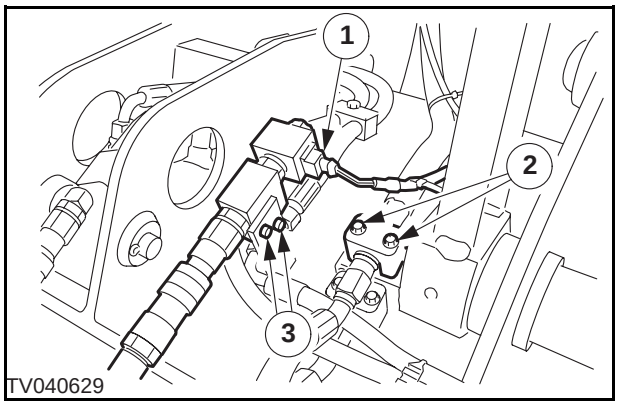
Note:
- Make a note of the position of the hydraulic hoses prior to disconnection to aid installation.

Note:
- Install blanking plugs to avoid contamination.

1. Remove the loader bucket. For additional information, refer to STANDARD LOADER BUCKET FROM A QUICK ATTACH UNIT, PAGE A01–01–1 or MULTI PURPOSE BUCKET FROM A QUICK ATTACH UNIT , PAGE A01–01–3 in this section.
2. Position the quick attach loader unit flat on the ground.
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
4. Release the pressure from the hydraulic system. For additional information, refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
5. Disconnect the loader unit auxiliary service hydraulic hoses.

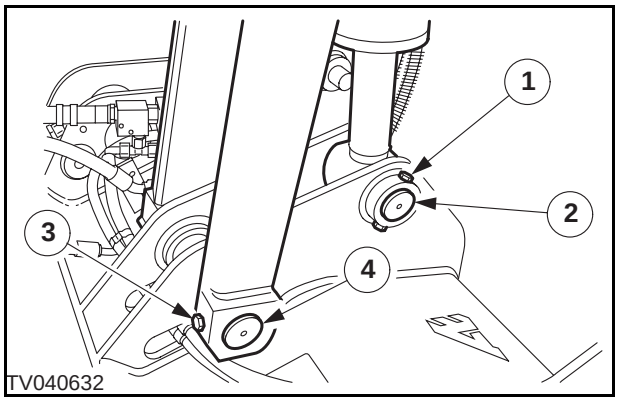

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6. Disconnect the electrical connector (1), hose clamp (2), detach the quick attach control valve (3) and position it to one side.

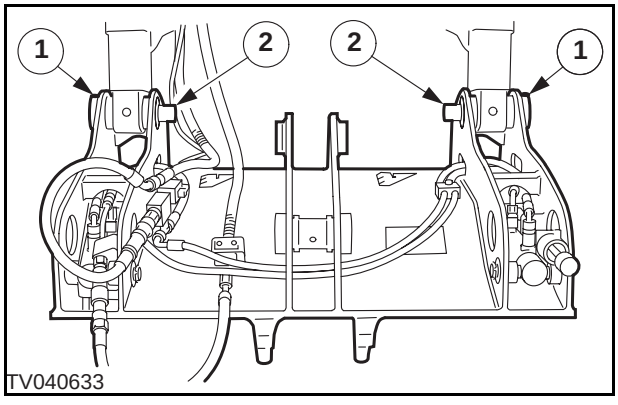


⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

7. Using suitable lifting equipment, support the hydraulic crowd cylinder.
8. Remove the crowd hydraulic cylinder pivot pin retaining bolt (1).
9. Remove the pivot pin (2).
10. Detach the crowd hydraulic cylinder.
11. Remove the crowd hydraulic beam pivot pin retaining bolt (3).
12. Remove the crowd hydraulic beam pin (4).
13. Detach the crowd hydraulic beam.



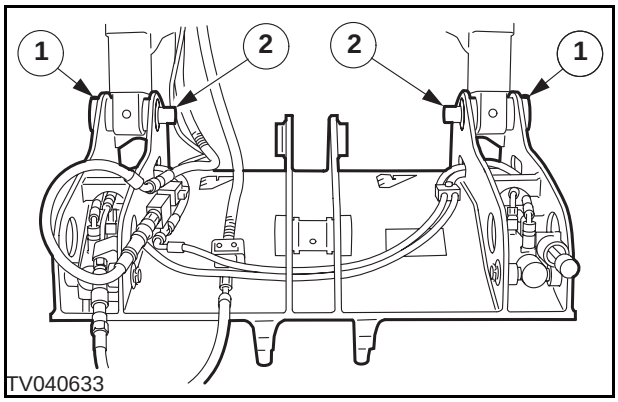
14. Remove the pivot pin retaining bolts (1).
15. Remove the pivot pins (2).
16. Remove the quick attach loader unit.



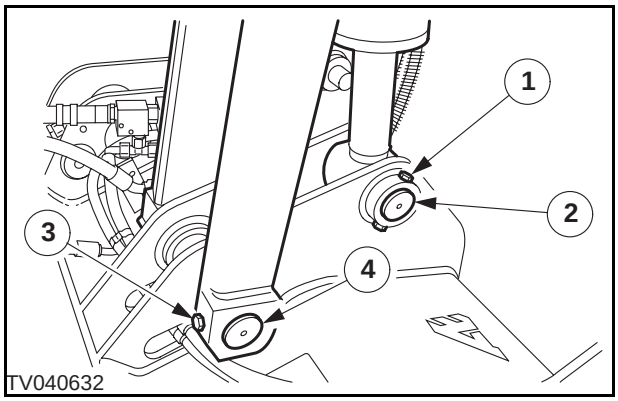
Installation

Note:
- Install new pivot pin lock nuts.

1. To install, reverse the removal procedure.
2. Tighten (1) to 10Nm (7 lb.ft).



3. Tighten (1) and (3) to 10Nm (7 lb.ft).



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REMOVAL AND INSTALLATION — QUICK ATTACH LOADER UNIT HYDRAULIC CYLINDER

BHA0101RE

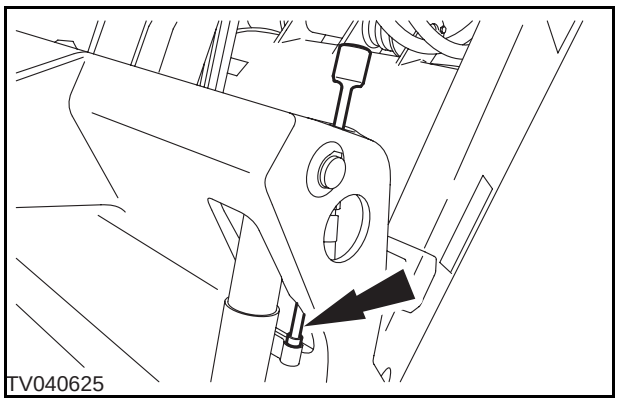
Operation: **Removing and Installing the Quick Attach Loader Unit Hydraulic Cylinder**	*Job Code:* **01 11 13 xx**		
None	Standard tools		

Removal

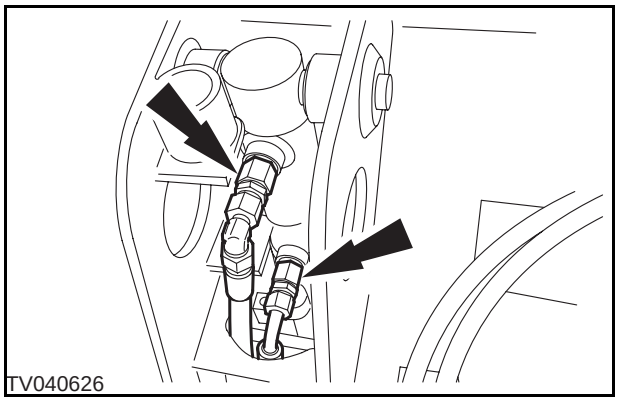
Note:
- Make a note of the position of the hydraulic hoses prior to disconnection, to aid installation.

Note:
- Install blanking plugs to avoid contamination.

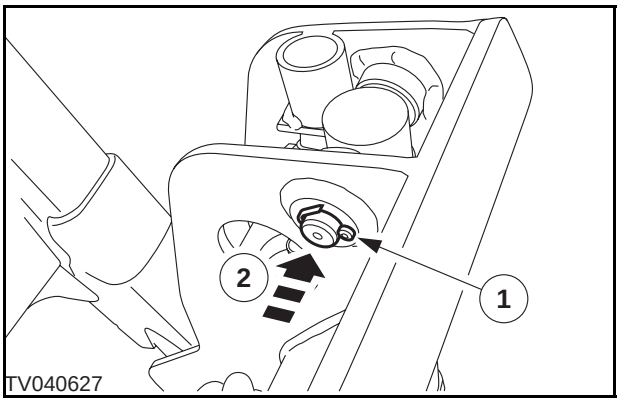
1. Remove the loader bucket. For additional information, refer to STANDARD LOADER BUCKET FROM A QUICK ATTACH UNIT, PAGE A01–01–1 or MULTI PURPOSE LOADER BUCKET FROM A QUICK ATTACH UNIT , PAGE A01–01–3 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the quick attach loader unit status indicator.


TV040625

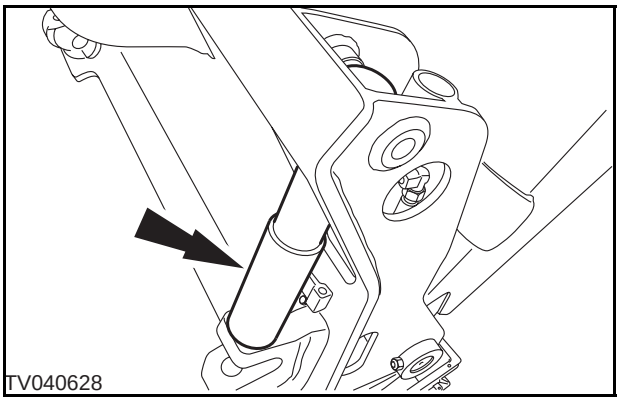
4. Disconnect the quick attach loader unit hydraulic cylinder supply and return hoses.


TV040626

5. Remove the split pin (1) and remove the quick attach loader unit hydraulic cylinder pivot pin (2).



6. Remove the quick attach loader unit hydraulic cylinder.



Installation

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

SPECIFICATIONS — ACCESSORIES

BHA0101SA

Torque Values

Description	Nm	Lb.ft
Pivot Pin Retaining Nut	10	7

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DESCRIPTION AND OPERATION — HOSE BURST VALVES

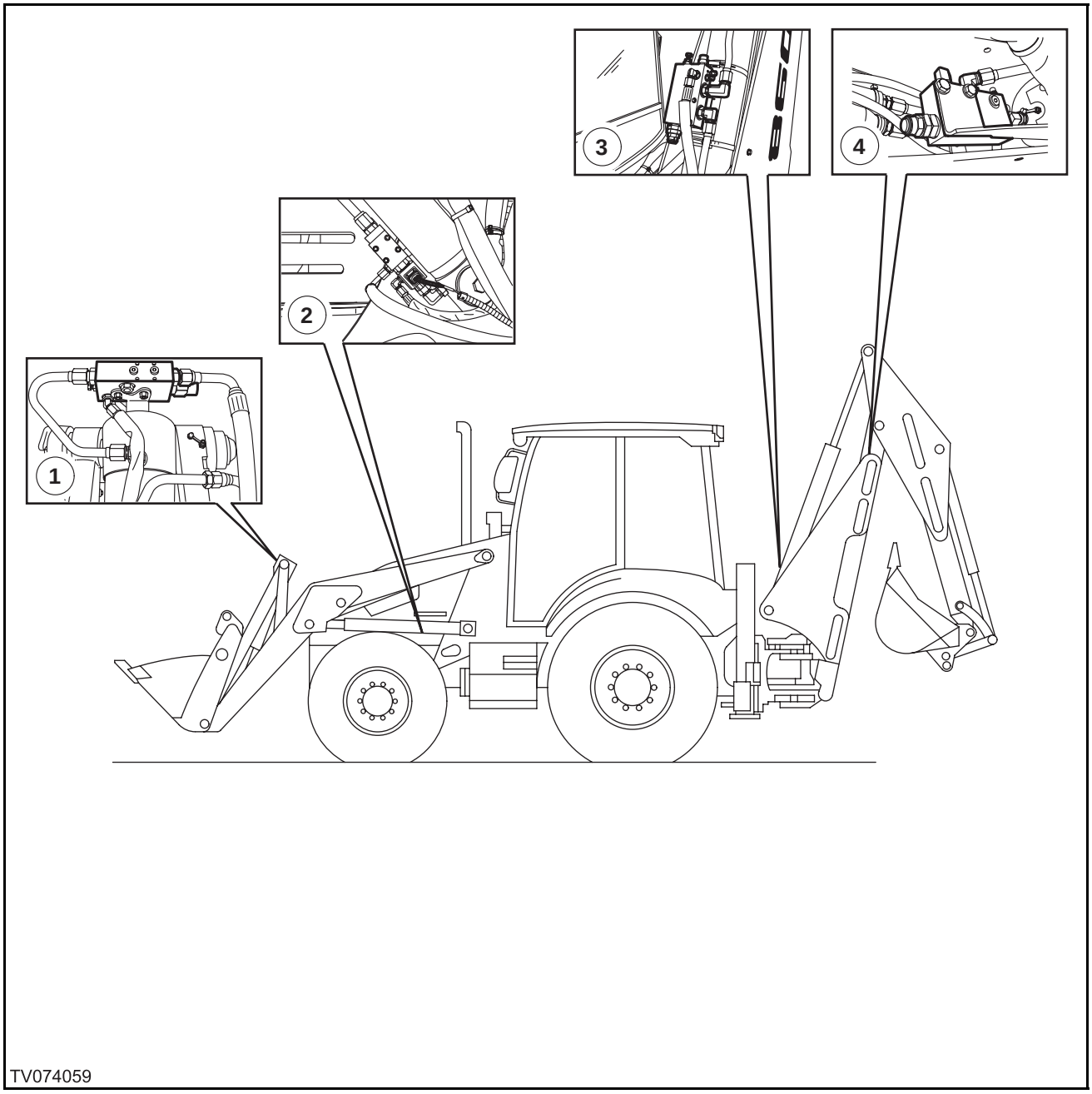
BHA0102OA

General Description

These valves are installed within the hydraulic circuit, they are specifically designed to be used on machinery that handles a suspended load. They are installed to prevent the backhoe boom / loader arm dropping or lowering in an uncontrolled manner if a hose fails in the hydraulic circuit.

⚠ **Warning:**

- **No attempt should be made to repair or adjust these valves failure to follow this instruction may result in personal injury.**



TV074059

Item	Description	Position
1	Loader bucket crowd hydraulic cylinder burst valve	Top of the crowd hydraulic cylinder
2	Loader beam hydraulic cylinder burst valves	Below the loader beam hydraulic cylinder
3	Backhoe dipper arm hydraulic cylinder burst valve	Mounted to the dipper arm hydraulic cylinder
4	Backhoe boom arm hydraulic cylinder burst valve	Inside the top of the boom arm

REMOVAL AND INSTALLATION — LOADER BEAM HYDRAULIC CYLINDERS BURST VALVES

BHA0102RA

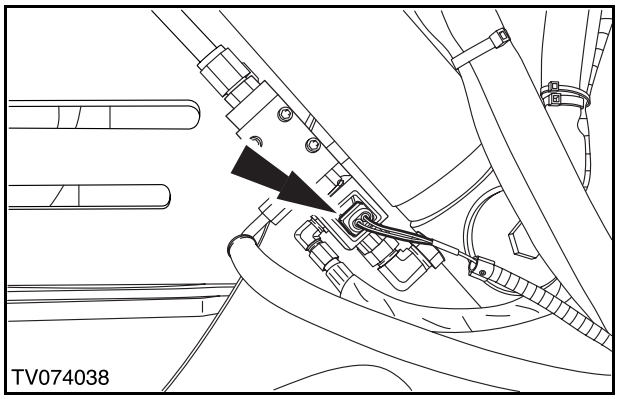
Operation: **Removing and Installing the Loader Beam Hydraulic Cylinders Burst Valves**	*Job Code:* **xx xx xx xx**		
None	Standard tools		

Removal

1. Park the machine on firm level ground.
2. Position the loader bucket flat on the ground.
3. Release the pressure from the hydraulic system. For additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE .
4. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

   Note:
   - Left-hand side shown, right-hand side similar.

5. Disconnect the electrical connector.

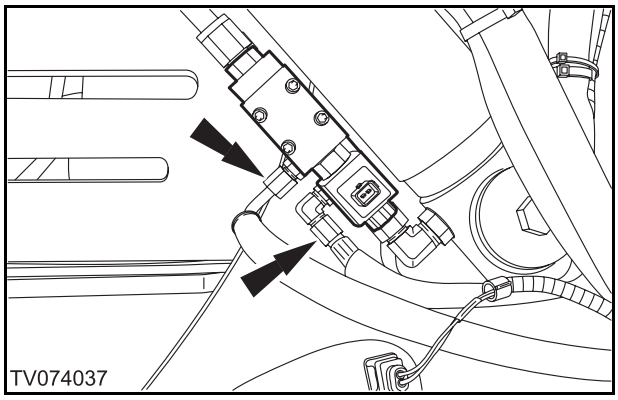


⚠ **Caution:**
- **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

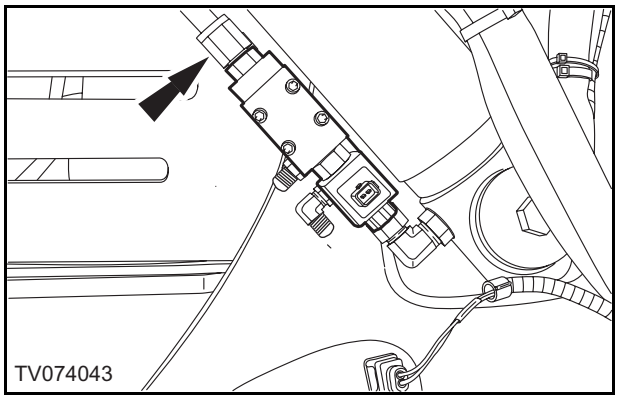
Note:
- Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

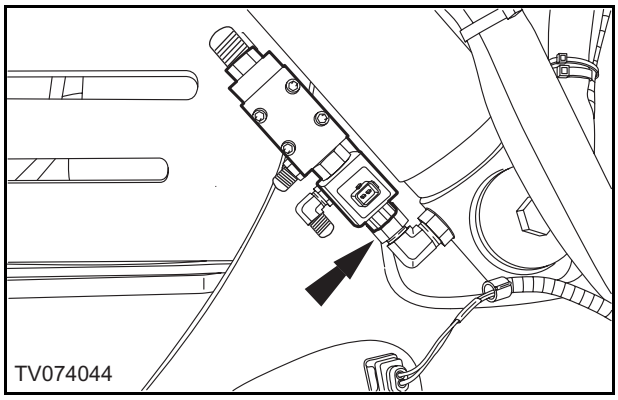
6. Detach and reposition the hydraulic hoses.



7. Detach the hydraulic pipe.



8. Detach the hydraulic fitting and remove the burst valve.



Installation

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — LOADER BUCKET CROWD HYDRAULIC CYLINDER BURST VALVE

BHA0102RB

Operation: **Removing and Installing the Loader Bucket Crowd Hydraulic Cylinder Burst Valve**	*Job Code:* **XX XX XX XX**		
None	Standard tools		

Removal

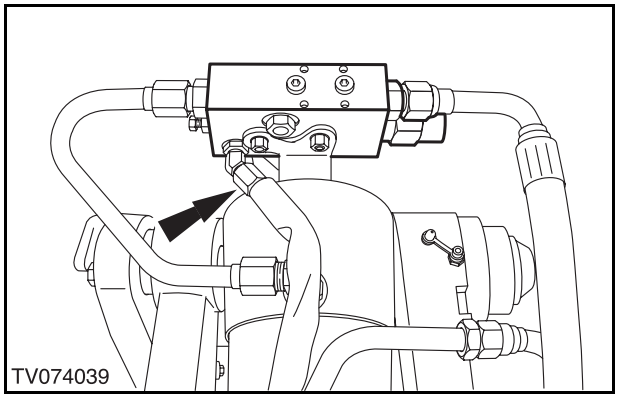
1. Park the machine on firm level ground.
2. Position the loader bucket flat on the ground.
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
4. Release the pressure from the hydraulic system. For additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE .

   ⚠ Caution:
   - **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

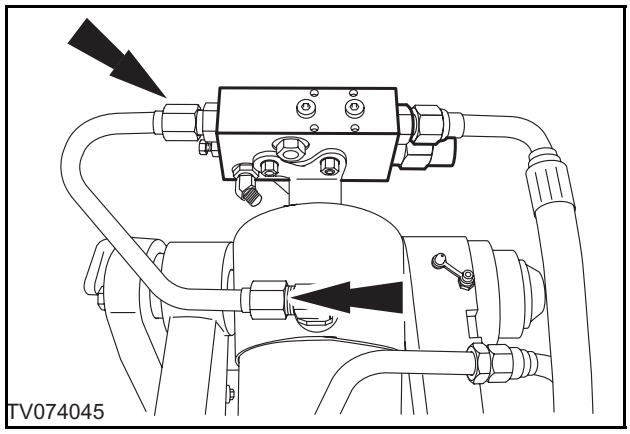
   Note:
   - Make a note of the position of the hydraulic hoses prior to disconnection to aid installation.

   Note:
   - Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

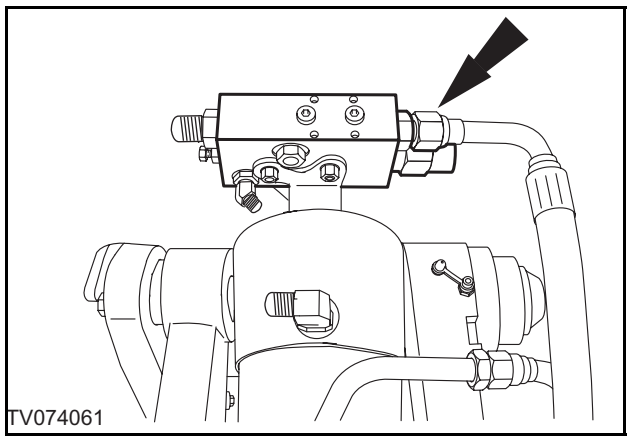
5. Detach and reposition the hydraulic hose.



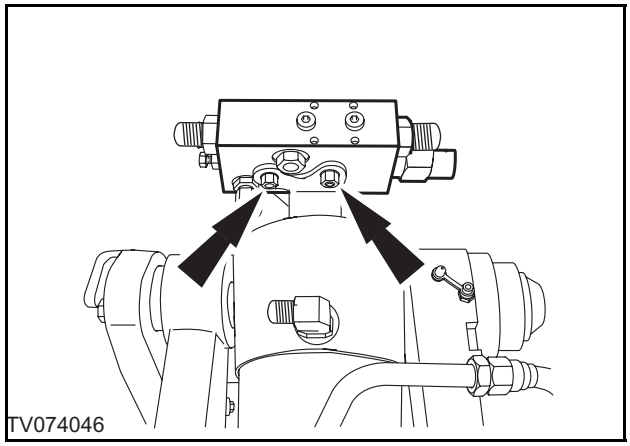
6. Remove the hydraulic pipe.



7. Detach and reposition the hydraulic hose.

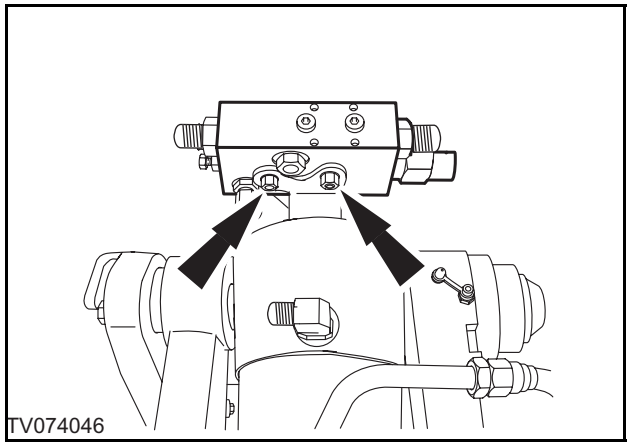


8. Remove the burst valve.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 60Nm (44lb.ft).



3. Check and adjust the hydraulic oil level as required.

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REMOVAL AND INSTALLATION — BACKHOE DIPPER ARM CYLINDER BURST VALVE

BHA0102RC

Operation: **Removing and Installing the Backhoe Dipper Arm Cylinder Burst Valve**	*Job Code:* **XX XX XX XX**		
Suitable Lifting Equipment	Standard tools		

Removal

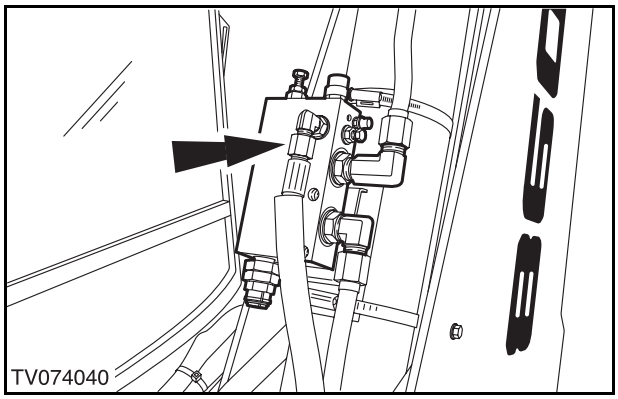
1. Park the machine on firm level ground.
2. Position the backhoe bucket flat on the ground to gain access to the valve.
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
4. Release the pressure from the hydraulic system. For additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE .

   ⚠ Caution:
   - **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

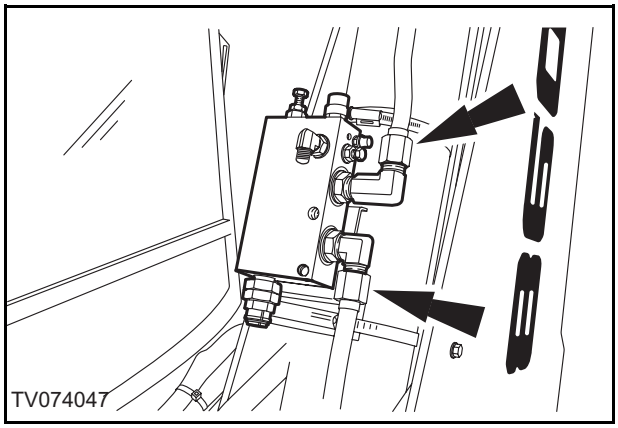
   Note:
   - Make a note of the position of the hydraulic hoses prior to disconnection to aid installation.

   Note:
   - Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

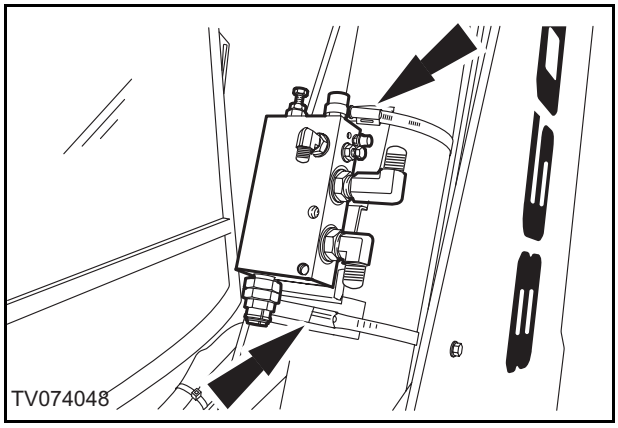
5. Detach and reposition the hydraulic hose.



6. Detach the hydraulic pipes.



7. Remove the burst valve.



Installation

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — BACKHOE BOOM CYLINDER BURST VALVE

BHA0102RD

Operation: **Removing and Installing the Backhoe Boom Cylinder Burst Valve**	*Job Code:* **xx xx xx xx**		
None	Standard tools		

Removal

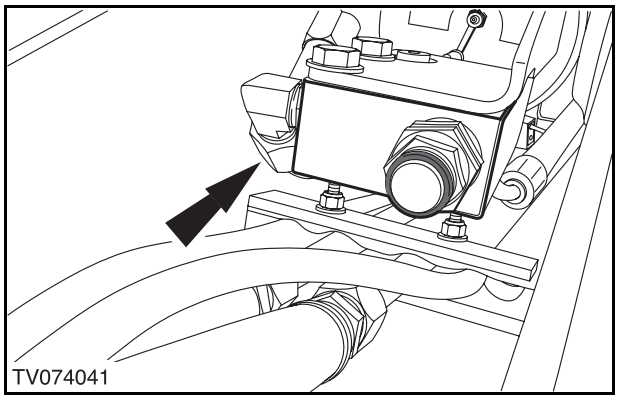
1. Park the machine on firm level ground.
2. Position the backhoe bucket flat on the ground to gain access to the valve.
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
4. Release the pressure from the hydraulic system. For additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE .

   ⚠ Caution:
   - **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

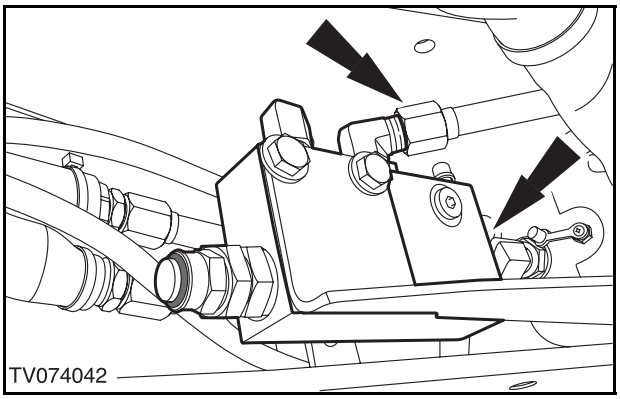
   Note:
   - Make a note of the position of the hydraulic hoses prior to disconnection to aid installation.

   Note:
   - Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

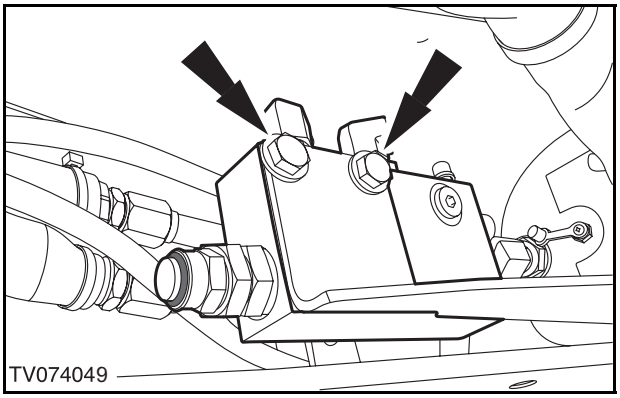
5. Detach and reposition the hydraulic hose.


TV074041

6. Detach the hydraulic pipes.

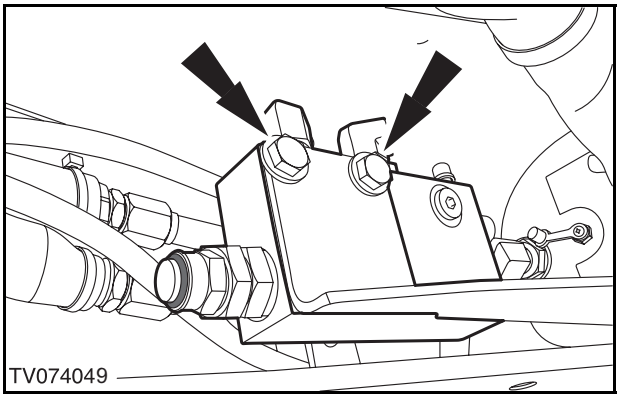


7. Remove the burst valve.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 60Nm (44lb.ft).



3. Check and adjust the hydraulic oil level as required.

SPECIFICATIONS — HOSE BURST VALVES

BHA0101SA

Torque Values

Torque Values For JIC Hydraulic Hose Fittings

Hex. Size A/F		Termination Dash Size	Thread Size UNF	Machines Built With "Gates/Global" Hydraulic Hoses		Machines Built With "Manuli" Hydraulic Hoses	
mm	inch			Nm	Lb.ft	Nm	Lb.ft
—	9/16	04	7/16"-20	14	10	15	11
—	5/8	05	1/2"-20	18	13	20	15
—	11/16	06	9/16"-18	22	16	35	26
—	7/8	08	3/4"-16	41	30	50	37
24	—	10	7/8"-14	60	44	80	59
—	1	10	7/8"-14	60	44	80	59
27	—	10	7/8"-14	60	44	80	59
—	1 1/4	12	1 1/16"-12	90	66	100	74
—	1 1/2	16	1 5/16"-12	130	96	150	111

Torque Values For O-Ring Face Seal (ORFS) Hydraulic Fittings

Termination Dash Size	Inch Size	Thread Size UNF	Torque Value	
			Nm	Lb.ft
04	1/4	9/16–18	15	11
06	3/8	11/16–16	26	19
08	1/2	13/16–16	45	33
10	5/8	1–14	65	48
12	3/4	1 3/16–12	92	68
16	1	1 7/16–12	130	96
20	1 1/4	1 11/16–12	180	133
24	1 1/2	2–12	215	159

Torque Values For Split Flange Retaining Bolts

Size	Torque Value	
	Nm	Lb.ft
5/16–18	24	18
3/8–16	45	33
7/16–14	54	40
1/2–13	81	60
5/8–11	197	145

Torque Values For Dryseal Pipe (NPTF or Equivalent) Steel Fittings

Size Inch	Torque Value	
	Nm	Lb.ft
1/8	25	18
1/4	45	33
3/8	70	52
1/2	125	92
3/4	180	132
1	240	177
1 1/4	280	206

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BUCKETS

B02
SECTION

REMOVAL AND INSTALLATION — STANDARD LOADER BUCKET B02–01–1
REMOVAL AND INSTALLATION — MULTI PURPOSE LOADER BUCKET B02–01–3
REMOVAL AND INSTALLATION — MULTI PURPOSE LOADER BUCKET CLAMPING CYLINDER B02–01–7
DISASSEMBLY AND ASSEMBLY — MULTI-PURPOSE LOADER BUCKET B02–01–9
DISASSEMBLY AND ASSEMBLY — MULTI-PURPOSE LOADER BUCKET CLAMPING CYLINDER B02–01–15
SPECIFICATIONS — BUCKETS B02–01–19

REMOVAL AND INSTALLATION — STANDARD LOADER BUCKET

BHB0201RA

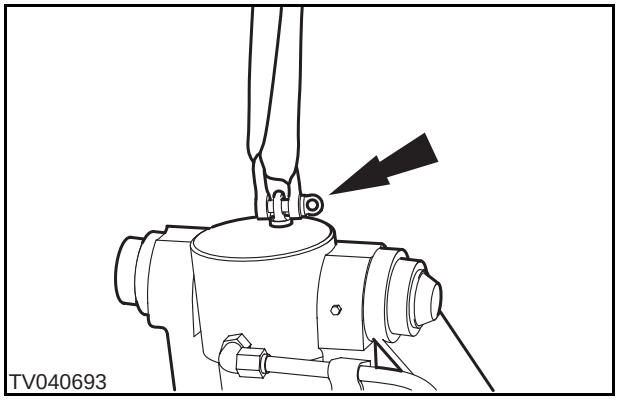
Operation: **Removing and Installing the Standard Loader Bucket**	*Job Code:* **02 10 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

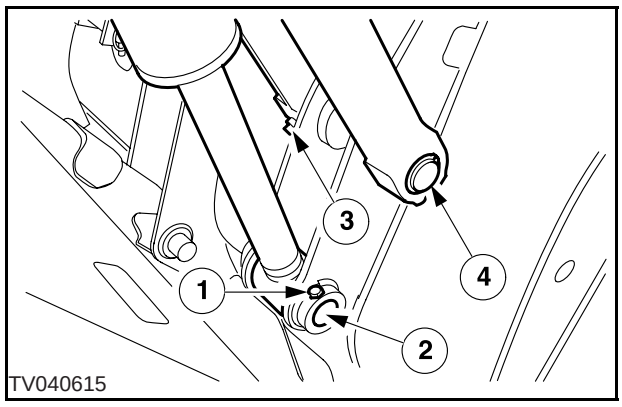
1. Park the machine on firm, level ground.
2. Lower the loader beam and position the loader bucket flat on the ground.
3. Release the pressure from the hydraulic system. For additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
4. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

   ⚠ Warning:
   - **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

5. Using suitable lifting equipment, support the hydraulic crowd cylinder.

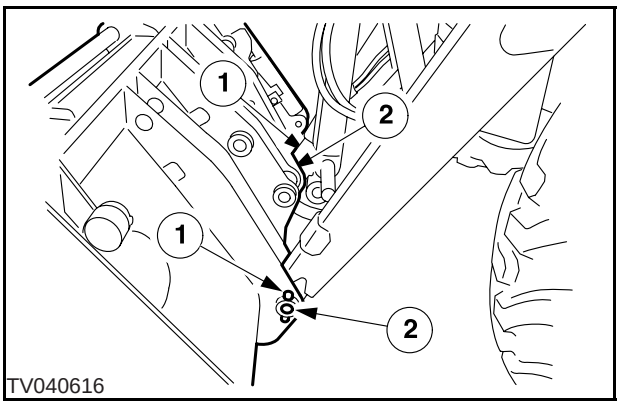

TV040693

6. Remove the hydraulic crowd cylinder pin retaining bolt (1).
7. Detach the hydraulic crowd cylinder from the loader (2).
8. Remove the hydraulic crowd beam pin retaining bolt (3).
9. Detach the hydraulic crowd beam from the loader (4).



TV040615

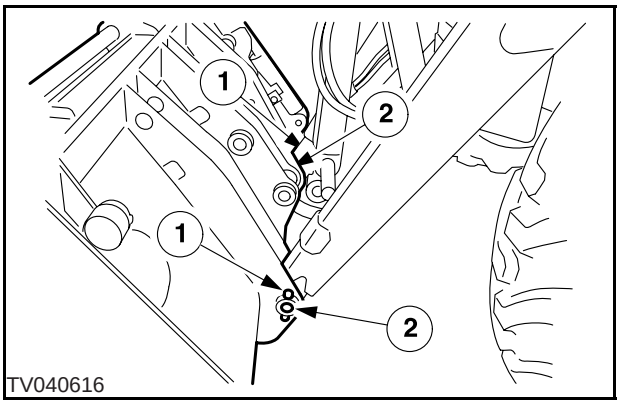
10. Remove the loader pivot pin retaining bolts (1).
11. Remove the loader pivot pins and remove the loader bucket(2).



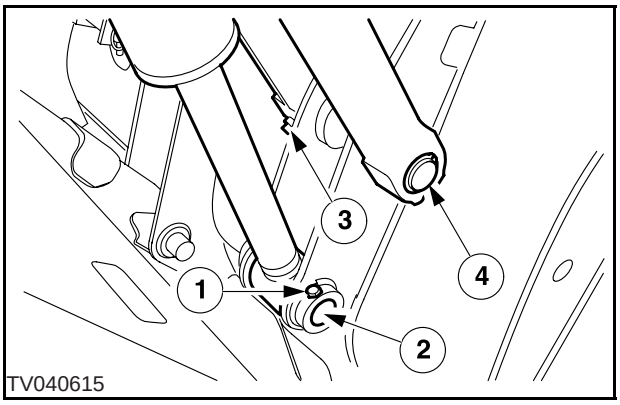
Installation

Note:
- Install new pivot pin lock nuts.

1. To install, reverse the removal procedure.
2. Tighten (1) to 10Nm (7 lb.ft).



3. Tighten (1) and (3) to 10Nm (7 lb.ft).



REMOVAL AND INSTALLATION — MULTI PURPOSE LOADER BUCKET

BHB0201RB

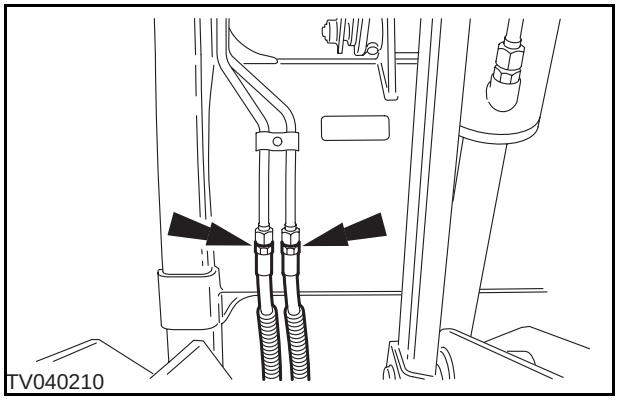
Operation: **Removing and Installing the Multi Purpose Loader Bucket**	*Job Code:* **02 09 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

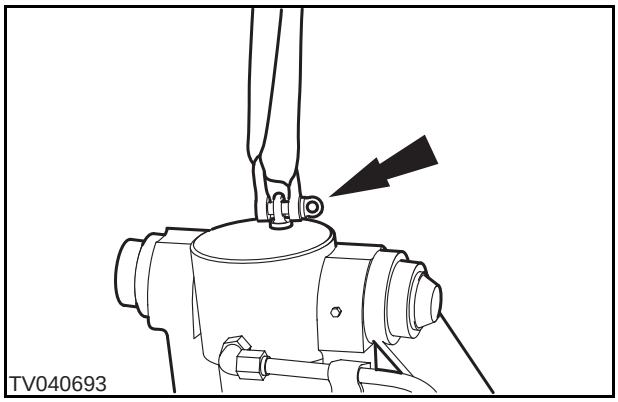
1. Park the machine on firm, level ground.
2. Close the clam shell.
3. Lower the loader beam and position the loader bucket flat on the ground.
4. Place the forks in the stowed position and secure them using the pins (if equipped).
5. Release the pressure from the hydraulic system. For additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
6. Isolate the battery ground cable. For additional information, refer to J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
7. Disconnect the loader auxiliary service hydraulic hoses.


TV040210

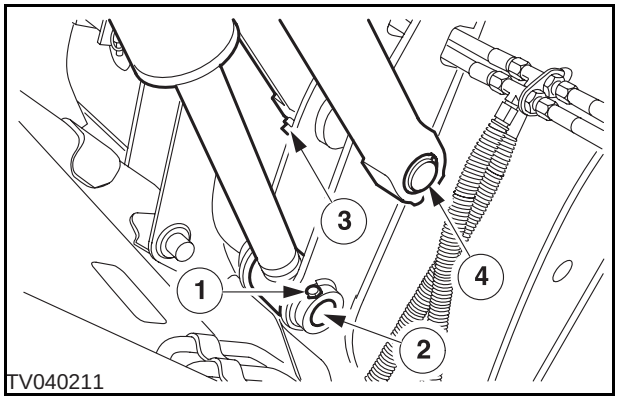
⚠ **Warning:**

- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

8. Using suitable lifting equipment, support the hydraulic crowd cylinder.

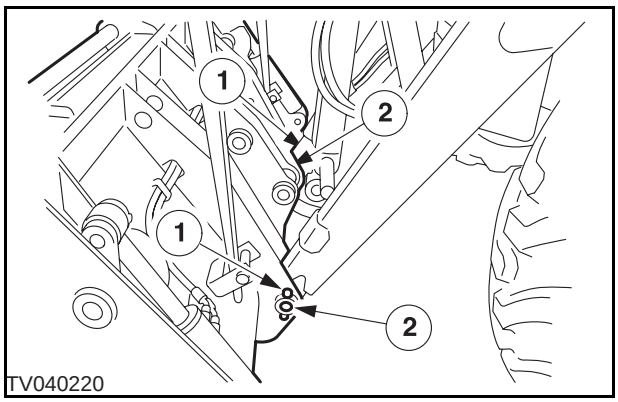

TV040693

9. Remove the hydraulic crowd cylinder pin retaining bolt (1).
10. Detach the hydraulic crowd cylinder from the loader bucket (2).
11. Remove the hydraulic crowd beam pivot pin retaining bolt (3).
12. Detach the hydraulic crowd beam from the loader bucket (4).



TV040211

13. Remove the loader bucket pivot pin retaining bolts (1).
14. Remove the loader bucket pivot pins and remove the loader bucket (2).

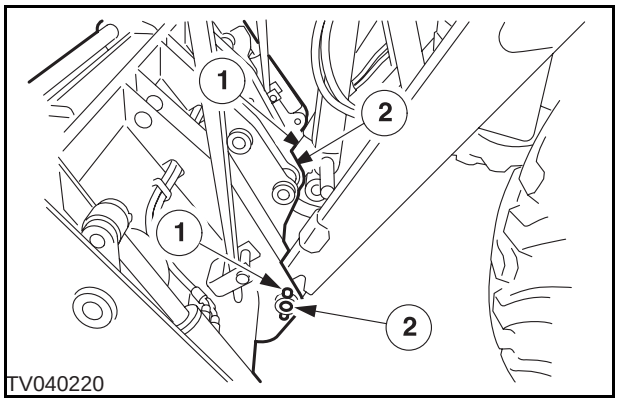


TV040220

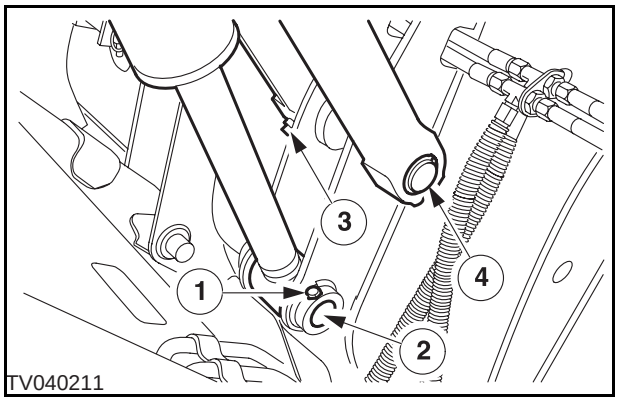
Installation

Note:
- Install new pivot pin lock nuts.

1. To install, reverse the removal procedure.
2. Tighten (1) to 10Nm (7 lb.ft).



3. Tighten (1) and (3) to 10Nm (7 lb.ft).



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REMOVAL AND INSTALLATION — MULTI PURPOSE LOADER BUCKET CLAMPING CYLINDER

BHB0201RC

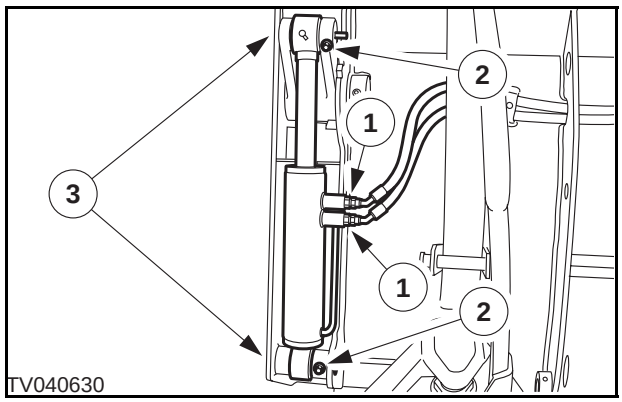
Operation: **Removing and Installing the Multi Purpose Loader Bucket Clamping Cylinder**	*Job Code:* **02 02 13 xx**		
None	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

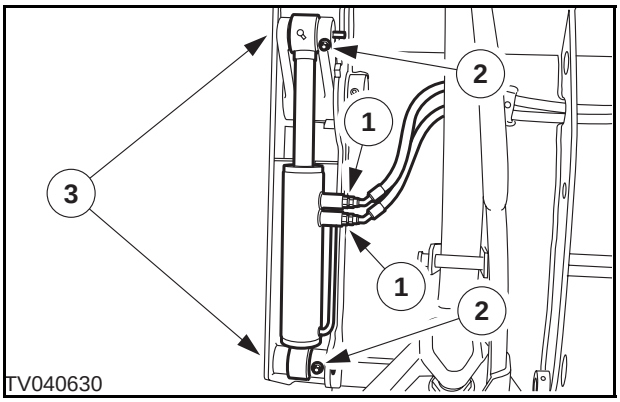
1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Park the machine on on firm, level ground.
3. Close the clam shell.
4. Lower the loader beam and position the loader bucket flat on the ground.
5. Release the pressure from the hydraulic system. For additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
6. Disconnect the hydraulic hoses from the loader bucket clamping cylinder (1).
7. Remove the loader bucket clamping cylinder pivot pin retaining bolts (2).
8. Remove the loader bucket clamping cylinder pivot pins and remove the loader bucket clamping cylinder (3).



Installation

Note:
- Install new pivot pin lock nuts.

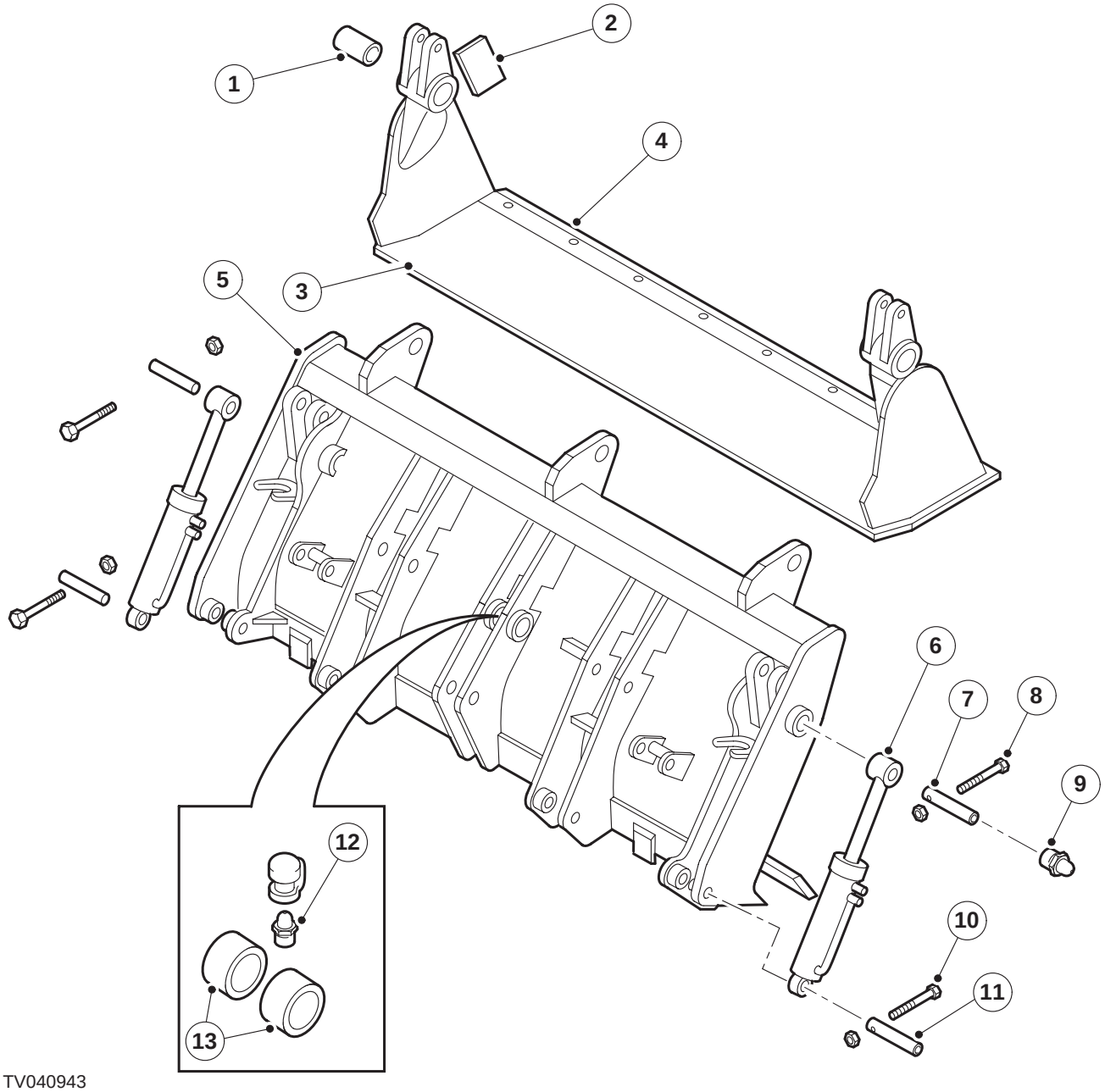
1. To install, reverse the removal procedure.
2. Tighten (3) to 10Nm (7 lb.ft).



DISASSEMBLY AND ASSEMBLY — MULTI-PURPOSE LOADER BUCKET

BHB0201DB

Operation: **Disassembling and Assembling the Multi-Purpose Loader Bucket**	*Job Code:* **02 09 17 xx**		
Suitable lifting equipment	Standard tools		



TV040943

1	Bush
2	Cutting Edge
3	Clamp Assembly
4	Lower Cutting Edge
5	Bucket
6	Clamping Cylinder
7	Retaining Pin
8	Retaining Bolt
9	Grease Nipple
10	Retaining Bolt
11	Retaining Pin
12	Grease Nipple
13	Bush

Disassembly

⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Remove the clamping cylinder. For additional information, refer to Section B02-01 MULTI PURPOSE LOADER BUCKET CLAMPING CYLINDER .

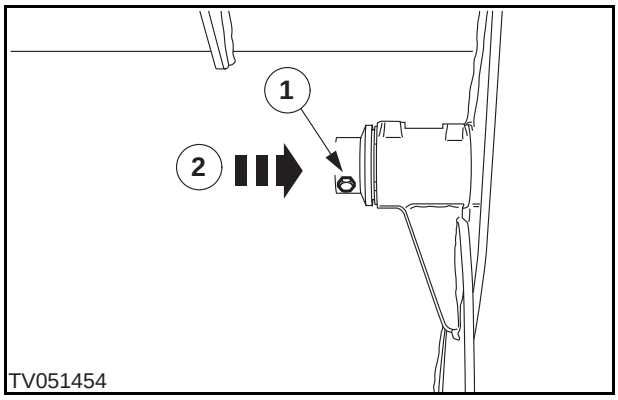
Note:
- Discard the locking nut.

2. Remove the clamshell pivot pin retaining bolt (1).

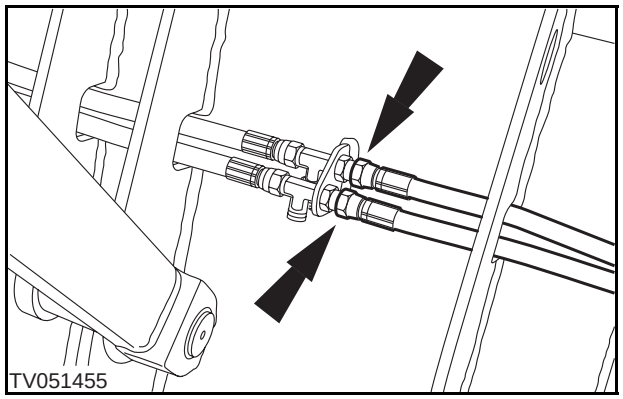
⚠ **Warning:**
- **Support the multi-purpose loader bucket and clamshell. Failure to follow this instruction may result in personal injury.**

3. Using a suitable drift, remove the clamshell pivot pin (2).
4. Repeat steps 2 to 4 for the remaining side of the bucket.

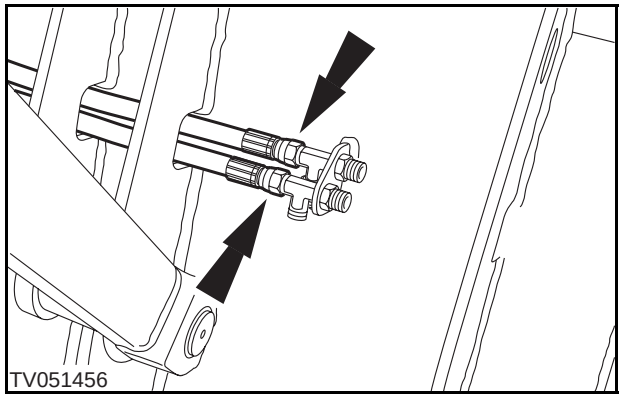
5. Remove the clamshell from the multi purpose loader bucket.



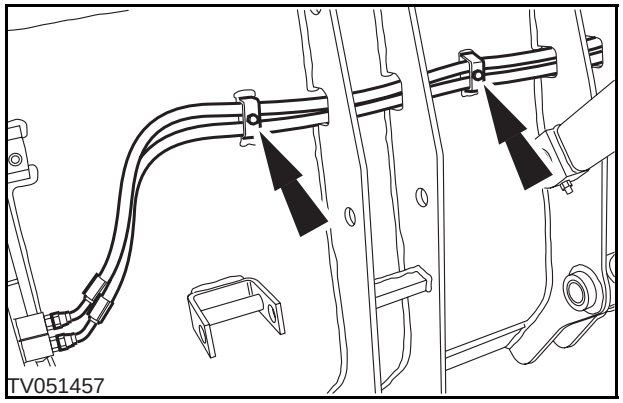
6. Remove the right-hand clamshell hydraulic supply hoses.



7. Detach the left-hand clamshell hydraulic supply hoses.

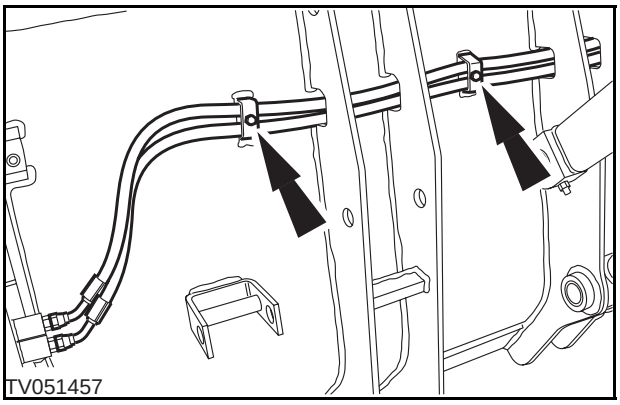


8. Remove the left-hand clamshell hydraulic supply hoses brackets retaining bolts and remove the brackets.
9. Remove the left-hand clamshell hydraulic supply hoses.

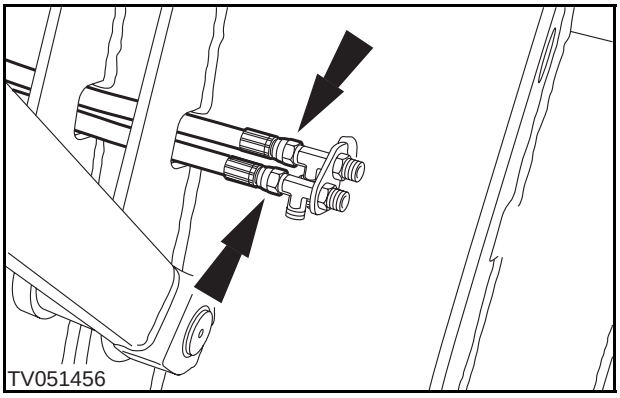


Assembly

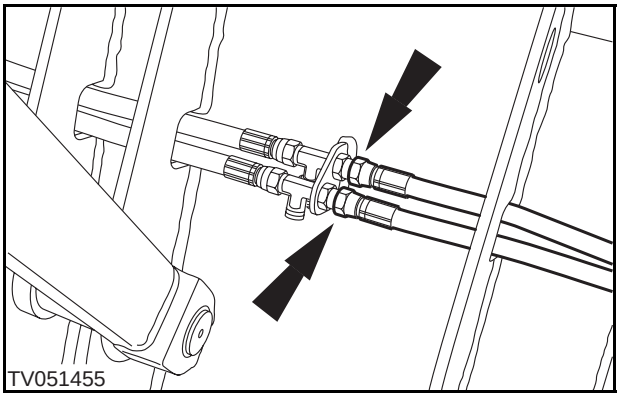
1. Install the left-hand clamshell hydraulic supply hoses.
2. Install the left-hand clamshell hydraulic supply hoses brackets and install the bracket retaining bolts.


TV051457

3. Install the left-hand clamshell hydraulic supply hoses.


TV051456

4. Install the right-hand clamshell hydraulic supply hoses.


TV051455

⚠ **Warning:**

- **Support the multi-purpose loader bucket and clamshell. Failure to follow this instruction may result in personal injury.**

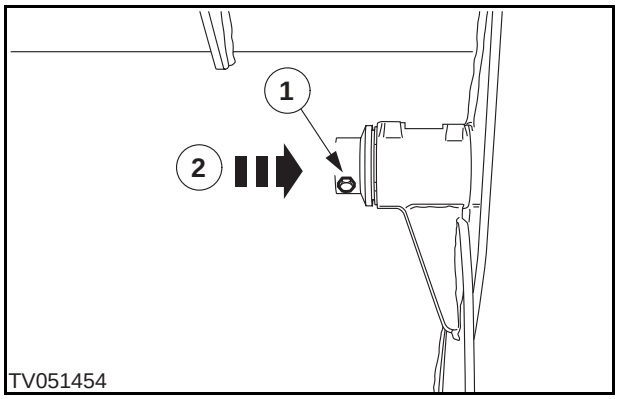
5. Install the clamshell to the multi purpose loader bucket.
6. Using a suitable drift, Install the clamshell pivot pin (2).

Note:

- Install a new locking nut.

7. Install the clamshell pivot pin retaining bolt (1).

8. Tighten to 98Nm (72 lb.ft).



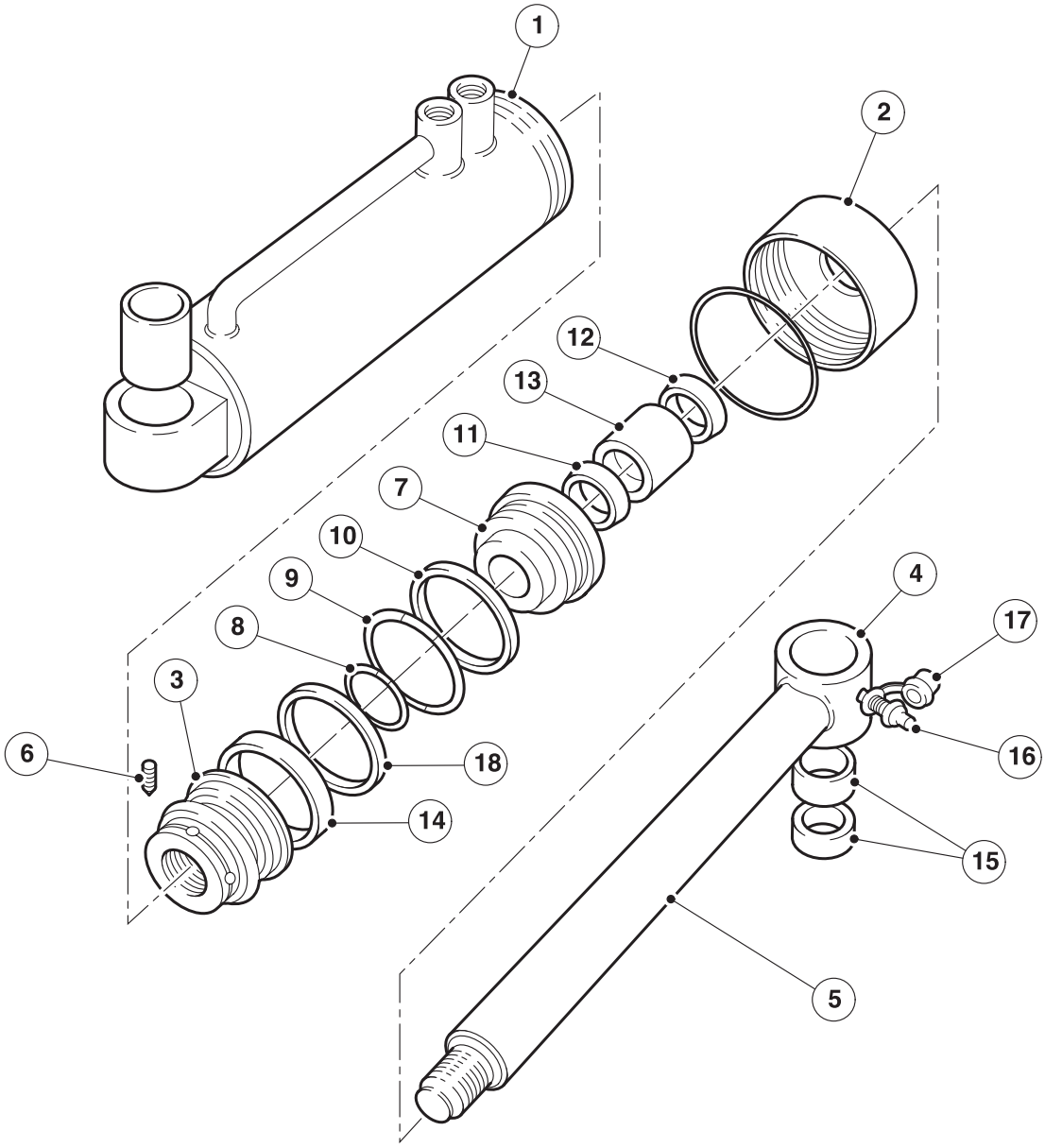
9. Install the clamping cylinder. For additional information, refer to Section B02-01 MULTI PURPOSE LOADER BUCKET CLAMPING CYLINDER .
10. Repeat steps 6 to 9 for the remaining side of the bucket.

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DISASSEMBLY AND ASSEMBLY — MULTI-PURPOSE LOADER BUCKET CLAMPING CYLINDER

BHB0201DC

Operation: **Disassembling and Assembling the Multi-Purpose Loader Bucket Clamping Cylinder**	*Job Code:* **02 02 17 xx**		
None	Standard tools, Suitable vice equipment		



TV040499

1	Tube
2	Cap
3	Piston
4	Piston rod eye
5	Piston rod
6	Screw
7	Cylinder gland
8	O-ring
9	O-ring
10	Back-up ring
11	Seal
12	Wiper
13	Gland bearing
14	Sealing ring
15	Bushing
16	Grease nipple
17	Cap
18	Ring

Disassembly

Clean the outside of the cylinder.

1. Fasten the tube (1) in a vice. Be careful to prevent damage to the tube (1).
2. Use the gland wrench OEM 6202, to loosen and remove the cap (2) from the tube (1).
3. Pull the piston rod (5) straight out of the tube (1) to prevent damage to the tube (1).
4. Fasten the piston rod eye (4) in a vice and put a support below the piston rod (5) near the piston (3).
5. Remove the screw (6) securing the piston (3) to the piston rod (5).
6. Loosen and remove the piston (3) from the piston rod (5). Use a torque multiplier for pistons that have a high torque value.
7. Remove the cylinder gland (7) from the piston rod (5).
8. Remove the cap (2) from the piston rod (5).
9. Remove the O-rings (8) and (9), back-up ring (10), and seal (11) from the cylinder gland (7).
10. Remove the gland bearing (13) from the piston (3).
11. Remove the wiper (12) from the cap (2).

Assembly

1. Install a new wiper (12) in the cap (2). Orientate the wiper (12) with the lip pointing towards the cap (2).
2. Install the wide seal (11) in the cylinder gland (7). The side of the seal (11) with the lip must be towards the small end of the cylinder gland (7). The seal (11) can be difficult to install.
3. Install the O-ring (9) next to the back-up ring (10) in the groove on the outside of the cylinder gland (7).
4. Install a new O-ring (8) in the cylinder gland (7).

5. Fasten the piston rod eye (4) in the vice.
6. Remove any marks and sharp edges on the chamfer at the end of the piston rod (5).
7. Install the cap (2) on the piston rod (5).
8. Lubricate the bore of the cylinder gland (7) with clean oil.
9. Push the cylinder gland (7) onto the piston rod (5). If necessary, use a soft hammer to drive the cylinder gland (7) onto the piston rod (5).
10. Put a support below and near the end of the piston rod (5). Use a shop cloth between the support and the piston rod (5) to prevent damage to the piston (3).
11. Put the piston (3) on the end of the piston rod (5).
12. Tighten the piston (3) for the cylinder that is being repaired. A torque multiplier can be used to help tighten the piston (3).
13. Install a new screw (6) securing the piston (3) to the piston rod (5).
14. Lubricate the inside of the tube (1) and the piston (3) with the clean oil.
15. Push the tube (1) straight onto the piston (3).
16. Lubricate the O-ring (9) on the cylinder gland (7) with clean oil.
17. Install the cylinder gland (7) in the tube (1).
18. Apply Loctite 242 to the threads of the tube (1) and the cap (2).
19. Tighten the cap (2).

Note: This page intentionally left blank.

SPECIFICATIONS — BUCKETS

BHB0201SA

Torque Values

Description	Nm	Lb.ft
Pivot Pin Lock nut	10	7
Loader Bucket Cylinder Piston	2400	1770
Loader Bucket Cylinder Gland	320–550	236–405
Lock Screw	23	17

DIGGER QUICK ATTACH

C03
SECTION

REMOVAL AND INSTALLATION — QUICK ATTACH BACKHOE BUCKET..... C03–01–1
REMOVAL AND INSTALLATION — BACKHOE QUICK ATTACH UNIT C03–01–3
REMOVAL AND INSTALLATION — BACKHOE QUICK ATTACH UNIT CONTROL VALVE C03–01–5
REMOVAL AND INSTALLATION — BACKHOE QUICK ATTACH UNIT HYDRAULIC CYLINDER.... C03–01–7
DISASSEMBLY AND ASSEMBLY — QUICK ATTACH HYDRAULIC CYLINDER..... C03–01–9
SPECIFICATIONS — DIGGER QUICK ATTACH C03–01–13

REMOVAL AND INSTALLATION — QUICK ATTACH BACKHOE BUCKET

BHC0301RA

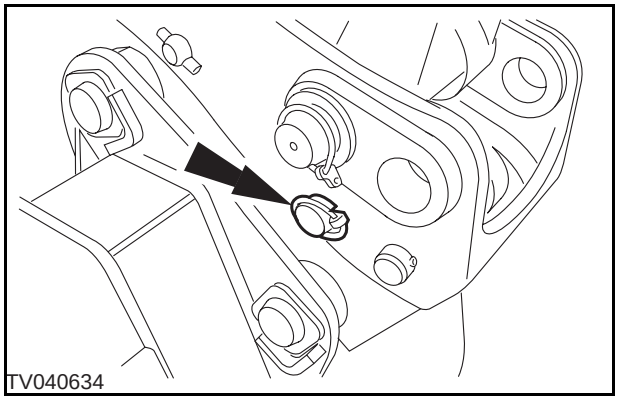
Operation: **Removing and Installing the Quick Attach Backhoe Bucket**	*Job Code:* **03 08 13 xx**		
None	Standard tools		

Removal

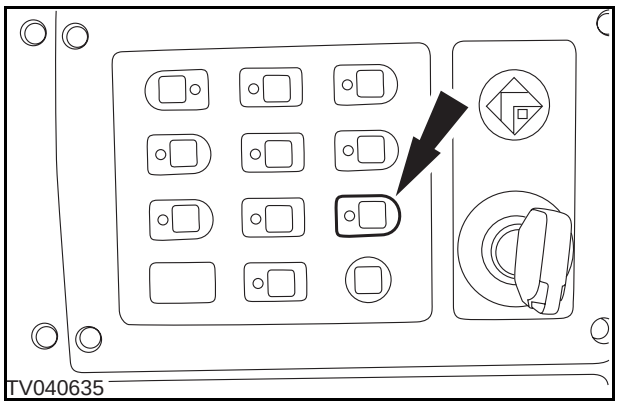
⚠ **Warning:**

- **Never place your hands inside the quick coupler if the engine is running. Failure to follow this instruction may result in personal injury.**

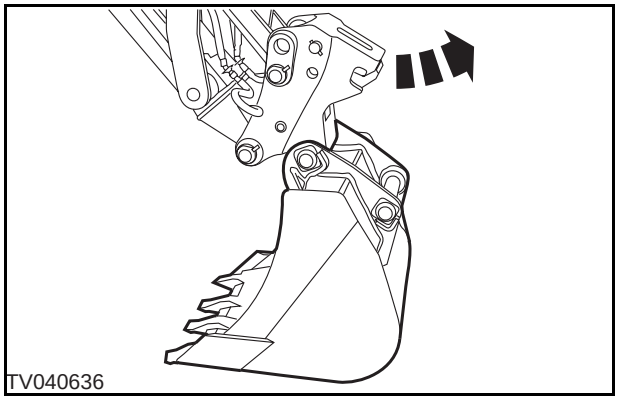
1. Park the machine on firm, level ground.
2. Place the backhoe bucket on firm, level ground.
3. Remove the quick attach backhoe bucket safety pin (if equipped).


TV040634

4. Press and hold the backhoe quick attach release switch.


TV040635

5. Remove the bucket.


TV040636

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION — BACKHOE QUICK ATTACH UNIT

BHC0301RB

Operation: **Removing and Installing the Backhoe Quick Attach Unit**	*Job Code:* **03 09 13 xx**		
Suitable axle stand, Suitable trolley jack	Standard tools		

Removal

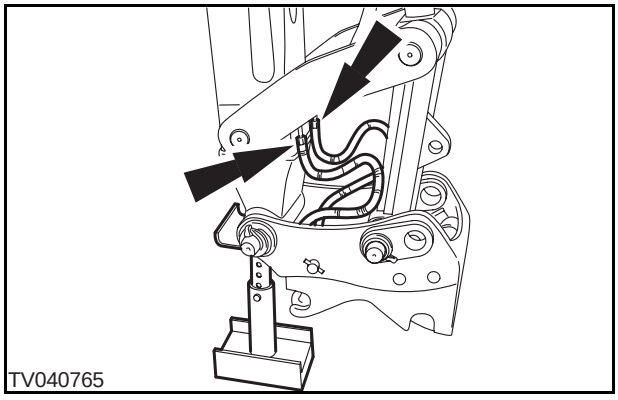
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Remove the quick attach backhoe bucket. For additional information, refer to QUICK ATTACH BACKHOE BUCKET, PAGE C03–01–1 in this section.

Note:
- Make sure the axle stand is only supporting the backhoe arm and is not resting on the quick attach unit.

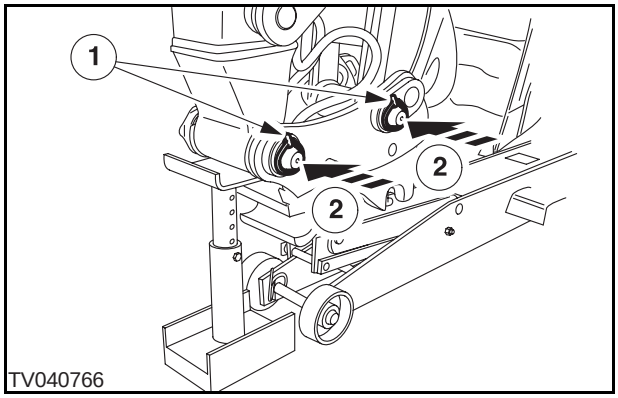
2. Using a suitable axle stand, support the backhoe.
3. Release the pressure from the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
4. Disconnect the quick attach unit supply and return hydraulic hoses.


TV040765

5. Using a suitable trolley jack, support the quick attach unit.
6. Remove the pivot pin locking pins (1).

Note:
- Recover the pivot pin washers.

7. Remove the pivot pins (2) and remove the quick attach unit.



Installation

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — BACKHOE QUICK ATTACH UNIT CONTROL VALVE

BHC0301RC

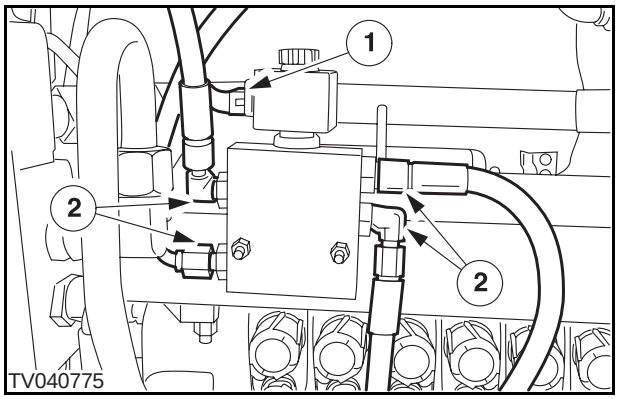
Operation: **Removing and Installing the Backhoe Quick Attach Unit Control Valve**	*Job Code:* **03 10 13 xx**		
None	Standard tools		

Removal

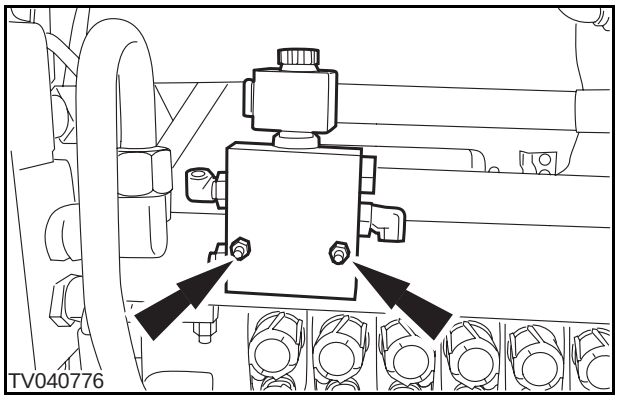
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Park the machine on firm level ground.
2. Release the pressure from the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
3. Disconnect the backhoe quick attach unit control valve electrical connector (1).
4. Disconnect the backhoe quick attach unit control valve hydraulic hoses (2).



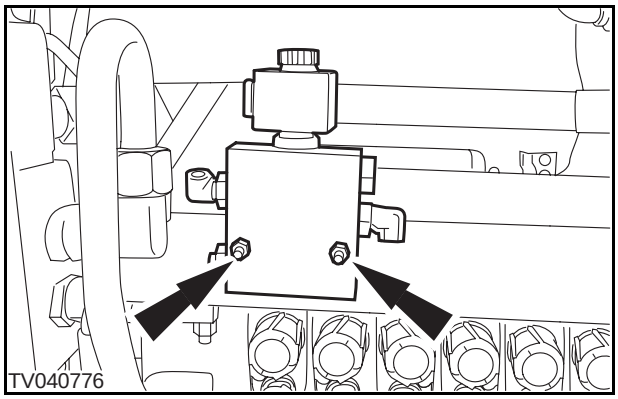
5. Remove the backhoe quick attach unit control valve.



Installation

1. To install, reverse the removal procedure.

2. Tighten to 12Nm (9 lb.ft).



3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — BACKHOE QUICK ATTACH UNIT HYDRAULIC CYLINDER

BHC0301RD

Operation: **Removing and Installing the Backhoe Quick Attach Unit Hydraulic Cylinder**	*Job Code:* **03 11 13 xx**		
Suitable axle stand, Suitable trolley jack	Standard tools		

Removal

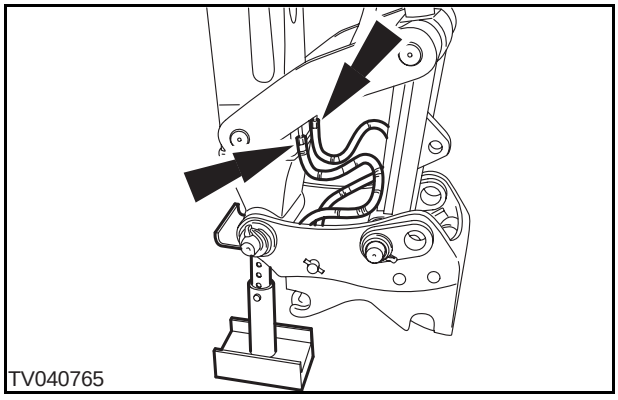
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

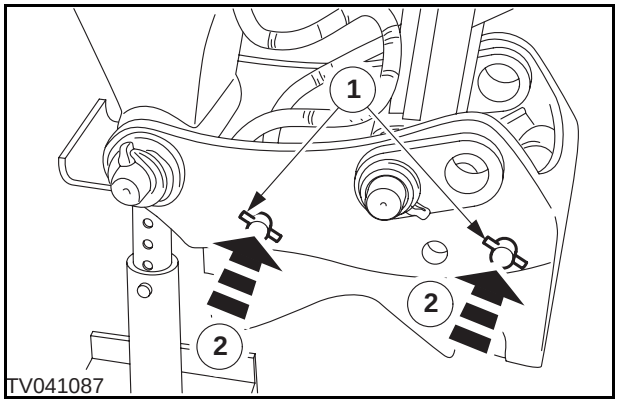
1. Remove the quick attach backhoe bucket. For additional information, refer to QUICK ATTACH BACKHOE BUCKET, PAGE C03–01–1 in this section.

Note:
- Make sure the axle stand is only supporting the backhoe arm and is not resting on the quick attach unit.

2. Using a suitable axle stand, support the backhoe.
3. Disconnect the quick attach unit supply and return hydraulic hoses.

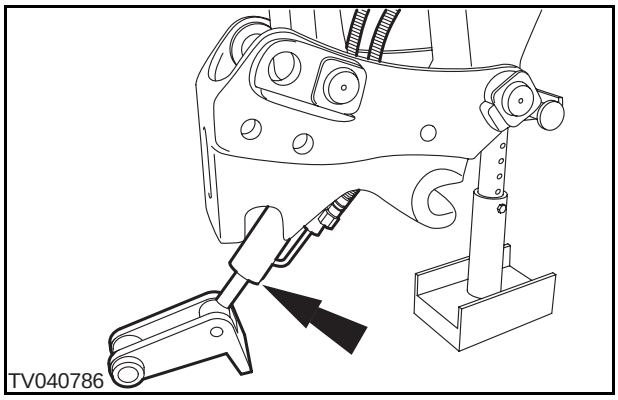

TV040765

4. Using a suitable trolley jack, support the quick attach hydraulic cylinder.
5. Remove the roll pins (1).
6. Remove the quick attach hydraulic cylinder retaining pins (2).

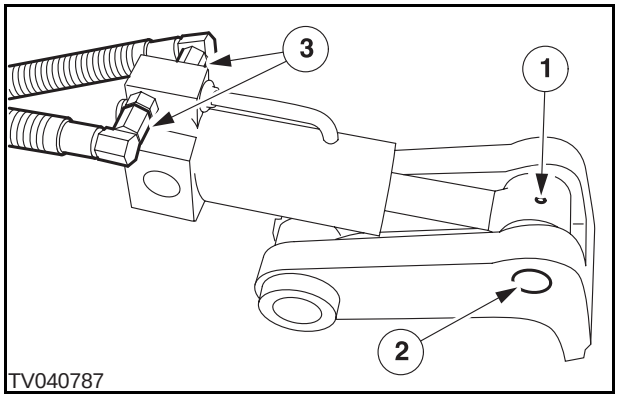


TV041087

7. Remove the quick attach hydraulic cylinder from the quick attach unit.



8. Remove the pivot pin grub screw (1).
9. Remove the pivot pin (2).
10. Remove the hydraulic hoses (3).



Installation

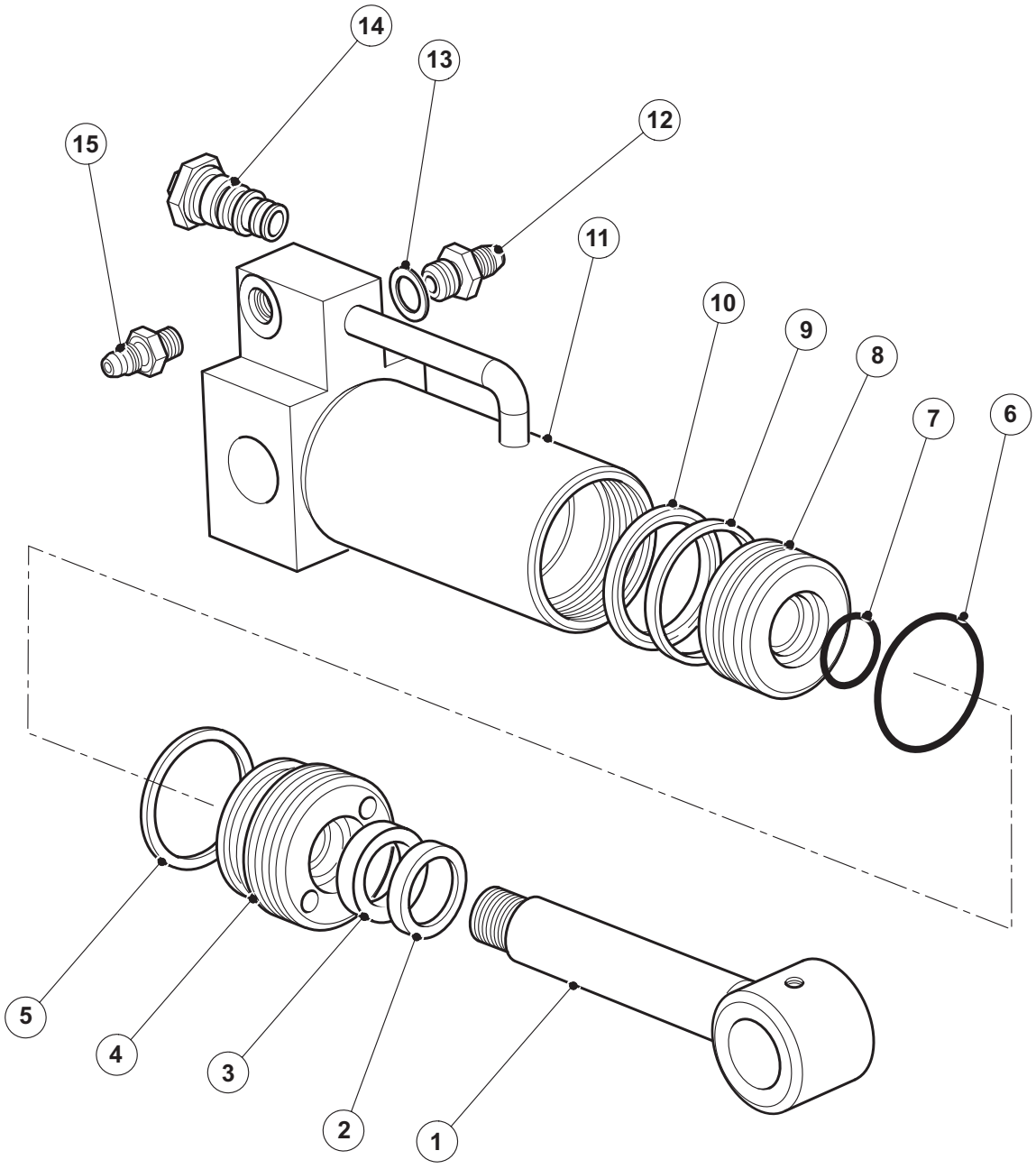
Note:
- Install new roll pins.

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

DISASSEMBLY AND ASSEMBLY — QUICK ATTACH HYDRAULIC CYLINDER

BHC0301DA

Operation: **Disassembling and Assembling the Quick Attach Hydraulic Cylinder**	*Job Code:* **03 11 17 xx**		
None	Standard tools		



TV041146

1	Piston Rod
2	Wiper Seal
3	Rod Seal
4	Gland Nut
5	Gland Back—Up Ring
6	Gland O-Ring
7	Piston O-Ring
8	Piston Head
9	Piston Ring Bearing
10	Rod Seal
11	Cylinder Assembly
12	Adaptor
13	Dowty Washer
14	Check Valve
15	Adaptor

Disassembly

Note:
- Note the orientation of all components as they are removed to aid installation.

1. Clean the outside of the hydraulic cylinder.
2. Securely clamp the ram asembly horizontaly in a vice.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

3. Loosen the gland nut (4).
4. Withdraw the piston rod assembly from the cylinder.
5. Secure the eye end of the piston rod (1) in a vice.
6. Remove the piston locking screw (not illustrated).

Note:
- This is staked and may require the deformed area to be filed off.

7. Remove the piston head (8).
8. Remove the gland nut (4) from the piston rod (1).
9. Remove the rod seal (10), piston ring bearing (9) and O-ring seal (7) from the piston head .
10. Remove the gland O-ring (6) and the gland back-up ring (5) from the gland nut (4).
11. Remove the ram seal (3) and the wiper (2) from the gland nut (4).
12. Remove the check valve (14).

Note:
- Removing the check valve will aid in assembly allowing air trapped inside the cylinder to escape.

Note:
- There are no servicable componenets within the check valve.

13. Remove the adaptors (12) and (15) if damaged. Collect the dowty washer (13).

Assembly

Note:
- Install new O-ring seals, seals and back-up rings.

Note:
- Clean all internal componenets thoroughly.

1. Install the gland nut back-up ring (5) and gland O-ring (6) into the gland nut (4).
2. Install the rod seal (3) and wiper (2) into the gland nut (4).
3. Install the piston O-ring seal (7) into the piston head (8).
4. Install the gland nut assembly onto the piston rod (1).
5. Install the piston ring bearing (9) and the rod seal (10) into the piston head.
6. Apply Loctite 242 to the thread and install the piston head assembly onto the piston rod. Tighten to 100 to 150Nm (74 to 111 lb.ft). Ensure the dog point locates correctly into the locating groove and stake to prevent back-off.

⚠ Caution:
- **Ensure there is no damage to any componenet during assembly as this may cause premature failure of the componenet.**

7. Lightly lubricate the piston assembly with hydraulic oil and install the piston rod asembly into the hydraulic cylinder (11).
8. Tighten the gland nut to 150 to 200Nm (111 to 148 lb.ft).
9. Ensure the piston is in the fully retracted position and install the check valve (14)into the cylinder assembly (11).
10. Install the adaptor (15).
11. Install the adaptor (12) using a new dowty washer (13).

Note: This page intentionally left blank.

SPECIFICATIONS — DIGGER QUICK ATTACH

BHC0301SA

Torque Values

Description	Nm	Lb.ft
Backhoe Quick Attach Unit Control Valve	12	9

DIGGER BOOM AND DIPPERSTICK

D04
SECTION

REMOVAL AND INSTALLATION — STANDARD BACKHOE BUCKET..... D04–01–1
REMOVAL AND INSTALLATION — BACKHOE BOOM..... D04–01–3
REMOVAL AND INSTALLATION — BACKHOE DIPPER ARM D04–01–7
REMOVAL AND INSTALLATION — BOOM SWING TOWER.....D04–01–11
DISASSEMBLY AND ASSEMBLY — EXTENDABLE DIPPER ARM HYDRAULIC CYLINDER D04–01–15
GENERAL PROCEDURE — BACKHOE CONTROL LEVER ADJUSTMENT D04–01–19
GENERAL PROCEDURE — AUXILIARY FUNCTION/TELESCOPIC DIPPER CONTROL PEDAL ADJUSTMENT D04–01–23
SPECIFICATIONS — DIGGER BOOM AND DIPPERSTICK.....D04–01–25

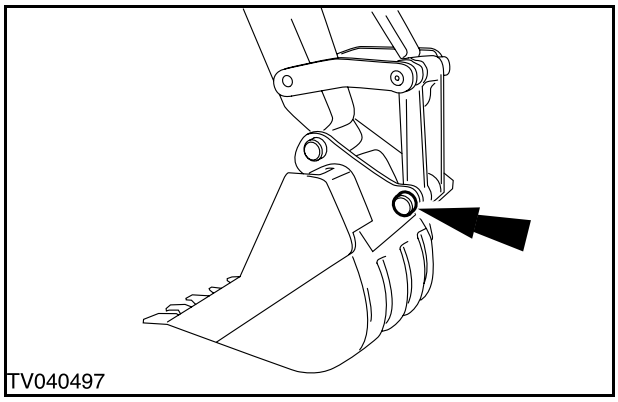
REMOVAL AND INSTALLATION — STANDARD BACKHOE BUCKET

BHD0401RA

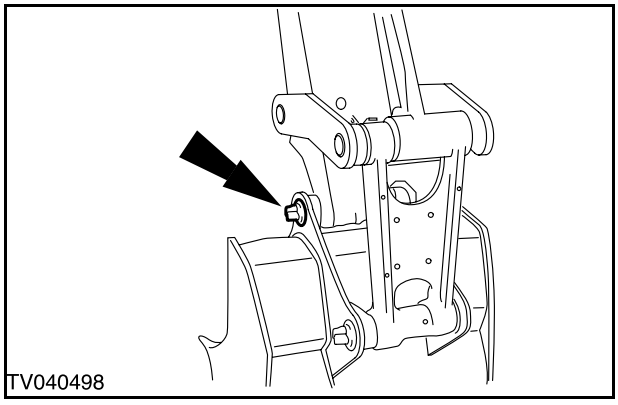
Operation: **Removing and Installing the Standard Backhoe Bucket**	*Job Code:* **04 19 13 xx**		
None	Standard tools		

Removal

1. Park the machine on firm, level ground.
2. Lower the stabilizers until the rear wheels are just clear of the ground.
3. Lower the backhoe bucket on firm, level ground.
4. Stop the engine and engage the park brake.
5. Remove the snap ring and remove the pivot pin.


TV040497

6. Start the engine and retract the bucket hydraulic cylinder.
7. Operate the attachment controls so the dipper/bucket linkage pin is not under load.
8. Stop the engine.
9. Remove the snap ring and remove the pivot pin.


TV040498

10. Start the engine and operate the attachment controls to disconnect the dipper from the bucket.

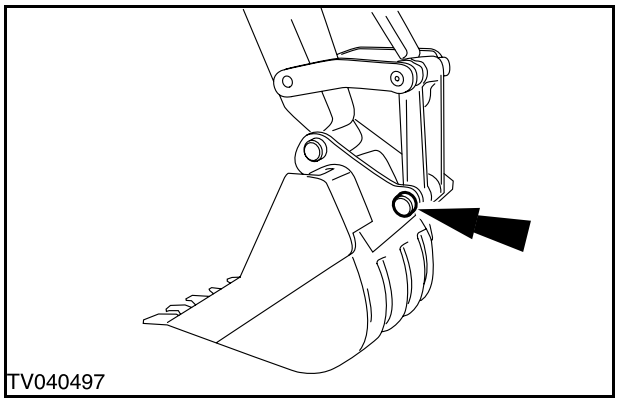
Installation

⚠ **Caution:**

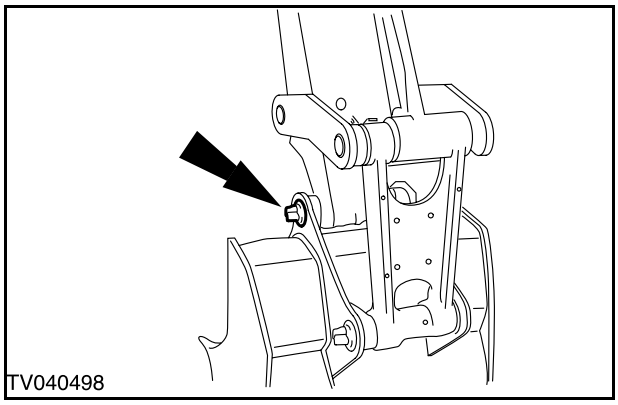
- **Make sure the bucket is in a safe position on firm, level ground.**

1. Start the engine and extend the bucket hydraulic cylinder rod to bring the connecting rod into the housing.

2. Stop the engine and install the pivot pin and the snap ring.


TV040497

3. Start the engine.
4. Carefully raise the attachment and operate the bucket and dipper control to bring the dipper lugs in line with the bucket lugs.
5. Stop the engine and install the pivot pin and the snap ring.


TV040498

REMOVAL AND INSTALLATION — BACKHOE BOOM

BHD0401RB

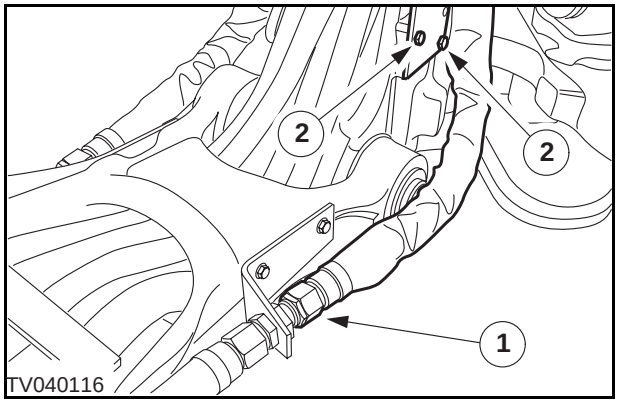
Operation: **Removing and Installing the Backhoe Boom**	*Job Code:* **04 01 13 xx**		
Suitable lifting equipment **3000Kg**	Standard tools		

Removal

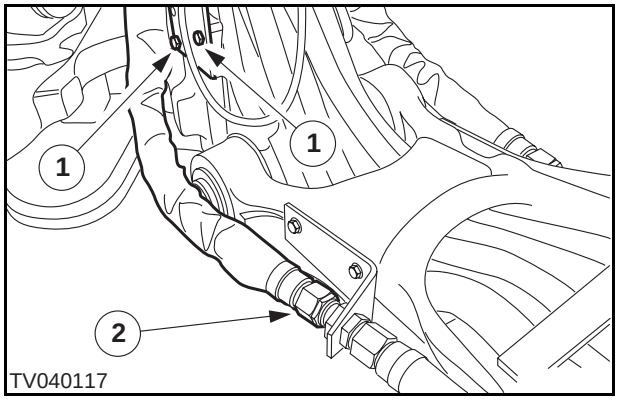
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

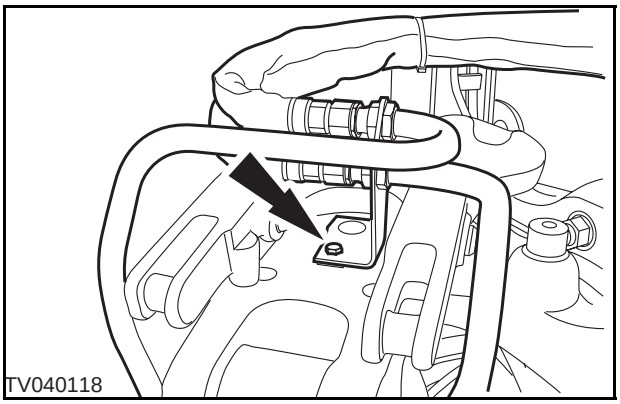
1. Park the machine of firm level ground.
2. Remove the Backhoe dipper arm. For additional information, refer to BACKHOE DIPPER ARM, PAGE D04–01–7 in this section.
3. Disconnect the right-hand auxiliary service hose (1).
4. Remove the auxiliary service hose right-hand bracket retaining bolts (2).



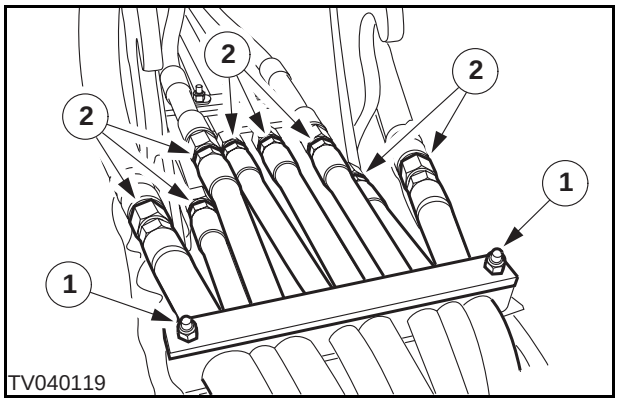
5. Disconnect the left-hand auxiliary service hose (2).
6. Remove the auxiliary service hose left-hand bracket retaining bolts (1).



7. Remove the auxiliary service hose upper bracket retaining bolt and position to one side.



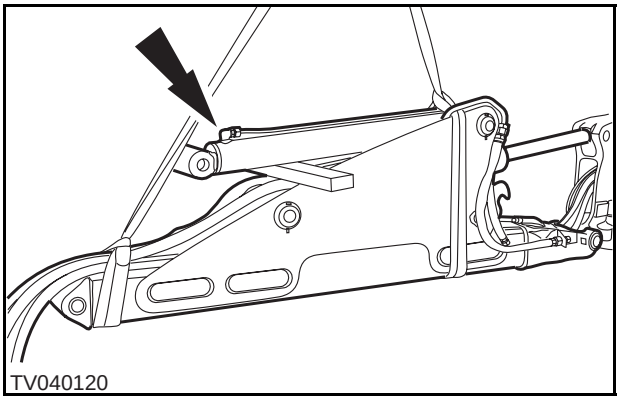
8. Remove the hydraulic hose bracket (1).
9. Disconnect the hydraulic hoses from the boom (2).



⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

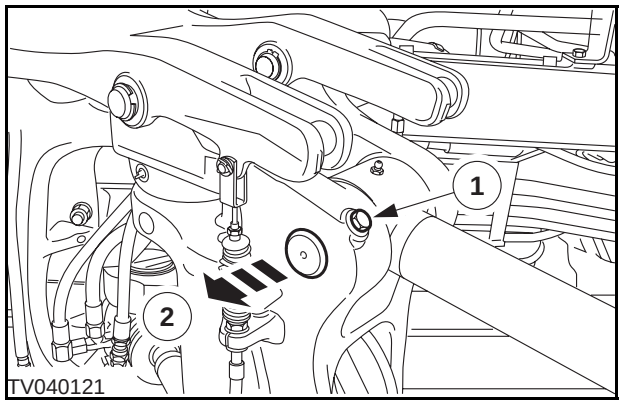
Note:
- Support the hydraulic cylinder.

10. Using suitable lifting equipment, support the boom.

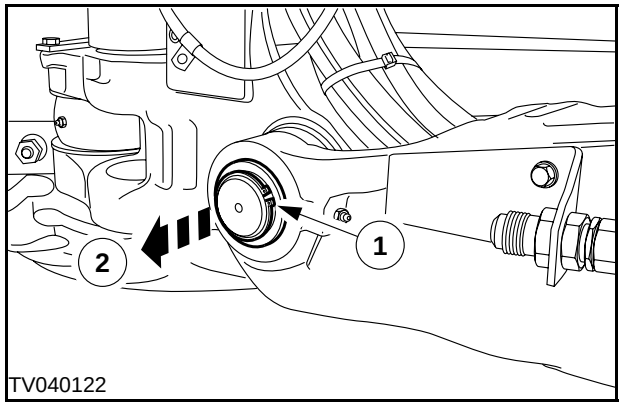


11. Remove the hydraulic cylinder pivot pin retaining bolt (1).

12. Remove the hydraulic cylinder pivot pin (2).



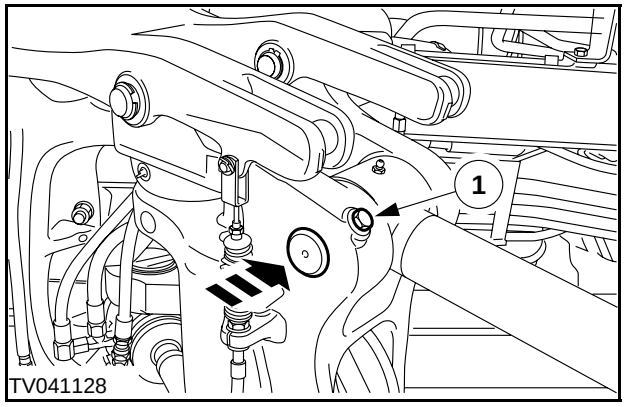
13. Remove the boom pivot pin circlip (1).
14. Remove the boom pivot pin (2).
15. Remove the boom.



Installation

Note:
- Install a new pivot pin lock nut.

1. To install, reverse the removal procedure.
2. Tighten (1) to 10Nm (7 lb.ft).



3. Check and adjust the hydraulic fluid level as required.

Note: This page intentionally left blank.

REMOVAL AND INSTALLATION — BACKHOE DIPPER ARM

BHD0401RC

Operation: **Removing and Installing the Backhoe Dipper Arm**	*Job Code:* **04 04 13 xx**		
Suitable lifting equipment, Suitable trolley jack 	Standard tools 		

Removal

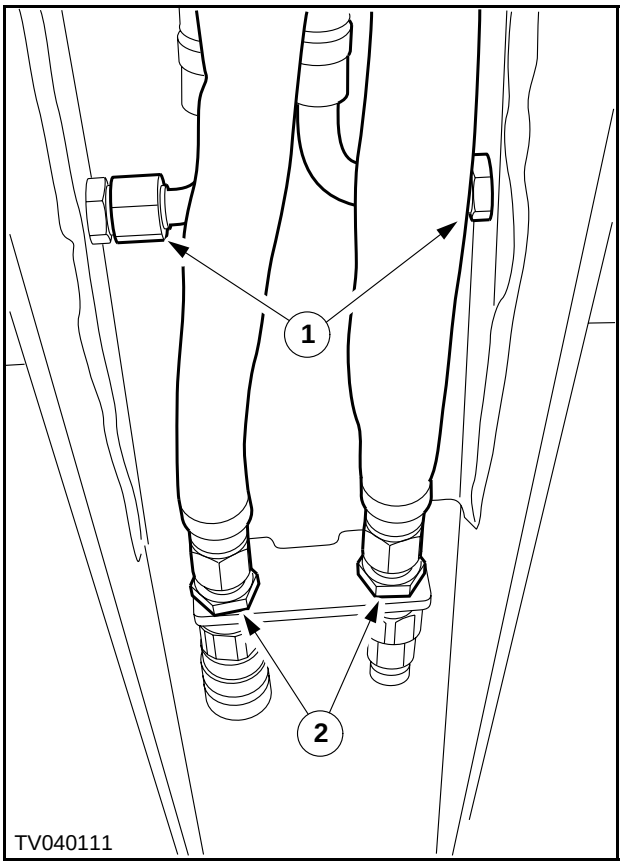
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

Note:
- Secure the bucket linkage to prevent movement.

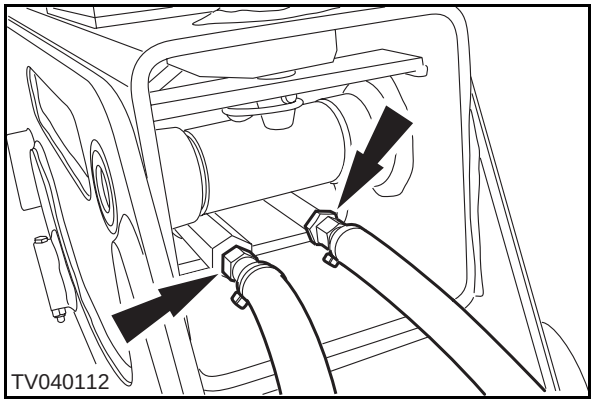
1. Remove the backhoe bucket. For additional information, refer to STANDARD BACKHOE BUCKET, PAGE D04–01–1 or QUICK ATTACH BACKHOE BUCKET, PAGE C03–01–1 in this section.
2. Park the machine on firm level ground and lower the stabilizer legs. Make sure the machine is not raised from the ground.
3. Position the backhoe bucket straight behind the machine and fully extend the dipper.
4. Release the pressure from the hydraulic system. For additional information, refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE .
5. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
6. Disconnect the bucket hydraulic cylinder hoses (1).

7. Disconnect the auxiliary service hydraulic hoses (2).



Vehicles with Extendable Dipper

8. Disconnect the extendable dipper hydraulic cylinder hoses.



All Vehicles

⚠ **Warning:**

- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

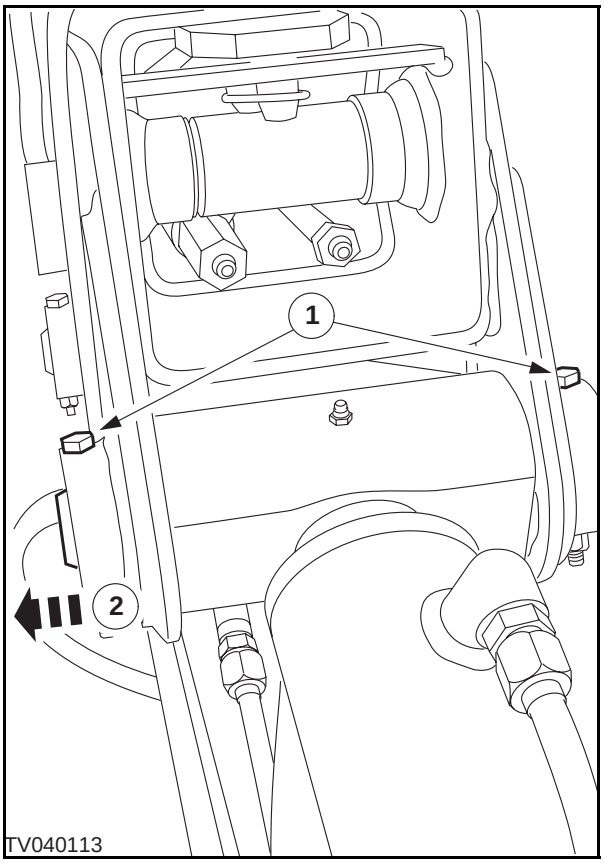
9. Using suitable lifting equipment, support the backhoe dipper arm.
10. Using a suitable trolley jack, support the boom.

Note:

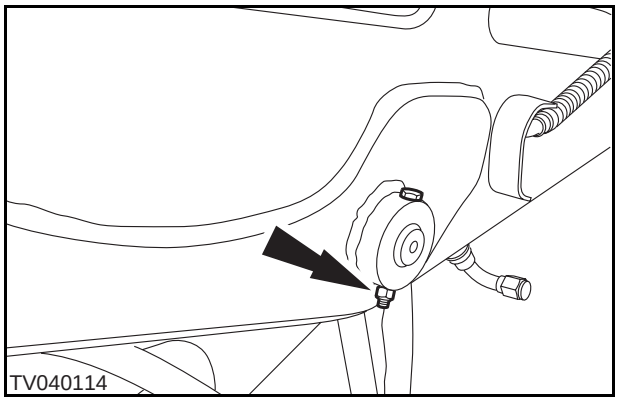
- Support the hydraulic cylinder.

11. Remove the hydraulic cylinder pivot pin retaining bolts (1).

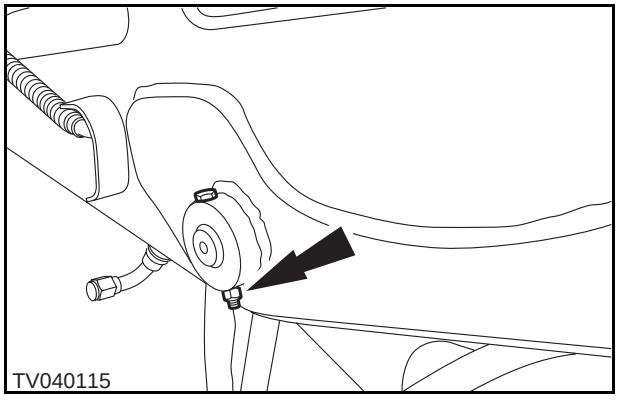
12. Remove the hydraulic cylinder pivot pin (2).



13. Remove the backhoe dipper arm pivot pin retaining bolt.



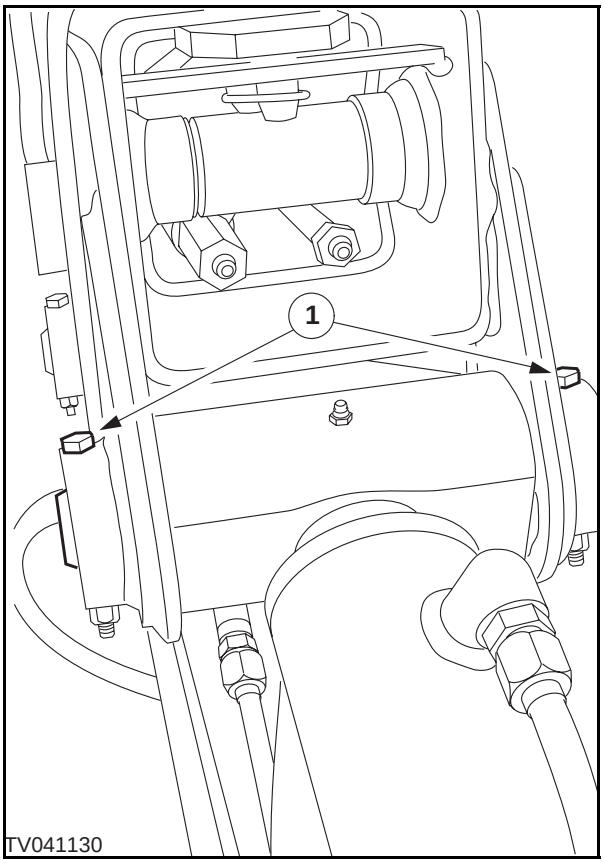
14. Remove the backhoe dipper arm pivot pin retaining bolt and remove the rear backhoe dipper arm pivot pin.
15. Remove the backhoe dipper arm.



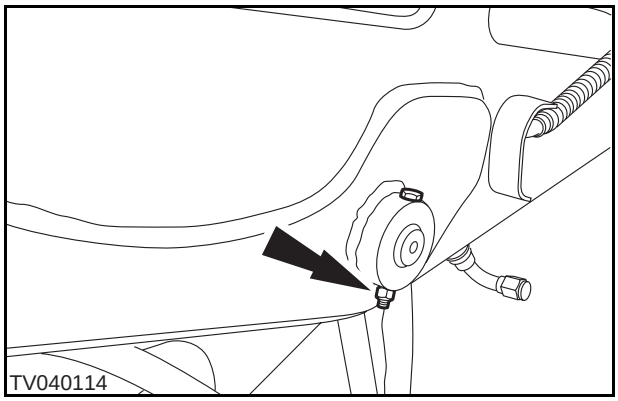
Installation

Note:
- Install new pivot pin retaining bolt lock nuts.

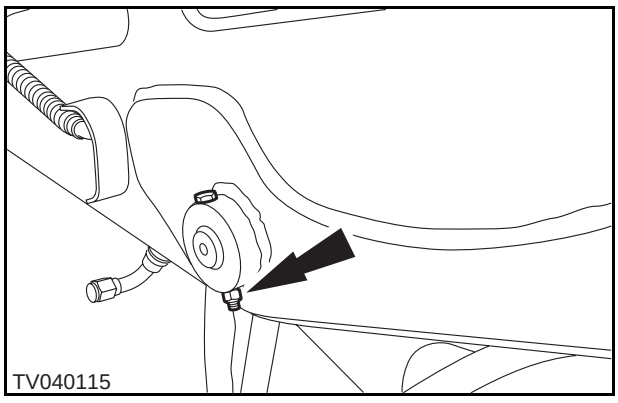
1. To install, reverse the removal procedure.
2. Tighten (1) to 10Nm (7 lb.ft).



3. Tighten to 10Nm (7 lb.ft).



4. Tighten to 10Nm (7 lb.ft).



5. Check and adjust the hydraulic oil level as required.

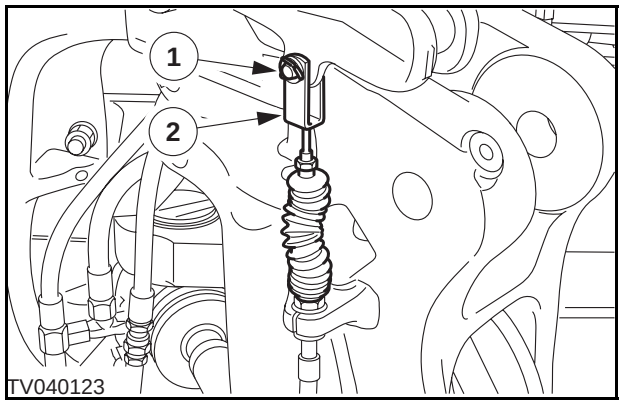
REMOVAL AND INSTALLATION — BOOM SWING TOWER

BHD0401RD

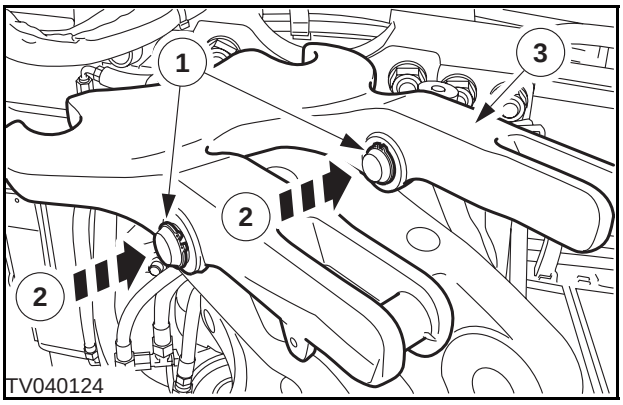
Operation: **Removing and Installing the Boom Swing Tower**	*Job Code:* **04 20 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

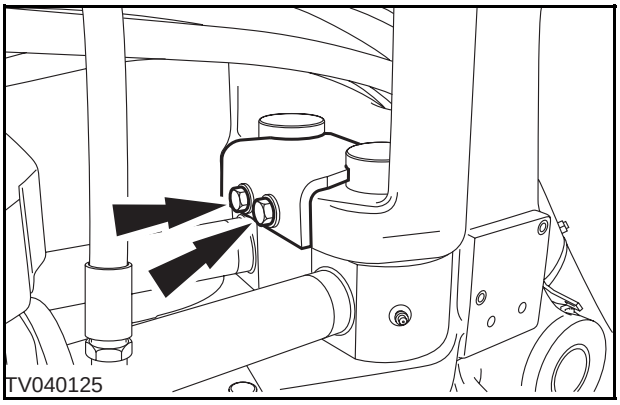
1. Park the machine on firm level ground.
2. Remove the backhoe boom. For additional information, refer to Section D04-01 BACKHOE BOOM .
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
4. Remove the backhoe locking cable pin (1).
5. Detach the backhoe locking cable (2).



6. Remove the circlips (1).
7. Remove the pivot pins (2).
8. Remove the backhoe locking plate (3).



9. Remove the retaining bolts and remove the slew pins locking plate.

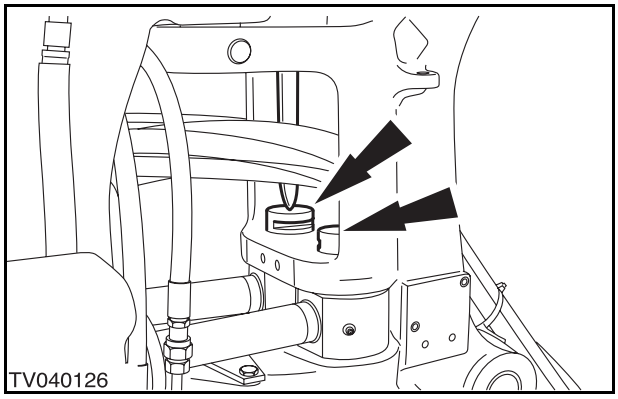


10. Using a suitable drift, remove the slew pins.

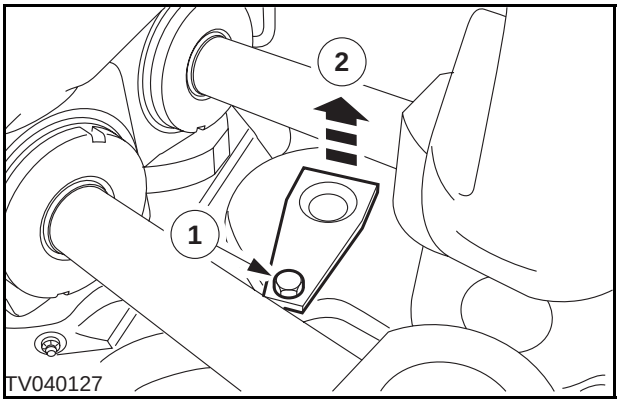
⚠ Warning:

- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

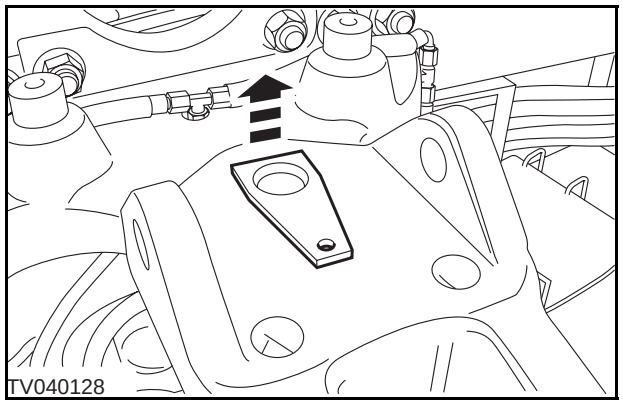
11. Using suitable lifting equipment, support the boom swing tower.



12. Remove the boom swing tower lower pivot pin retaining bolt (1) and remove the pivot pin (2).



13. Remove the boom swing tower upper pivot pin.

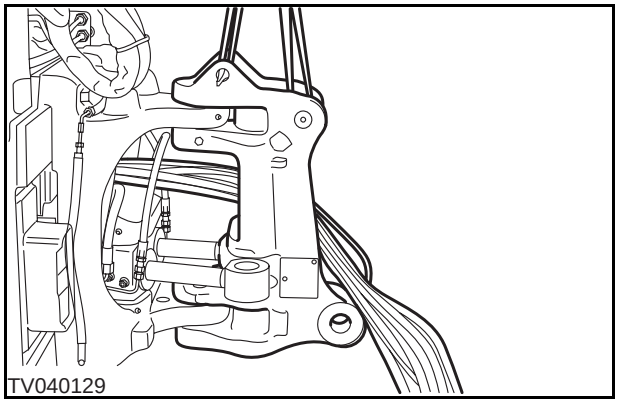

TV040128

Note:
- Withdraw the hydraulic hoses through the boom swing tower.

14. Remove the boom swing tower.

Note:
- Note the position of the boom swing tower wear washers.

15. Recover the boom swing tower wear washers.


TV040129

Installation

Note:
- Apply the correct specification grease to the boom swing tower upper and lower pivot pins.

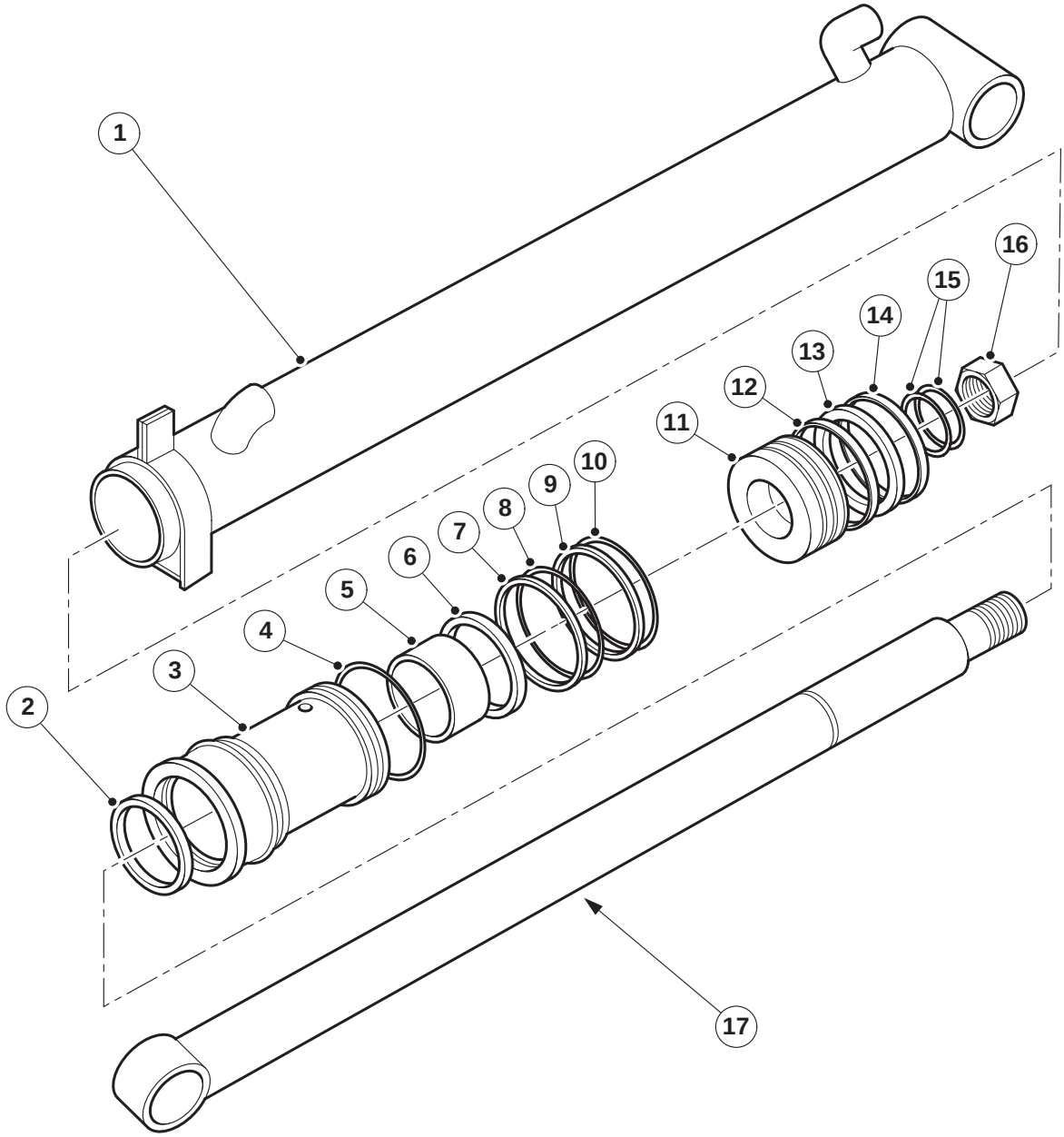
1. To install, reverse the removal procedure.

Note: This page intentionally left blank.

DISASSEMBLY AND ASSEMBLY — EXTENDABLE DIPPER ARM HYDRAULIC CYLINDER

BHD0401DA

Operation: **Disassembling and Assembling the Extendable Dipper Hydraulic Cylinder**	*Job Code:* **04 12 17 xx**		
Suitable lifting equipment	Standard tools, Suitable vice, Suitable piston ring compressor		



TV040505

1	Cylinder
2	Wiper
3	Retaining Bush
4	O-Ring
5	Bearing
6	Seal
7	Ring
8	O-Ring
9	Ring
10	O-Ring
11	Piston
12	Ring
13	Seal
14	Ring
15	O-Ring
16	Lock Nut
17	Piston Rod

Disassembly

⚠ **Warning:**

- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.
2. Fasten the cylinder (1) in a vice. Be careful to prevent damage to the cylinder (1).
3. Loosen the retaining bush (3).
4. Pull the piston rod (17) straight out of the cylinder (1) to prevent damage to the cylinder (1).
5. Position horizontally and fasten the piston rod eye in a vice. Position a support below the piston rod (17) near the piston (11).
6. Remove the piston lock nut (16).
7. Remove the piston (11) from the piston rod (17).
8. Remove the O-ring (15), the ring (14), the seal (13), and the ring (12) from the piston (11).

   Note:
   - Discard the O-ring seal.

9. Remove the retaining bush (3) from the piston rod (17).
10. Remove the O-ring (10), the ring back-up (9), the O-ring (8), the ring (7), the seal (6), the bearing (5), and the O-ring (4) from the retaining bush (3).

    Note:
    - Discard the O-ring seal.

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the O-ring (4), the bearing (5), the seal (6), the ring (7), the O-ring (8), the ring back-up (9) and the O-ring (10) to the retaining bush (3).

Note:
- To aid installation of the bush, lubricate the bore of the bush with clean oil.

2. Install the retaining bush (3) onto the piston rod (17).
3. Install the ring (12), the seal (13), the ring (14), the O-ring (15) to the piston (11).

Note:
- To aid installation of the piston, lubricate the bore of the piston with clean oil.

4. Install the piston assembly onto the piston rod (17).
5. Install the piston lock nut (16) and tighten to 800Nm (590 lb.ft).
6. Using a suitable piston ring compression tool to hold the new rings in place, start the tube onto the piston tube assembly. Push the tube onto the piston rod assembly until the compression tool is pushed off the piston rod assembly.
7. Install the retaining bush (3).

Note: This page intentionally left blank.

GENERAL PROCEDURE — BACKHOE CONTROL LEVER ADJUSTMENT

BHD0401GA

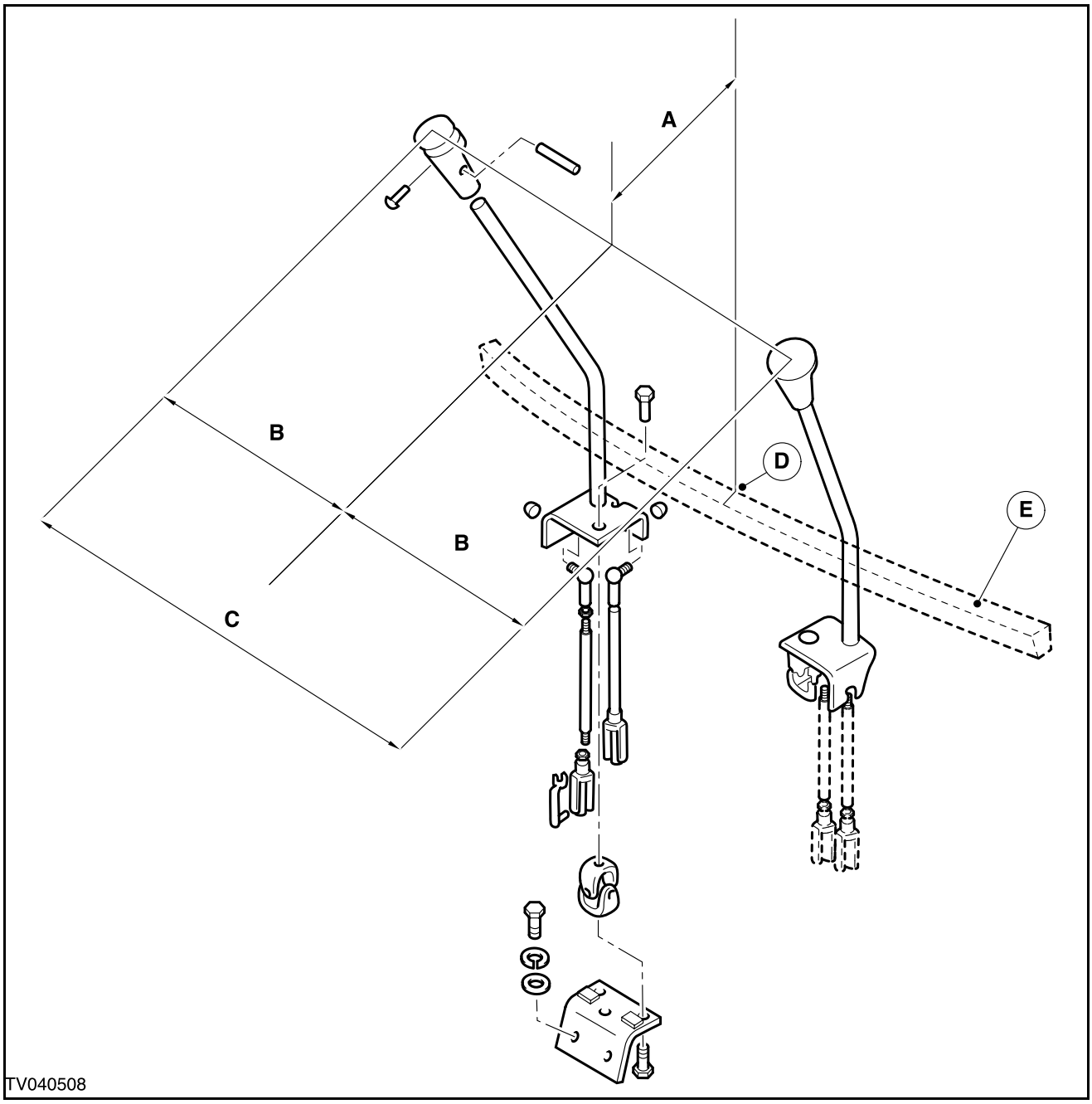
Adjustment Procedure

1. Park the machine on firm, level ground.
2. Switch off the engine.
3. Check that the distance from the cab frame (E) to the top of the backhoe control levers corresponds to (A).
4. Check that the distance between the top of each backhoe control lever and the centre line (D) of the machine corresponds to (B).
5. Adjust the control rods at the backhoe valve assembly until the distances are correct.

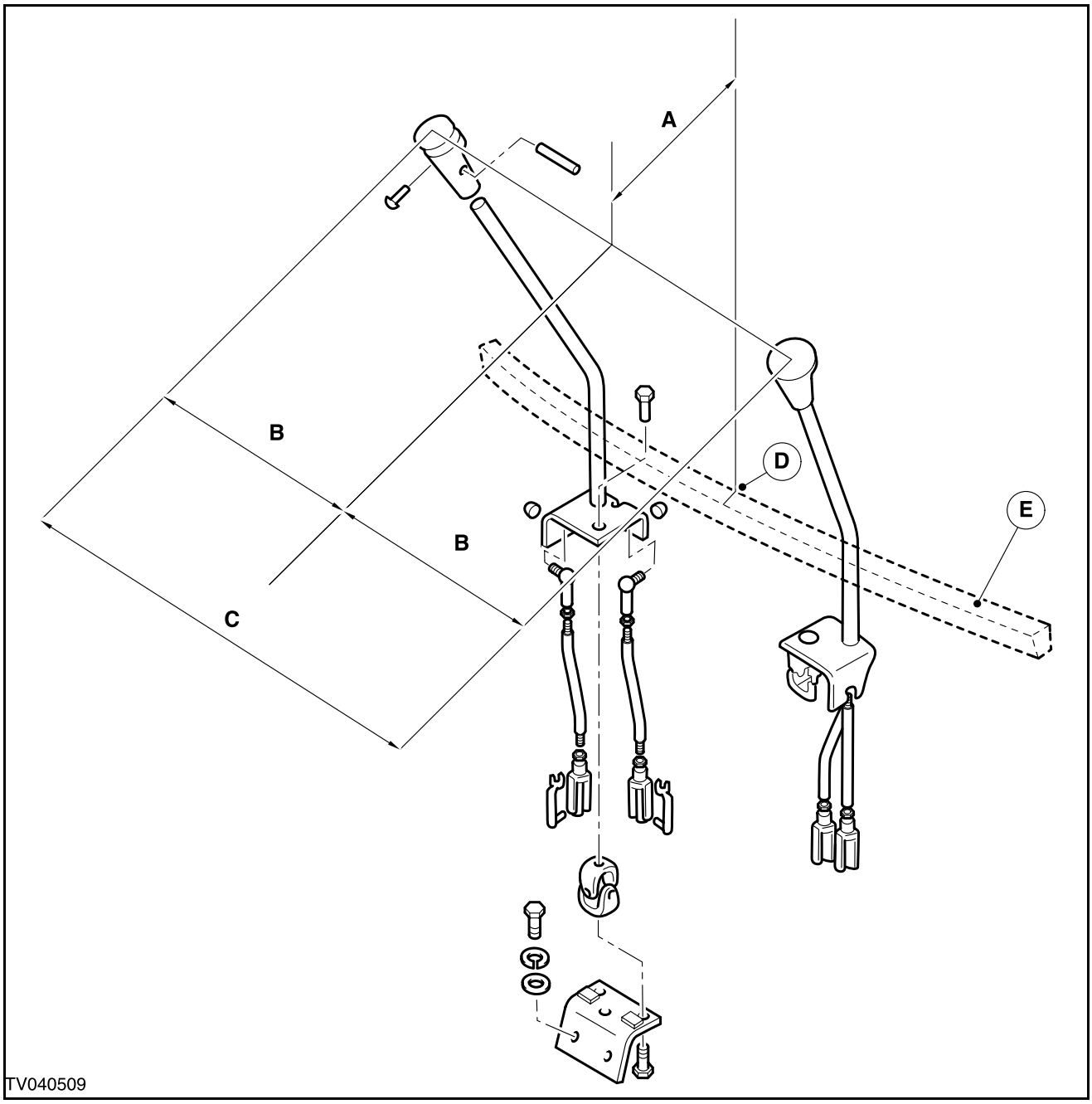
Lever Adjustment Parameters

Version	A	B	C
Standard mm (in)	254mm (10in)	143.5mm (5.65in)	287mm (11.3in)
I.S.O. mm (in)	254mm (10in)	143.5mm (5.65in)	287mm (11.3in)
X Pattern mm (in)	251mm (9.88in)	153.5mm (6.04in)	307mm (12.08in)

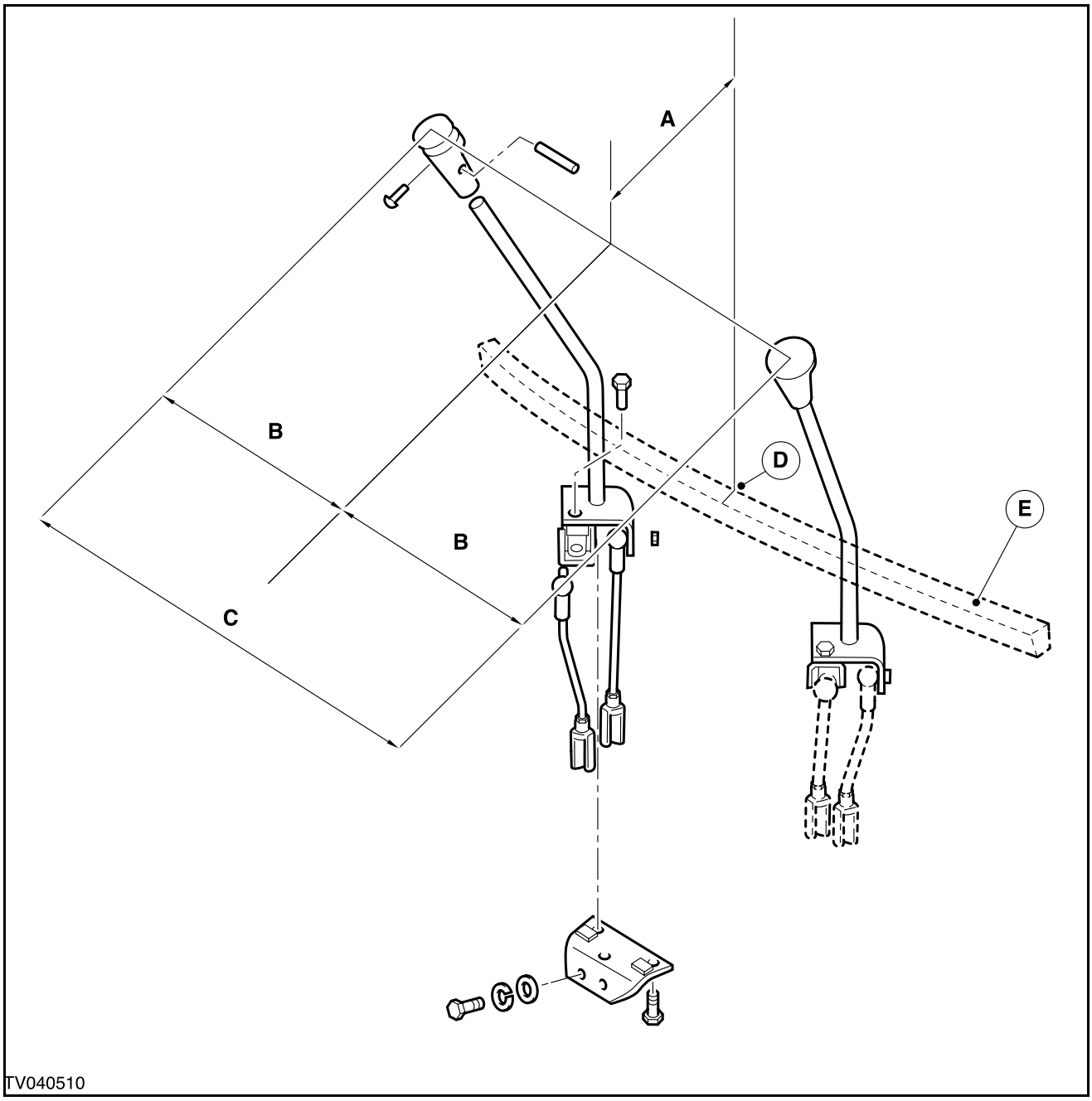
Standard Version



I.S.O. Version



X Pattern Version

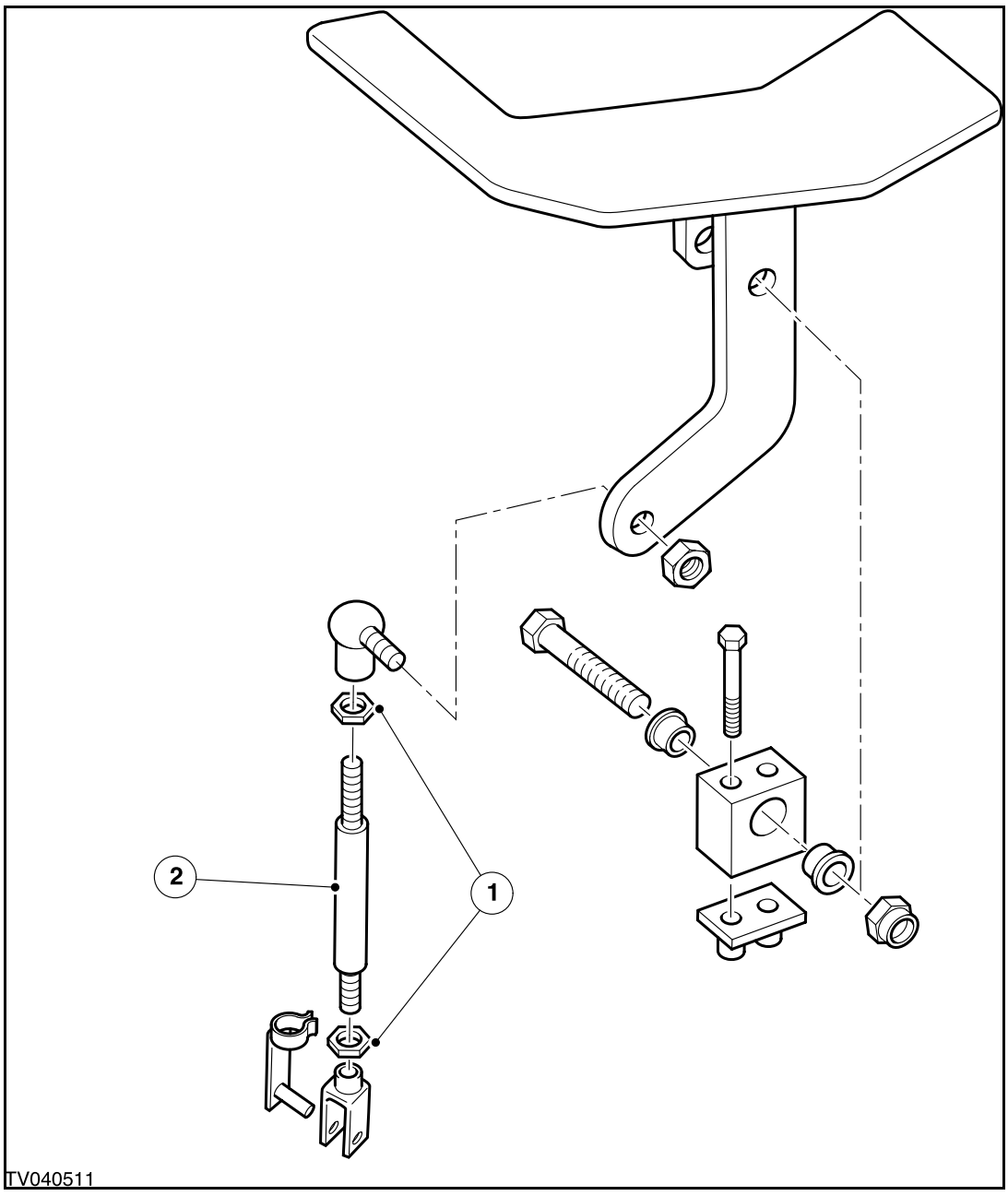


GENERAL PROCEDURE — AUXILIARY FUNCTION/TELESCOPIC DIPPER CONTROL PEDAL ADJUSTMENT

BHD0401GB

Adjustment Procedure

1. Park the machine on firm, level ground.
2. Stop the engine.
3. Operate the auxiliary function control pedal over its full range of movement. Make sure that the spool on the backhoe control valve bank operates over its full travel.
4. If the stroke of the spool is not correct, loosen the locknuts (1).
5. Adjust the length of the connecting rod (2) at the backhoe control valve bank as required and tighten the locknuts (1).



TV040511

1	Lock Nuts
2	Connecting Rod

Note: This page intentionally left blank.

SPECIFICATIONS — DIGGER BOOM AND DIPPERSTICK

BHD0401SA

Torque Values

Description	Nm	Lb.ft
Pivot Pin Lock nut	10	7
Piston Lock Nut	800	590
Slew Pin Plate Retaining Bolts	98	72
Boom Swing Tower Upper Pivot Pin Retaining Bolt	58	43

DIGGER SWING SYSTEM

E05
SECTION

REMOVAL AND INSTALLATION — MAST CASTING E05–01–1
REMOVAL AND INSTALLATION — MAST CASTING CLAMP SEALS E05–01–5
REMOVAL AND INSTALLATION — STABILIZER LEG (CENTREMOUNT)..... E05–01–9
REMOVAL AND INSTALLATION — STABILIZER LEG (CENTREMOUNT) CYLINDER E05–01–11
REMOVAL AND INSTALLATION — STABILIZER LEG (SIDESHIFT) E05–01–13
REMOVAL AND INSTALLATION — STABILIZER LEG HYDRAULIC CYLINDER (SIDESHIFT)..... E05–01–17
DISASSEMBLY AND ASSEMBLY — DIPPER HYDRAULIC CYLINDER E05–01–21
DISASSEMBLY AND ASSEMBLY — BACKHOE BUCKET HYDRAULIC CYLINDER E05–01–25
DISASSEMBLY AND ASSEMBLY — BOOM HYDRAULIC CYLINDER E05–01–29
DISASSEMBLY AND ASSEMBLY — SLEW HYDRAULIC CYLINDER..... E05–01–33
DISASSEMBLY AND ASSEMBLY — STABILIZER HYDRAULIC CYLINDER (SIDESHIFT)..... E05–01–37
DISASSEMBLY AND ASSEMBLY — STABILIZER LEG HYDRAULIC CYLINDER (CENTREMOUNT) E05–01–41
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REMOVAL AND INSTALLATION — MAST CASTING

BHE0501RA

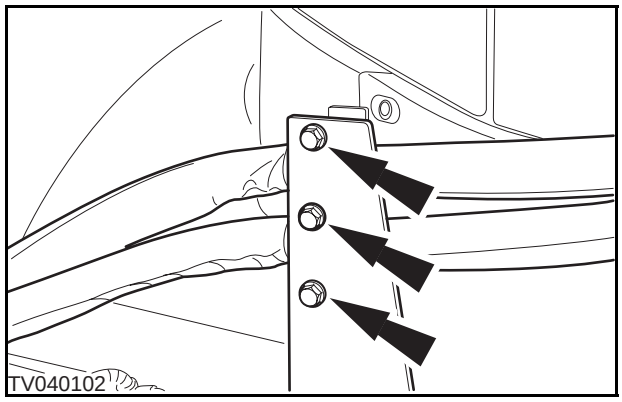
Operation: **Removing and Installing the Mast Casting**	*Job Code:* **05 06 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

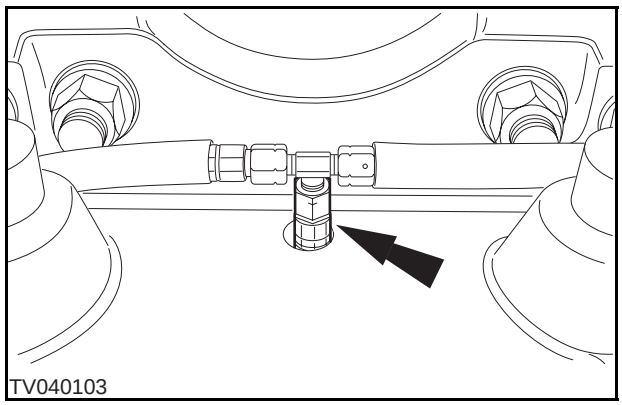
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

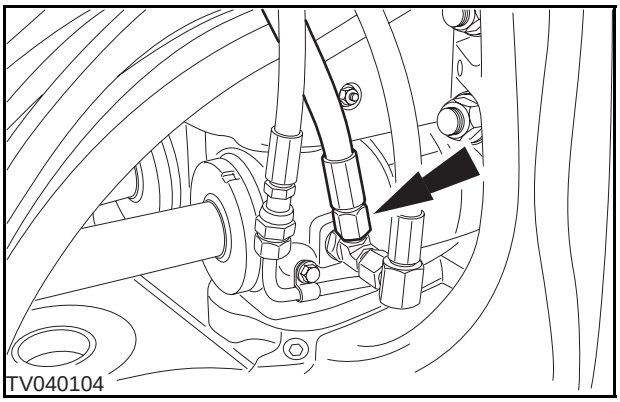
1. Park the machine on firm level ground.
2. Remove the boom swing tower. For additional information, refer to Section D04-01 BOOM SWING TOWER, PAGE D04–01–11 .
3. Detach the auxiliary service hoses from the mounting bracket and position to one side.


TV040102

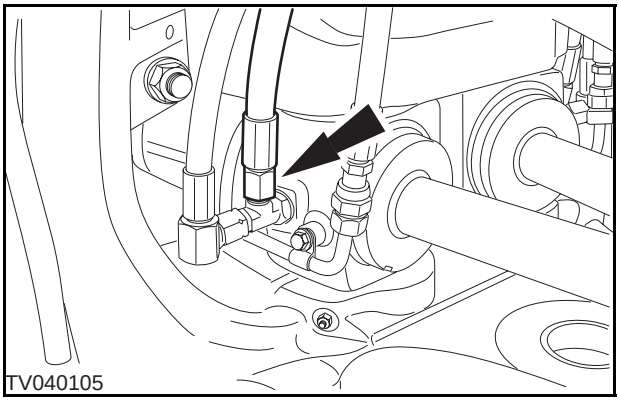
4. Disconnect the mast casting clamp pipe.


TV040103

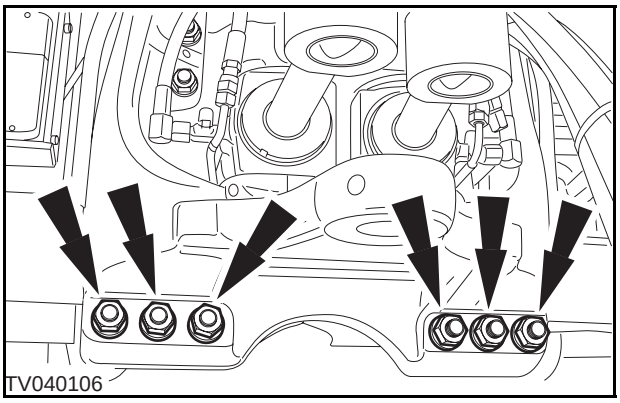
5. Disconnect the right-hand slew hydraulic cylinder pipe.


TV040104

6. Disconnect the left-hand slew hydraulic cylinder pipe.


TV040105

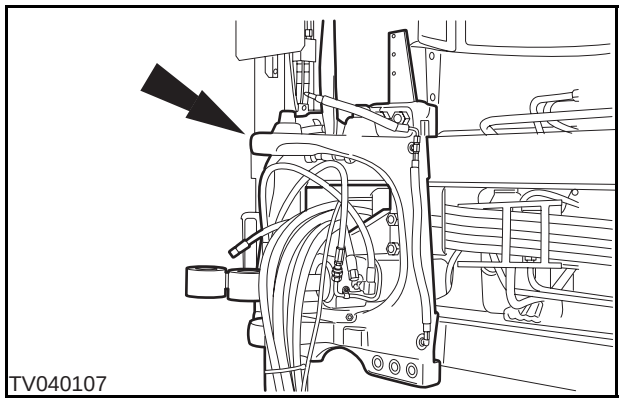
7. Remove the mast casting lower retaining bolts.


TV040106

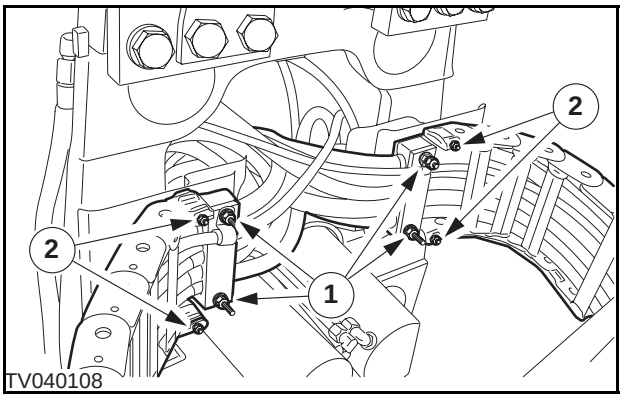
⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

8. Using suitable lifting equipment, support the mast casting.

9. Detach the mast casting assembly.

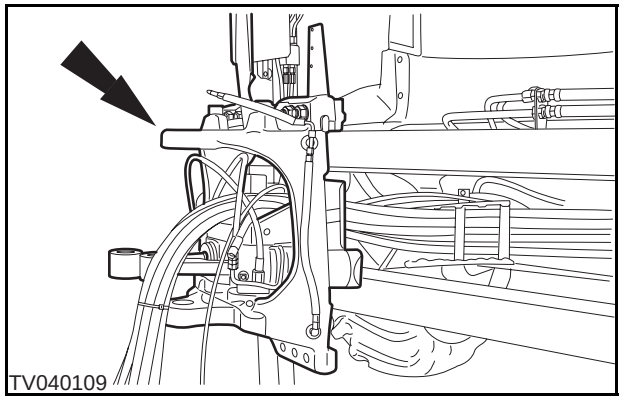


10. Remove the backhoe hydraulic hose clamps (1).
11. Detach the hydraulic hose guides (2).



Note:
- Withdraw the hydraulic hoses through the mast casting.

12. Remove the mast casting.

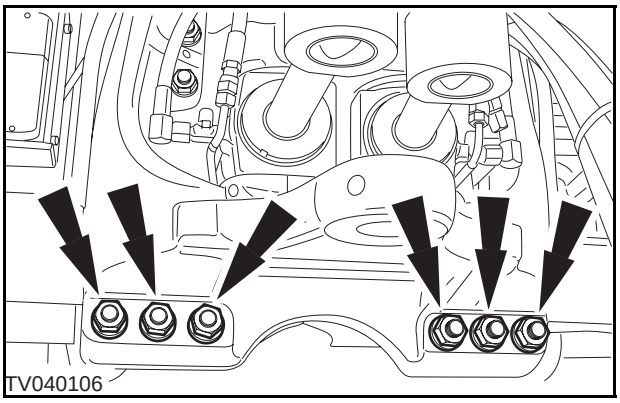


Installation

Note:
- Ensure the clamp seals do not become dislodged from the mast assembly.

1. To install, reverse the removal procedure.

2. Tighten to 1067Nm (787 lb.ft).



3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — MAST CASTING CLAMP SEALS

BHE0501RB

Operation: **Removing and Installing the Mast Casting Clamp Seals**	*Job Code:* **05 07 13 xx**		
Suitable lifting equipment, Suitable trolley jack	Standard tools, Seal tool BC001.		

Removal

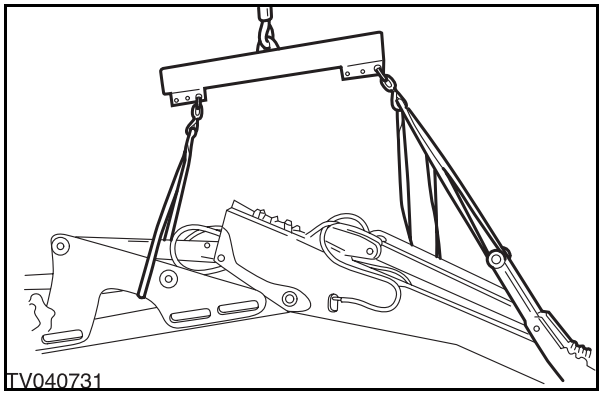
1. Park the machine on firm level ground.
2. Extend the backhoe to between half and three quarters full reach.
3. Position the backhoe bucket straight behind the machine with the backhoe bucket resting on the floor.
4. Engage the backhoe transport lock.
5. Release the sideshift clamps.

   Note:
   - Do not raise the wheels from the ground.

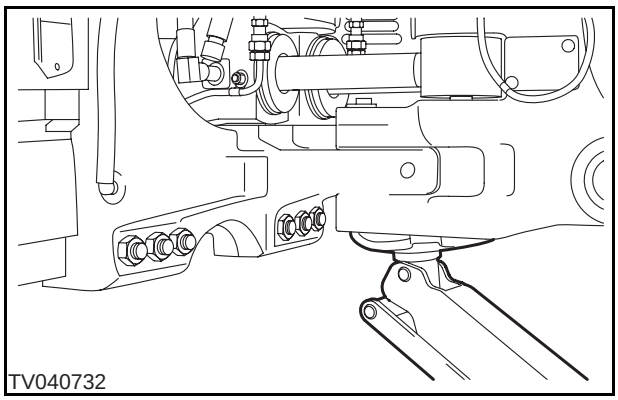
6. Lower the stabilizer legs and stop the engine.
7. Release the pressure from the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .

   ⚠ **Warning:**
   - **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

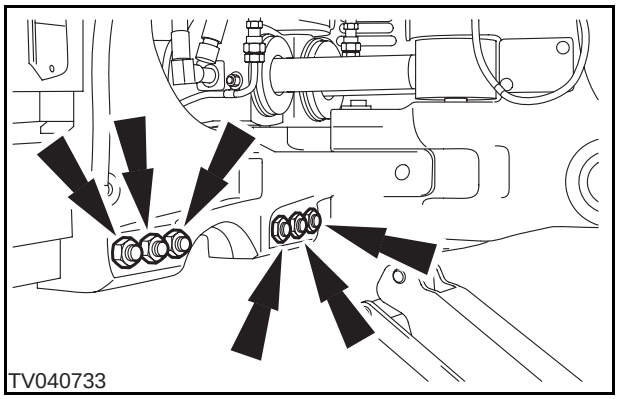
8. Using suitable lifting equipment, support the boom and dipper assembly.


TV040731

9. Using a suitable trolley jack, support the mast casting.


TV040732

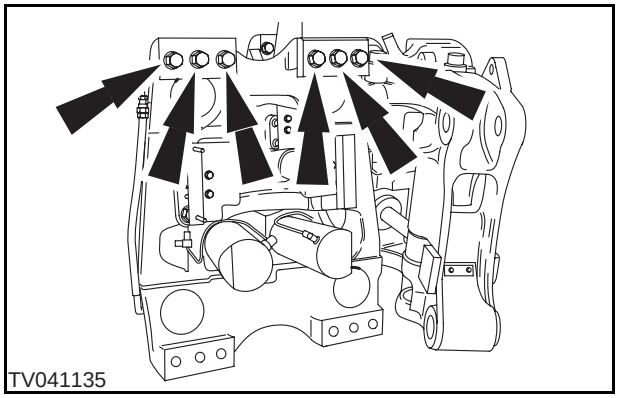
10. Remove the mast casting lower retaining bolts.



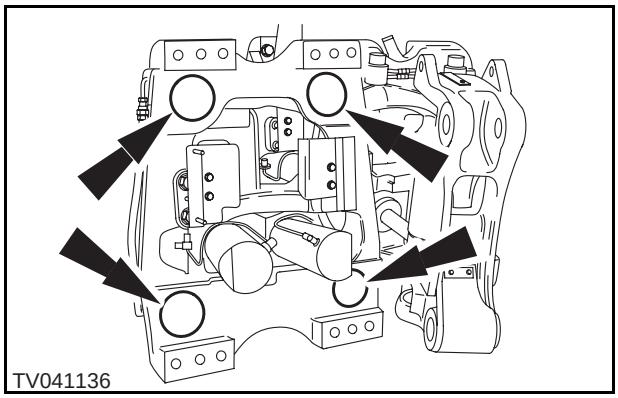
11. Using suitable lifting equipment, support the mast casting.
12. Raise the stabilizer legs.
13. Raise the mast casting until the upper lip of the mast casting clears the backframe.
14. Carefully drive the machine forward until there is approximately 125mm clearance between the mast casting and the backframe.
15. Stop the engine.

⚠ Warning:
- **Make sure the backhoe dipper assembly is secure. Failure to follow this instruction may result in personal injury.**

16. Remove the mast casting upper retaining bolts.



17. Remove the mast casting clamp pistons and seals.



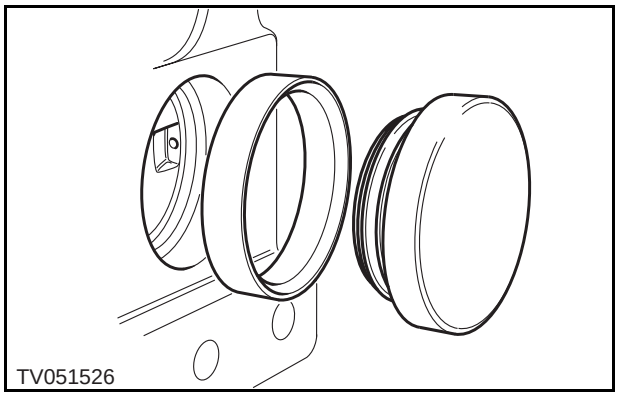
Installation

Note:
- Ensure the clamp seals do not become dislodged from the mast casting.

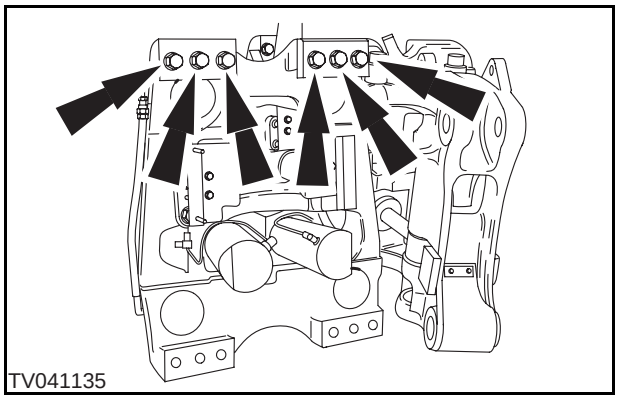
1. To install, reverse the removal procedure.

Note:
- Clean the mast casting faces before installing new pistons and seals.

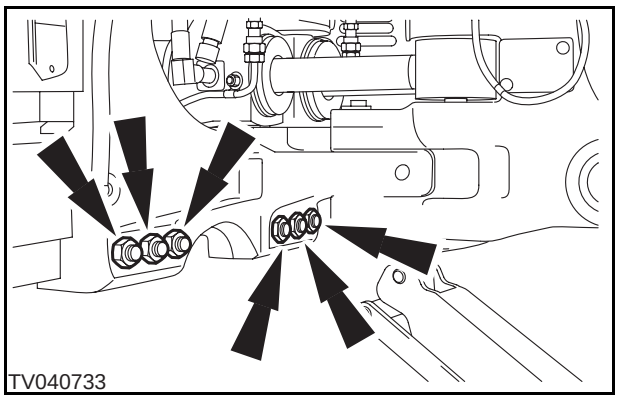
2. Using the special tool **BC001** , install the seals in to the mast casting.


TV051526

3. Tighten to 1067Nm (787 lb.ft).


TV041135

4. Tighten to 1067Nm (787 lb.ft).


TV040733

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REMOVAL AND INSTALLATION — STABILIZER LEG (CENTREMOUNT)

BHE0501RC

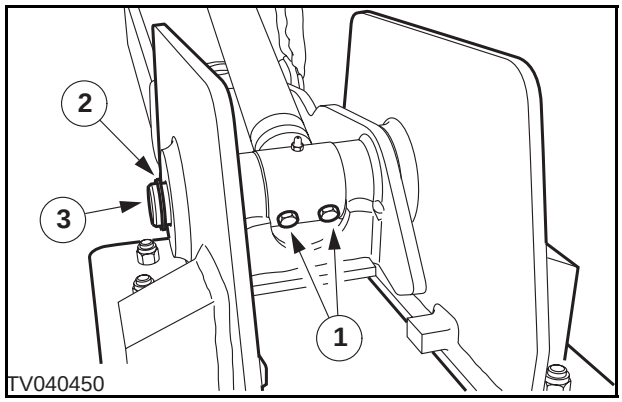
Operation: **Removing and Installing the Stabilizer Leg (Centremount)**	*Job Code:* **05 15 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

1. Park the machine on firm, level ground. Lower the stabilizer leg to the horizontal position to aid removal of the stabilizer leg.
2. Release the pressure from the hydraulic system. For further information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE., PAGE F06–01–95

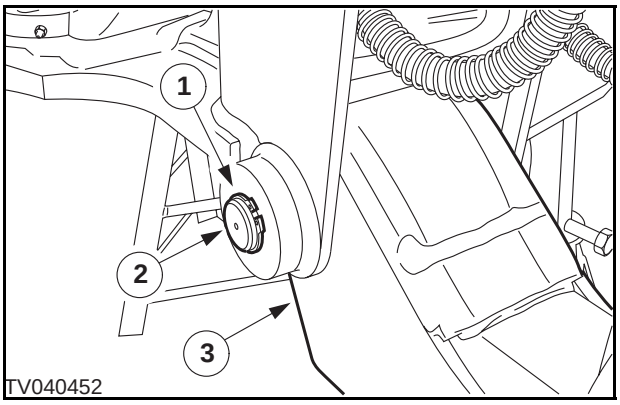
   ⚠ **Warning:**
   - **These components are very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

3. Using suitable lifting equipment, support the stabilizer leg foot.
4. Using suitable lifting equipment, support the stabilizer leg.
5. Remove the stabilizer leg lower pivot pin retaining bolts (1).
6. Using suitable circlip pliers, remove the stabilizer leg lower pivot pin circlip (2).
7. Remove the stabilizer leg lower pin (3) and remove the stabilizer foot.



8. Using suitable lifting equipment support the stabilizer leg hydraulic cylinder.
9. Using suitable circlip pliers, remove the stabilizer leg upper pivot pin circlip (1).
10. Remove the stabilizer leg retaining pin (2).

11. Remove the stabilizer leg (3).



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION — STABILIZER LEG (CENTREMOUNT) CYLINDER

BHE0501RD

Operation: **Removing and Installing the Stabilizer Leg (Centremount) Cylinder**	*Job Code:* **05 16 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

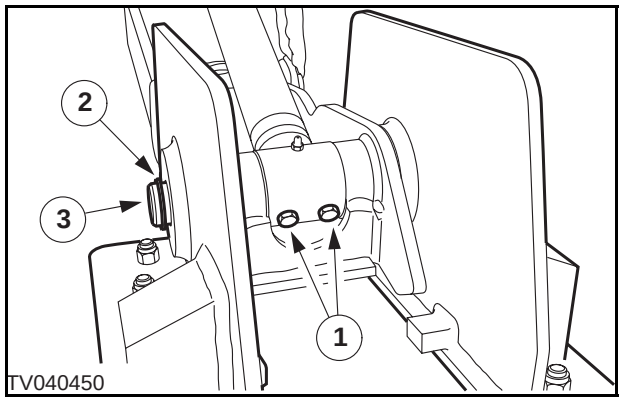
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Park the machine on firm level ground. Lower the stabilizer leg to the horizontal position to aid removal of the stabilizer leg.
2. Release the pressure from the hydraulic system. Refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .

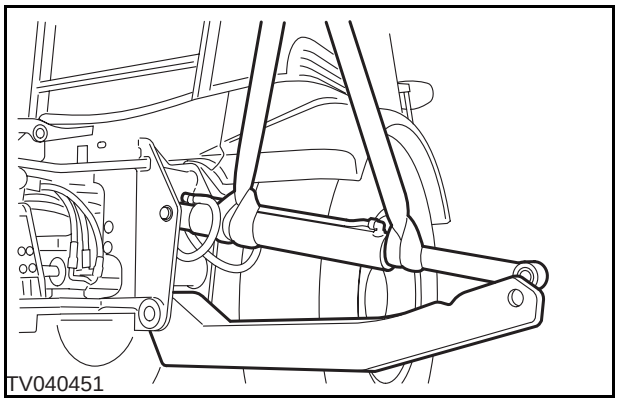
   ⚠ **Warning:**
   - **These components are very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

3. Using suitable lifting equipment, support the Stabilizer leg foot.
4. Using suitable lifting equipment, support the stabilizer leg.
5. Remove the stabilizer leg lower pivot pin retaining bolts (1).
6. Using suitable circlip pliers, remove the stabilizer leg lower pivot pin circlip (2).
7. Remove the stabilizer leg lower pivot pin (3) and remove the stabilizer foot.

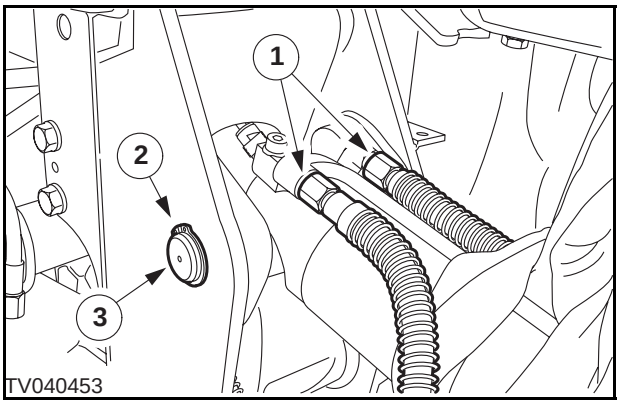


⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

8. Using suitable lifting equipment, support the stabilizer leg hydraulic cylinder.


TV040451

9. Disconnect the hydraulic hoses from the stabilizer leg ram cylinder (1).
10. Using the suitable circlip pliers, remove the pivot pin circlip (2).
11. Remove the pivot pin (3) and recover the stabilizer leg ram cylinder.



TV040453

Installation

Note:
- Install new pivot pin lock nuts

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — STABILIZER LEG (SIDESHIFT)

BHE0501RE

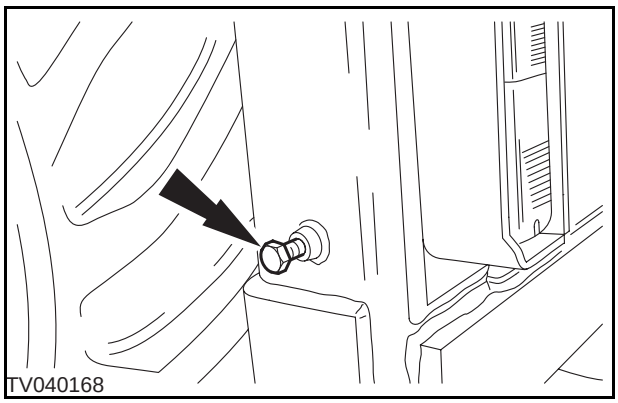
Operation: **Removing and Installing the Stabilizer Leg (Sideshift)**	*Job Code:* **05 17 13 xx**		
Suitable lifting equipment, Suitable trolley jack	Standard tools		

Removal

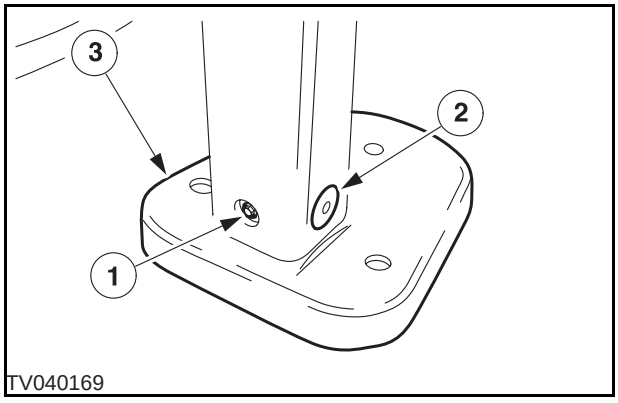
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Park the machine on firm level ground.
2. Lower the stabilizer leg sufficiently to allow removal of the stabilizer leg lower pin.
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
4. Release the pressure from the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
5. Using a suitable trolley jack, support the stabilizer leg foot.
6. Install an M10x1.5 bolt into the stabilizer post and clamp the stabilizer leg to the stabilizer post.

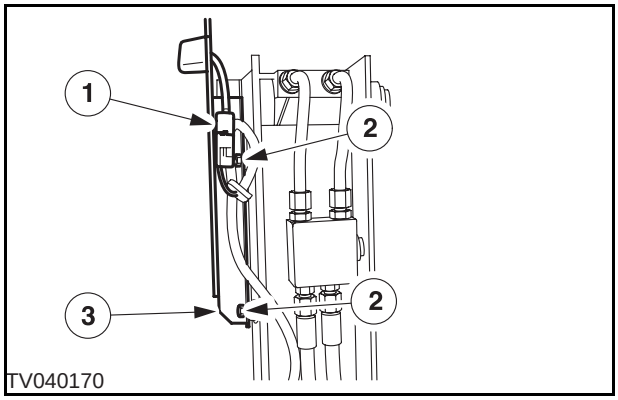

TV040168

7. Remove the stabilizer leg lower retaining pin retaining bolt (1).
8. Remove the stabilizer leg lower retaining pin (2) and remove the stabilizer foot (3).

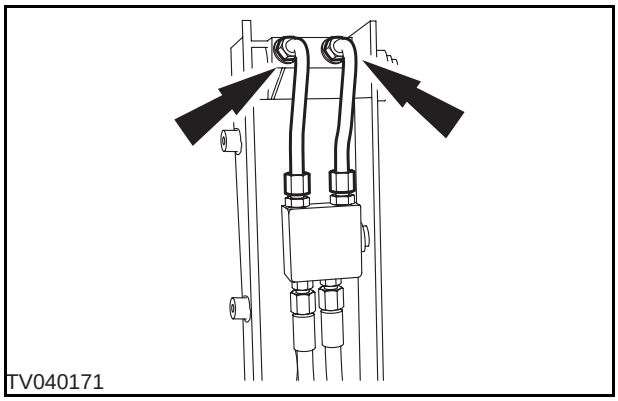


TV040169

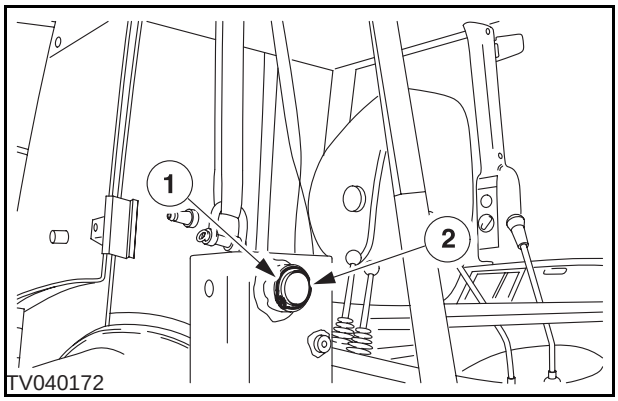
9. Disconnect the license plate lamp electrical connector (1).
10. Remove the retaining bolts (2).
11. Remove the license plate mounting bracket (3).



12. Disconnect the stabilizer leg hydraulic cylinder supply and return lines.

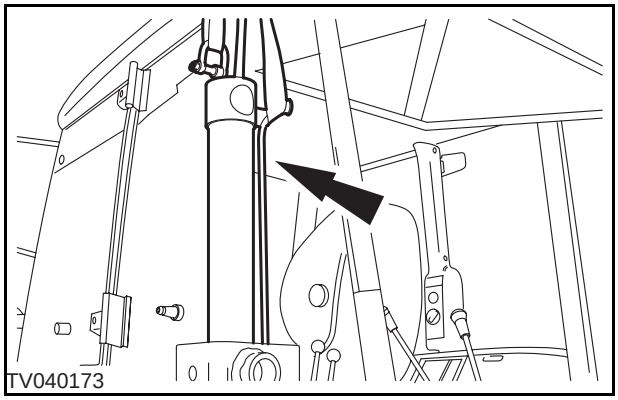


13. Using suitable lifting equipment, support the stabilizer leg hydraulic cylinder.
14. Using suitable circlip pliers, remove the circlip (1).
15. Remove the stabilizer leg hydraulic cylinder upper retaining pin (2).

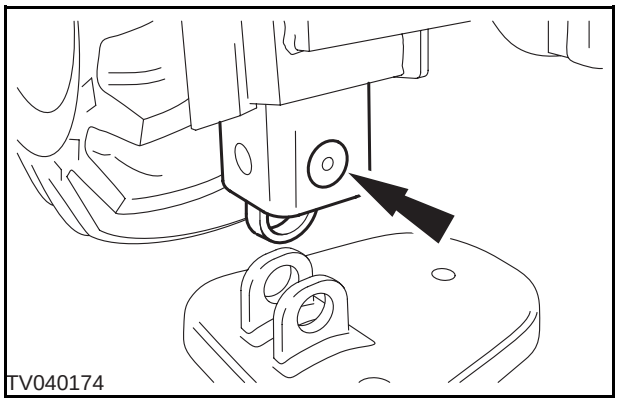


Note:
- Recover the stabilizer leg hydraulic cylinder upper retaining pin spacers.

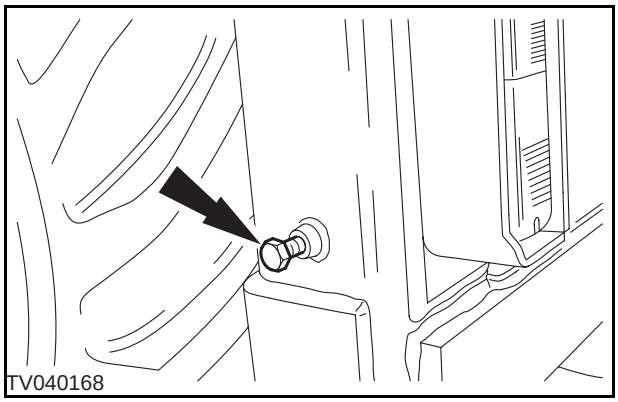
16. Remove the stabilizer leg hydraulic cylinder.


TV040173

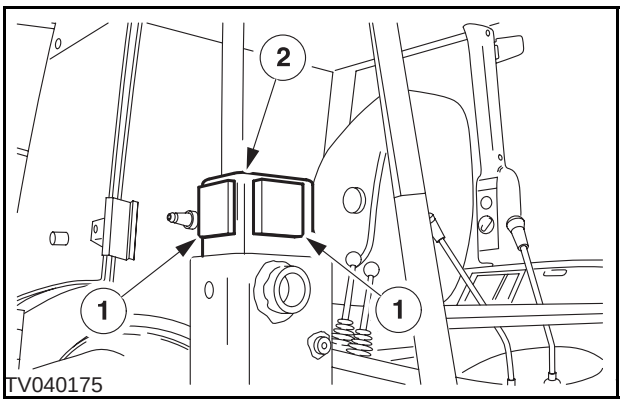
17. Using a suitable hoist and strap/chain, thread through the middle of the stabilizer leg and secure with a suitable pin.


TV040174

18. Remove the bolt from the stabilizer post.

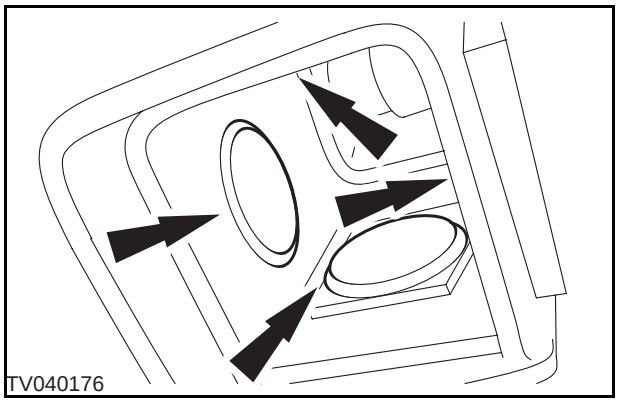

TV040168

19. Remove the stabilizer leg upper wear pads (1).
20. Remove the stabilizer leg (2).



TV040175

21. Remove the stabilizer leg lower wear pads.



Installation

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — STABILIZER LEG HYDRAULIC CYLINDER (SIDESHIFT)

BHE0501RF

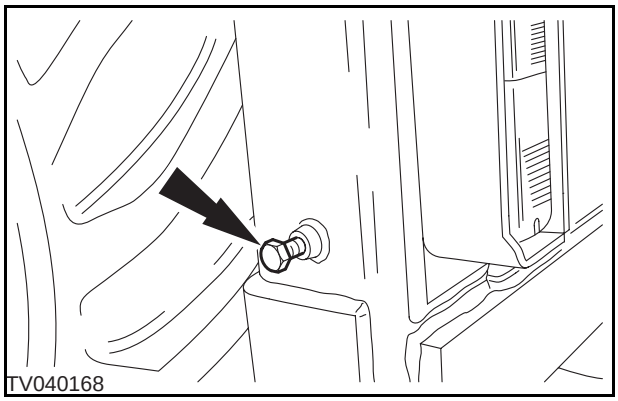
Operation: **Removing and Installing the Stabilizer Leg Hydraulic Cylinder (Sideshift)**	*Job Code:* **05 18 13 xx**		
Suitable lifting equipment, Suitable trolley jack	Standard tools		

Removal

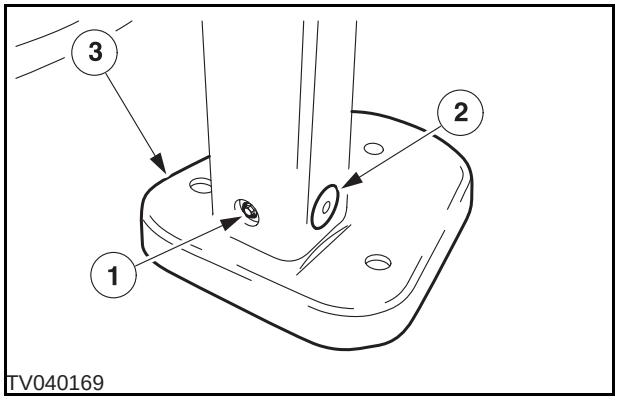
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Park the machine on firm level ground. Lower the stabilizer leg sufficiently to allow removal of the stabilizer leg lower pin.
3. Release the pressure from the hydraulic system F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
4. Using a suitable trolley jack, support the stabilizer leg foot.
5. Install a suitable bolt into the stabilizer post and clamp the stabilizer leg to the stabilizer post.

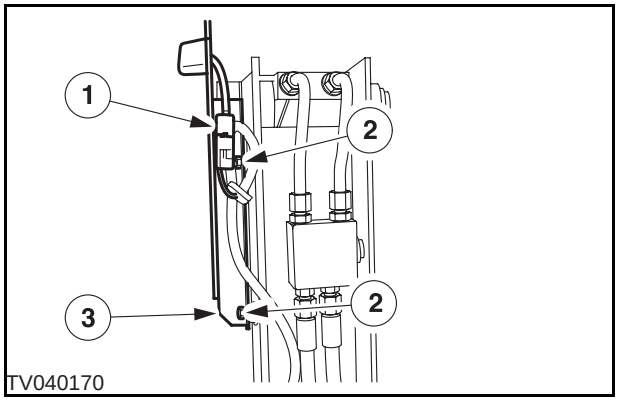

TV040168

6. Remove the stabilizer leg lower retaining pin retaining bolt (1).
7. Remove the stabilizer leg lower retaining pin (2) and remove the stabilizer foot (3).

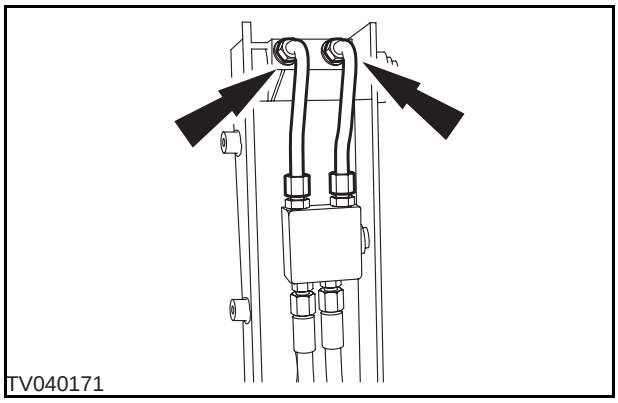


TV040169

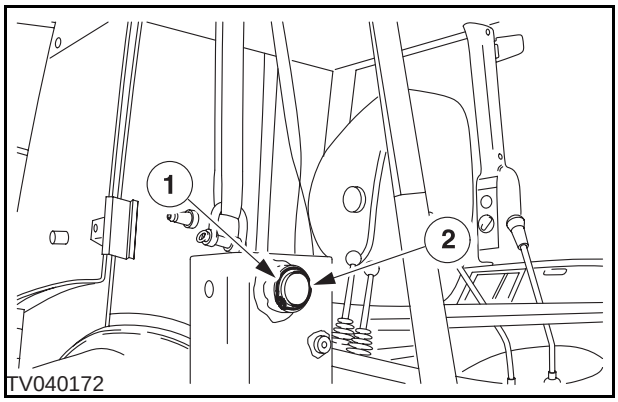
8. Disconnect the license plate lamp electrical connector (1).
9. Remove the retaining bolts (2).
10. Remove the license plate mounting bracket (3).



11. Remove the stabilizer leg hydraulic cylinder supply and return lines.

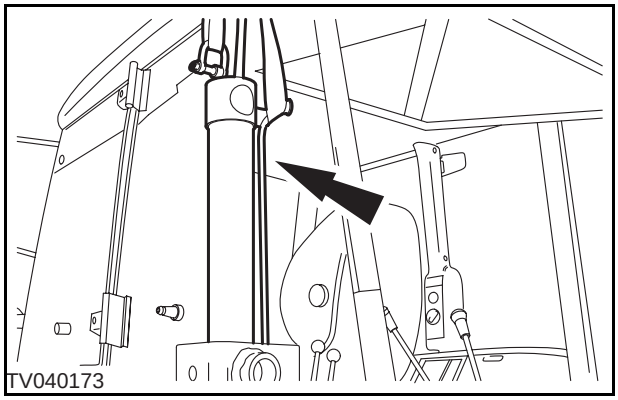


12. Using suitable lifting equipment, support the stabilizer leg hydraulic cylinder.
13. Using suitable circlip pliers, remove the circlip (1).
14. Remove the stabilizer leg hydraulic cylinder upper retaining pin (2).



Note:
- Recover the stabilizer leg hydraulic cylinder upper retaining pin spacers.

15. Remove the stabilizer leg hydraulic cylinder.



Installation

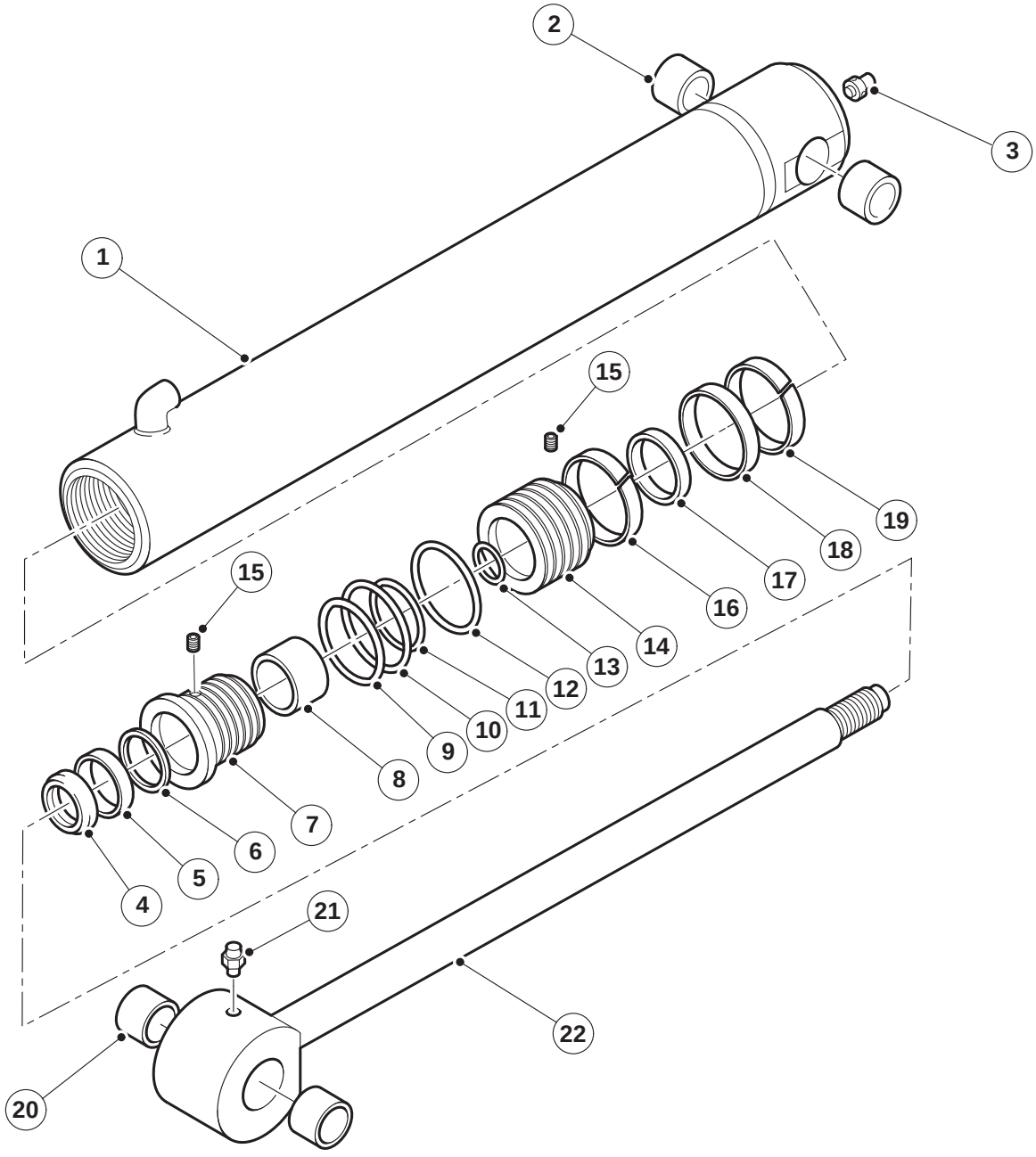
1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic oil level as required.

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DISASSEMBLY AND ASSEMBLY — DIPPER HYDRAULIC CYLINDER

BHE0501DA

Operation: **Disassembling and Assembling the Dipper Hydraulic Cylinder**	*Job Code:* **05 09 17 xx**		
Suitable lifting equipment	Standard tools, Suitable piston ring compressor		



TV040502

1	Cylinder
2	Bushing
3	Grease Point
4	Ring
5	Seal
6	Ring
7	Bush
8	Ring
9	O-ring
10	Back-up Ring
11	O-Ring
12	Piston Ring
13	Back-up ring
14	Piston
15	Lock Screw
16	Guide Ring
17	Ring
18	Seal
19	Guide Ring
20	Bushing
21	Grease Point
22	Piston Rod

Disassembly

⚠ **Warning:**

- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.
2. Fasten the cylinder (1) in a soft jaw vice. Be careful to prevent damage to the cylinder (1).
3. Remove the lock screw from the bush (7) and cylinder (1).
4. Remove the bush (7) from the cylinder (1).
5. Pull the piston rod (22) straight out of the cylinder (1).
6. Fasten the piston rod eye (22) in a vice and put a support below the piston rod (22) near the piston.
7. Remove the locking screw (15), and unscrew the piston (14) from the piston rod (22).
8. Remove the bush (7) from the piston rod (22).
9. Remove the guide ring (19), seal (18), ring (17), guide ring (16) and the back-up ring (13) from the piston (14).
10. Remove the ring (12), O-ring (11), back-up ring (10), O-ring (9), ring (8), ring (6), seal (5) and wiper seal (4) from the bush (7).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (4), seal (5), ring (6), ring (8), O-ring (9), back-up ring (10), O-ring (11) and ring (12) to the bush (7).
2. Install the back-up ring (13), guide ring (16), ring (17), seal (18) and guide ring (19) to the piston (14).

Note:
- To aid installation of the bush, lubricate the bore of the bush with clean oil.

3. Install the bush (7) onto the piston rod (22).

⚠ Caution:
- **Do not apply Loctite to the first 7mm of the piston rod threads. Failure to follow this instruction may result in damage to the piston.**

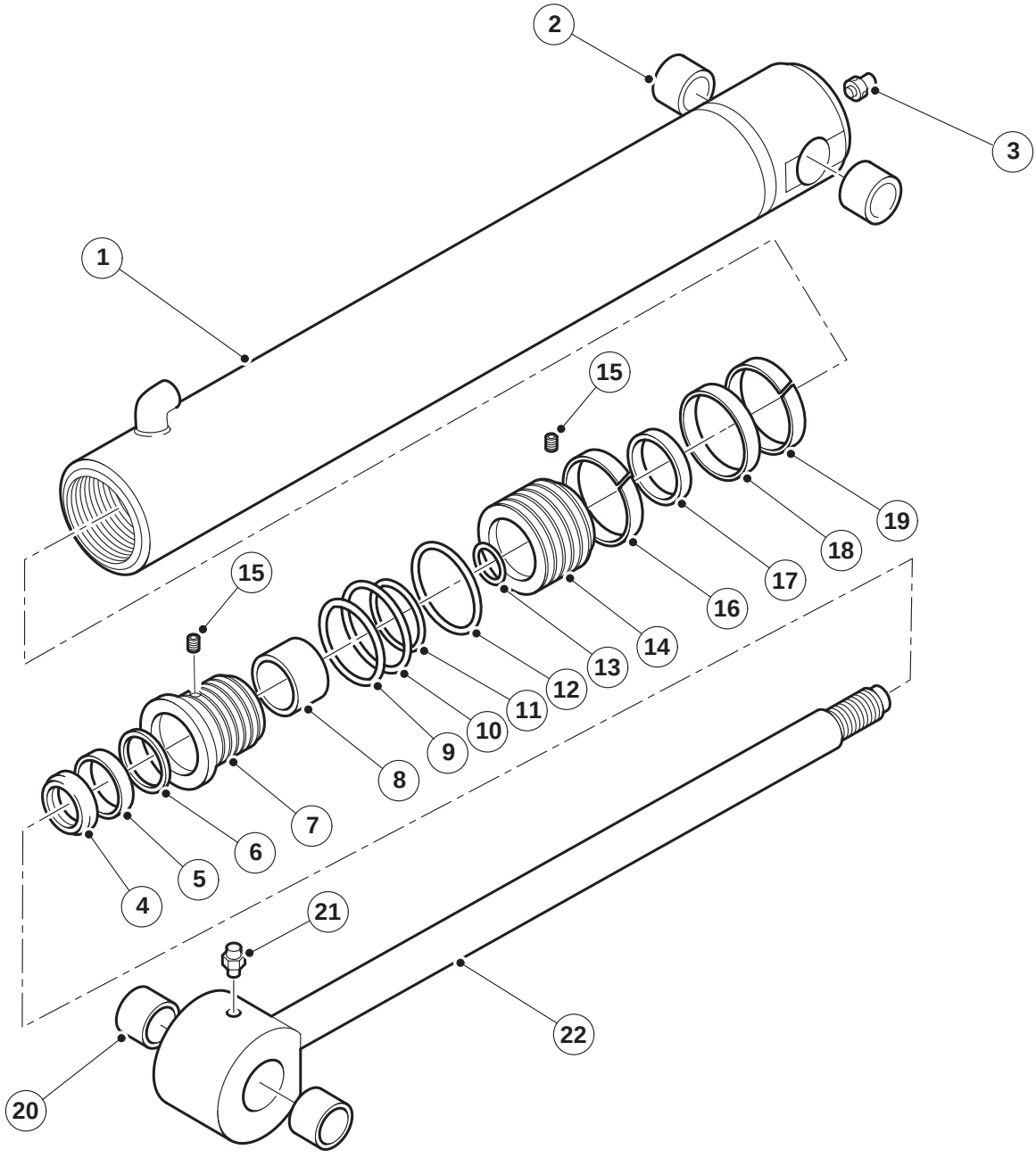
4. Clean the threads on the end of the piston rod. Apply Loctite 242 to the piston rod threads from the open end of the piston rod.
5. Install piston (14) onto the piston rod (22) and install the locking screw (15) and tighten to 2.3Nm (1.7 lb.ft).
6. Lubricate the inside of the cylinder (1) and the piston (14) with clean oil. Use a piston ring compression tool to hold the new carrier rings in place.
7. Start the cylinder (1) onto the piston rod assembly. Push the tube onto the piston rod assembly until the compression tool is pushed off the piston rod assembly. Be careful not to damage the carrier rings and seal.
8. When the piston (14) is in the smooth part of the cylinder (1), start the bush (7) into the cylinder (1).
9. Tighten the bush (7) to a torque between 400 and 450 Nm (295 and 332 lb.ft). When the lock screw (2) holes become aligned in this torque range, install the lock screw (2). Tighten the lock screw (2) to 23 Nm (17 lb.ft).

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DISASSEMBLY AND ASSEMBLY — BACKHOE BUCKET HYDRAULIC CYLINDER

BHE0501DB

Operation: **Disassembling and Assembling the Dipper Hydraulic Cylinder**	*Job Code:* **05 11 17 xx**		
Suitable lifting equipment	Standard tools, Suitable piston ring compression tool		



TV040502

1	Cylinder
2	Bushing
3	Grease Nipple
4	Ring
5	Seal
6	Ring
7	Cylinder Gland
8	Bush
9	O-ring
10	Back-up Ring
11	O-Ring
12	Piston Ring
13	O-Ring
14	Piston
15	Locking Screw
16	Guide Ring
17	Ring
18	Seal
19	Guide Ring
20	Bushing
21	Grease Nipple
22	Piston Rod

Disassembly

⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (1) in a soft jawed vice.
3. Remove the locking screw from the cylinder gland (7) and cylinder (1).
4. Remove the cylinder gland (7) from the cylinder (1).
5. Pull the piston rod (22) straight out of the cylinder (1).
6. Fasten the piston rod eye (22) in a vice and put a support below the piston rod (22) near the piston.
7. Remove the locking screw (15), and unscrew the piston (14) from the piston rod (22).
8. Remove the bush (7) from the piston rod (22).
9. Remove the guide ring (19), seal (18), ring (17), guide ring (16) and the O-ring (13) from the piston (14).
10. Remove the ring (12), O-ring (11), back-up ring (10), O-ring (9), back-ring (8), ring (6), seal (5) and wiper seal (4) from the cylinder gland (7).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (4), seal (5), ring (6), bush (8), O-ring (9), back-up ring (10), O-ring (11) and ring (12) to the cylinder gland (7).
2. Install the O-ring (13), guide ring (16), ring (17), seal (18) and guide ring (19) to the piston (14).

Note:
- To aid installation of the bush, lubricate the bore of the bush with clean oil.

3. Install the cylinder gland (7) onto the piston rod (22).

⚠ Caution:
- **Do not apply Loctite to the first 7mm of the piston rod threads. Failure to follow this instruction may result in damage to the piston.**

4. Clean the threads on the end of the piston rod. Apply Loctite 242 to the piston rod threads from the open end of the piston rod.
5. Install piston (14) onto the piston rod (22) and install the locking screw (15) and tighten to 2.3Nm (1.7 lb.ft).
6. Lubricate the inside of the cylinder (1) and the piston (14) with clean oil. Use a piston ring compression tool to hold the new carrier rings in place.
7. Start the cylinder (1) onto the piston rod assembly. Push the tube onto the piston rod assembly until the compression tool is pushed off the piston rod assembly. Be careful not to damage the sealing rings and seal.
8. When the piston (14) is in the smooth part of the cylinder (1), start the cylinder gland (7) into the cylinder (1).

Note:
- Install a new locking screw.

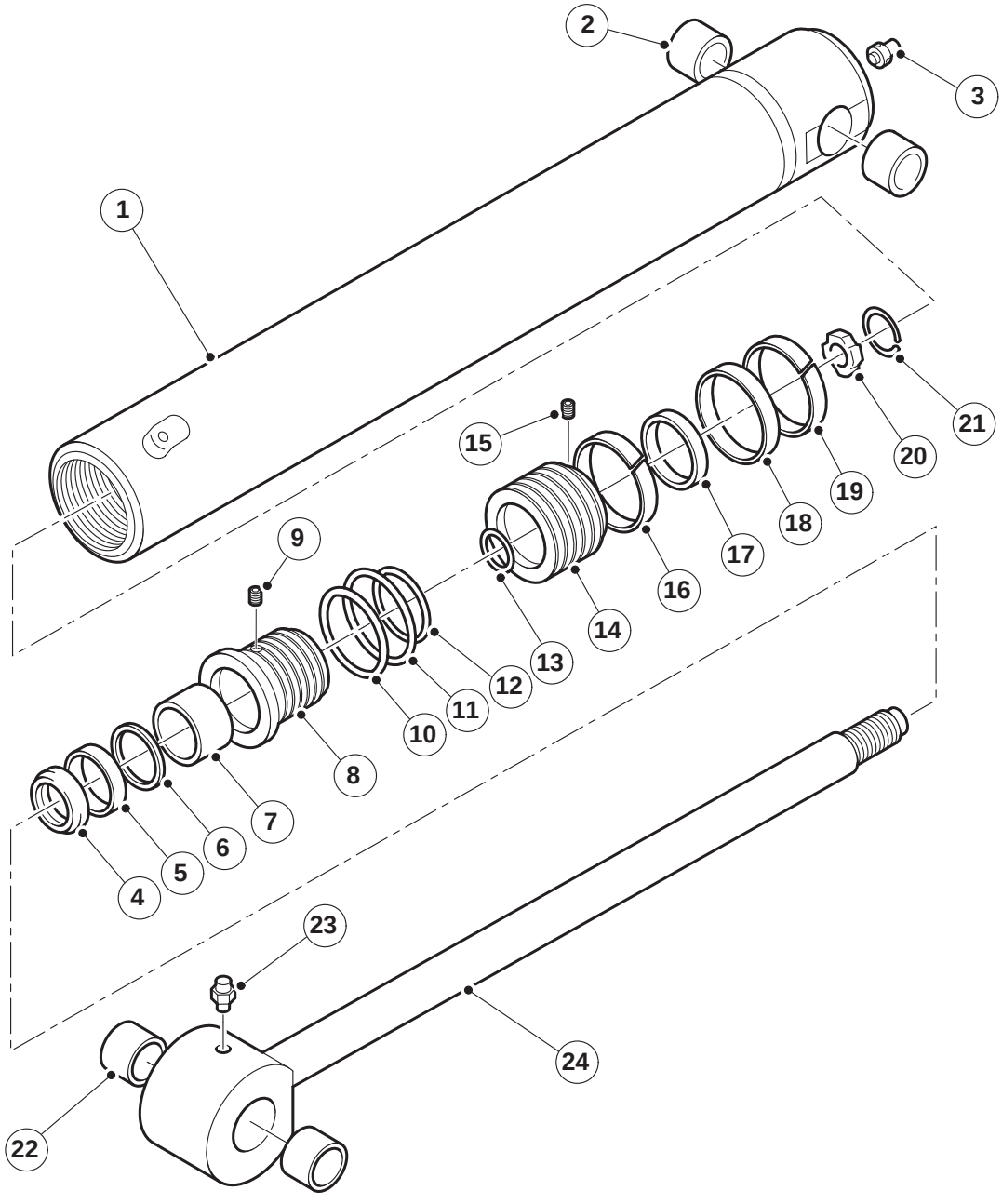
9. Tighten the cylinder gland (7) to a torque between 400 and 450 Nm (295 and 332 lb.ft). When the locking screw holes become aligned in this torque range, install the locking screw (2). Tighten the locking screw (2) to 23Nm (17 lb.ft).

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DISASSEMBLY AND ASSEMBLY — BOOM HYDRAULIC CYLINDER

BHE0501DC

Operation: **Disassembling and Assembling the Boom Hydraulic Cylinder**	*Job Code:* **05 13 17 xx**		
Suitable lifting equipment	Standard tools, Suitable piston ring compression tool		



TV040503

1	Cylinder
2	Bush
3	Grease Nipple
4	Wiper Seal
5	Seal
6	Ring
7	Ring
8	Cylinder Gland
9	Locking Screw
10	O-Ring
11	Back-up Ring
12	O-Ring
13	O-Ring
14	Piston
15	Locking Screw
16	Guide Ring
17	Ring
18	Seal
19	Guide Ring
20	Retaining Nut
21	Snap Ring
22	Bush
23	Grease Nipple
24	Piston Rod

Disassembly

⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (1) in a soft jawed vice.
3. Remove the locking screw (9) from the cylinder gland (8) and cylinder (1).
4. Remove the cylinder gland (8) from the cylinder (1).
5. Pull the piston rod (24) straight out of the cylinder (1).
6. Fasten the piston rod eye (24) in a vice and put a support below the piston rod (24) near the piston.
7. Remove the snap ring (21) and the retaining nut (20) from the piston rod.
8. Remove the locking screw (15), and unscrew the piston (14) from the piston rod (24).
9. Remove the cylinder gland (8) from the piston rod (24).

10. Remove the guide ring (19), seal (18), ring (17), guide ring (16) and the O-ring (13) from the piston (14).
11. Remove the ring (12), O-ring (11), back-up ring (10), O-ring (9), ring (8), ring (6), seal (5) and wiper seal (4) from the cylinder gland (8).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (4), seal (5), ring (6), ring (8), O-ring (9), back-up ring (10), O-ring (11) and ring (12) to the cylinder gland (8).
2. Install the O-ring (13), guide ring (16), ring (17), seal (18) and guide ring (19) to the piston (14).

Note:
- To aid installation of the bush, lubricate the bore of the bush with clean oil.

3. Install the cylinder gland (8) onto the piston rod (24).

⚠ Caution:
- **Do not apply Loctite to the first 7mm of the piston rod threads. Failure to follow this instruction may result in damage to the piston.**

4. Clean the threads on the end of the piston rod. Apply Loctite 242 to the piston rod threads from the open end of the piston rod.

Note:
- Install a new locking screw.

5. Install the piston (14) onto the piston rod (24) and install the locking screw (15) and tighten to 23Nm (17 lb.ft).
6. Install the retaining nut (20) and the snap ring (21) onto the piston rod.
7. Lubricate the inside of the cylinder (1) and the piston (14) with clean oil. Use a piston ring compression tool to hold the new carrier rings in place.
8. Start the cylinder (1) onto the piston rod assembly. Push the tube onto the piston rod assembly until the compression tool is pushed off the piston rod assembly.
9. When the piston (14) is in the smooth part of the cylinder (1), start the cylinder gland (8) into the cylinder (1).

Note:
- Install a new locking screw.

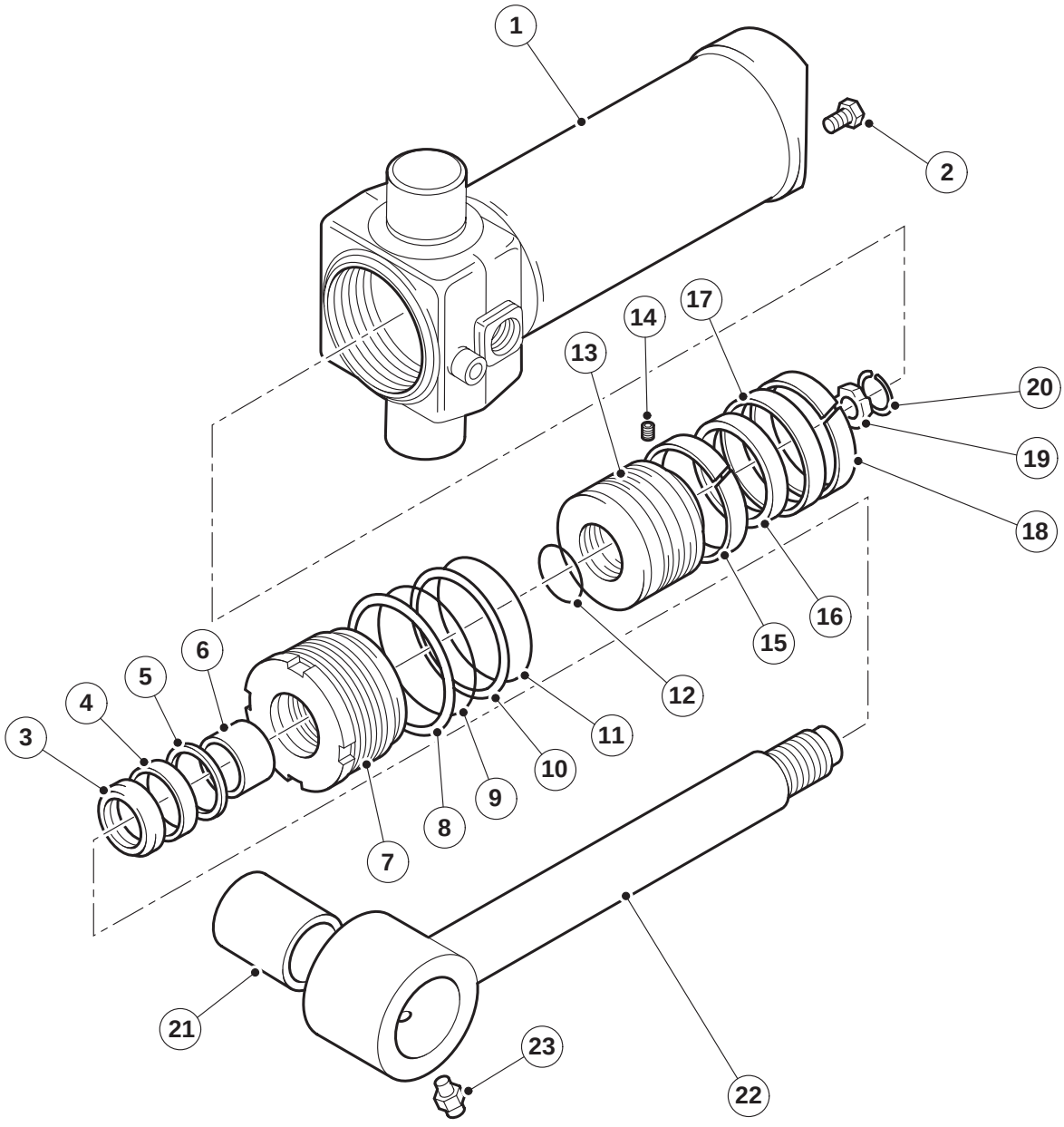
10. Tighten the cylinder gland (8) to a torque between 500 and 550Nm (369 and 406 lb.ft). When the locking screw holes become aligned in this torque range, install the locking screw. Tighten the locking screw to 23Nm (17 lb.ft).

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DISASSEMBLY AND ASSEMBLY — SLEW HYDRAULIC CYLINDER

BHE0501DD

Operation: **Disassembling and Assembling the Slew Hydraulic Cylinder**	*Job Code:* **05 03 17 xx**		
Suitable lifting equipment	Standard tools, Piston ring compression tool		



TV040504

1	Cylinder
2	Plug
3	Wiper Seal
4	Seal
5	Sealing Ring
6	Bush
7	Cylinder Gland
8	Retaining Ring
9	O-Ring
10	Back-up Ring
11	O-Ring
12	O-Ring
13	Piston
14	Locking Screw
15	Guide Ring
16	Seal
17	Back-up Seal
18	Guide Ring
19	Ring
20	Snap Ring
21	Bush
22	Piston Rod
23	Grease Nipple

Disassembly

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (1) in a soft jawed vice.
3. Using a suitable tool, remove the cylinder gland (7) from the cylinder (1).
4. Pull the piston rod (22) straight out of the cylinder (1).
5. Remove the locking screw (14) from the piston (13).

Note:
- Discard the locking screw .

6. Remove the snap ring (20) and the retaining nut (19) from the piston rod (22).
7. Remove the piston (13) from the piston rod (22).
8. Remove the cylinder gland (7) from the piston rod (22).

9. Remove the guide ring (18), back-up seal (17), seal (16), guide ring (15) and the O-ring (12) from the piston (13).
10. Remove the O-ring (11), back-up ring (10), O-ring (9), retaining ring (8), bush (6), sealing ring (5), seal (4) and the wiper seal (3) from the cylinder gland (7).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (3), seal (4), sealing ring (5), bush (6), retaining ring (8), O-ring (9), back-up ring (10) and ring (11) to the cylinder gland (7).
2. Install the O-ring (12), guide ring (15), seal (16), back-up seal (17) and the guide ring (18) to the piston (13).
3. Install the cylinder gland (7) onto the piston rod (22).
4. Install the piston (13) onto the piston rod (22).
5. Tighten the piston (13) to 1075Nm.

Note:
- Install a new locking screw.

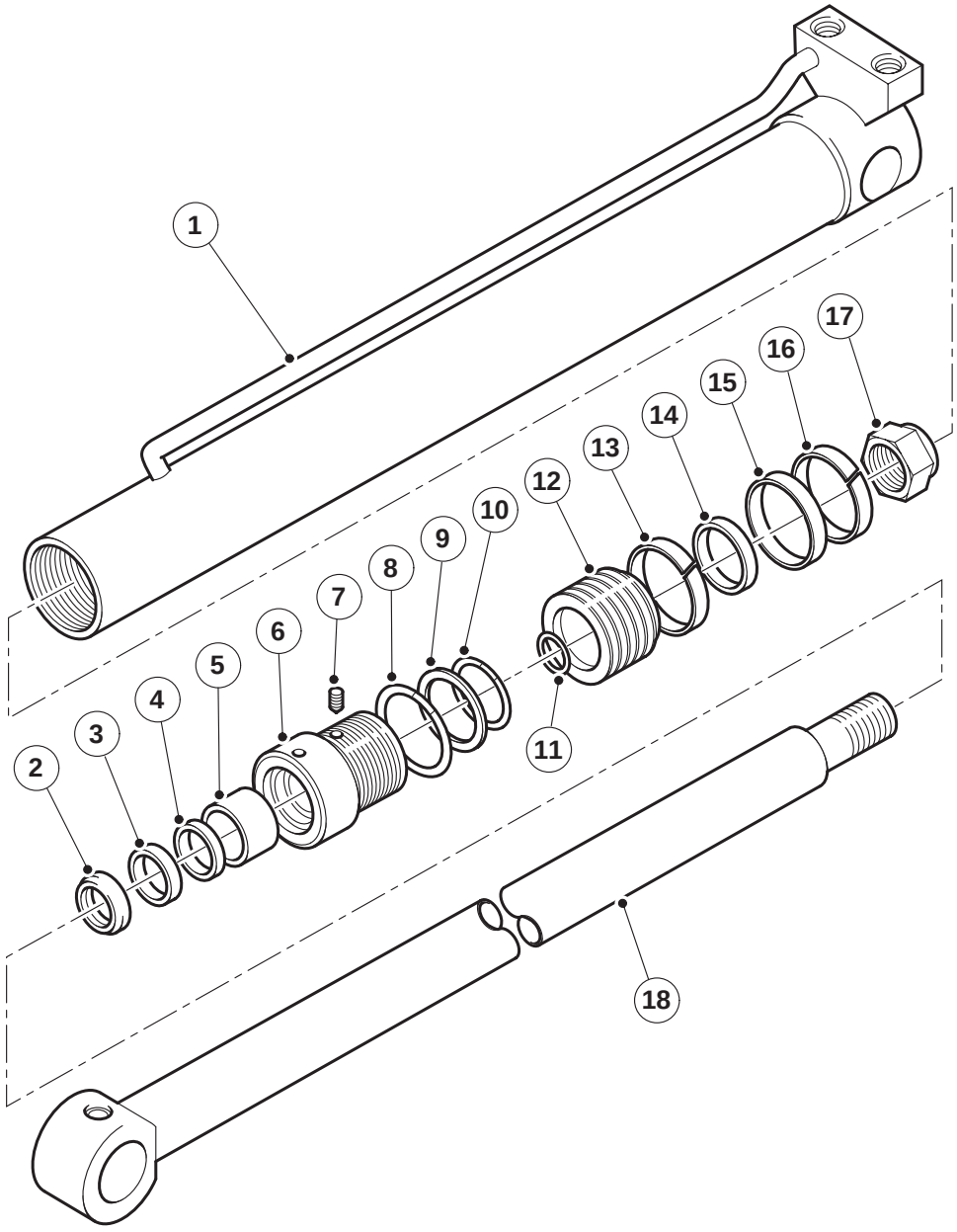
6. Apply Loctite NR275 to the locking screw (14) threads and install the locking screw (14) in the piston (13). Tighten the locking screw (14) to a torque between 23Nm.
7. Install the ring (19) and the snap ring (20) onto the piston rod (22).
8. Lubricate the bore of the cylinder gland (7) with clean oil.
9. Lubricate the inside of the cylinder (1) and the piston (13) with clean oil. Use a piston ring compression tool to hold the new carrier rings in place.
10. Start the cylinder (13) onto the piston rod assembly (22). Push the cylinder onto the piston rod (22) assembly until the compression tool is pushed off the piston rod assembly. Be careful not to damage the carrier rings and seal.

11. Using a suitable tool, install the cylinder gland (7) into the cylinder (1).
12. Tighten the gland (7) to 395Nm (291 lb.ft).

DISASSEMBLY AND ASSEMBLY — STABILIZER HYDRAULIC CYLINDER (SIDESHIFT)

BHE0501DE

Operation: **Disassembling the Stabilizer Hydraulic Cylinder (Sideshift)**	*Job Code:* **05 18 17 xx**		
Suitable Lifting Equipment	Standard Tools, Piston Ring Compression Tool		



TV040506

1	Cylinder
2	Wiper Seal
3	Seal
4	Ring
5	Bush
6	Cylinder Gland
7	Locking Screw
8	O-Ring
9	Back-up Ring
10	Seal
11	O-Ring
12	Piston
13	Guide Ring
14	Ring
15	Ring
16	Guide Ring
17	Lock Nut
18	Piston Rod

Disassembly

⚠ Warning:
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ Caution:
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (1) in a soft jawed vice.
3. Remove the locking screw (7) from the cylinder gland.

Note:
- Discard the locking screw

4. Using a suitable tool, remove the cylinder gland (6) from the cylinder (1).
5. Pull the piston rod (18) straight out of the cylinder (1).
6. Fasten the piston rod eye (18) in a vice and put a support below the piston rod (18) near the piston.
7. Remove the lock nut (17) from the piston rod (18).
8. Remove the piston (12) from the piston rod (18).
9. Remove the cylinder gland (6) from the piston rod (18).
10. Remove the guide ring (16), ring (15), ring (14), guide ring (13) and the O-ring (11) from the piston.
11. Remove the seal (10), back-up ring (9), O-ring (8), bush (5), ring (4), seal (3) and the wiper seal (2) from the cylinder gland (6).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (2), seal (3), ring (4), bush (5), O-ring (8), back-up ring (9) and the seal (10) to the cylinder gland (6).
2. Install the O-ring (11), guide ring (13), ring (14) ring (15) and the guide ring (16) to the piston (6).

Note:
- To aid installation of the cylinder gland , lubricate the bore of the gland with clean oil.

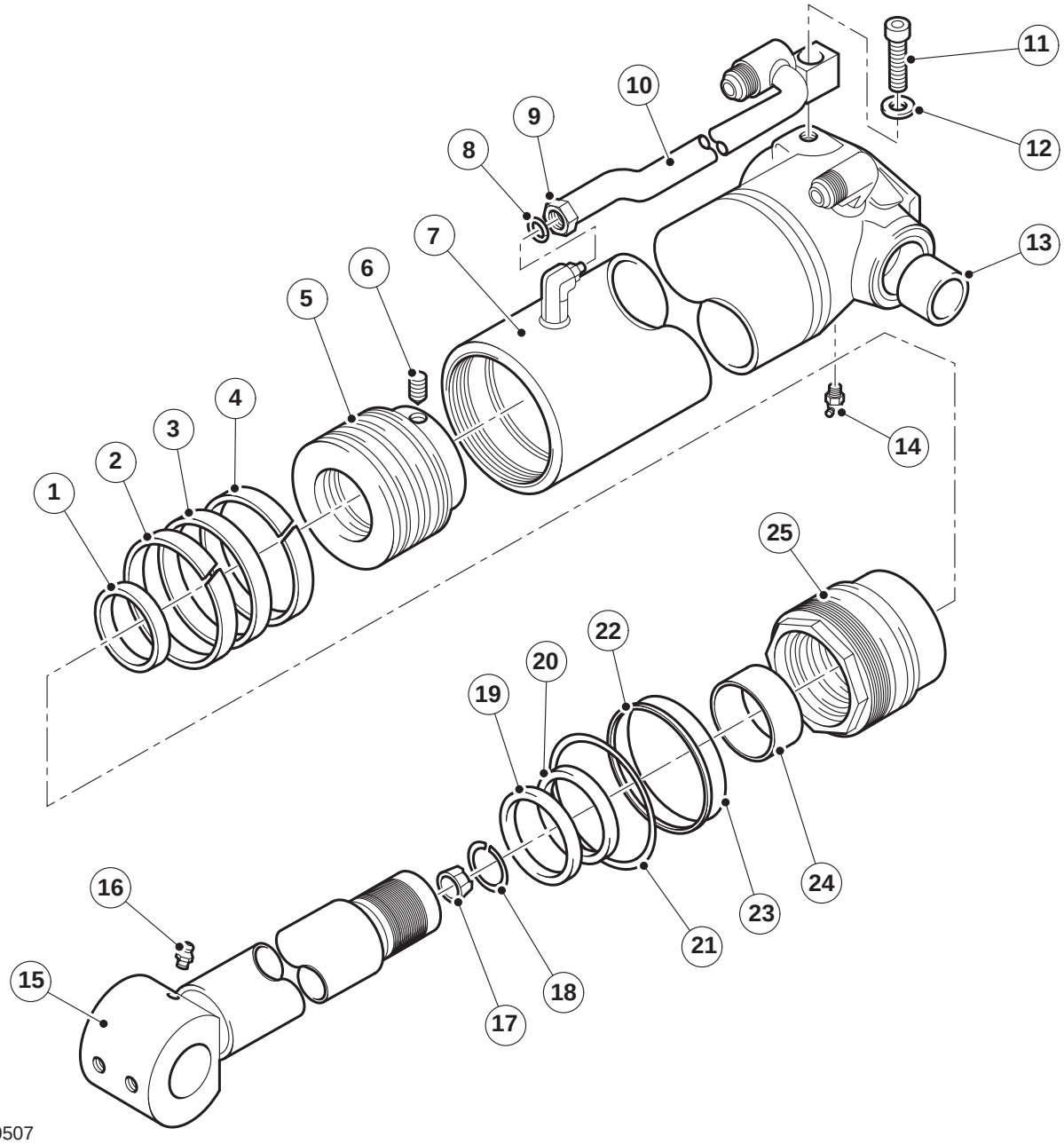
3. Install the cylinder gland (6) onto the piston rod (18).
4. Install the piston (12) onto the piston rod (18).
5. Apply Loctite HTS 915 066 to the threads of a new lock nut (17) and install the new lock nut (17) in the piston rod (18). Tighten the lock nut (17) to 825Nm (608 lb.ft).
6. Lubricate the inside of the cylinder (1) and the piston (12) with clean oil. Use a piston ring compression tool to hold the new carrier rings in place.
7. Start the cylinder (1) onto the piston rod (18) assembly. Push the cylinder onto the piston rod assembly until the compression tool is pushed off the piston rod assembly. Be careful not to damage the carrier rings and seals.
8. Tighten the cylinder gland (6) to a torque between 320 and 350Nm (236 and 258 lb.ft). When the locking screw holes become aligned in this torque range, install the locking screw (7). Tighten the locking screw (7) to 23Nm (17 lb.ft).

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DISASSEMBLY AND ASSEMBLY — STABILIZER LEG HYDRAULIC CYLINDER (CENTREMOUNT)

BHE0501DF

Operation: **Disassembling and Assembling the Stabilizer Leg Hydraulic Cylinder (Centremount)**	*Job Code:* **05 16 17 xx**		
Suitable lifting equipment	Standard tools, Suitable piston ring compressor		



TV040507

1	O-Ring
2	Ring
3	Seal
4	Ring
5	Cylinder Gland
6	Locking Screw
7	Cylinder
8	O-Ring
9	Nut
10	Tube Assembly
11	Bolt
12	Washer
13	Bush
14	Grease Nipple
15	Piston Rod
16	Grease Nipple
17	Retaining Nut
18	Snap Ring
19	Wiper Seal
20	Seal
21	Retaining Ring
22	Back-up ring
23	O-Ring
24	Bush
25	Cylinder Gland

Disassembly

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (7) in a soft jawed vice.
3. Remove the cylinder gland (25) from the cylinder (7).
4. Pull the piston rod (15) straight out of the tube (7) to prevent damage to the tube (7).
5. Fasten the piston rod eye (15) in a vice and put a support below the piston rod (15) near the piston (5).
6. Remove the snap ring (18) and the retaining nut (17) from the piston rod (15).
7. Remove the locking screw (6) from the piston (7).

Note:
- Discard the locking screw (6).

8. Remove the piston (5) from the piston rod (15).
9. Remove the cylinder gland (25) from the piston rod (15).
10. Remove the ring (4), seal (3), ring (2) and the O-ring (1) from the piston (5).
11. Remove the bush (24), O-ring (23), back-up ring (22), retaining ring (21), seal (20), wiper seal (19) from the cylinder gland (25).
12. Loosen the nut (9) on the tube assembly (23).
13. Remove the bolt (11) and washer (12) from the tube assembly (10).
14. Remove the tube assembly (10) from the cylinder (7).

Note:
- Discard the O-ring seal.

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the O-ring (8) to the tube assembly (10).
2. Install the tube assembly (10) onto cylinder (7) and install the washer (12) and the bolt (11).
3. Tighten the nut (9).
4. Install the wiper seal (19), seal (20), retaining ring (21), back-up ring (22), O-ring (23) and the bush (24) to the cylinder gland (5).
5. Install the O-ring (1), ring (2), seal (3) and ring (4) to the piston (25).
6. Lubricate the bore of the cylinder gland (25) with clean oil.
7. Push the cylinder gland (25) onto the piston rod (15).
8. Put the piston (5) on the end of the piston rod (15).
9. Tighten the piston (5) to 675Nm (498 lb.ft).

Note:
- Install a new locking screw.

10. Apply Loctite 648 to the threads of the locking screw (6) and install the locking screw (6) into the piston (5). Tighten the locking screw (6) to 23Nm (17 lb.ft).
11. Install the retaining nut (17) and the snap ring (18) onto the piston rod (15).
12. Lubricate the inside of the tube (1) and the piston (4) with clean oil. Use a piston ring compression tool to hold the new sealing rings in place.
13. Push the cylinder (7) straight onto the piston (5).
14. Push the cylinder onto the piston rod (15) assembly until the compression tool is pushed off the piston rod assembly (15). Be careful not to damage the sealing rings and seals.
15. Lubricate the O-ring (23) on the cylinder gland (25) with clean oil.
16. Install the cylinder gland (25) into the cylinder tube (7).
17. Tighten the cylinder gland (25) to 325Nm (240 lb.ft).

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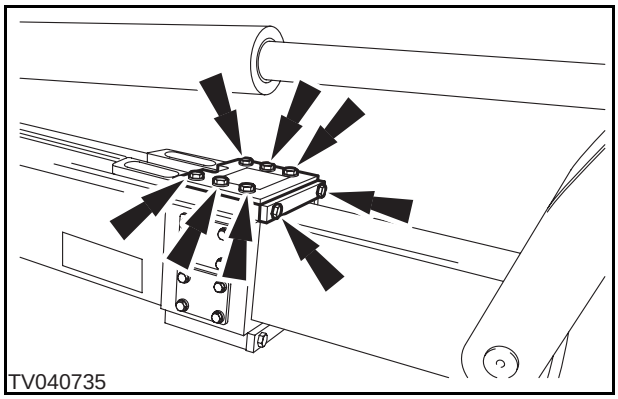
GENERAL PROCEDURE — CHECKING AND ADJUSTING THE EXTENDABLE DIPPER LOWER EXTERNAL WEAR PADS

BHE0501GB

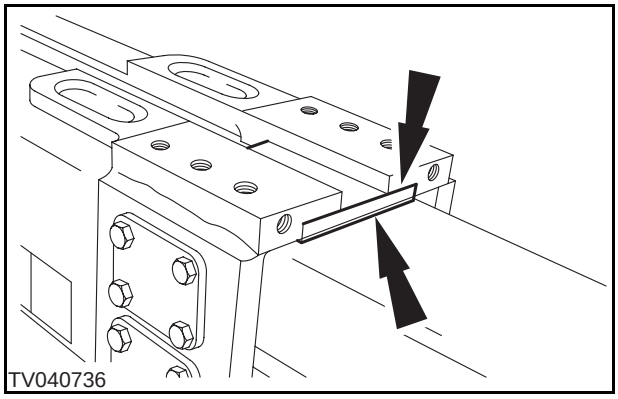
Top and Bottom Bearing Pads

Note:
- Make sure the weight of the inner section is on the bottom bearing pad.

1. Fully extend the dipper arm and boom to a suitable working height.
2. Extend the extendable dipper approximately 300mm.
3. Remove the top bearing pad covers.

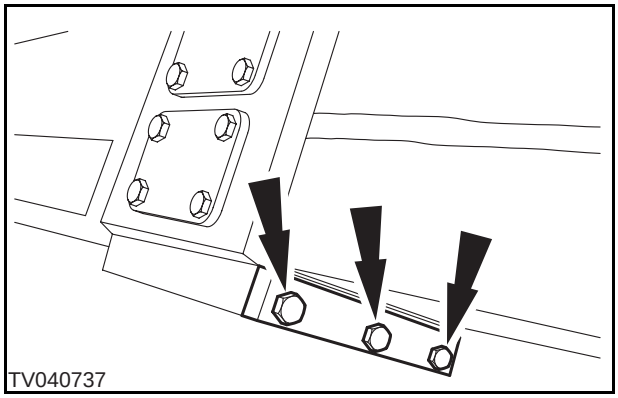

TV040735

4. Remove the top bearing pad and shim(s).

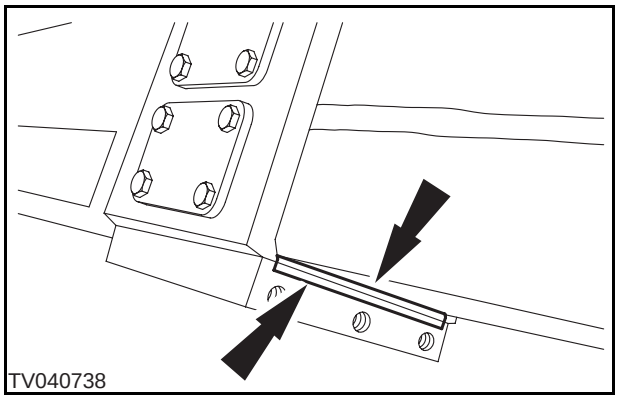

TV040736

Note:
- Make sure the weight of the inner section is not on the bottom bearing pad.

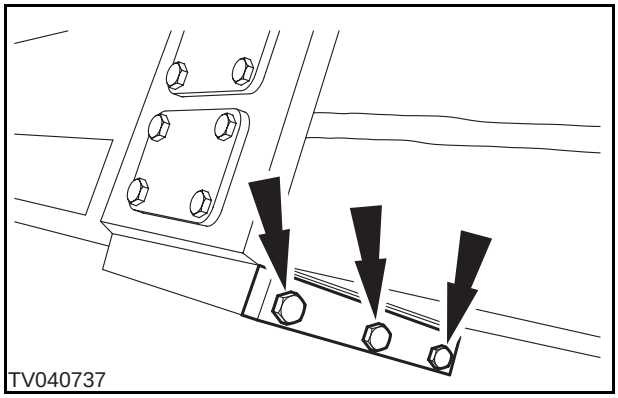
5. Lower the dipper arm and boom to the ground.
6. Remove the bottom bearing pad cover.


TV040737

7. Remove the bottom bearing pad and shim(s).

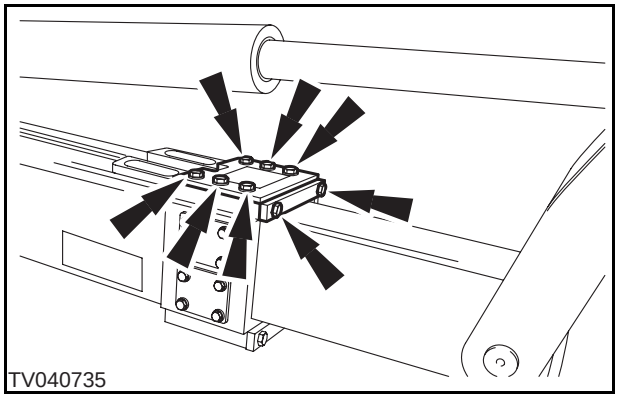

TV040738

8. Install a new bottom bearing pad.
9. Install the bottom bearing pad cover and tighten to 140Nm (103 lb.ft).


TV040737

Note:
- Make sure the weight of the inner section is on the bottom bearing pad.

10. Fully extend the dipper arm and boom to a suitable working height.
11. Install a new top bearing pad.
12. Install the top bearing pad covers and tighten to 140Nm (103 lb.ft).


TV040735

13. Using a suitable measuring device, measure the clearance between the extendable dipper inner section and the top bearing pad.

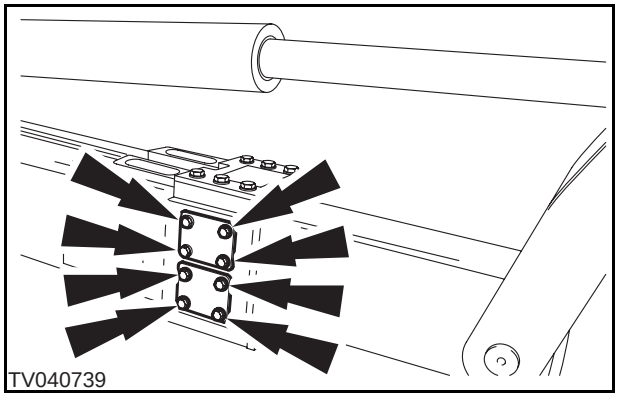
Note:
- Shims are available in 0.5mm, 1.0mm, 2.0mm and 4.0mm thicknesses.

⚠ **Caution:**
- **Make sure the shims are installed between the bearing pad and the outer section of the dipper.**

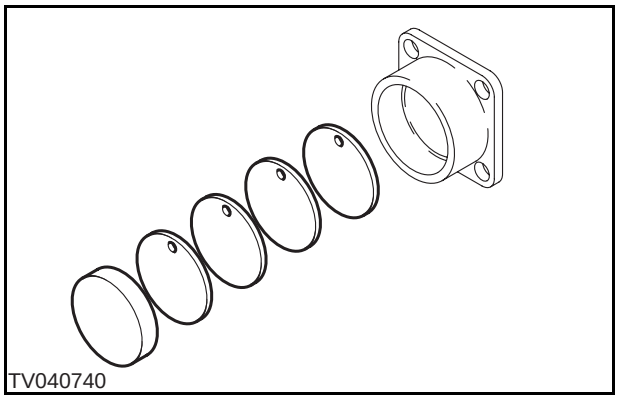
14. Install equal quantities of adjusting shims as required to the top and bottom bearing pads to achieve a total clearance of less than 1.0mm.

Side Wear Pads

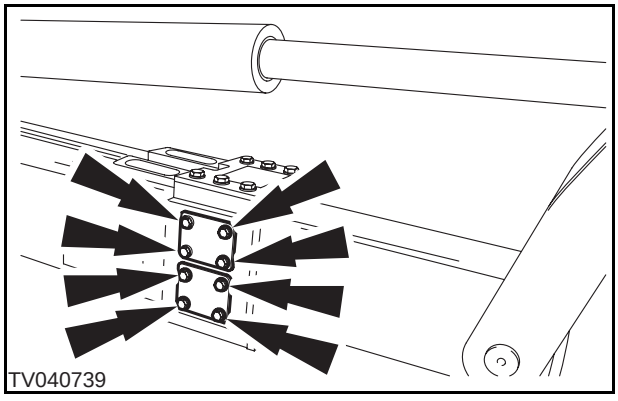
1. Fully extend the dipper arm and boom to a suitable working height.
2. Remove the left-hand and right-hand side bearing pad covers (right-hand side shown).


TV040739

3. Remove the side bearing pads and shims from the covers.


TV040740

4. Install new bearing pads to the four bearing pad covers.
5. Install the left-hand and right-hand side bearing pad covers and tighten to 60Nm (right-hand side shown, left-hand side similar).


TV040739

Note:
- Make sure no clearance is present between the left-hand side of the extendable dipper inner section and the left-hand side bearing pad.

6. Apply pressure to right-hand side of the extendable dipper inner section.
7. Using a suitable measuring device, measure the clearance between the extendable dipper inner section and the right-hand side bearing pads.

Note:
- Shims are available in 1.0mm or 2.0mm thicknesses.

⚠ **Caution:**
- **Make sure the shims are installed between the bearing pads and the covers.**

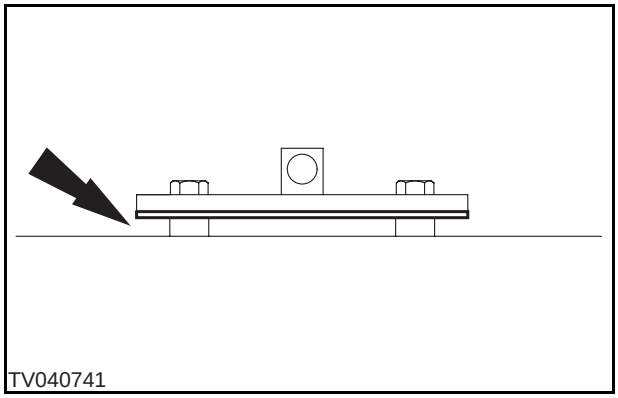
8. Install equal quantities of adjusting shims as required to the left-hand and right-hand side bearing pads to achieve a total clearance of less than 1.0mm.

GENERAL PROCEDURE — CHECKING AND ADJUSTING THE EXTENDABLE DIPPER UPPER EXTERNAL WEAR PADS

BHE0501GC

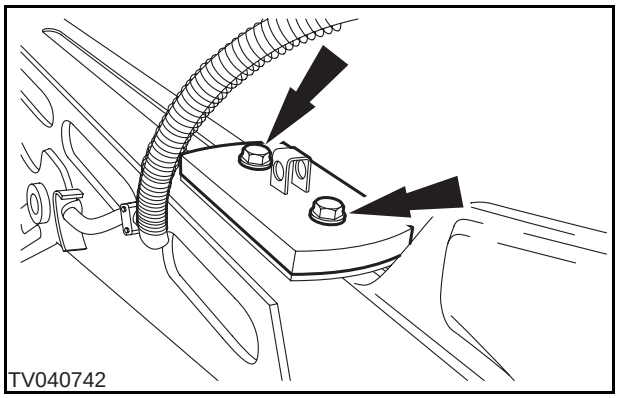
Extendable Dipper Upper External Wear Pads

1. Fully extend the dipper arm and boom.
2. Extend the extendable dipper approximately three quarters and position the bucket 50mm from the ground.
3. Using a suitable measuring device, measure the clearance between the upper external wear pad and the extendable dipper outer section.

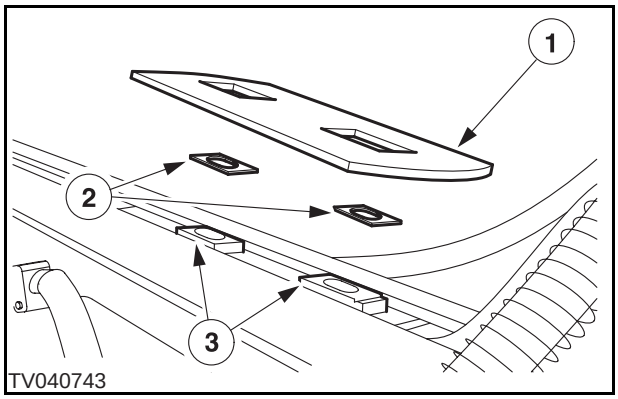

TV040741

Note:
- If the clearance is less than 1.0mm, replacement is not required.

4. If the clearance is greater than 1.0mm, remove the upper external wear pad cover.


TV040742

5. Remove the upper external wear pad (1), shims (2) and the spacers (3).



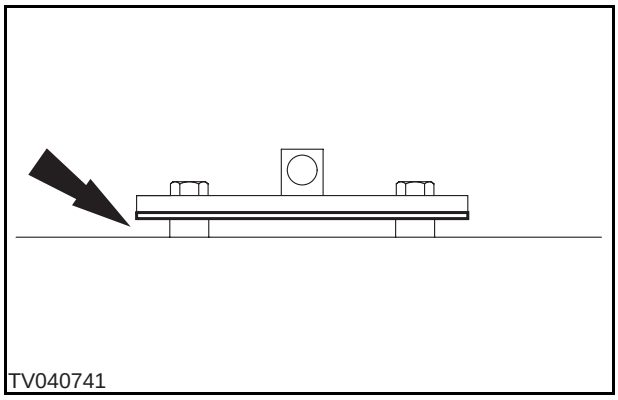
TV040743

Note:

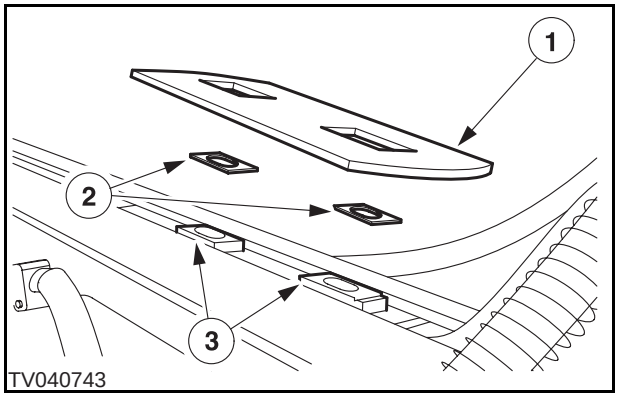
- If the initial clearance was 2.0mm and the shims are 3.0mm, the replacement shims required would be 2.0mm to obtain the required clearance of 1.0mm.

  Shims are available in 1.0mm, 2.0mm and 3.0mm thicknesses.

6. Using a suitable measuring device, measure the shims and replace as required to reduce the clearance shown to below 1.0mm.

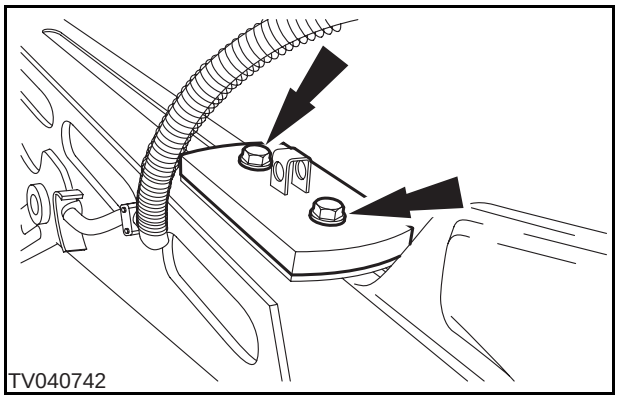

TV040741

7. Install the upper external wear pad (1), replacement shims (2) and the spacers (3).



TV040743

8. Install the upper external wear pad cover and tighten to 920Nm +/- 120Nm (679 lb.ft +/- 89 lb.ft).


TV040742

GENERAL PROCEDURE — CHECKING AND ADJUSTING THE EXTENDABLE DIPPER UPPER INTERNAL WEAR PADS

BHE0501GD

Extendable Dipper Upper Internal Wear Pads

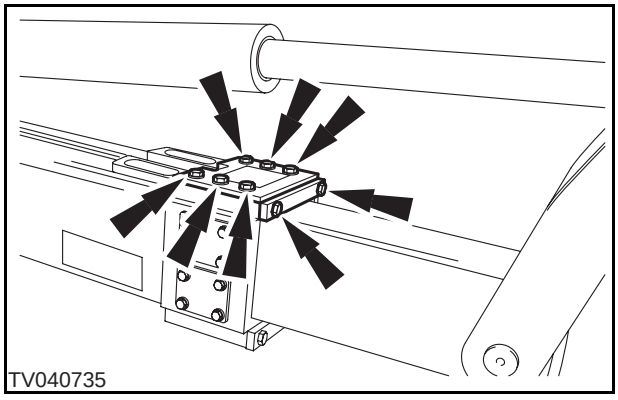
1. Remove the backhoe bucket. For additional information, refer to STANDARD BACKHOE BUCKET, PAGE D04–01–1 or QUICK ATTACH BACKHOE BUCKET, PAGE C03–01–1 in this section.

   Note:
   - Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

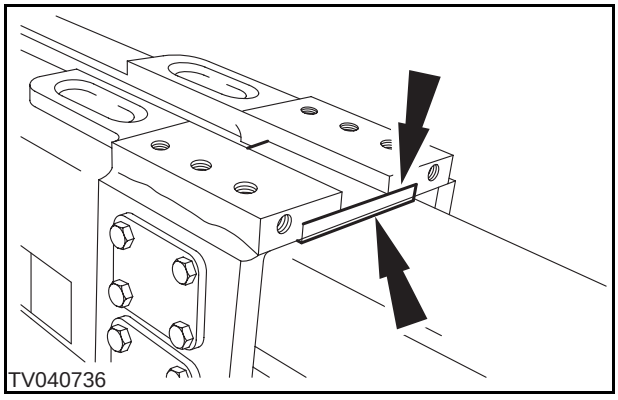
   Note:
   - Always install blanking plugs to any open ports to avoid contamination.

   Note:
   - Make sure the weight of the inner section is on the bottom bearing pad.

2. Fully extend the dipper arm and boom to a suitable working height.
3. Extend the extendable dipper approximately 300mm.
4. Remove the top bearing pad covers.


TV040735

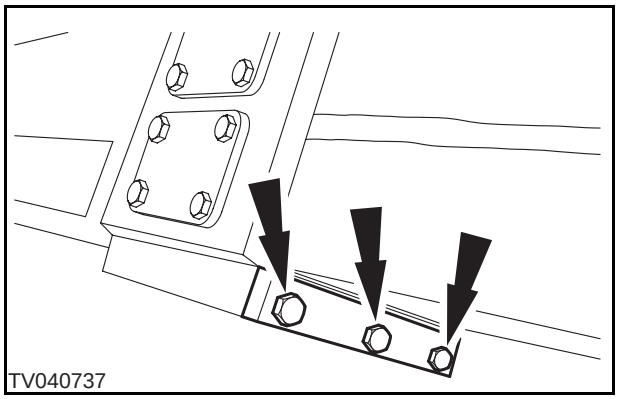
5. Remove the top bearing pad and shim(s).


TV040736

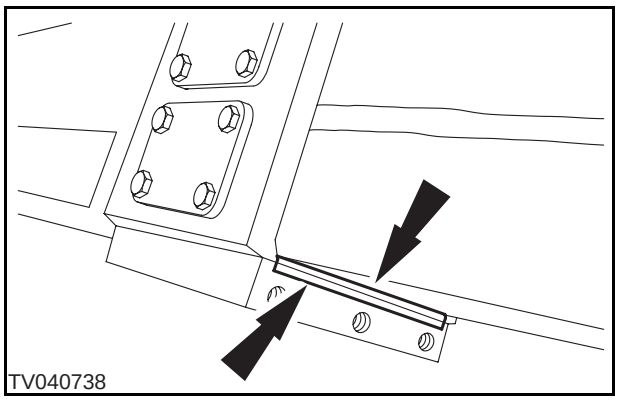
   Note:
   - Make sure the weight of the inner section is not on the bottom bearing pad.

6. Lower the dipper arm and boom to the ground.

7. Remove the bottom bearing pad cover.


TV040737

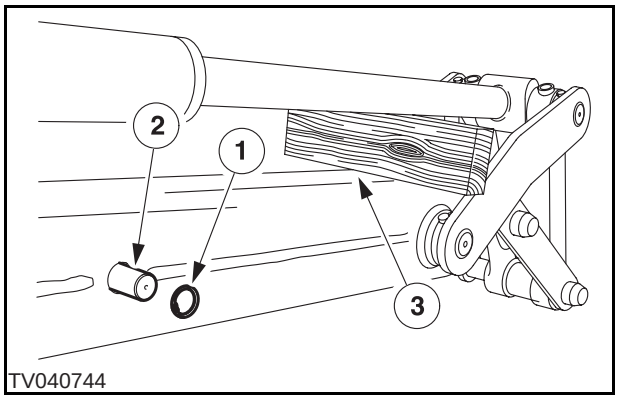
8. Remove the bottom bearing pad and shim(s).


TV040738

9. Fully extend the dipper arm and boom until the dipper arm is in horizontal position.
10. Fully extend the extendable dipper.

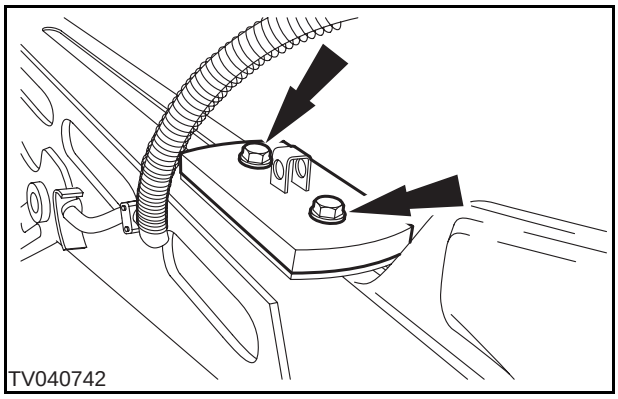
Note:
- Using a suitable block (3), support the hydraulic cylinder.

11. Remove the extendable dipper hydraulic cylinder pivot pin circlip (1) and remove the pivot pin (2).

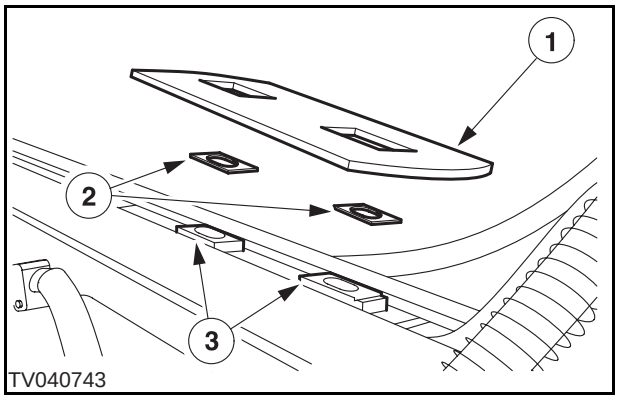


TV040744

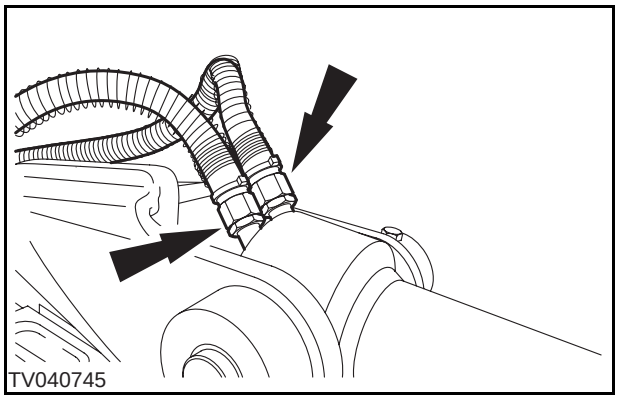
12. Remove the upper external wear pad cover.



13. Remove the upper external wear pad (1), shims (2) and the spacers (3).



14. Disconnect the backhoe bucket hydraulic cylinder pipes.

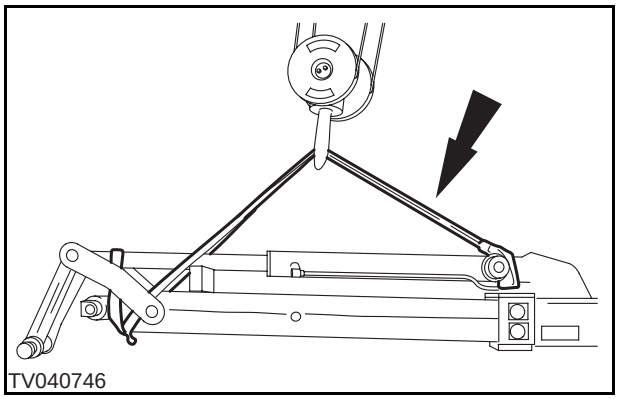


⚠ **Warning:**

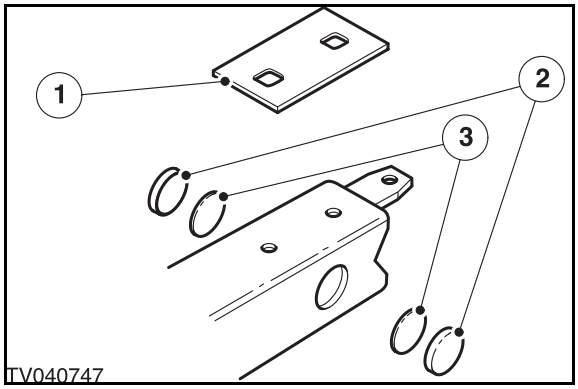
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

15. Using suitable lifting equipment, support the extendable dipper inner section.

16. Carefully slide out the extendable dipper inner section.


TV040746

17. Remove the internal upper wear pad (1).
18. Remove the internal side wear pads (2) and shims (3).



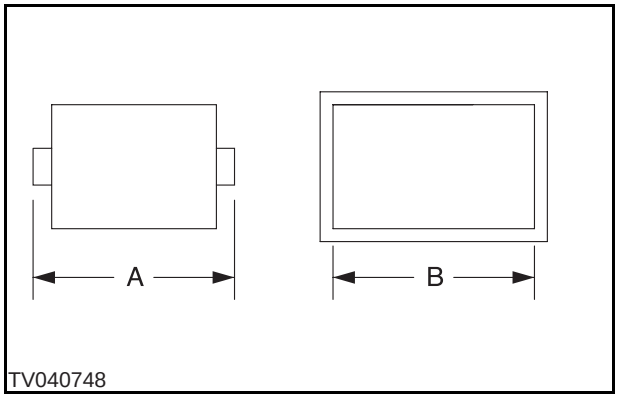
TV040747

Note:
- Do not install the shims at this time.

19. Install new side wear pads to the extendable dipper inner section.
20. Measure the distance across the wear pads (A).
21. Measure the internal diameter of the extendable dipper outer section (B).

Note:
- Shims are available in 1.0mm and 2.0mm thicknesses.

22. The difference between dimensions A and B = X. Total clearance of 0.5mm to 1.0mm is required. Dimension X minus the clearance required is the total thickness of shims required.

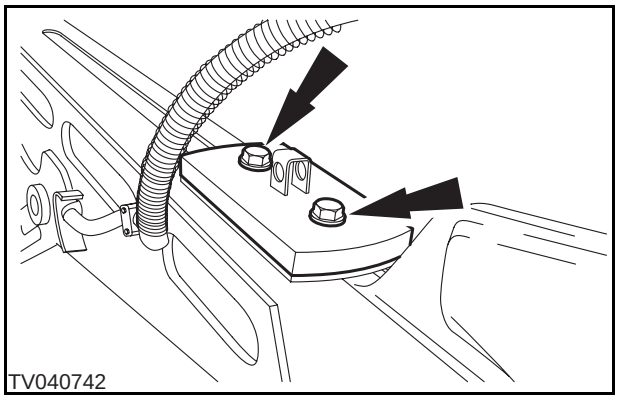


TV040748

⚠ **Caution:**
- **Make sure the shims are installed between the bearing pad and the extendable dipper inner section.**

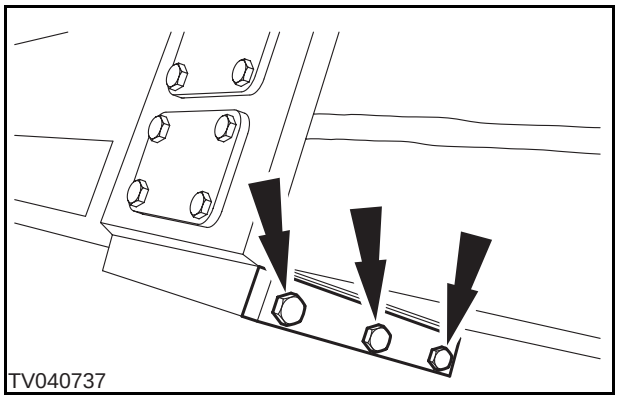
Note:
- Use a suitable grease to stop the pads becoming dislodged during installation.

23. Install equal amounts of shims behind the left and right wear pads to give the correct clearance required.
24. Install a new upper internal wear pad.
25. Install the extendable dipper inner section.
26. Connect the backhoe bucket hydraulic cylinder pipes.
27. Install the upper external wear pad, shims and the spacers.
28. Install the upper external wear pad cover and tighten to 920Nm +/- 120Nm (679 lb.ft +/- 89 lb.ft).


TV040742

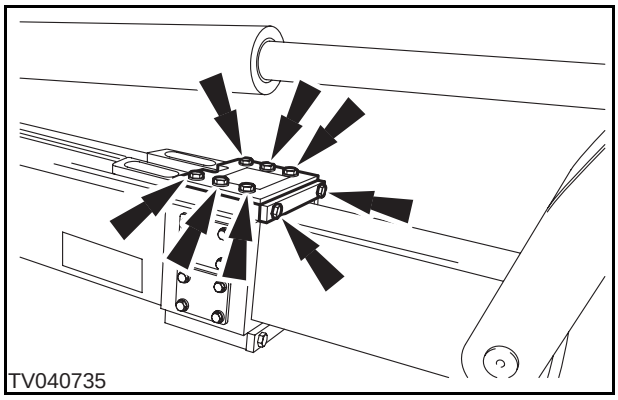
Note:
- Make sure the hydraulic cylinder is aligned with the pivot pin hole.

29. Install the extendable dipper hydraulic cylinder pivot pin and circlip.
30. Install the bottom bearing pad and shim(s).
31. Install the bottom bearing pad cover and tighten to 140Nm (103 lb.ft).


TV040737

32. Install the top bearing pad and shim(s).

33. Install the top bearing pad covers and tighten to 140Nm (103 lb.ft).



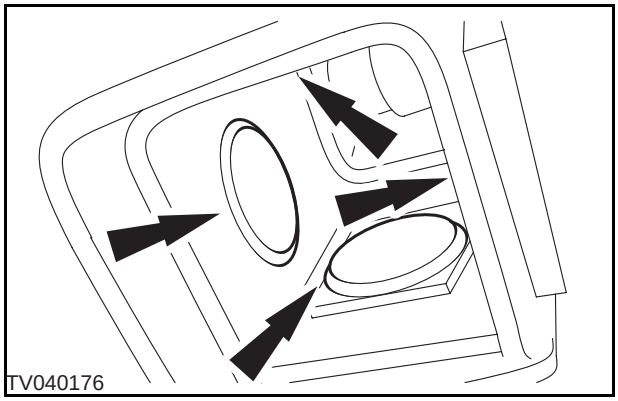
34. If required, adjust the extendable dipper upper external wear pads. For additional information, refer to EXTENDABLE DIPPER UPPER EXTERNAL WEAR PADS, PAGE E05–01–49 in this section.
35. Install the backhoe bucket. For additional information, refer to STANDARD BACKHOE BUCKET, PAGE D04–01–1 or QUICK ATTACH BACKHOE BUCKET, PAGE C03–01–1 in this section.

GENERAL PROCEDURE — STABILIZER LEG WEAR PADS (SIDESHIFT)

BHE0501GE

Stabilizer Leg Wear Pads (Sideshift)

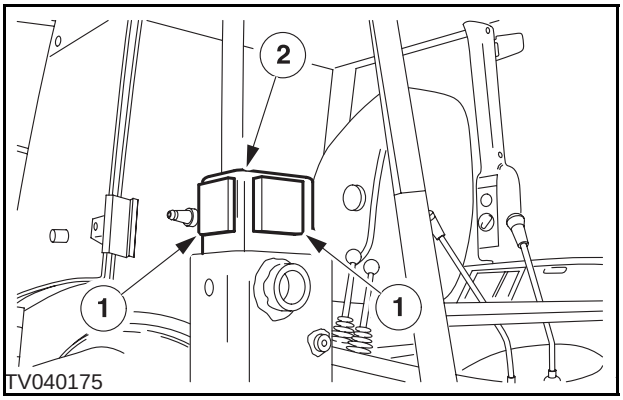
1. Remove the stabilizer leg. For additional information, refer to STABILIZER LEG (SIDESHIFT), PAGE E05–01–13 in this section.
2. Remove the stabilizer leg lower wear pads.


TV040176

3. Remove the stabilizer leg upper wear pads (1).
4. Clean the stabilizer leg and housing.

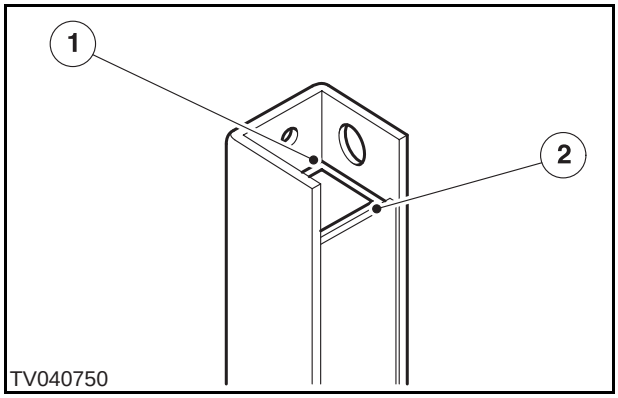
Note:
- Do not install the wear pads.

5. Using suitable lifting equipment, install the stabilizer leg (2).



TV040175

6. Position the stabilizer leg until the top is level with the upper part of the stabilizer leg housing inner face.



TV040750

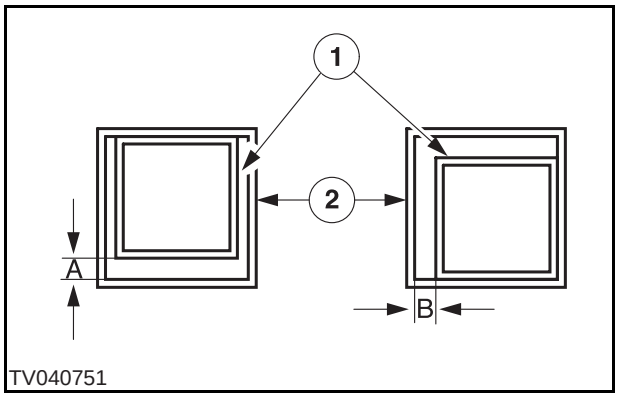
7. Position the stabilizer leg (1) flush with the stabilizer leg housing (2) in the two positions indicated.
8. Measure the distance at positions (A) and (B).

Note:

- A maximum clearance of 1.0mm is required when new wear pads are installed.

  Wear pads are available in green 3.6mm, blue 4.0mm, yellow 4.5mm, black 5.0mm, grey 5.5mm, natural 6.0mm and red 6.5mm.

9. Calculate the upper wear pads required. Distance (A) minus 1.0mm will give the total wear pad thickness required. This value divided by two will indicate the thickness of the two wear pads required to give the correct clearance.
10. Calculate the upper wear pads required. Distance (B) minus 1.0mm will give the total wear pad thickness required. This value divided by two will indicate the thickness of the two wear pads required to give the correct clearance.



11. Position the stabilizer leg until the bottom is level with the lower part of the stabilizer leg housing.
12. Position the stabilizer leg (1) flush with the stabilizer leg housing (2) in the two positions indicated.
13. Measure the distance at positions (A) and (B).

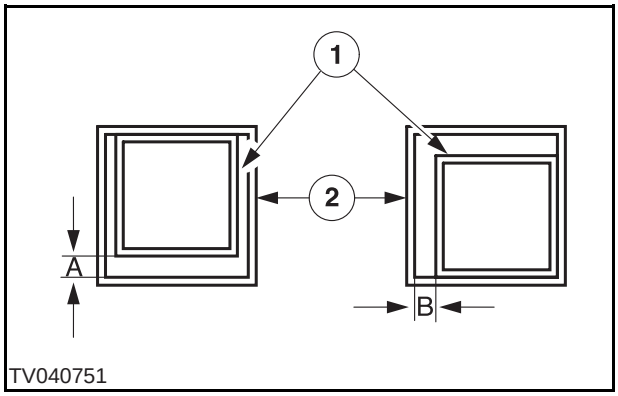
Note:

- A maximum clearance of 1.0mm is required when new wear pads are installed.

  Wear pads are available in green 3.6mm, blue 4.0mm, yellow 4.5mm, black 5.0mm, grey 5.5mm, natural 6.0mm and red 6.5mm.

14. Calculate the lower wear pads required. Distance (A) minus 1.0mm will give the total wear pad thickness required. This value divided by two will indicate the thickness of the two wear pads required to give the correct clearance.

15. Calculate the lower wear pads required. Distance (B) minus 1.0mm will give the total wear pad thickness required. This value divided by two will indicate the thickness of the two wear pads required to give the correct clearance.



16. Remove the stabilizer leg from the housing.

    Note:
    - Use a suitable grease to stop pads becoming dislodged during installation.

17. Install the correct thickness upper and lower wear pads.
18. Install the stabilizer leg. For additional information, refer to STABILIZER LEG (SIDESHIFT), PAGE E05–01–13 in this section.

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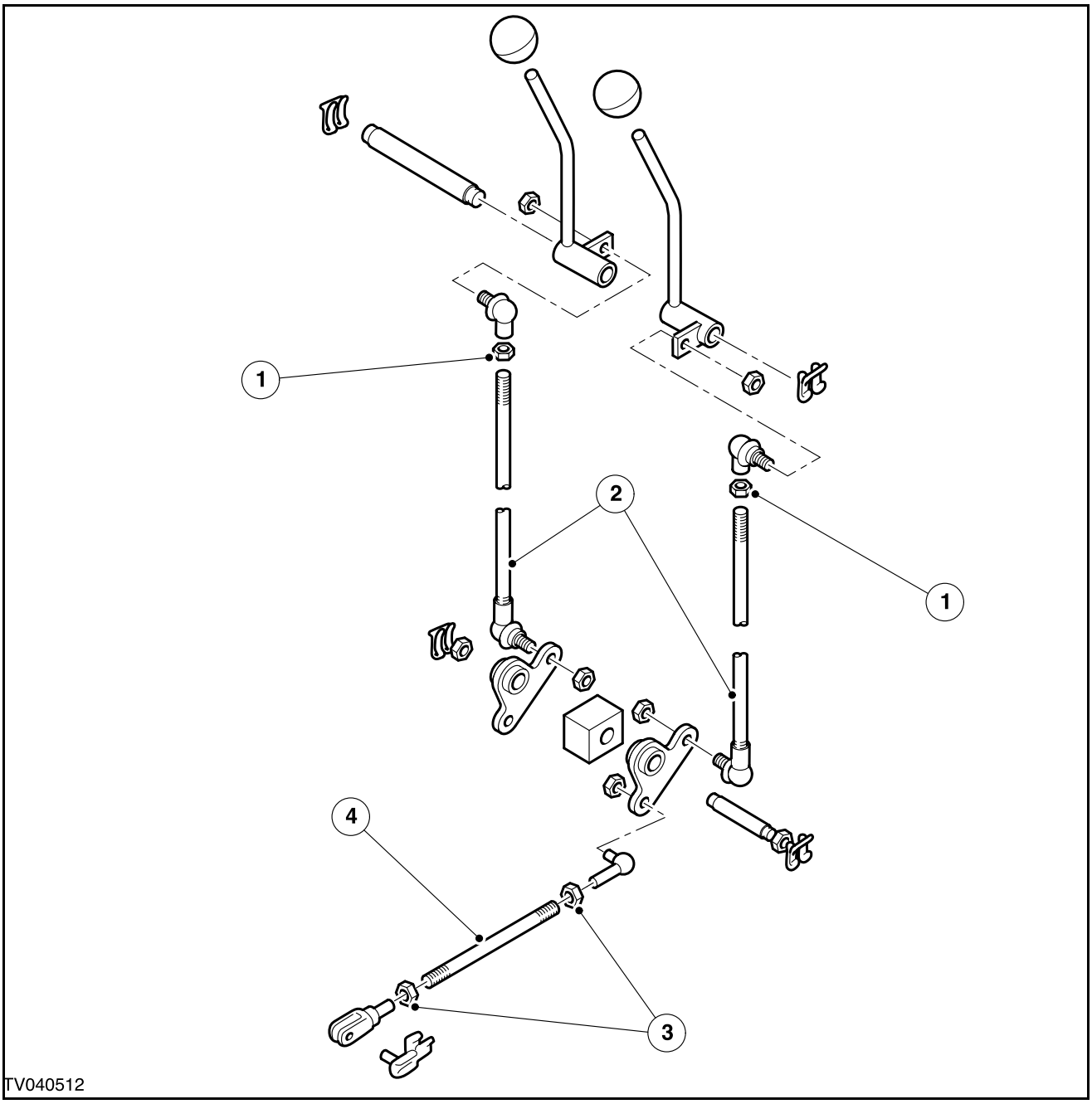
GENERAL PROCEDURE — STABILIZER LEGS CONTROL LEVER ADJUSTMENT

BHE0501GF

Adjustment Procedure

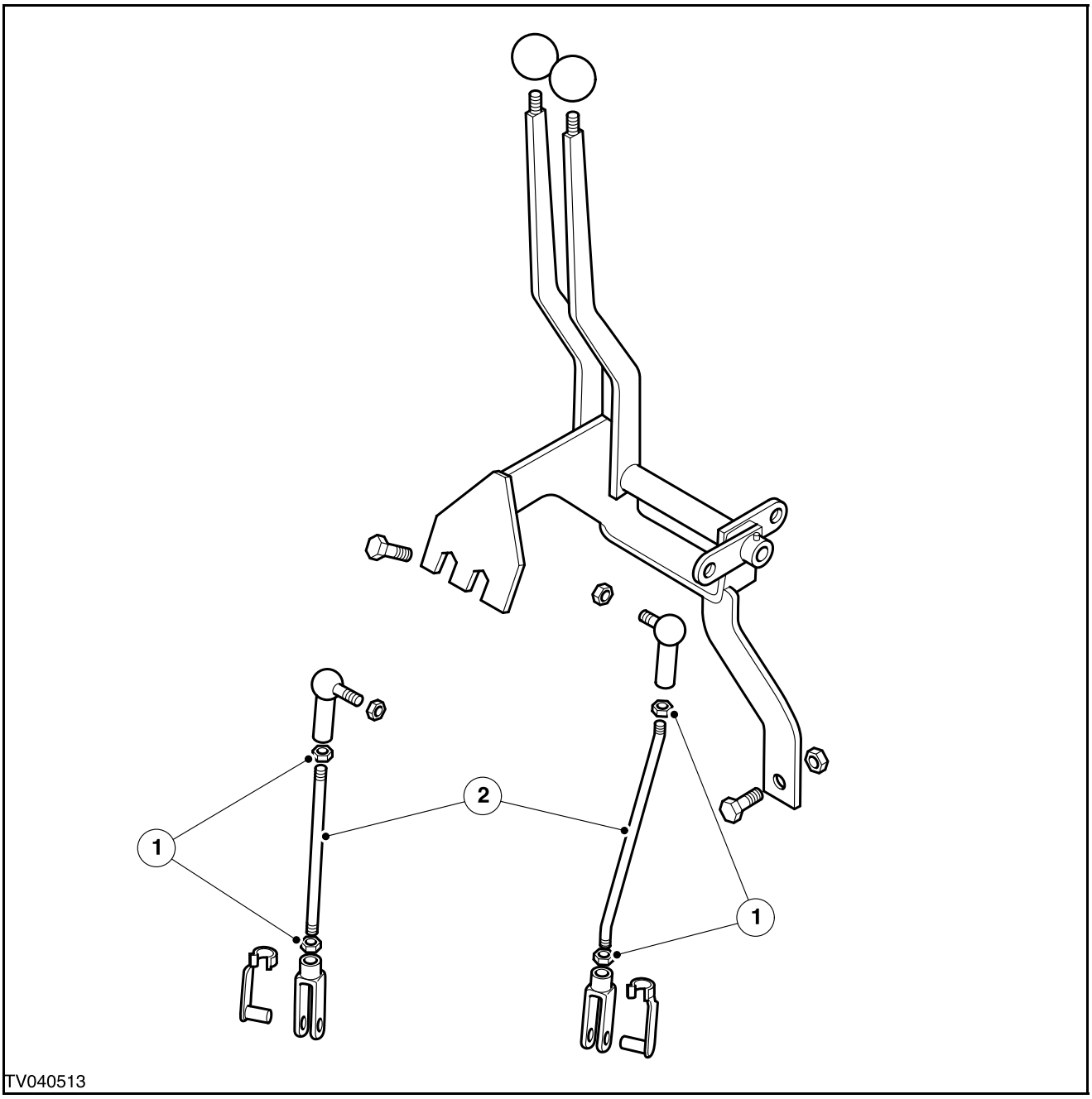
1. Park the machine on firm level ground.
2. Switch off the engine.
3. Make sure that both stabilizer control levers are vertical and that the knobs are in line.
4. Adjust the connecting rods located behind the left side trim panel to make the control levers vertical or to align the knobs.
5. Operate each stabilizer control lever over its full range of movement. Make sure that the relevant spool on the backhoe valve operates over its full stroke and the knobs are in line.
6. Tighten the lock nuts in position.

GLAZED/R.O.P.S Cab



1	Lock nuts
2	Connecting rod
3	Lock nuts
4	Rod assembly

R.O.P.S Cab



TV040513

1	Lock nuts
2	Connecting rod

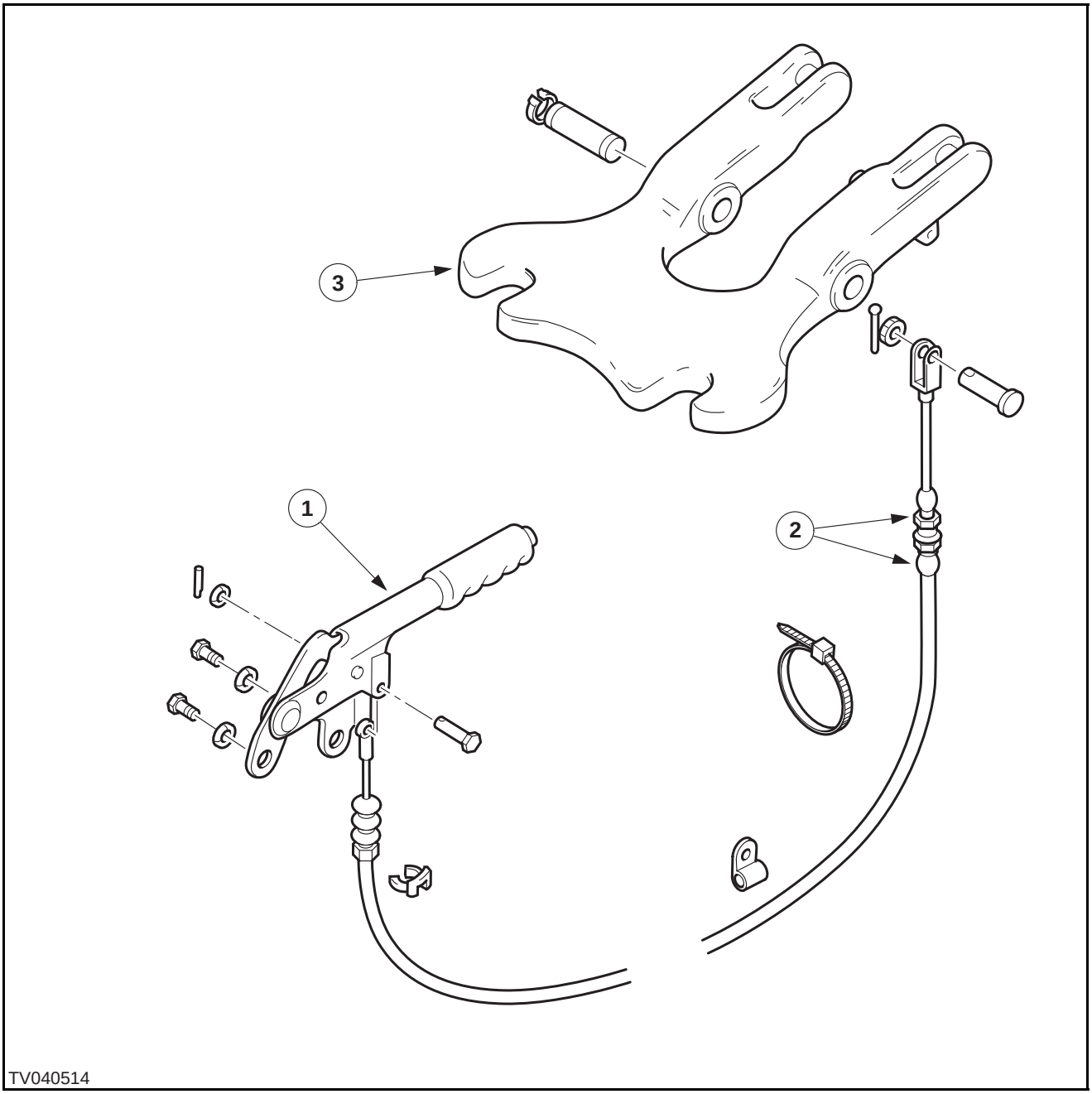
Note: This page intentionally left blank.

GENERAL PROCEDURE — BOOM LATCH CABLE ADJUSTMENT

BHE0501GG

Adjustment Procedure

1. Make sure the boom latch cable is correctly fixed to the boom latch control lever (1).
2. Adjust the cable sheath stop (2) on the latch side of the boom, so that the cable is slightly slack.
3. Lower the boom latch control lever (1). If the boom latch (3) does not engage fully over the stops on the mast casting, slacken the cable by moving the cable sheath stop (2) towards the boom until full engagement is achieved.
4. Raise the boom latch control lever (1) and make sure the boom latch is fully disengaged from the stops on the mast casting, adjust as required.



TV040514

1	Boom latch control lever
2	Cable sheath stop
3	Boom latch

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SPECIFICATIONS — DIGGER SWING SYSTEM

BHE0501SA

Torque Values

Description	Nm	Lb.ft
Dipper hydraulic cylinder gland	320 — 550	236 — 405
Dipper hydraulic cylinder lock screw	23	17
Backhoe bucket hydraulic cylinder piston locking screw	23	17
Backhoe bucket hydraulic cylinder gland	320 — 550	236 — 405
Backhoe bucket hydraulic cylinder gland locking screw	23	17
Slew hydraulic cylinder piston	1075	793
Slew hydraulic cylinder piston locking screw	23	17
Slew hydraulic cylinder gland	395	291
Sideshift stabilizer hydraulic cylinder piston nut	825	608
Sideshift stabilizer hydraulic cylinder gland	320 — 350	236 — 258
Sideshift stabilizer hydraulic cylinder gland locking screw	23	17
Centremount stabilizer leg hydraulic cylinder piston	675	498
Centremount stabilizer leg hydraulic cylinder piston locking screw	23	17
Centremount stabilizer leg hydraulic cylinder gland	325	240
Extendable dipper lower external top/bottom bearing pad covers	140	103
Extendable dipper lower external side bearing pad covers	60	44
Extendable dipper upper external wear pad cover	920	679
Mast casting	1067	787

Extendable Dipper Shim Sizes

Wear Pad Description	Shim Sizes (mm)	Required Clearance (mm)
Lower external top/bottom	0.5, 1, 2 and 4	1
Lower external side	1 and 2	1
Upper external	1, 2 and 3	1
Side internal	1 and 2	1

Sideshift Stabilizer Leg Wear Pad Sizes

Colour	Size (mm)
Green	3.6
Blue	4.0
Yellow	4.5
Black	5.0
Grey	5.5
Natural	6.0
Red	6.5

Required clearance = 1mm

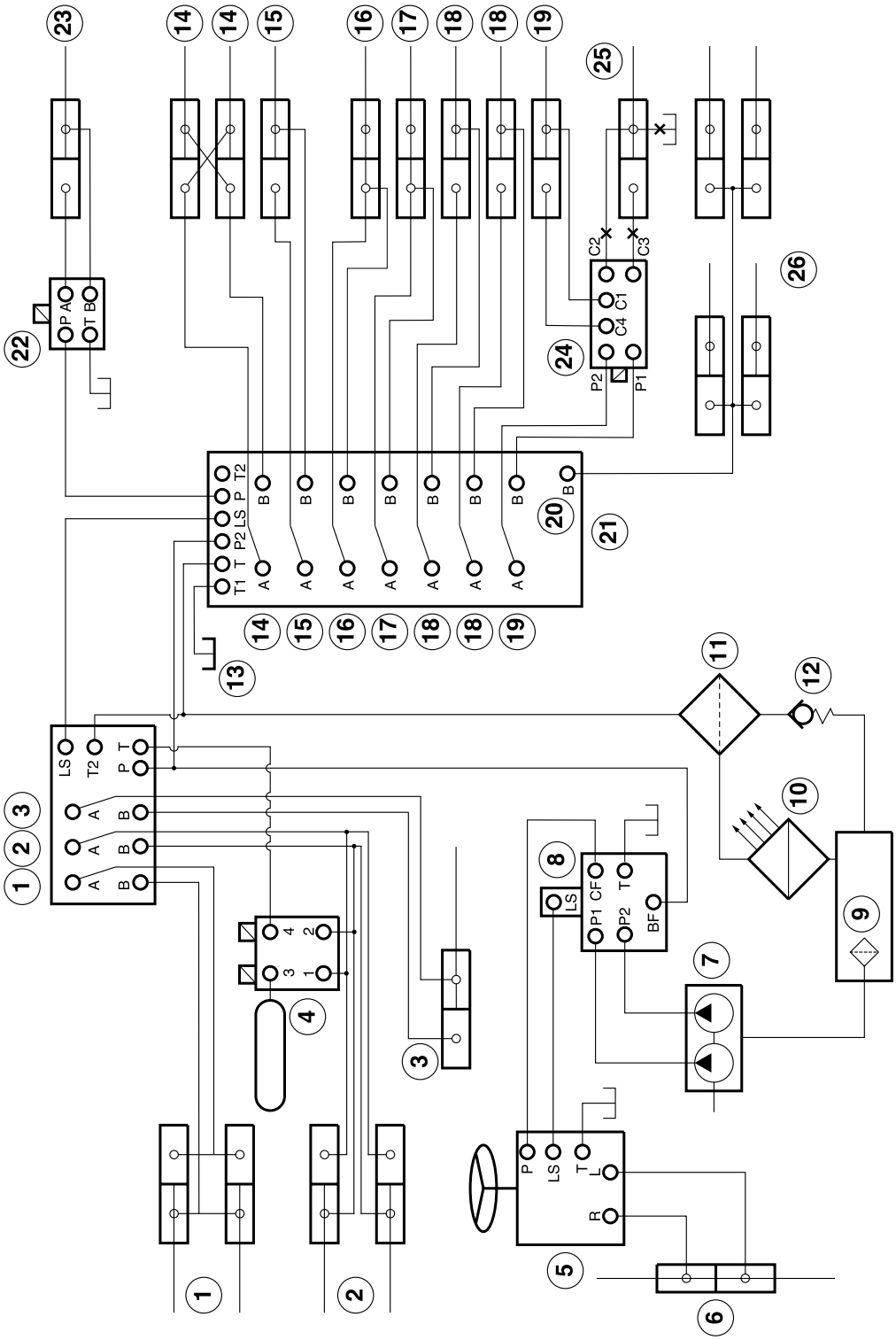
MAIN HYDRAULICS

F06
SECTION

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HYDRAULIC SYSTEM DIAGRAM

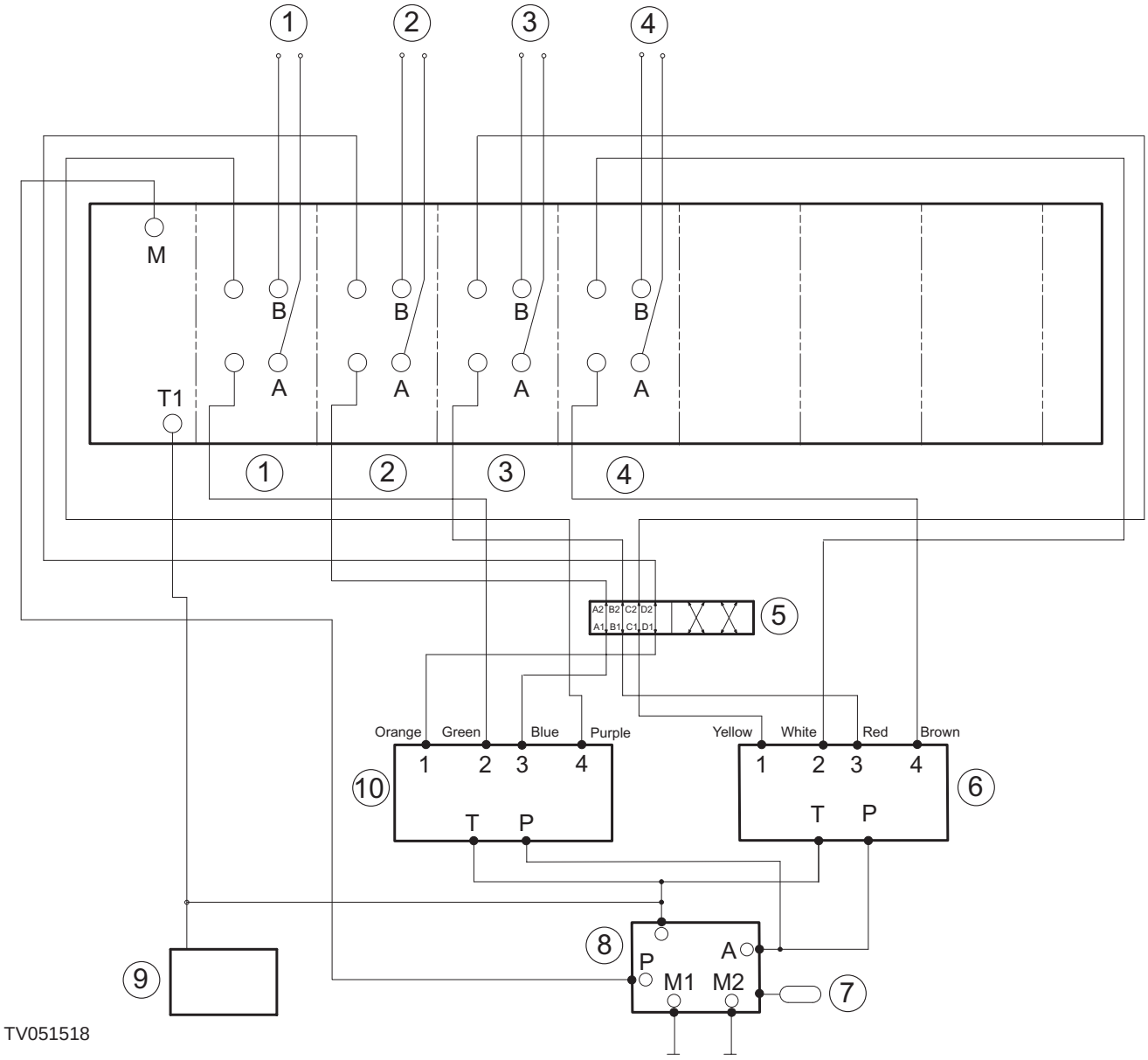
BHF0601OA



TV040935

1	Multi-Purpose Bucket
2	Loader Beam
3	Loader Bucket
4	Ride Control Valve
5	Orbitrol Steering Motor
6	Steering Hydraulic Cylinder
7	Tandem Gear Hydraulic Pumps
8	Steering Priority/Unloader Valve (SP/UV)
9	Oil Reservoir
10	Oil Cooler
11	Return Oil Filter
12	Back-Pressure Check Valve
13	Load Sense Drain
14	Backhoe Slew
15	Backhoe Boom
16	Backhoe Dipper
17	Backhoe Bucket
18	Backhoe Stabilizers
19	Backhoe Extendable Dipper
20	Mast Casting Clamps (Sideshift Only)
21	Backhoe Control Valve Bank
22	Backhoe Bucket Quick Attach Unit Control Valve
23	Backhoe Bucket Quick Attach Unit Hydraulic Cylinder
24	Change Over Valve
25	Auxiliary Services
26	Mast Casting Clamp Hydraulic Cylinders (Sideshift Only)

Hydraulic System Diagram-Servo Controls



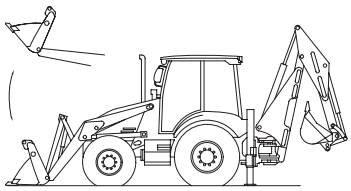
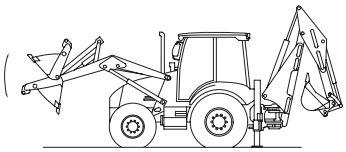
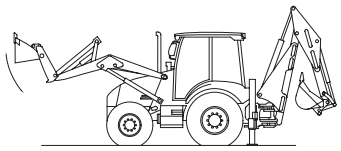
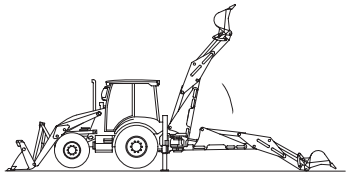
TV051518

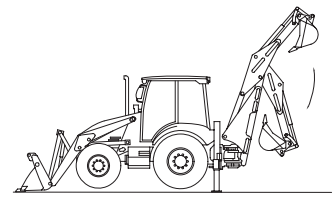
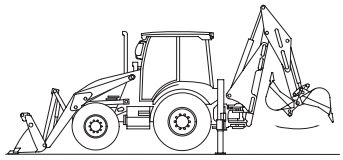
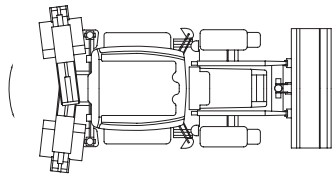
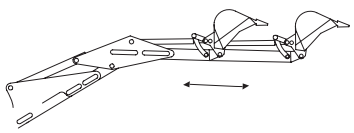
1	Backhoe Slew
2	Backhoe Boom
3	Backhoe Dipper
4	Backhoe Bucket
5	Change Over Valve
6	Right Hand Joystick Control
7	Accumulator
8	Servo Control Valve
9	Oil Reservoir
10	Left Hand Joystick Control

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DIAGNOSING AND TESTING — HYDRAULICS/PRESSURE TESTING

BHF0601TB

Classification	Check Item	Conditions		Pump 1 Operation Time (± 15%)	Pump 1 and 2 Operation Time (± 15%)
Operational Speed	Front Loader Beam	Positioning  TV074050 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Raise	9.5 Secs (± 1.4 Secs)	5.3 Secs (± 0.8 Secs)
			Lower	3.2 Secs (± 0.5 Secs)	3.0 Secs (± 0.5 Secs)
	Front Loader Bucket	Positioning  TV074051 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Crowd	4.5 Secs (± 0.7 Secs)	2.7 Secs (± 0.4 Secs)
			Dump	3.2 Secs (± 0.5 Secs)	2.0 Secs (± 0.3 Secs)
	Multi-Purpose Loader Bucket	Positioning  TV074052 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Open	1.8 Secs (± 0.3 Secs)	1.3 Secs (± 0.2 Secs)
			Close	1.9 Secs (± 0.3 Secs)	1.3 Secs (± 0.2Secs)
	Backhoe Boom	Positioning  TV074053 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Raise	5.8 Secs (± 0.9 Secs)	4.0 Secs (± 0.6 Secs)
			Lower	4.0 Secs (± 0.6 Secs)	3.6 Secs (± 0.5 Secs)

Classification	Check Item	Conditions		Pump 1 Operation Time (± 15%)	Pump 1 and 2 Operation Time (± 15%)
Operational Speed	Backhoe Dipper Arm	Positioning  TV074055 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Raise	5.8 Secs (± 0.9 Secs)	3.6 Secs (± 0.5 Secs)
			Lower	8.1 Secs (± 1.2 Secs)	4.8 Secs (± 0.7 Secs)
	Backhoe Bucket	Positioning  TV074054 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Crowd	4.7 Secs (± 0.7 Secs)	2.8 Secs (± 0.4 Secs)
			Dump	3.1 Secs (± 0.5 Secs)	2.0 Secs (± 0.3 Secs)
	Backhoe Boom Swing	Positioning  TV074056 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Left	6.3 Secs (± 0.9 Secs)	5.8 Secs (± 0.9 Secs)
			Right	6.3 Secs (± 0.9 Secs)	5.8 Secs (± 0.9 Secs)
	Extendable Dipper Arm	Positioning  TV074057 • Engine Speed 1800 rpm • Oil Temp 50–60 °C (122–140 °F)	Extend	4.9 Secs (± 0.7 Secs)	2.9 Secs (± 0.4 Secs)
			Retract	3.7 Secs (± 0.6 Secs)	3.2 Secs (± 0.5 Secs)

Fault Finding General

Problem	Possible Cause	Action
All circuits fail to operate.	• Low hydraulic oil level.	• CHECK hydraulic oil level.
	• Restricted hydraulic pump suction line.	• CHECK for restriction.
	• Faulty hydraulic pump.	• PRESSURE and FLOW TEST.
Speed low at all hydraulic cylinders	• Fast mode is not selected.	• SELECT fast mode.
	• Unloader pressure relief valve set too low.	• ADJUST.
	• LS pressure relief valve set too low.	• ADJUST.
	• Faulty LS pressure relief valve.	• REPLACE.
	• Faulty hydraulic pump.	• PRESSURE and FLOW TEST.
Force low on one hydraulic cylinder	• Secondary pressure relief valve set too low.	• ADJUST.
	• Faulty secondary pressure relief valve.	• REPLACE.
Slow operation on one hydraulic cylinder	• Secondary pressure relief valve set too low.	• ADJUST.
	• Control valve spool stroke incorrect.	• ADJUST.
	• Individual pressure compensator piston blocked.	• REPLACE.
Erratic hydraulic cylinder operation	• Secondary pressure relief valve set too low.	• ADJUST.
	• Hydraulic cylinder worn/damaged.	• REPLACE.
	• Hydraulic pump cavitation.	• CHECK for cavitation
Lack of load hold	• Load hold check valve worn/damaged.	• REPLACE.
	• Excessive clearance between the spool and the control valve housing.	• REPLACE.
	• Hydraulic cylinder oil seal(s) worn/damaged.	• REPLACE.
Increased force required to operate the controls	• Tie-rod bolts too tight.	• CHECK torque of tie-rod bolts. (Loosen and torque to 42Nm).
	• Control valve spool sticking.	• CHECK torque of tie-rod bolts. (Loosen and torque to 42Nm). REPLACE control valve.
	• Control linkage worn/damaged.	• REPLACE.
	• Control valve spool oil seals damaged.	• REPLACE spool oil seals.

Problem	Possible Cause	Action
Sideshift clamps not operating	• No voltage present at the solenoid coil.	• CHECK for 12 Volts at the solenoid connector.
	• Solenoid coil faulty.	• CHECK solenoid coil resistance (7.6 Ohms at 20 °C). REPLACE solenoid coil.
	• Solenoid valve faulty.	• REPLACE.
	• Shuttle valve faulty.	• REPLACE.
Hydraulic system overheating	• Oil cooler blocked.	• CLEAN.
	• Hydraulic oil supply low.	• CHECK hydraulic oil level. • CHECK for supply line restriction.
	• Hydraulic oil contaminated.	• DRAIN and REFILL Hydraulic oil.
	• LS Pressure relief valve set incorrectly.	• ADJUST.
	• LS Pressure relief valve worn/damaged.	• REPLACE.
	• Control valve spool/housing worn/damaged.	• REPLACE.
	• Secondary pressure relief valve set incorrectly.	• ADJUST.
	• Secondary pressure relief valve worn/damaged.	• REPLACE.
	• Control valve spool not centering.	• CHECK spool stroke.
	• Hydraulic cylinder oil seals too tight causing partial flow through pressure relief valve.	• REPLACE oil seals.
	• Hydraulic cylinder worn/damaged.	• Replace.
	• Hydraulic pump cavitation.	• CHECK for cavitation.
Hydraulic pump cavitation	• Vacuum in hydraulic oil reservoir.	• CHECK/REPLACE filler cap.
	• Air entering through hydraulic pump shaft oil seal.	• CHECK for hydraulic pump inlet restriction. REPLACE hydraulic pump shaft oil seal.
	• Air entering at hydraulic pump inlet.	• CHECK retaining bolt torques and oil seals.
	• Suction screen blocked.	• CLEAN/REPLACE.
	• Incorrect specification of oil.	• REPLACE with correct specification of hydraulic oil.

Pressure Testing

A pressure test kit is available, part number 6108395M91. This test kit contains adaptors specifically designed for access to test ports.

⚠ **Warning:**

- **Do not work on or around hydraulic systems without wearing safety glasses. Failure to follow this instruction, may result in personal injury.**

⚠ **Caution:**

- **If serious hydraulic pump failure is suspected, do not run the hydraulic pump for longer than is absolutely necessary to determine its condition. If metal fragments are found in the hydraulic lines, oil reservoir, hydraulic pump outlet port, suction screen and/or return oil filter. DO NOT restart the hydraulic pump. Replace the hydraulic pump and clean the hydraulic system. For additional information, refer to** CLEAN THE HYDRAULIC SYSTEM**, PAGE F06–**01**–89 in this section. Failure to follow this instruction, may result in further damage to the hydraulic system.**

Note:

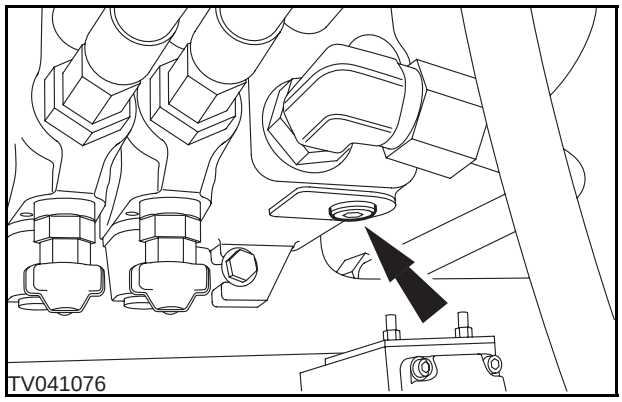
- Hydraulic gauges will have a + or – 5% tolerance. Testing at 200 bar it is possible to have a 10 bar discrepancy in the readings. Allow for this if using two separate gauges. Use the same gauge for all tests if possible.

Inlet Compensating Valve

Note:

- Hydraulic gauge to be fitted to the Backhoe Hydraulic Control Valve.

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the pressure test port plug and install a 9/16 UNF stor adapter and attach a 0-40 bar (0-580 PSI) pressure gauge to the Backhoe Hydraulic Control Valve.


TV041076

4. Connect the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

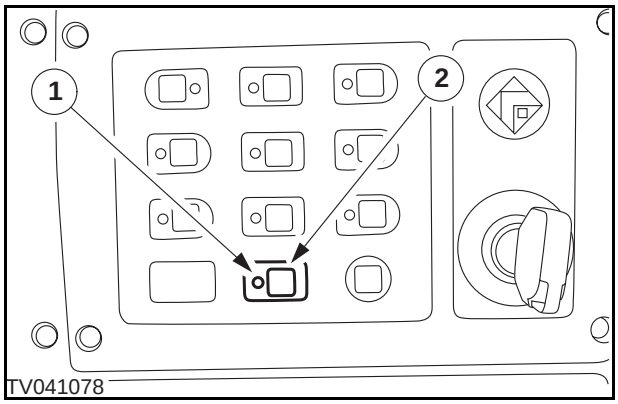
   ⚠ **Warning:**

   - **Do not operate any hydraulic service during this test.**

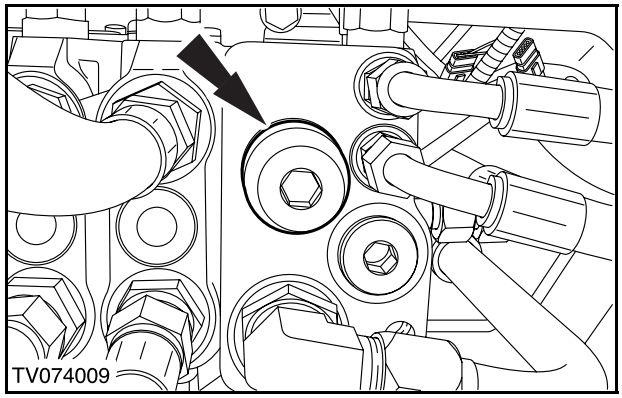
5. Start the engine. Inspect the diagnostic equipment connectors for oil leaks.
6. Allow the system to warm up to approximately 50–60 °C (122–140 °F).

7. Set the engine speed to 1800 RPM.

8. Select slow mode. Make sure the indicator light (1) on the hydraulic pumps flow control switch is illuminated. By selecting slow mode, the hydraulic system is not influenced by the outer hydraulic pump or the unloader valve. If the indicator light is not illuminated, depress the switch (2).



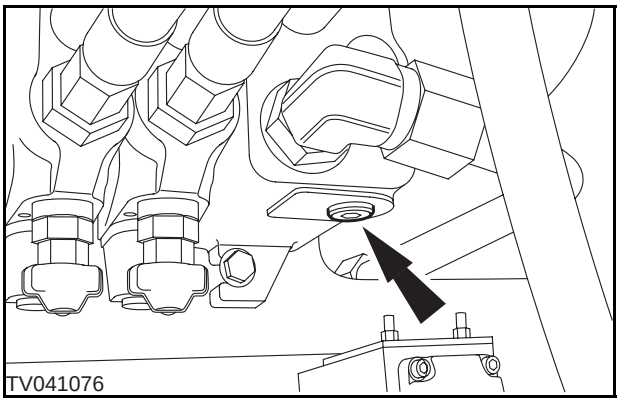
9. The Inlet Compensator Valve pressure should be 20–21 bar (290–305 PSI).
10. Stop the engine and release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
11. If the pressure reading is not to specification, add or remove shims from the Inlet Compensator as required.



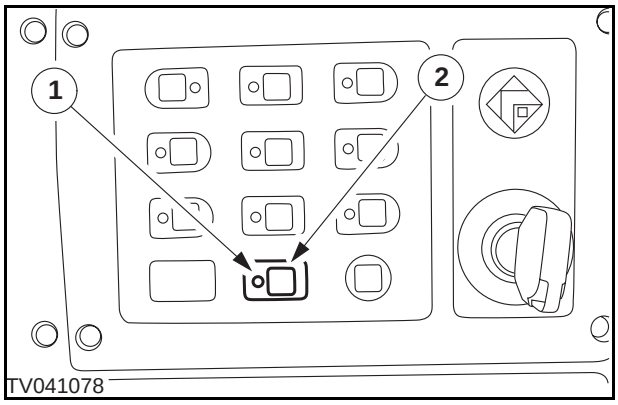
Main Pressure Relief Valve Pressure Test

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the pressure test port plug and install a 9/16 UNF stor adapter.
4. Attach a 0–400 bar (0–5800 PSI) pressure gauge.
5. Connect the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
6. Start the engine. Inspect the diagnostic equipment connectors for oil leaks.
7. Allow the system to warm up to approximately 50–60 °C (122–140 °F).

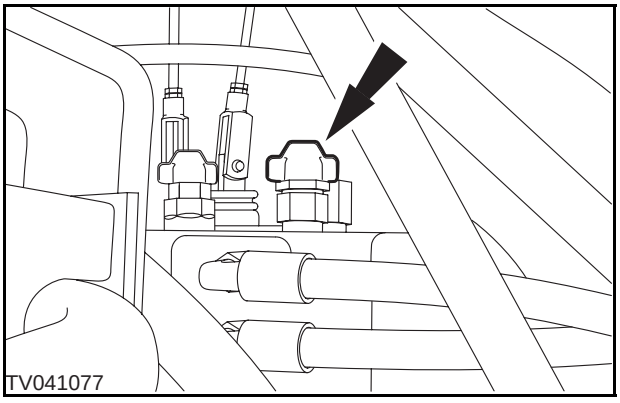
8. Set the engine speed to 1800 RPM.



9. Select slow mode. Make sure the indicator light (1) on the hydraulic pumps flow control switch is illuminated. By selecting slow mode, the hydraulic system is not influenced by the outer hydraulic pump or the unloader valve. If the indicator light is not illuminated, depress the switch (2).



10. Fully raise the backhoe boom and record the pressure indicated.
11. The pressure reading should be 225 bar (3260 PSI).
12. If the pressure reading is not to specification, remove the protective cap and adjust the pressure relief valve.
    - To increase the pressure, turn the adjusting screw (2) clockwise.
    - To decrease the pressure, turn the adjusting screw (2) anti-clockwise.

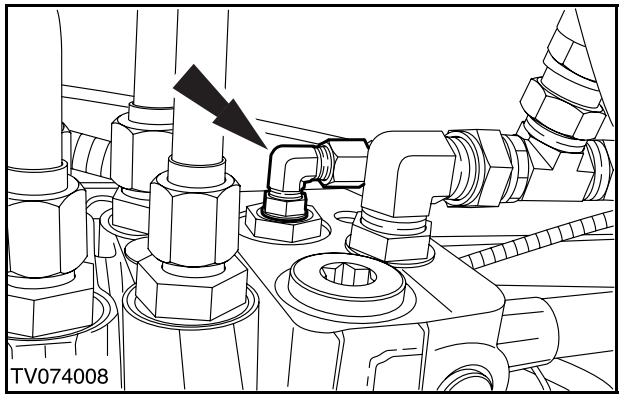


13. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.

14. Remove the diagnostic equipment and install/connect the removed items.
15. Start the engine and check for oil leaks.

Load Sense Pressure Test

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the load sense hydraulic hose from the Loader Control Valve.

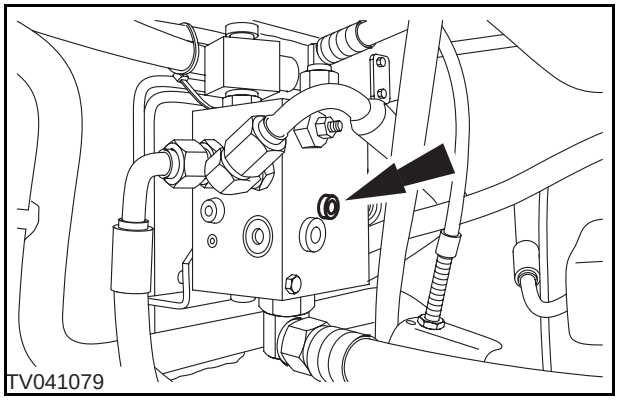


4. Plug and seal the Loader Control Valve fitting using a 9/16 JIC cap.
5. In the open end of the hydraulic hose, install a 0–400 bar hydraulic pressure gauge.
6. Connect the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
7. Start the engine. Inspect the diagnostic equipment connectors for oil leaks.
8. Allow the system to warm up to approximately 50–60 °C (122–140 °F).
9. Set the engine speed to 1800 RPM.
10. Operate each service of the backhoe control valve, one at a time, note the readings on the hydraulic gauge, should be 205–212 bar (2973–3074) (Backhoe Pressure Relief).
11. If the pressure readings are not to specification, there is a fault in the backhoe control valve section of the Load Sense line.
12. Stop the engine and release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
13. Remove the plug and seal from the Loader Control Valve, install a hydraulic “Tee” fitting in its place. Remove the hydraulic gauge fitted to the backhoe load sense hose. Connect the load sense hydraulic hose to one end of the hydraulic “Tee” fitting, and the hydraulic gauge, to the other side of the hydraulic “Tee” fitting.
14. Start the engine. Inspect the diagnostic equipment connectors for oil leaks.
15. Allow the system to warm up to approximately 50–60 °C (122–140 °F).
16. Set the engine speed to 1800 RPM.

17. Operate each service of the Loader Valve, one at a time, the readings on the hydraulic pressure gauge should be around 205–212 bar (2973–3074) .
18. If the readings are not the same, there is a loss in the loader control valve Load Sense line.
19. Stop the engine and release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
20. Remove the diagnostic equipment and install/connect the removed items.
21. Start the engine and check for oil leaks.

Steering Pressure Relief Valve Pressure Test

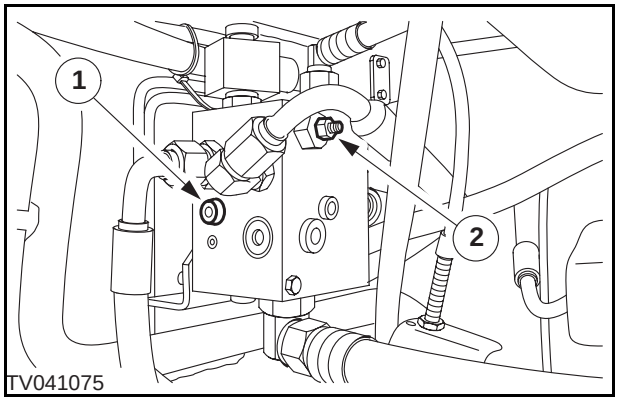
1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the pressure test port plug and install an M10 x 1.0 adaptor.


TV041079

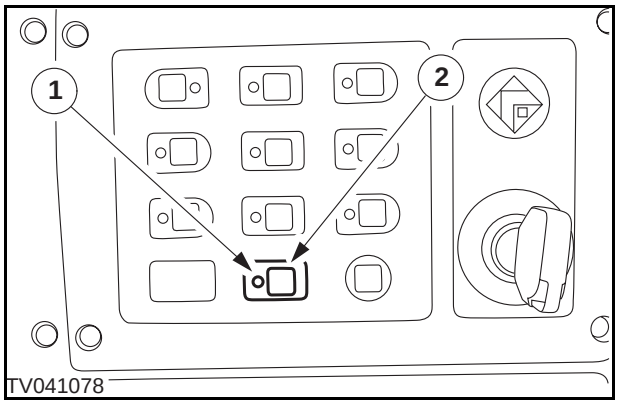
4. Attach a 0–400 bar (0–5800 PSI) pressure gauge.
5. Connect the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
6. Start the engine. Inspect the diagnostic equipment connectors for oil leaks.
7. Allow the system to warm up to approximately 50–60 °C (122–140 °F).
8. Set the engine speed to 1800 RPM.
9. Turn the steering wheel to full left-hand lock and record the pressure indicated.
10. Turn the steering wheel to full right-hand lock and record the pressure indicated.
11. The pressure readings should be 170–175 bar (2465–2538 PSI).
12. If the pressure reading is not to specification, adjust the pressure relief valve in the Orbitrol steering motor.
13. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
14. Remove the diagnostic equipment and install/connect the removed items.
15. Start the engine and check for oil leaks.

Unloader Pressure Relief Valve Pressure Test

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the pressure test port plug (1) and install an M10 x 1.0 adaptor.
4. Attach a 0–400 bar (0–5800 PSI) pressure gauge.
5. Connect the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
6. Start the engine. Inspect the diagnostic equipment connectors for oil leaks.
7. Allow the system to warm up to approximately 50–60 °C (122–140 °F).
8. Set the engine speed to 1800 RPM.

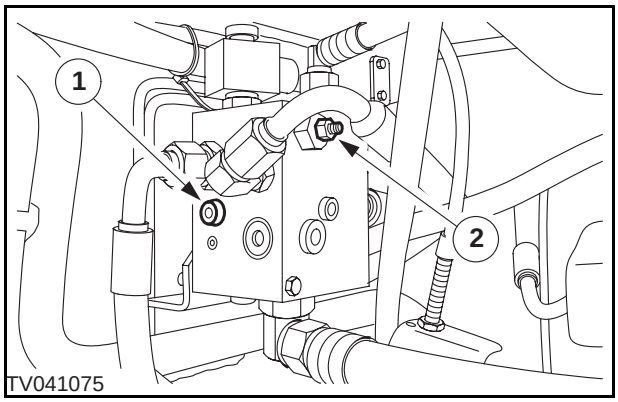


9. Select fast mode. Make sure the indicator light (1) on the hydraulic pumps flow control switch is not illuminated. This indicates that full flow from both hydraulic pumps is provided. If the indicator light is illuminated, depress the switch (2).



10. Slowly raise the loader beam, the pressure will slowly increase until the pressure is released back to the oil reservoir by the pressure relief valve. The maximum pressure indicated on the pressure gauge before zero pressure is indicated is the unloader relief valve pressure.
11. The pressure reading should be 207–214 bar (3000–3100 PSI).

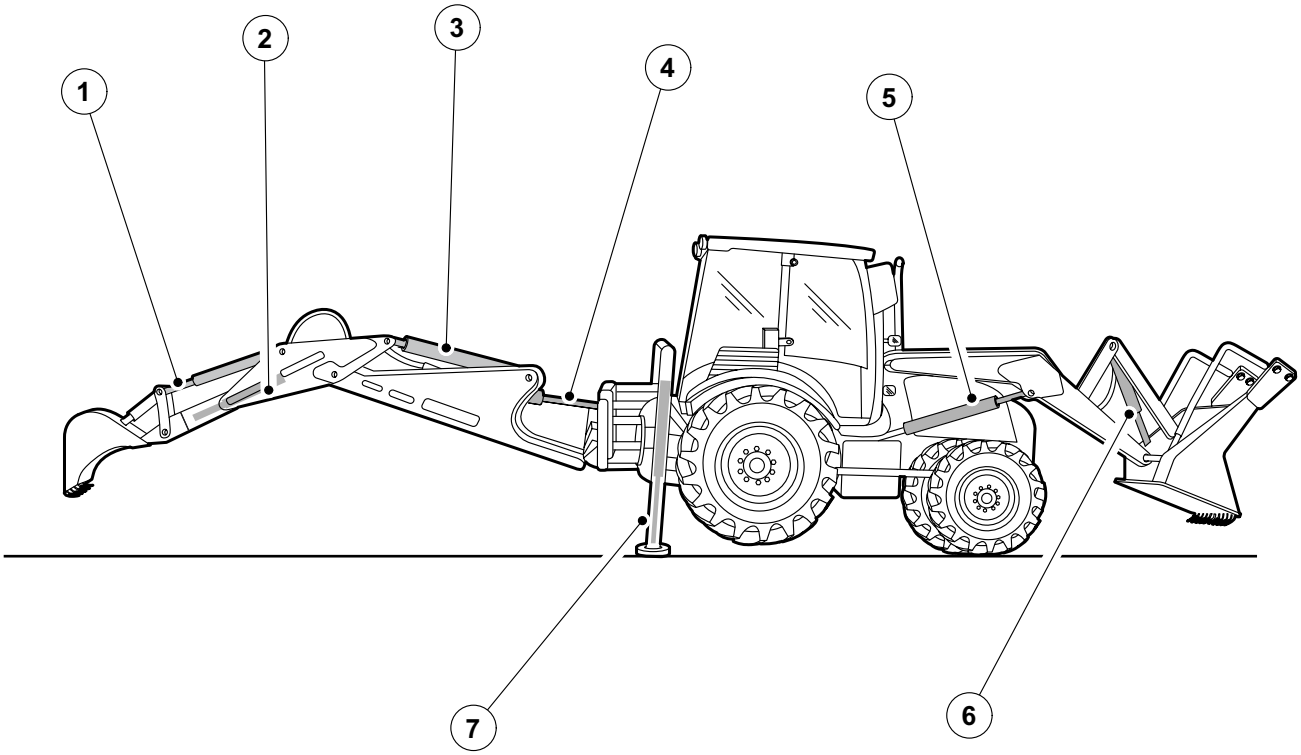
12. If the pressure reading is not to specification, adjust the pressure relief valve (2).
    - To increase the pressure, turn the adjusting screw (2) clockwise.
    - To decrease the pressure, turn the adjusting screw (2) anti-clockwise.



13. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
14. Remove the diagnostic equipment and install/connect the removed items.
15. Start the engine and check for oil leaks.

Cylinder Leak Down Test Procedure

1. Park the machine on firm, level ground.
2. Place the machine in the posture shown, and switch off the engine.



TV074063

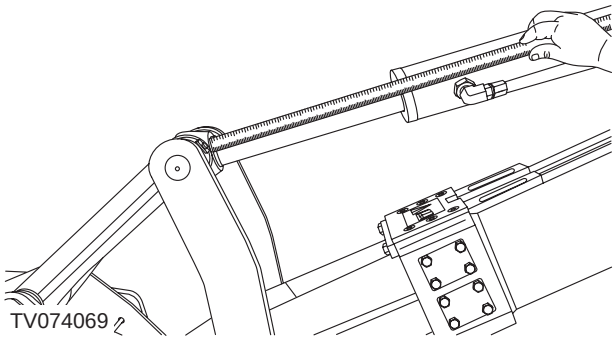
3. Measure each of the hydraulic cylinders as shown leave the machine for 5 minutes then remeasure the hydraulic cylinders. Check with the table for the maximum permissible amount of leak down.

Position Number	Hydraulic Service	Permissible Leak Down (mm)	
		Low Specification	High Specification
1	Backhoe Bucket	17	
2	Extendable Dipper Arm (if fitted)	33	
3	Backhoe Dipper Arm	11	10
4	Backhoe Boom	14	
5	Loader Beam	10	9
6	Loader Bucket	13	11
7 — Side Shift	Stabiliser Legs	17	
7 — Centre Mount	Stabiliser Legs	29	

Note:

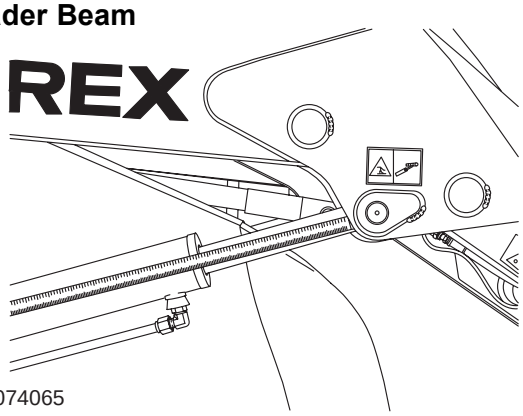
- The maximum amount of leak down in a 5 minute period with the hydraulic oil at an operating temperature of 50 — 60 °C (122–140 °F).

Backhoe Bucket



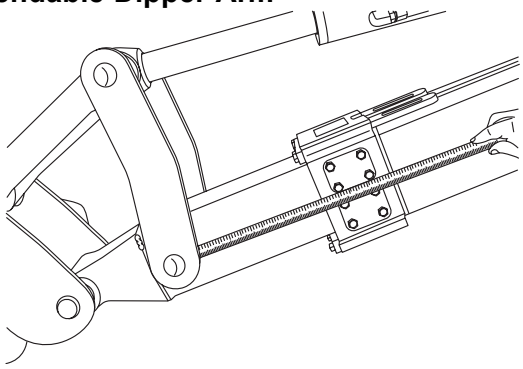
TV074069

Loader Beam



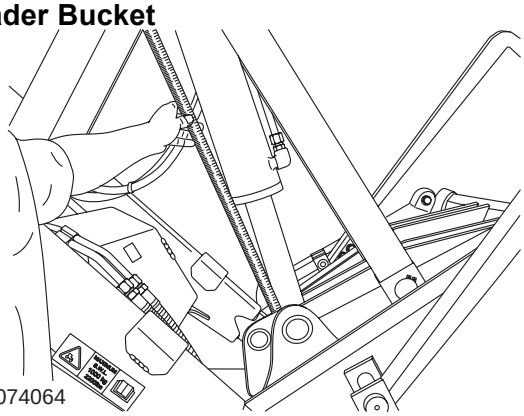
TV074065

Extendable Dipper Arm



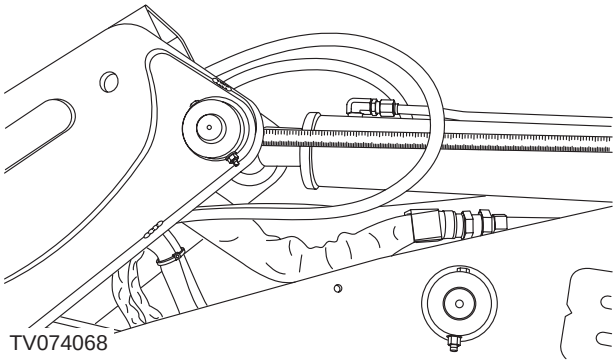
TV074070

Loader Bucket



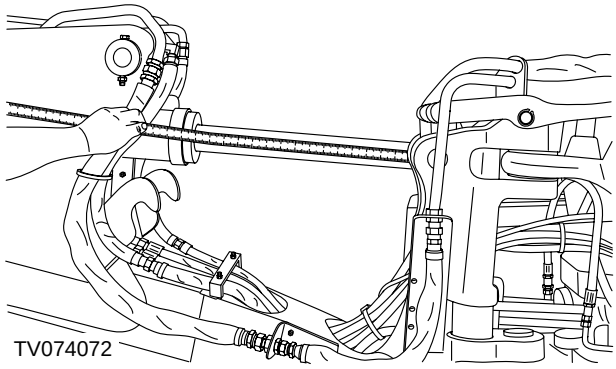
TV074064

Backhoe Dipper Arm



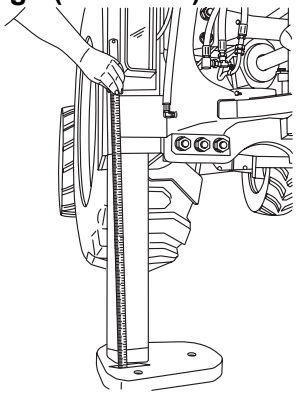
TV074068

Backhoe Boom



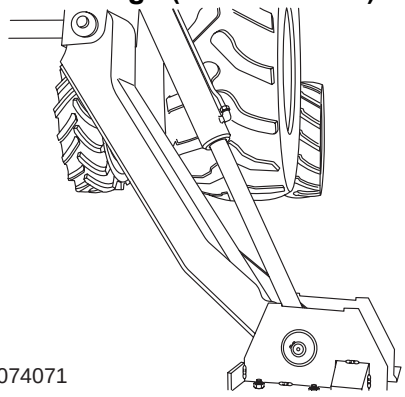
TV074072

Stabiliser Legs (side shift)



TV074067

Stabiliser Legs (centre mount)



TV074071

DIAGNOSING AND TESTING — HYDRAULIC OIL CONTAMINATION

BHN0601TA

Hydraulic Oil Contamination

Contamination in the hydraulic system is a major cause of the malfunction of hydraulic components. Contamination is any foreign material in the hydraulic oil. Contamination can enter the hydraulic system in several ways:

- When the oil is drained or any line disconnected.
- When a component is disassembled.
- From normal wear of the hydraulic components.
- From damaged or worn seals.
- From a damaged component in the hydraulic system.

All hydraulic systems operate with some contamination. The design of the components in this hydraulic system permits efficient operation with a small amount of contamination. An increase in this amount of contamination can cause problems in the hydraulic system. The following list includes some of these problems.

- Cylinder rod seals leak.
- Control valve spools do not return to neutral.
- Movement of control valve spools is difficult.
- Hydraulic oil becomes too hot.
- Pump gears, housing, and other parts wear rapidly.
- Relief valves or check valves held open by dirt.
- Quick failure of components that have been repaired.
- Cycle times are slow; machine does not have enough power.

If any of the above problems are encountered, check the hydraulic oil for contamination. See Types of Contamination. If contamination is found, use the Portable Filter to clean the hydraulic system. For additional information, refer to CLEANING THE HYDRAULIC SYSTEM, PAGE F06–01–89 in this section.

Types of Contamination

There are two types of contamination:

- Microscopic
- Visible

Microscopic contamination occurs when very fine particles of foreign material are in suspension in the hydraulic oil.

Microscopic particles are too small to see or feel. Microscopic contamination can be found by identification of the following problems or by testing in a laboratory. Examples of the problems are:

- Cylinder rod seal leak.
- Control valve spools do not return to NEUTRAL.
- The hydraulic system has a high operating temperature.

Visible contamination is foreign material that can be found by sight, touch, or odour. Visible contamination can cause a sudden failure of components. Examples of visible contamination:

- Particles of metal or dirt in the oil.
- Air in the oil.
- The oil is dark and thick.
- The oil has the odour of burnt oil.
- Water in the oil.

Note:

- If water is present in the oil, flush the water from the hydraulic system. For additional information, refer to FLUSHING WATER FROM THE HYDRAULIC SYSTEM, PAGE F06–01–91 in this section.

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REMOVAL AND INSTALLATION — HYDRAULIC OIL RESERVOIR

BHF0601RA

Operation: **Removing and Installing the Hydraulic Oil Reservoir**	*Job Code:* **06 09 13 xx**		
Suitable trolley jack	Standard tools, Suitable container (90 Ltrs),		

Removal

All Vehicles

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

Vehicles with Single Battery

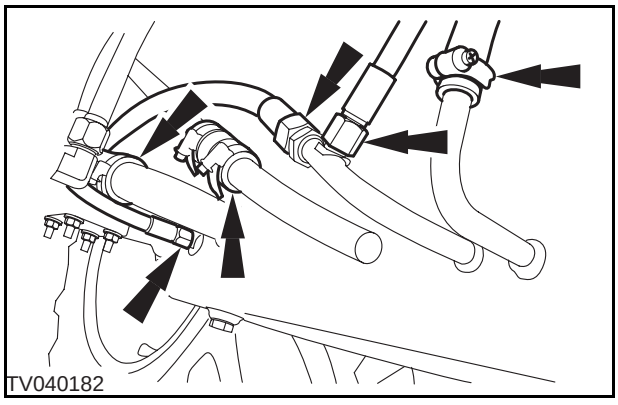
2. Remove the battery. For additional information, refer to Section J09-01 BATTERY (SINGLE), PAGE J09–01–11 .

Vehicles with Twin Batteries

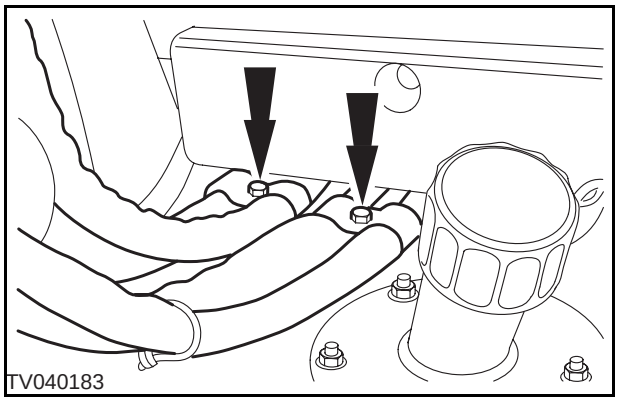
3. Remove the batteries. For additional information, refer to Section J09-01 BATTERY (TWIN), PAGE J09–01–13 .

All Vehicles

4. Drain the hydraulic oil into a suitable container.
5. Disconnect the hydraulic oil reservoir hoses and pipes.

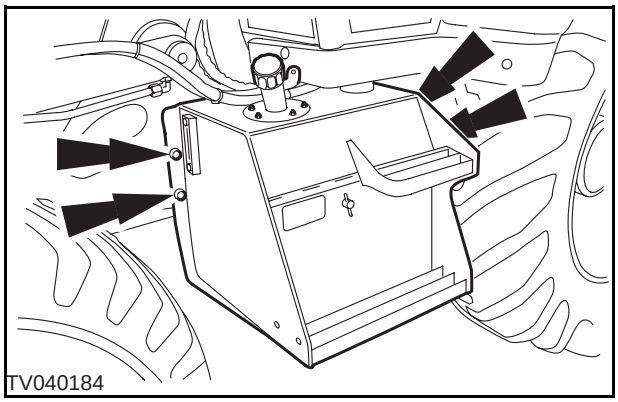

TV040182

6. Detach the front loader hydraulic hoses from the top of the hydraulic oil reservoir.


TV040183

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

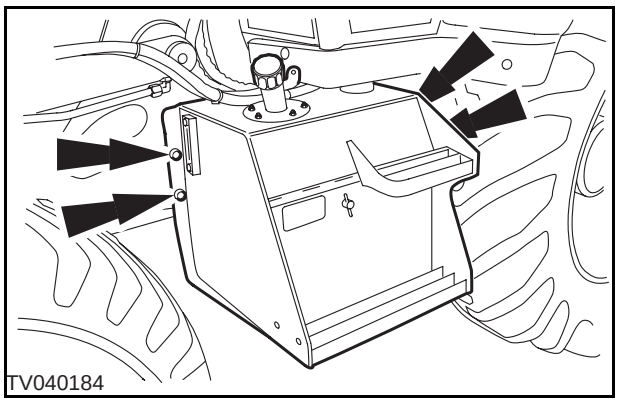
7. Using a suitable trolley jack, support the hydraulic oil reservoir.
8. Remove the hydraulic oil reservoir.


TV040184

9. Withdraw the battery wiring harness through the hydraulic oil reservoir.

Installation

1. To install, reverse the removal procedure.
2. Tighten to 98Nm (72 lb.ft).


TV040184

3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — OIL COOLER

BHF0601RB

Operation: **Removing and Installing the Oil Cooler**	*Job Code:* **06 07 13 xx**		
None	Standard tools		

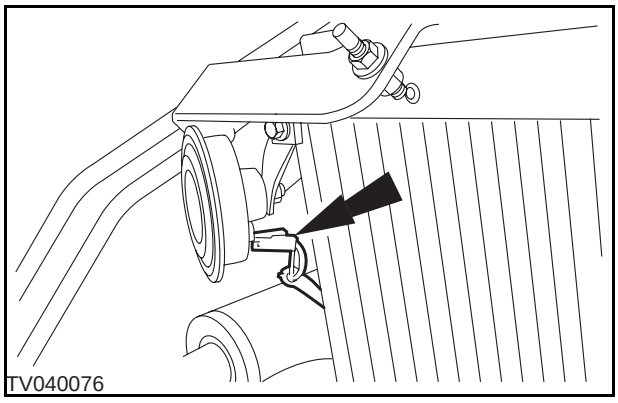
Removal

All Vehicles

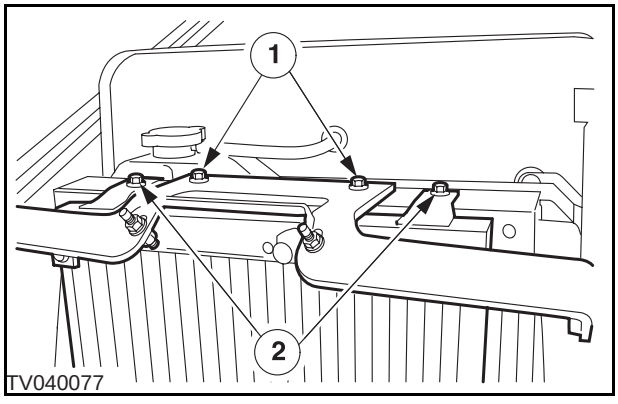
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Disconnect the horn electrical connectors.


TV040076

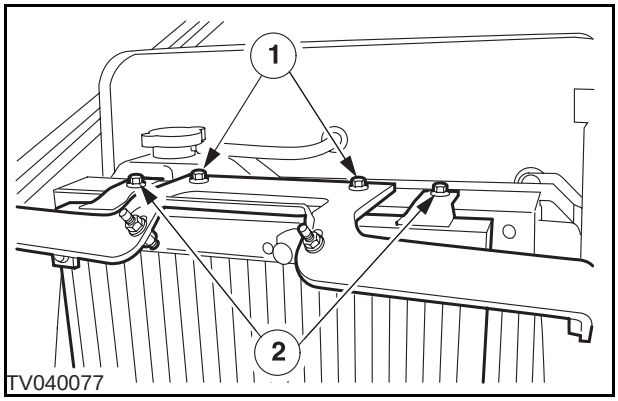
3. Remove the radiator support bracket. (1)



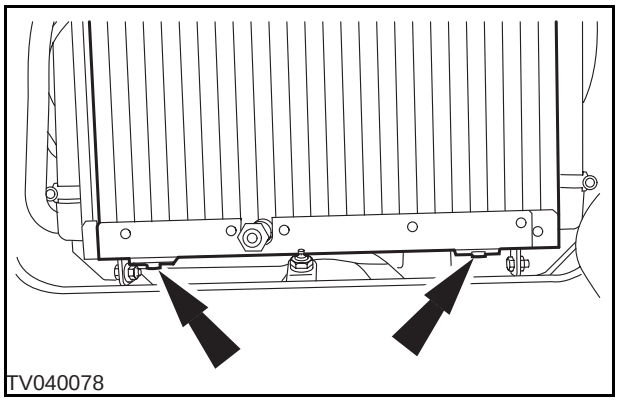
TV040077

Vehicles with Air Conditioning

4. Remove the A/C condenser upper retaining bolts (2).



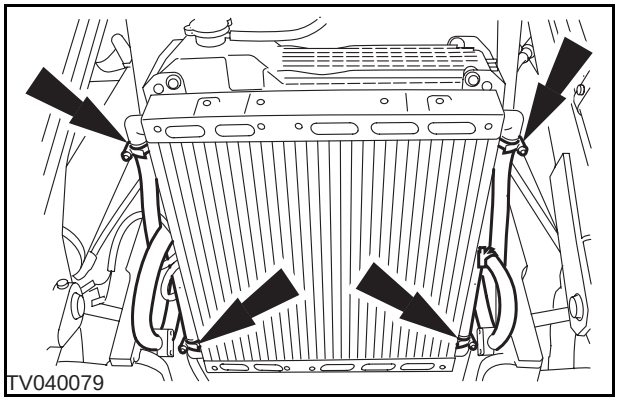
5. Remove the A/C condenser lower retaining bolts.



6. Detach the A/C condenser and position it to one side.

All Vehicles

7. Disconnect the oil cooler pipes from the oil cooler and remove the oil cooler.



Installation

1. To install, reverse the removal procedure.
2. Check and adjust the hydraulic and transmission oil levels as required.

REMOVAL AND INSTALLATION — HYDRAULIC PUMP

BHF0601RC

Operation: **Removing and Installing the Hydraulic Pump**	*Job Code:* **06 11 13 xx**		
Suitable container	Standard tools		
Vehicles with Powershift transmission			
Vehicles with Synchroshuttle transmission			

Removal

All Vehicles

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

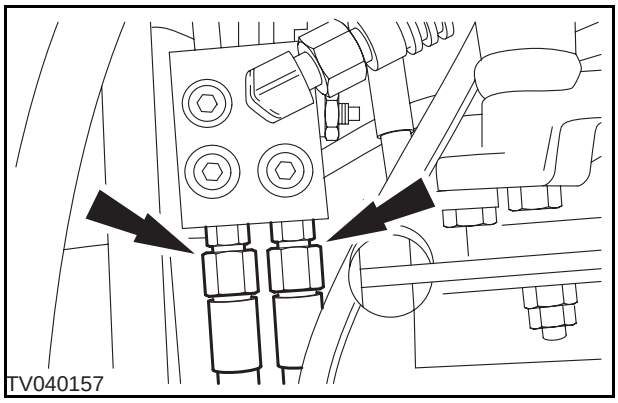
1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Drain the hydraulic oil into a suitable container.

Vehicles with Powershift Transmission

4. Remove the cabin heater ducting. For additional information, refer to section H08-01 CABIN HEATER DUCTING, PAGE H08–01–13 .

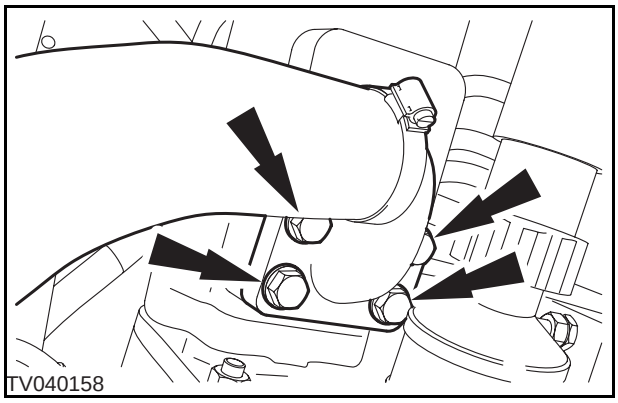
All Vehicles

5. Disconnect the hydraulic pump hoses from the steering priority/unloader valve.


TV040157

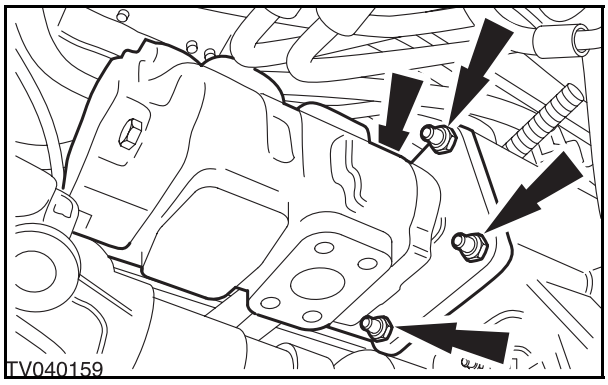
6. Disconnect the suction hose from the tandem gear pump.

Note:
- Remove and discard the O-ring seal.



⚠ **Warning:**
- **This component is very heavy. Make sure it is supported adequately. Failure to follow this instruction may result in personal injury.**

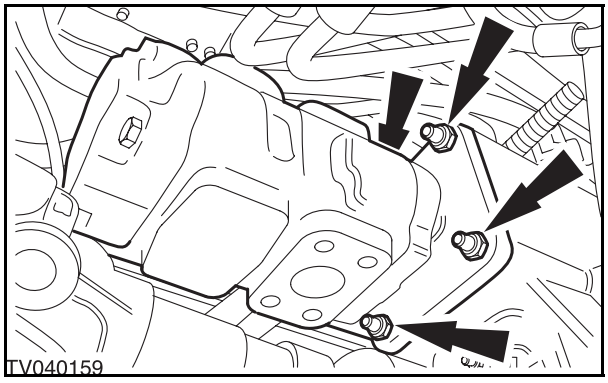
7. Remove the hydraulic pump.



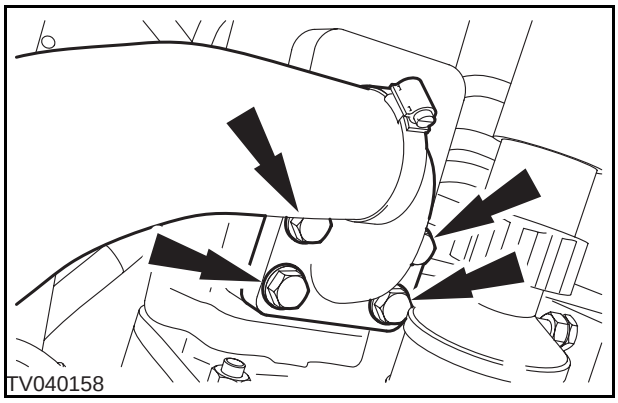
Installation

Note:
- Install a new O-ring seal.

1. To install, reverse the removal procedure.
2. Tighten to 98Nm (72 lb.ft).



3. Tighten to 98Nm (72 lb.ft).



4. Fully extend and retract all hydraulic services and check for correct operation.

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REMOVAL AND INSTALLATION — HYDRAULIC PUMP 2007

BHF0601RK

Operation: **Removing and Installing the Hydraulic Pump**	*Job Code:* **xx xx xx xx**		
Suitable container	Standard tools		
Vehicles with Powershift transmission			
Vehicles with Synchroshuttle transmission			

Removal

All Vehicles

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE , PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

Note:
- Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

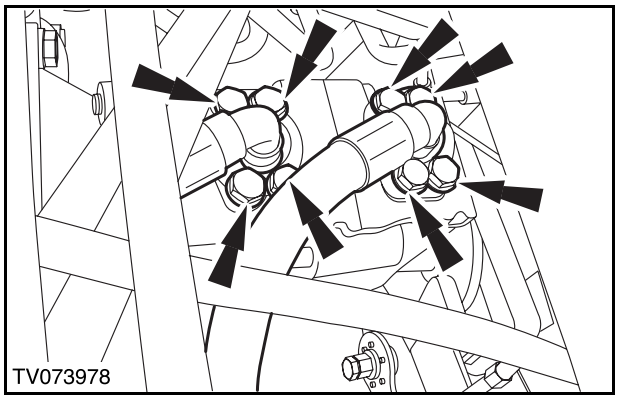
3. Drain the hydraulic oil into a suitable container.

Vehicles with Powershift Transmission

4. Remove the cabin heater ducting. For additional information, refer to section H08-01 CABIN HEATER DUCTING, PAGE H08–01–13 .

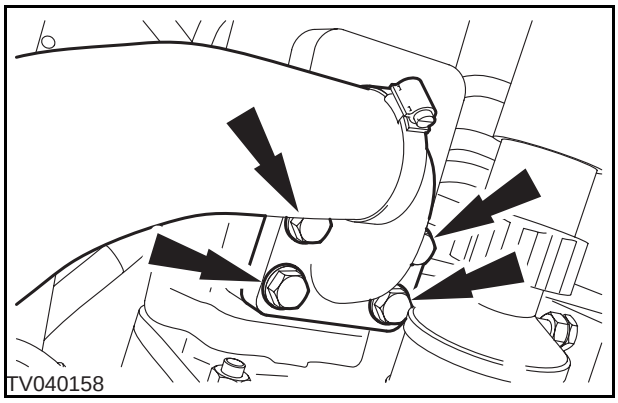
All Vehicles

5. Disconnect the hydraulic pump hoses from the pump.



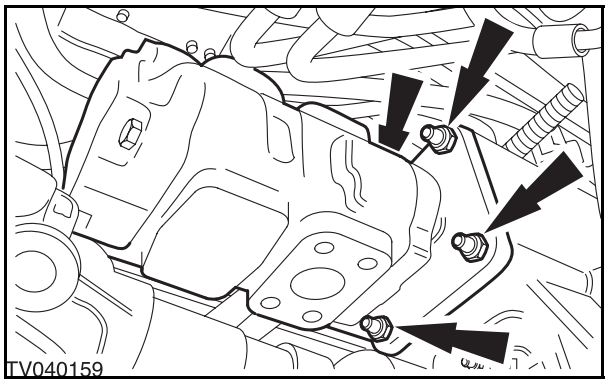
6. Disconnect the suction hose from the tandem gear pump.

Note:
- Remove and discard the O-ring seal.



⚠ **Warning:**
- **This component is very heavy. Make sure it is supported adequately. Failure to follow this instruction may result in personal injury.**

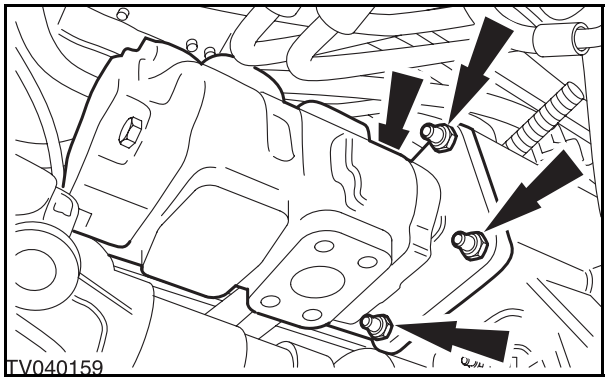
7. Remove the hydraulic pump.



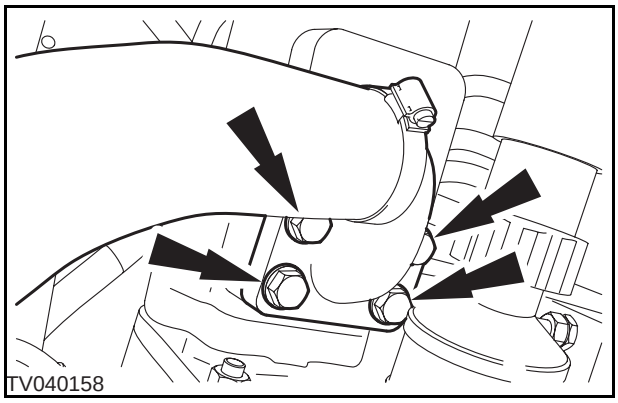
Installation

Note:
- Install a new O-ring seal.

1. To install, reverse the removal procedure.
2. Tighten to 98Nm (72 lb.ft).



3. Tighten to 98Nm (72 lb.ft).



4. Fully extend and retract all hydraulic services and check for correct operation.

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REMOVAL AND INSTALLATION — BACKHOE CONTROL VALVE BANK

BHF0601RD

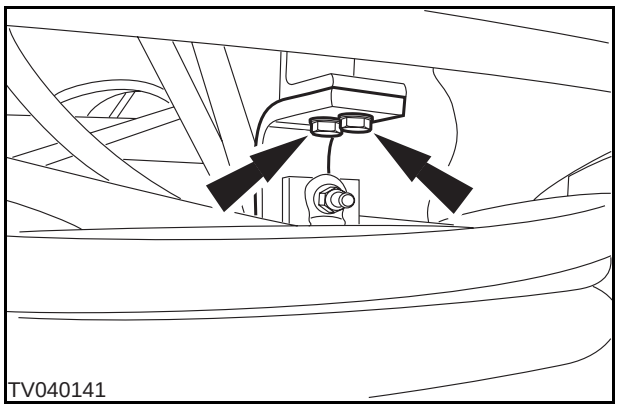
Operation: **Removing and Installing the Backhoe Control Valve Bank**	*Job Code:* **06 01 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

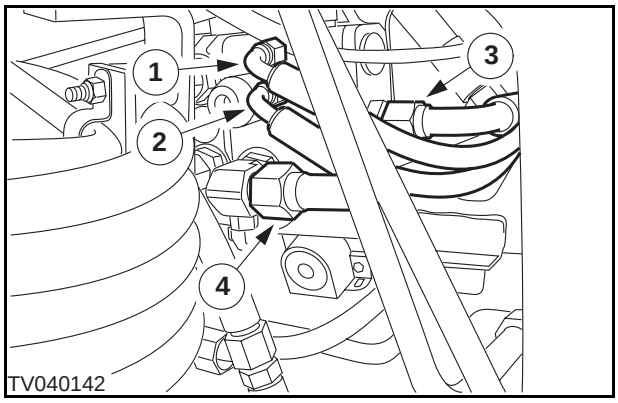
Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Park the machine on firm level ground.
2. If the backhoe is equipped with an extendable dipper, install the extendable dipper locking pin.
3. Lower the stabilizers until the stabilizer pads just touch the floor.
4. Extend the backhoe straight behind the machine with the backhoe bucket resting on the floor and stop the engine.
5. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 in this section.
6. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
7. Remove the extendable dipper/auxiliary service changeover valve. For additional information, refer to EXTENDABLE DIPPER/AUXILIARY SERVICE CHANGEOVER VALVE, PAGE F06–01–43 in this section.
8. Remove the retaining bolts and detach the hydraulic hose bracket.

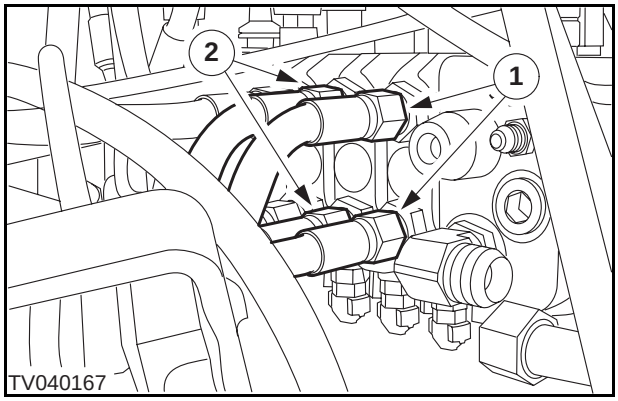

TV040141

9. Disconnect the load sensing line (1) from the valve bank.
10. Disconnect the load sensing drain line (2) from the valve bank.
11. Disconnect the supply line (3) from the valve bank.

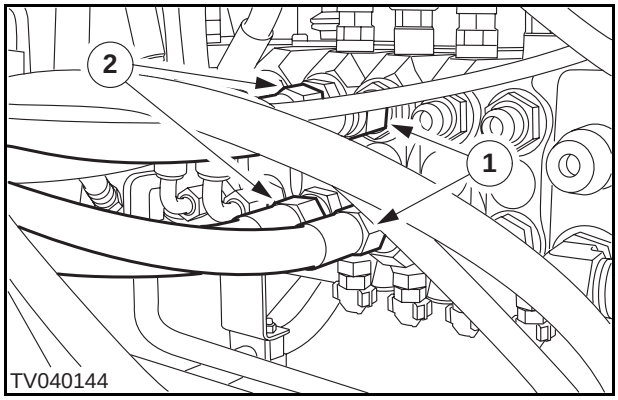
12. Disconnect the return line (4) from the valve bank.



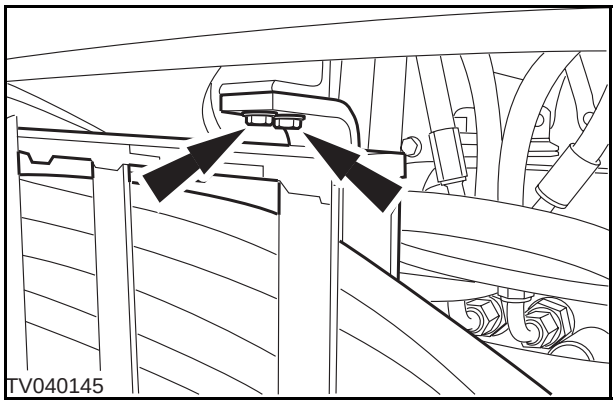
13. Disconnect the slew supply and return hoses (1) from the valve bank.
14. Disconnect the boom supply and return hoses (2) from the valve bank.



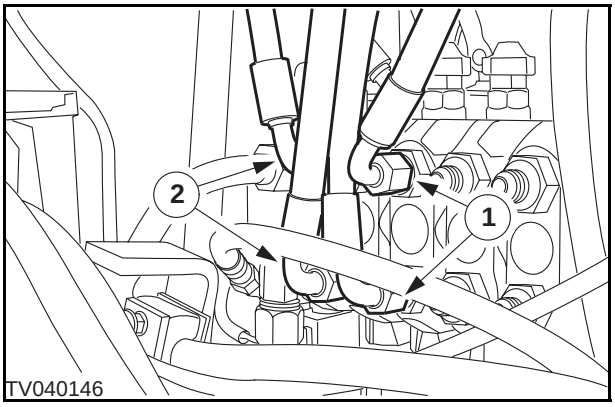
15. Disconnect the dipper arm supply and return hoses (1) from the valve bank.
16. Disconnect the bucket supply and return hoses (2) from the valve bank.



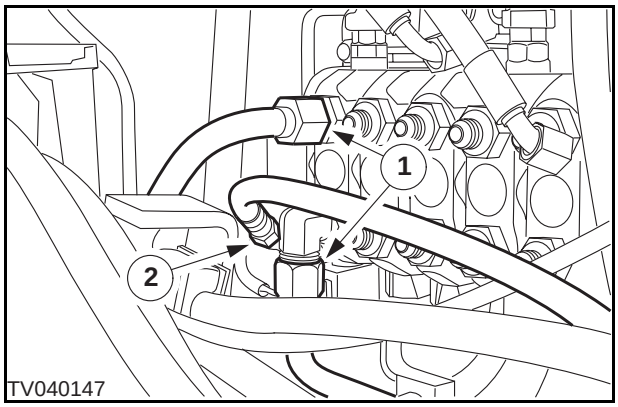
17. Remove the retaining bolts and detach the hydraulic hose bracket.



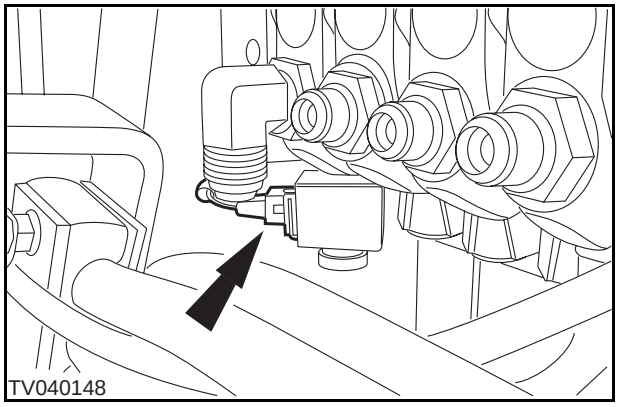
18. Disconnect the right-hand stabilizer leg supply and return hoses (1) from the valve bank.
19. Disconnect the left-hand stabilizer leg supply and return hoses (2) from the valve bank.



20. Disconnect the auxiliary service supply and return lines (1).
21. Disconnect the side shift clamp hose (2).

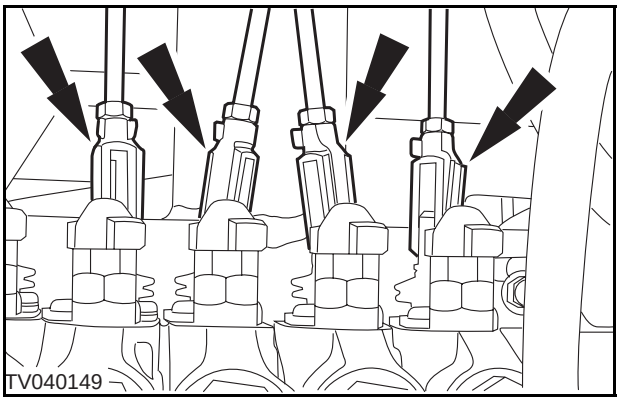


22. Disconnect the side shift clamp solenoid electrical connector.



Note:
- Make a note of the position of the control linkage prior to disconnection to aid installation.

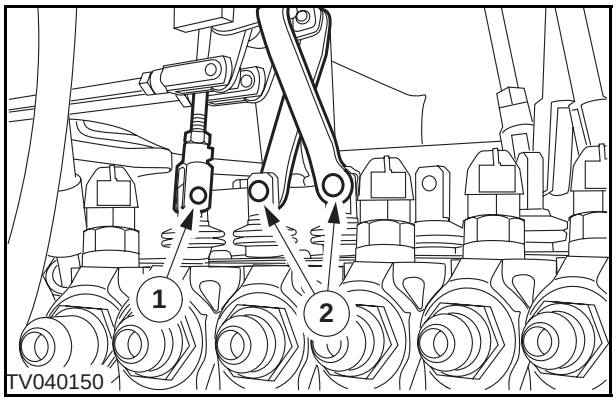
23. Disconnect the backhoe control linkage.



24. Disconnect the auxiliary service/extendable dipper control linkage (1).

Note:
- Make a note of the position of the control linkage prior to disconnection to aid installation.

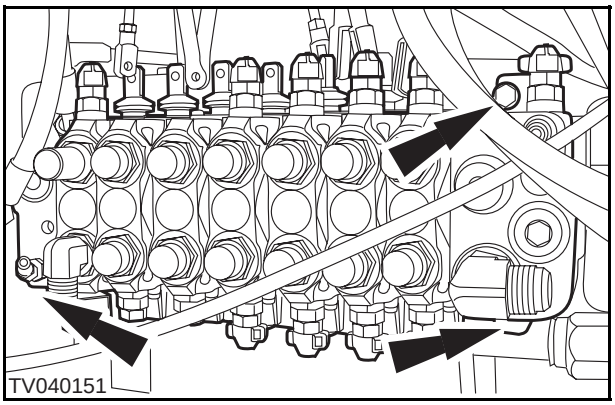
25. Disconnect the left-hand and right-hand stabilizer leg control linkages (2).



26. Position the hydraulic hoses to one side.

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

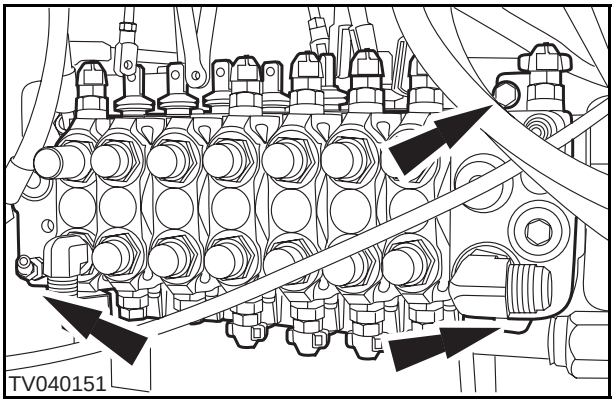
27. Using suitable lifting equipment, support the backhoe control valve bank. Remove the retaining bolts and remove the backhoe control valve bank from the chassis.



Installation

Note:
- Install new lock nuts.

1. To install, reverse the removal procedure.
2. Tighten to 58Nm (43 lb.ft).



3. Check and adjust the hydraulic oil level as required.
4. Fully extend and retract all hydraulic services and check for correct operation.

Note: This page intentionally left blank.

REMOVAL AND INSTALLATION — LOADER CONTROL VALVE

BHF0601RE

Operation: **Removing and Installing the Loader Control Valve**	*Job Code:* **06 13 13 xx**		
None	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

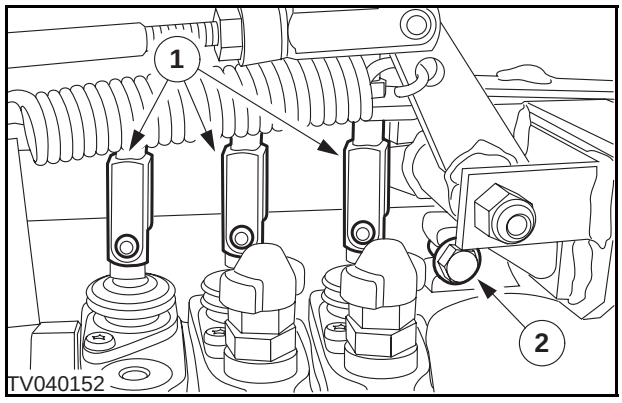
Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Park the machine on firm level ground.
2. Extend the backhoe straight behind the machine with the backhoe bucket resting on the floor.
3. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 in this section.
4. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

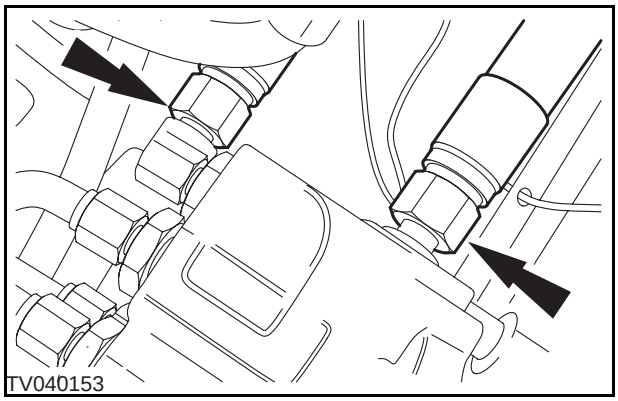
Note:
- Make a note of the position of the control linkages prior to disconnection to aid installation.

Note:
- Cab shown removed for clarity

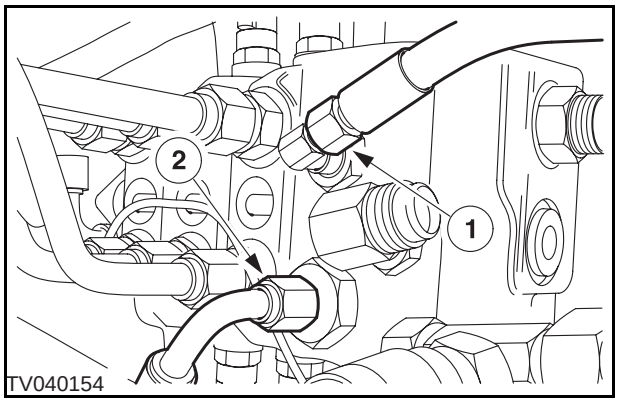
5. Disconnect the loader control valve linkage (1).
6. Remove the loader control valve upper retaining bolt (2).



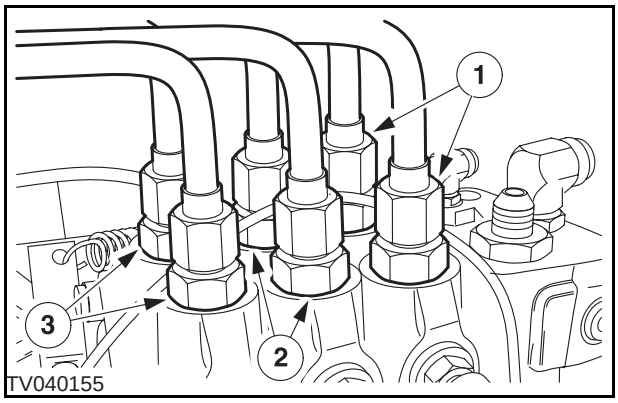
7. Disconnect the loader control valve supply and return lines from the loader control valve.



8. Disconnect the load sensing line from the loader control valve (1).
9. Disconnect the ride control hose from the loader control valve (2).



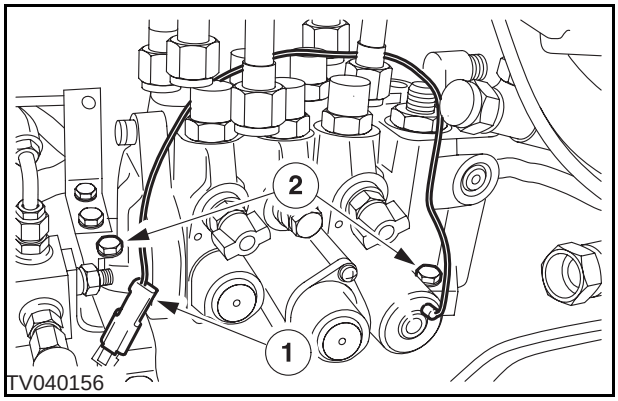
10. Disconnect the loader auxiliary service supply and return pipes (1).
11. Disconnect the loader supply and return pipes (2).
12. Disconnect the bucket supply and return pipes (3).



13. Disconnect the loader auxiliary service electrical connector (1).

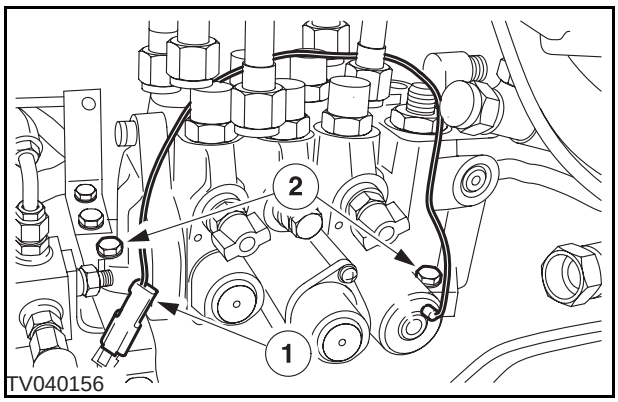
⚠ **Warning:**
- **This component is very heavy. Make sure it is supported adequately. Failure to follow this instruction may result in personal injury.**

14. Support the loader control valve. Remove the retaining bolts and remove the loader control valve (2).

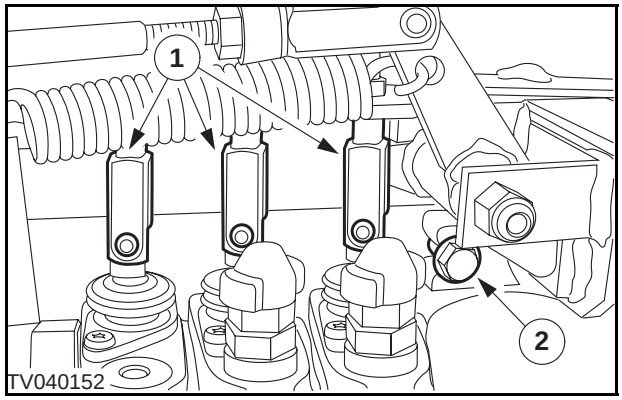


Installation

1. To install, reverse the removal procedure.
2. Tighten (2) to 58Nm (43 lb.ft).



3. Tighten (2) to 58Nm (43 lb.ft).



4. Check and adjust the hydraulic oil level as required.
5. Fully extend and retract all hydraulic services and check for correct operation.

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REMOVAL AND INSTALLATION — CHANGEOVER VALVE

BHF0601RF

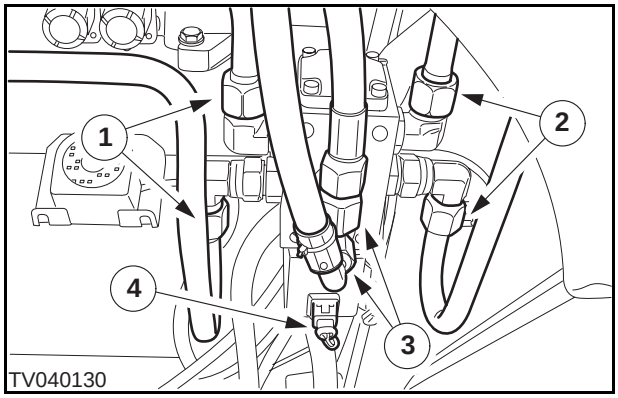
Operation: **Removing and Installing the Changeover Valve**	*Job Code:* **06 03 13 xx**		
None	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

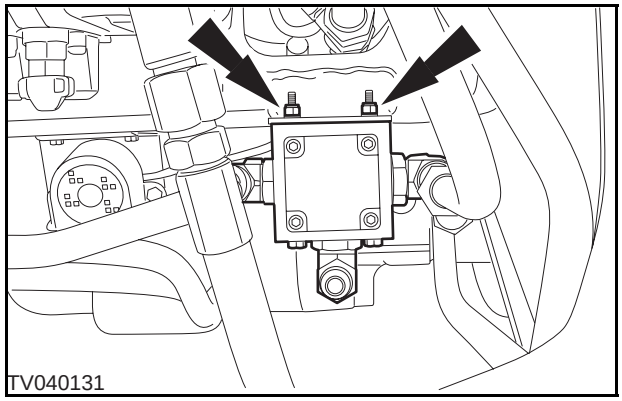
Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Disconnect the changeover valve supply and return pipes from the changeover valve (1).
4. Disconnect the auxiliary service supply and return pipes from the changeover valve (2).
5. Disconnect the extendable dipper supply and return hoses from the changeover valve (3).
6. Disconnect the electrical connector from the changeover valve (4).



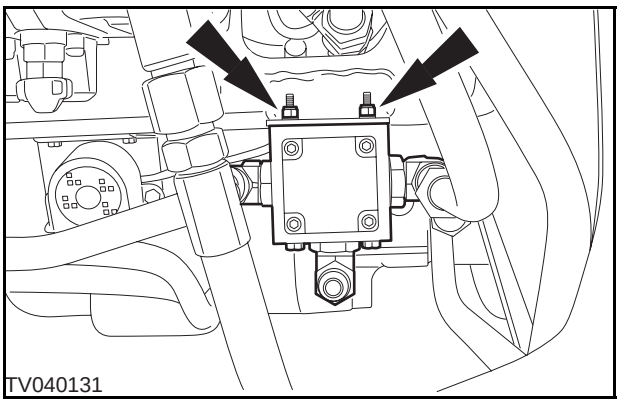
TV040130

7. Remove the changeover valve.


TV040131

Installation

1. To install, reverse the removal procedure.
2. Tighten to 12Nm (9 lb.ft).



3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — STEERING PRIORITY/UNLOADER VALVE

BHF0601RG

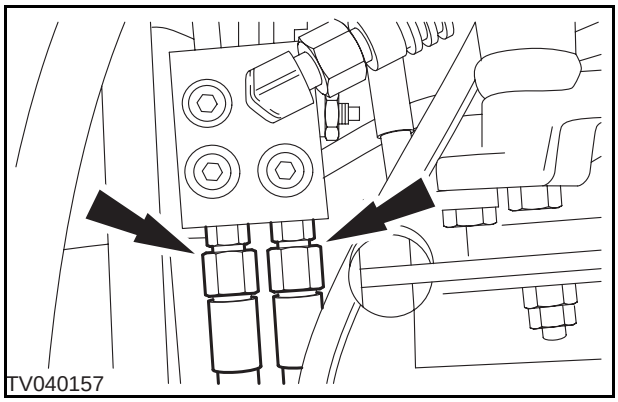
Operation: **Removing and Installing the Steering Priority/Unloader Valve**	*Job Code:* **06 20 13 xx**		
None	Standard Tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

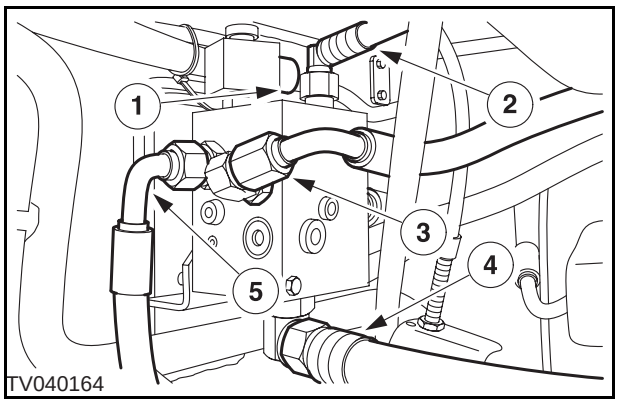
Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-09 BATTERY ISOLATION, PAGE J09–01–33 .
3. Disconnect the hydraulic pump hoses from the steering priority/unloader valve (SP/UV).

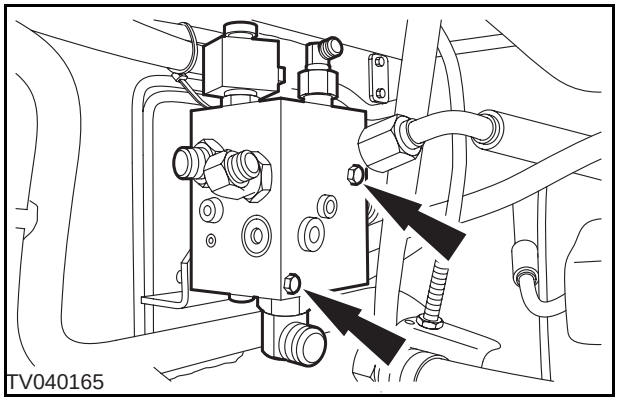

TV040157

4. Disconnect the SP/UV solenoid electrical connector (1).
5. Disconnect the load sensing hose (2) from the SP/UV.
6. Disconnect the steering orbitrol valve hose (3) from the SP/UV.
7. Disconnect the backhoe/loader supply pipe (4) from the SP/UV.

8. Disconnect the steering priority return line (5) from the SP/UV.

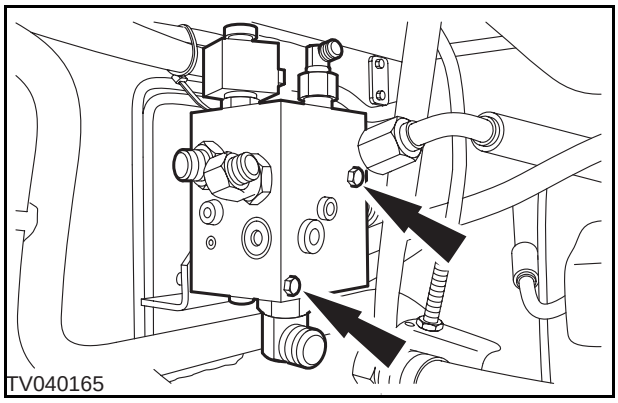


9. Remove the steering priority/unloader valve.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 30Nm (22 lb.ft).



3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — RIDE CONTROL VALVE

BHF0601RH

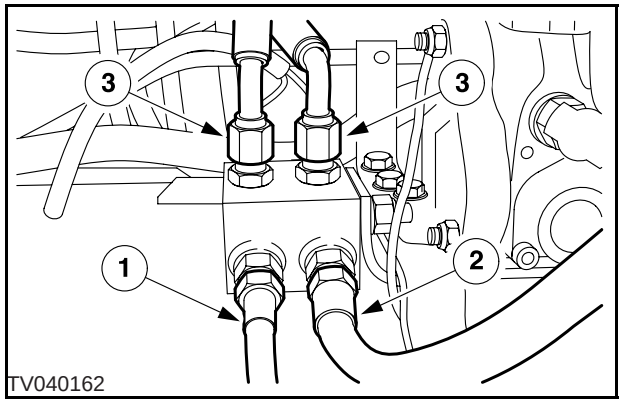
Operation: **Removing and Installing the Ride Control Valve**	*Job Code:* **06 17 13 xx**		
None	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

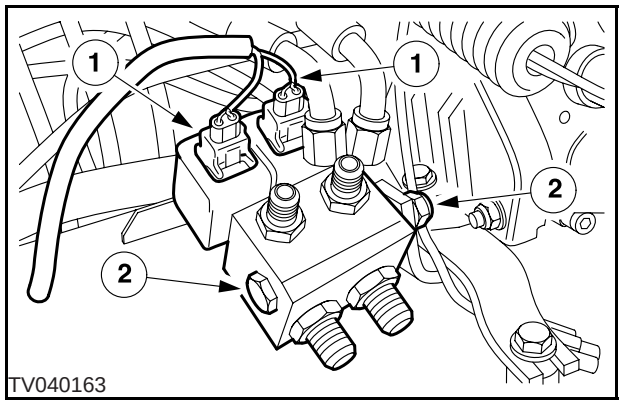
Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Release the pressure from the hydraulic system. For additional information, refer to RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 in this section.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Disconnect the ride control accumulator pipe (1).
4. Disconnect the loader valve hose from the ride control valve (2).
5. Disconnect the front loader pipes from the ride control valve (3).



TV040162

6. Disconnect the solenoid electrical connectors (1).
7. Remove the ride control retaining bolt, and remove the ride control valve (2).

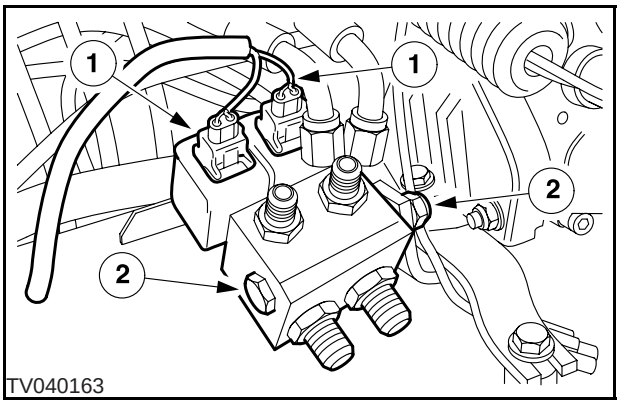


TV040163

Installation

1. To install, reverse the removal procedure.

2. Tighten (2) to 56Nm (41 lb.ft).



3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — SERVO CONTROL VALVE

BHN1301DB

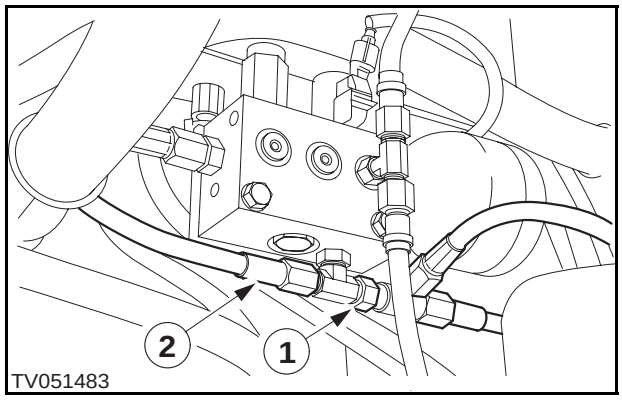
Operation: **Removal and installation — Servo Control Valve**	*Job Code:* **06 21 13 xx**		
None	Standard tools,		

Removal

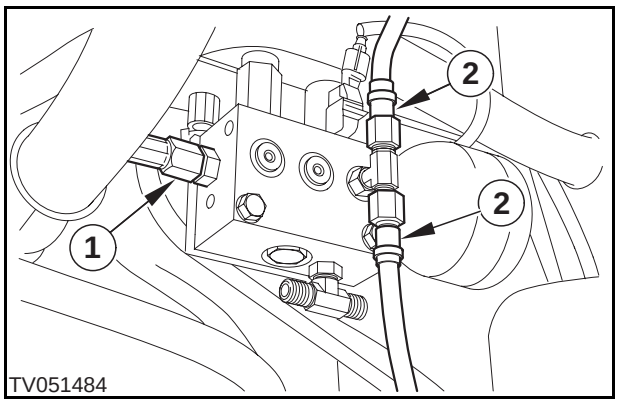
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

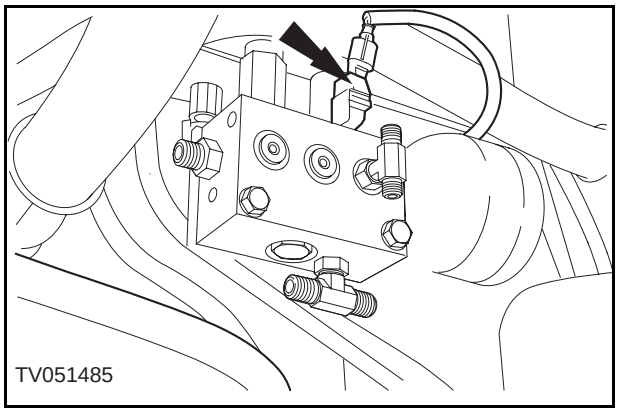
1. Release the pressure in the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE., PAGE F06–01–95
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Disconnect the joystick return hoses (1).
4. Disconnect the servo control valve return hose (2).



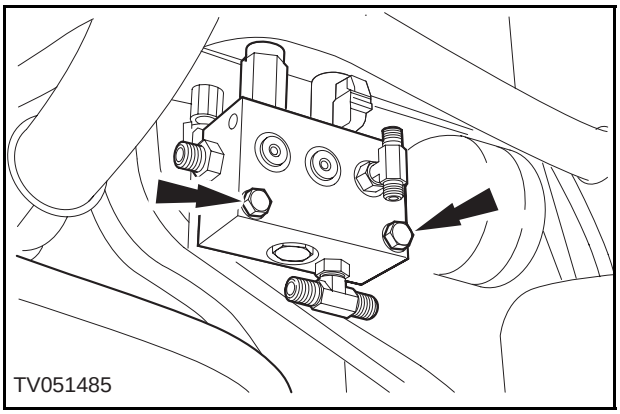
5. Disconnect the servo control valve supply hose (1).
6. Disconnect the servo control joystick supply hoses (2).



7. Disconnect the servo control solenoid electrical connector.



8. Remove the retaining bolts and remove the servo control valve.

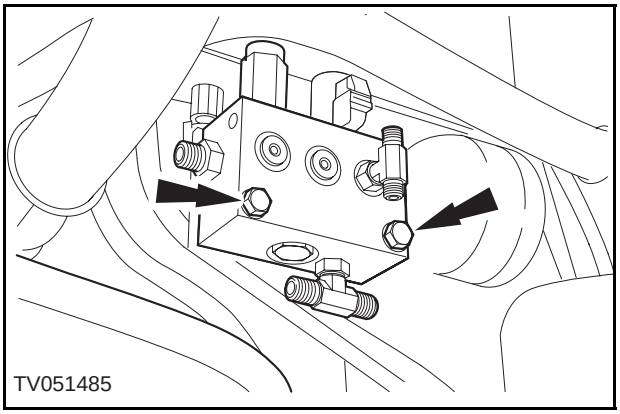


Installation

⚠ **Warning:**

- **Incorrect connection of the hoses will result in the incorrect function of the backhoe controls. Failure to follow this instruction may result in personal injury.**

1. To install, reverse the removal procedure.
2. Tighten to 23Nm (17 lb.ft).



REMOVAL AND INSTALLATION — SERVO CONTROL CONFIGURATION CHANGEOVER VALVE.

BHN1301DB

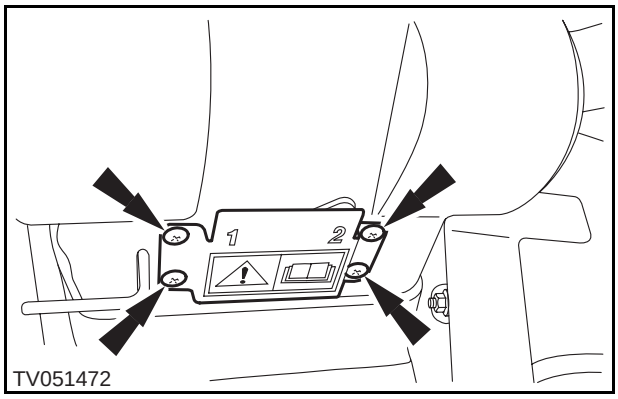
Operation: **Removal and Installation— Servo Control Configuration Changeover Valve**	*Job Code:* **06 22 13 xx**		
None	Standard tools,		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

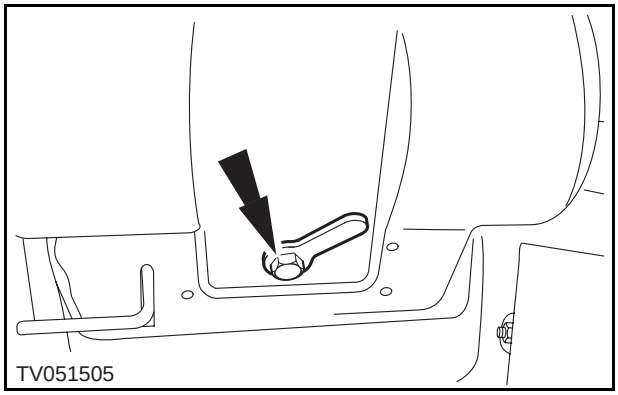
Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Release the pressure in the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE., PAGE F06–01–95
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION., PAGE J09–01–33
3. Remove the cover plate.



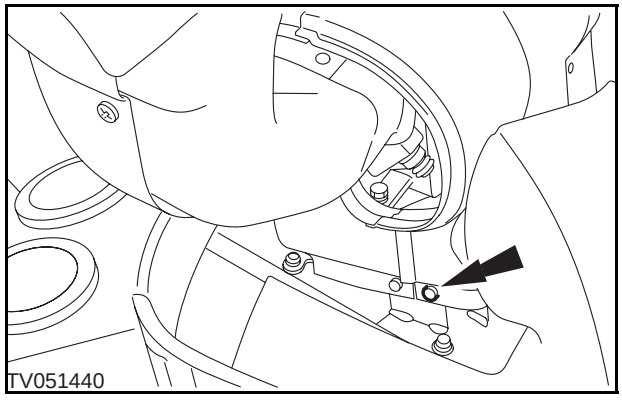
TV051472

4. Remove the retaining bolt and remove the selector lever.


TV051505

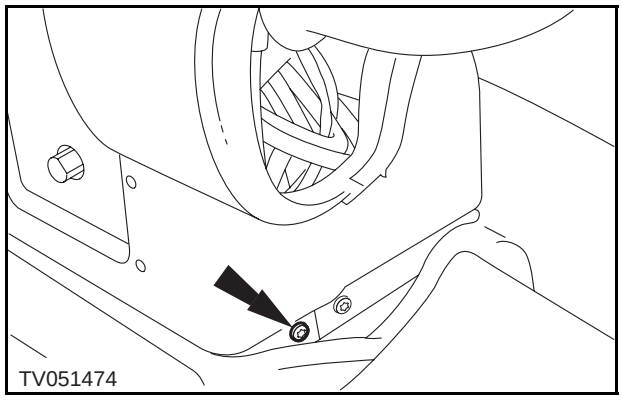
Note:
- Reposition the floor mat to gain access.

5. Remove the pedestal cover left hand lower retaining bolt.

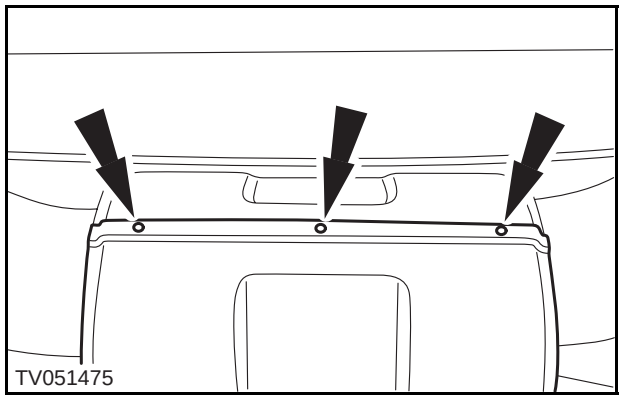


Note:
- Reposition the floor mat to gain access.

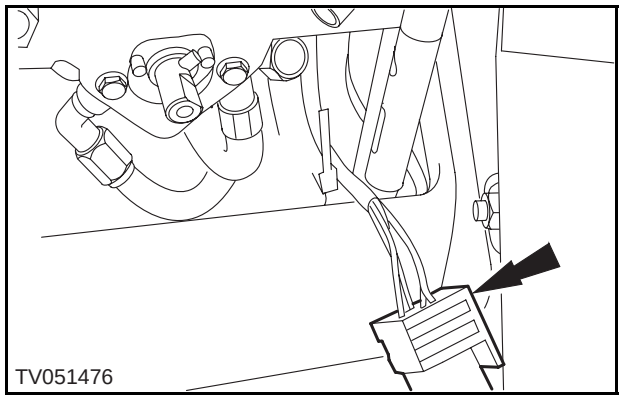
6. Remove the pedestal cover right hand lower retaining bolt.



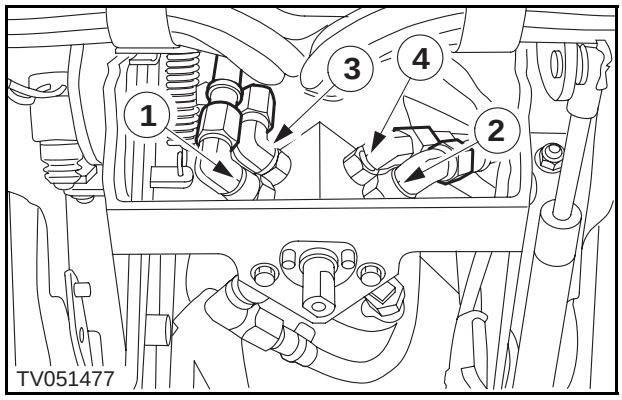
7. Remove the pedestal cover upper retaining bolts and remove the front section of the pedestal cover.



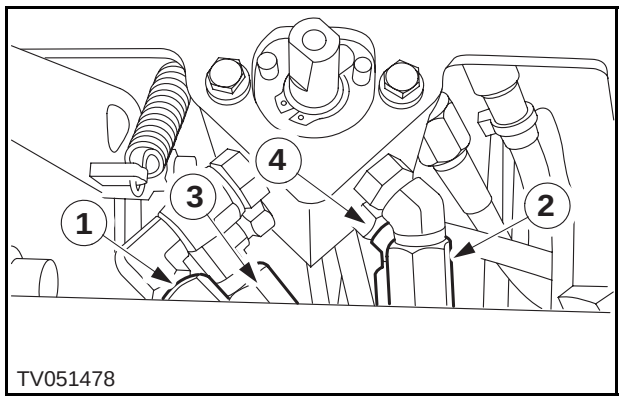
8. Cut the cable tie securing the servo control relay to the velcro pad. Position the relay to one side.



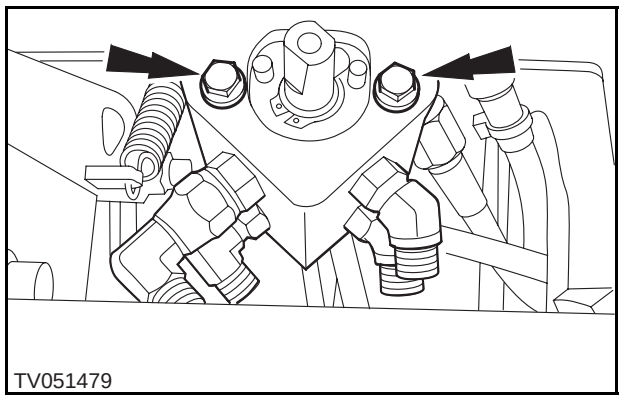
9. Disconnect the upper hydraulic hoses from the changeover valve in the order indicated.



10. Disconnect the lower hydraulic hoses from the changeover valve in the order indicated.



11. Remove the retaining bolts and remove the changeover valve.

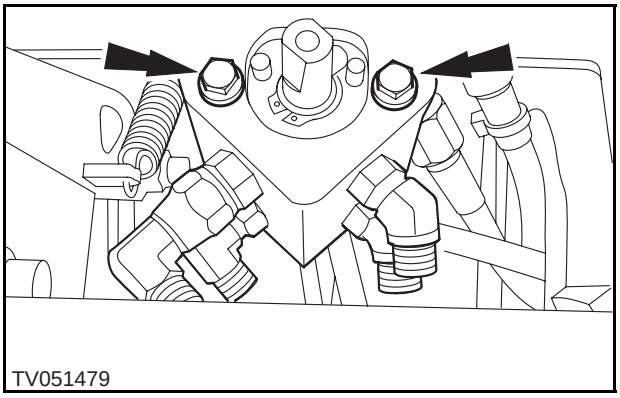


Installation

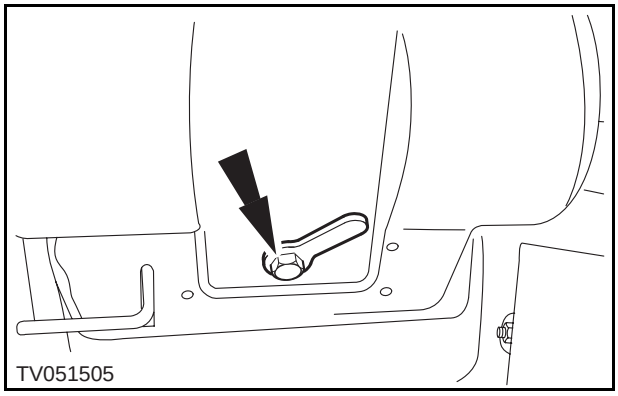
⚠ **Warning:**

- **Incorrect connection of the hoses will result in the incorrect function of the backhoe controls. Failure to follow this instruction may result in personal injury.**

1. To install, reverse the removal procedure.
2. Tighten to 23Nm (17 lb.ft).


TV051479

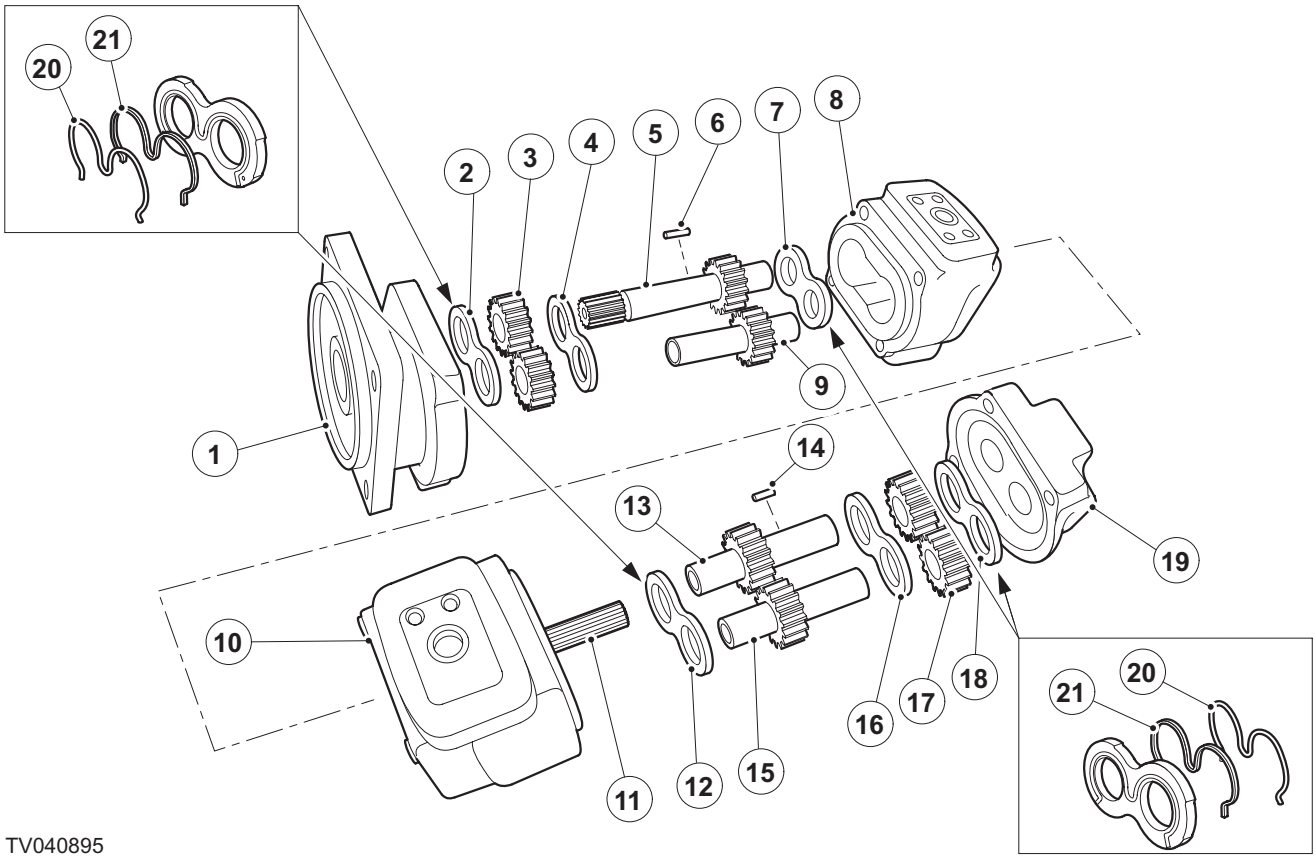
3. Tighten to 18Nm (13 lb.ft).


TV051505

DISASSEMBLY AND ASSEMBLY — HYDRAULIC PUMP

BHF0601DA

Operation: **Disassembling and Assembling the Hydraulic Pump**	*Job Code:* **06 11 17 xx**		
None	Standard tools		

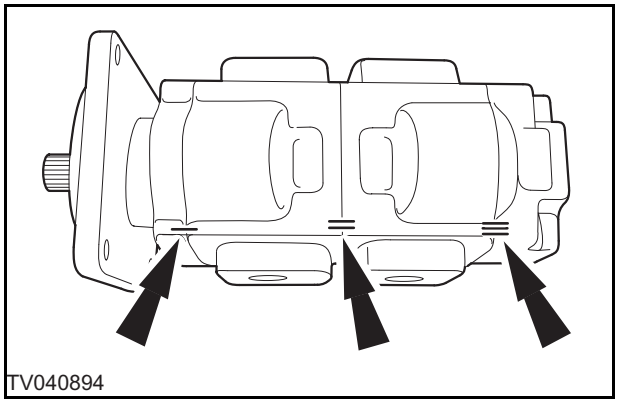


TV040895

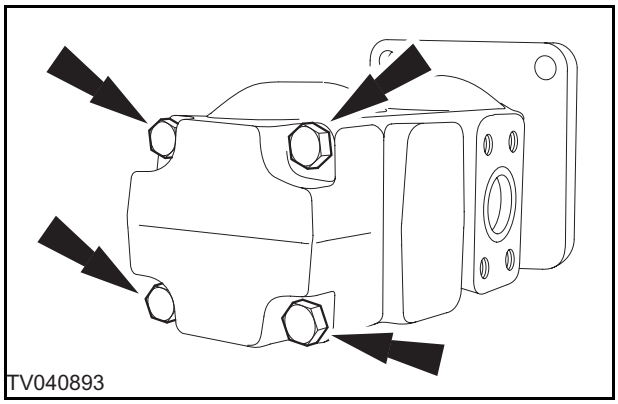
1	Mounting Flange
2	Sealing Bushing
3	Tandem Gears
4	Wear Bushing
5	Drive Shaft
6	Tandem Gear Locking Pin
7	Sealing Bushing
8	Housing
9	Driven Shaft
10	Housing
11	Connecting Shaft
12	Sealing Bushing
13	Drive Shaft
14	Tandem Gear Locking Pin
15	Driven Shaft
16	Wear Bushing
17	Tandem Gears
18	Sealing Bushing
19	End Housing
20	Back Up Seal
21	Sealing Ring

Disassembly

1. Place the hydraulic pump on a suitable work surface.
2. Mark the hydraulic pump casing to aid installation.


TV040894

3. Remove the hydraulic pump clamping bolts.

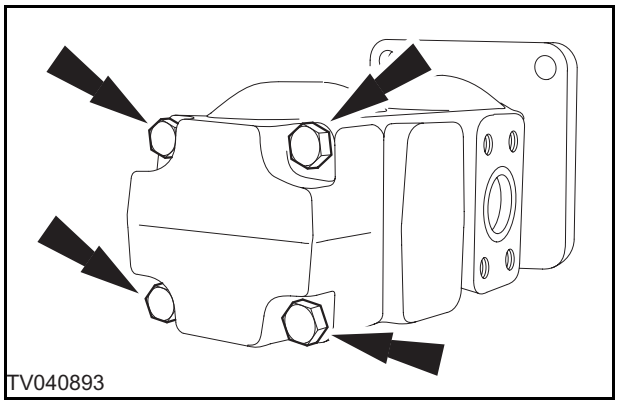

TV040893

Assembly

Note:
- Lubricate the piston O-ring seals with a suitable light grease.

Note:
- Install new O-ring seals.

1. To assemble, reverse the disassembly procedure.
2. Tighten to between 90 and 100Nm (66 and 74 lb.ft).

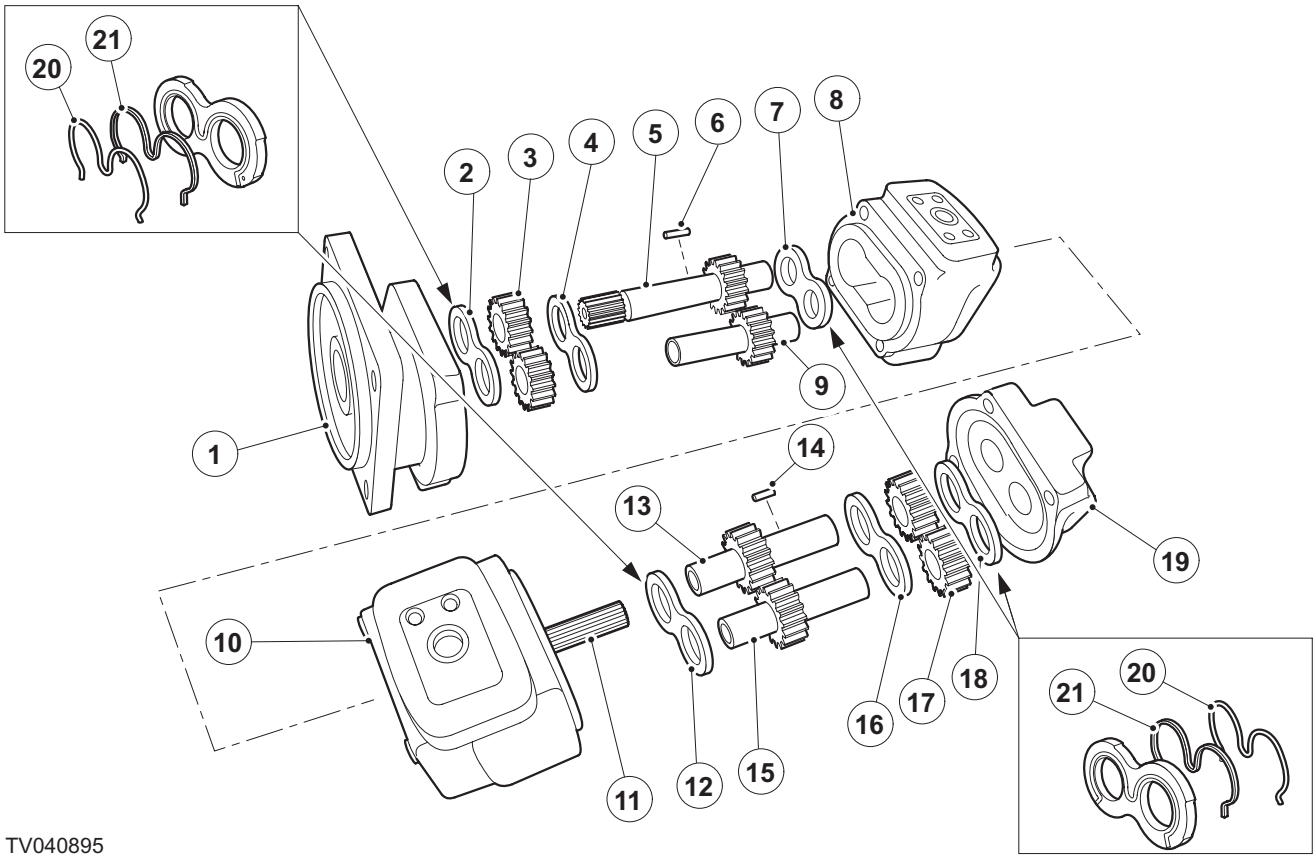

TV040893

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DISASSEMBLY AND ASSEMBLY — HYDRAULIC PUMP - 2007

BHF0601DH

Operation: **Disassembling and Assembling the Hydraulic Pump**	*Job Code:* **06 11 17 xx**		
None	Standard tools		

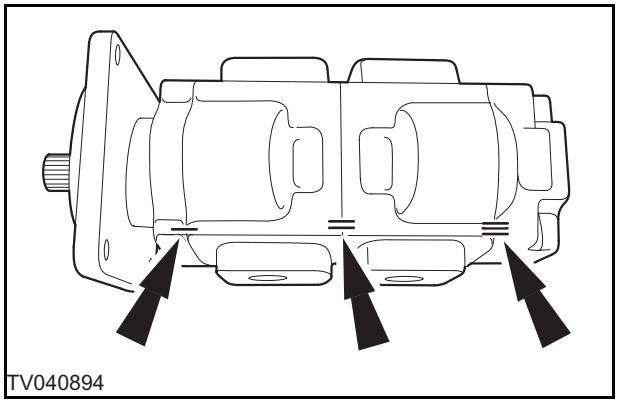


TV040895

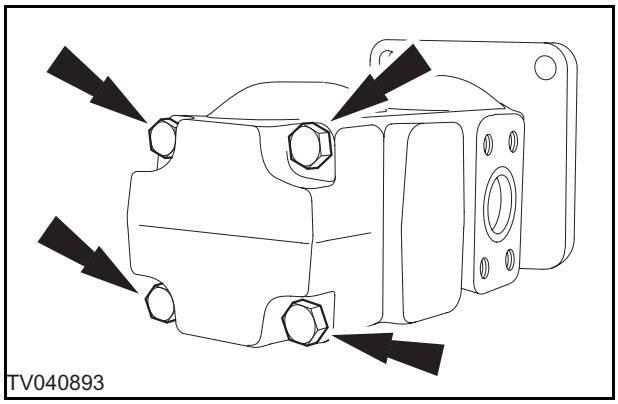
1	Mounting Flange
2	Sealing Bushing
3	Tandem Gears
4	Wear Bushing
5	Drive Shaft
6	Tandem Gear Locking Pin
7	Sealing Bushing
8	Housing
9	Driven Shaft
10	Housing
11	Connecting Shaft
12	Sealing Bushing
13	Drive Shaft
14	Tandem Gear Locking Pin
15	Driven Shaft
16	Wear Bushing
17	Tandem Gears
18	Sealing Bushing
19	End Housing
20	Back Up Seal
21	Sealing Ring

Disassembly

1. Place the hydraulic pump on a suitable work surface.
2. Mark the hydraulic pump casing to aid installation.


TV040894

3. Remove the hydraulic pump clamping bolts.

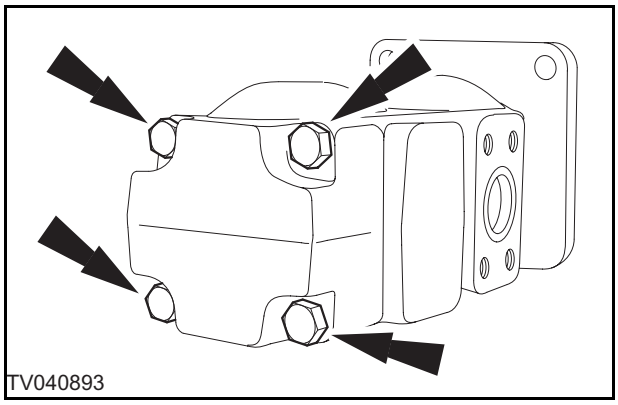

TV040893

Assembly

Note:
- Lubricate the piston O-ring seals with a suitable light grease.

Note:
- Install new O-ring seals.

1. To assemble, reverse the disassembly procedure.
2. Tighten to between 90 and 100Nm (66 and 74 lb.ft).

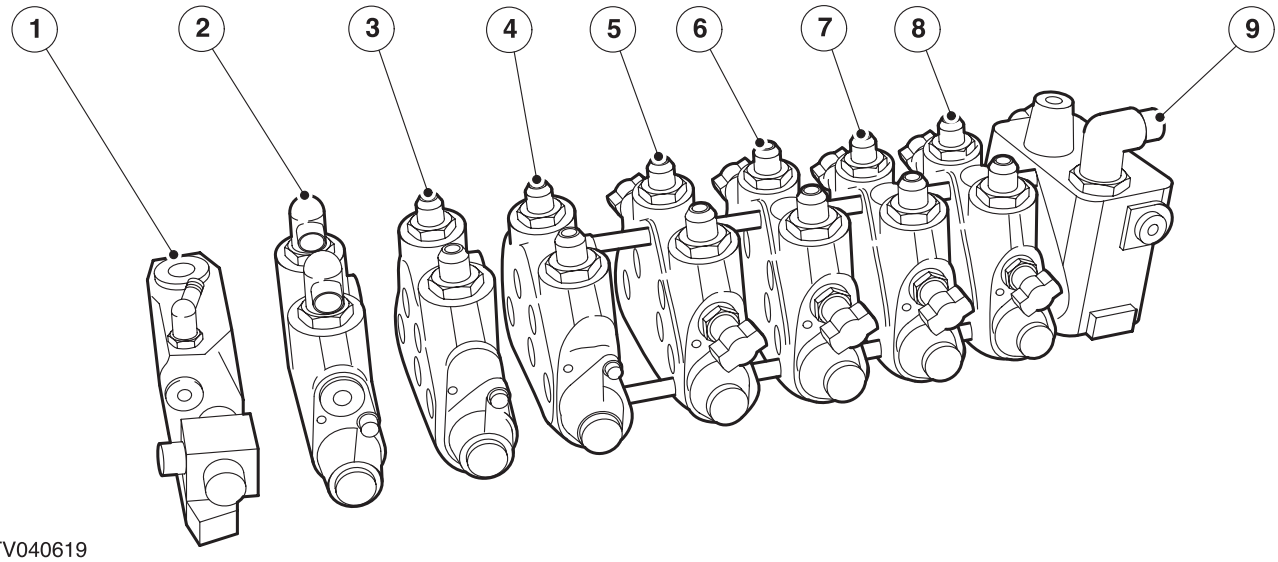

TV040893

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DISASSEMBLY AND ASSEMBLY — BACKHOE CONTROL VALVE

BHF0601DB

Operation: **Disassembling and Assembling the Backhoe Control Valve**	*Job Code:* **06 01 17 xx**		
None	Standard tools		

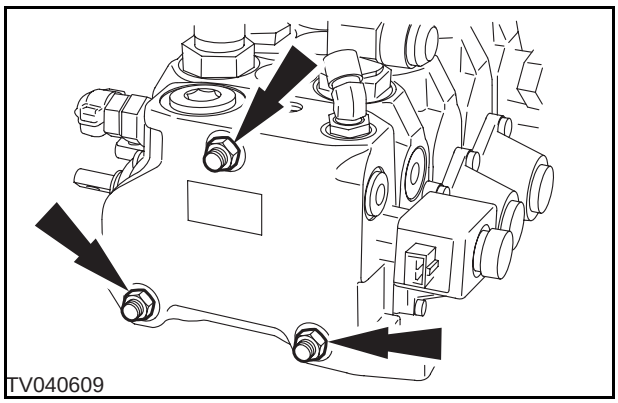


TV040619

1	Outlet Element
2	Auxiliary Service/Extendable Dipper Element
3	Right Stabiliser Element
4	Left Stabiliser Element
5	Bucket Element
6	Dipper Element
7	Boom Element
8	Slew Element
9	Inlet Element

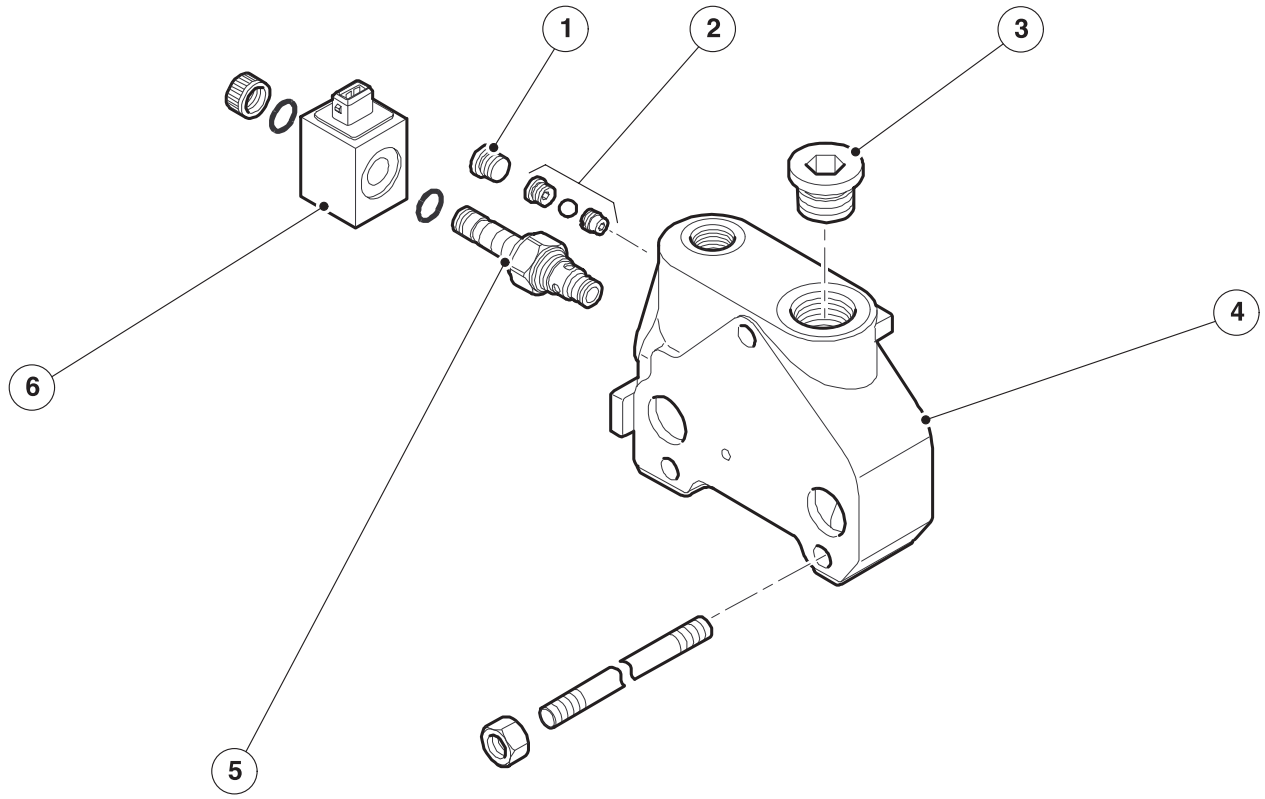
Disassembly

1. Place the backhoe control valve on a suitable work surface.
2. Remove the backhoe control valve clamping nuts.



TV040609

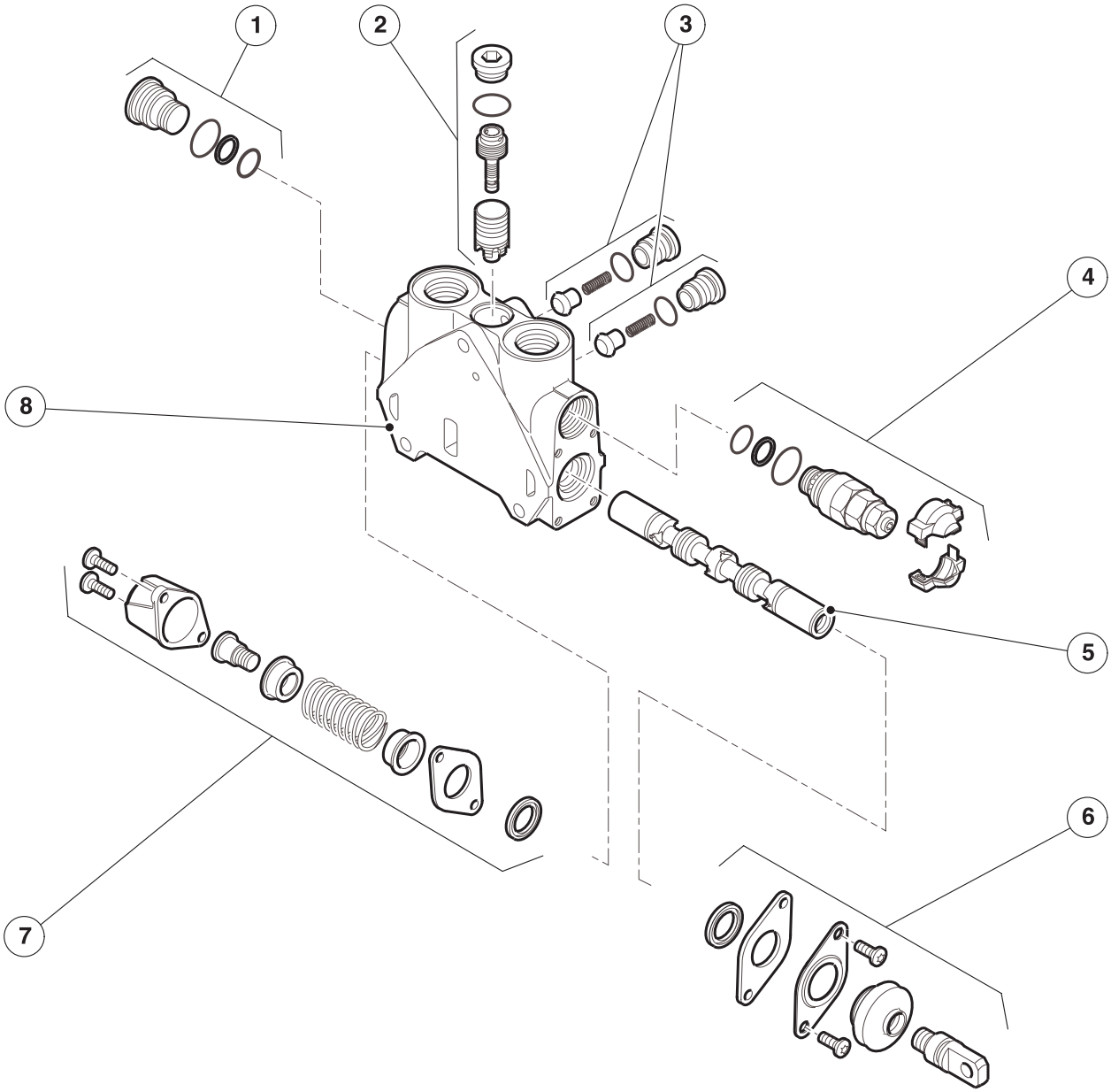
Outlet Element



TV040671

1	9/16” UNF plug
2	Shuttle Throttle
3	11/16” UNF Plug
4	Valve Body
5	2 Way Valve
6	Solenoid

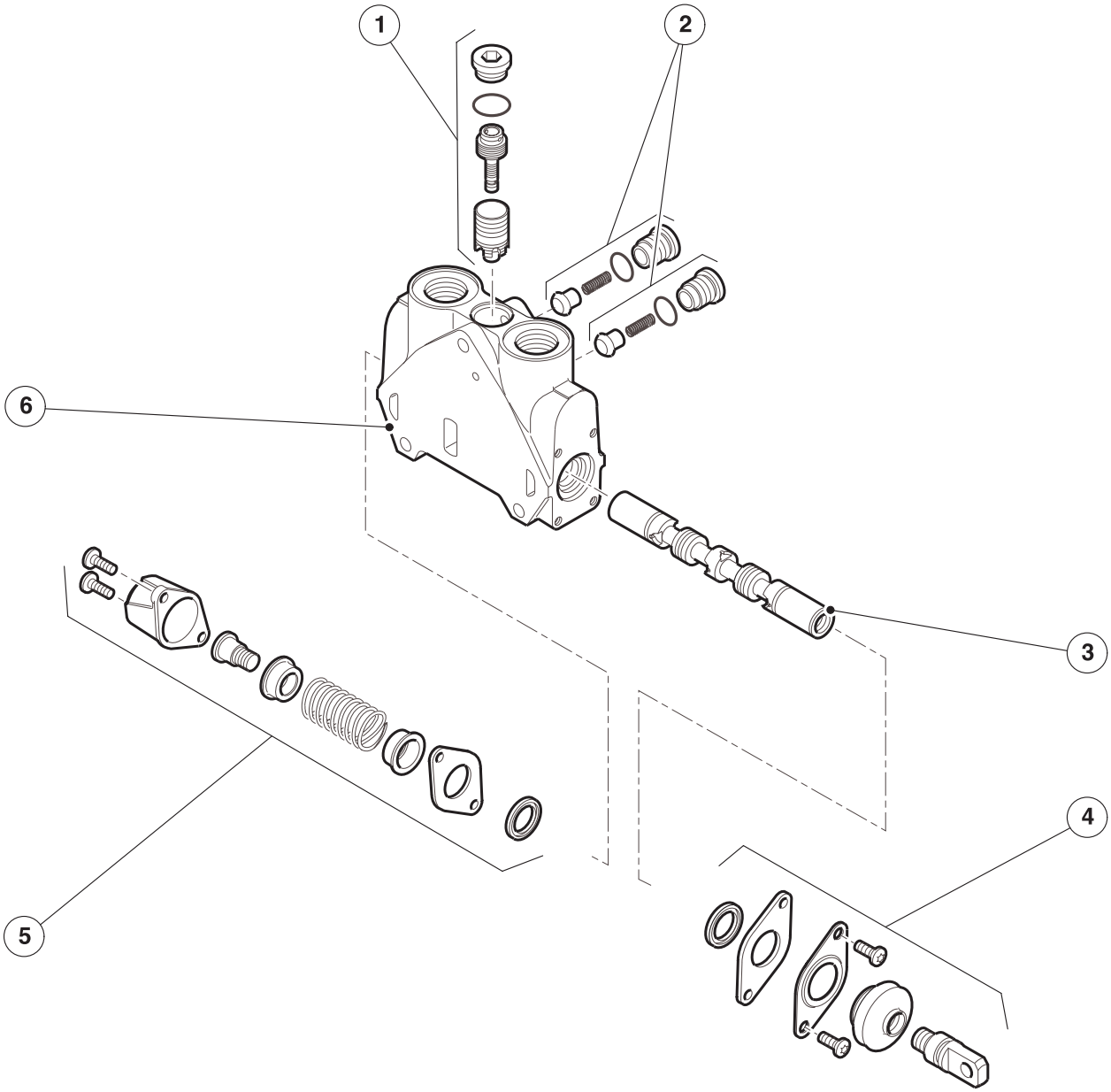
Auxiliary Service/Extendable Dipper element



TV040670

1	Plug
2	Compensator Valve
3	Check Valves
4	Pressure Relief Valve
5	Valve
6	Mechanical Actuator
7	Mechanical Return
8	Valve Body

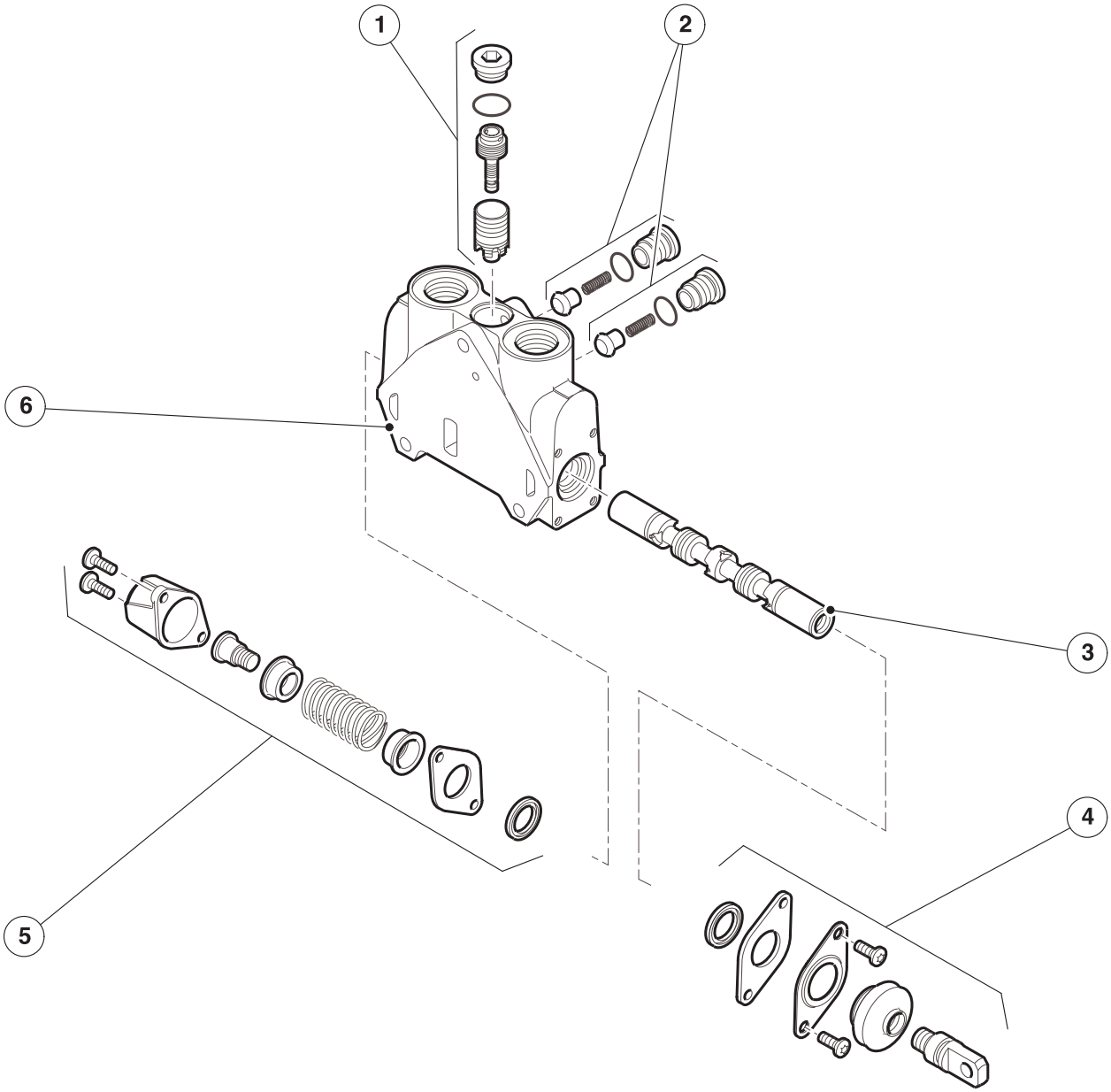
Right Stabiliser Element



TV040669

1	Compensator Valve
2	Check Valves
3	Valve
4	Mechanical Actuator
5	Mechanical Return
6	Valve Body

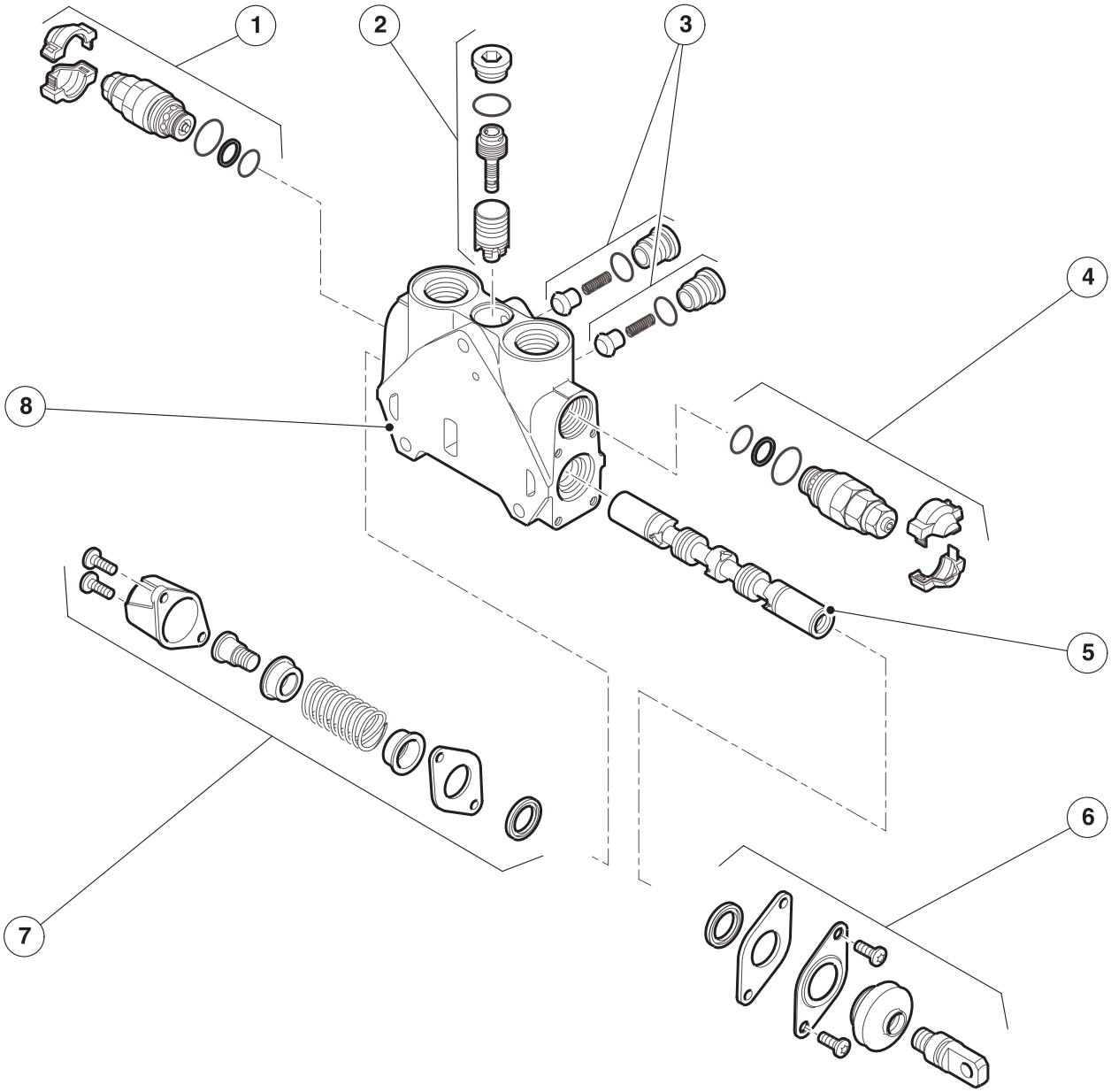
Left Stabiliser Element



TV040669

1	Compensator Valve
2	Check Valves
3	Valve
4	Mechanical Actuator
5	Mechanical Return
6	Valve Body

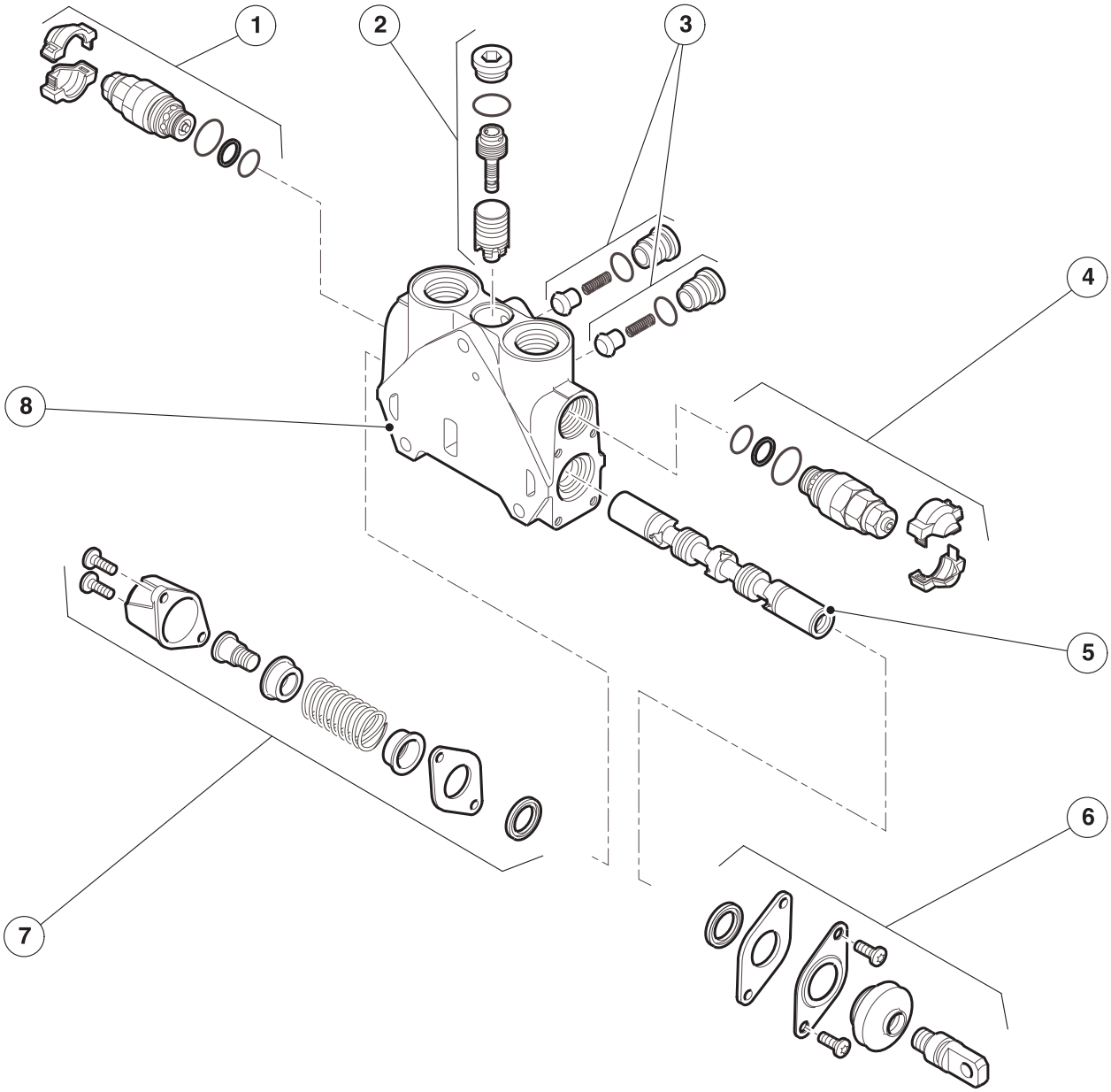
Bucket Element



TV040668

1	Pressure Relief Valve
2	Compensator Valve
3	Check Valves
4	Pressure Relief Valve
5	Valve
6	Mechanical Actuator
7	Mechanical Return
8	Valve Body

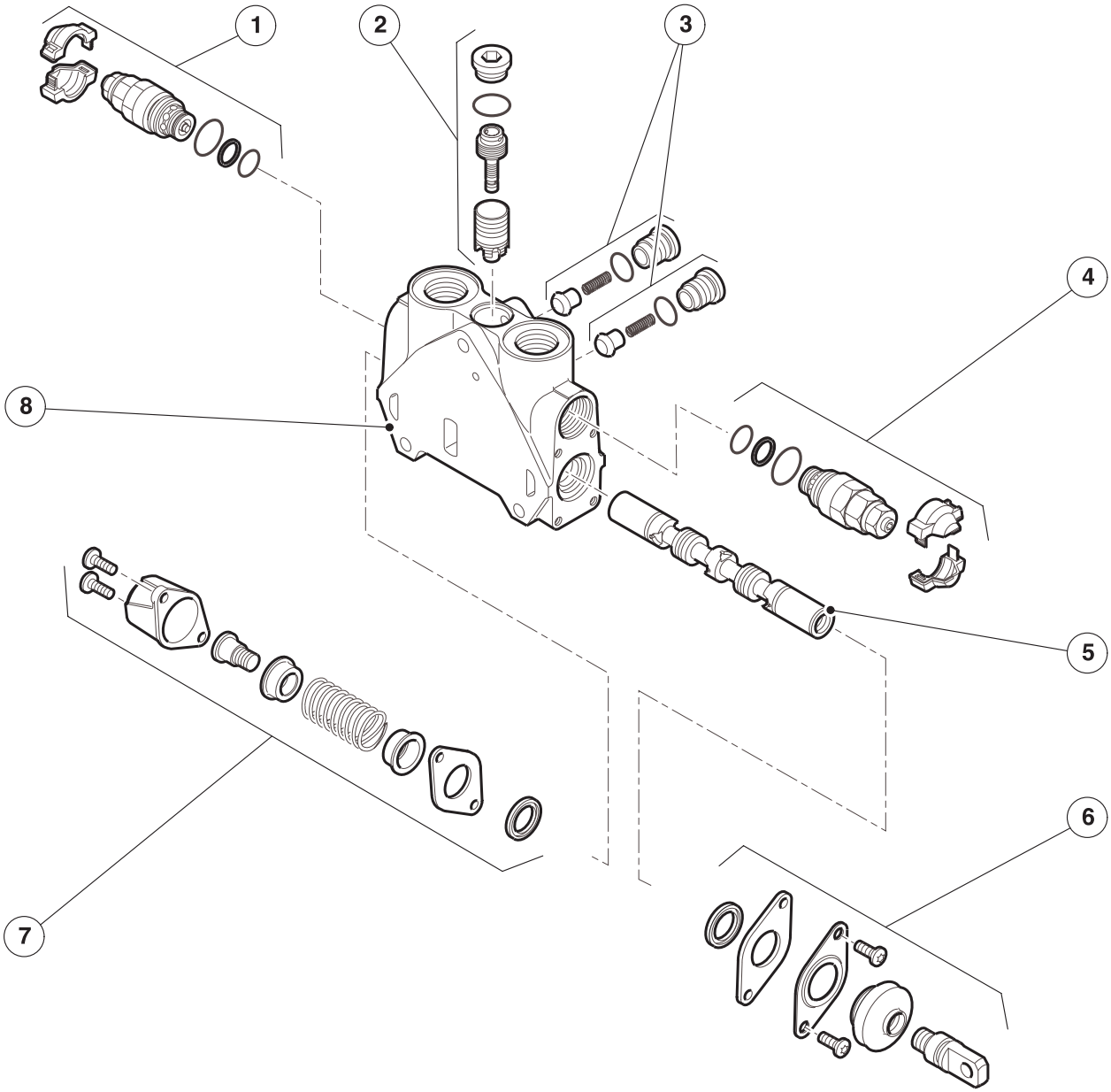
Dipper Element



TV040668

1	Pressure Relief Valve
2	Compensator Valve
3	Check Valves
4	Pressure Relief Valve
5	Valve
6	Mechanical Actuator
7	Mechanical Return
8	Valve Body

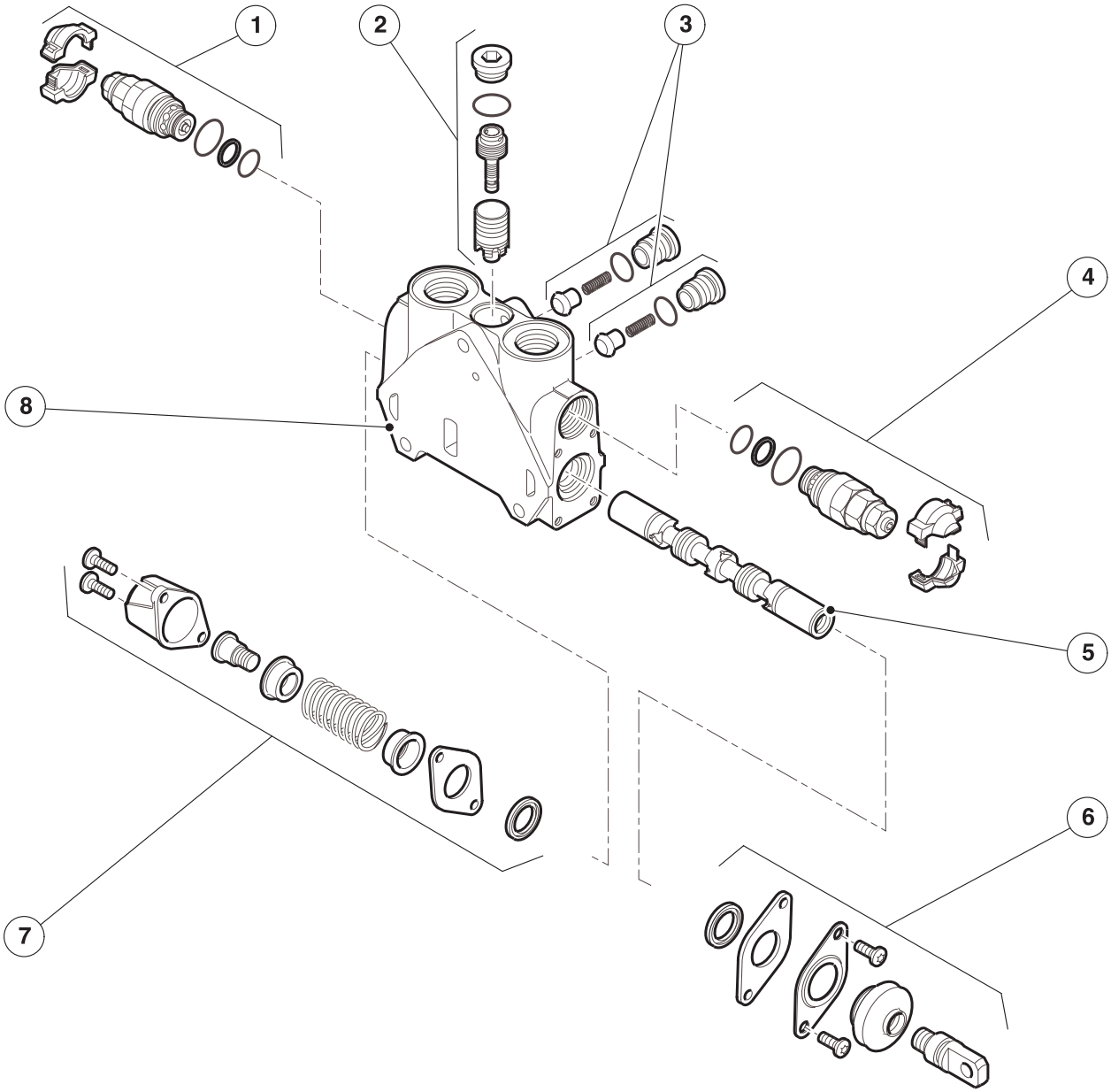
Boom Element



TV040668

1	Pressure Relief Valve
2	Compensator Valve
3	Check Valves
4	Pressure Relief Valve
5	Valve
6	Mechanical Actuator
7	Mechanical Return
8	Valve Body

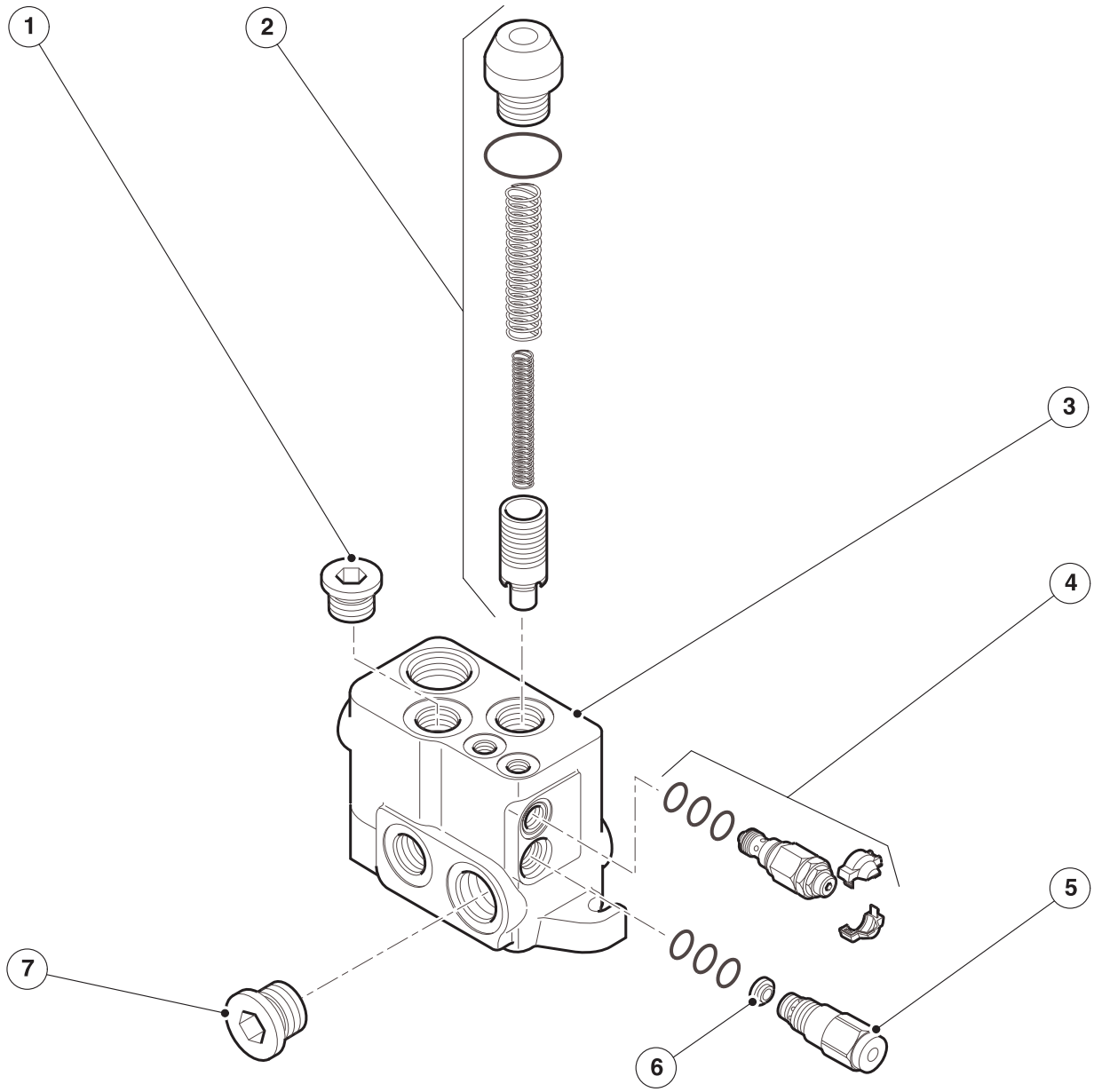
Slew Element



TV040668

1	Pressure Relief Valve
2	Compensator Valve
3	Check Valves
4	Pressure Relief Valve
5	Valve
6	Mechanical Actuator
7	Mechanical Return
8	Valve Body

Inlet Element



TV040667

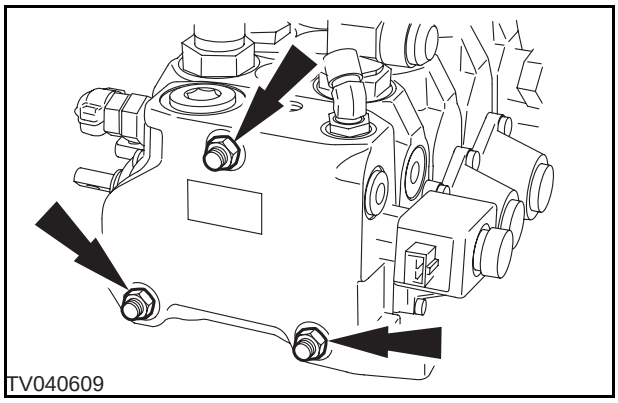
1	11/16” UNF Plug
2	Inlet Compensator
3	Valve Body
4	Load sensing Pressure Relief Valve
5	Flow Regulator
6	Filter
7	5/16” UNF Plug

Assembly

Note:
- Install new O-ring Seals

1. To assemble, reverse the disassembly procedure.

2. Tighten to 42Nm (31 lb.ft).

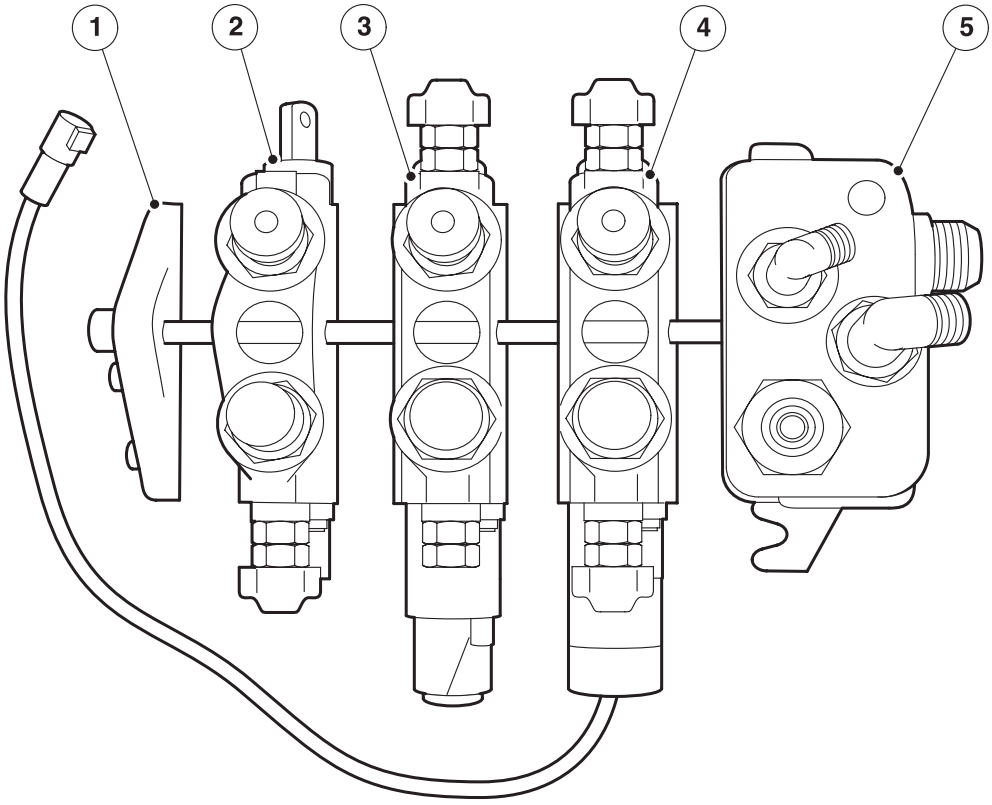

TV040609

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DISASSEMBLY AND ASSEMBLY — LOADER CONTROL VALVE

BHF0601DC

Operation: **Disassembling and Assembling the Loader Control Valve**	*Job Code:* **06 13 17 xx**		
None	Standard tools		

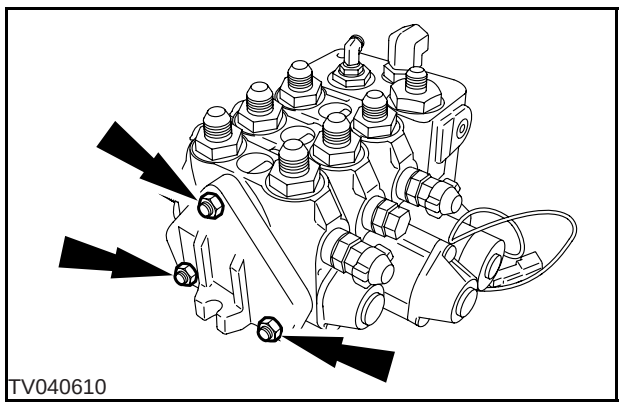


TV040581

1	Cover
2	Auxiliary Service Element
3	Loader Beam Cylinder Element
4	Bucket Hydraulic Cylinder Element
5	Inlet Element

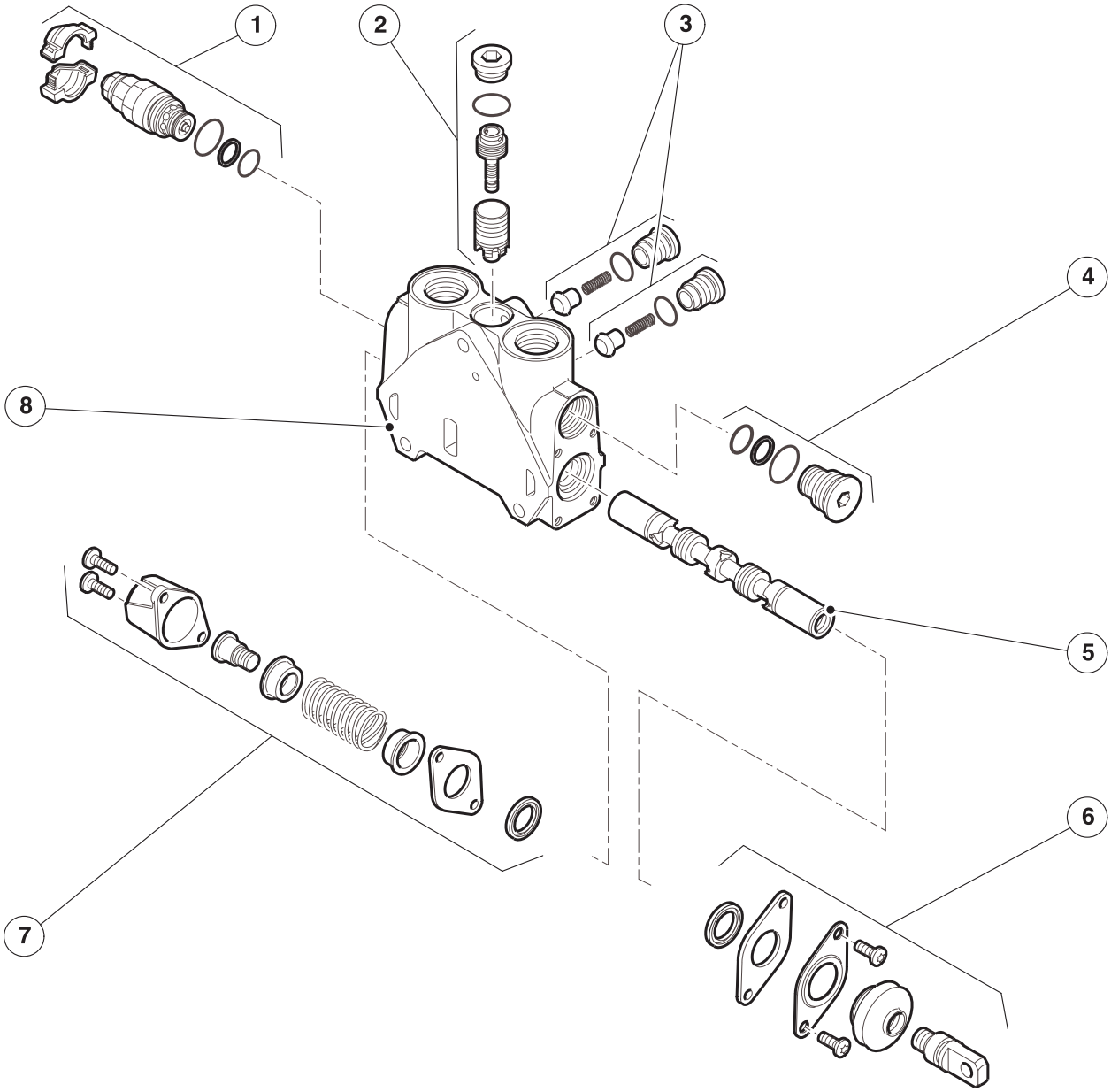
Disassembly

1. Place the loader control valve on a suitable work surface.
2. Remove the loader control valve clamping nuts.



TV040610

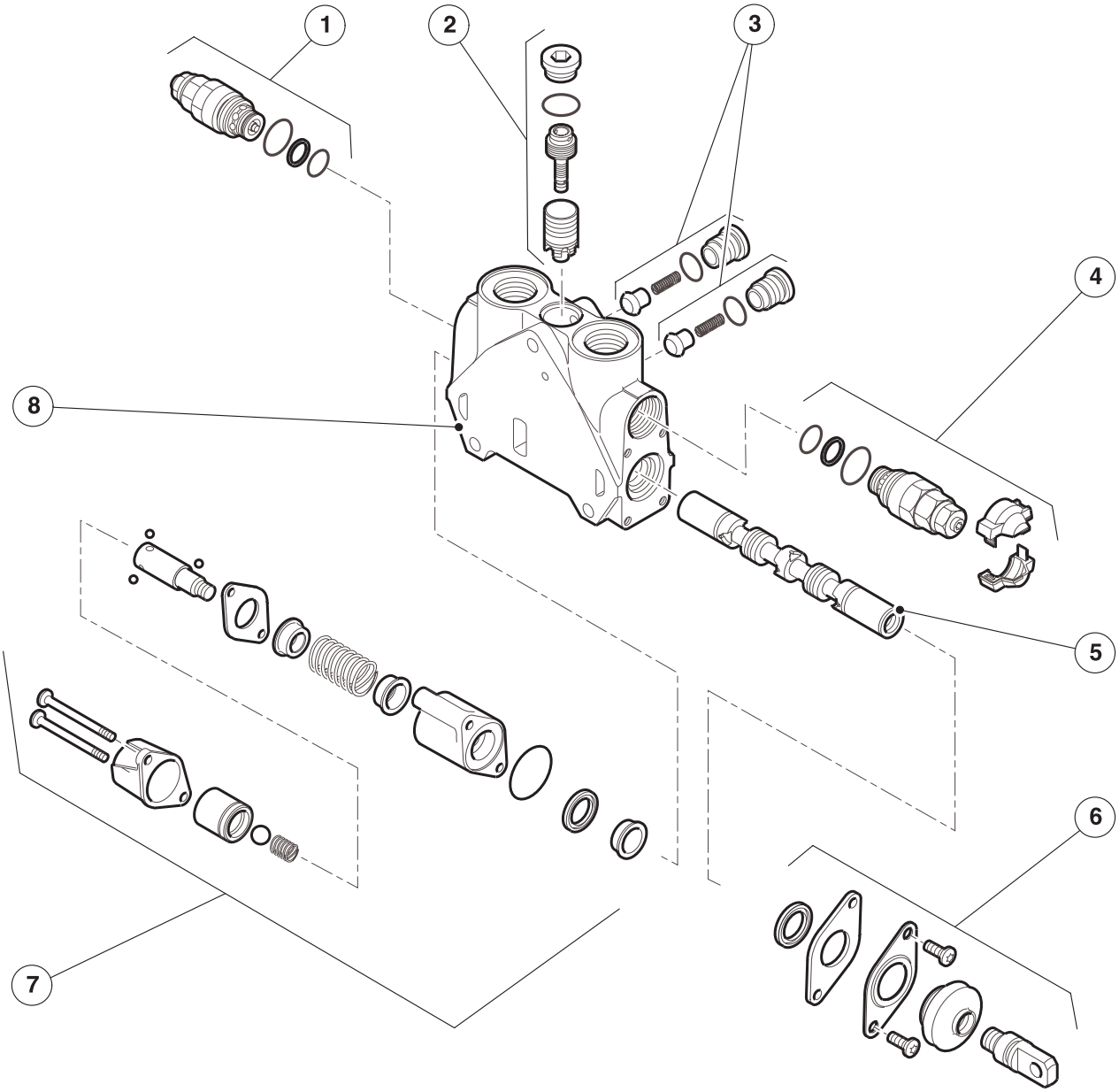
Auxiliary Service Element



TV040666

1	Pressure Relief Valve
2	Compensator Valve
3	Check Valves
4	Plug
5	Valve
6	Mechanical Actuator
7	Mechanical Return
8	Valve Body

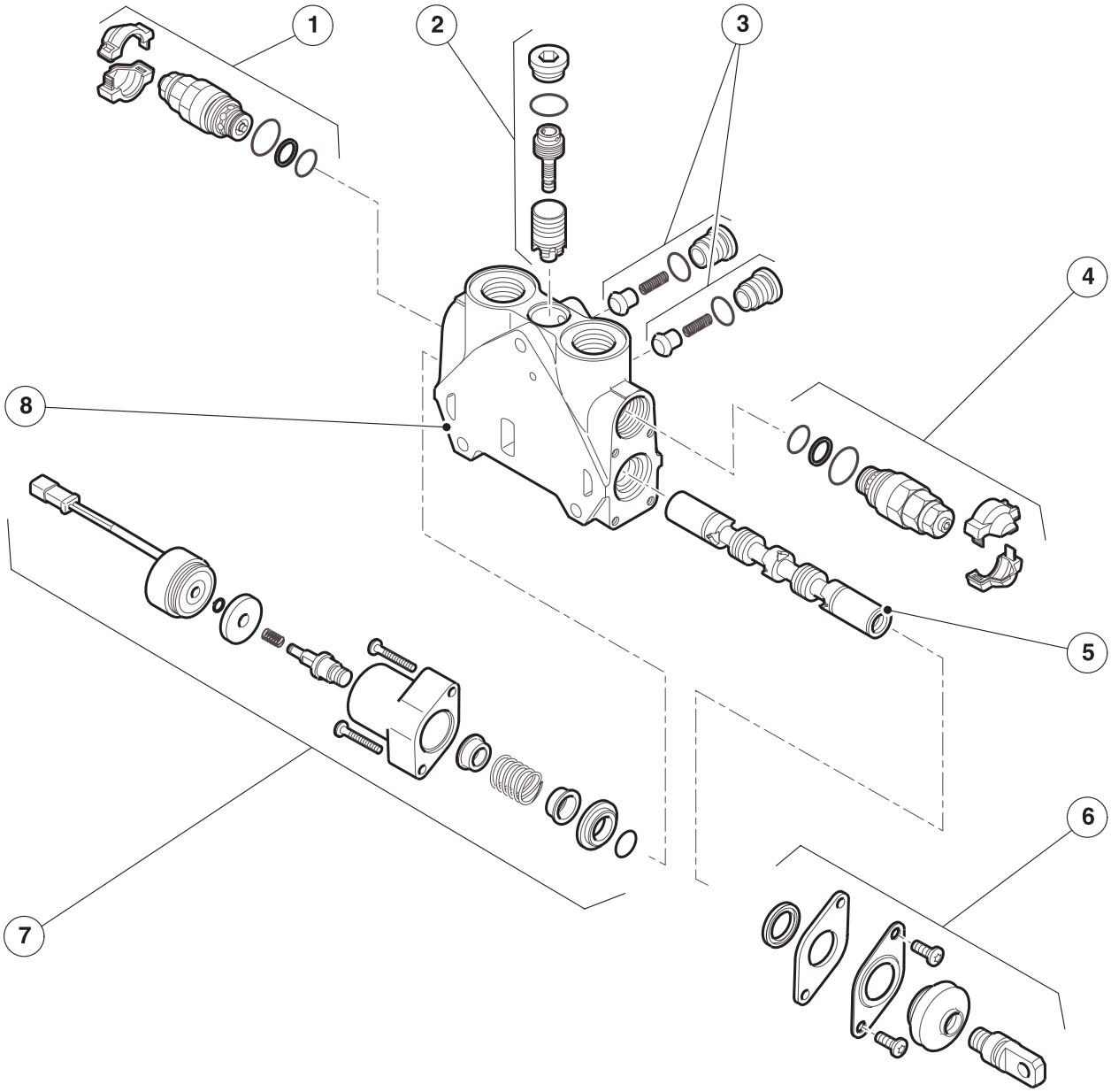
Loader Beam Cylinder Element



TV040665

1	Anti Cavitation Valve
2	Compensator Valve
3	Check Valves
4	Pressure Relief Valve
5	Valve
6	Mechanical Actuator
7	Mechanical Detent
8	Valve Body

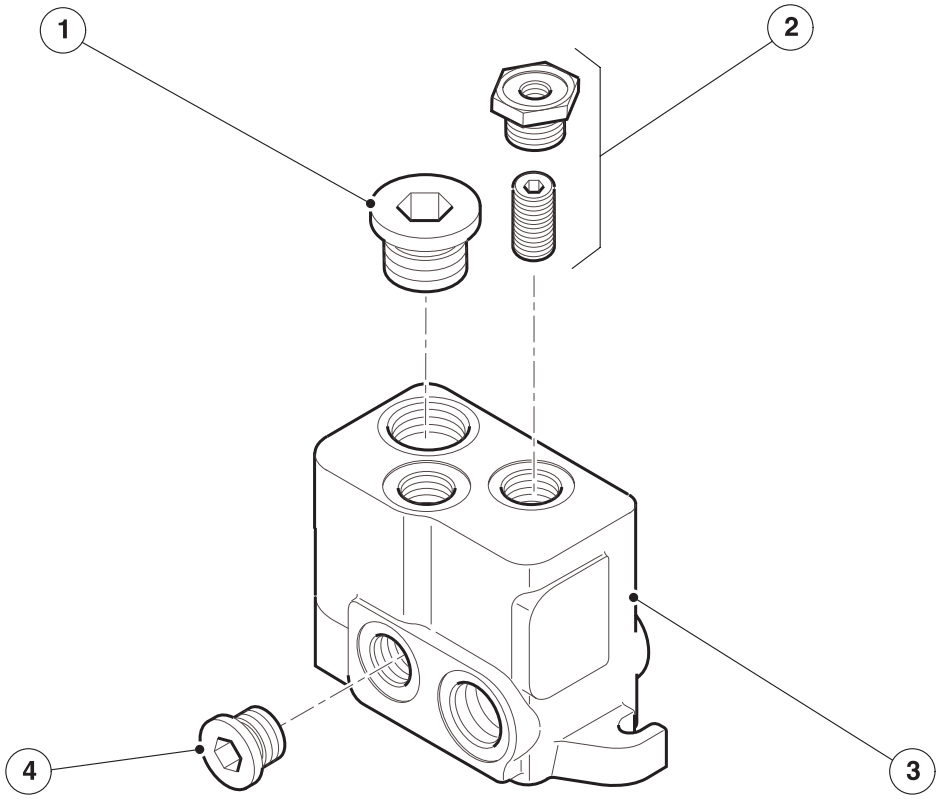
Bucket Ram Cylinder Element



TV040664

1	Pressure Relief Valve
2	Compensator Valve
3	Check Valves
4	Pressure Relief Valve
5	Valve
6	Mechanical Actuator
7	Electrical Detent
8	Valve Body

Inlet Element



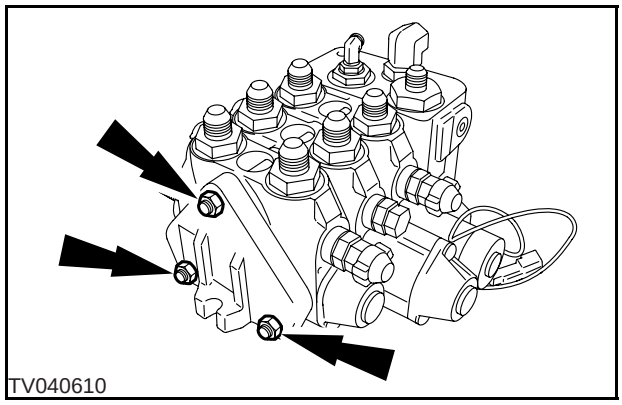
TV040663

1	5/16” UNF Plug
2	Closed Centre Valve
3	Valve Body
4	11/16” UNF Plug

Assembly

Note:
- Install new O-ring seals.

1. To assemble, reverse the disassembly procedure.
2. Tighten to 42Nm +/-4Nm (31 lb.ft +/-3 lb.ft).



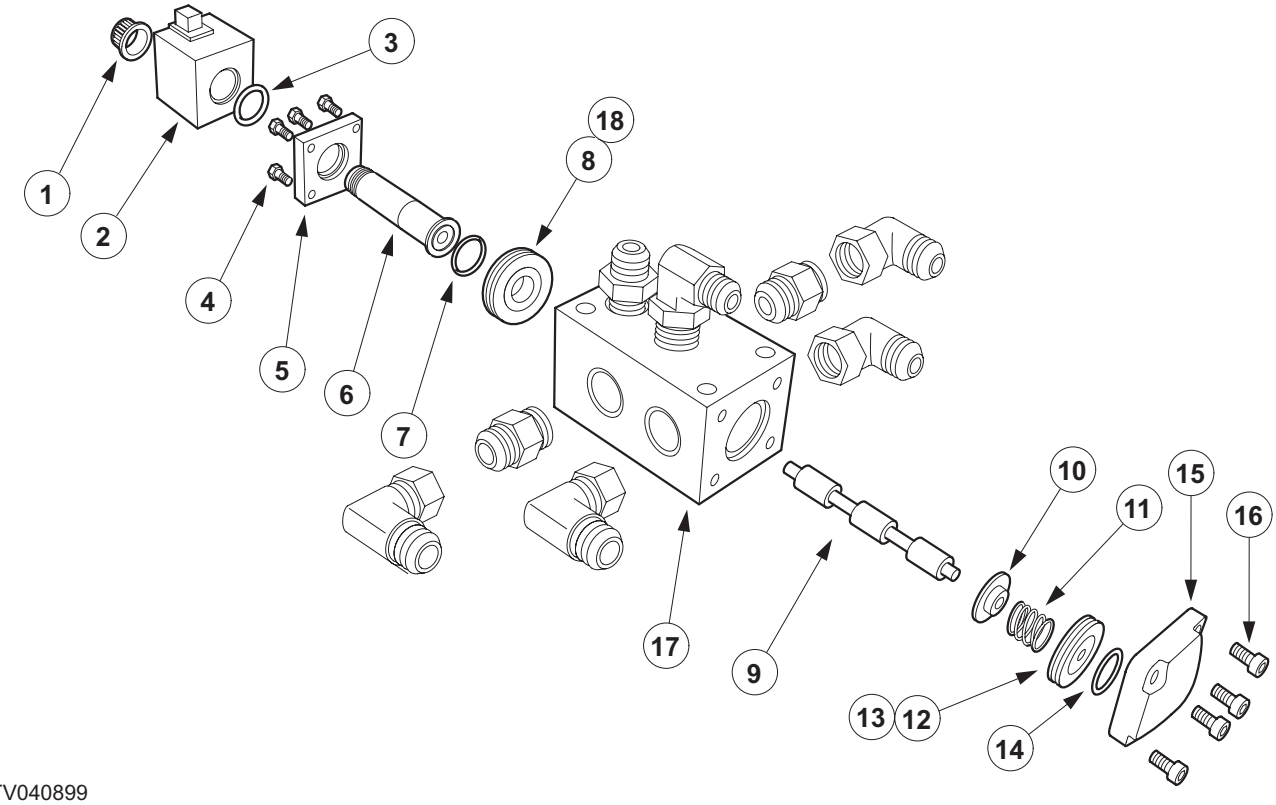
TV040610

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DISASSEMBLY AND ASSEMBLY — CHANGEOVER VALVE

BHF0601DD

Operation: **Disassembling and Assembling the Changeover Valve**	*Job Code:* **06 03 17 xx**		
None	Standard tools		



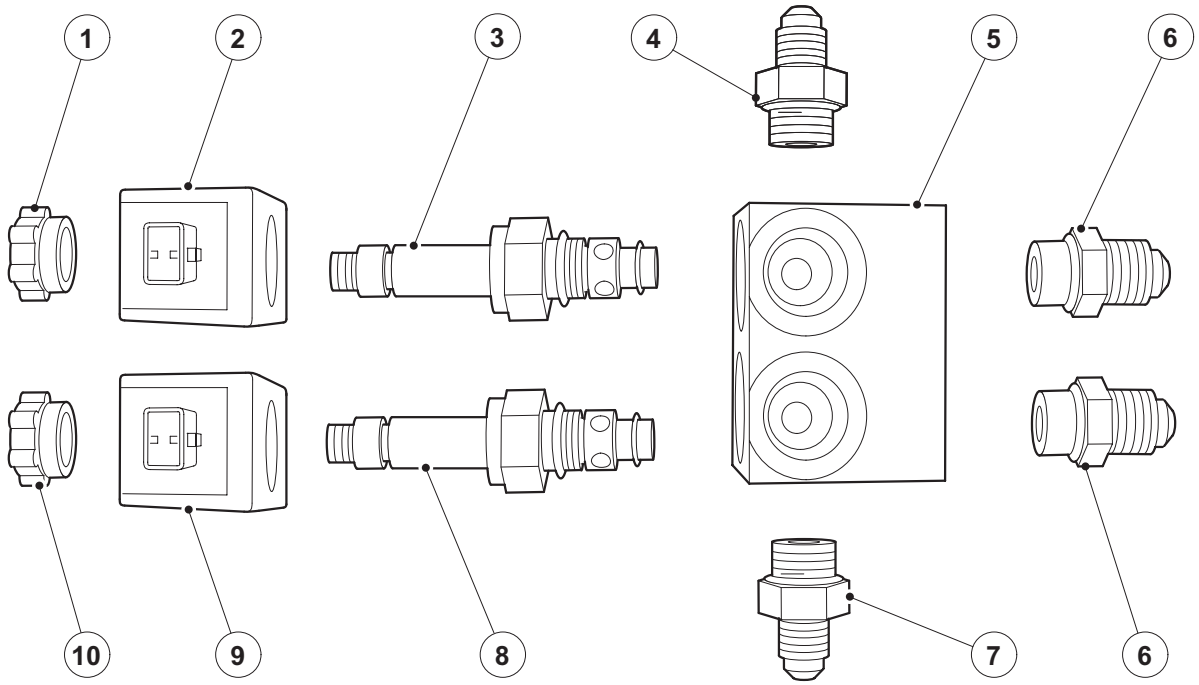
TV040899

1	Solenoid Retaining Cap
2	Solenoid Coil
3	O-ring
4	Retaining Bolts
5	Valve End Cap
6	Solenoid valve
7	O-ring
8	Valve Retainer
9	Changeover Valve
10	Spacer
11	Spring
12	Valve Retainer
13	O-ring
14	O-ring
15	End Cap
16	Retaining Bolt
17	Valve Body
18	O-ring

DISASSEMBLY AND ASSEMBLY — RIDE CONTROL VALVE

BHF0601DF

Operation: **Disassembling and Assembling the Ride Control Valve**	*Job Code:* **06 17 17 xx**		
None	Standard Tools		



TV040897

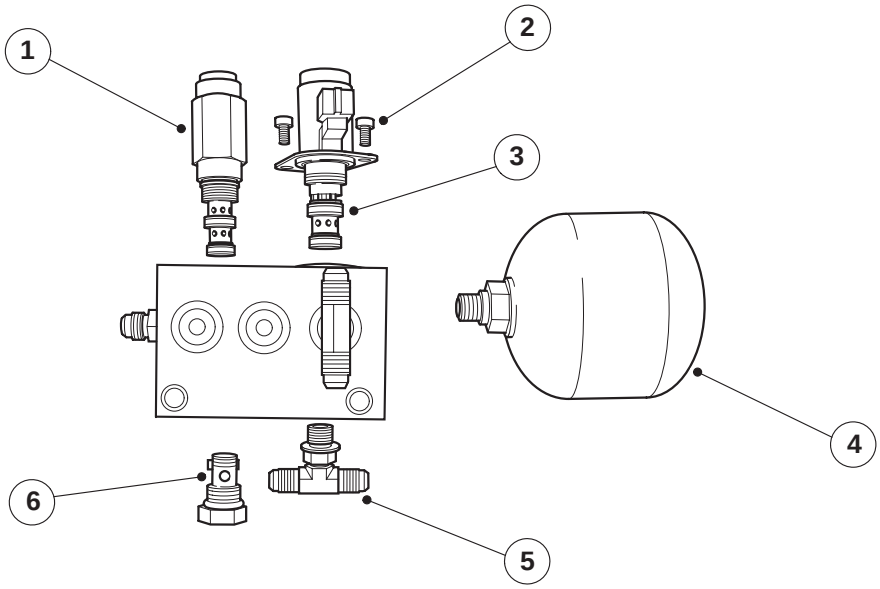
1	Solenoid Retaining Cap
2	Solenoid Coil
3	Solenoid Valve
4	Union
5	Valve Body
6	Unions
7	Union
8	Solenoid Valve
9	Solenoid Coil
10	Solenoid Retaining Cap

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DISASSEMBLY AND ASSEMBLY — SERVO CONTROL VALVE

BHN1301DB

Operation: **Disassembly and Assembly — Servo Control Valve**	*Job Code:* **06 21 17 xx**		
None	Standard tools,		



TV051502

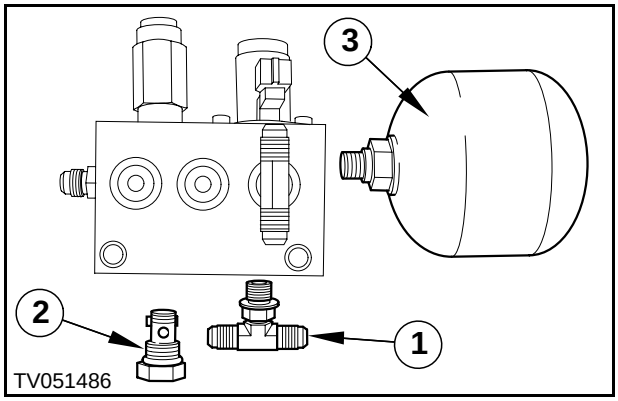
1	Pressure Regulator Valve Assembly
2	Retaining Bolts
3	Activation Solenoid Valve Assembly
4	Accumulator
5	Union
6	Valve Assembly

Disassembly

1. Remove the union (1) to gain access to the valve assembly (2).
2. Remove the valve assembly (2).

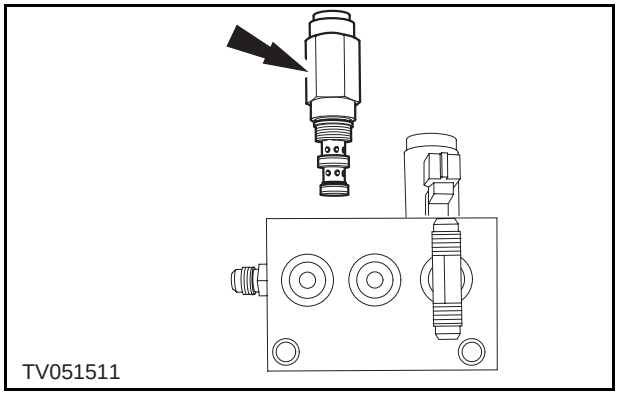
   Note:
   - Discard the O-ring seals.

3. Remove the accumulator (3).

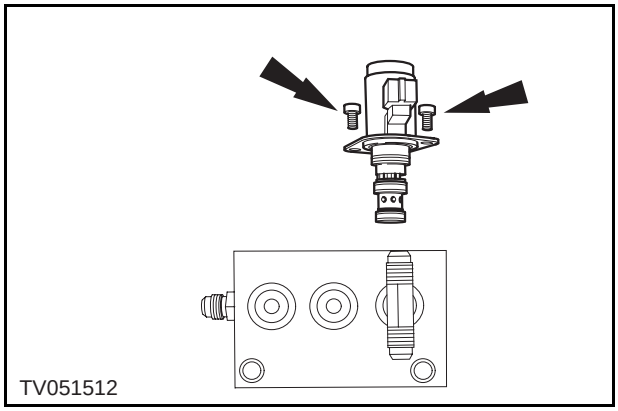


4. Remove the pressure regulator valve assembly.

   Note:
   - Discard the O-ring seals.



5. Remove the retaining bolts and remove the activation solenoid valve assembly.



Assembly

Note:
- Use new O-ring seals.

1. To assemble, reverse the disassembly procedure.

GENERAL PROCEDURE — HYDRAULIC CYLINDER INSPECTION

BHF0601GA

Inspection

1. Clean the piston, gland, piston rod and tube in cleaning solvent.
2. Discard the parts that were removed from the piston and the gland.
3. Illuminate the inside of the tube. Inspect the inside of the tube for deep grooves and other damage. If there is damage to the tube, a new tube must be used.
4. Check to be sure that the piston rod is straight. If the piston rod is not straight, install a new piston rod.
5. Remove small scratches on the inside of the tube with emery cloth of medium grit. Use the emery cloth with a rotary motion.
6. Inspect the gland for rust and clean and remove rust as required.
7. Inspect the gland end of the tube for sharp edges that will cut the gland O-ring. Remove as required.
8. Inspect the piston for damage and wear. If the piston is damaged or worn, a new piston must be used.

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GENERAL PROCEDURE — CLEANING THE HYDRAULIC SYSTEM

BHF0601GB

Cleaning the Hydraulic System

Note:
- This procedure requires the special tools **CAS-10162A-Portable Filter** and the **CAS-10508-Fitting kit** .

1. Prepare the portable filter by carrying out the following steps:
   a. Remove all the hydraulic oil from the inlet and outlet hoses for the portable filter.
   b. Remove the filter element from the portable filter.
   c. Remove all hydraulic oil from the portable filter.
   d. Clean the inside of the housing for the filter element.
2. Check if the contamination is microscopic or visible. For additional information, refer to HYDRAULIC OIL CONTAMINATION in this section.
3. If the contamination is microscopic:
   a. Check the maintenance schedule for the machine to see if the hydraulic oil is due to be changed. If required, change the hydraulic oil and hydraulic filter.
   b. Carry out Steps 6 through to 32.
4. If the contamination is visible:
   a. Change the hydraulic oil and hydraulic filter.
   b. Carry out Steps 5 through to 32.
5. Check the amount of contamination in the hydraulic system by carrying out the following steps:
   a. Disassemble one cylinder from two different circuits. Check for damage to seals, scoring of the cylinder wall, etc. Repair the cylinders as necessary.
   b. If the damage to the cylinders appears to be caused by severe contamination and is not the result of normal wear, it is necessary to remove, clean and repair valves, pump, lines, cylinders, hydraulic reservoir, etc. in the hydraulic system.
6. Position a suitable clean container under the hydraulic reservoir drain plug.

   Note:
   - Make sure the valve in the fitting kit (CAS-10508) is in the closed position.

   Note:
   - Some oil will be lost during this operation, replace the drain plug with the valve as quickly as possible.

7. Remove the drain plug from the hydraulic reservoir and install a suitable valve from the fitting kit (CAS-10508) into the drain plug hole.
8. Fill with hydraulic oil as required.
9. Connect the inlet hose of the portable filter to the valve that is installed in the drain plug hole.
10. Remove the hydraulic reservoir filler cap.
11. Install the outlet hose of the portable filler through the filler cap into the hydraulic reservoir.
12. Open the valve installed in the drain plug hole.

13. Move the switch for the portable filter to the ON position. Start and run the engine at 1500 rpm.
14. Run the portable filter for 10 minutes.
15. Continue to run the portable filter and increase the engine speed to full throttle. Heat the oil to operating temperature by doing the following steps:
    a. Hold the bucket control lever in the ROLLBACK position for 15 seconds.
    b. Return the bucket control lever to NEUTRAL for 30 seconds.
    c. Repeat Steps 14a and 14b until the oil in the hydraulic system is at operating temperature.
16. Continue to run the engine at full throttle and continue to run the portable filter.
17. Operate each hydraulic circuit to completely extend and retract the cylinders. Continue to operate each hydraulic circuit twice, one after the other, for 45 minutes.
18. Decrease the engine speed to low idle.
19. Continue to run the portable filter for 10 minutes.
20. Stop the portable filter.
21. Stop the engine.
22. Remove the outlet hose of the portable filter from the hydraulic reservoir.
23. Close the valve that is installed in the drain plug hole.
24. Disconnect the inlet hose of the portable filter from the valve in the drain plug hole.
25. Position a suitable clean container under the hydraulic reservoir drain plug.

    ⚠ Warning:
    - **The hydraulic oil can be extremely hot, allow it to cool to a moderately warm temperature before proceeding. Failure to follow this instruction may result in personal injury.**

    Note:
    - Some oil will be lost during this operation, replace the valve with the drain plug as quickly as possible.

26. Remove the valve from the drain plug hole and install the hydraulic reservoir drain plug.
27. Remove the hydraulic filter element from the machine.
28. Install a new hydraulic filter element on the machine.
29. Fill with hydraulic oil as required.
30. Install the hydraulic reservoir filler cap.
31. Start the engine and check for oil leakage around the new hydraulic filter.
32. Stop the engine.

GENERAL PROCEDURE — FLUSHING WATER FROM THE HYDRAULIC SYSTEM

BHF0601GE

Flushing Water from the Hydraulic System

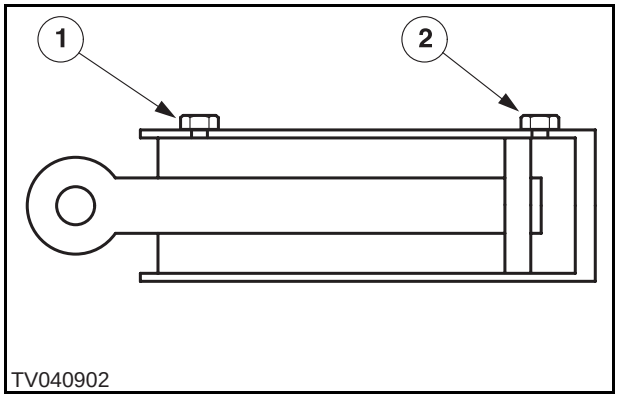
1. Start and run the engine at 1500 rpm.

⚠ Warning:
- **If retracting the hydraulic cylinder rods causes any part of an attachment to be in the raised position, secure the attachment in place using suitable hydraulic cylinder safety stops or lifting equipment. Failure to follow these instructions may result in personal injury.**

2. Completely retract all of the hydraulic cylinders.
3. Remove the filler cap from the hydraulic oil reservoir.
4. Drain the hydraulic oil into a suitable container and discard.
5. Install the drain plug in the hydraulic oil reservoir.
6. Replace the hydraulic oil filter.
7. Fill with hydraulic oil as required.
8. Move each hydraulic cylinder attachment control lever in all directions to release the hydraulic system pressure.

Note:
- Note the position of the hydraulic lines to aid installation.

9. Disconnect the hydraulic lines from the rod end (1) and cylinder end (2) of one of the hydraulic cylinders.



⚠ Caution:
- **Make sure the hydraulic cylinder control levers are in the neutral position.**

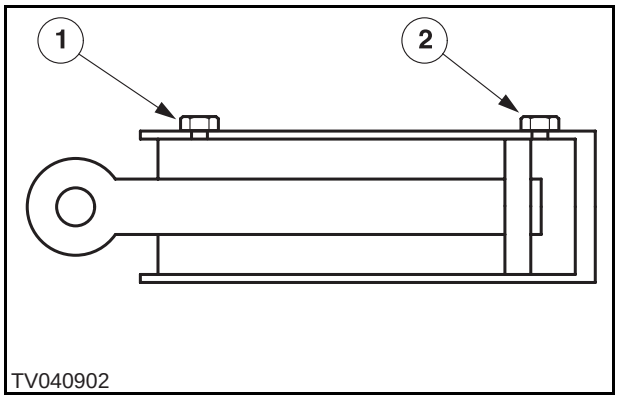
⚠ Caution:
- **Make sure the hydraulic oil level does not go below the minimum level or damage to the hydraulic system may occur.**

10. Start the and run the engine at low idle speed.
11. Position a suitable container under the disconnected hydraulic cylinder lines.

Note:
- Hold the control lever in each position until clean hydraulic oil is visible from the line(s).

12. Slowly move the control lever for the disconnected hydraulic cylinder in each direction until clean oil begins to flow from the open line(s).

13. Switch off the engine.
14. Connect the line to the cylinder end (2) of the disconnected hydraulic cylinder.
15. Connect a suitable hose to the rod end of the hydraulic cylinder (1) and place the open end in a suitable container.



⚠ Caution:
- **Make sure the hydraulic cylinder control levers are in the neutral position.**

⚠ Caution:
- **Make sure the hydraulic oil level does not go below the minimum level or damage to the hydraulic system may occur.**

16. Start and run the engine at low idle speed.

⚠ Warning:
- **Extending the hydraulic cylinder rod may cause a part of an attachment to move, support the attachment using suitable lifting equipment. Failure to follow this instruction may result in personal injury.**

⚠ Caution:
- **Oil will be forced out of the hydraulic cylinder and into the suitable container.**

17. Slowly and completely extend the disconnected hydraulic cylinder.
18. Switch off the engine.
19. Disconnect the suitable hose from the rod end of the hydraulic cylinder (1) and connect the disconnected hydraulic line.
20. Repeat steps 9 to 19 to clean the remaining hydraulic cylinders and lines.
21. Start and run the engine at 1500 rpm.
22. Fully operate all hydraulic cylinders in all directions.
23. Switch off the engine.
24. Check the hydraulic oil level and fill as required.
25. Install the hydraulic oil reservoir filler cap.

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GENERAL PROCEDURE — RELEASING THE HYDRAULIC SYSTEM PRESSURE

BHF0601GC

Inspection

All Vehicles

1. Park the machine on firm level ground.
2. Position the loader and backhoe flat on the ground.
3. Lower the rear stabilizer legs to the ground.
4. Switch off the engine.
5. Remove the hydraulic reservoir cap.
6. Operate the stabilizer control levers in all directions several times until the pressure is fully released.
7. Operate all the backhoe and the loader control levers and pedals in all directions several times.
8. Operate the loader auxiliary service control switches until the pressure is fully released.

Vehicles with Extendable Dipper

9. Turn the ignition switch to the ON position.
10. Operate the extendable dipper/auxiliary service changeover valve control switch.
11. Operate the extendable dipper/auxiliary service pedal until the pressure is fully released.
12. Switch off the ignition.

All Vehicles

13. Refit the hydraulic reservoir cap.

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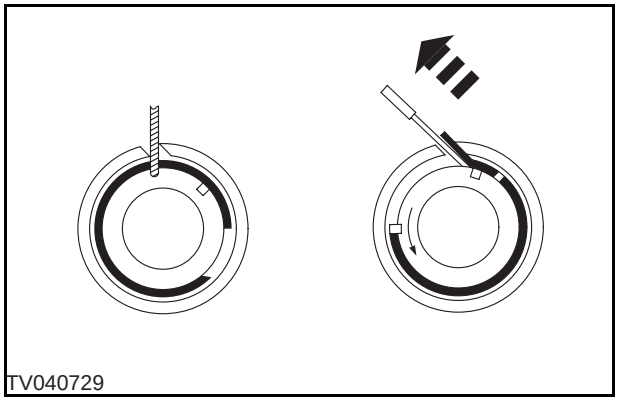
GENERAL PROCEDURE — HYDRAULIC CYLINDER RING LUG EXTRACTION

BHF0601GD

Extraction

A failed ring lug can be removed using the following process:

1. Through the insertion hole, centre punch the ring as near to the centre of the ring as possible.


TV040729

2. Refering to the diagram, use a size (B) drill, and drill through the ring and into the gland to the depth (C).

   ⚠ **Caution:**
   - **The drilled hole must not be drilled deeper than shown, or the drill may break through the gland, in which case the gland must be scrapped.**

3. Cut off a section of ring or piano wire of diameter (A), to the length (D) and insert it into the blind hole. This will now take the place of the lug and drive the broken ring out in the normal way.

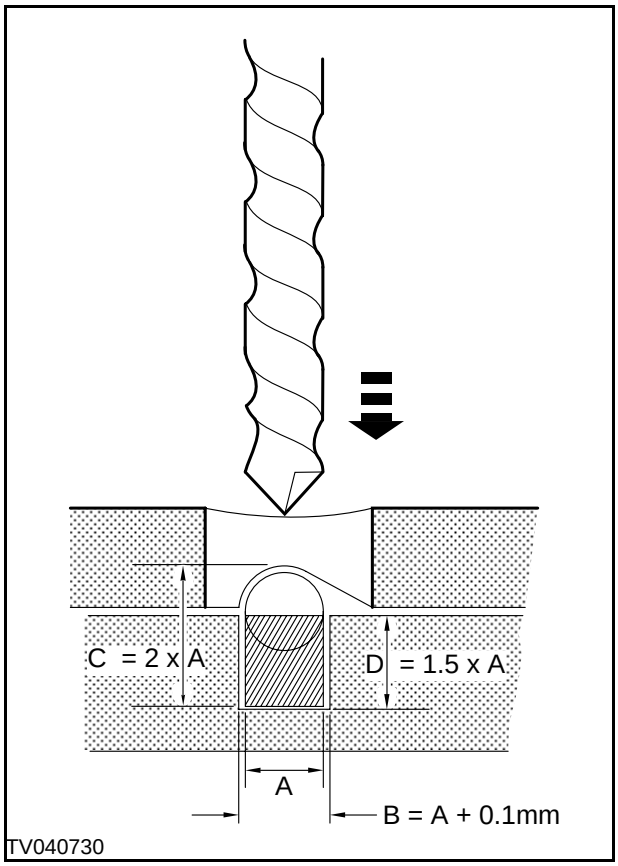
4. After complete withdrawal of the ring, pull the piston rod sharply out until it contacts the gland, this will normally remove it.

Note:

- In the event of failure to remove the gland in this way due to burrs around the ring grooves, it is suggested that either a hydraulic press or a hand operated pump be used to remove the gland.

⚠ **Warning:**

- **If a hydraulic pump is used to dismantle the gland from the cylinder, extreme care must be taken to purge all air from the cylinder before pressurisation. COMPRESSED AIR INSIDE THE CYLINDER AT THIS STAGE IS EXTREMELY DANGEROUS. Robust restraints should be attached to both the piston rod-eye and the cylinder mounting, as a further precaution. Failure to follow this instruction may result in personal injury.**



SPECIFICATIONS — MAIN HYDRAULIC SYSTEM

BHF0601SA

Torque Values

Cylinder	Cylinder Gland (Nm)	Lock screw (Nm)	Piston (Nm)	Stop screw (Nm)	Piston bolt (Nm)	Piston nut (Nm)
Dipper	320—550	23	—	—	1780–2180	—
Backhoe bucket	320–550	23	—	—	1780–2180	—
Loader bucket	320–55	23	2300–2500	23	—	—
Boom	320–550	23	2300–2500	23	—	—
Extendable dipper	—	—	—	—	—	790–810
Loader lift Models 820 and 760B	350–400	—	1000–1100	23	—	—
Loader lift Models 860(B) to 970	350–400	—	1170–1220	23	—	—
Slew	370–420	—	1050–1100	23	—	—
Stabiliser centremount	—	—	650–700	23	—	—
Stabiliser side shift	300–350	—	—	—	—	800–850

General Information

Hydraulics	820	860 – 970
Tandem Gear Pump Make	Commercial	
Pump 1 Flow	80 l/min	80 l/min
Pump 2 Flow	62 l/min	80 l/min
Pump 1 Pressure	225bar (225min – 232max)	225bar (225min – 232max)
Pump 2 Pressure	207bar (207min – 214max)	207bar (207min – 214max)
Control Valves	Closed Center Type and Inlet Compensator	
Make	Rexroth	
Loader Control Valve Type	SX14 – 3 Spool	
Backhoe Control Valve Type	SX14 – 7 Spool	
Spool Leakage Oil Flow @ 100bar	11cc/min	
Compensator Pressure (Engine @ 1800rpm)	20bar (20min – 21max)	
Spool Stroke	16mm	
Tie Rod Nuts Tightening Torque	42Nm +/-4	
Ride Control System Gas	Nitrogen	
Gas Charge Pressure	25bar	

Capacity

System	Temperatures	Viscocity	Specification	Capacity	Notes
Hydraulics	Up to +30°C	ISO VG 46	DIN 51524	143 (Total System)	Tank Capacity = 85 Litre
	Up to +50°C	ISO VG 68			

Torque Values For JIC Hydraulic Hose Fittings

Hex. Size A/F		Termination Dash Size	Thread Size UNF	Machines Built With "Gates/Global" Hydraulic Hoses		Machines Built With "Manuli" Hydraulic Hoses	
mm	inch			Nm	Lb.ft	Nm	Lb.ft
—	9/16	04	7/16"-20	14	10	15	11
—	5/8	05	1/2"-20	18	13	20	15
—	11/16	06	9/16"-18	22	16	35	26
—	7/8	08	3/4"-16	41	30	50	37
24	—	10	7/8"-14	60	44	80	59
—	1	10	7/8"-14	60	44	80	59
27	—	10	7/8"-14	60	44	80	59
—	1 1/4	12	1 1/16"-12	90	66	100	74
—	1 1/2	16	1 5/16"-12	130	96	150	111

Torque Values For O-Ring Face Seal (ORFS) Hydraulic Fittings

Termination Dash Size	Inch Size	Thread Size UNF	Torque Value	
			Nm	Lb.ft
04	1/4	9/16–18	15	11
06	3/8	11/16–16	26	19
08	1/2	13/16–16	45	33
10	5/8	1–14	65	48
12	3/4	1 3/16–12	92	68
16	1	1 7/16–12	130	96
20	1 1/4	1 11/16–12	180	133
24	1 1/2	2–12	215	159

Torque Values For Split Flange Retaining Bolts

Size	Torque Value	
	Nm	Lb.ft
5/16–18	24	18
3/8–16	45	33
7/16–14	54	40
1/2–13	81	60
5/8–11	197	145

Torque Values For Dryseal Pipe (NPTF or Equivalent) Steel Fittings

Size Inch	Torque Value	
	Nm	Lb.ft
1/8	25	18
1/4	45	33
3/8	70	52
1/2	125	92
3/4	180	132
1	240	177
1 1/4	280	206

LOADER

G07
SECTION

REMOVAL AND INSTALLATION — FRONT LOADER BEAM..... G07–01–1
REMOVAL AND INSTALLATION — LOADER BEAM HYDRAULIC CYLINDER..... G07–01–7
REMOVAL AND INSTALLATION — FRONT LOADER HYDRAULIC CROWD CYLINDER..... G07–01–9
REMOVAL AND INSTALLATION — LOADER BUCKET POTENTIOMETER..... G07–01–13
DISASSEMBLY AND ASSEMBLY — LOADER BUCKET HYDRAULIC CYLINDER G07–01–15
GENERAL PROCEDURE — ANTI ROLLBACK ADJUSTMENT G07–01–19
GENERAL PROCEDURE — RETURN TO DIG ADJUSTMENT G07–01–21
SPECIFICATIONS — LOADER G07–01–23

REMOVAL AND INSTALLATION — FRONT LOADER BEAM

BHG0701RA

Operation: **Removing and Installing the Front Loader Beam**	*Job Code:* **07 08 13 xx**		
Suitable axle Stands Suitable lifting equipment	Standard tools, Suitable slide hammer		

Removal

All vehicles

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Park the machine on firm level ground.
2. Position the loader bucket flat on the ground.
3. Release the pressure from the hydraulic system, for additional information refer to Section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
4. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

Vehicles with Quick Attach Loader

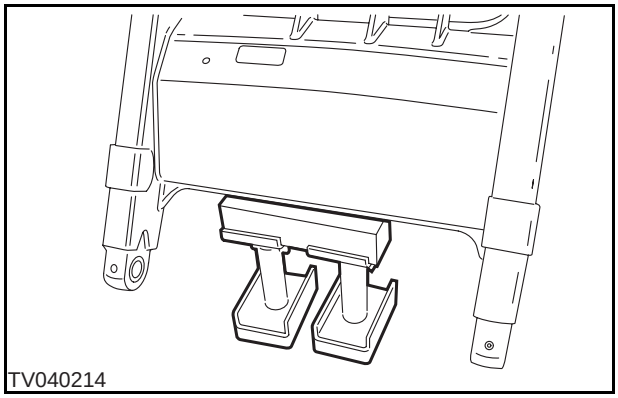
5. Remove the quick attach loader unit. For additional information, refer to Section A01-01 QUICK ATTACH LOADER UNIT, PAGE A01–01–5 .

Vehicles without Quick Attach Loader

6. Remove the standard loader bucket. For additional information, refer to Section B02-01 STANDARD LOADER BUCKET, PAGE B02–01–1 or B02-01 MULTI PURPOSE LOADER BUCKET, PAGE B02–01–3 .

All Vehicles

7. Remove the front loader hydraulic crowd cylinder. For additional information, refer to FRONT LOADER HYDRAULIC CROWD CYLINDER, PAGE G07–01–9 in this section.
8. Using suitable axle stands, support the front loader beam.


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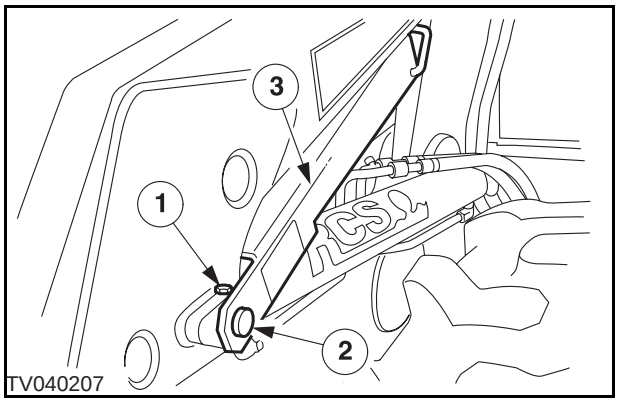
⚠ **Warning:**

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

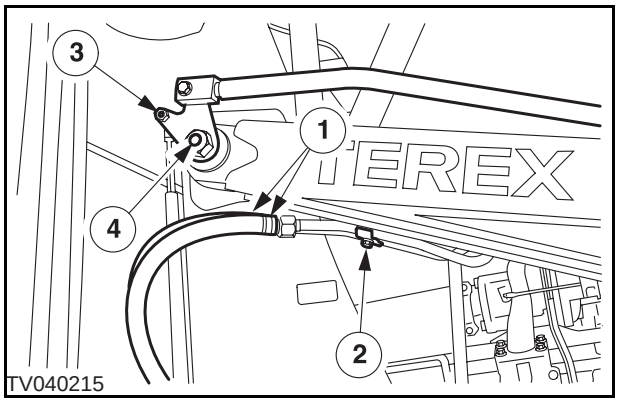
Note:

- Left-hand side shown, right-hand side similar.

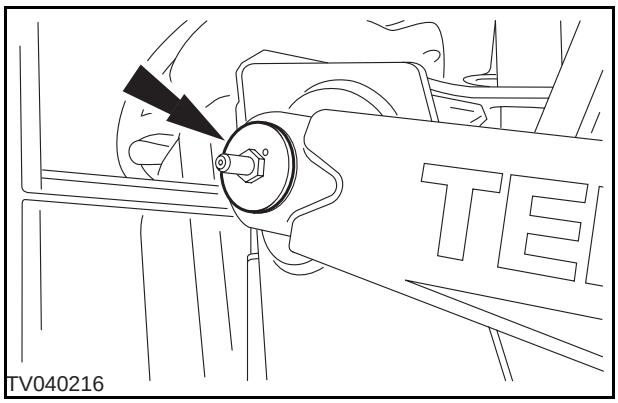
9. Using suitable lifting equipment, support the front loader hydraulic cylinder.
10. Remove the hydraulic cylinder pivot pin retaining bolt (1).
11. Remove the hydraulic cylinder pivot pin and detach the front loader hydraulic cylinder from the front loader beam (2).
12. Remove the loader beam safety strut (3).
13. Repeat steps 9 to 11 to detach the right-hand side front loader hydraulic cylinder from the front loader beam.



14. Disconnect the front loader hydraulic pipes (1).
15. Remove the hydraulic pipe retaining bracket (2).
16. Detach the feed back link strut from the feed back link bracket (3).
17. Remove the feed back link (4).

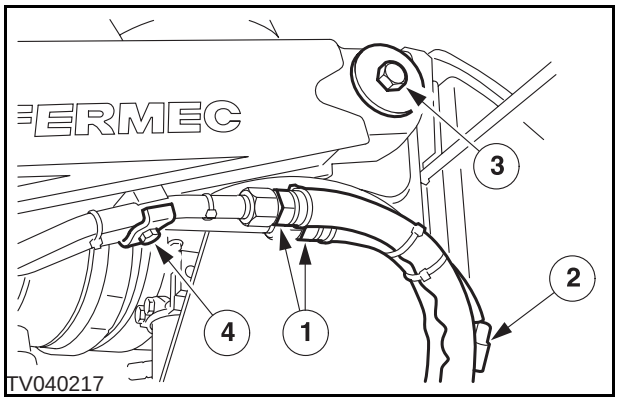


18. Remove the right-hand outer pivot pin retaining bolt.

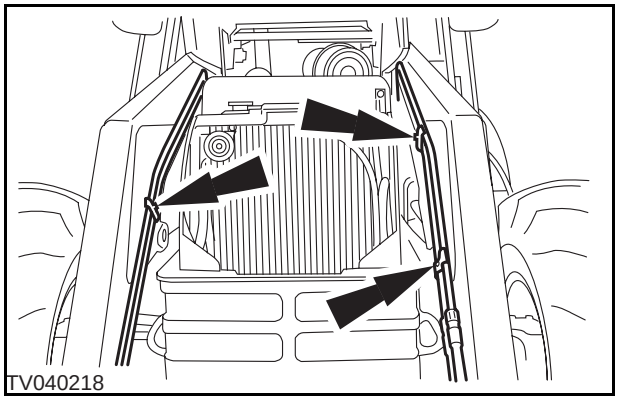


19. Disconnect the front loader crowd cylinder hydraulic pipes (1).
20. Disconnect the load potentiometer electrical connector. (2).
21. Remove the left-hand outer pin retainer bolt (3).
22. Detach the front loader hydraulic pipes (4).

Note:
- Cut the cable ties.

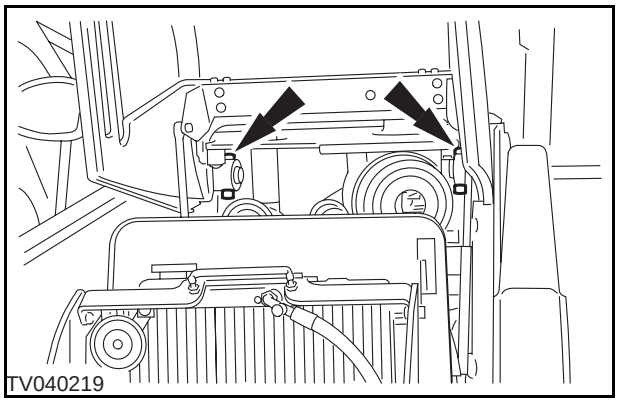


23. Remove the front loader and crowd cylinder hydraulic pipes.



24. Remove the air cleaner assembly. For further information, refer to Section P14-01 AIR CLEANER, PAGE P14–01–33 .

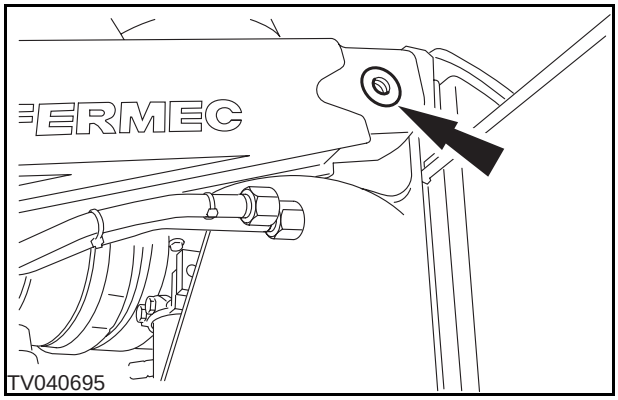
25. Remove the front loader beam upper pivot pin retaining bolts.



⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:
- Left-hand side shown, right-hand side similar.

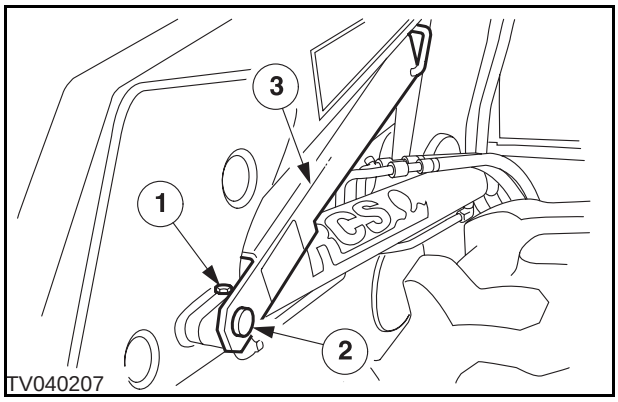
26. Using suitable lifting equipment, support the front loader arm.
27. Using a suitable slide hammer, remove the front loader beam upper pivot pins and remove the front loader beam.



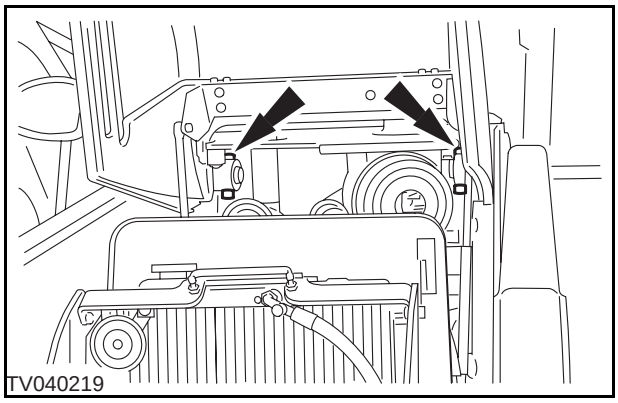
Installation

Note:
- Install new pivot pin lock nuts.

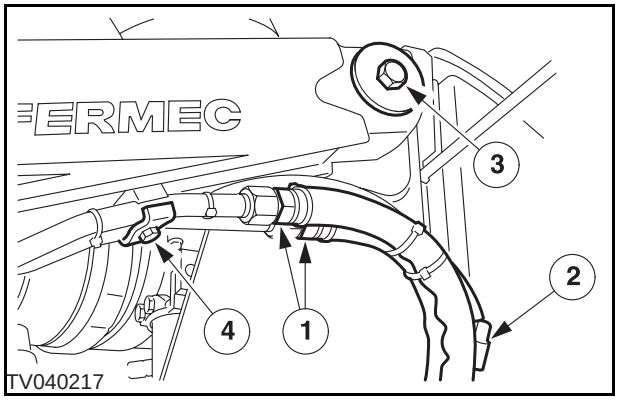
1. To install, reverse the removal procedure.
2. Tighten (1) to 48Nm (35 lb.ft).



3. Tighten to 67Nm (49 lb.ft).

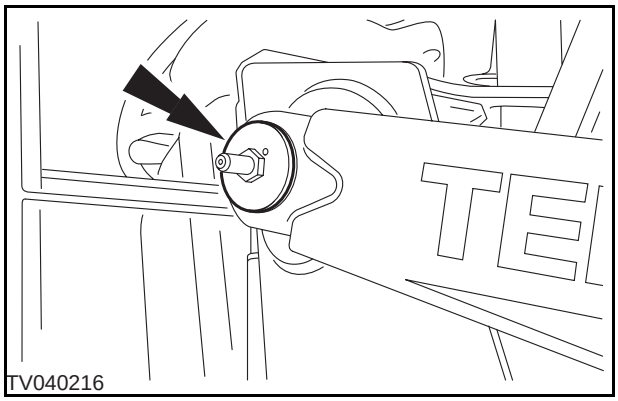

TV040219

4. Tighten (3) to 230Nm (170 lb.ft).



TV040217

5. Tighten to 230Nm (170 lb.ft).


TV040216

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REMOVAL AND INSTALLATION — LOADER BEAM HYDRAULIC CYLINDER

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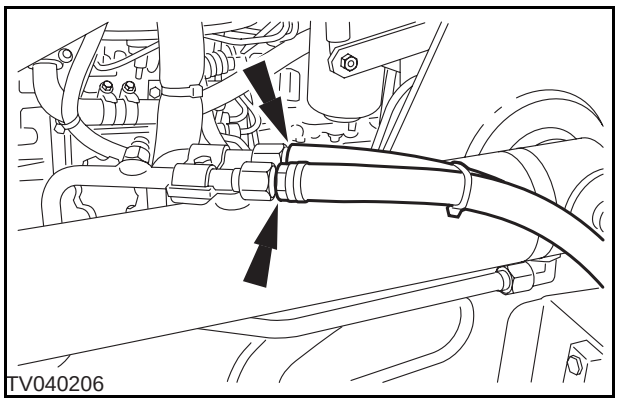
Operation: **Removing and Installing the Loader Beam Hydraulic Cylinder**	*Job Code:* **07 07 13 xx**		
Suitable lifting equipment	Standard tools, Suitable slide hammer		

Removal

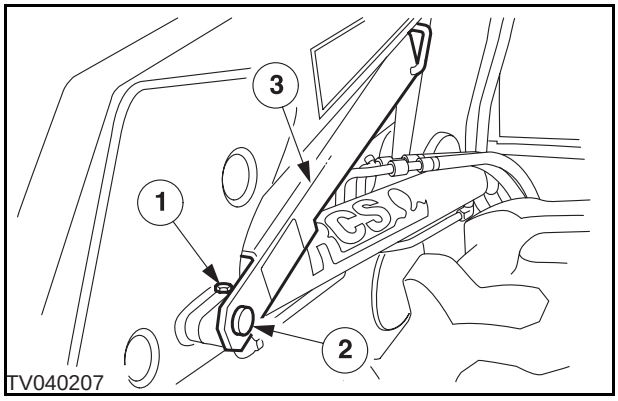
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Park the machine on firm level ground.
2. Position the loader bucket flat on the ground.
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
4. Release the pressure from the hydraulic system . For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
5. Disconnect the loader arm cylinder hydraulic hoses.


TV040206

6. Remove the hydraulic cylinder pivot pin retaining bolt (1).
7. Remove the hydraulic cylinder pivot pin (2).
8. Remove the loader arm safety strut (3).

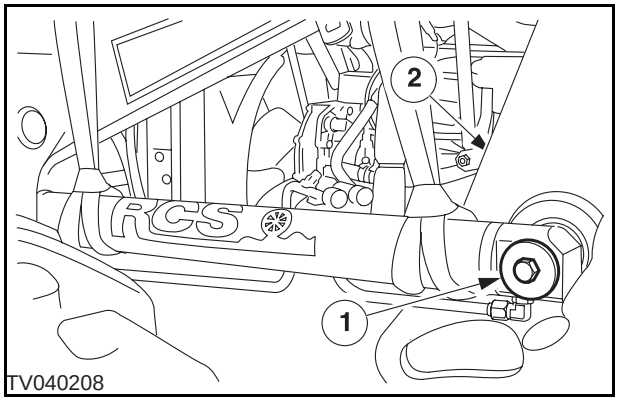


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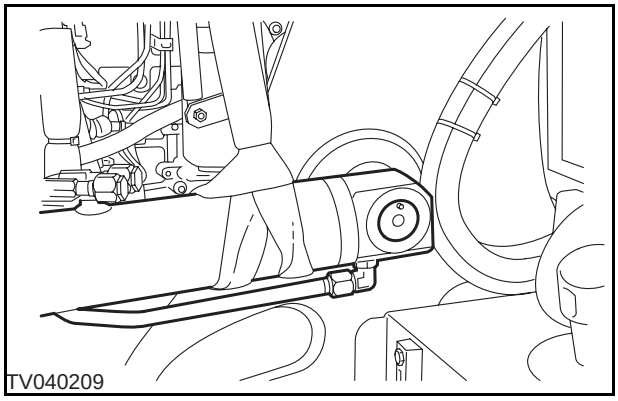
⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:
- Using suitable lifting equipment support the front loader cylinder.

9. Remove the hydraulic cylinder outer retaining bolt (1).
10. Remove the hydraulic pivot pin inner retaining bolt (2).



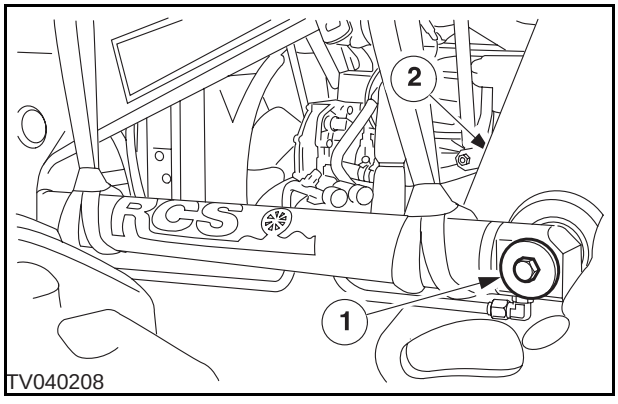
11. Using a suitable slide hammer, remove the cylinder pivot pin and remove the front loader cylinder.



Installation

Note:
- Install new pivot pin lock nuts.

1. To install, reverse the removal procedure.
2. Tighten to 230Nm (170 lb.ft).



3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — FRONT LOADER HYDRAULIC CROWD CYLINDER

BHG0701RC

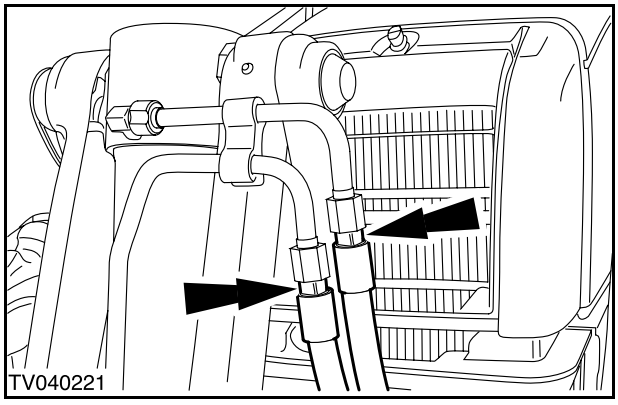
Operation: **Removing and Installing the Front Loader Hydraulic Crowd Cylinder**	*Job Code:* **07 01 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

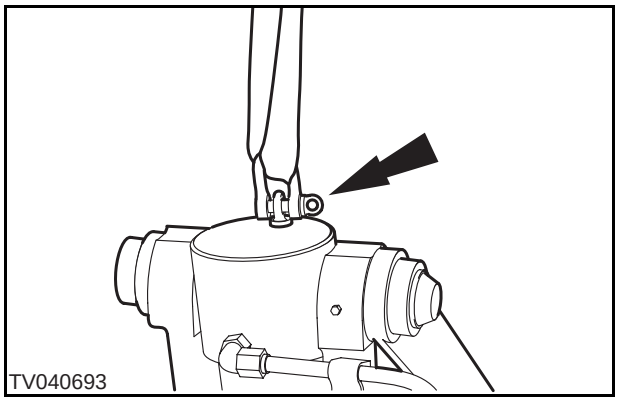
1. Park the machine on firm, level ground.
2. Position the loader bucket flat on the ground.
3. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–35 .
4. Release the pressure from the hydraulic system. For additional information, refer to section F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
5. Disconnect the front loader crowd cylinder hydraulic pipes.



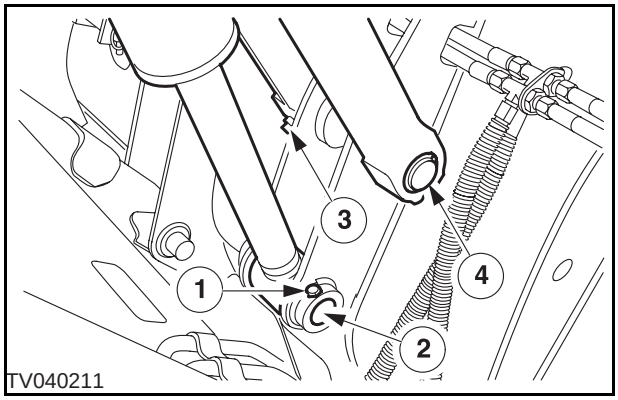
⚠ **Warning:**

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

6. Using suitable lifting equipment, support the front hydraulic crowd cylinder.

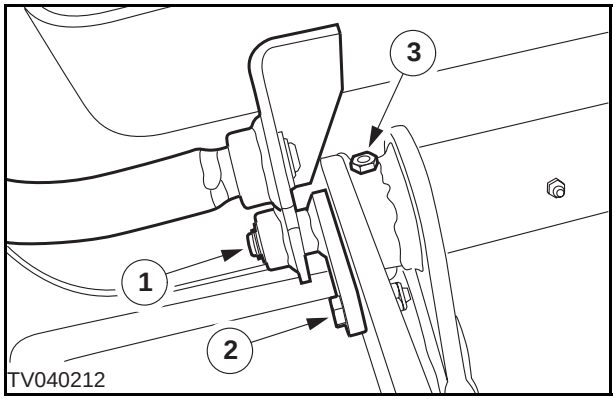

TV040693

7. Remove the hydraulic crowd cylinder pivot pin retaining bolt (1).
8. Detach the crowd cylinder from the front loader (2).
9. Remove the hydraulic crowd beam pivot pin retaining bolt (3).
10. Detach the hydraulic crowd beam from the front loader (4).



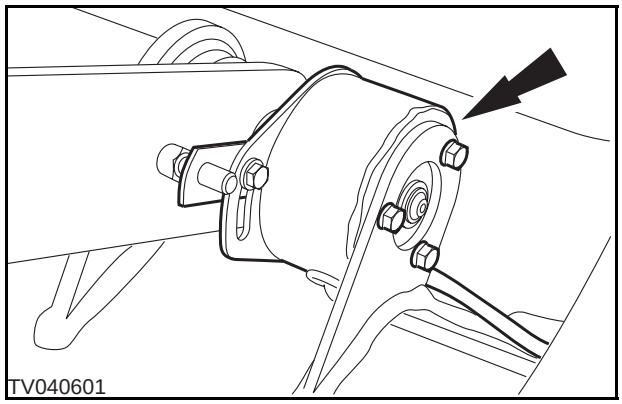
TV040211

11. Remove the circlip and detach the feed back link from the feed back link bracket (1).
12. Remove the feed back link bracket from the front loader crowd pin (2).
13. Remove the hydraulic crowd cylinder pivot pin retaining bolt (3).

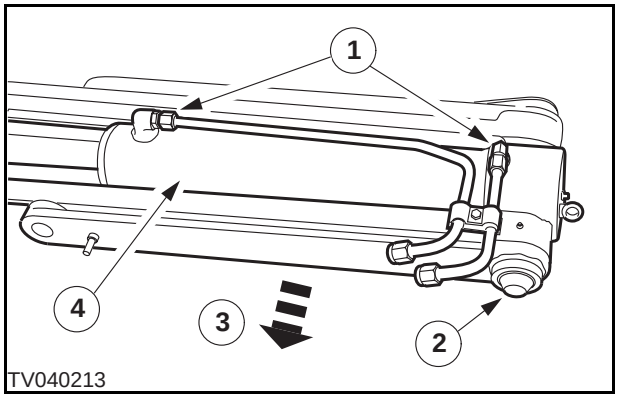


TV040212

14. Detach the automatic return to dig switch and position it to one side.



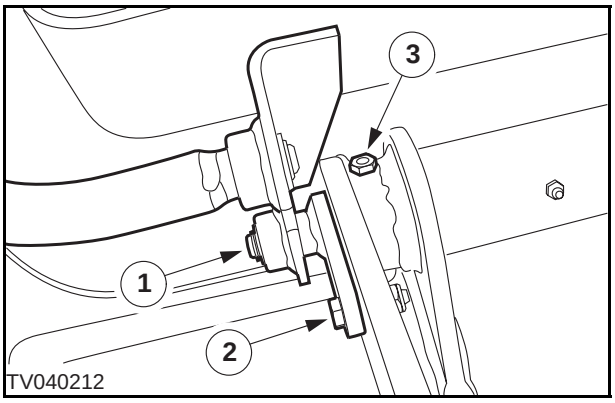
15. Disconnect and remove the hydraulic pipes from the crowd cylinder (1).
16. Remove the pivot pin circlip (2).
17. Remove the front loader hydraulic crowd beam (3) and hydraulic crowd cylinder (4).



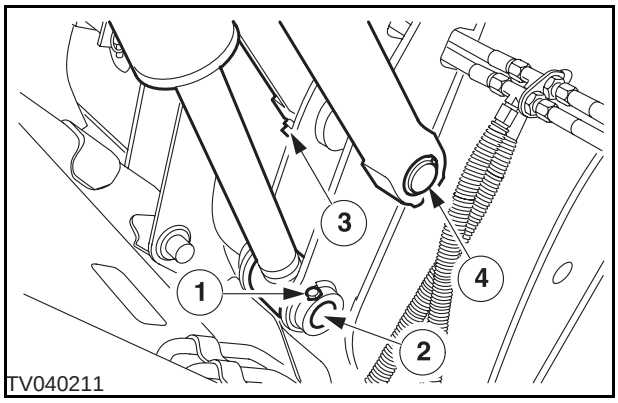
Installation

Note:
- Install new pivot pin lock nuts.

1. To install, reverse the removal procedure.
2. Tighten (2) and (3) to 10Nm (7 lb.ft).



3. Tighten (1) and (3) 10Nm (7 lb.ft).



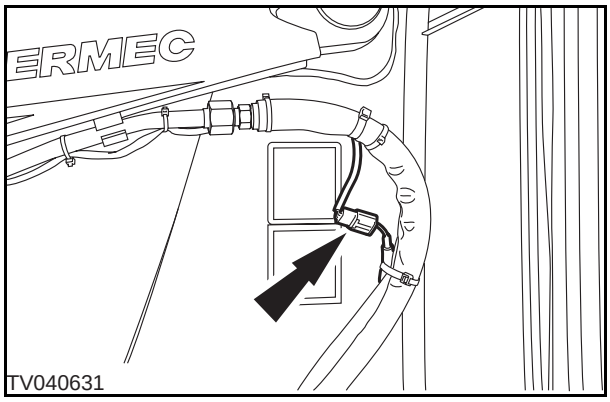
REMOVAL AND INSTALLATION — LOADER BUCKET POTENTIOMETER

BHG0701RD

Operation: **Removing and Installing the Loader Bucket Potentiometer**	*Job Code:* **07 09 13 xx**		
None	Standard tools		

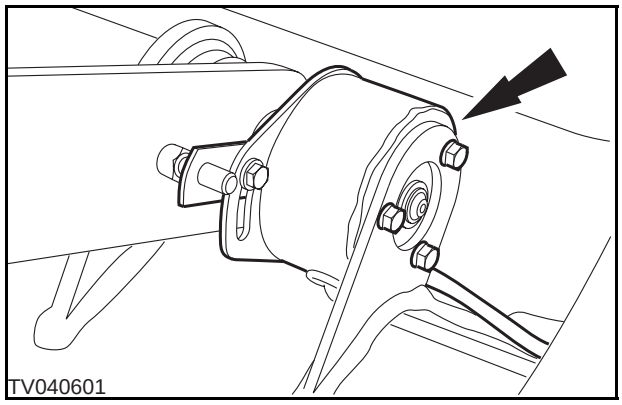
Removal

1. Position the loader bucket flat on the ground.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Disconnect the loader bucket switch electrical connector.
   - Cut the cable ties.



Note:
- Make a note of the position of the loader bucket switch prior to removal, to aid installation.

4. Remove the loader bucket switch.



Installation

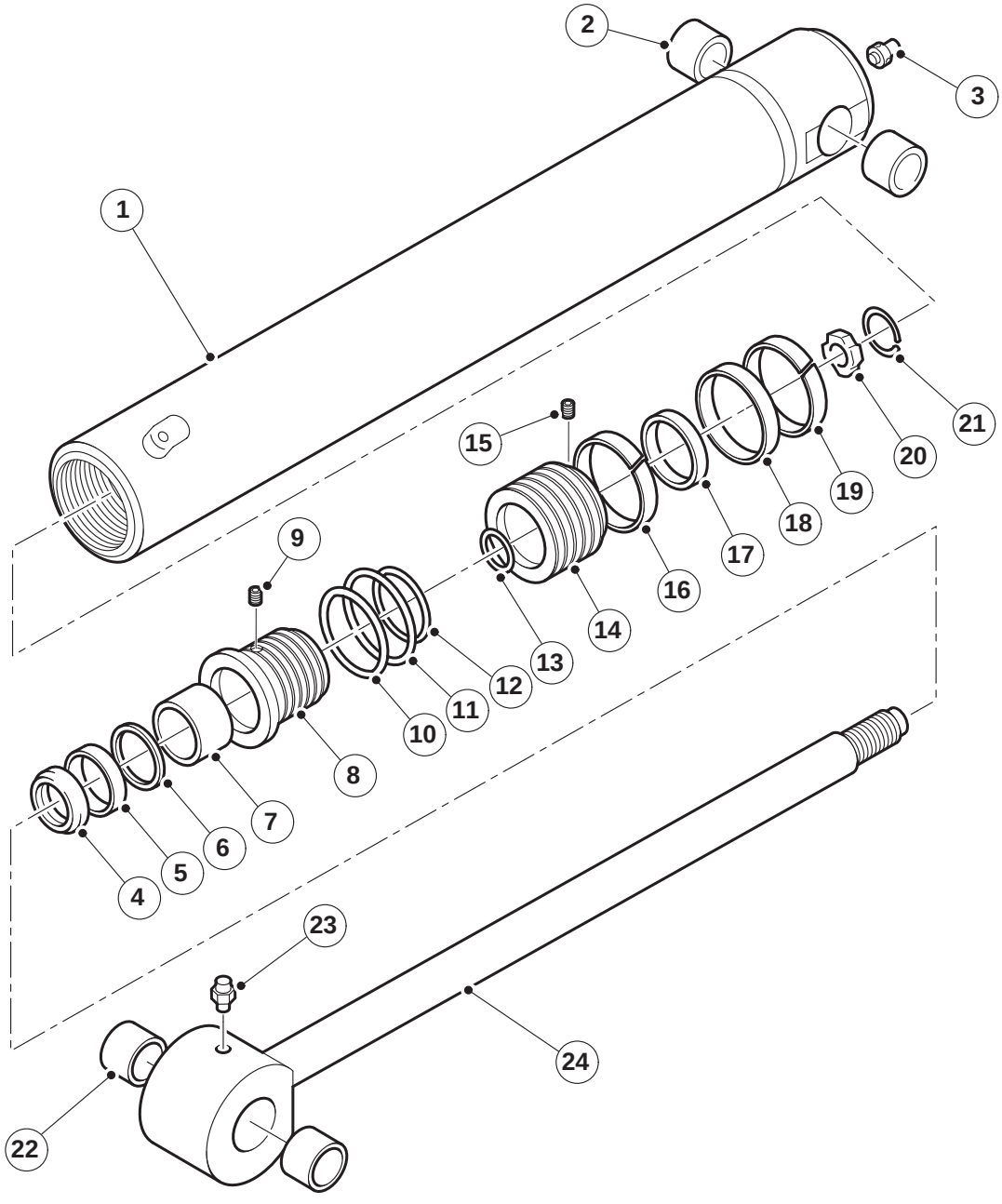
1. To install, reverse the removal procedure.

Note: This page intentionally left blank.

DISASSEMBLY AND ASSEMBLY — LOADER BUCKET HYDRAULIC CYLINDER

BHE0701DA

Operation: **Disassembling and Assembling the Loader Bucket Hydraulic Cylinder**	*Job Code:* **07 01 17 xx**		
Suitable lifting equipment	Standard tools, Suitable piston ring compression tool		



TV040503

1	Cylinder
2	Bush
3	Grease Nipple
4	Wiper Seal
5	Seal
6	Ring
7	Ring
8	Bush
9	Locking Screw
10	O-Ring
11	Back-up Ring
12	O-Ring
13	O-Ring
14	Piston
15	Locking Screw
16	Guide Ring
17	Ring
18	Seal
19	Guide Ring
20	Retaining Nut
21	Snap Ring
22	Bush
23	Grease Point
24	Piston Rod

Disassembly

⚠ Warning:
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ Caution:
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (1) in a soft jawed vice.
3. Remove the locking screw (9) from the bush (8) and cylinder (1).
4. Remove the bush (8) from the cylinder (1).
5. Pull the piston rod (24) straight out of the cylinder (1).
6. Fasten the piston rod eye (24) in a vice and put a support below the piston rod (24) near the piston.
7. Remove the snap ring (21) and the retaining nut (20) from the piston rod (24).
8. Remove the locking screw (15), and unscrew the piston (14) from the piston rod (24).
9. Remove the bush (8) from the piston rod (24).

10. Remove the guide ring (19), seal (18), ring (17), guide ring (16) and the O-ring (13) from the piston (14).
11. Remove the ring (12), O-ring (11), back-up ring (10), O-ring (9), ring (8), ring (6), seal (5) and wiper seal (4) from the bush (8).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (4), seal (5), ring (6), ring (7), back-up ring (10), O-ring (11) and ring (12) to the bush (8).
2. Install the O-ring (13), guide ring (16), ring (17), seal (18) and guide ring (19) to the piston (14).

Note:
- To aid installation of the bush, lubricate the bore of the bush with clean oil.

3. Install the bush (8) onto the piston rod (24).

⚠ Caution:
- **Do not apply Loctite to the first 7mm of the piston rod threads. Failure to follow this instruction may result in damage to the piston.**

4. Clean the threads on the end of the piston rod. Apply Loctite 242 to the piston rod threads from the open end of the piston rod.
5. Install the piston (14) onto the piston rod (24) and install the locking screw (15) and tighten to 23Nm (17 lb.ft).
6. Install the retaining nut (20) and the snap ring (21) onto the piston rod.
7. Lubricate the inside of the cylinder (1) and the piston (14) with clean oil. Use a piston ring compression tool to hold the new sealing rings in place.
8. Start the cylinder (1) onto the piston rod assembly. Push the tube onto the piston rod assembly until the compression tool is pushed off the piston rod assembly. Be careful not to damage the carrier rings and seals.
9. When the piston (14) is in the smooth part of the cylinder (1), start the bush (8) into the cylinder (1).
10. Tighten the bush (8) to a torque between 320 and 550Nm. When the locking screw holes become aligned in this torque range, install the lock screw. Tighten the lock screw to 23Nm (17 lb.ft).

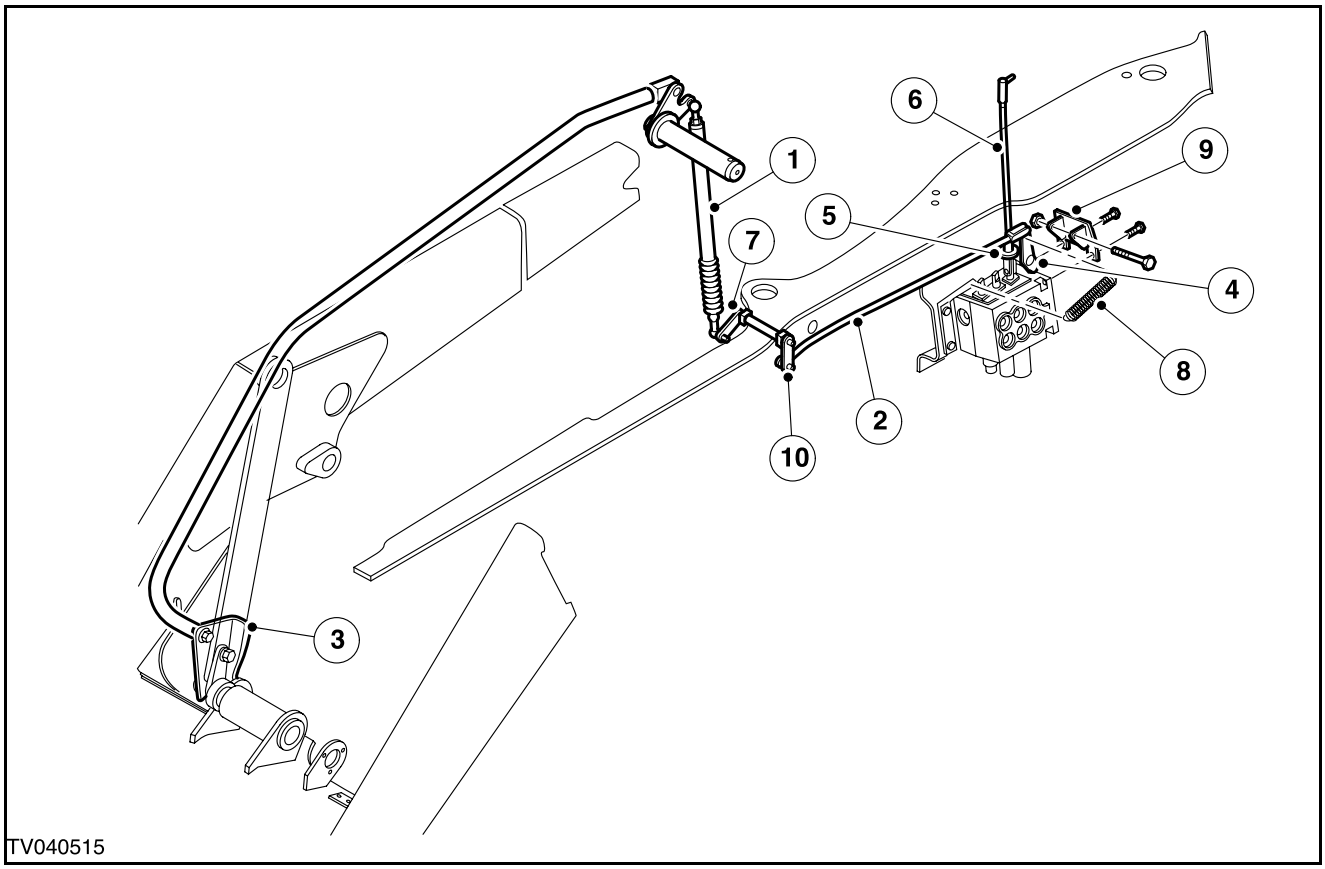
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GENERAL PROCEDURE — ANTI ROLLBACK ADJUSTMENT

BHG0701GA

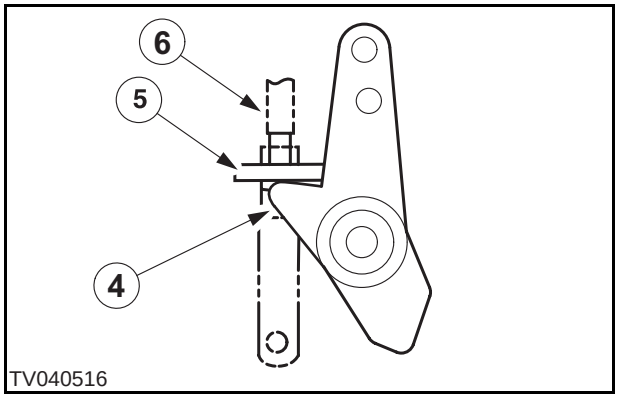
Adjustment Procedure

1. Park the machine on firm level ground and engage the parking brake.
2. Raise the lift arm until the bucket commences to self level (roll forward).
3. Check the height of the bucket (lift arm pivot should be 1200 to 1400 mm above ground).
4. If the height is above or below the recommended measurement, carry out the following procedure.
5. Make sure the loader controls are set correctly.
6. Position the bucket/lift arm pivot pin 675 mm above the ground.
7. Roll back the bucket until contact stops on the lift arm (fully crowded).
8. Make sure the link assembly (3) is in contact with the bucket link.



TV040515

9. Adjust the strut (1) until the lever (4) just makes contact with the disc (5) on the bucket control rod (6) in neutral position.



TV040516

10. If excessive adjustment of the strut (1) is required, position the lever (7) as required.
11. Lower the lift arm to the ground.
12. Raise the lift arm until the bucket commences to self level (roll forward).
13. Check the height of the bucket (lift arm pivot should be 1200 to 1400 mm above ground).
14. Check that the lever (7) does not contact the cab cross member when the loader is fully raised and lowered.

Note:

- Rod assembly (2) standard length should be 723 mm.

Note:

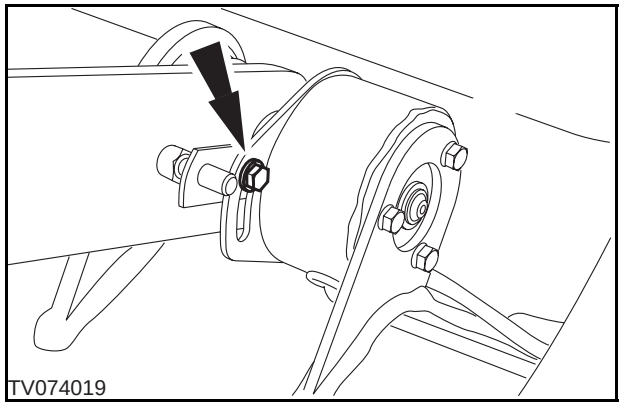
- Gas strut (1) standard length should be 610 mm.

GENERAL PROCEDURE — RETURN TO DIG ADJUSTMENT

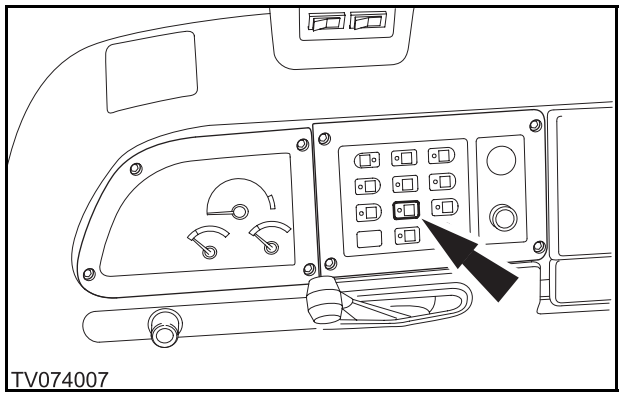
BHG0701GB

Adjustment Procedure

1. Park the machine on firm level ground and engage the parking brake.
2. Lower the loader bucket to the ground and make sure that the bottom of the bucket is at the required digging angle.
3. Stop the engine and remove the starter switch key.
4. Disconnect the return to dig electrical connector and place a multimeter across the switch side of the connector.
5. Unscrew the return to dig switch lock bolt and slide the switch in the groove until the multimeter reads open circuit, then tighten the bolt.


TV074019

6. Remove the multimeter and re-connect the electrical connector.
7. Start the engine, raise the loader attachment completely and place the bucket in the dump position.
8. Press the return to dig override switch to illuminate the light.


TV074007

9. Place the control lever in the return to dig position to enable the bucket to reset.
10. Lower the arms to the ground and check the digging angle. Adjust if necessary.

Note:

- If a multimeter is not available, set the return to dig switch to the middle position and test the system, adjusting as necessary.

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SPECIFICATIONS — LOADER

BHG0701SA

Torque Values

Description	Nm	Lb.ft
Lock Screw	23	17
Bush	320–550	236–405
Left-hand Outer Pin Retainer Bolt	230	170
Right-hand Outer Pin Retainer Bolt	230	170
Upper Pivot Pin Retaining Bolt	67	49
Pivot Pin Lock Nuts	48	35
Hydraulic Ram Cylinder Outer Retaining Bolt	230	170

OPERATORS ENVIRONMENT

H08
SECTION

REMOVAL AND INSTALLATION — CAB H08–01–1
REMOVAL AND INSTALLATION — CAB HEATER AIR DUCTING H08–01–13
REMOVAL AND INSTALLATION — CAB HEATER MOTOR H08–01–17
REMOVAL AND INSTALLATION — CAB HEATER MATRIX H08–01–19
REMOVAL AND INSTALLATION — DRIVER SEAT (ALL MODELS) H08–01–23
REMOVAL AND INSTALLATION — CAB DOOR GLAZING PANEL H08–01–25
REMOVAL AND INSTALLATION — AIR CONDITIONING EVAPORATOR H08–01–27
REMOVAL AND INSTALLATION — REAR WINDOW OPEN POSITION LATCH H08–01–31
REMOVAL AND INSTALLATION — SERVO CONTROL JOYSYICK H08–01–33
REMOVAL AND INSTALLATION — CONTROLS TILT PEDAL H08–01–37
REMOVAL AND INSTALLATION — HOSE REMOVAL AND INSTALLATION H08–01–41
GENERAL PROCEDURE — AIR CONDITIONING RECOVERY AND CHARGING H08–01–45
SPECIFICATIONS — OPERATORS ENVIRONMENT H08–01–49

REMOVAL AND INSTALLATION — CAB

BHH0801RA

Operation: **Removing and Installing the Cab**	*Job Code:* **08 08 13 xx**		
Suitable lifting equipment, Suitable wheel chocks	Standard tools		
Vehicles with Air Conditioning			
Vehicles without Air Conditioning			

Removal

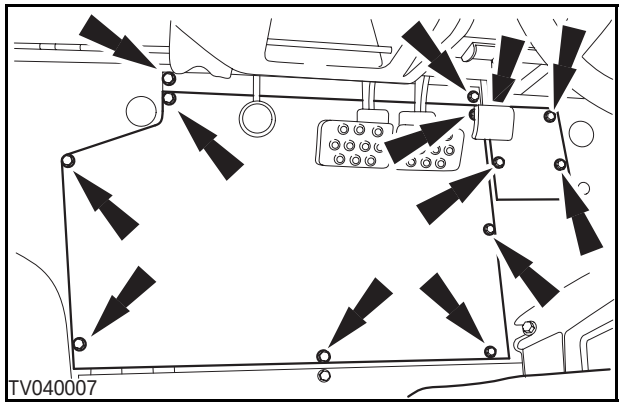
Note:
- Make a note of the position of any pipes / hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

⚠ **Warning:**
- **Place suitable wheel chocks against the wheels to prevent vehicle movement. Failure to follow this instruction may result in personal injury.**

All Vehicles

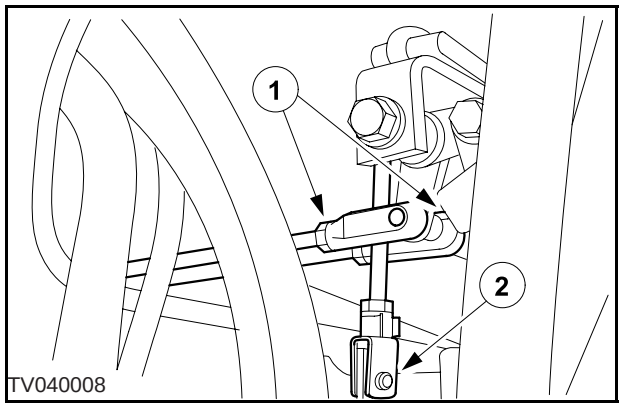
1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Evacuate the air conditioning system (where fitted). For additional information, refer to AIR CONDITIONING RECOVERY AND CHARGING, PAGE H08–01–45 in this section.
3. Remove the cab floor mat.
4. Remove the cab floor access panel(s).



Note:
- Make a note of the position of the auxiliary service control linkage prior to disconnection, to aid installation.

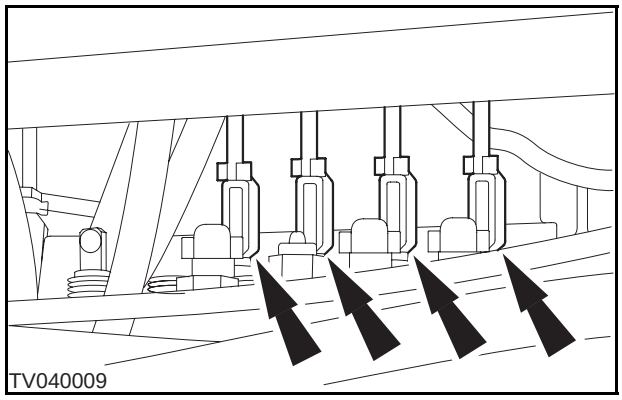
5. Disconnect the auxiliary service control linkage (2).

6. Disconnect the stabilizer legs control linkage (1).

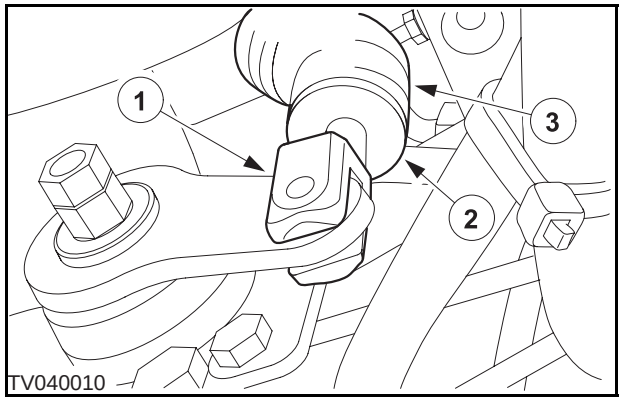


Note:
- Make a note of the position of the backhoe control linkage prior to disconnection, to aid installation.

7. Disconnect the backhoe control linkages.

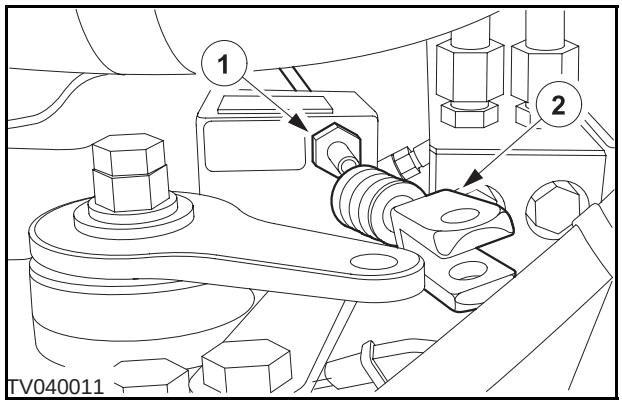


8. Remove the parking brake cable retaining clip (1).
9. Remove the parking brake return spring retainer (2).
10. Remove the parking brake return spring (3).



11. Remove the parking brake cable adjustment nut (1).

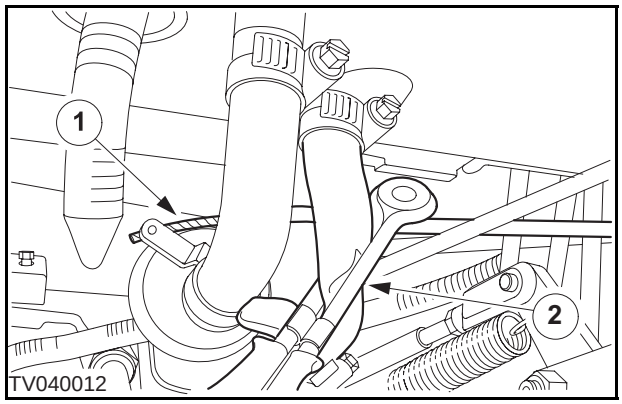
12. Detach the parking brake cable (2).



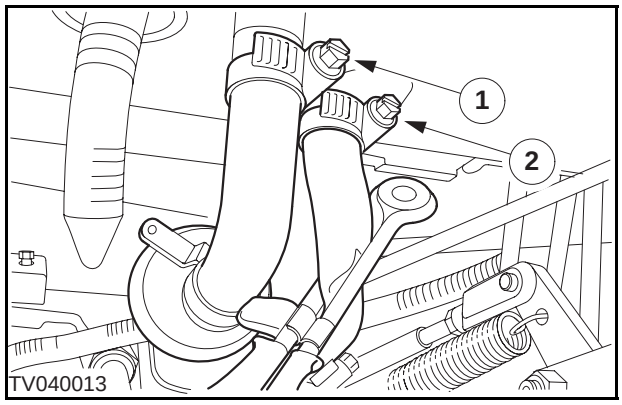
13. Turn the heater control fully to the COLD position.
14. Remove the heater control cable retaining clip (1).

Note:
- Make sure the heater control valve is still in the COLD position.

15. Detach the heater control cable (2).
16. Clamp the heater return hose (3).

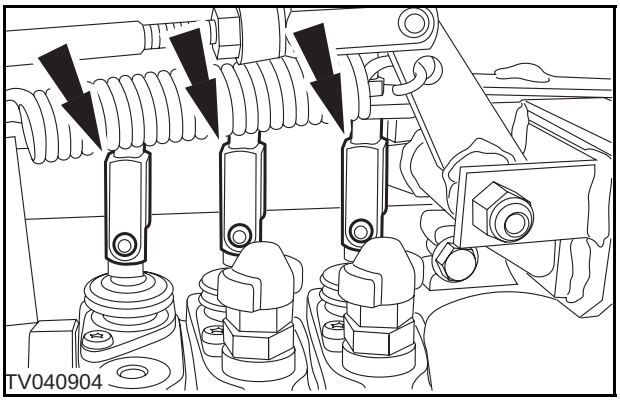


17. Disconnect the heater inlet hose (1).
18. Disconnect the heater return hose (2).

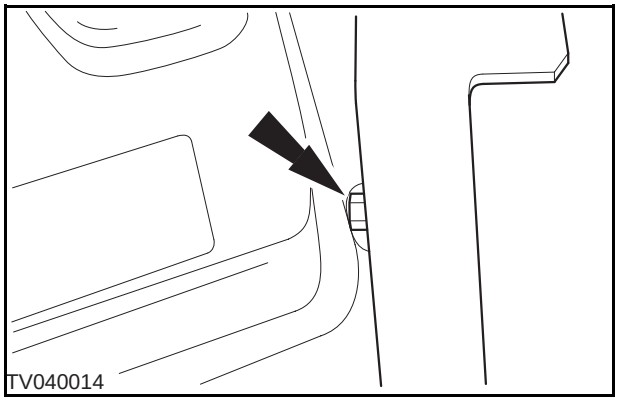


Note:
- Make a note of the position of the loader control linkages prior to disconnection, to aid installation.

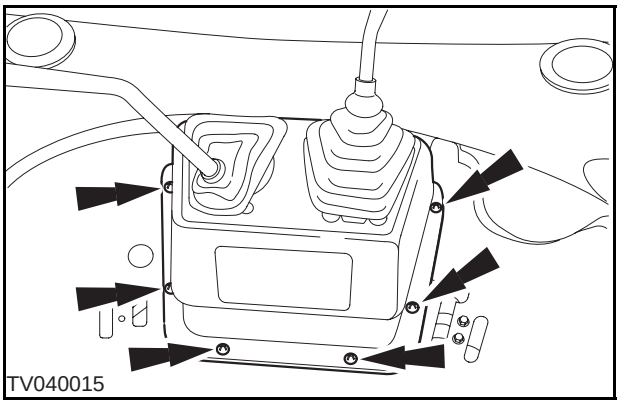
19. Disconnect the loader control valve linkage (cab shown removed for clarity).


TV040904

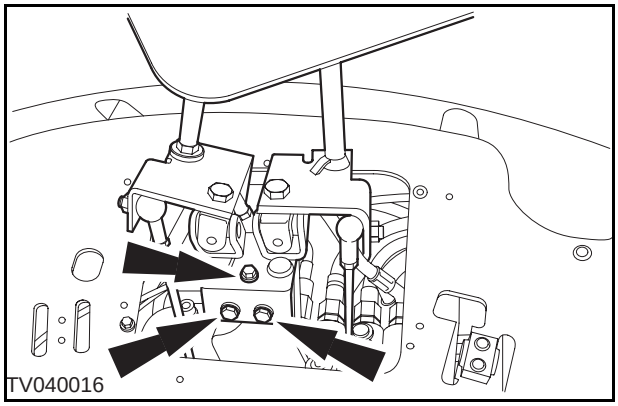
20. Remove the retaining nut and remove the auxiliary service pedal.


TV040014

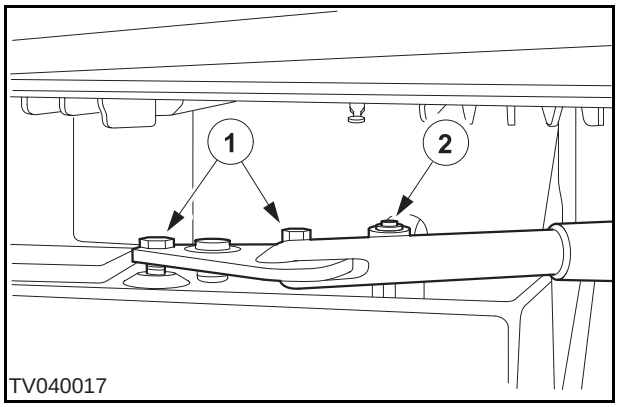
21. Remove the rear cab floor mat.
22. Detach the backhoe control trim cover.


TV040015

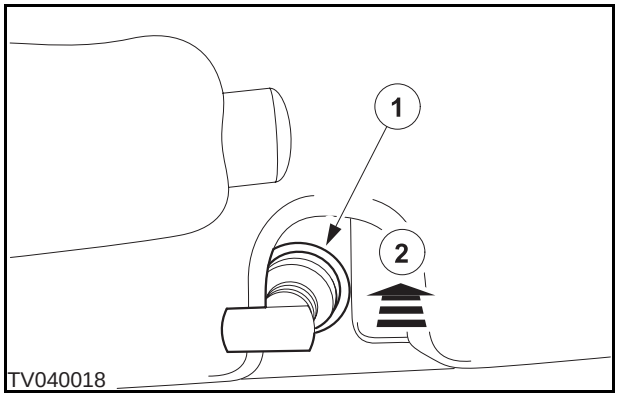
23. Remove the backhoe control levers.


TV040016

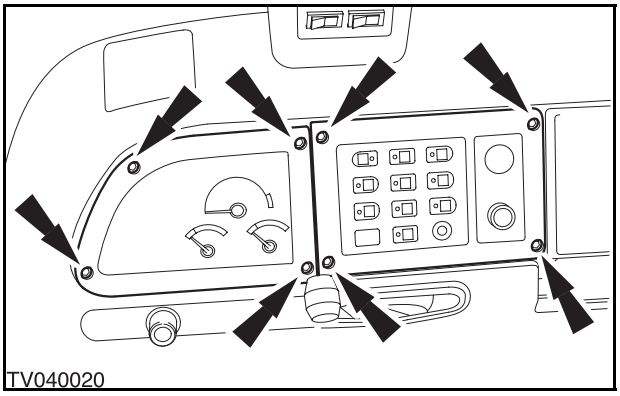
24. Remove the backhoe lock lever retaining bolts (1).
25. Remove the backhoe lock cable retaining pin (2).
26. Remove the lever.



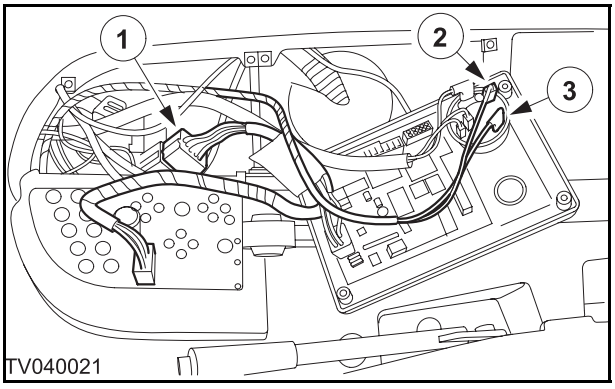
27. Remove the backhoe lock cable retaining clip (1) and push the cable through the floor (2).



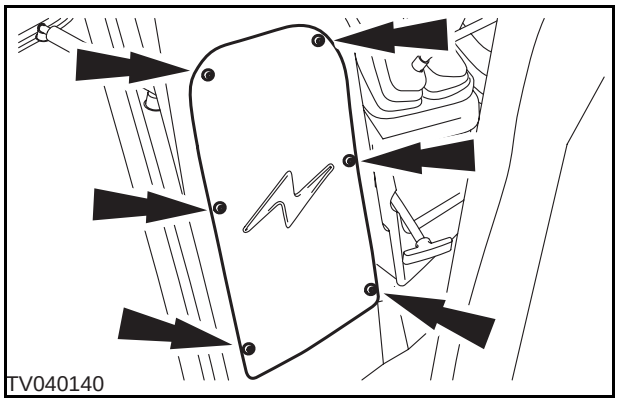
28. Detach the instrument cluster and the switch panel.



29. Disconnect the instrument cluster electrical connector (1).
30. Disconnect the ignition switch electrical connectors (2) and (3).

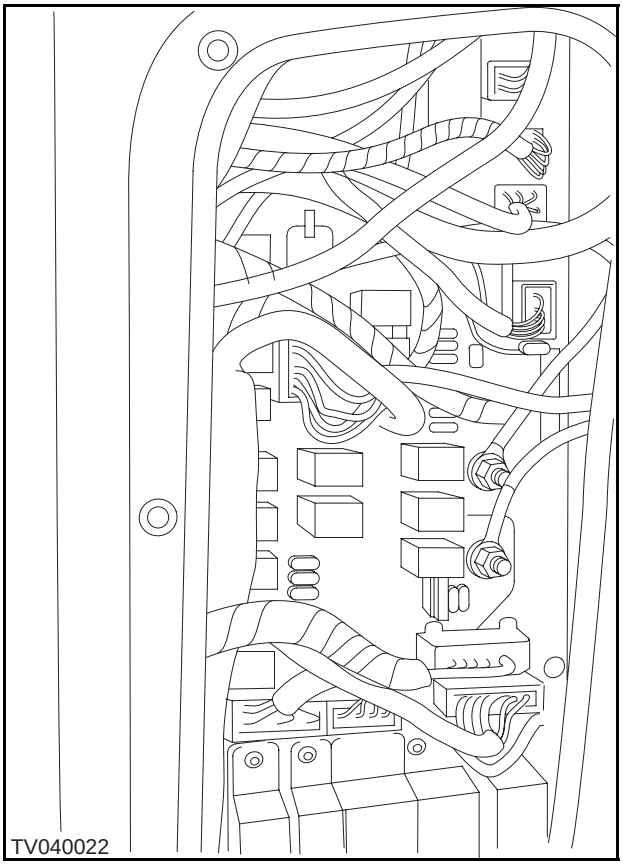


31. Remove the fuse panel cover.

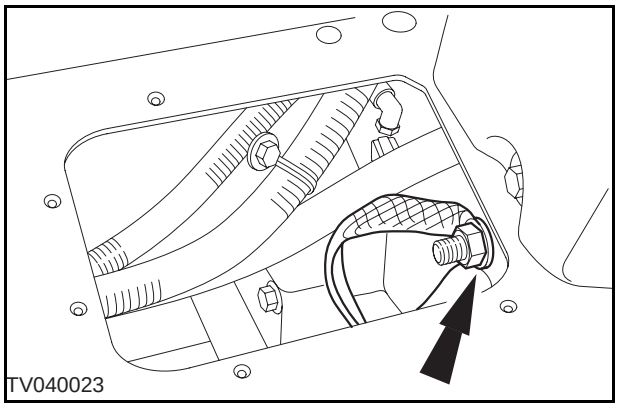


Note:
- Make a note of the position of the electrical connectors to aid installation.

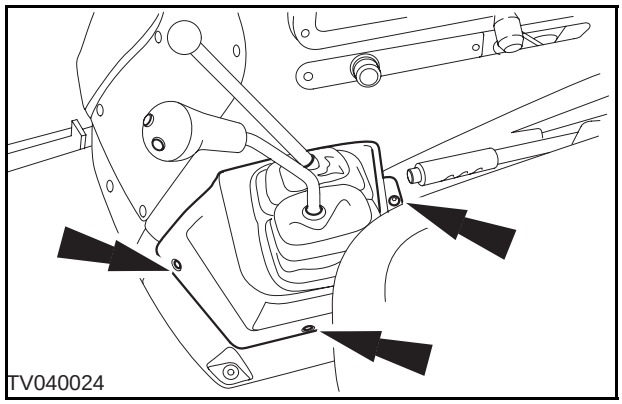
32. Disconnect the fuse box electrical connectors and push the wiring harness through the bottom of the cab.



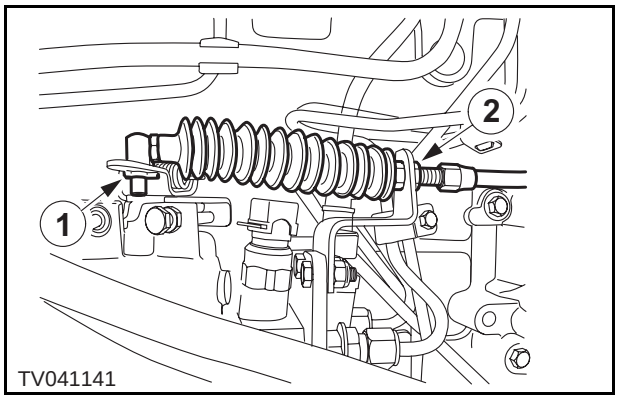
33. Disconnect the earth strap.



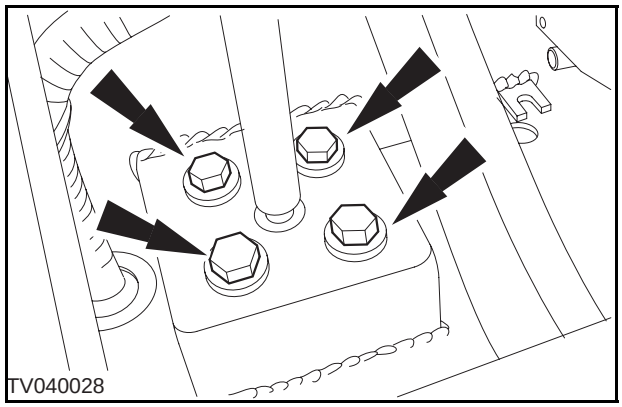
34. Detach the front loader control lever trim.
35. Disconnect the front loader lever electrical connector.



36. Remove the retaining clip (1).
37. Loosen the throttle cable adjustment nut (2) and detach the throttle cable from the fuel pump.

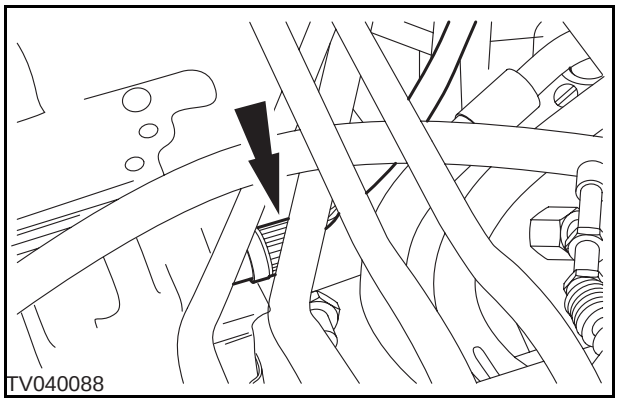


38. Remove the steering motor retaining bolts.



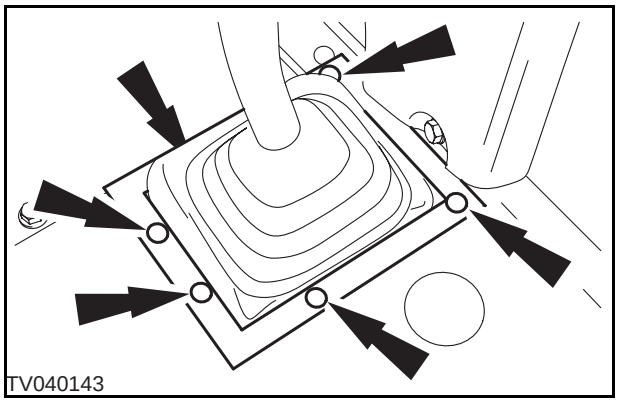
Vehicles with Powershift Transmission

39. Disconnect the powershift electrical connector.

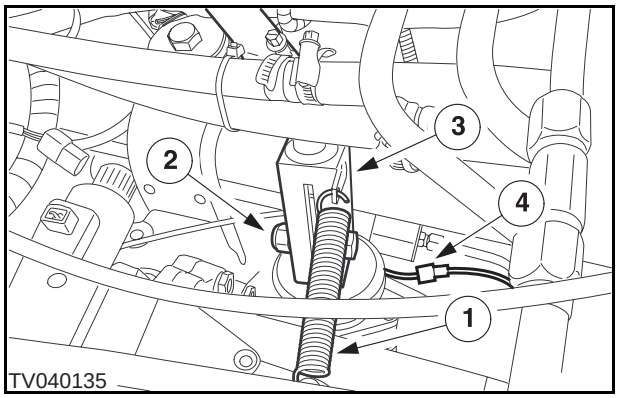


Vehicles with Synchro-shuttle Transmission

40. Remove the gearshift lever boot trim cover.

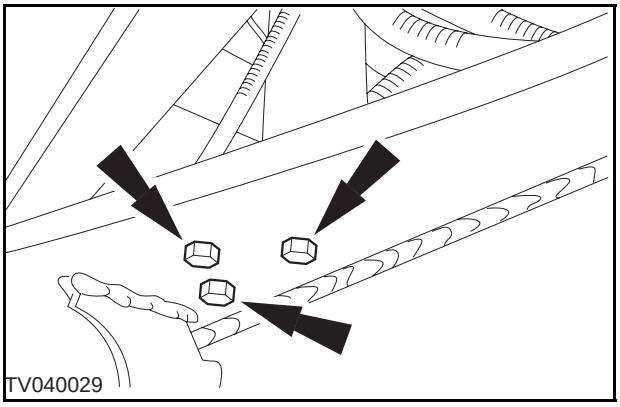


41. Remove the gearshift lever return spring (1).
42. Remove the gearshift lever retaining bolt (2).
43. Remove the gearshift selector lever (3).
44. Disconnect the dump button electrical connector (4).

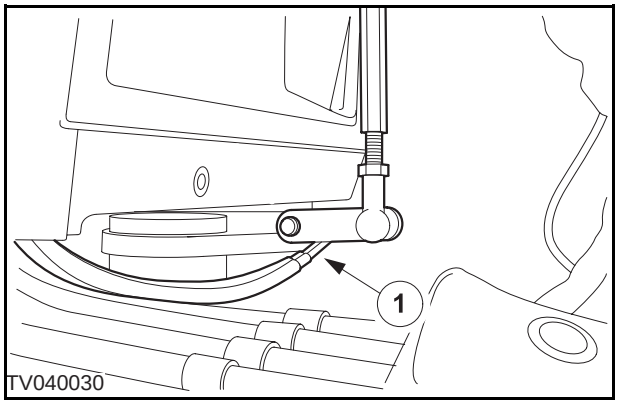


All Vehicles

45. Remove the rear fenders. For additional information, refer to Section K10-01 REAR FENDER, PAGE K10–01–1 .
46. Remove the front loader levers and linkage.



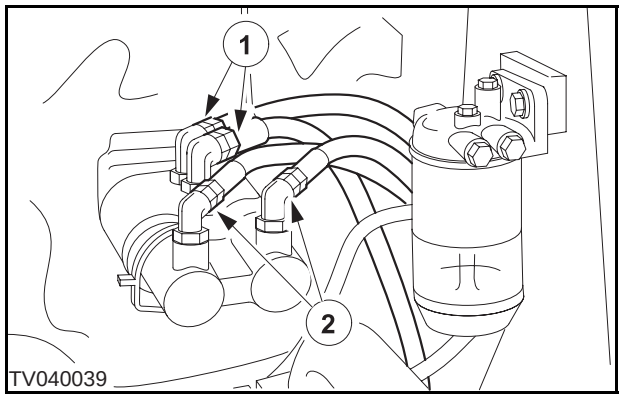
47. Disconnect the window washer tubes (1).



48. Remove the air cleaner. For additional information, refer to Section P14-01 AIR CLEANER, PAGE P14–01–33 .

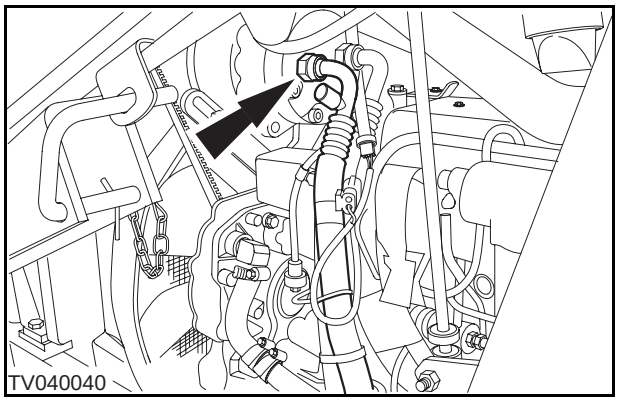
    Note:
    - Install blanking plugs to avoid contamination.

49. Disconnect the master cylinder supply and return hoses from the master cylinder (1).
50. Disconnect the left-hand and right-hand brake supply hose (2).



51. Disconnect the air conditioning low pressure pipe.

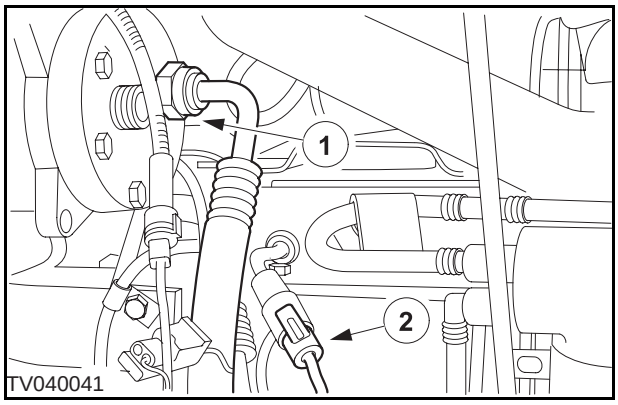
    Note:
    - Remove and discard the O-ring seals.



52. Disconnect the air conditioning high pressure pipe (1).

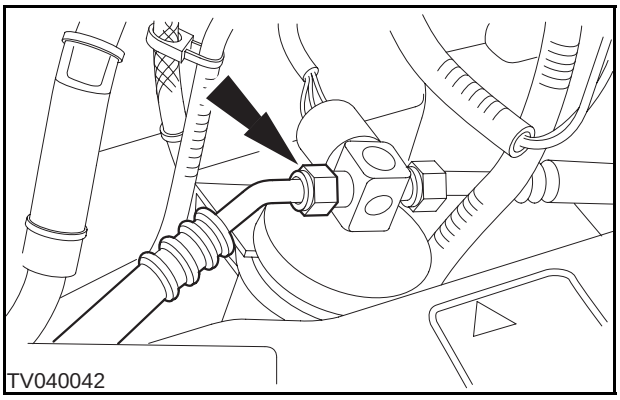
    Note:
    - Remove and discard the O-ring seals.

53. Disconnect the glow plug electrical connector (2).

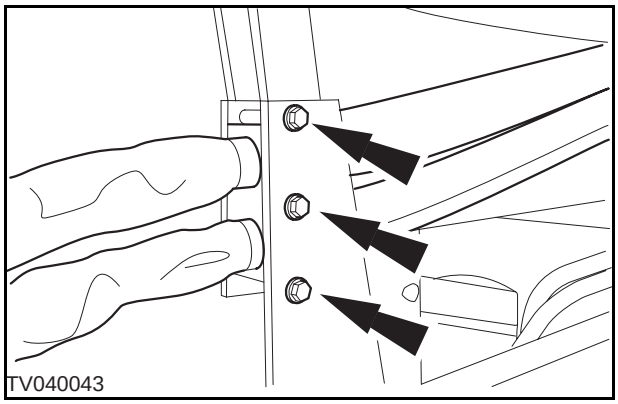


54. Disconnect the air conditioning filter/drier pipe.

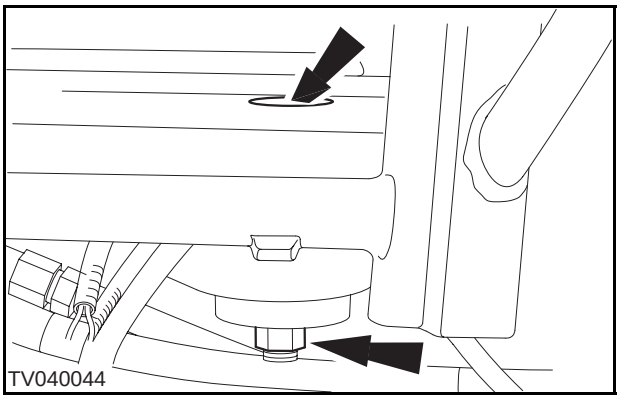
Note:
- Remove and discard the O-ring seals.



55. Detach the auxiliary service hoses and position to one side.



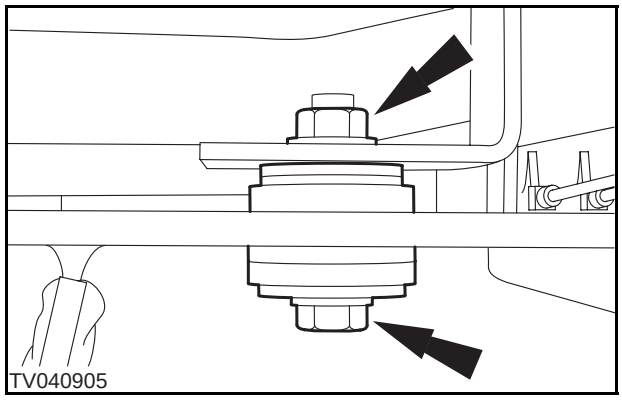
56. Remove the front cab mounting bolts (left-hand side shown, right-hand side similar).



57. Remove the rear cab mounting bolts (left-hand side shown, right-hand side similar).

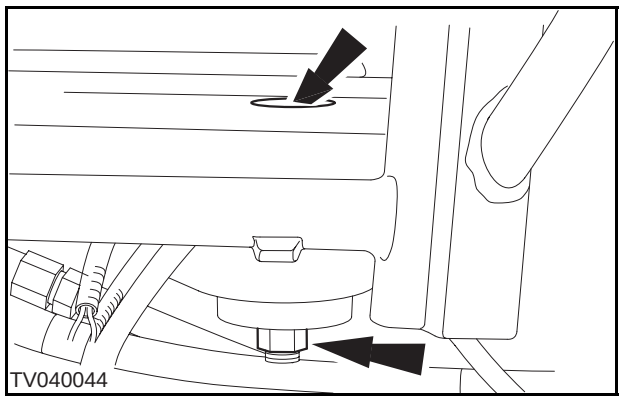
⚠ Warning:
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

58. Using suitable lifting equipment, remove the cab.

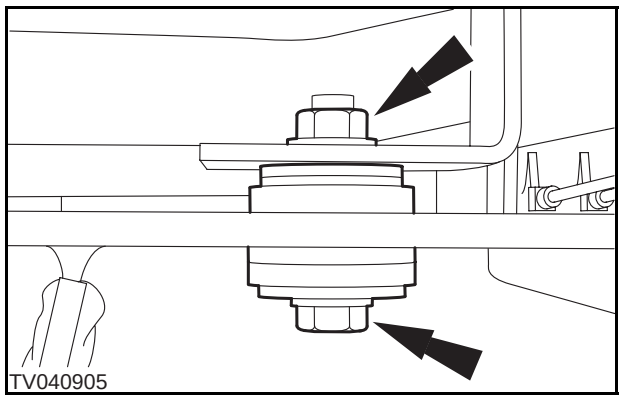


Installation

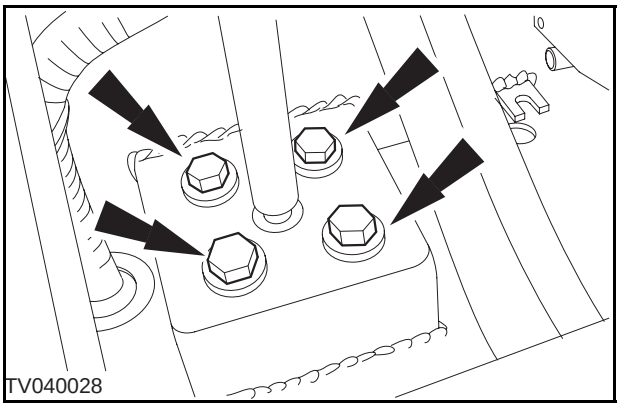
1. To install, reverse the removal procedure.
2. Tighten to 395Nm (291 lb.ft).



3. Tighten to 395Nm (291 lb.ft).



4. Tighten to 24Nm (18 lb.ft).



5. Bleed the brake system. For additional information, refer to section N13-03 BRAKE BLEEDING, PAGE N13–03–19 .
6. Adjust the parking brake cable. For additional information, refer to the Operator's Manual.
7. Recharge the air conditioning system. For additional information, refer to Section AIR CONDITIONING RECOVERY AND CHARGING, PAGE H08–01–45 in this section.

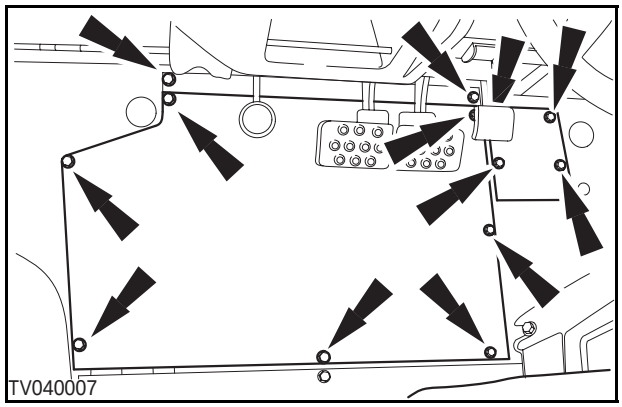
REMOVAL AND INSTALLATION — CAB HEATER AIR DUCTING

BHH0801RB

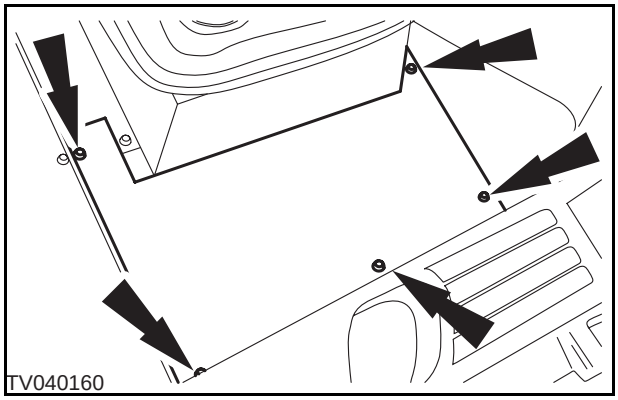
Operation: **Removing and Installing the Cab Heater Air Ducting**	*Job Code:* **08 38 13 xx**		
Suitable transmission jack	Standard tools		

Removal

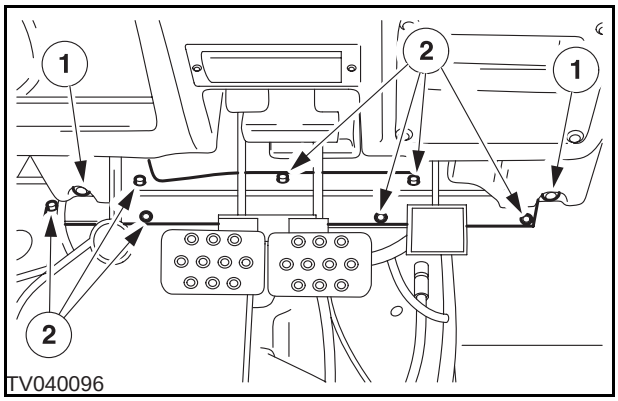
1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the cab front mat.
3. Detach the cab rear mat and position it to one side.
4. Remove the cab floor front access panel(s).


TV040007

5. Remove the cab floor rear access panel.

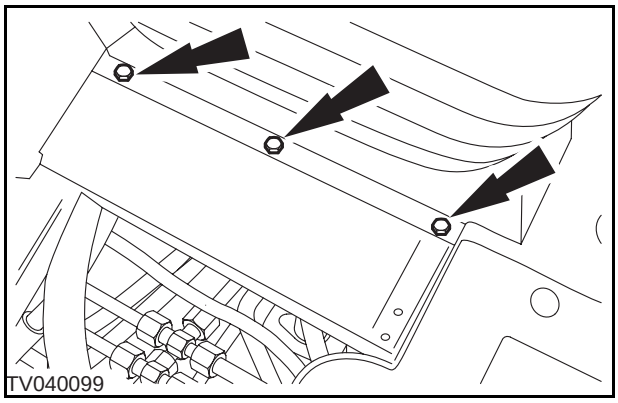

TV040160

6. Remove the front console lower retaining bolts (1).
7. Remove the pedal box floor plate (2).

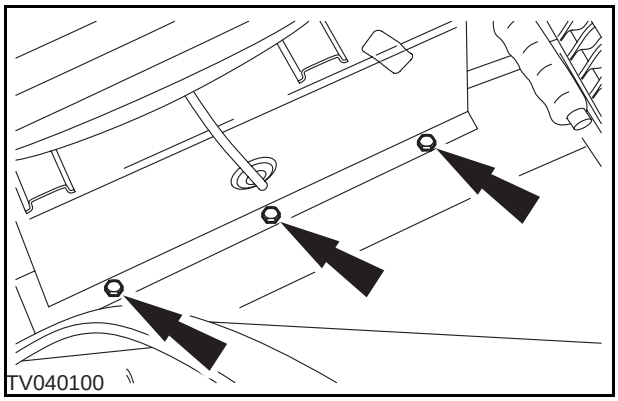


TV040096

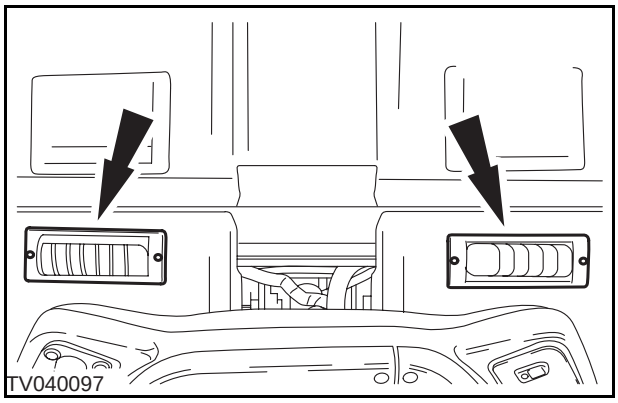
8. Remove the seat box front retaining bolts.



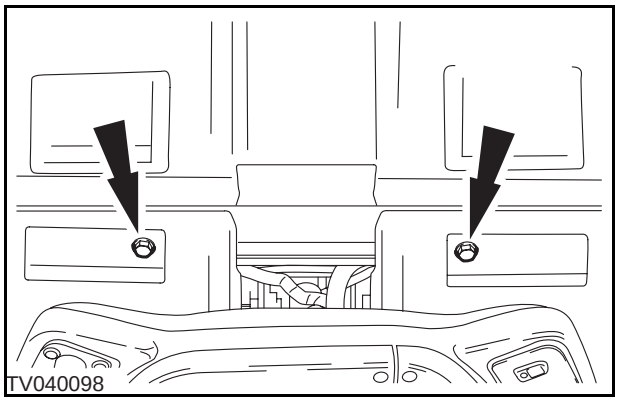
9. Remove the seat box rear retaining bolts.
10. Pull the seat away from the back of the cab, away from the ducting.



11. Remove the front console upper air vents.



12. Remove the front console.

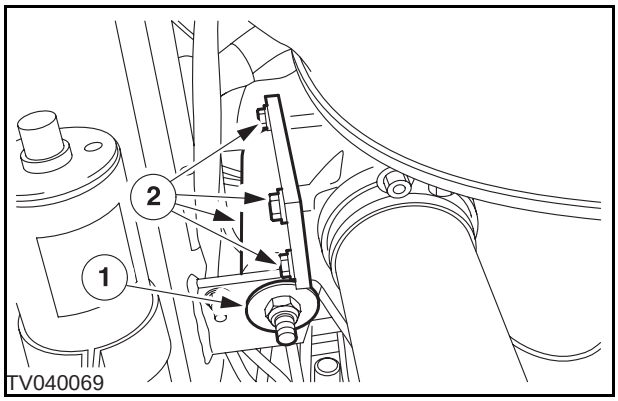


13. Open the hood.
14. Remove the exhaust stack. For additional information, refer to Section P14-01 EXHAUST PIPE, PAGE P14–01–35 .

15. Using a suitable transmission jack, support the transmission.

⚠ Warning:
- **Secure the transmission to the transmission jack. Failure to follow this instruction may result in personal injury.**

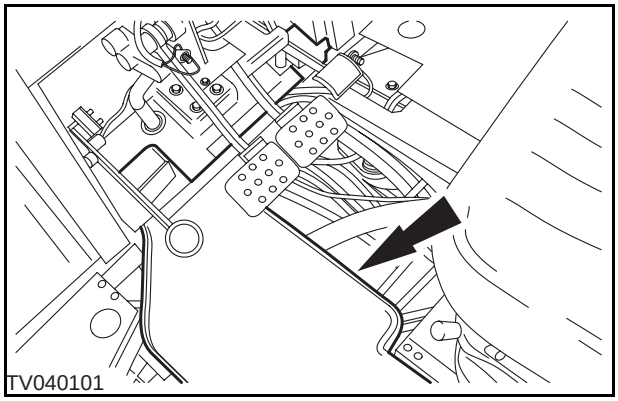
16. Loosen the transmission mount to chassis retaining bolts (1), both sides. (Right-hand shown, left-hand similar).
17. Remove the transmission mount retaining bolts (2), both sides. (Right-hand shown, left-hand similar).



⚠ Caution:
- **Make sure excessive force is not applied to any pipes, hoses or wiring harnesses.**

Note:
- Remove and discard the cabin heater air ducting seal.

18. Carefully lower the transmission to enable the removal of the cabin heater air ducting.
19. Remove the cab heater air ducting.

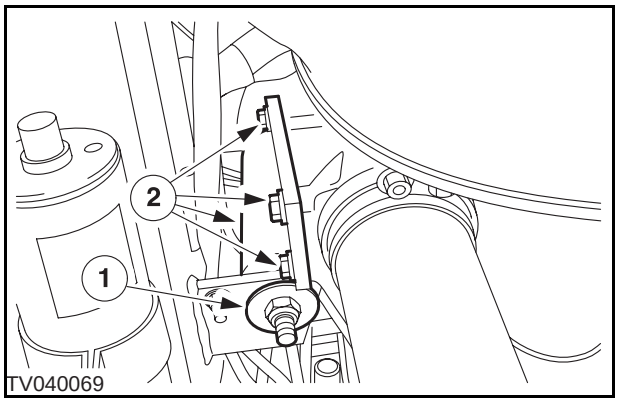


Installation

Note:
- Install a new cabin heater air ducting seal.

1. To install, reverse the removal procedure.

2. Tighten (2) to 98Nm (72 lb.ft).



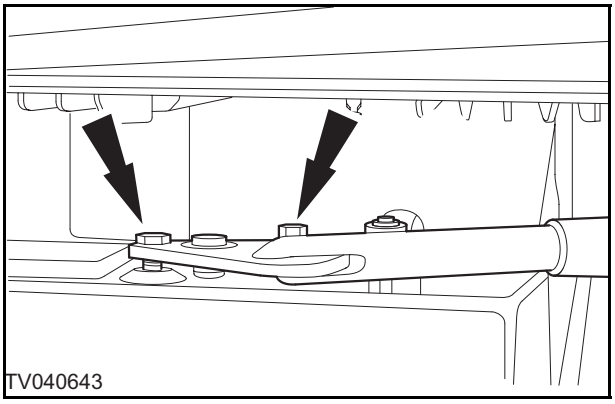
REMOVAL AND INSTALLATION — CAB HEATER MOTOR

BHH0801RG

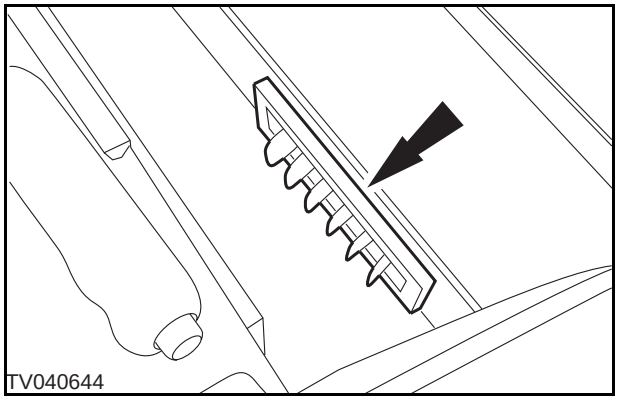
Operation: **Removing and Installing the Cab Heater Motor**	*Job Code:* **08 39 13 xx**		
None	Standard tools		

Removal

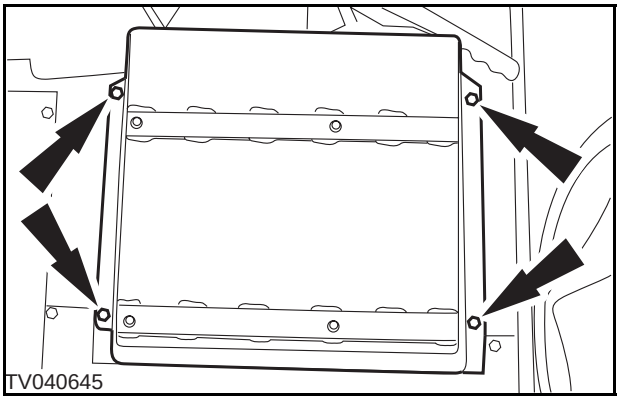
1. Isolate the battery. For additional information, J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the driver seat. For additional information, refer to DRIVER SEAT, PAGE H08–01–23 in this section.
3. Remove the floor front mat.
4. Detach the cab floor rear mat and position it to one side.
5. Detach the backhoe lock lever.


TV040643

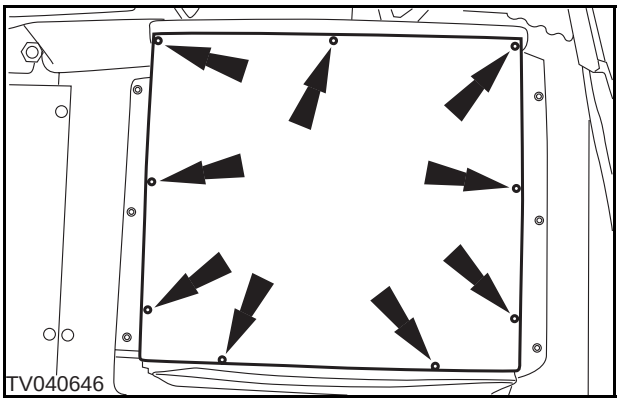
6. Remove the blower vent.


TV040644

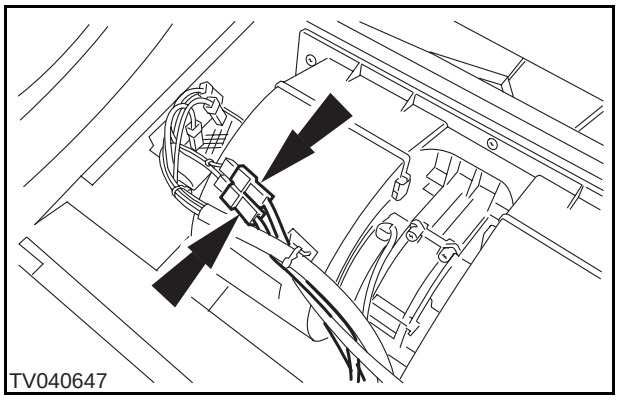
7. Remove the cab heater cover.


TV040645

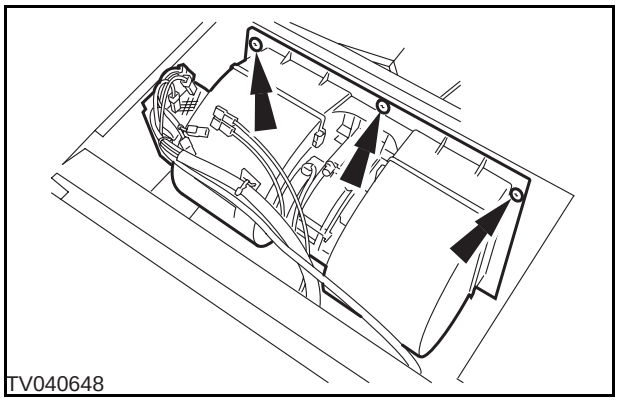
8. Remove the cab heater top cover.



9. Disconnect the cab blower motor electrical connectors.



10. Remove the cab blower motor.



Installation

1. To install, reverse the removal procedure.

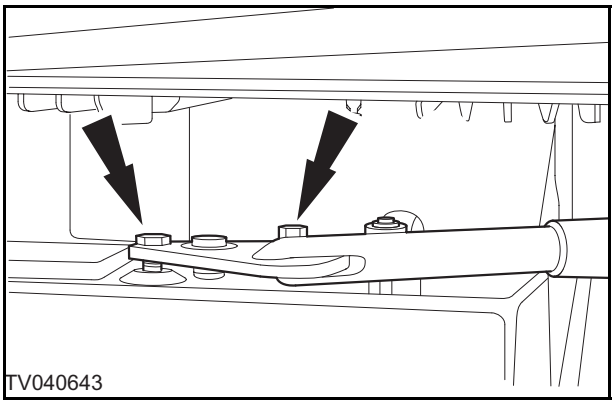
REMOVAL AND INSTALLATION — CAB HEATER MATRIX

BHH0801RC

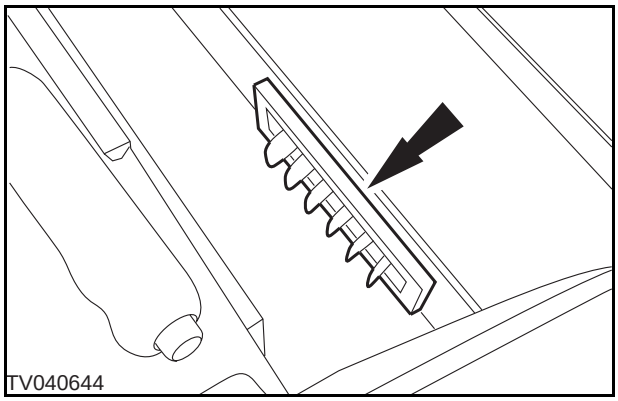
Operation: **Removing and Installing the Cab Heater Matrix**	*Job Code:* **08 40 13 xx**		
None	Standard tools		

Removal

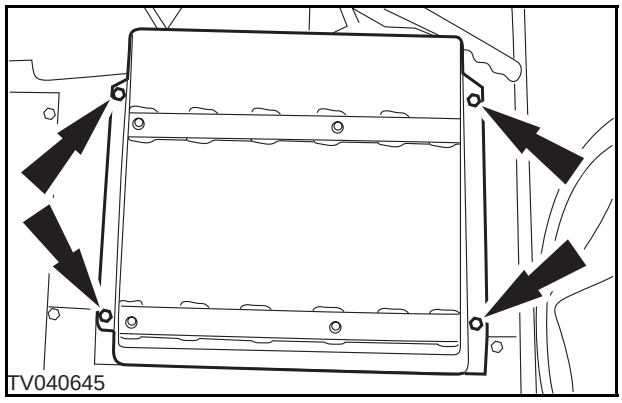
1. Isolate the battery. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the driver seat. For additional information, refer to Section DRIVER SEAT, PAGE H08–01–23 in this section.
3. Remove the floor front mat.
4. Detach the cab floor rear mat and position it to one side.
5. Detach the backhoe lock lever.


TV040643

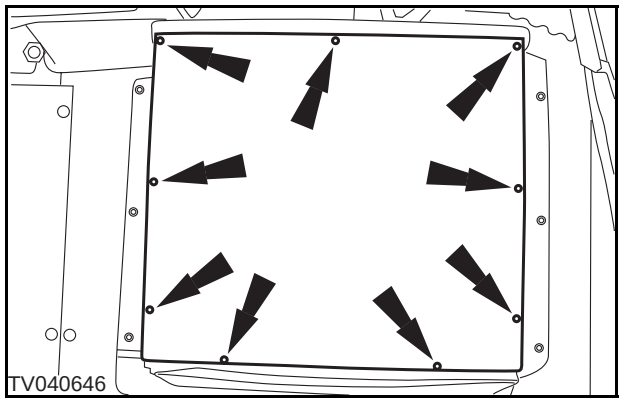
6. Remove the blower vent.


TV040644

7. Remove the cab heater cover.


TV040645

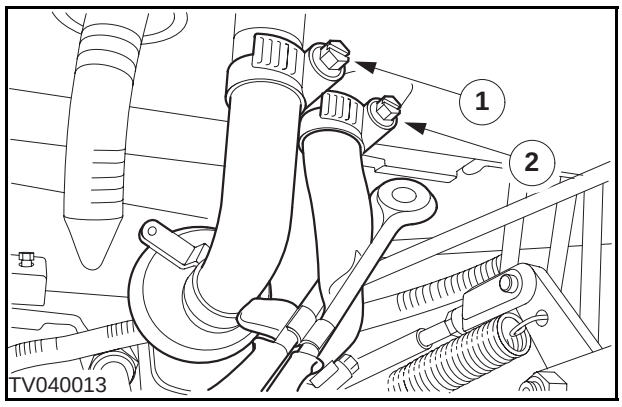
8. Remove the cab heater top cover.



⚠ **Warning:**
- **Do not release the cooling system pressure when the system is hot. Failure to follow this instruction may result in personal injury.**

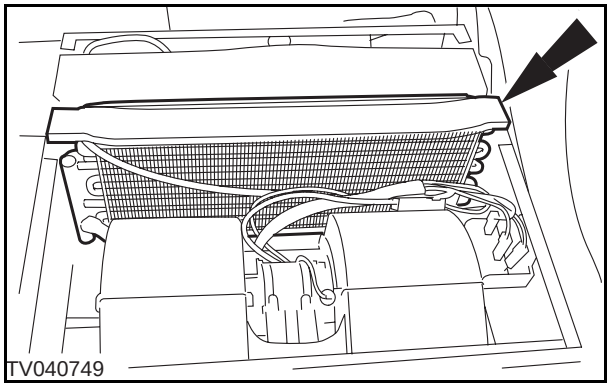
⚠ **Warning:**
- **When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.**

9. Loosen the radiator cap.
10. Turn the heater control fully to the COLD position.
11. Clamp the heater return hose (2).
12. Disconnect the heater inlet hose (1).
13. Disconnect the heater return hose (2).



14. Remove the cab heater matrix.

Note:
- Lubricate all grommets to aid installation.



Installation

1. To install, reverse the removal procedure.
2. Make sure the correct grade, and quality of antifreeze is added to the water. Recommended content mixture is 50% water, with 50% antifreeze.
3. Refill the cooling system through the radiator cap until completely full. Re-install the radiator cap and refill the coolant expansion tank to the full mark.
4. Start the engine and run until the normal engine operating temperature is achieved. Check for leaks, allow to cool then recheck the coolant level.

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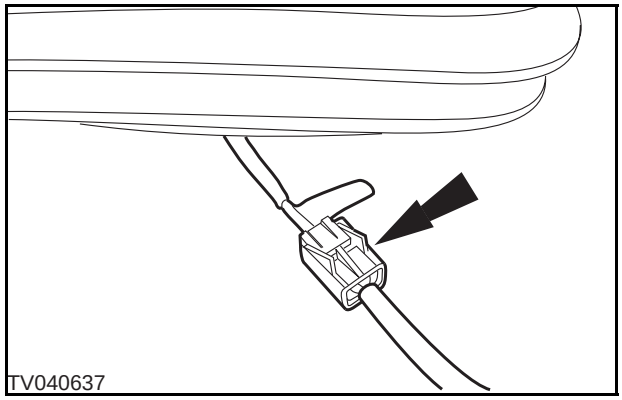
REMOVAL AND INSTALLATION — DRIVER SEAT (ALL MODELS)

BHH0801RD

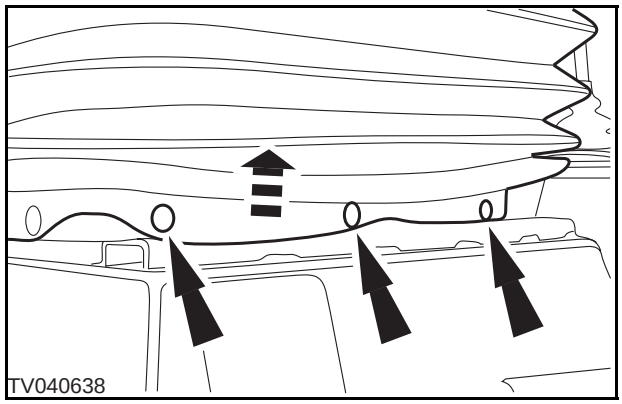
Operation: **Removing and Installing the Driver Seat (All Models)**	*Job Code:* **08 41 13 xx**		
None	Standard tools		

Removal

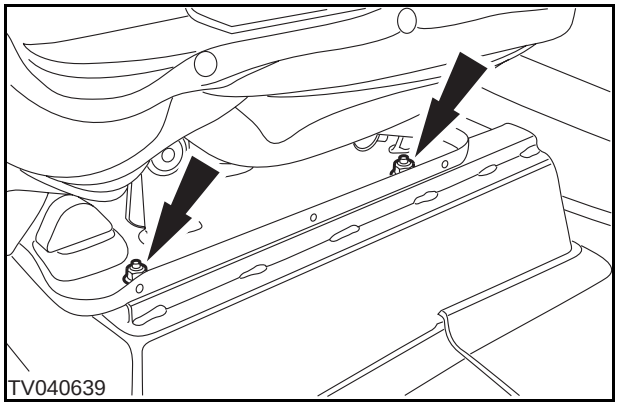
1. Isolate the battery. For additional information, refer to Section J09-01 BATTERY ISOLATION .
2. Disconnect the air seat electrical connector (if equipped).



3. Remove the bellows retaining clips. (Left-hand side shown, right-hand side similar).
4. Detach the belows from the drivers seat.

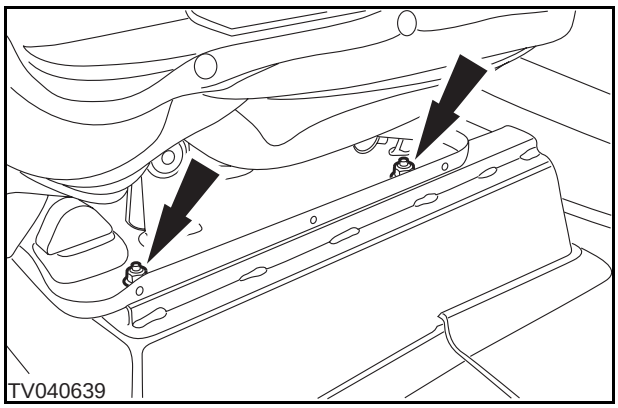


5. Remove the driver's seat retaining bolts (left-hand side shown, right-hand side similar) and remove the driver's seat.



Installation

1. To install, reverse the removal procedure.
   - Tighten to 29Nm (21 lb.ft).



REMOVAL AND INSTALLATION — CAB DOOR GLAZING PANEL

BHH0801RE

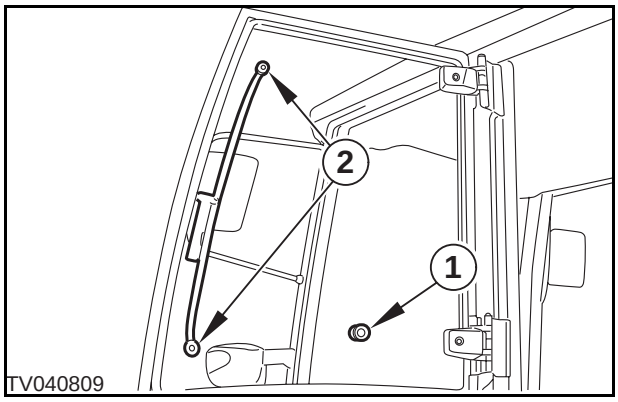
Operation: **Removing and Installing the Cab Door Glazing Panel**	*Job Code:* **08 20 13 xx**		
None	Standard tools		

Removal

1. Open the cab door.
2. Remove the cab glazing panel bump stop (1).

Note:
- Remove the bolt caps.

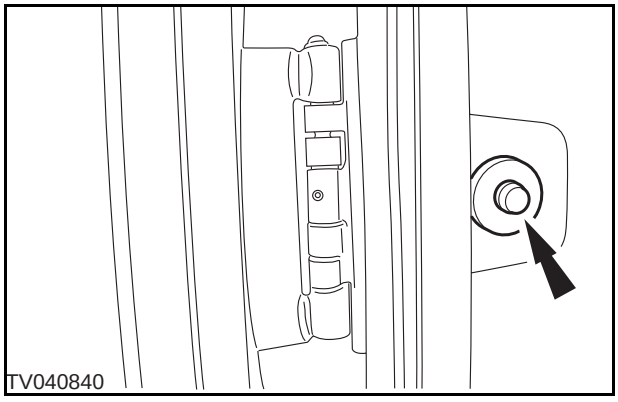
3. Remove the cab glazing panel grab handle (2).



⚠ Caution:
- **Support the cab glazing panel. Failure to follow this instruction may result in damage to the machine.**

Note:
- Remove the bolt caps.

4. Remove the cab glazing panel upper and lower retaining nuts, rubbers and washers.



5. Remove the cab glazing panel.
6. Remove and discard the cab glazing panel seal.

Installation

Note:
- Install a new cab glazing panel seal.

1. To install, reverse the removal procedure.
2. Using a suitable cleaning solution, clean the cab glazing panel.

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REMOVAL AND INSTALLATION — AIR CONDITIONING EVAPORATOR

BHH0801RH

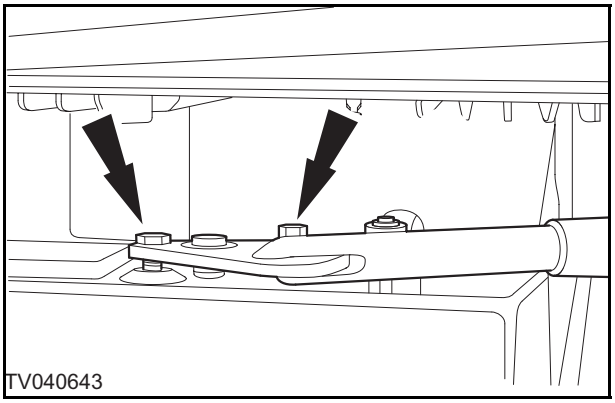
Operation: **Removing and Installing the Air Conditioning Evaporator**	*Job Code:* **08 01 13 xx**		
None	Standard tools		

Removal

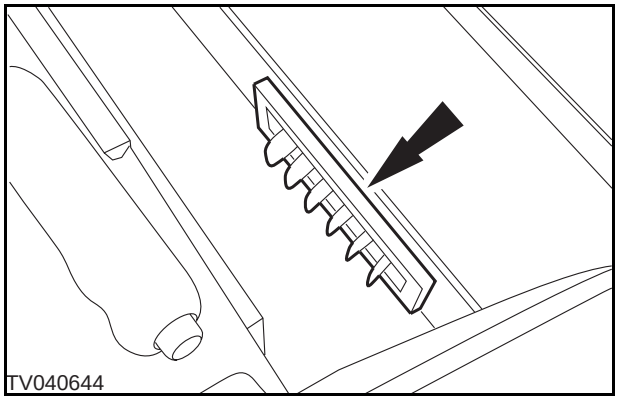
Note:
- Make a note of the position of any pipes / hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

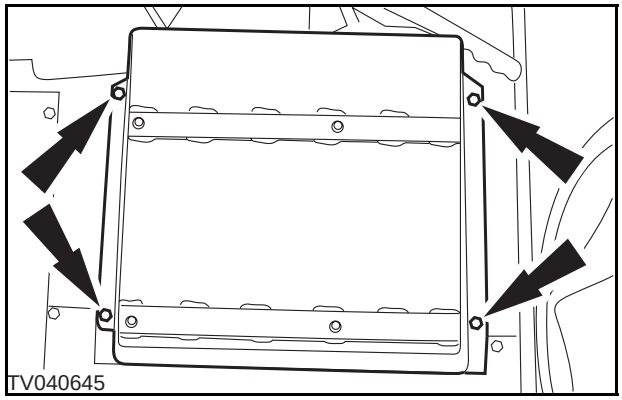
1. Isolate the battery. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the driver's seat. For additional information, refer to DRIVERS SEAT, PAGE H08–01–23 in this section.
3. Evacuate the air conditioning system. For additional information, refer to AIR CONDITIONING RECOVERY AND CHARGING, PAGE H08–01–31 in this section.
4. Remove the floor front mat.
5. Detach the cab floor rear mat and position to one side.
6. Remove the two retaining bolts and detach the backhoe lock lever.


TV040643

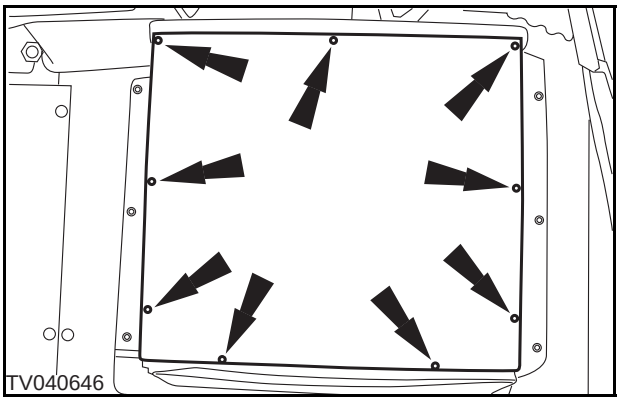
7. Remove the blower vent.


TV040644

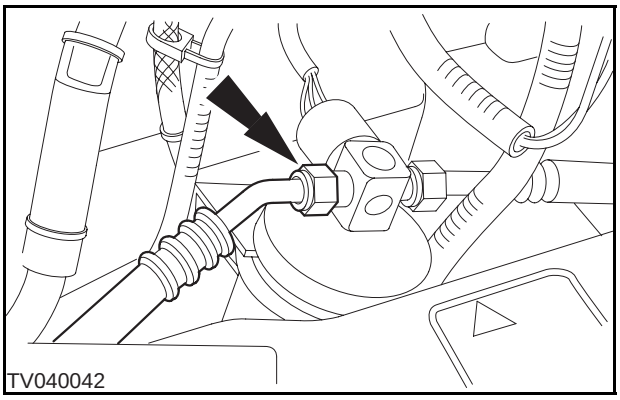
8. Remove the cab heater cover.



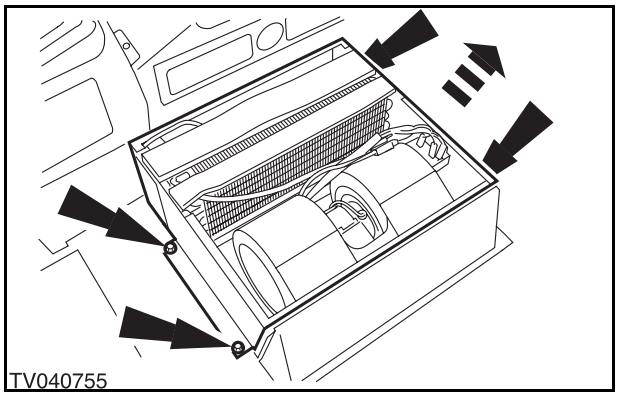
9. Remove the cab heater top cover.



10. Disconnect the air conditioning filter/drier.

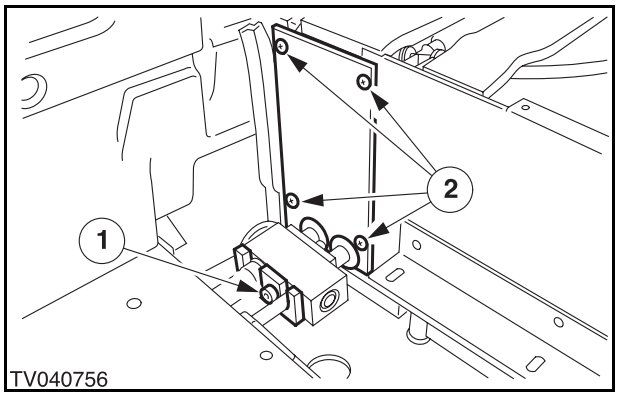


11. Remove the cab heater box retaining bolts.
12. Position the cab heater box to one side.

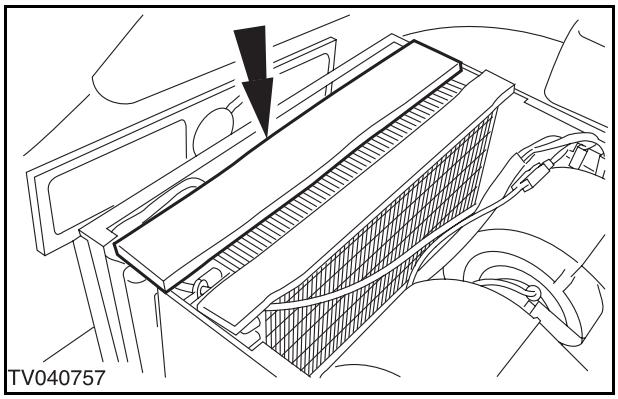


13. Remove the air conditioning evaporator pipe clamp (1) and detach the pipes.

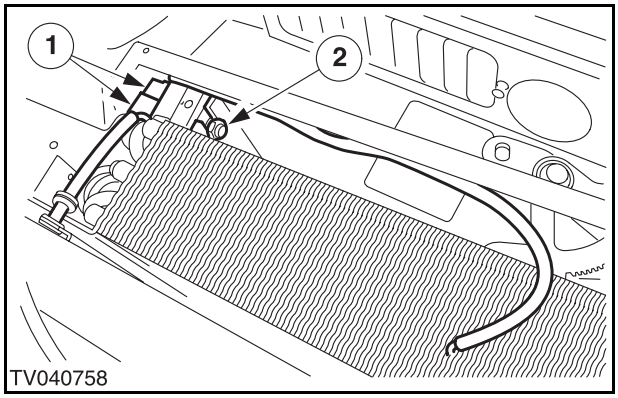
14. Remove the cab heater box plate (2).



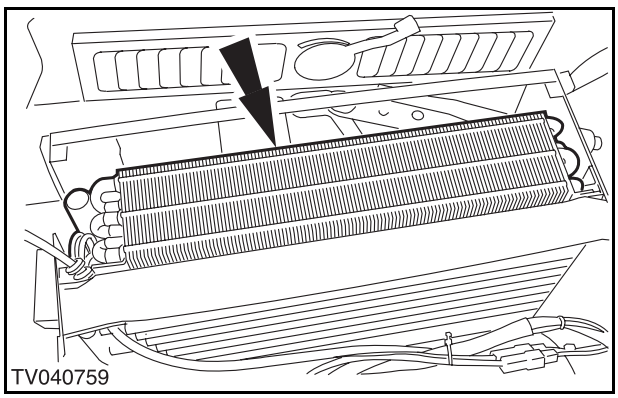
15. Remove the evaporator protective foam.



16. Remove the air conditioning temperature control switch electrical connectors (1).
17. Remove the air conditioning temperature control switch (2).



18. Remove the air conditioning evaporator.



Installation

1. To install, reverse the removal procedure.

Note: This page intentionally left blank.

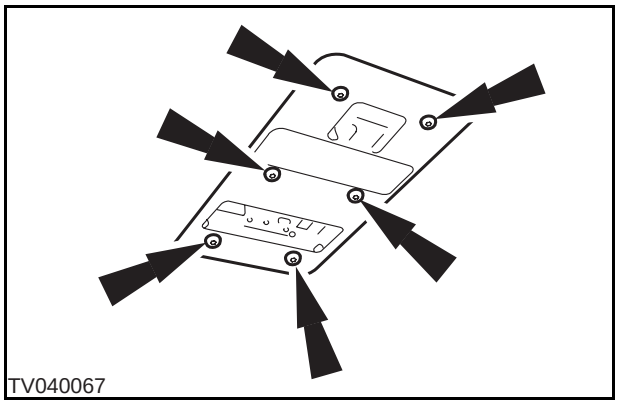
REMOVAL AND INSTALLATION — REAR WINDOW OPEN POSITION LATCH

BHH0801RI

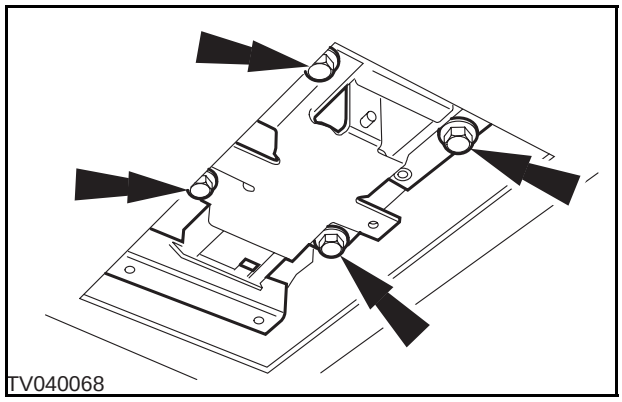
Operation: **Removing and Installing the Rear Window Open Position Latch**	*Job Code:* **08 42 13 xx**		
None	Standard tools		

Removal

1. Remove the rear window open position latch plate.

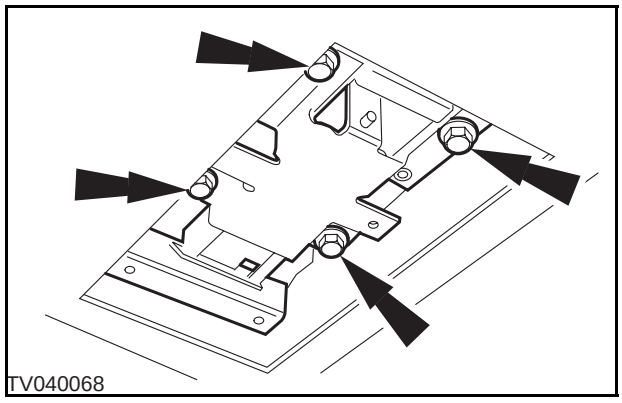

TV040067

2. Remove the rear window open position latch.


TV040068

Installation

1. To install, reverse the removal procedure.
2. Tighten to 28Nm (21 lb.ft).


TV040068

Note: This page intentionally left blank.

REMOVAL AND INSTALLATION — SERVO CONTROL JOYSYICK

BHN1301DB

Operation: **Removal and Installation — Servo Control Joystick**	*Job Code:* **08 43 13 xx**		
None	Standard tools,		

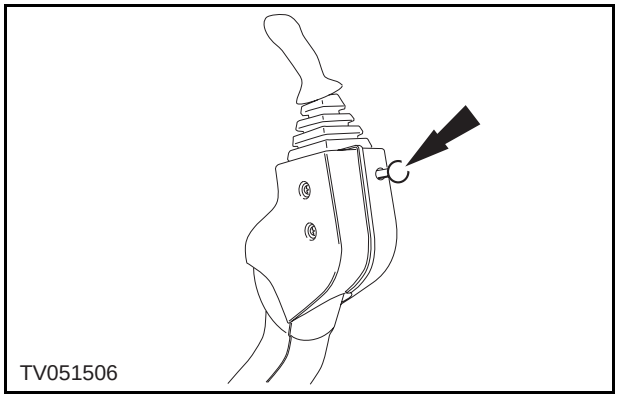
Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

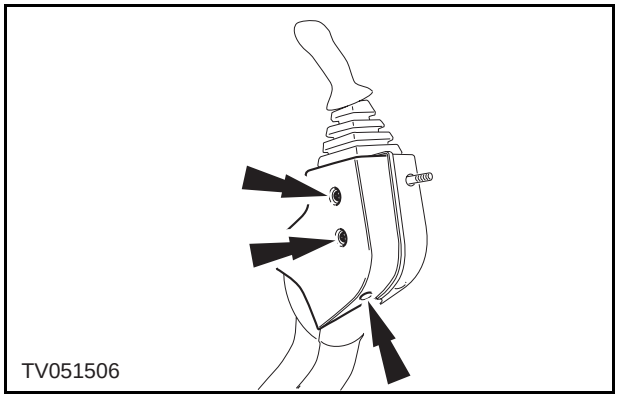
Note:
- Always install blanking plugs to any open ports to avoid contamination.

Note:
- Right-hand shown, left-hand similar.

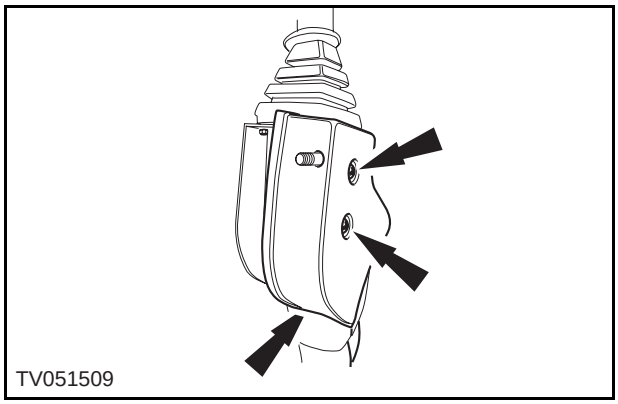
1. Release the pressure in the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the position adjustment knob.


TV051506

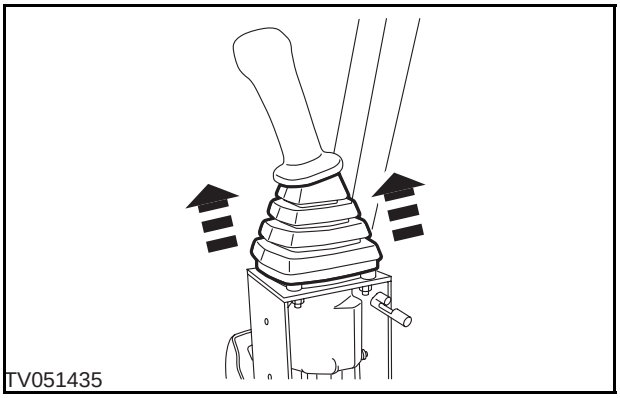
4. Remove the joystick control valve inner cover.


TV051506

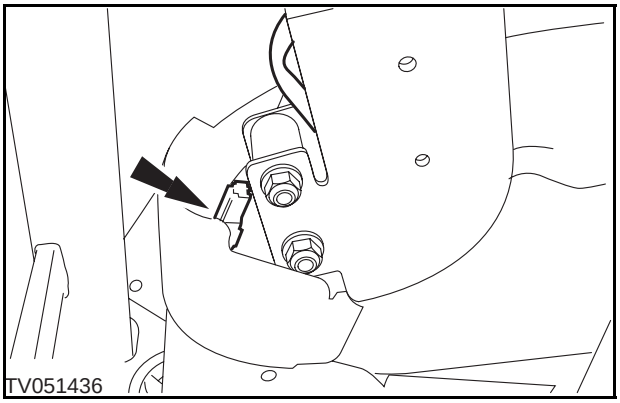
5. Remove the three retaining screws and remove the joystick control valve outer cover.


TV051509

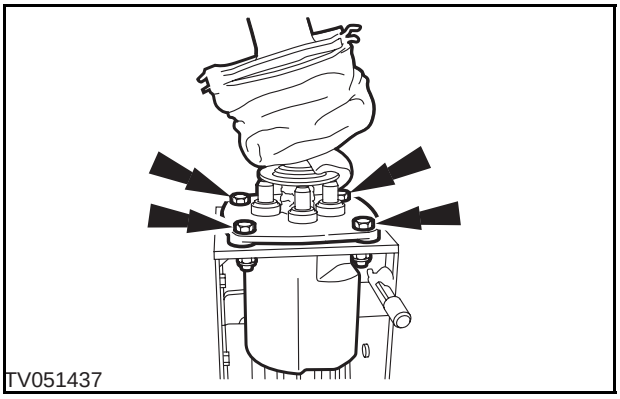
6. Reposition the joystick gaiter.


TV051435

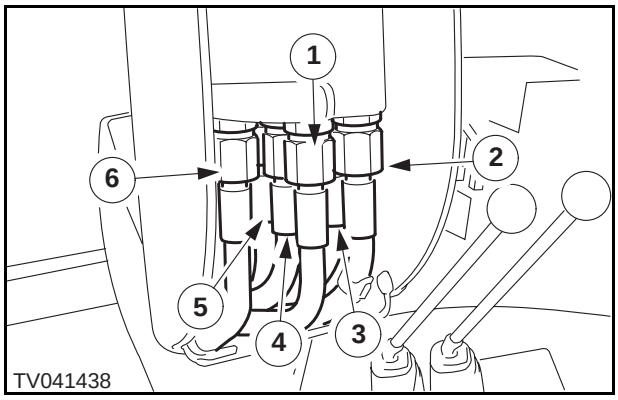
7. Disconnect the override button electrical connector.


TV051436

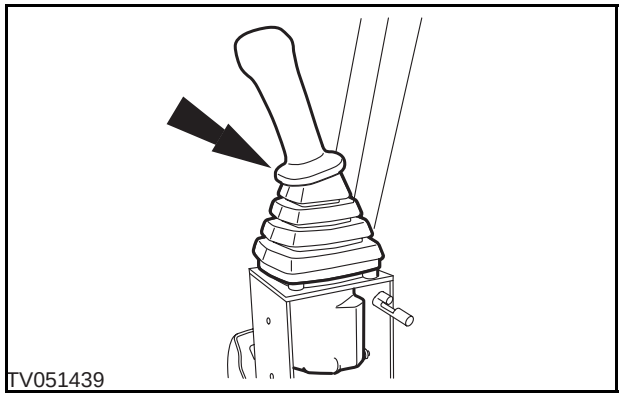
8. Remove the retaining bolts and detach the servo control joystick assembly.


TV051437

9. Disconnect the six hydraulic hoses in the order indicated.

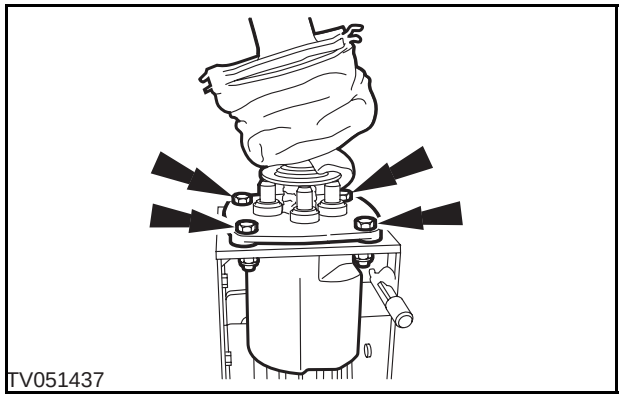


10. Remove the servo control joystick.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 18Nm (13 lb.ft).



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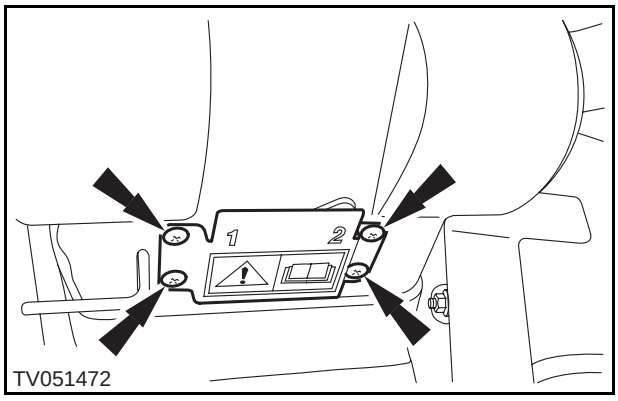
REMOVAL AND INSTALLATION — CONTROLS TILT PEDAL

BHN1301DB

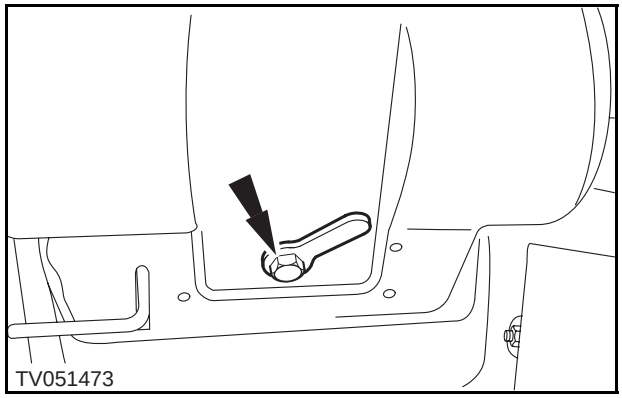
Operation: **Removal and Installation — Controls Tilt Pedal.**	*Job Code:* **08 44 13 xx**		
None	Standard tools,		

Removal

1. Release the pressure in the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the cover plate.

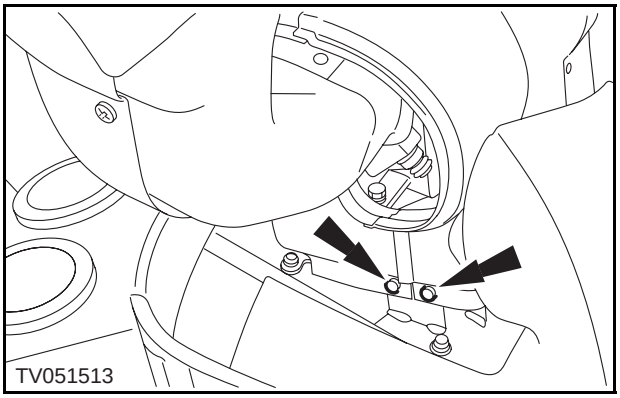


4. Remove the retaining bolt and remove the selector lever.



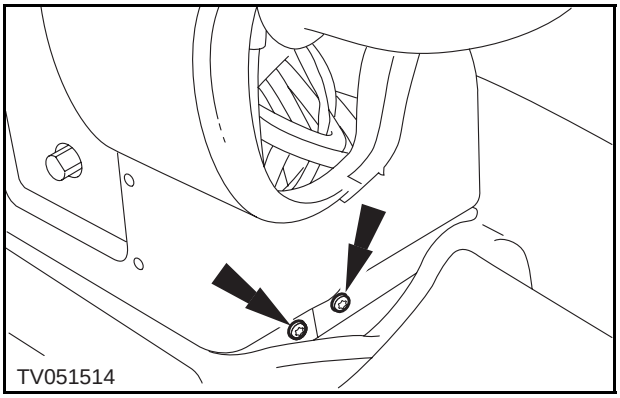
Note:
- Reposition the floor mat to gain access.

5. Remove the pedestal cover left hand lower retaining bolts.

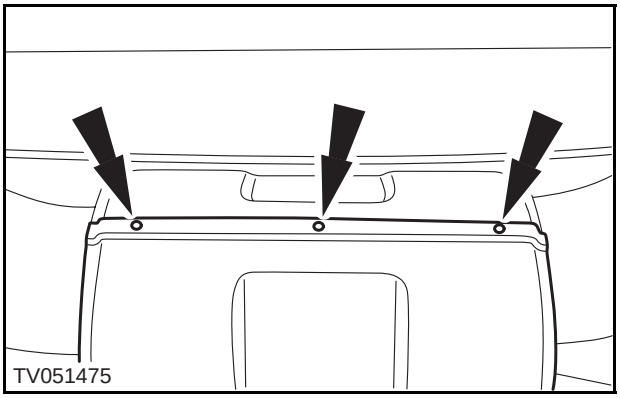


Note:
- Reposition the floor mat to gain access.

6. Remove the pedestal cover right hand lower retaining bolts.

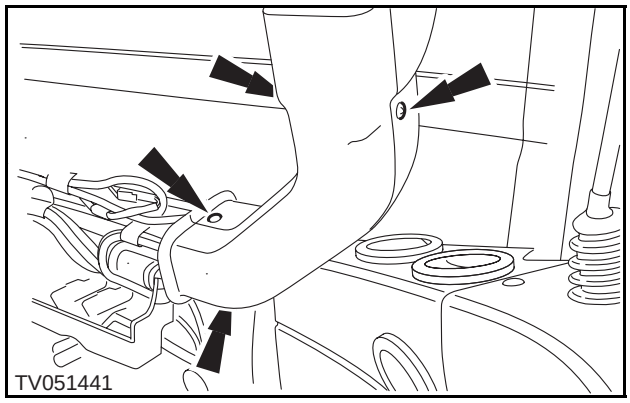


7. Remove the pedestal cover upper retaining bolts and remove the pedestal cover.



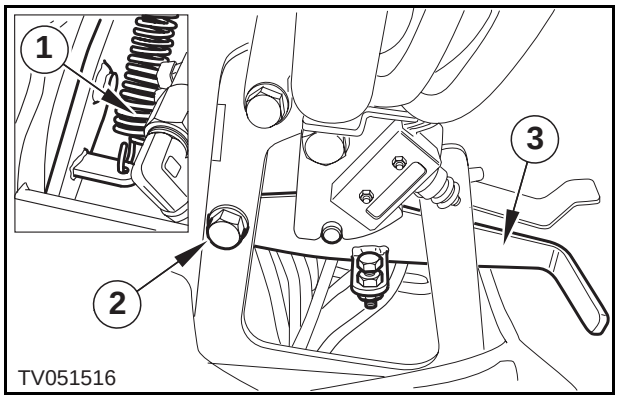
Note:
- Right side shown, left hand similar.

8. Remove the four retaining screws and remove the servo control arm covers.


TV051441

Note:
- Position the servo control arms in the up position.

9. Remove the foot pedal return spring (1).
10. Remove the pivot bolt (2).
11. Remove the foot pedal (3).

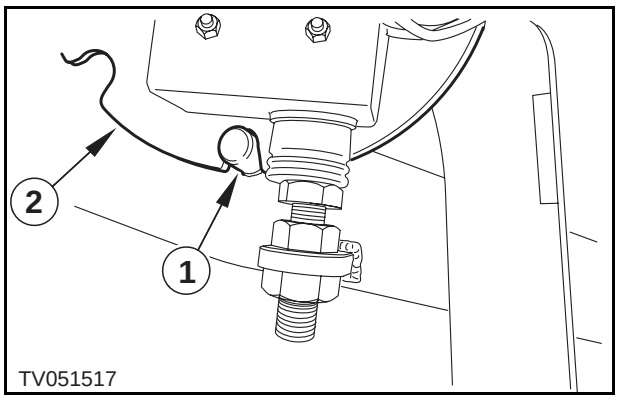


TV051516

Installation

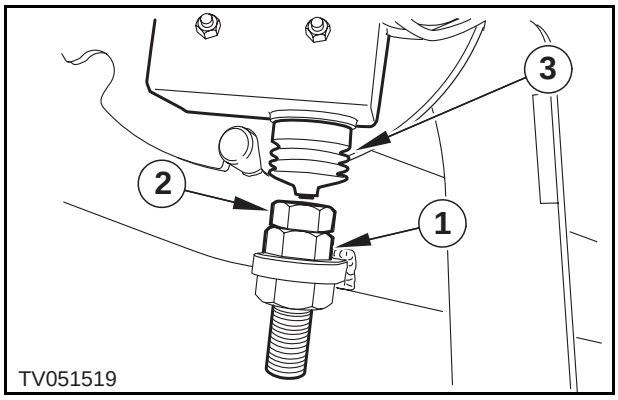
Note:
- Position the servo control arms in the up position.

1. To install, reverse the removal procedure.
2. Position the controls in the working position, making sure the locating pin (1) on the foot pedal is fully engaged in the cam (2).

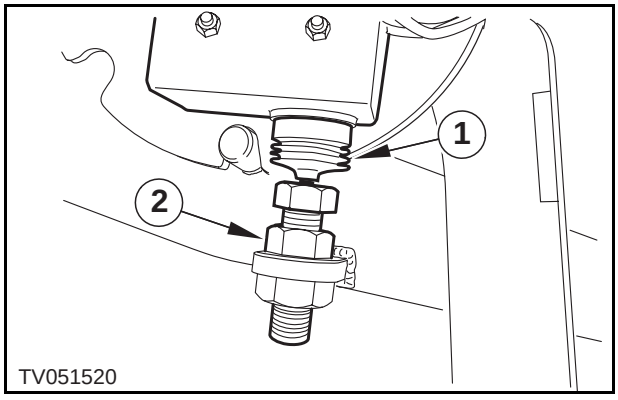


TV051517

3. Loosen the locknut (1) and adjust the bolt (2) until it is clear of the microswitch plunger (3).



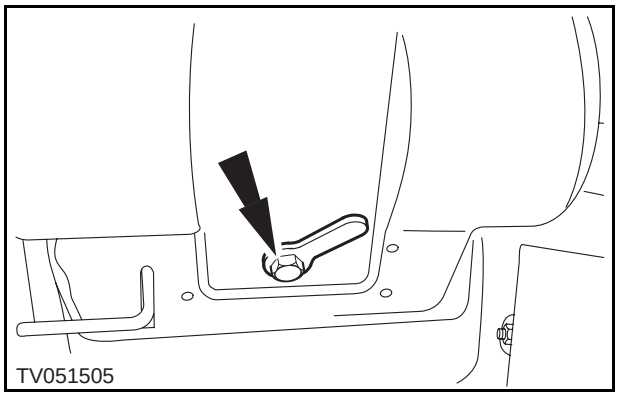
4. Adjust the bolt height until the microswitch plunger (1) is compressed by 5mm. Tighten the locknut (2).



Note:

- Ensure that the microswitch breaks the circuit as soon as the pedal is depressed and before the pin is released from the cam.

5. Tighten to 18Nm (13 lb.ft).



REMOVAL AND INSTALLATION — HOSE REMOVAL AND INSTALLATION

BHN1301DB

Operation: **Removal and Installation — Hose removal and install**	*Job Code:* **08 45 13 xx**		
None	Standard tools,		

Removal

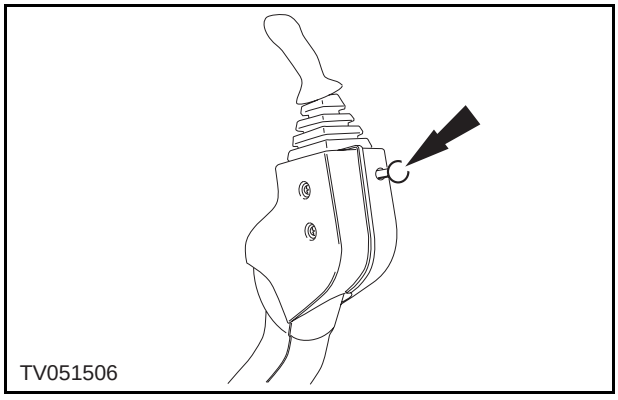
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

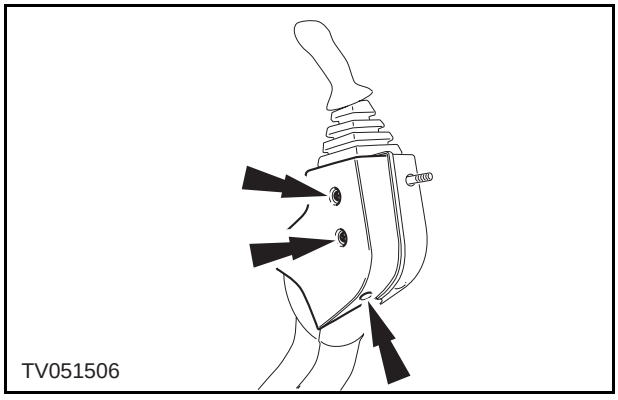
Note:
- This procedure describes the removal and installation of a joystick hydraulic return hose. Use this procedure when removing any joystick hydraulic hose.

Note:
- Right-hand shown, left-hand similar.

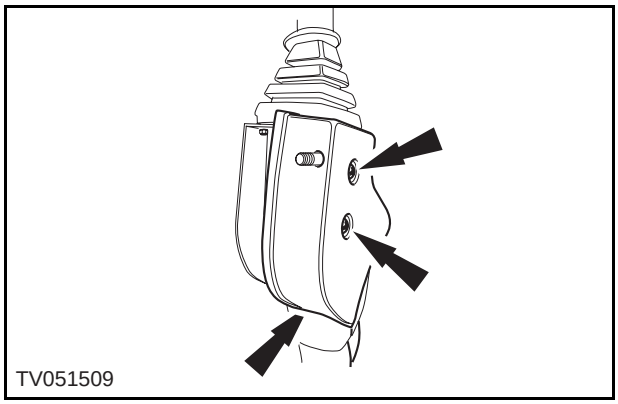
1. Release the pressure in the hydraulic system. For additional information, refer to F06-01 RELEASING THE HYDRAULIC SYSTEM PRESSURE, PAGE F06–01–95 .
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the position adjustment knob.


TV051506

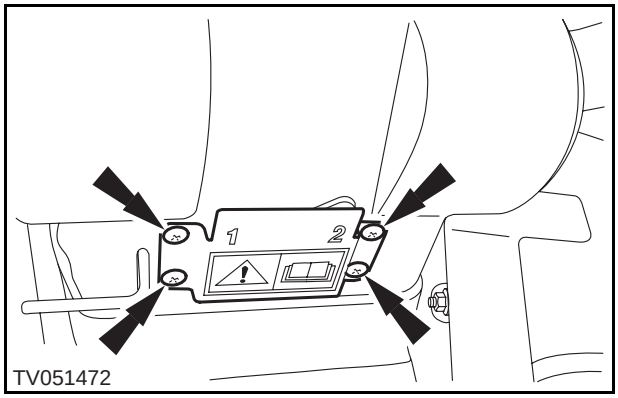
4. Remove the joystick control valve inner cover.


TV051506

5. Remove the three retaining screws and remove the joystick control valve outer cover.

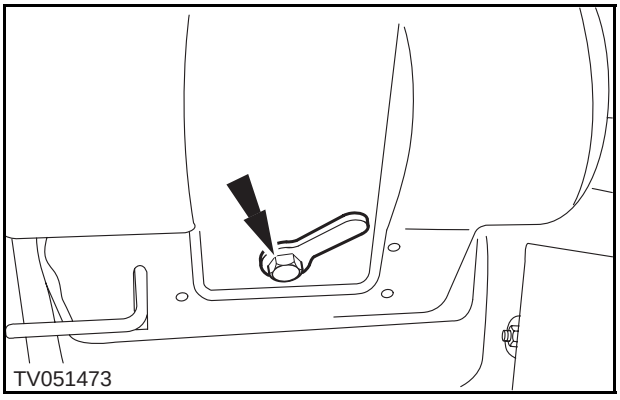

TV051509

6. Remove the cover plate.



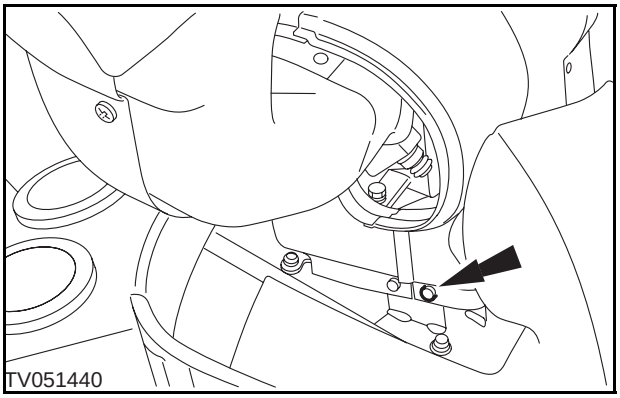
TV051472

7. Remove the retaining bolt and remove the selector lever.


TV051473

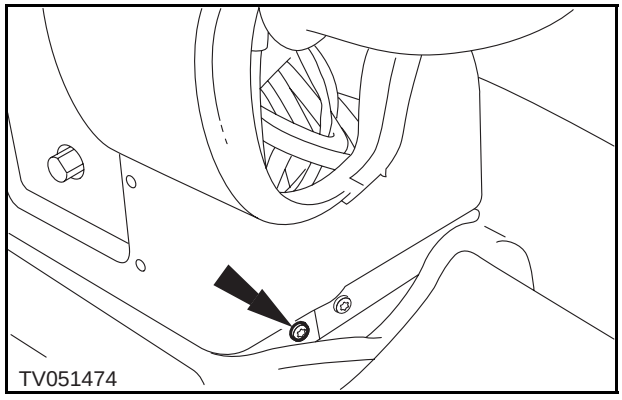
Note:
- Reposition the floor mat to gain access.

8. Remove the pedestal cover left hand lower retaining bolts.

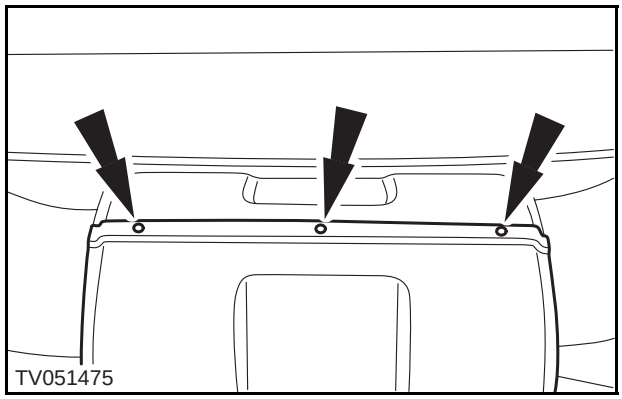

TV051440

Note:
- Reposition the floor mat to gain access.

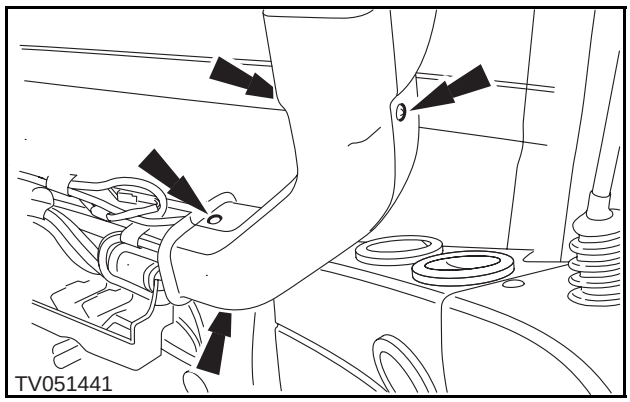
9. Remove the pedestal cover right hand lower retaining bolts.



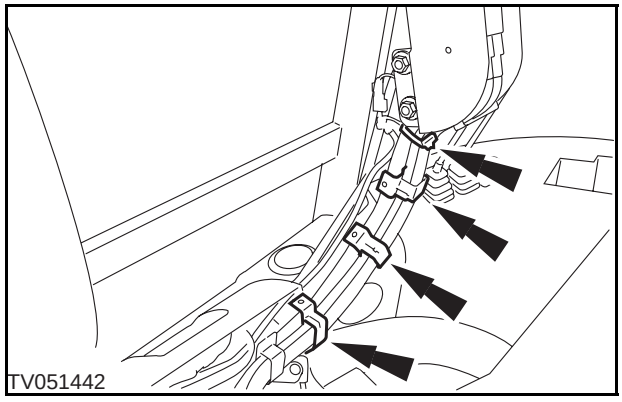
10. Remove the pedestal cover upper retaining bolts and remove the pedestal cover.



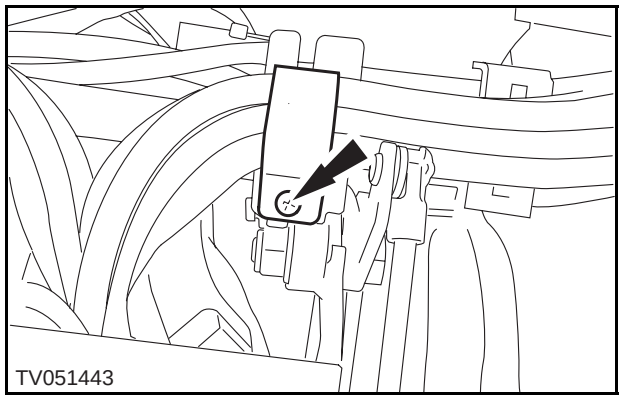
11. Remove the four retaining screws and remove the servo control arm covers.



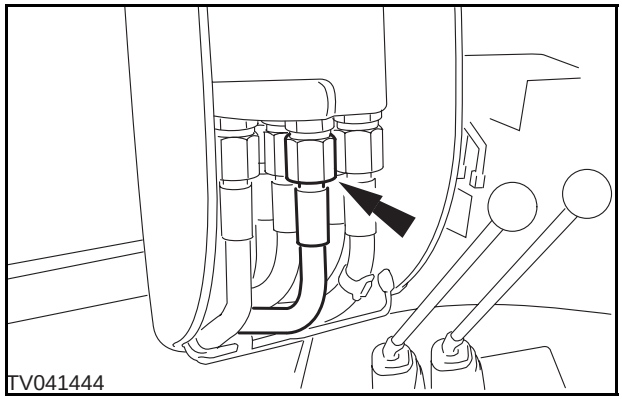
12. Cut the cable ties and recover the three hydraulic hose retaining brackets.



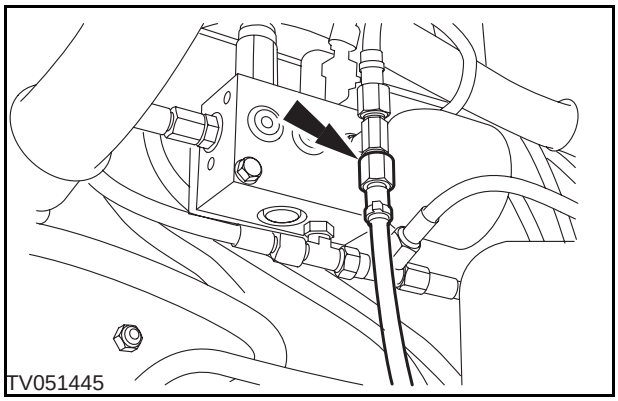
13. Remove the hydraulic hose retaining bracket.
14. Cut any remaining cable ties.


TV051443

15. Disconnect the joystick hydraulic return hose from the joystick.


TV041444

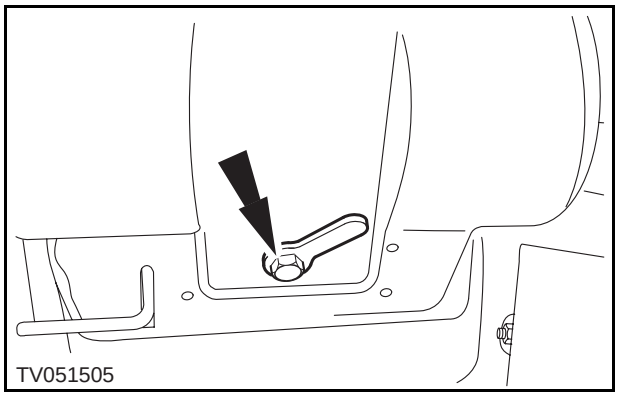
16. Disconnect the joystick hydraulic return hose from the servo control valve.


TV051445

17. Remove the hose.

Installation

1. To install, reverse the removal procedure.
2. Tighten to 18Nm (13 lb.ft).


TV051505

GENERAL PROCEDURE — AIR CONDITIONING RECOVERY AND CHARGING

BHH0801GA

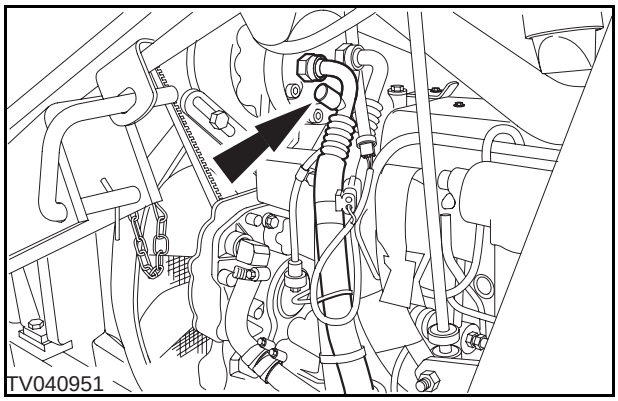
Operation: **Recovery and Recharging the Air Conditioning System**	*Job Code:* **08 02 09 xx**		
None	Refrigerant management station		

Recovery

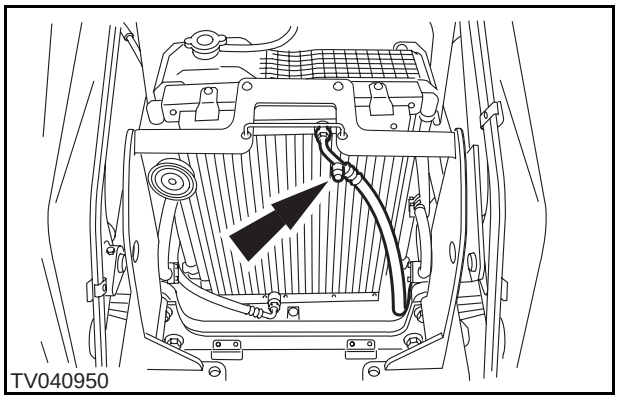
⚠ **Warning:**

- **Before overhauling an air conditioning system observe the following Safety Precautions.**
- **When servicing air conditioning units a certified refrigerant management station operated by a certified technician must be used. Always refer to and follow the refrigerant management station's operating instructions.**
- **Do not allow refrigerant to escape into the atmosphere.**
- **Refrigerant must be handled with care in order to avoid hazards.**
- **Direct contact with liquid refrigerant may cause freezing of the skin or eyes.**
- **Keep the refrigerant container and air conditioning system away from naked flames and sources of heat.**
- **Recover the refrigerant in the system in a well ventilated area.**
- **Always wear suitable safety glasses and gloves to protect against accidental spillage of the refrigerant.**
- **Never disconnect fittings or lines until the refrigerant has been properly discharged.**

1. Make sure the valves on the refrigerant management station are closed.
2. Connect the low pressure (blue) hose of the refrigerant management station to the machine.


TV040951

3. Connect the high pressure (red) hose of the refrigerant management station to the machine.



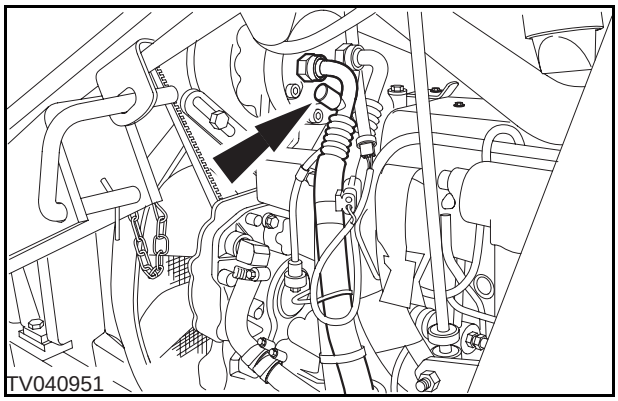
⚠ **Warning:**

- **Follow and observe the refrigerant management station operating instructions. Failure to follow this instruction may result in personal injury.**

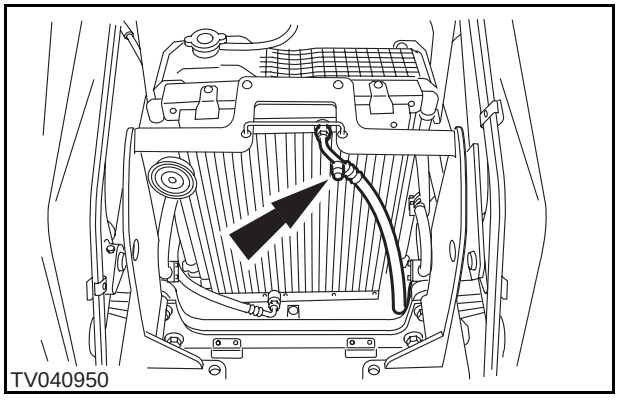
4. Recover the refrigerant. For additional information, refer to the refrigerant management station operating instructions.
5. Disconnect the low pressure (blue) and high pressure (red) hoses of the refrigerant management station from the machine.

Charging

1. Make sure the valves on the refrigerant management station are closed.
2. Connect the low pressure (blue) hose of the refrigerant management station to the machine.



3. Connect the high pressure (red) hose of the refrigerant management station to the machine.



⚠ **Warning:**
- **Follow and observe the refrigerant management station operating instructions. Failure to follow this instruction may result in personal injury.**

4. Vacuum down the air conditioning system. For additional information, refer to the refrigerant management station operating instructions.

	Quantity (g)
Standard Recharge	900–1000
Total System Capacity	1200

5. Charge the system with the correct specified quantity of R-134A refrigerant. For additional information, refer to the refrigerant management station operating instructions.
6. Disconnect the low pressure (blue) and high pressure (red) hoses of the refrigerant management station from the machine.

Note:
- Make sure the air conditioning is switched off.

7. Start the engine and allow to idle.
8. Switch the air conditioning on and allow the system to operate for at least one minute before increasing the engine speed.

⚠ **Warning:**
- **Use a suitable certified R-134A gas detector to check the system for possible leaks.**

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SPECIFICATIONS — OPERATORS ENVIRONMENT

BHH0801SA

Torque Values

Description	Nm	Lb.ft
Cab Mounts	395	291
Steering Motor Retaining Bolts	24	18
Cab Earth Strap	98	72
Backhoe Control Lever Bracket	28	21
Cab Floor Access Panel Retaining Bolts	28	21
Front Loader Linkage Retaining Bolts	28	21
Auxiliary Service Hoses Retaining Bracket	28	21
Cab Heater Cover	28	21
Cab Heater Box	28	21
Rear Window Open Position Latch	28	21

Air Conditioning Specifications

	Refrigerant Type	Quantity (g)
Standard Recharge	R–134A	900–1000
Total System Capacity	R–134A	1200

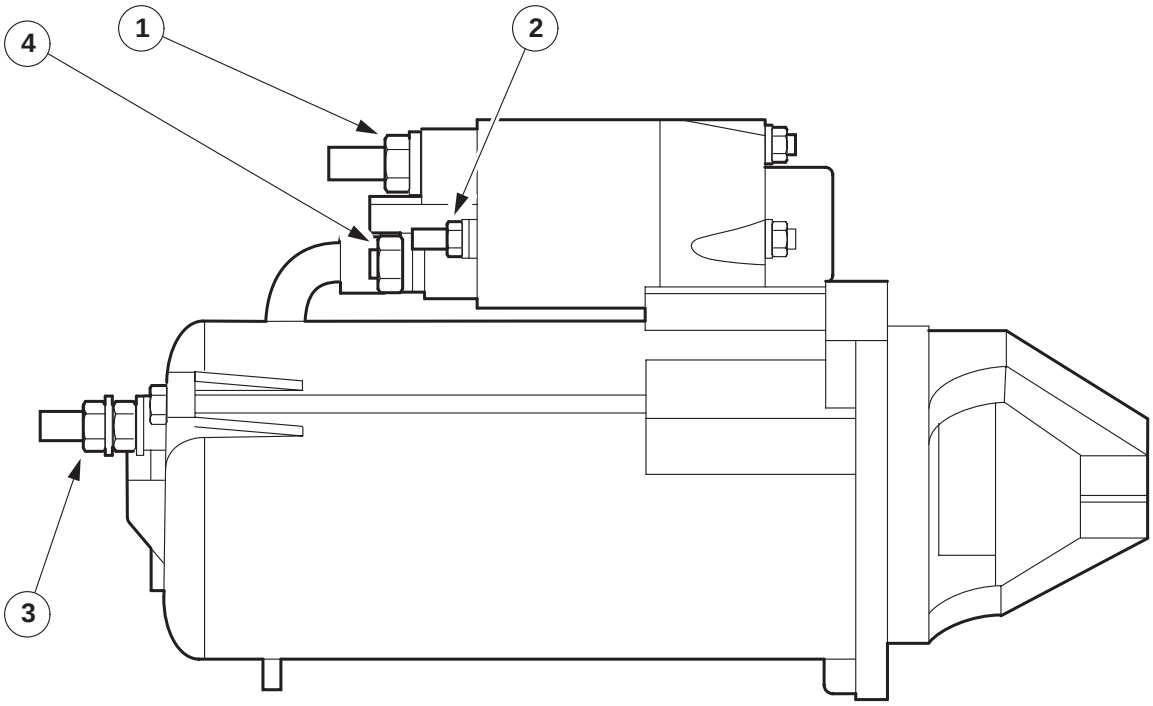
ELECTRICS

J09
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DIAGNOSING AND TESTING — STARTING SYSTEM

BHJ0901TD



TV040942

1	Solenoid Positive (+) Terminal (From Battery)
2	Solenoid Terminal (From Ignition Switch)
3	Negative Terminal (-) (Ground)
4	Solenoid Positive (+) After Contact Terminal (To Motor)

General Information

Power which is available during starting varies according to the temperature and condition of the battery. The following table shows the voltages that are expected from a battery at the various temperature ranges.

Typical Voltages Expected During Starting At Various Ambient Temperatures

Temperature ºC (ºF)	Expected Voltage (Volts)
−23 to −7 (−10 to 20)	6 to 8
−7 to 10 (20 to 50)	7 to 9
10 to 27 (50 to 80)	8 to 10

The following table shows the maximum acceptable loss of voltage in the battery circuit. The battery circuit supplies high current to the starter motor.

Voltage drops that are greater than the values in the table below are normally caused by the following conditions.

- Loose connections
- Corroded connections
- Faulty switch contacts

Note:

- The values in the table are for batteries that have been in service for more than 2000 hours.

Maximum Acceptable Voltage Drop In The Starter Motor Circuit During Starting

Circuit	Maximum Voltage Drop (Volts)
Battery negative terminal (-) to starter motor negative terminal (-) (3)	0.7
Drop across the disconnect switch	0.5
Battery positive terminal (+) to starter motor solenoid positive terminal (+) (1)	0.5
Starter motor solenoid terminal (1) to the solenoid terminal (4)	0.4

Test A — Testing The Battery Voltage Under Load

1. Disconnect the fuel injection pump stop solenoid electrical connector to prevent the engine from starting.
2. Using a suitable multimeter connected between the battery positive (+) terminal and the battery negative (-) terminal, measure the voltage.
3. Operate the starter motor. The voltage indicated should be 8 to 10 Volts at an ambient temperature of 10 to 27ºC (50 to 80ºF). A low voltage reading indicates excessive current flow in the circuit due to low resistance.
4. Connect the fuel injection pump stop solenoid electrical connector, if no further tests are required.

Test B — Testing The Starter Motor Terminal Voltage Under Load

1. Disconnect the fuel injection pump stop solenoid electrical connector (if connected) to prevent the engine from starting.

2. Using a suitable multimeter connected between the solenoid positive (+) terminal (1) and the negative (-) terminal (3), measure the voltage.
3. Operate the starter motor. The voltage indicated should not be more than 0.5 Volts less than the battery voltage indicated in “Test A — Testing the battery voltage under load”.
4. A low voltage (more than 0.5 Volts difference between tests A and B), indicates high resistance in cables or contacts.
5. A high voltage indicates high resistance in the starter motor.
6. Connect the fuel injection pump stop solenoid electrical connector.

Test C — Testing The Voltage Drop In The Positive Circuit

1. Using a suitable multimeter connected between the solenoid positive (+) after contact terminal (4) and the battery positive (+) terminal, measure the voltage.
2. The voltage indicated should be:
   Battery voltage with the key start switch OFF.
   Approximately zero voltage with the starter motor engaged.
3. A high voltage indicates a high resistance in the positive circuit. Check all positive connections. Continue to “Test D”.

Test D — Testing The Voltage Drop Across The Solenoid Terminals

1. Using a suitable multimeter connected between the solenoid positive (+) terminal (1) and the solenoid positive (+) after contact terminal (4), measure the voltage.
2. The voltage indicated should be:
   Battery voltage with the key start switch OFF.
   Less than 0.4 Volts with the starter motor engaged.
3. A voltage less than 0.4 Volts indicates the high resistance in the starter circuit is due to either a high resistance in the starter cable or soldered connections. Clean and tighten all positive cable connections. Test the system. If a high resistance is still indicated, install a new battery positive cable.
4. A voltage greater than 0.4 Volts indicates a faulty starter solenoid or connection.

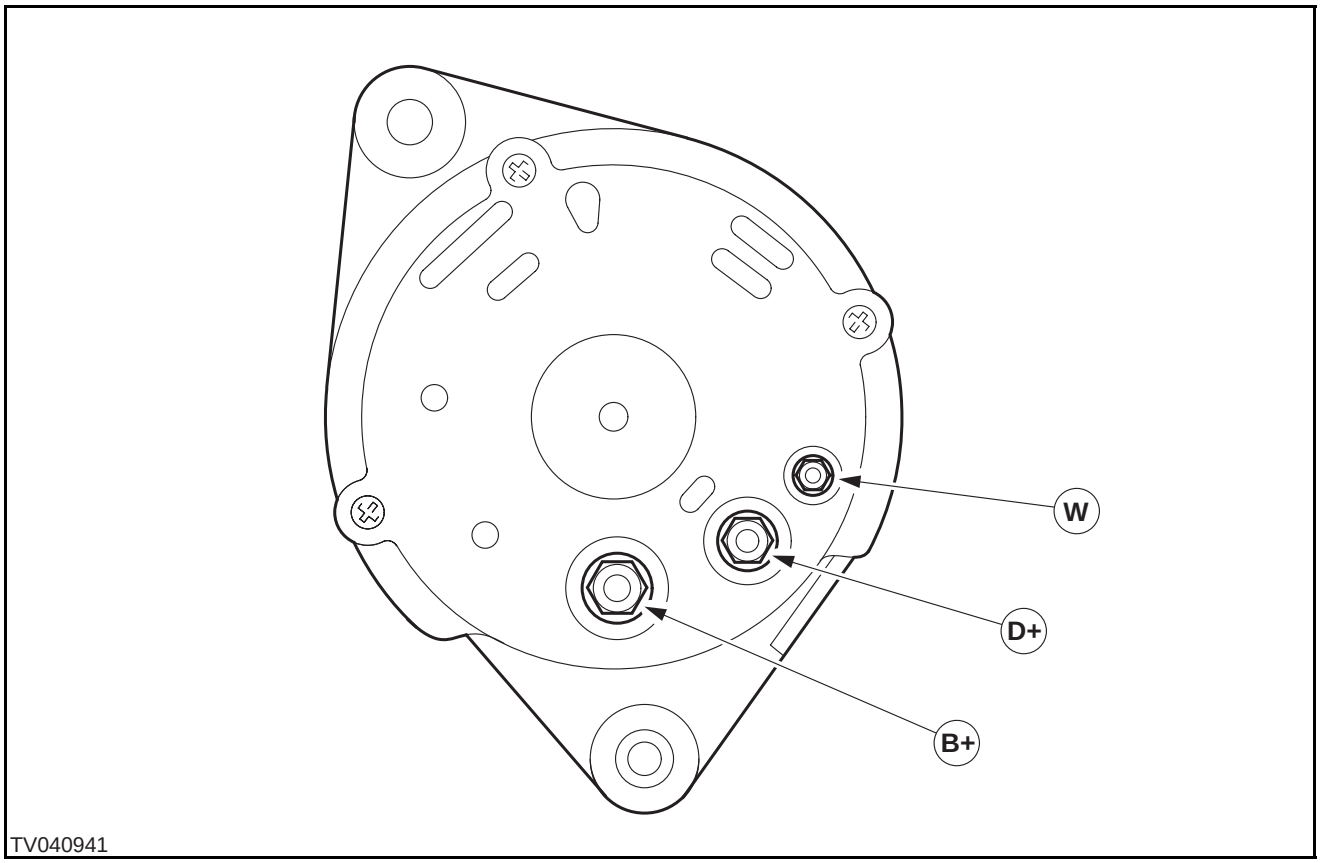
Test E — Testing The Voltage Drop In The Ground Circuit

1. Using a suitable multimeter connected between the starter motor negative (-) terminal (3) and the battery negative (-) terminal, measure the voltage.
2. The voltage indicated should be less than 0.7 Volts with the starter motor engaged.
3. A voltage greater than 0.7 Volts indicates a high resistance in the ground circuit. Clean and tighten all battery ground cable connections, starter motor mounting and body to ground straps. Test the system. If a high resistance is still indicated, install a new battery ground cable.

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DIAGNOSING AND TESTING — CHARGING SYSTEM

BHJ0901TB



TV040941

Testing Cable Continuity

1. Check the charge warning lamp illuminates with the ignition switch ON.
2. Using a suitable multimeter, check for battery voltage between the alternator terminal (B+) and ground. If the voltage indicated is less than battery voltage, check the electrical connectors and the wiring harness, repair or replace as required.
3. Using a suitable multimeter, check for battery voltage between the alternator terminal (D+) and ground. If the voltage indicated is less than battery voltage, check the electrical connectors and the wiring harness, repair or replace as required.

Testing The Voltage Drop

1. Using a suitable multimeter connected between the battery positive terminal and the alternator terminal (B+), measure the voltage.
2. Start and run the engine at maximum engine RPM.
3. Switch ON all vehicle electrical loads i.e. headlamps, worklamps etc.
4. Check the voltage indicated is less than 0.5V. If the voltage indicated is more than 0.5V, this indicates a high resistance in the wiring harness between the battery positive terminal and the alternator terminal (B+).
5. Turn the ignition key to the OFF position.
6. Connect the multimeter between the battery ground terminal and the alternator housing.
7. Start and run the engine at maximum engine RPM.
8. Switch ON all vehicle electrical loads i.e. headlamps, worklamps etc.

9. Check the voltage indicated is less than 0.25V. If the voltage indicated is more than 0.25V, this indicates a high resistance in ground circuit.

Warning Lamp Does Not Illuminate

Note:
- The warning lamp for the charging system should illuminate when the ignition switch is in the ON position.

1. Check the charge warning indicator warning lamp. Replace the lamp if the element is blown.
2. Using a suitable multimeter, check the battery voltage. Check the battery voltage with the ignition switch OFF.
3. Check the voltage between the alternator terminal (B+) and ground. The voltage indicated should equal the battery voltage.
4. Turn the ignition switch to the ON position. Check the voltage between the alternator terminal (D+) and ground. If the voltage indicated is more than approximately 2 volts, replace the alternator.

Warning Lamp Is On When the Engine is Running

1. Start the engine and run the engine at fast idle.
2. Measure the voltage between the alternator terminal (B+) and ground.
3. Measure the voltage between the alternator terminal (D+) and ground.
4. The voltages indicated at the alternator terminals (B+) and ground and (D+) and ground should indicate between approximately 13 and 15 Volts.
5. If the voltages indicated are not correct, replace the alternator.
6. Increase the engine to high idle and operate an electrical load.
7. Measure the voltage between the alternator terminal (B+) and ground.
8. Measure the voltage between the alternator terminal (D+) and ground.
9. The voltages indicated at the alternator terminals (B+) and ground and (D+) and ground should indicate between approximately 13 and 15 Volts.
10. If the voltages indicated are not correct, replace the alternator.

DIAGNOSING AND TESTING — BATTERY

BHJ0901TC

Quiescent Current Drain

The machines, ex-factory, have no permanently live circuits and should have zero quiescent current drain, when the key-switch is off and all lights are switched off.

It should be noted that permanently live accessories fitted by the dealer, such as a clock or theft alarm system, will place a quiescent drain on the battery. Typically the quiescent drain will be in the range of 10–20 mA. If the quiescent drain measures 40 mA or more, there is a problem with the wiring insulation or the accessories, which must be cured.

Battery Safety

⚠ **Warning:**

- **NEVER add electrolyte to an already charged battery.**

⚠ **Warning:**

- **Sparks can fly from electrical system or the engine. Before you operate this machine in an area which may contain inflammable vapour, completely ventilate the area.**

⚠ **Warning:**

- **A spark or naked flame can cause the hydrogen in a battery to explode. To avoid all risk of explosion, follow these instructions:**
- **Turn the battery isolator to the "OFF" position (circuit disconnected).**
- **When disconnecting the battery cables, always disconnect the negative (-) cable first.**
- **To reconnect the battery cables, always connect the negative (-) cables last.**
- **Never use metal parts to short circuit the terminals of a battery.**
- **Do not weld, grind or smoke near a battery.**

⚠ **Warning:**

- **A battery produces explosive gases. Keep all flames, sparks and cigarettes away. Provide adequate ventilation when charging the battery or when using it in an enclosed space. Always wear eye protection and protective clothing when working on or near a battery.**

⚠ **Warning:**

- **Battery acid causes severe burns. The battery contains sulphuric acid. Avoid contact with skin, eyes or clothing.**

  Antidote:

  EXTERNAL: Flush with water.

  INTERNAL: Drink large quantities of water or milk. Follow with milk of magnesia, a beaten egg or vegetable oil. Do not give fluids that induce vomiting. Call a doctor immediately.

  EYES: Flush with water for 15 minutes and get prompt medical attention.

⚠ **Warning:**

- **When the battery electrolyte is frozen, the battery can explode if you try to charge the battery or try to jump start and run the engine using another battery. To prevent battery electrolyte from freezing, keep the battery at full charge.**

⚠ **Caution:**

- **Always connect/disconnect leads to/from the battery while the charger is switched off.**

⚠ **Caution:**

- **If the battery temperature rises to 60°C (140°F) stop the charging process and allow the battery to cool.**

⚠ **Caution:**

- **Always measure battery temperature in the centre cell.**

⚠ **Caution:**

- **Always place a damp cloth over the vent covers when charging a battery.**

⚠ **Caution:**

- **Use hot water to remove all evidence of corrosion from battery terminal post and connections, then smear with petroleum jelly or other non-acid grease.**

Battery inspection before test or charge

Reject the battery if:

1. The electrolyte is excessively low.
2. Electrolyte levels vary by more than 20 mm (0.8 in) between cells.
3. Battery case, lid or mountings are cracked or damaged.
4. Terminals are damaged or loose in the case.

Test the open circuit voltage

Do the open circuit voltage test as follows:

1. The engine must be stopped and all electrical circuits switched off during this test.
2. Measure the open circuit voltage of the battery only if it has not been charged or discharged in the past 16 hours.
   If the machine has recently been started, switch on the headlights for 15 seconds then wait one minute before testing.
3. Connect the voltmeter directly across both battery terminals and note the voltage. 12.5V or above — no action required. Below 12.5V, recharge the battery. For additional information, refer to BATTERY CHARGING, PAGE J09–01–35 in this section.

Load testing of the battery

⚠ Caution:

- **Use a current controlled, high rate discharge tester with at least 500A capacity.**

Load test the battery as follows:

1. Remove the battery from the machine. For additional information, refer to BATTERY (SINGLE), PAGE J09–01–11 or BATTERY (TWIN), PAGE J09–01–13 in this section.
2. Set the appropriate current on the discharge tester:

CURRENT FOR SINGLE BATTERY	295A
CURRENT FOR TWIN BATTERY	410A

3. Connect a voltmeter across the battery terminals.
4. Apply the load tester across the battery terminals for 15 seconds and note the voltage during the test.

Above 10V and steady	Battery is serviceable
Above 10V but falling rapidly	Replace battery
Below 10V	Replace battery

Poor Battery Performance Diagnostic Test with the Battery Still on the Machine

1. Test the open circuit voltage of the battery. For additional information, refer to TEST THE OPEN CIRCUIT, in this section.
   Is the voltage indicated greater than 12.5 Volts?
   a. YES – Continue to step 4.
   b. NO – Recharge the battery. For additional information, refer to BATTERY CHARGING, PAGE J09–01–35 in this section. Continue to step 2.

2. Test the open circuit voltage of the battery. For additional information, refer to TEST THE OPEN CIRCUIT, in this section.
   Is the voltage indicated greater than 12.5 Volts?
   a. YES – Continue to step 4.
   b. NO – Continue to step 3.
3. Carry out a Load test on the battery. For additional information, refer to LOAD TEST THE BATTERY, in this section.
   Is the voltage indicated greater than 10 Volts?
   a. YES – Continue to step 4.
   b. NO – Replace the battery.
4. Check the charging system voltage. For additional information, refer to CHARGING SYSTEM, PAGE J09–01–5 in this section.
   Is the voltage indicated between 14.0 and 14.4 Volts?
   a. YES – Continue to step 5.
   b. NO – Test the alternator output. For additional information, refer to DIAGNOSING AND TESTING – CHARGING SYSTEM, PAGE J09–01–5 in this section.
5. Check the quiescent current drain.
   Is the current drain indicated zero with all electrical systems switched off?
   a. YES – Continue to step 7.
   b. NO – Continue to step 6.
6. Check if the quiescent current drain is caused by dealer/customer accessories.
   Check if there are dealer/customer accessories fitted such as a clock or theft alarm. If any of these are fitted, is the current drain indicated less than 20mA with all electrical systems switched off?
   a. YES – Continue to step 7.
   b. NO – Additional leakage is occurring in the circuit. Ensure the top of the battery is clean and dry. Check the wiring insulation for damage between the battery and key switch.
7. Check the battery voltage during cranking.
   Connect a voltmeter across the battery terminals and disconnect the fuel injection pump cut-off solenoid electrical connector. Crank the engine in the normal way. Is the voltage indicated greater than approximately 10 Volts?
   a. YES – Battery is okay. Possible fault in the charging or starting system. For additional information, refer to DIAGNOSING AND TESTING – CHARGING SYSTEM, PAGE J09–01–5 or DIAGNOSING AND TESTING – STARTING SYSTEM in this section.
   b. NO – Continue to step 8.

8. Carry out a Load test on the battery. For additional information, refer to LOAD TEST THE BATTERY, in this section.
   Is the voltage indicated greater than 10 Volts?
   a. YES – Battery is okay. Possible fault in the charging or starting system. For additional information, refer to DIAGNOSING AND TESTING – CHARGING SYSTEM, PAGE J09–01–5 or DIAGNOSING AND TESTING – STARTING SYSTEM in this section.
   b. NO – Replace the battery.

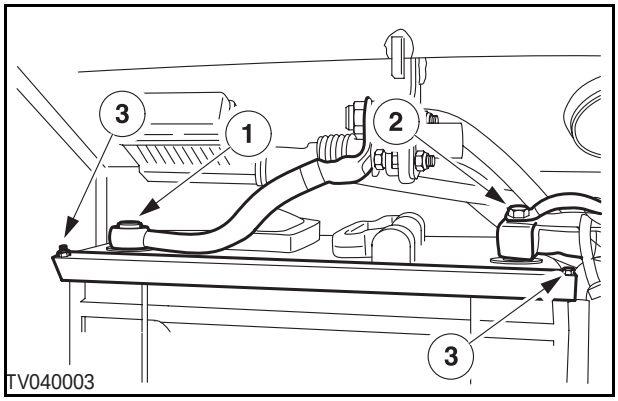
REMOVAL AND INSTALLATION — BATTERY (SINGLE)

BHJ0901RA

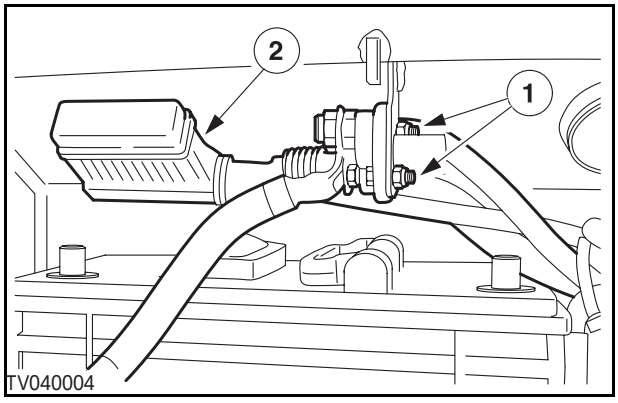
Operation: **Removing and Installing the Battery (Single)**	*Job Code:* **09 03 13 xx**		
None	Standard tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to BATTERY ISOLATION, PAGE J09–01–33 in this section.
2. Disconnect the battery ground cable (1).
3. Disconnect the battery positive cable (2).
4. Loosen the battery clamp retaining nuts (3) and remove the clamp assembly.



5. Detach the wiring harness (1) and position to one side.
6. Detach the fuse box (2).
7. Remove the battery.



Installation

⚠ **Warning:**

- **A spark or naked flame can cause the hydrogen in a battery to explode. To avoid all risk of explosion, follow these instructions: Turn the battery master switch key to the "OFF" position (circuit disconnected). When disconnecting the battery cable(s), always disconnect the negative (-) cable first. To reconnect the battery cables, always connect the positive (+) cable(s) first. Never use metal parts to short circuit the terminals of a battery. Do not weld, grind or smoke near a battery.**

⚠ **Caution:**

- **Use hot water to remove all evidence of corrosion from battery terminal post and connections, then smear with petroleum jelly or other non acid grease.**

1. To install, reverse the removal procedure.

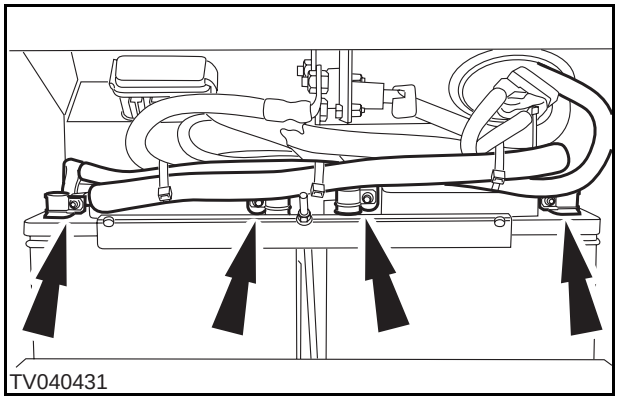
REMOVAL AND INSTALLATION — BATTERY (TWIN)

BHJ0901RB

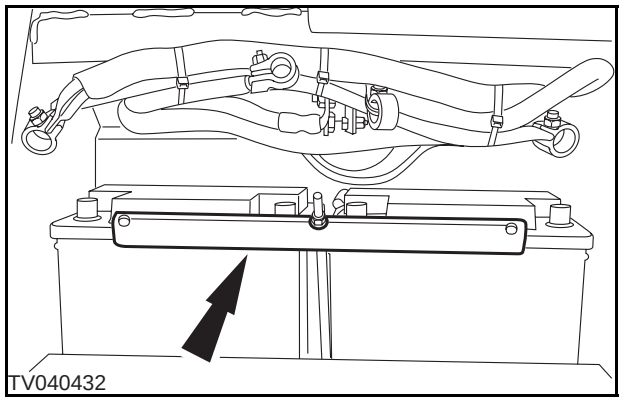
Operation: **Removing and Installing the Battery (Twin)**	*Job Code:* **09 03 13 xx**		
None	Standard tools		

Removal

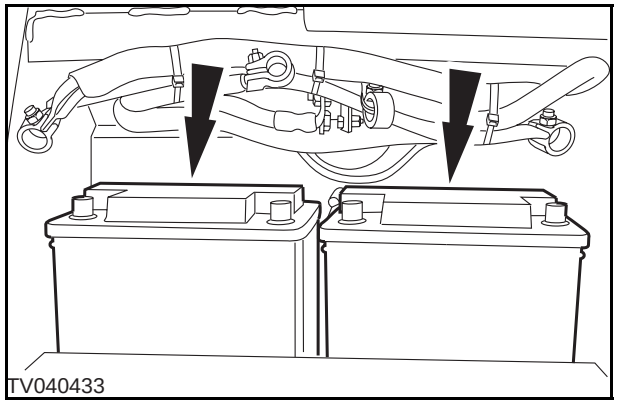
1. Isolate the battery ground cable. For additional information, refer to BATTERY ISOLATION, PAGE J09–01–33 in this section.
2. Disconnect the battery positive and negative cables.


TV040431

3. Loosen the battery clamp retaining nuts and remove the clamp assembly.


TV040432

4. Remove the batteries.


TV040433

Installation

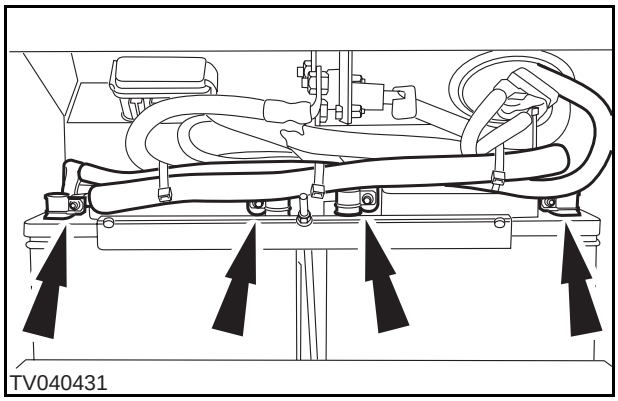
⚠ **Warning:**

- **A spark or naked flame can cause the hydrogen in a battery to explode. To avoid all risk of explosion, follow these instructions: Turn the battery master switch key to the "OFF" position (circuit disconnected). When disconnecting the battery cables, always disconnect the negative (-) cable(s) first. To reconnect the battery cables, always connect the positive (+) cable(s) first. Never use metal parts to short circuit the terminals of a battery. Do not weld, grind or smoke near a battery.**

⚠ **Caution:**

- **Use hot water to remove all evidence of corrosion from battery terminal post and connections, then smear with petroleum jelly or other non acid grease.**

1. To install, reverse the removal procedure.
2. Tighten to 6Nm (4 lb.ft).


TV040431

REMOVAL AND INSTALLATION — STARTER MOTOR

BHJ0901RC

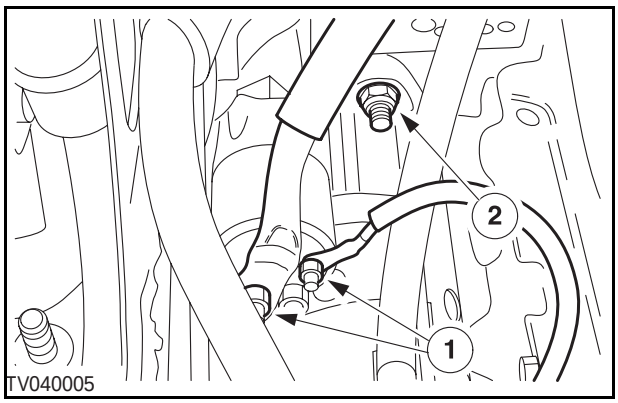
Operation: **Removing and Installing the Starter Motor**	*Job Code:* **09 27 13 xx**		
None	Standard tools		

Removal

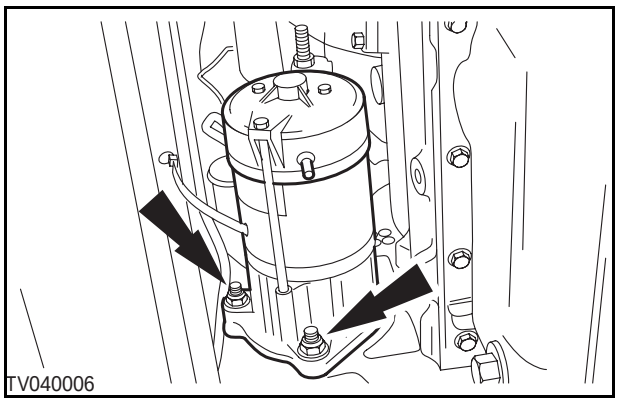
1. Isolate the battery ground cable. For additional information, refer to Section BATTERY ISOLATION, PAGE J09–01–33 in this section.
2. Open the hood.

   Note:
   - Make a note of the position of the electrical connectors to aid installation.

3. Disconnect the starter motor electrical connectors (1).
4. Remove the starter motor upper retaining bolt (2).



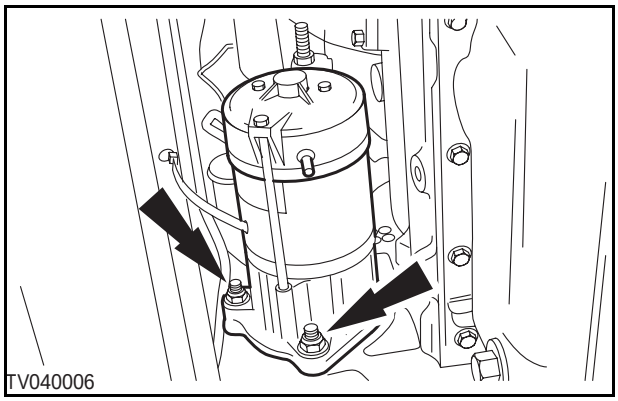
5. Remove the two lower retaining bolts and remove the starter motor.



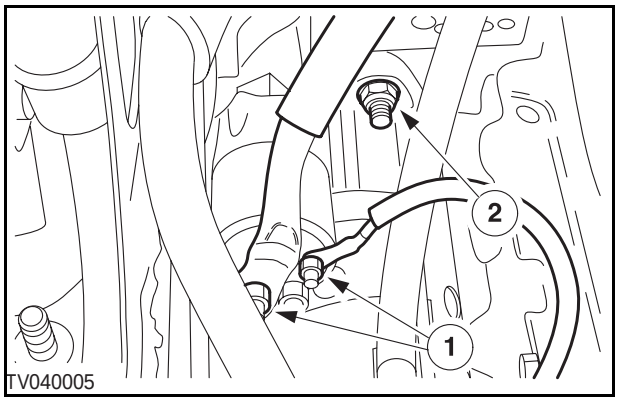
Installation

1. To install, reverse the removal procedure.

2. Tighten to 44Nm (32 lb.ft).



3. Tighten (2) to 44Nm (32 lb.ft).



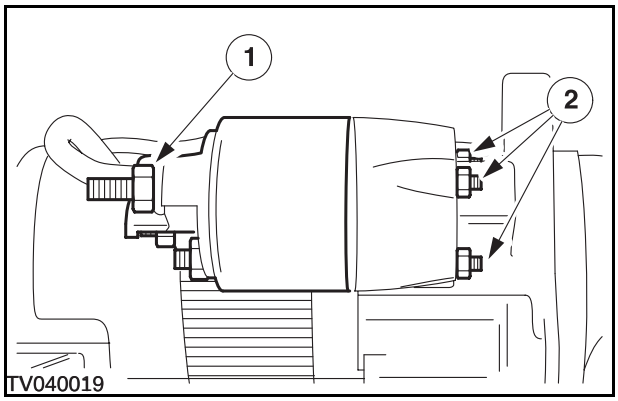
REMOVAL AND INSTALLATION — STARTER MOTOR SOLENOID

BHJ0901RD

Operation: **Removing and Installing the Starter Motor Solenoid**	*Job Code:* **09 26 13 xx**		
None	Standard tools		

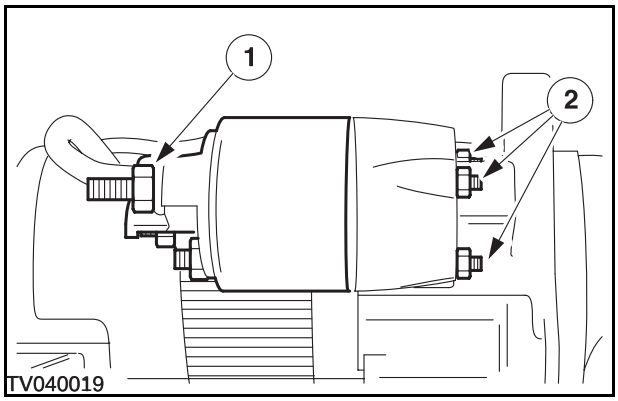
Removal

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 in this section.
2. Remove the starter motor. For additional information, refer to STARTER MOTOR in this section.
3. Disconnect the starter motor feed wire (1) from the starter motor solenoid.
4. Remove the starter motor solenoid (2).



Installation

1. To install, reverse the removal procedure.
2. Tighten (1) to 12Nm (9 lb.ft).
3. Tighten (2) to 6Nm (4 lb.ft).



Note: This page intentionally left blank.

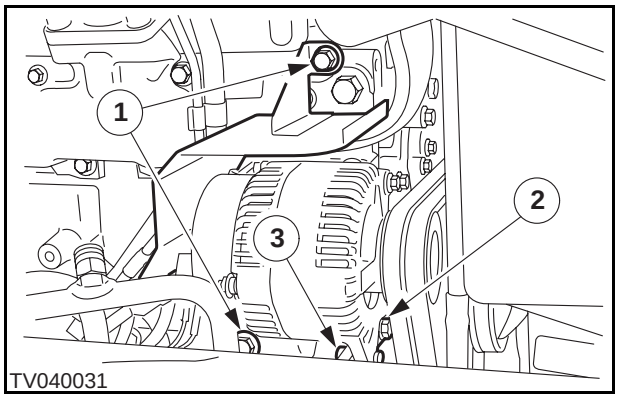
REMOVAL AND INSTALLATION — ALTERNATOR

BHJ0901RE

Operation: **Removing and Installing the Alternator**	*Job Code:* **09 02 13 xx**		
None	Suitable belt tension tool. Standard tools		

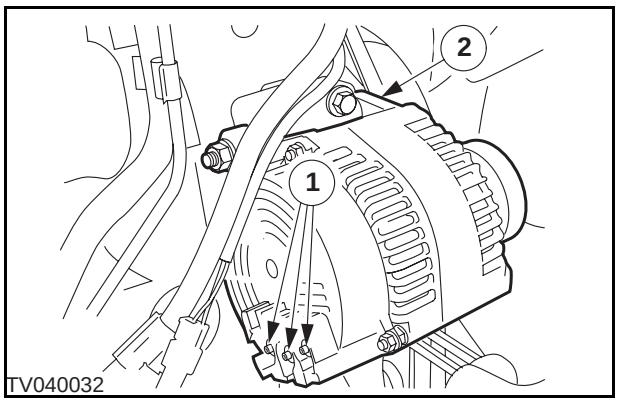
Removal

1. Isolate the battery ground cable. For additional information, refer to BATTERY ISOLATION, PAGE J09–01–33 in this section.
2. Remove the alternator shield (1).
3. Loosen the alternator drive belt adjustment bracket retaining bolt (2).
4. Remove the alternator drive belt adjustment bolt (3) and detach the alternator drive belts.



Note:
- Make a note of the electrical connector locations to aid installation.

5. Disconnect the alternator electrical connectors (1).
6. Remove the alternator (2).



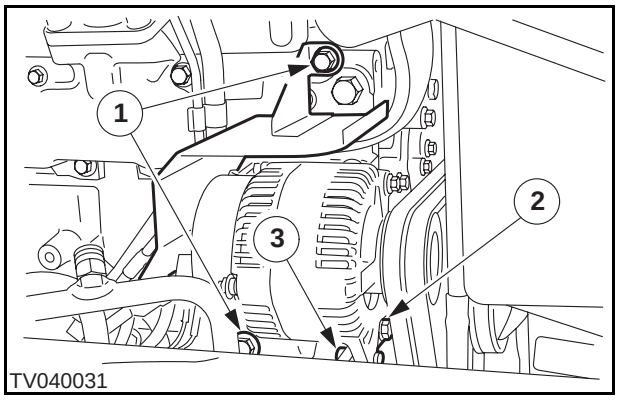
Installation

1. To install, reverse the removal procedure.
2. Using a suitable belt tension tool, adjust the belt tension.

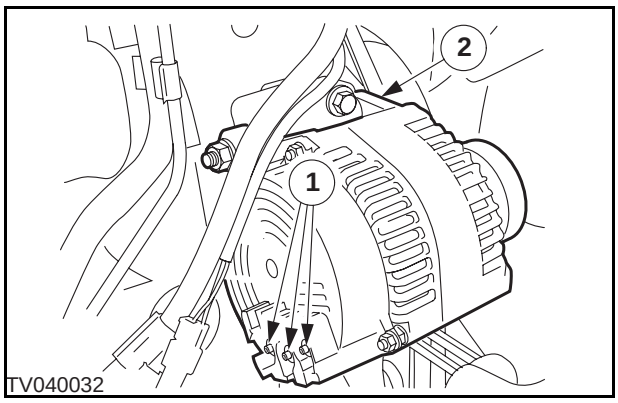
Note:
- The belt tension should be checked at the centre of the longest part of the belt.

- New belt tension 535N (120 lb.ft).
- Used belt tension 355N (80 lb.ft).

3. Tighten (2) to 78Nm (55 lb.ft).



4. Tighten (2) to 22Nm (16 lb.ft).



REMOVAL AND INSTALLATION — FRONT WIPER MOTOR

BHJ0901RF

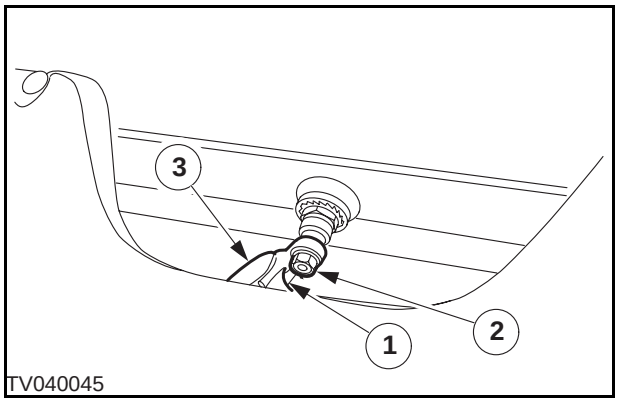
Operation: **Removing and Installing the Front Wiper Motor**	*Job Code:* **09 32 13 xx**		
None	Standard tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

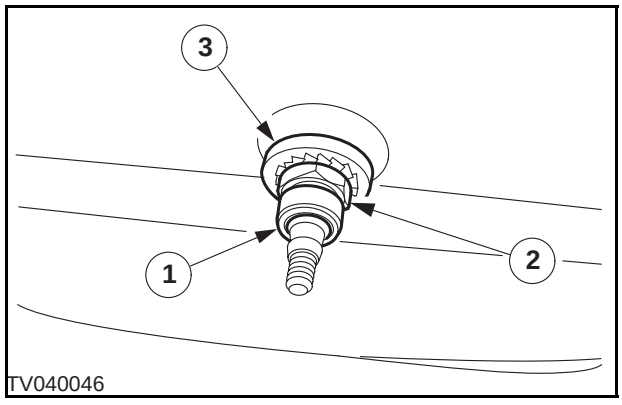
Note:
- Note the position of the wiper arm.

2. Open the front wiper arm retaining nut cap (1).
3. Remove the front wiper arm retaining nut (2).
4. Remove the front wiper arm (3).



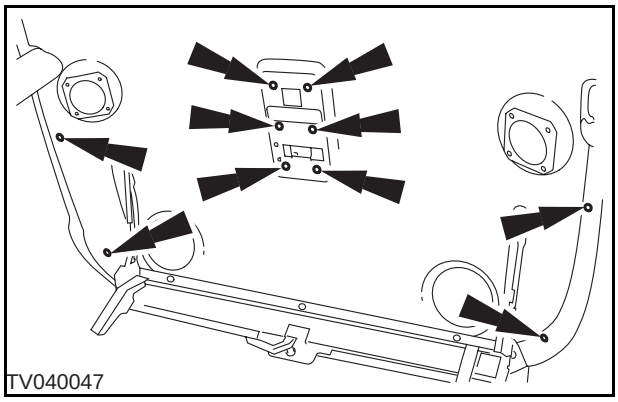
TV040045

5. Remove the front wiper motor spindle cover (1).
6. Remove the front wiper motor spindle retaining nut (2).
7. Remove the front wiper motor spindle seal (3).

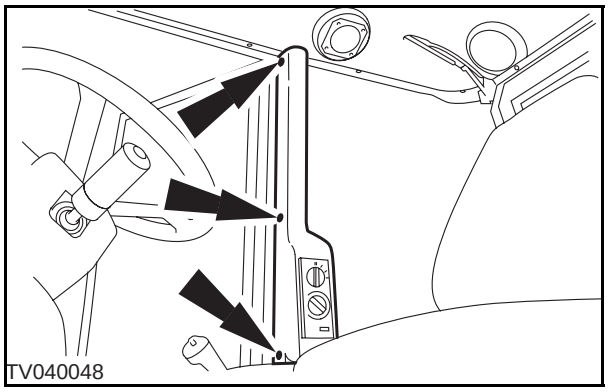


TV040046

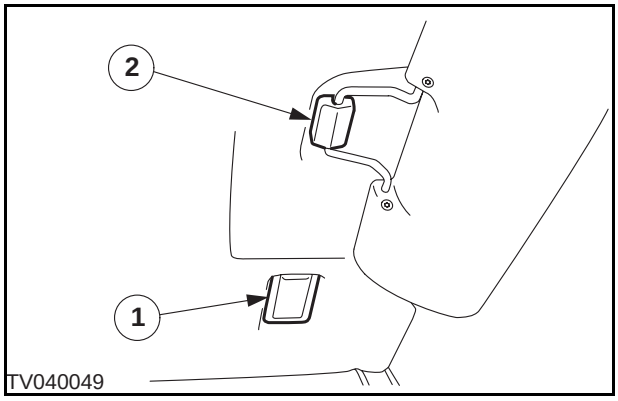
8. Remove the rear window open position latch cover and headlining rear side clips.



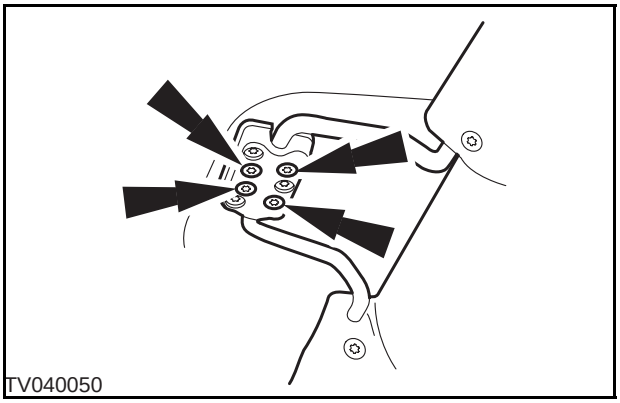
9. Detach the B pillar trim panel and position to one side.



10. Remove the interior light (1).
11. Remove the sun visor retaining screw cover (2).

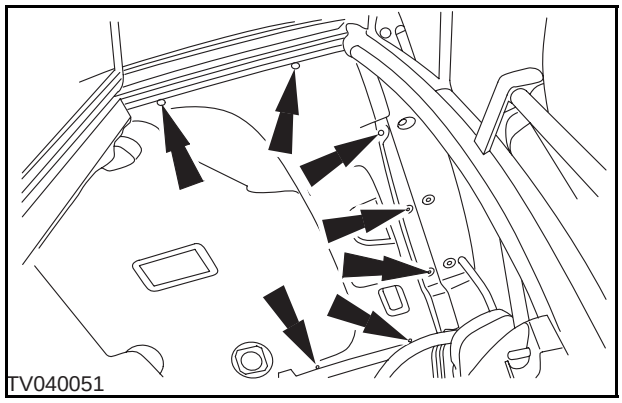


12. Remove the sun visor retaining clips.

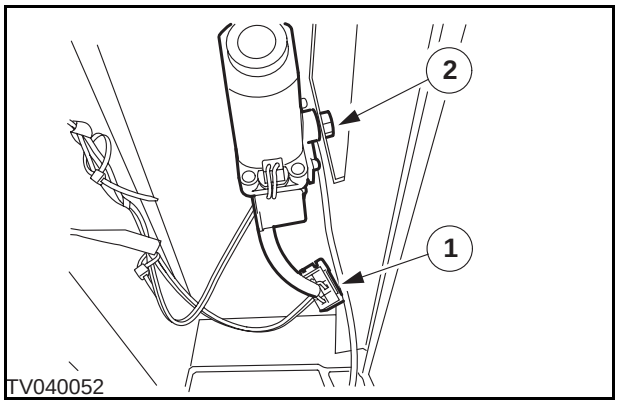


Note:
- Make sure excessive force is not applied to the headlining when lowering.

13. Remove the headlining front retaining clips and lower the front of the headlining.


TV040051

14. Disconnect the wiper motor electrical connector (1).
15. Remove the wiper motor retaining nut (2) and remove the front wiper motor.



TV040052

Installation

⚠ **Caution:**
- **Do not operate the windscreen wiper on a dry windscreen. Failure to follow this instruction may result in damage to the wiper.**

1. To install, reverse the removal procedure.
2. Check the range of movement and operation of the wiper.

Note: This page intentionally left blank.

REMOVAL AND INSTALLATION — REAR WIPER MOTOR

BHJ0901RG

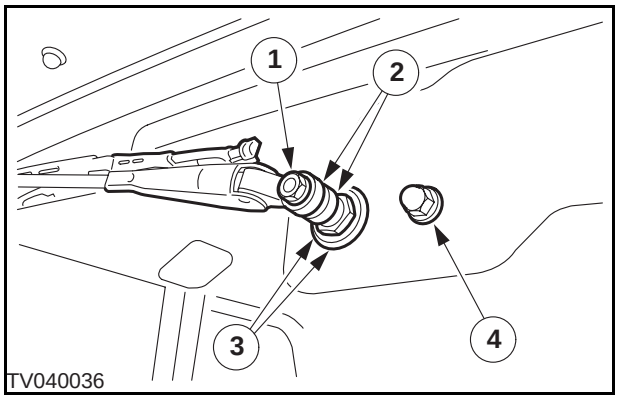
Operation: **Removing and Installing the Rear Wiper Motor**	*Job Code:* **09 32 13 xx**		
None	Standard tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to Section BATTERY ISOLATION, PAGE J09–01–33 in this section.

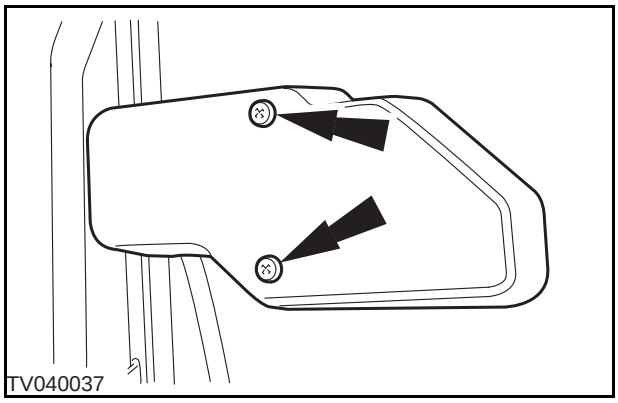
Note:
- Note the position of the rear wiper arm.

2. Open the wiper arm cap.
3. Remove the rear wiper retaining nut (1).
4. Remove the rear wiper arm and spindle cover (2).
5. Remove the rear wiper arm spindle retaining nut and seal (3).
6. Remove the rear wiper motor retaining nut and seal (4).

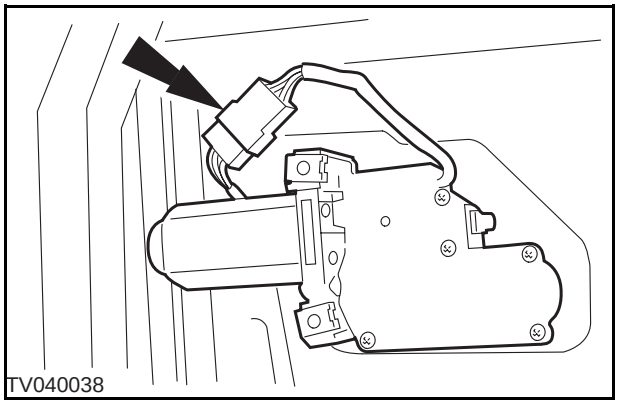


TV040036

7. Remove the rear wiper motor cover.


TV040037

8. Disconnect the rear wiper motor electrical connector and remove the rear wiper motor.



Installation

Do not operate the windscreen wiper on a dry windscreen. Failure to follow this instruction may result in damage to the wiper.

1. To install, reverse the removal procedure.
2. Check the range of the movement and operation of the wiper.

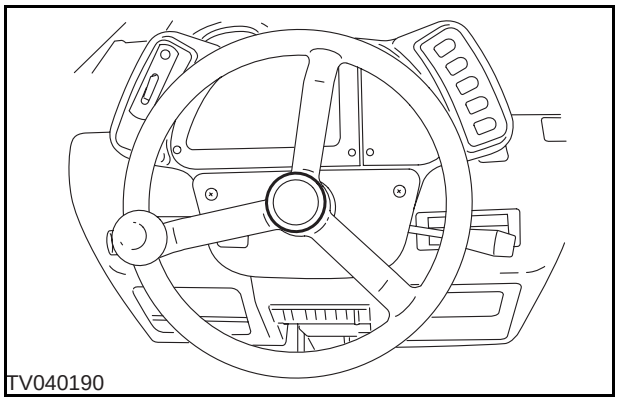
REMOVAL AND INSTALLATION — INDICATOR SWITCH

BHJ0901RH

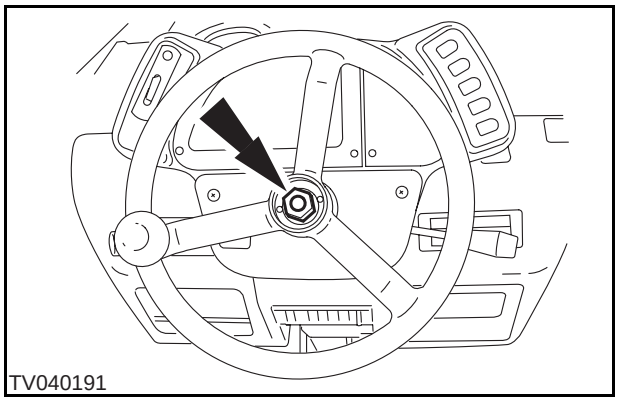
Operation: **Removing and Installing the Indicator Switch**	*Job Code:* **09 38 13 xx**		
None	Suitable steering wheel puller, Standard tools		

Removal

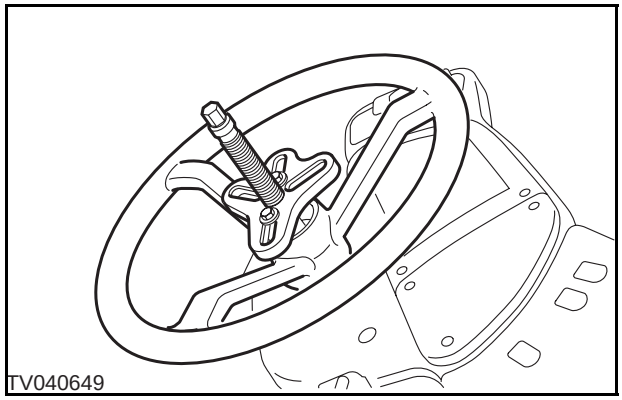
1. Isolate the battery ground cable. For additional information, refer to BATTERY ISOLATION, PAGE J09–01–33 in this section.
2. Remove the steering wheel centre cap.


TV040190

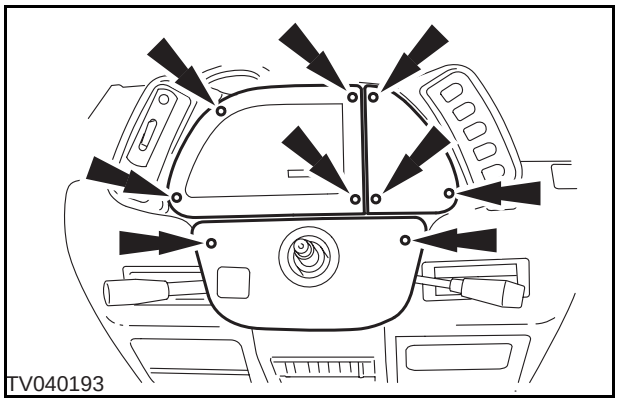
3. Remove the steering wheel retaining nut.


TV040191

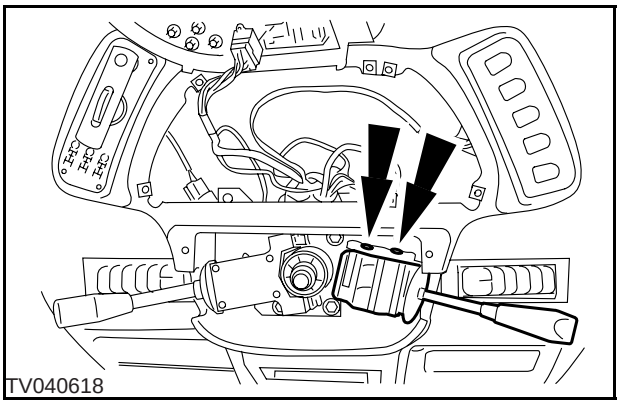
4. Using a suitable steering wheel puller, remove the steering wheel.


TV040649

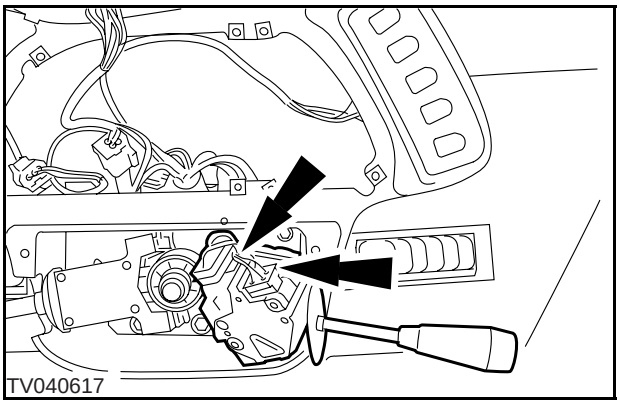
5. Detach the front instrument panel trim covers.



6. Detach the turn signal stalk.

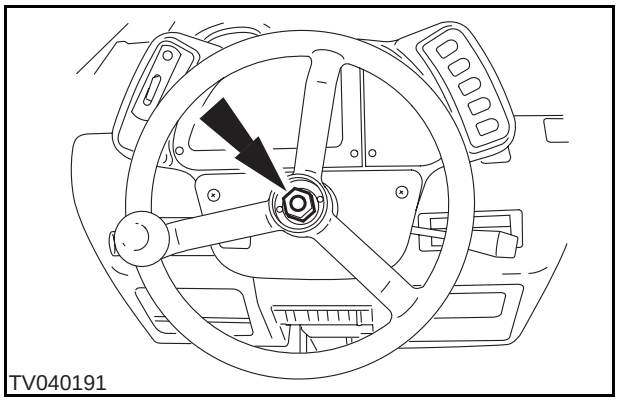


7. Disconnect the turn signal stalk electrical connectors and remove the turn signal stalk.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 58Nm (43 lb.ft).



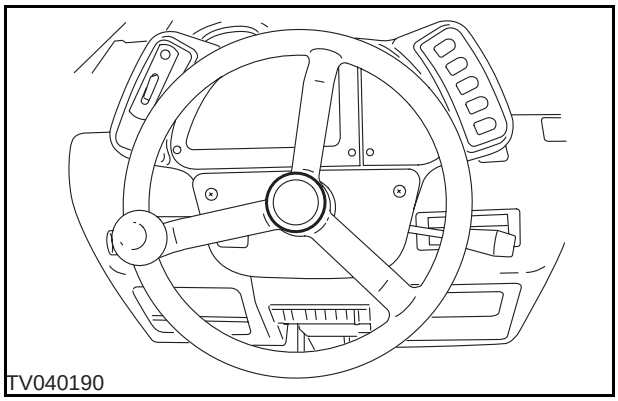
REMOVAL AND INSTALLATION — FORWARD/REVERSE SWITCH

BHJ0901RJ

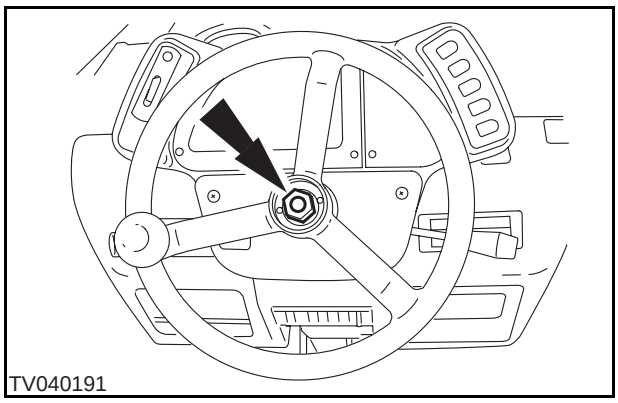
Operation: **Removing and Installing the Forward/Reverse Switch**	*Job Code:* **09 30 13 xx**		
None	Suitable steering wheel puller, Standard tools		

Removal

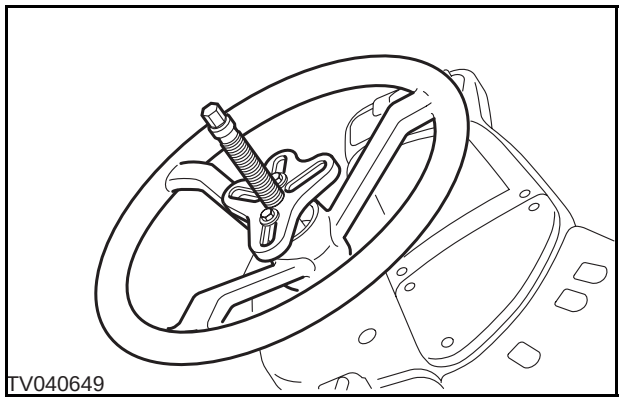
1. Isolate the battery ground cable. For additional information, refer to BATTERY ISOLATION, PAGE J09–01–29 in this section.
2. Remove the steering wheel centre cap.


TV040190

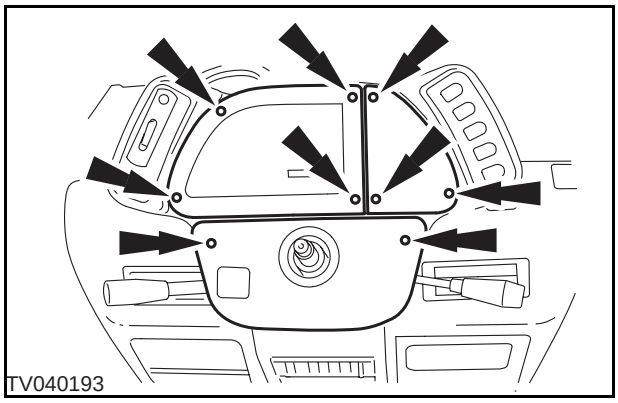
3. Remove the steering wheel retaining nut.


TV040191

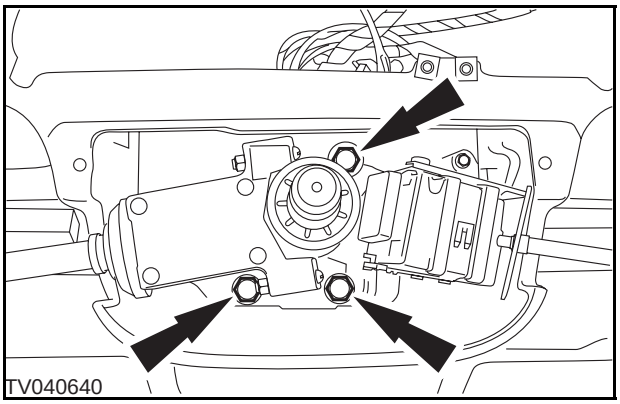
4. Using a suitable steering wheel puller, remove the steering wheel.


TV040649

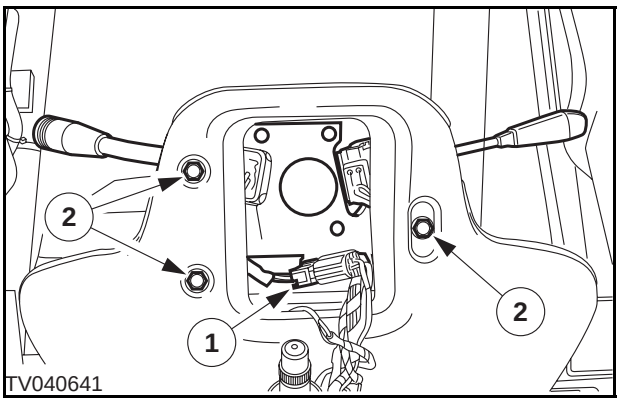
5. Detach the front instrument panel trim covers.



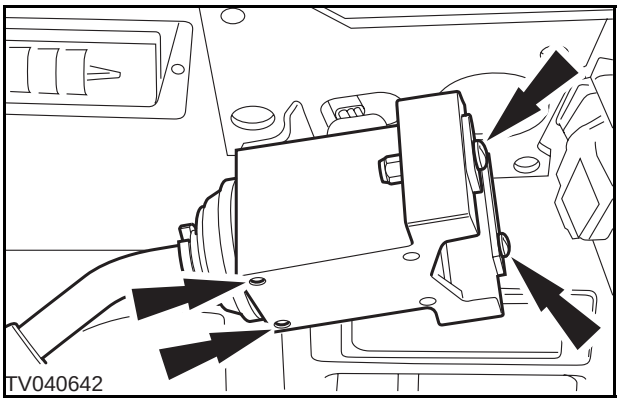
6. Remove the shuttle lever bracket retaining bolts.



7. Disconnect the shuttle lever electrical connector (1).
8. Detach the shuttle lever and bracket (2) from the instrument shroud.

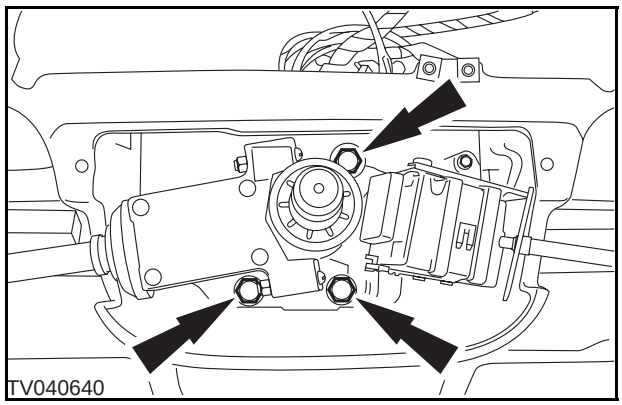


9. Remove the shuttle lever.

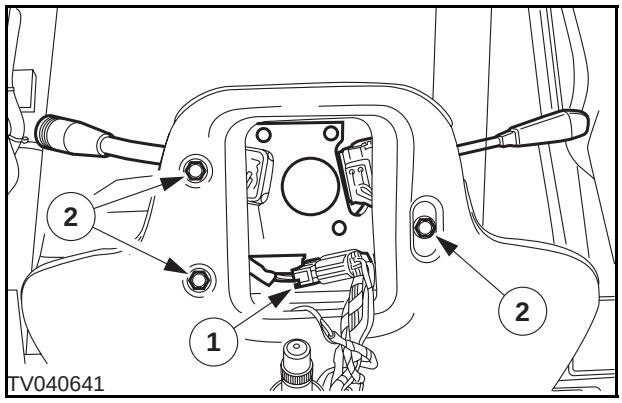


Installation

1. To install, reverse the removal procedure.
2. Tighten to 28Nm (21 lb.ft).

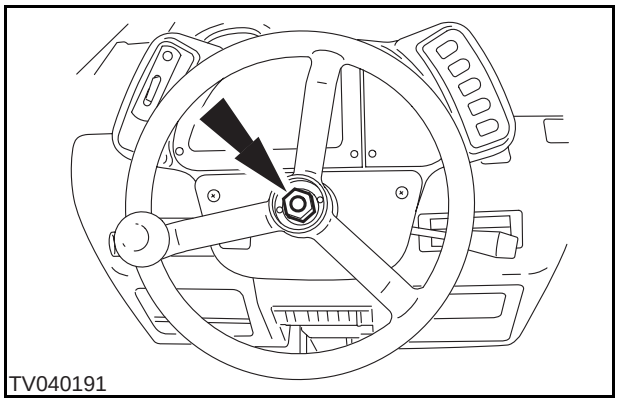

TV040640

3. Tighten (2) to 28Nm (21 lb.ft).



TV040641

4. Tighten to 58Nm (43 lb.ft).


TV040191

Note: This page intentionally left blank.

GENERAL PROCEDURE — BATTERY ISOLATION

BHJ0901GA

Isolation

⚠ **Warning:**

- **Batteries normally produce explosive gases which may cause personal injury, therefore do not allow flames, sparks or lighted substances to come near the battery. When charging or working near the battery always shield your face and protect your eyes. Always provide adequate ventilation. Failure to follow these instructions may result in personal injury.**

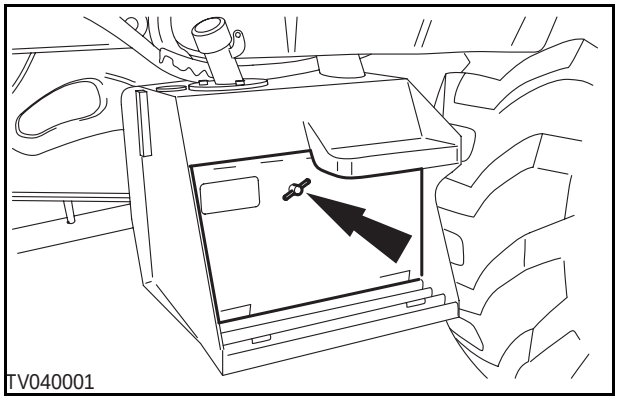
⚠ **Warning:**

- **Batteries contain sulphuric acid, avoid contact with skin eyes or clothing. Shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately for a minimum of 15 minutes and seek prompt medical attention. If swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.**

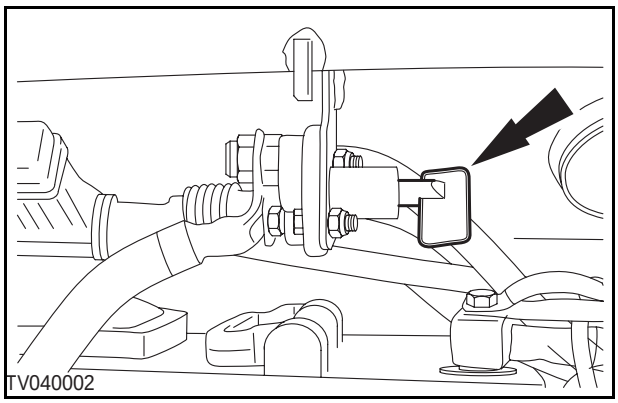
⚠ **Caution:**

- **Make sure the engine is not running before isolating the battery ground cable in order to avoid damage to the vehicle electrical system.**

1. Open the battery cover.


TV040001

2. Rotate the battery isolator key counterclockwise and remove.


TV040002

GENERAL PROCEDURE — BATTERY CHARGING

BHJ0901GB

Special Tools

Battery charger — For slow and standard charging it is necessary to use a constant current type, with an output of at least 14 amps and an upper voltage limit of 50 volts per battery. (A constant voltage charger limited to 16 volts will not recover a battery with an open circuit voltage below 11 volts).
For fast charging, an output of 35 amps is required.
Digital voltmeter — with a precision of 0.2% or better and reading to two decimal places, over the range 0 to 19 volts.
High-rate discharge tester — with a capacity of at least 500 amps.
Thermometer — covering the range of −10°C to 110°C (14°F to 230°F).

General Description

The machines are equipped with a single or twin batteries. In temperate climates no maintenance will be needed throughout the life of the battery, unless a charging system fault develops, which may cause some water loss.
In hot climates there will be some water loss.
It is therefore good practice to check the electrolyte level every 250 hours.

	Twin	Single
Cold Cranking Performance (CCA) (amps) — SAE	590	825
Cold Starting Performance (CCA) (amps) — IEC	420	590
Reserve Capacity (Rc) (minutes)	130	200
Ampere Hour Capacity	72	115
Standard Charge Rate (amps)	9	14

Pre-delivery Inspection

- Test the open circuit voltage, For additional information, refer to DIAGNOSING AND TESTING – BATTERY in this section. This precaution is very important when there is a long shipment/port handling time.
- If the voltage is above 12.5 volts the battery is good.
- If the voltage is below 12.5 volts, recharge the battery, according to the state of the battery. For additional information, refer to STANDARD CHARGING OF THE BATTERY in this section

Stock Machines

Due to the frequent starts, but with little work, the batteries on stock machines will become discharged more quickly. Therefore, check the open circuit voltage every 2 weeks. For additional information, refer to DIAGNOSING AND TESTING – BATTERY, PAGE J09–01–7 in this section.
If the voltage measures 12.3 volts or less, recharge the battery. For additional information, refer to STANDARD CHARGING OF THE BATTERY in this section.

Quiescent Current Drain

The machines, ex-factory, have no permanently live circuits and should have zero quiescent current drain,

when the key-switch is off and all lights are switched off.

It should be noted that permanently live accessories fitted by the dealer, such as a clock or theft alarm system, will place a quiescent drain on the battery. Typically the quiescent drain will be in the range of 10–20 mA. If the quiescent drain measures 40 mA or more, there is a problem with the wiring insulation or the accessories, which must be cured.

Battery Safety

⚠ **Warning:**
- **NEVER add electrolyte to an already charged battery.**

⚠ **Warning:**
- **Sparks can fly from electrical system or the engine. Before you operate this machine in an area which may contain inflammable vapour, completely ventilate the area.**

⚠ **Warning:**
- **A spark or naked flame can cause the hydrogen in a battery to explode. To avoid all risk of explosion, follow these instructions:**
- **Turn the isolator to the "OFF" position (circuit disconnected).**
- **When disconnecting the battery cables, always disconnect the negative (-) cable first.**
- **To reconnect the battery cables, always connect the negative (-) cables last.**
- **Never use metal parts to short circuit the terminals of a battery.**
- **Do not weld, grind or smoke near a battery.**

⚠ **Warning:**
- **A battery produces explosive gases. Keep all flames, sparks and cigarettes away. Provide adequate ventilation when charging the battery or when using it in an enclosed space. Always wear eye protection and protective clothing when working on or near a battery.**

⚠ **Warning:**
- **Battery acid causes severe burns. The battery contains sulphuric acid. Avoid contact with skin, eyes or clothing.**

  Antidote:

  EXTERNAL: Flush with water.

  INTERNAL: Drink large quantities of water or milk. Follow with milk of magnesia, a beaten egg or vegetable oil. Do not give fluids that induce vomiting. Call a doctor immediately.

  EYES: Flush with water for 15 minutes and get prompt medical attention.

⚠ **Warning:**
- **When the battery electrolyte is frozen, the battery can explode if you try to charge the battery or try to jump start and run the engine using another battery. To prevent battery electrolyte from freezing, keep the battery at full charge.**

⚠ **Caution:**
- **Always connect/disconnect leads to/from the battery while the charger is switched off.**

⚠ **Caution:**
- **If the battery temperature rises to 60°C (140°F) stop the charging process and allow the battery to cool.**

⚠ **Caution:**
- **Always measure battery temperature in the centre cell.**

⚠ **Caution:**
- **Always place a damp cloth over the vent covers when charging a battery.**

⚠ **Caution:**
- **Use hot water to remove all evidence of corrosion from battery terminal post and connections, then smear with petroleum jelly or other non-acid grease.**

Battery inspection before test or charge

Reject the battery if:

1. The electrolyte is excessively low.
2. Electrolyte levels vary by more than 20 mm (0.8 in) between cells.
3. Battery case, lid or mountings are cracked or damaged.
4. Terminals are damaged or loose in the case.

Slow charging of the battery

⚠ Caution:

- **Use a battery charger of constant current type with an output of at least 14A and an upper voltage limit of 50V per battery.**

⚠ Caution:

- **Parallel charging is not recommended, therefore on machines fitted with twin batteries, charge each one individually.**

1. Remove the battery from the machine. For additional information, refer to BATTERY (SINGLE), PAGE J09–01–11 or BATTERY (TWIN), PAGE J09–01–13 in this section.
2. If a battery has been neglected and produces an open circuit voltage of 11V or less, it will be completely discharged and the plates will have suffered sulphation. Initially the battery will draw higher than normal voltage but lower than specified current.

CURRENT FOR SINGLE BATTERY	9A
CURRENT FOR TWIN BATTERY	14A

3. Connect the battery charger to the battery. Make sure the polarity of the connections is correct and connect the (+) positive connection first.
4. After 30 minutes, check the charging voltage (the charging current may still be lower than specified).
   Below 12V reject the battery.
   Above 16V reject the battery.
   Between 12V and 16V, continue with charging process for 15 hours.

⚠ Warning:

- **Check the battery temperature regularly and if it reaches 60°C (140°F) stop the charging process.**

5. Set the battery charger to OFF. Disconnect the cables from the battery. Make sure you disconnect the (-) negative cable first.
6. Allow the battery to stand for 24 hours.
7. Load test the battery. For additional information, refer to DIAGNOSING AND TESTING – BATTERY, PAGE J09–01–7 in this section.

Standard charging of the battery

⚠ **Caution:**
- **Use a battery charger of constant current type with an output of at least 14A.**

⚠ **Caution:**
- **Parallel charging is not recommended, therefore on machines fitted with twin batteries, charge each one individually.**

1. Remove the battery from the machine. For additional information, refer to BATTERY (SINGLE), PAGE J09–01–11 or BATTERY (TWIN), PAGE J09–01–13 in this section.

⚠ **Caution:**
- **Do not use the standard charge process on a battery producing an open circuit voltage of 11V or less.**

2. Connect the battery charger to the battery. Make sure the polarity of the connections is correct and connect the (+) positive cable first.
3. Set the battery charger to ON.
4. Set the appropriate charger current:

CURRENT FOR SINGLE BATTERY	9A
CURRENT FOR TWIN BATTERY	14A

5. Charge the battery for the time indicated in the table below:

MINIMUM charging period	
Open circuit volts	**Charge period (hours)**
Above 12.5	0
12.4	3
12.3	4
12.2	5
12.1	6
12.0	7
11.9	8
11.8	9
11.7	10
11.6	11
11.0 to 11.6	12
Below 11.0	Use slow charge

⚠ **Warning:**
- **Check the battery temperature regularly and if it reaches 60°C (140°F), stop the charging process.**

6. Set the battery charger to OFF. Disconnect the cables from the battery. Make sure you disconnect the (-) negative cable first.

7. Load test the battery. For additional information, refer to DIAGNOSING AND TESTING – BATTERY, PAGE J09–01–7 in this section.

Fast charging of the battery

⚠ Caution:
- **Use a battery charger of constant current type with an output of at least 35A.**

⚠ Caution:
- **Parallel charging is not recommended, therefore on machines fitted with twin batteries, charge each one individually.**

⚠ Caution:
- **The standard charge should always be used in preference to the fast charge procedure.**

1. Remove the battery from the machine. For additional information, refer to BATTERY (SINGLE), PAGE J09–01–11 or BATTERY (TWIN), PAGE J09–01–13 in this section.

⚠ Caution:
- **Never use the fast charge procedure for batteries producing an open circuit voltage of 11V or less.**

2. Connect the battery charger to the battery. Make sure the polarity of the connections is correct and connect the (+) positive cable first.
3. Set the battery charger to ON.
4. Set the appropriate charger current:

CURRENT FOR SINGLE BATTERY	9A
CURRENT FOR TWIN BATTERY	14A

5. Charge the battery for the time indicated in the table below:

MAXIMUM charging period	
Open circuit volts	**Charge period (hours)**
Above 12.5	0
12.4	0.25
12.3	0.5
12.2	0.75
12.1	1.0
12.0	1.25
11.9	1.5
11.8	1.75
11.7	2.0
11.6	2,25
11.0 to 11.6	2.5
Below 11.0	Use slow charge

⚠ Warning:
- **Check the battery temperature frequently as the high charging current can cause a rapid rise in temperature. Stop the charging process if the temperature reaches 60°C (140°F).**

⚠ Caution:
- **To avoid deterioration of the battery, do not exceed the charging time specified in the table.**

6. Set the battery charger to OFF. Disconnect the cables from the battery. Make sure you disconnect the (-) negative cable first.
7. Load test the battery. For additional information, refer to DIAGNOSING AND TESTING – BATTERY, PAGE J09–01–7 in this section.
   Voltage above 10V — Install the battery.
   Voltage below 10V — charge battery using the standard charge procedure.

Boost charging of the battery

⚠ Caution:
- **Use a battery charger with an output of 60A.**

⚠ Caution:
- **Boost charging is not recommended. Boost charging may be carried out but the current must be limited to 60A.**

⚠ Caution:
- **Parallel charging is not recommended, therefore on machines fitted with twin batteries, charge each one individually.**

1. Remove the battery from the machine. For additional information, refer to BATTERY (SINGLE), PAGE J09–01–11 or BATTERY (TWIN), PAGE J09–01–13 in this section.
2. Remove the vent manifolds from the battery.

3. Connect the battery charger to the battery. Make sure the polarity of the connections is correct and connect the (+) positive cable first.
4. Set the battery charger to ON.
5. Limit the battery charge to the minimum period required for the battery to start the engine.

   ⚠ **Warning:**
   - **Check the battery temperature frequently as the high charging current can cause a rapid rise in temperature. Stop the charging process if the temperature reaches 60°C (140°F).**

6. Set the battery charger to OFF. Disconnect the cables from the battery. Make sure you disconnect the (-) negative cable first.
7. Install the vent manifolds on the battery.

SPECIFICATIONS — ELECTRICS

BHJ0901SA

General Information

System Voltage	12V Negative Ground
Battery Capacity (Single)	105Ah
Battery Capacity (Double)	70Ah
Alternator	14V
Make	Denso
Type	A115i
Capacity (Without Air Con)	75A
Perkins P/N	2871A302
Capacity (With Air Con)	100A
Perkins (P/N)	2871A304
Starter Motor	
Make	Denso
Type	P95RL
Power	3kW
Hydraulic Control Valve	
Clamp Solenoid Resistance	7.6Ω at 20°C

Torque Values

Description	Nm	Lb.ft
Battery Terminals	6	4
Battery Isolation Switch Retaining Bolts	6	4
Battery Clamp	6	4
Alternator Retaining Bolt	22	16
Starter Motor Retaining Bolts	44	32
Solenoid Main ’BAT’ Terminal M8 Stud	6	4
Cable Fixing Nut M10 Stud	12	9
Solenoid Terminal M10 Stud	12	9
Solenoid Terminal M8 Nut	6	4
Starter Terminal 1/4 BSF Nut	4	3
Solenoid End-Cover Screws	2	1
Solenoid Unit Screws	6	4
Brush-Plate Screws	7	5
Starter Earth Nuts	8	6
Poles Shoes Fixing Screws	41	30
Through Bolts	11	8
Eccentric Pivot Pin Lock-Nut	20	15
Steering Wheel Retaining Bolt	58	43
Shuttle Lever Bracket Retaining Bolts	28	21
Shuttle Lever Bracket Retaining Bolts	28	21
Alternator Terminal ’W’	2	1
Alternator Terminal ’D+’	4	3
Alternator Terminal ’B+’	4	3
Alternator Pulley Nut	80	59

GENERAL ELECTRICAL INFORMATION

BHJ0902TA

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4	Harness numbering
4	Wire Colour table
5	Codes and keys
5	Abbreviations
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7	Relay (K) identification numbers
8	Fuse and relay board layout
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11	Fuse board connector J2
12	Fuse board connector J3
13	Fuse board connector J4
14	Fuse board connector J4 (ROPS)
16	Fuse board connector J5A
17	Fuse board connector J5B
18	Fuse board connector J6A
19	Fuse board connector J6A (ROPS)
20	Fuse board connector J6B
21	Fuse board connector J6B (ROPS)
22	Fuse board connector J7
23	Fuse board connector J8
24	Fuse board connector J8 (Powershift)
25	Fuse board connector J9
26	Fuse board connector J9 (Powershift)
27	Fuse board Connector J10
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41	Component locations – ROPS side console instruments and controls
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46	Wiring diagram – power supply Powershift
48	Wiring diagram - engine
50	Wiring diagram - transmission Synchroshuttle
52	Wiring diagram – transmission Powershift

PAGE	TITLE
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58	Wiring diagram - steer mode (4WS)
60	Wiring diagram - front console panel Synchroshuttle
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64	Wiring diagram - side console panel
66	Wiring diagram - illumination front
68	Wiring diagram - illumination rear
70	Wiring diagram - direction indicators with cabin
72	Wiring diagrams - direction indicators without cabin (ROPS)
74	Wiring diagram - optional roof rear lights (ROPS)
76	Wiring diagram - worklights with cabin
78	Wiring diagram - worklights without cabin (ROPS)
80	Wiring diagram - warning functions with cabin
82	Wiring diagrams - warning functions without cabin (ROPS)
84	Wiring diagram - wiper washer
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88	Wiring diagram - heating and air conditioning
90	Wiring diagram - ride control and hose burst
92	Wiring diagram - loader, return to dig with cabin
94	Wiring diagram - loader, return to dig without cabin (ROPS)
96	Wiring diagram - quick attach and change over with cabin
98	Wiring diagram - quick attach and change over without cabin (ROPS)
100	Connector locations - chassis harness Synchroshuttle
106	Connector locations - chassis harness Powershift and four wheel steer
112	Connector locations - engine harness
116	Connector locations - front console cabin lower harness
118	Connector locations - side console ignition harness
120	Connector locations - ROPS side console ignition harness
122	Connector locations - cabin upper harness
124	Connector locations - ROPS cabin upper harness
126	Connector locations - Battery harness
128	Component lists

SCHEMATICS SYMBOLS

A (n)	Fuse and Relay board / Radio / Transmission controller
B (n)	Pressure switches / Sensors / Proximity switches
E (n)	Lighting components
F (n)	Fuses
G (n)	Electrical supply generators
H (n)	Warning devices
J (n)	Connectors
K (n)	Relays
M (n)	Motors
P (n)	Instruments
R (n)	Heating elements/heater plugs
S (n)	Switches/master switch
V (n)	Diodes
X (n)	Supply line connections
Y (n)	Solenoid valves/solenoids/lift pump

Note:
- (n) Indicates the component number.

Example: K2 stands for relay No. 2

HARNESS NUMBERING

UC	Cabin upper harness	Connector No. C100 — C199
LC	Cabin lower harness	Connector No. C200 — C299
IG	Ignition harness	Connector No. C300 — C399
CH	Chassis harness	Connector No. C400 — C499
EN	Engine harness	Connector No. C500 — C599
4WS	Four wheel steer	Connector No. C600 — C699

WIRE COLOUR TABLE

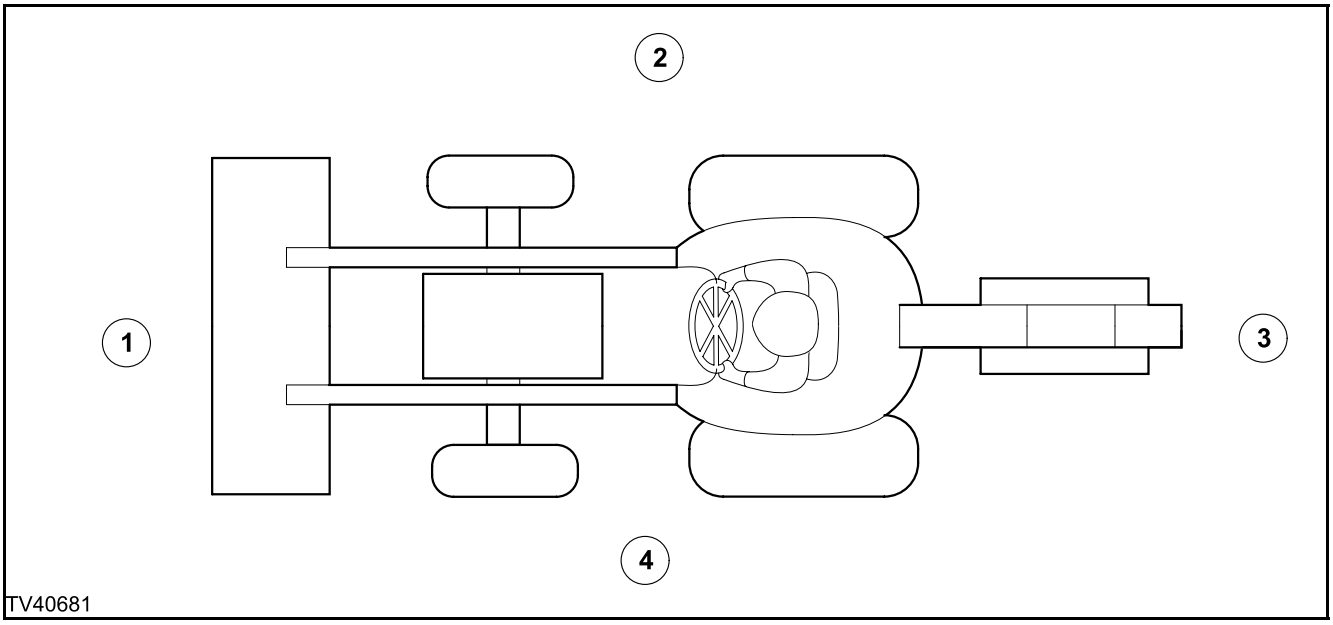
Symbol	**B**	**W**	**N**	**K**	**G**	**O**	**R**
Colour	Black	White	Brown	Pink	Green	Orange	Red
Symbol		**Y**	**U**	**LG**	**P**	**S**	
Colour		Yellow	Blue	Light green	Purple	Slate	

Note:
- B/W indicates that the wire is black, striped by white

⚠ **Caution:**
- **Ensure that the ignition key is "Off" when disconnecting and re-connecting connectors.**

CODES AND KEYS

The terms, Left hand, Right hand, Rear and Front used in this electrical section are sides of the machine as seen from the Operator's seat in the position below.



1. Front
2. Right hand
3. Rear
4. Left hand

*	Indicates other model variation
**	Indicates model specific
(Optional)	Indicates optional fit

ABBREVIATIONS

ROPS	Roll Over Protection System
4WS	Four Wheel Steer
4WB	Four Wheel Braking
TC	Transmission Controller
Diff	Differential
FWD	Forward
REV	Reverse
Synchroshuttle	Synchronizer Mechanical Shift
Powershift	Automatic

FUSE AND RELAY INFORMATION

BHJ0902TB

FUSE (F) IDENTIFICATION NUMBERS

Make sure when replacing a fuse the correct approved standard is used (DIN. 7.2581)

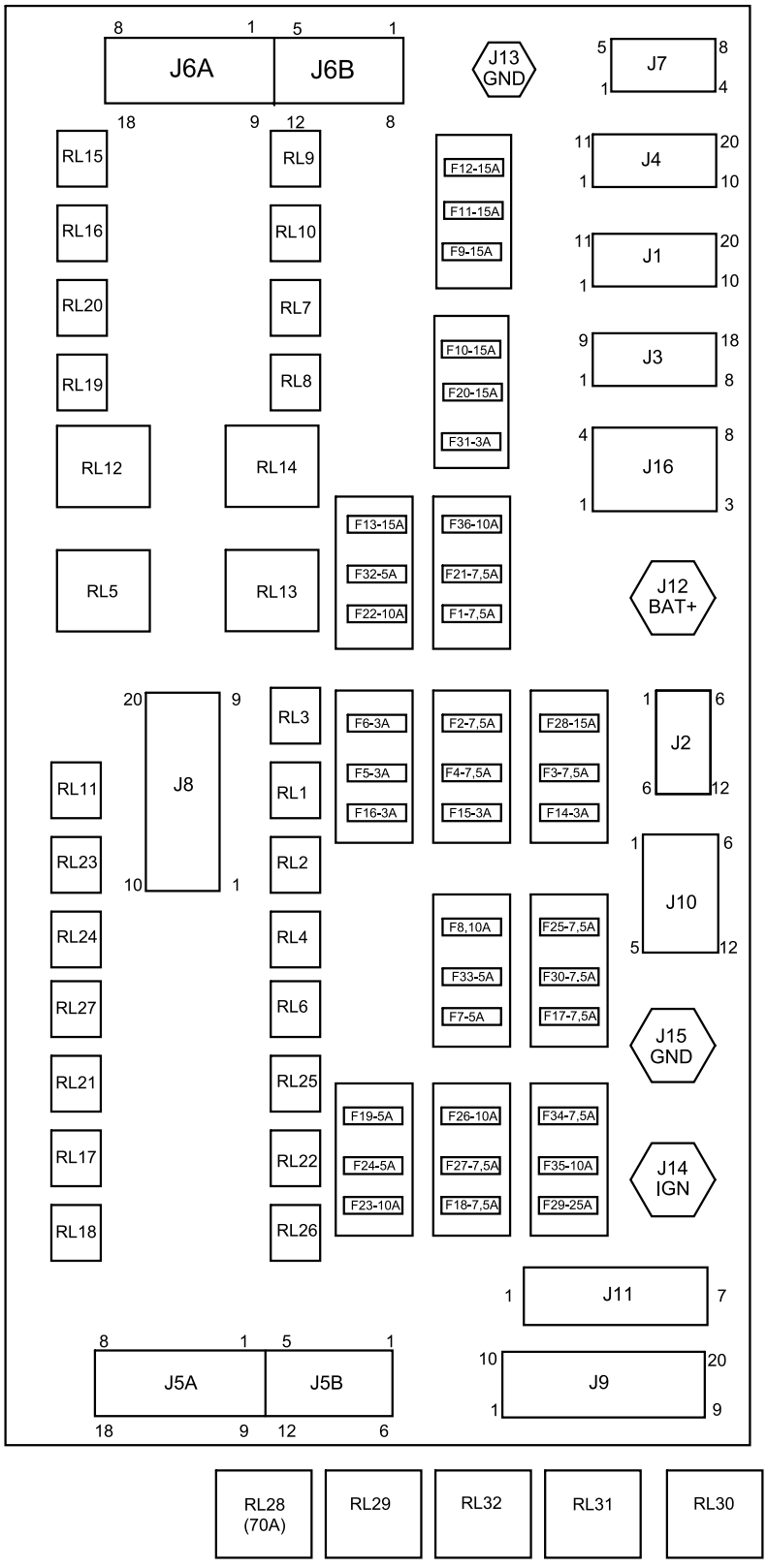
F1	7.5A	Left hand main headlight
F2	7.5A	Right hand main headlight
F3	7.5A	Left hand dip headlight
F4	7.5A	Right hand dip headlight
F5	3A	Left hand side light / Number Plate light
F6	3A	Right hand side light
F7	5A	Indicator light
F8	10A	Hazard light
F9	15A	Front worklight
F10	15A	Front worklight
F11	15A	Rear worklight
F12	15A	Rear worklight
F13	15A	Rotating beacons
F14	3A	Left hand brake light
F15	3A	Right hand brake light
F16	3A	Instrument pack illumination
F17	7.5A	Differential lock / 4WD
F18	7.5A	Clamp / Quick attach / Quick attach loader
F19	5A	Return to dig / Un-loader valve
F20	15A	Front wiper / Rear wiper / Front washer / Rear washer
F21	7.5A	Interior light / Radio
F22	10A	Front / Rear horn
F23	10A	Ride control solenoid
F24	5A	Forward / Reverse solenoid (Synchroshuttle)
F25	7.5A	Fuel solenoid / Enrichment solenoid
F26	10A	Four wheel steer / Crab solenoid
F27	7.5A	Air conditioning switch
F28	15A	Cigar lighter / Fuel lift pump
F29	25A	Heater
F30	10A	Switch pack & illumination pack — Ignition
F31	3A	Switch pack & illumination pack — Battery
F32	5A	Battery relay coils
F33	5A	Ignition relay coils
F34	7.5A	Powershift supply
F35	10A	Spare battery supply
F36	10A	Spare ignition supply
F40	80A	Ignition cabin
F41	20A	Ignition switch
F42	40A	Starter relay

F43	80A	Fuse and relay board
N/A	80A	Mega fuse

RELAY (K) OR (RL)IDENTIFICATION NUMBERS

K1	RL1	Main headlight relay
K2	RL2	Dip headlight relay
K3	RL3	Side lights / Number plate / Illumination pack relay
K4	RL4	Brake light relay
K5	RL5	Hazard relay
K6	RL6	Hazard enable relay
K7	RL7	Front wiper relay
K8	RL8	Rear wiper relay
K9	RL9	Front washer relay
K10	RL10	Rear washer relay
K11	RL11	Front / Rear horn relay
K12	RL12	Indicators flasher unit
K13	RL13	Front worklight relay
K14	RL14	Rear worklight relay
K15	RL15	Rotating beacon relay
K16	RL16	Float enable relay
K17	RL17	Clamp relay
K18	RL18	Digger quick attach relay
K19	RL19	Return to dig relay
K20	RL20	Un-loader relay
K21	RL21	Loader quick attach relay
K22	RL22	Ride control solenoid relay
K23	RL23	Forward relay (Synchroshuttle)
K24	RL24	Reverse relay (Synchroshuttle)
K25	RL25	Four wheel drive (4WD) relay (Synchroshuttle)
K26	RL26	Hose burst relay
K27	RL27	Neutral start relay (Synchroshuttle)
K28	RL28	Ignition relay
K29	RL29	Start relay
K30	RL30	Glow plug relay
K31	RL31	Fuel pump relay
K32	RL32	Auxiliary relay
K33	RL33	4WS relay board

FUSE AND RELAY BOARD LAYOUT



TV041129

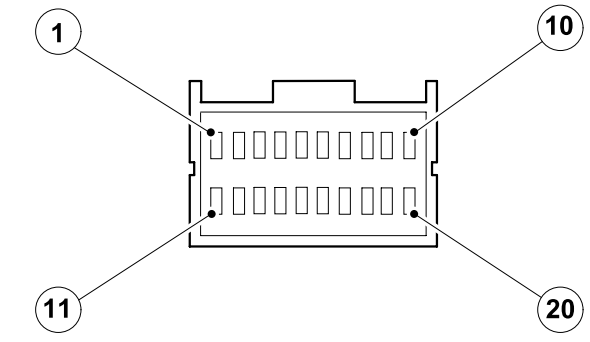
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CONNECTOR INFORMATION

BHJ0902TC

FUSE BOARD CONNECTOR J1 (SYNCHROSHUTTLE)

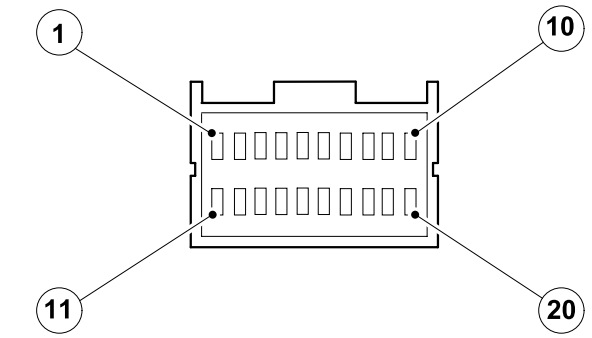
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	R/O	0.35	Side light switch	C209 — pin 4
2	G/R	0.5	Left hand indicator switch	C208 — pin 2
3	G/W	0.5	Right hand indicator switch	C208 — pin 3
4	P/Y	0.35	Horn switch	C208 — pin 5
5	LG	0.5	Indicator common (+)	C208 — pin 15
6	N/W	0.5	Neutral switch	C211 — pin 2
7	U	0.5	Forward (FWD) switch	C211 — pin 1
8	Y/W	0.5	Reverse (REV) switch	C211 — pin 3
9	B	0.5	FWD/REV switch common ground	C211 — pin 4
10	B	0.35 0.35 0.5	Ground	C208 — pin 4 C209 — pin 3 C212 — pin 3
11	LG/B	0.35	Front washer switch	C205 — pin 2
12	O/B	0.35	Front wiper switch	C205 — pin 4
13	R/G	0.35	Front drive axle switch (4WD)	C205 — pin 6
14	Y/O	0.35	Ride control switch	C205 — pin 8
15	O/N	0.35	Quick Attach switch	C205 — pin 9
16	U/K	0.35	Dipped beam switch	C209 — pin 2
17	G	0.5	Ignition (+)	C205 — pin 1
18	LG	0.35	Illumination (+)	C205 — pin 7
19	U/W	0.35	Main beam switch	C209 — pin 1
20	B	0.5	Ground	C205 — pin 5



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FUSE BOARD CONNECTOR J1 (POWERSHIFT)

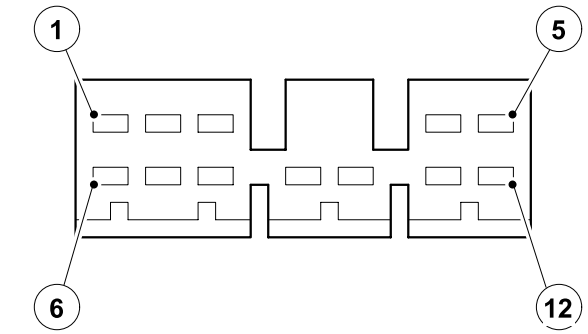
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	R/O	0.35	Side light switch	C209 — pin 4
2	G/R	0.5	Left hand indicator switch	C208 — pin 2
3	G/W	0.5	Right hand indicator switch	C208 — pin 3
4	P/Y	0.35	Horn switch	C208 — pin 5
5	LG	0.5	Indicator common (+)	C208 — pin 1
6	N/W	0.35	Neutral switch	C211 — pin 6
7	—	—	Not used	—
8	Y/W	0.35	Reverse (REV) switch	C216 — pin 5
9	B	0.35	FWD/REV switch common ground	C216 — pin 8
10	B	0.35 0.35 0.5	Ground	C208 — pin 4 C209 — pin 3 C212 — pin 3
11	LG/B	0.35	Front washer switch	C205 — pin 2
12	O/B	0.35	Front wiper switch	C205 — pin 4
13	R/G	0.35	Front drive axle switch (4WD)	C205 — pin 6 C214 — pin 16 C212 — pin 3
14	Y/O	0.35	Ride control switch	C205 — pin 8
15	O/N	0.35	Quick Attach switch	C205 — pin 9
16	U/K	0.35	Dipped beam switch	C209 — pin 2
17	G	0.5	Ignition (+)	C205 — pin 1
18	LG	0.35	Illumination (+)	C205 — pin 7
19	U/W	0.35	Main beam switch	C209 — pin 1
20	B	0.5	Auxiliary relay ground	C205 — pin 5



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FUSE BOARD CONNECTOR J2

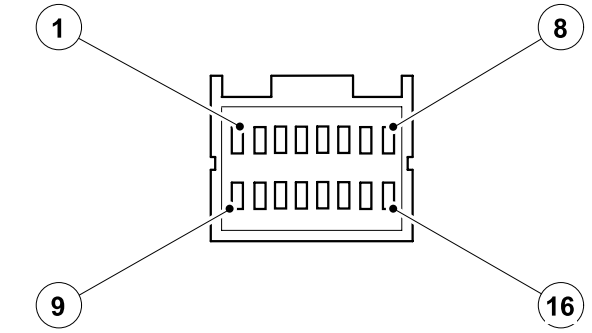
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	G/R	0.5	Left hand indicator light	C206 — pin 3
2	U/W	1.0	Left hand main beam light	C206 — pin 6
3	U/W	1.0	Right hand main beam light	C207 — pin 6
4	U/K	1.0	Right hand dipped beam light	C207 — pin 1
5	U/K	1.0	Left hand dipped beam light	C206 — pin 1
6	R/W	0.5	Right hand side light	C207 — pin 2
7	R/B	0.5	Left hand side light	C206 — pin 2
8	G/W	0.5	Right hand indicator light	C207 — pin 3
9	B	2.0	Right hand common ground	C207 — pin 4
10	B	2.0	Left hand common ground	C206 — pin 4
11	—	—	Not used	—
12	—	—	Not used	—



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FUSE BOARD CONNECTOR J3

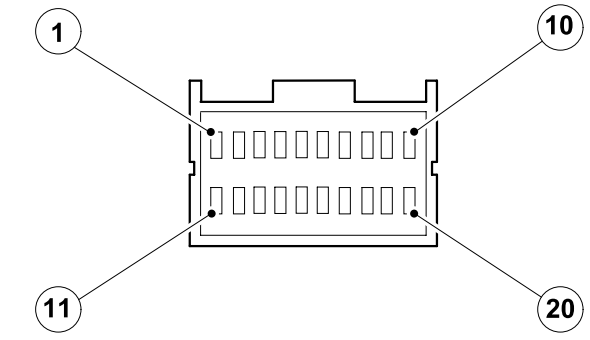
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	W/B	0.5	Differential lock switch (+)	C203 — pin 1
2	K/U	0.35	Engine fault	C210 — pin 14
3	K/R	0.35	Bucket float indicator lamp	C210 — pin 12
4	N/K	0.35	Battery (+)	C210 — pin 4
5	G/P	0.5	Brake switch (+)	C204 — pin b C212 — pin 2
6	B	0.5	Differential lock switch (-)	C203 — pin 1
7	B/Y	0.5	Speedo (+)	C210 — pin 2
8	B	0.5	Ground	C210 — pin 20
9	B/O	0.35	Brake pressure warning lamp	C210 — pin 6
10	G	0.5	Ignition supply	C210 — pin 1
11	LG/K	0.35	Indicator / Hazard warning lamp	C210 — pin 10
12	B/W	0.35	Speedo (-)	C210 — pin 3
13	S/B	0.35	Neutral position indicator lamp	C210 — pin 13
14	LG	0.35	Side light indicator lamp	C210 — pin 18
15	U/W	0.35	Main beam warning lamp	C210 — pin 11
16	B	0.5	Brake switch (-)	C204 — pin a



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FUSE BOARD CONNECTOR J4

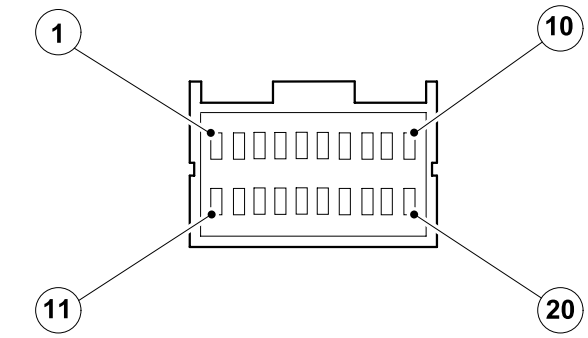
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	P/LG	0.5	Return to dig switch	C310 — pin 4
2	O/U	0.5	Backhoe quick attach switch	C310 — pin 5
3	—	—	Not used	—
4	O/P	0.5	Unloader switch	C319 — pin 2
5	P/Y	0.5	Horn switch	C310 — pin 15
6	—	—	Not used	—
7	—	—	Not used	—
8	—	—	Not used	—
9	R	0.5	Battery (+)	C310 — pin 6
10	—	—	Not used	—
11	G	0.5	Ignition supply	C310 — pin 8
12	LG/Y	0.5	Rear washer switch	C310 — pin 12
13	LG	0.5	Side console illumination	C310 — pin 16
14	U/G	0.5	Front worklight switch	C310 — pin 1
15	P/K	0.5	Beacon switch	C310 — pin 9
16	G/N	0.5	Rear worklight switch	C310 — pin 10
17	O/B	0.5	Rear wiper switch	C310 — pin 11
18	LG/K	0.5	Hazard switch	C310 — pin 2
19	K/B	0.5	Sideshift clamp switch	C310 — pin 3
20	B	0.5	Ground	C310 — pin 7



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FUSE BOARD CONNECTOR J4 ROPS

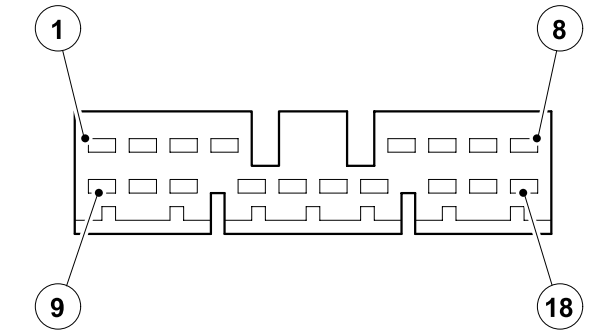
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	P/LG	0.5	Return to dig switch	C317 — pin 2
2	O/U	0.5	Backhoe quick attach switch	C326 — pin 2
3	LG/K	0.5	Hazard switch illumination	C316 — pin 1
4	O/P	0.5	Unloader switch	C310 — pin 14
5	P/Y	0.5	Horn switch	C325 — pin a
6	—	—	Not used	—
7	—	—	Not used	—
8	—	—	Not used	—
9	—	—	Not used	—
10	B	0.5	Ground	C312 — pin 2 C314 — pin 2 C322 — pin 2 C324 — pin 2 C318 — pin 2 C320 — pin 2 C315 — pin 6 C327 — pin 2
11	G	0.5	Switch illumination supply	C312 — pin 1 C314 — pin 1 C322 — pin 1 C324 — pin 1 C318 — pin 1 C320 — pin 1 C327 — pin 1
12	—	—	Not used	—
13	—	—	Not used	—
14	U/G	0.5	Front worklight switch	C311 — pin 2
15	P/K	0.5	Beacon switch	C313 — pin 2
16	G/N	0.5	Rear worklight switch	C323 — pin 2
17	—	—	Not used	—
18	LG/K	0.5	Hazard switch	C315 — pin 1
19	K/B	0.5	Centermount / Sideshift switch	C321 — pin 2
20	B	0.5	Ground	C311 — pin 6 C313 — pin 6 C321 — pin 6 C323 — pin 6 C317 — pin 6 C319 — pin 6 C315 — pin 5 C325 — pin b C326 — pin 6



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FUSE BOARD CONNECTOR J5A

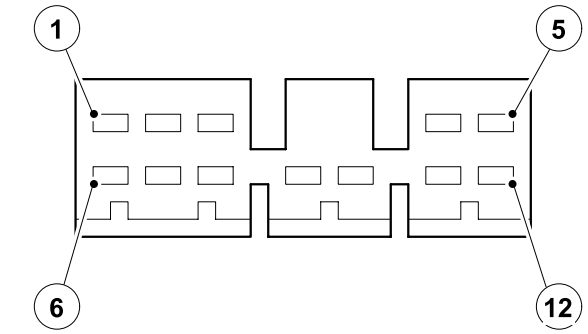
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	G	1.0	Ignition relay	K28 — pin 6
2	Y/P	1.0	Reverse alarm (optional)	C409 — pin 1
3	G/W	1.0	Right hand rear indicators	C412 — pin 3
4	G/R	1.0	Left hand rear indicators	C415 — pin 3
5	K/B	1.0	Sideshift clamp	C411 — pin 1
6	P/Y	1.0	Rear horn (optional)	C410 — pin a
7	O/U	1.0	Bucket rear quick attach	C408 — pin 1
8	G/P	1.0	Left hand brake lamp (+)	C415 — pin 2
9	B	1.0	Right hand rear lamps common ground	C412 — pin 4
10	B	1.0	Rear horn (optional)	C410 — pin b
11	B	1.0	Reverse alarm (optional)	C409 — pin 2
12	R/W	1.0	Registration plate lights (+)	C413 — pin 1 C414 — pin 1
13	R/G	1.0	Right hand side rear light (-)	C412 — pin 1
14	B	1.0	Number plate lights (-)	C413 — pin 2
15	G/P	1.0	Right hand brake light (+)	C412 — pin 2
16	B	1.0	Registration plate lights (-)	C414 — pin 2
17	R/B	1.0	Left hand side light (+)	C415 — pin 1
18	B	1.0	Left hand rear lamps common ground	C415 — pin 4



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FUSE BOARD CONNECTOR J5B

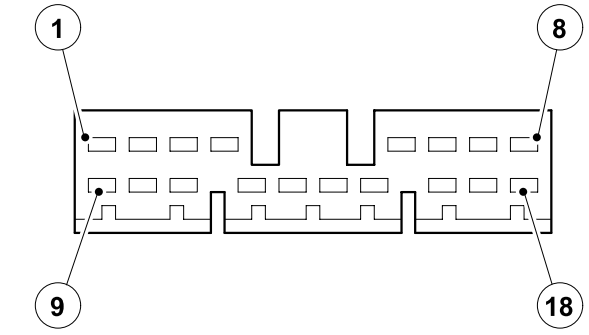
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	P/O	1.0	Return to dig solenoid (+)	C407 — pin 1
2	W/P	1.0	Differential lock solenoid (+)	C426 — pin 1
3	—	—	Not used	—
4	P/W	1.0	Return to dig switch	C431 — pin 2
5	B	1.0	Return to dig switch	C431 — pin 1
6	B	1.0	Return to dig solenoid (-)	C407 — pin 2
7	B	1.0	Sideshift clamp	C411 — pin 2
8	B	1.0	Bucket rear quick attach (optional)	C408 — pin 2
9	B	1.0	Ignition relay	K28 — pin 4
10	B	1.0	Differential lock solenoid (-)	C426 — pin 2
11	—	—	Not used	—
12	—	—	Not used	—



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FUSE BOARD CONNECTOR J6A (CABIN)

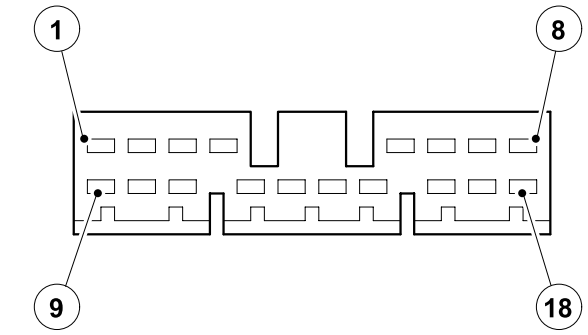
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	P/K	1.0	Front beacon	C112 — pin 1
2	B	1.0	Right hand rear worklight (outer)	C115 — pin 2
3	B	1.0	Right hand rear worklight (inner)	C116 — pin 2
4	O/LG	1.0	Rear wiper motor (park switch)	C108 — pin 3
5	O/Y	1.0	Rear wiper motor	C108— pin 2
6	O/G	1.0	Front wiper motor	C110 — pin 3
7	U/Y	1.0	Left hand front worklight	C117 — pin 3
8	U/Y	1.0	Right hand front worklight	C113 — pin 3
9	P/K	1.0	Rear beacon	C118 — pin 1
10	P/S	1.0	Left hand rear worklight (inner)	C120 — pin 1
11	P/S	1.0	Right hand rear worklight (inner)	C116 — pin 1
12	G/N	1.0	Left hand rear worklight (outer)	C121 — pin 1
13	G/N	1.0	Right hand rear worklight (outer)	C115 — pin 1
14	O/U	1.0	Rear wiper motor (park switch)	C108 — pin 1
15	O/R	1.0	Front wiper motor (park switch)	C110 — pin 2
16	O/B	1.0	Front wiper motor (park switch)	C110 — pin 1
17	U/G	1.0	Left hand front worklight	C117 — pin 1
18	U/G	1.0	Right hand front worklight	C113 — pin 1



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FUSE BOARD CONNECTOR J6A (ROPS)

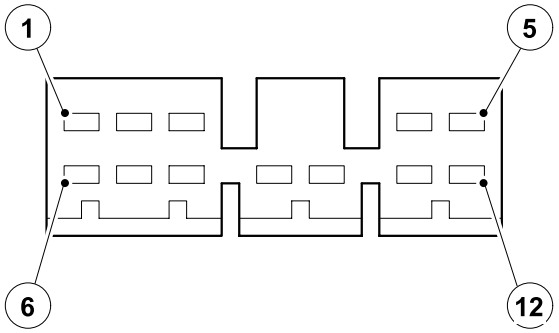
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	P/K	1.0	Front beacon	C112 — pin 1
2	B	1.0	Right hand rear worklight (outer)	C115 — pin 2
3	B	1.0	Right hand rear worklight (inner)	C116 — pin 2
4	—	—	Not used	—
5	—	—	Not used	—
6	—	—	Not used	—
7	U/Y	1.0	Left hand front worklight	C117 — pin 3
8	U/Y	1.0	Right hand front worklight	C113 — pin 3
9	P/K	1.0	Rear beacon	C118 — pin 1
10	P/S	1.0	Right hand rear worklight (inner)	C116 — pin 1
11	P/S	1.0	Left hand rear worklight (inner)	C120 — pin 1
12	G/N	1.0	Right hand rear worklight (outer)	C115 — pin 1
13	G/N	1.0	Left hand rear worklight (outer)	C121 — pin 1
14	—	—	Not used	—
15	—	—	Not used	—
16	—	—	Not used	—
17	U/G	1.0	Left hand front worklight	C117 — pin 1
18	U/G	1.0	Right hand front worklight	C113 — pin 1



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FUSE BOARD CONNECTOR J6B (CABIN)

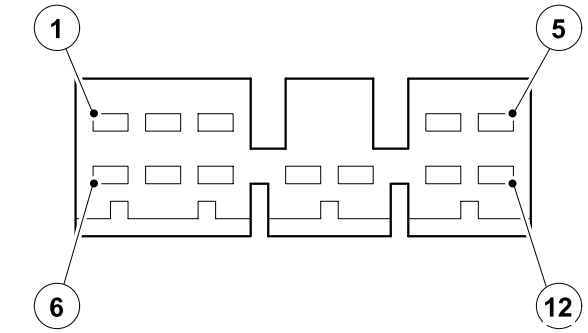
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	B	1.0	Rear beacon	C118 — pin 2
2	B	1.0	Front beacon	C112 — pin 2
3	B	1.0	Left hand rear worklight (outer)	C121 — pin 2
4	B	1.0	Left hand rear worklight (inner)	C120 — pin 2
5	B	2.0	Left hand front worklight	C117 — pin 2
6	B	2.0	Right hand front worklight	C113 — pin 2
7	B	1.0	Rear wiper motor (-)	C108 — pin 4
8	B	1.0	Front wiper motor (-)	C110 — pin 5
9	B	1.0	Radio (-)	C109 — pin b
10	B	1.0	Interior light (-)	C111 — pin b
11	R/K	1.0	Interior light (+)	C111 — pin a
12	R/P	1.0	Radio (+)	C109 — pin a



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FUSE BOARD CONNECTOR J6B (ROPS)

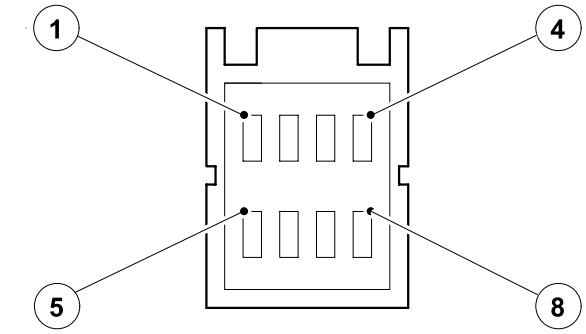
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	B	1.0	Rear beacon (-)	C118 — pin 2
2	B	1.0	Front beacon (-)	C112 — pin 2
3	B	1.0	Left hand rear worklight (outer)	C121 — pin 2
4	B	1.0	Left hand rear worklight (inner)	C120 — pin 2
5	B	2.0	Left hand front worklight	C117 — pin 2
6	B	2.0	Right hand front worklight	C113 — pin 2
7	—	—	Not used	—
8	—	—	Not used	—
9	—	—	Not used	—
10	—	—	Not used	—
11	—	—	Not used	—
12	—	—	Not used	—



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FUSE BOARD CONNECTOR J7

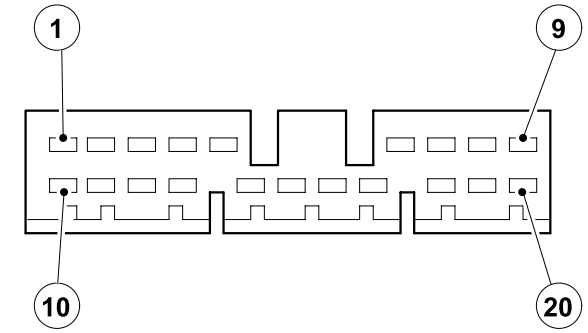
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	G	0.5	Ignition	C308 — pin 1
2	N/K	0.5	Battery (+)	C308 — pin 4
3	R/U	0.5	Illumination	C308 — pin 18
4	B	0.5	Ground	C308 — pin 20
5	—	—	Not used	—
6	S	0.5	Engine fault lamp (link)	C308 — pin 17
7	—	—	Not used	—
8	—	—	Not used	—



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FUSE BOARD CONNECTOR J8 (SYNCHROSHUTTLE)

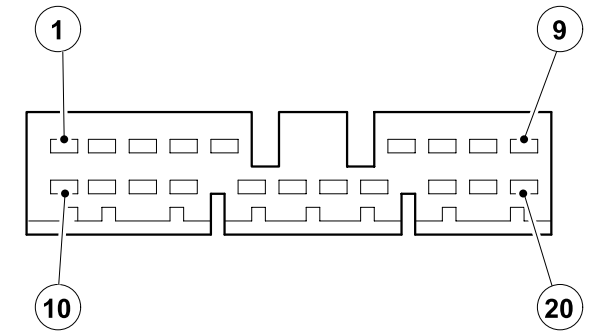
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	Y/O	1.0	Ride control solenoid (+) (optional)	C418 — pin 1
2	Y/O	1.0	Ride control solenoid (+) (optional)	C417 — pin 1
3	B	1.0	Ride control solenoid (-) (optional)	C418 — pin 2
4	U/S	1.0	Forward solenoid (+)	C425 — pin 2
5	B	1.0	Ride control solenoid (-) (optional)	C417 — pin 2
6	Y/P	1.0	Reverse solenoid (+)	C427 — pin 1
7	B	1.0	Forward solenoid (-)	C425 — pin 2
8	R/Y	1.0	Four wheel drive solenoid (+)	C428 — pin 1
9	B	1.0	Unloader valve solenoid (-)	C435 — pin 2
10	O/W	1.0	Unloader valve solenoid (+)	C435 — pin 1
11	B	1.0	Front horn (-)	C424 — b
12	P/Y	1.0	Front horn (+)	C424 — a
13	B	1.0	Loader quick attach (-) (optional)	C430 — pin 2
14	O/P	1.0	Loader quick attach (+) (optional)	C430 — pin 1
15	B	1.0	Front washer motor (-)	C422 — pin 2
16	LG/Y	1.0	Front washer motor (+)	C422 — pin 1
17	B	1.0	Rear washer motor (-)	C423 — pin 2
18	LG/B	1.0	Rear washer motor (+)	C423 — pin 1
19	B	1.0	Reverse solenoid (-)	C427 — pin 2
20	B	1.0	Four wheel drive solenoid (-)	C428 — pin 2



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FUSE BOARD CONNECTOR J8 (POWERSHIFT)

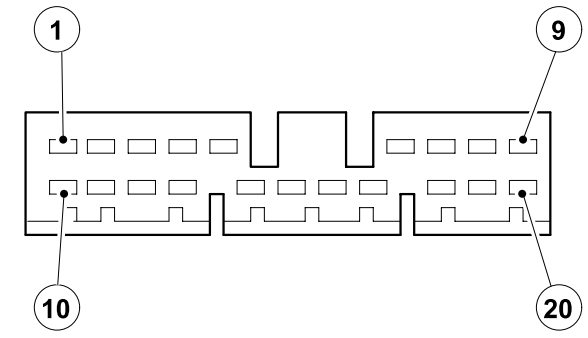
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	Y/O	1.0	Ride control solenoid (+) (optional)	C418 — pin 1
2	Y/O	1.0	Ride control solenoid (+) (optional)	C417 — pin 1
3	B	1.0	Ride control solenoid (-) (optional)	C418 — pin 2
4	—	—	Not used	—
5	B	1.0	Ride control solenoid (-) (optional)	C417 — pin 2
6	—	—	Not used	—
7	—	—	Not used	—
8	—	—	Not used	—
9	B	1.0	Unloader valve solenoid (-)	C435 — pin 2
10	O/W	1.0	Unloader valve solenoid (+)	C435 — pin 1
11	B	1.0	Front horn (-)	C424 — pin b
12	P/Y	1.0	Front horn (+)	C424 — pin a
13	B	1.0	Loader quick attach (-) (optional)	C430 — pin 2
14	O/P	1.0	Loader quick attach (+) (optional)	C430 — pin 1
15	B	1.0	Front washer motor (-)	C422 — pin 2
16	LG/Y	1.0	Front washer motor (+)	C422 — pin 1
17	B	1.0	Rear washer motor (-)	C423 — pin 2
18	LG/B	1.0	Rear washer motor (+)	C423 — pin 1
19	—	—	Not used	—
20	—	—	Not used	—



TV040394

FUSE BOARD CONNECTOR J9 (SYNCHROSHUTTLE)

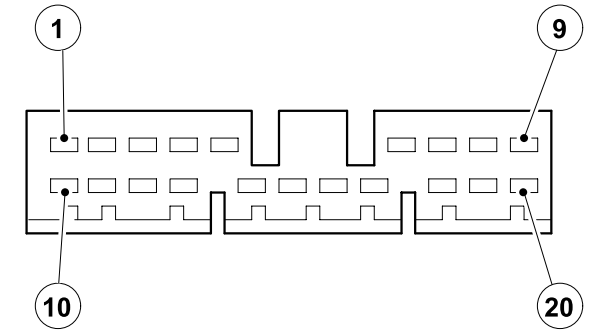
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	Y/G	1.0	Transmission de-clutch switch gearlever (+)	C442 — pin 2
2	O/R	1.0	Unloader switch (+)	C416 — pin 1
3	Y/G	1.0	Transmission de-clutch switch loader lever (+)	C416 — pin 4
4	W/G	1.0	Starter relay	K29 — pin 2
5	B	1.0	Transmission de-clutch switch gearlever (-)	C442 — pin 1
6	B	1.0	Transmission de-clutch switch loader lever (-)	C416 — pin 3
7	B	1.0	Un-loader switch (-)	C416 — pin 2
8	—	—	Not used	—
9	B	1.0	Fuel shut-off (-)	C506 — pin 2
10	B/W	1.0	Speed sensor (optional)	C429 — pin 1
11	B/Y	1.0	Speed sensor (optional)	C429 — pin 2
12	N/O	1.0	Fuel shut-off (+)	C506 — pin 1
13	W/B	1.0	Hose burst float switch	C420 — pin 3
14	B/S	1.0	Fuel enrichment sensor	C508 — pin 1
15	Y/B	1.0	Hose burst harness	C420 — pin 2
16	R	1.0	Four wheel steer / Crab supply (+)	C405 — pin 1
17	P/B	1.0	Air conditioning switch (optional)	C210 — pin 11
18	B	1.0	Fuel lift pump (-)	C503 — pin 2
19	B	1.0	Hose burst harness (-)	C420 — pin 1
20	B	1.0	Four wheel steer / Crab ground (-)	C405 — pin 2



TV040394

FUSE BOARD CONNECTOR J9 (POWERSHIFT)

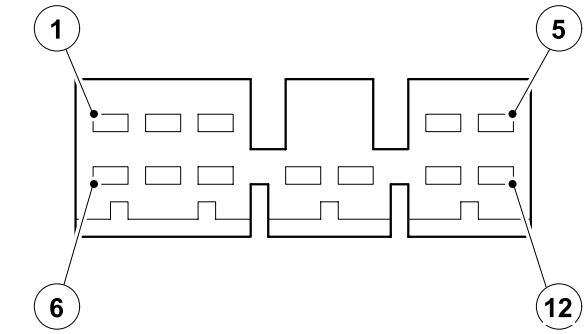
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	—	—	Not used	—
2	O/R	1.0	Unloader switch (+)	C416 — pin 1
3	Y/G	1.0	Transmission de-clutch switch wader lever (+)	C416 — pin 4
4	W/G	1.0	Starter relay	K29 — pin 2
5	—	—	Not used	—
6	B	1.0	Transmission de-clutch switch wader lever (-)	C416 — pin 3
7	B	1.0	Un-loader switch (-)	C416 — pin 2
8	—	—	Not used	—
9	B	1.0	Fuel shut-off (-)	C506 — pin 2
10	—	—	Not used	—
11	—	—	Not used	—
12	N/O	1.0	Fuel shut-off (+)	C506 — pin 1
13	W/B	1.0	Hose burst float switch	C420 — pin 3
14	B/S	1.0	Fuel enrichment sensor	508 — pin 1
15	Y/B	1.0	Hose burst harness	C420 — pin 2
16	R	1.0	Four wheel steer / Crab supply (+)	C405 — pin 1
17	P/B	1.0	Air conditioning switch (optional)	C210 — pin 11
18	B	1.0	Fuel lift pump (-)	C503 — pin 2
19	B	1.0	Hose burst harness	C420 — pin 1
20	B	1.0	Four wheel steer / Crab ground (-)	C405 — pin 2



TV040394

FUSE BOARD CONNECTOR J10

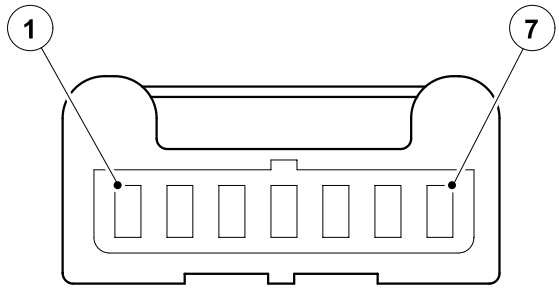
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	—	—	Not used	—
2	K/O	1.0	Cigar lighter (+)	C305 — pin 1
3	R	1.0	Fuel lift pump relay (+)	K31 — pin 8
4	W	2.0	Ignition switch	C306 — pin 2
5	R	1.0	Change over valve (optional)	C304 — pin 1
6	B	1.0	Change over valve (optional) (-)	C304 — pin 2
7	B	1.0	Glow plug relay	K30 — pin 6
8	B	1.0	Auxiliary relay	K32 — pin 2
9	B	1.0	Fuel lift pump relay (-)	K31 — pin 4
10	B	2.0	Cigar lighter (-)	C305 — pin 2
11	—	—	Not used	—
12	—	—	Not used	—



TV040384

FUSE BOARD CONNECTOR J11

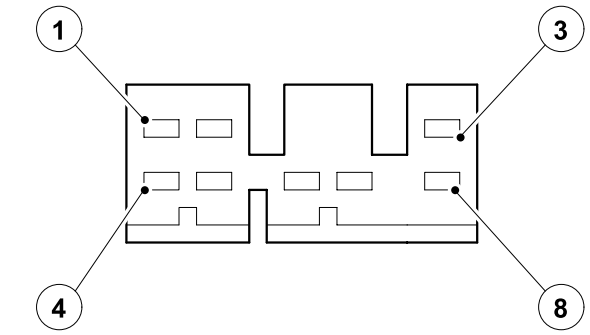
Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	G/U	2.5	Heater control switch	C105
2	—	—	Not used	—
3	P/R	1.0	Air conditioning thermostat	C106
4	P/G	1.0	Air conditioning thermostat	C101 — pin 3
5	B	2.5	Heater motor	C101 — pin 4
6	—	—	Not used	—
7	—	—	Not used	—



TV040382

FUSE BOARD CONNECTOR J16 (POWERSHIFT)

Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
1	R	1.0	Air seat pump supply	C217 — pin 2
2	—	—	Not used	—
3	G/R	0.5	Handbrake switch supply	C202 — pin b
4	G	1.0	Transmission control unit supply (+)	C214 — pin 1
5	B	1.0	Ground	C214 — pin 2
6	B	1.0	Ground	C213 — pin H
7	—	—	Not used	—
8	Y/G	1.0	Transmission de-clutch request	C214 — pin 17



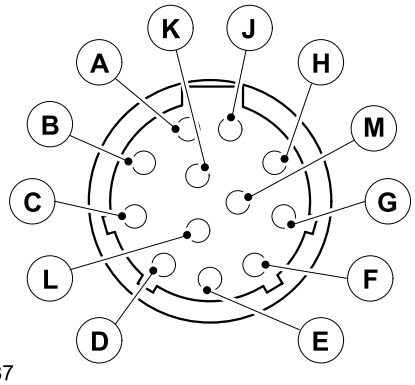
TV040385

TRANSMISSION CONTROLLER CONNECTOR 213

Pin No.	Colour	Wire Size	Function	To Connector / Pin No.
A	R/O xx	0.5	Speed sensor input	C214 — pin 21
B	G/Y	1.0	Forward Hi / Low selection solenoid	C214 — pin 5
C	U/S	1.0	Forward / Neutral selection solenoid	C214 — pin 6
D	O	1.0	1/2 selection solenoid	C214 — pin 4
E	R/Y	1.0	12v = All wheel drive / 0v = Rear wheel drive	c214 — pin 9
F	Y/P	1.0	Reverse / neutral selection solenoid	C214 — pin 7
G	B x	1.0	Direction modulation solenoid (-)	C214 — pin 3
H	B	1.0	Ground	J16 — pin 6
J	B xx	0.5	Sensor ground	C214 — pin 11
K	LG/S	1.0	Range modulation solenoid	C214 — pin 13
L	G/W xx	0.5	0 — 5K ohm temperature sensor	C214 — pin 18
M	R/S x	1.0	Supply range modulation / Direction modulation solenoid (+)	C214 — pin 22

xx = twisted together

x = twisted pair



TV040387

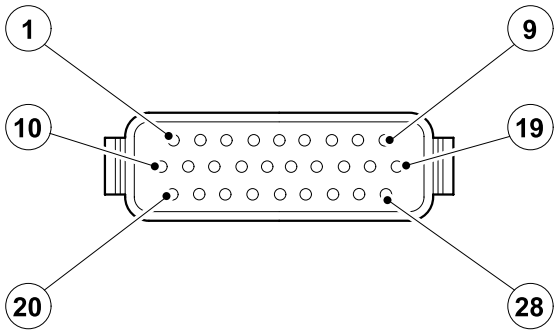
TRANSMISSION CONTROLLER CONNECTOR 214

Pin No.	Color	Wire Size	Function	To Connector / Pin No.
1	G xxx	1.0	12 volt supply	J16 — pin 4
2	B xxx	1.0	Ground	J16 — pin 5
3	B x	1.0	Direction modulation solenoid (-)	C213 — pin G
4	O	1.0	1/2 Selection solenoid	C213 — pin D
5	G/Y	1.0	Forward Hi / Low selection solenoid	C213 — pin B
6	U/S	1.0	Forward / Neutral selection solenoid	C213 — pin C
7	Y/P	1.0	Reverse / Neutral selection solenoid	C213 — pin F
8	S/W	0.5	Test probe RS232 receive input	C215 — pin 2
9	R/Y	1.0	12v = All wheel drive / 0V = Rear wheel drive	C213 — pin E
10	—	—	Not used	—
11	B xx	0.5	Sensor ground	C213 — pin J
12	U	0.5	Shift lever forward selection	C216 — pin 7
13	LG/S	1.0	Range modulation solenoid	C213 — pin K
14	O	0.5	Shift lever — forward hi / low switch	C216 — pin 3
15	G/Y	0.5	Shift lever 2 / 1 selection	C216 — pin 2
16	R/G	0.5	All wheel drive / Rear wheel drive selection	C212 — pin 3 C205 — pin 6 J1 — pin 13
17	Y/G	0.5	Transmission de-clutch request	J16 — pin 8
18	G/W xx	0.5	0 — 5 K ohm temperature sensor	C213 — pin L
19	Y/W	0.5	Shift lever reverse selection	J1 — pin 8
20	—	—	Not used	—
21	R/O xx	0.5	Speed sensor input	C213 — pin A
22	R/S x	1.0	Supply range modulation / Direction modulation solenoid (+)	C213 — pin M
23	—	—	Not used	—
24	—	—	Not used	—
25	B/Y	0.5	Speedometer signal	C210 — pin 2
26	B	0.5	Shift lever kick-down selection	C216 — pin 4
27	—	—	Not used	—
28	S/Y	0.5	Test probe RS232 transmit output	C215 — pin 3

xxx = twisted pair

xx = twisted together

x = twisted pair



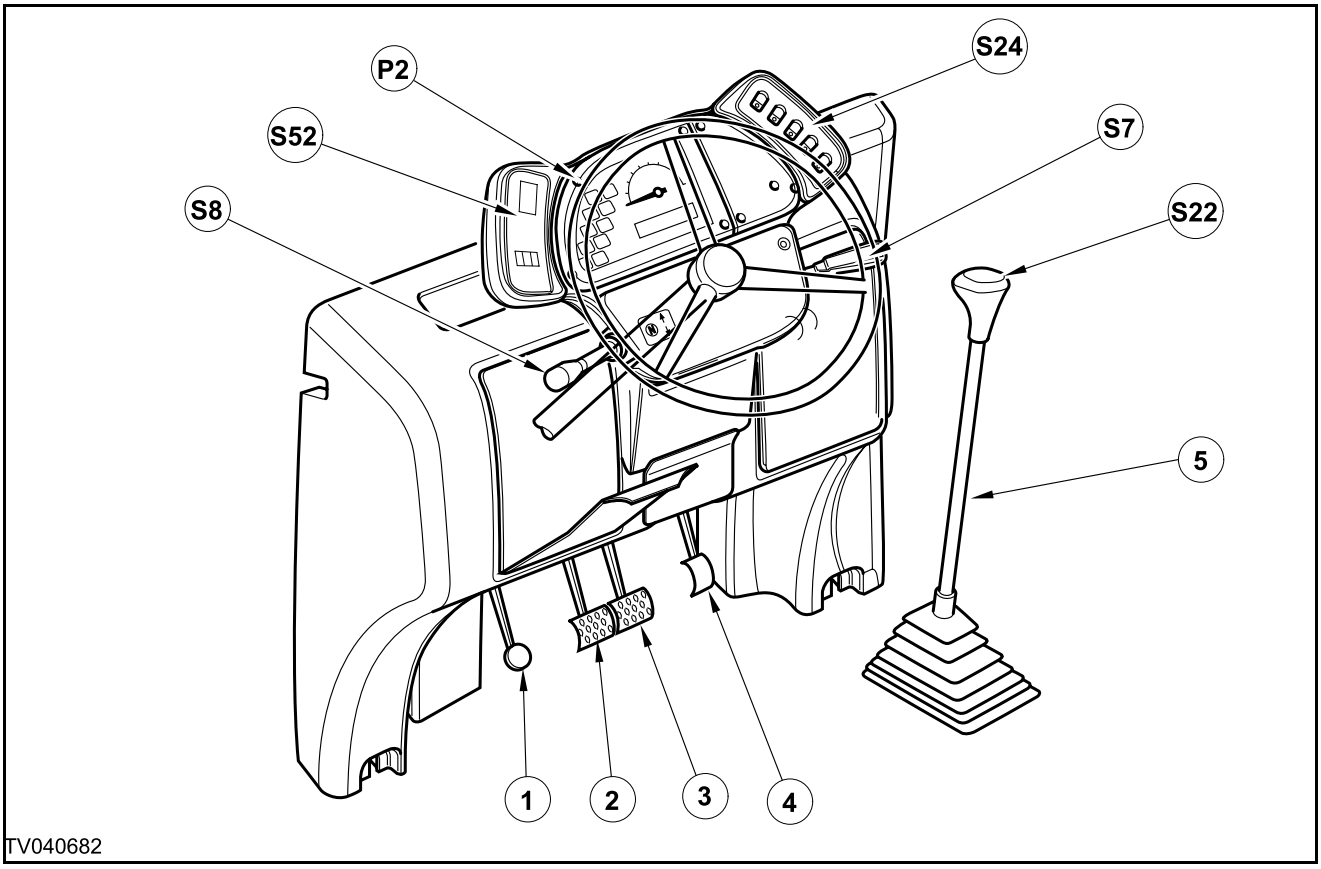
TV040386

COMPONENT LOCATIONS

BHJ0902TD

COMPONENT LOCATIONS — FRONT CONSOLE INSTRUMENTS AND CONTROLS

INSTRUMENTS	
P2	Instrument Panel
CONTROLS	
1	Differential lock pedal
2	Left hand brake pedal
3	Right hand brake pedal
4	Engine accelerator pedal
5	Gear change level (Synchroshuttle)
SWITCHES	
S7	Indicator / Front horn switch
S8	Direction lever (forward / reverse) * Transmission control lever (Powershift)
S22	Transmission de-clutch switch (Synchroshuttle)
S24	Front right console switch pack
S52	2WD/4WD position switch


P2
S24
S52
S7
S8
S22
5
1
2
3
4
TV040682

COMPONENT LOCATIONS — FRONT CONSOLE INSTRUMENTS AND CONTROLS

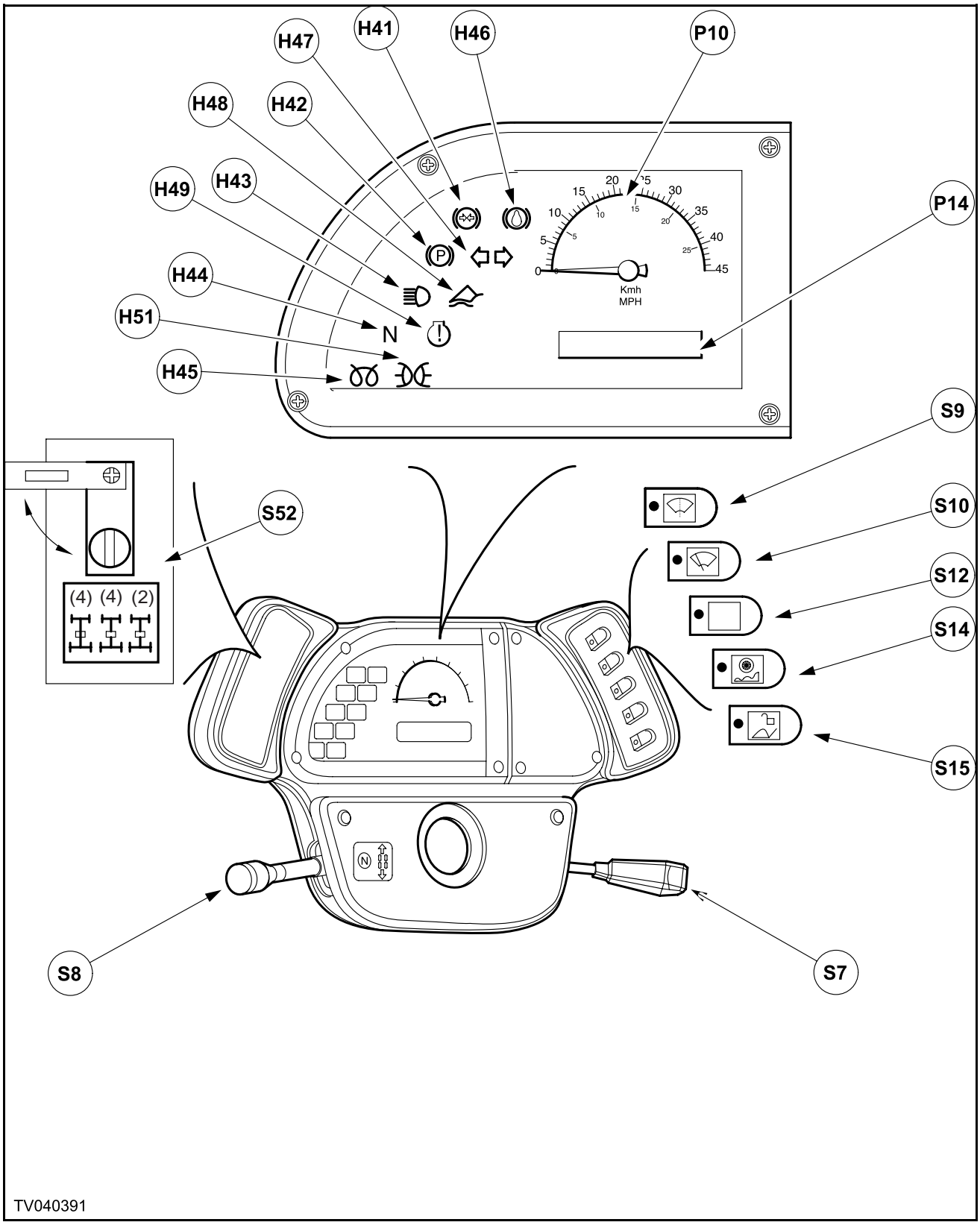
FRONT CONSOLE SWITCH PACK

INSTRUMENTS

H41	Low pressure brake warning lamp	
H42	Parking brake warning lamp	
H43	Main beam indicator lamp	
H44	Neutral position indicator lamp	
H45	Glow plug indicator lamp	
H46	Not used	
H47	Direction indicator lamp	
H48	Loader bucket on float mode indicator lamp	
H49	Engine fault indicator lamp	
H50	Side light indicator lamp	
P10	Speedometer (optional)	
P14	Hour-meter	

SWITCHES

S7	Direction indicator switch / Front horn	
S8	Forward / Reverse switch (Synchroshuttle) Transmission control lever (Powershift)	
S52	2WD/4WD — 2 Wheel braking / 4 Wheel braking switch	
S9	Front screen washer switch	including ON/OFF Indicator lamp
S10	Front wiper switch	including ON/OFF Indicator lamp
S12	Not used	—
S14	Ride control switch	including ON/OFF Indicator lamp
S15	Loader quick attach	including ON/OFF Indicator lamp


H47
H41
H46
P10
H48
H42
H49
H43
P14
H44
H51
H45
S9
S52
S10
S12
S14
S15
S8
S7
(4) (4) (2)
Kmh
MPH
N
TV040391

COMPONENT LOCATIONS — SIDE CONSOLE INSTRUMENTS AND CONTROLS

CONTROLS

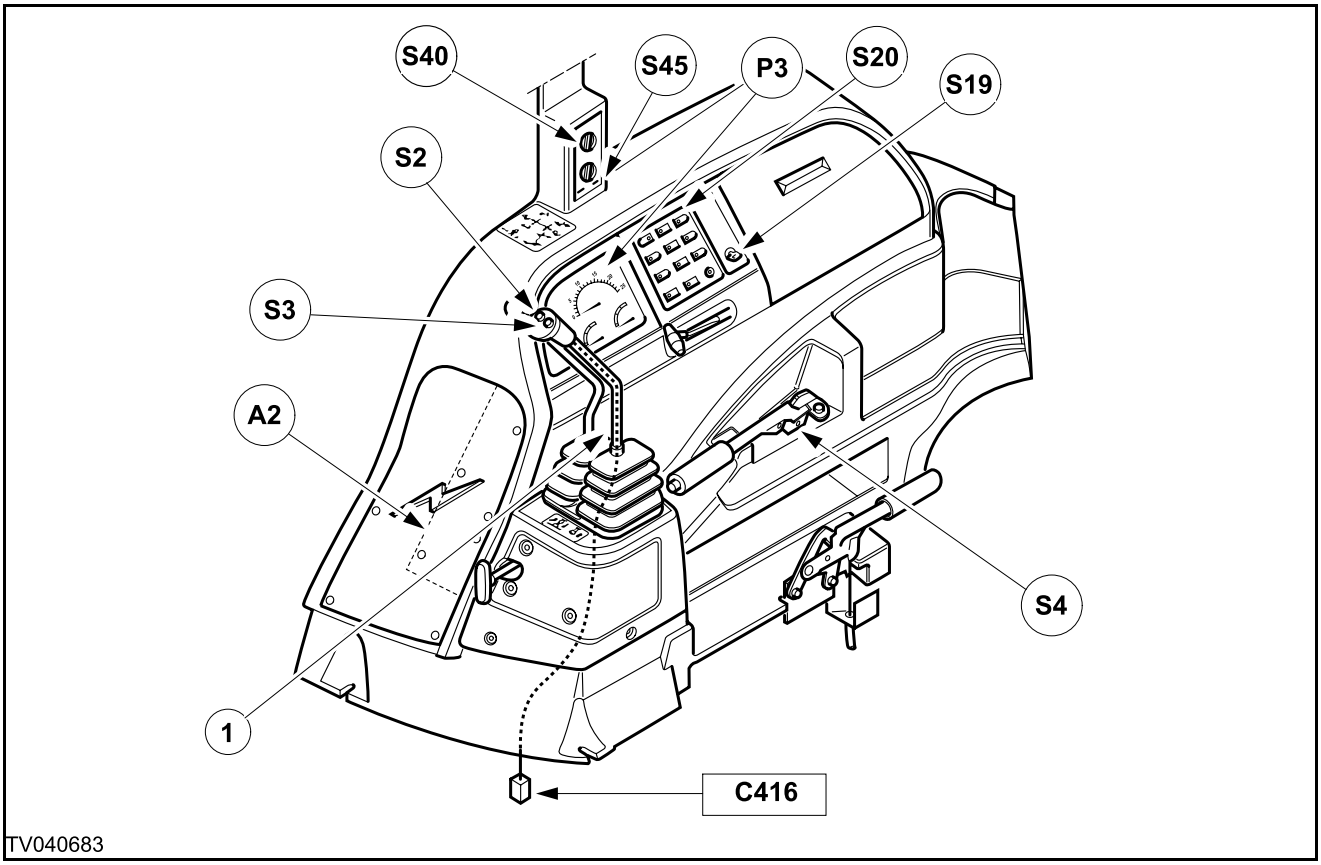
1	Loader lever

INSTRUMENTS

A2	Relay / Fuse board (cover)
P3	Side console panel

SWITCHES

S2	Unloader valve switch
S3	Transmission de-clutch switch
S4	Handbrake switch
S19	Ignition switch
S20	Side console switch pack
S40	Heater switches
S45	Air conditioning switch (optional)
C416	Intermediate connector (De-clutch / Unloader valve switches)


S40
S45
P3
S20
S19
S2
S3
A2
S4
1
C416
TV040683

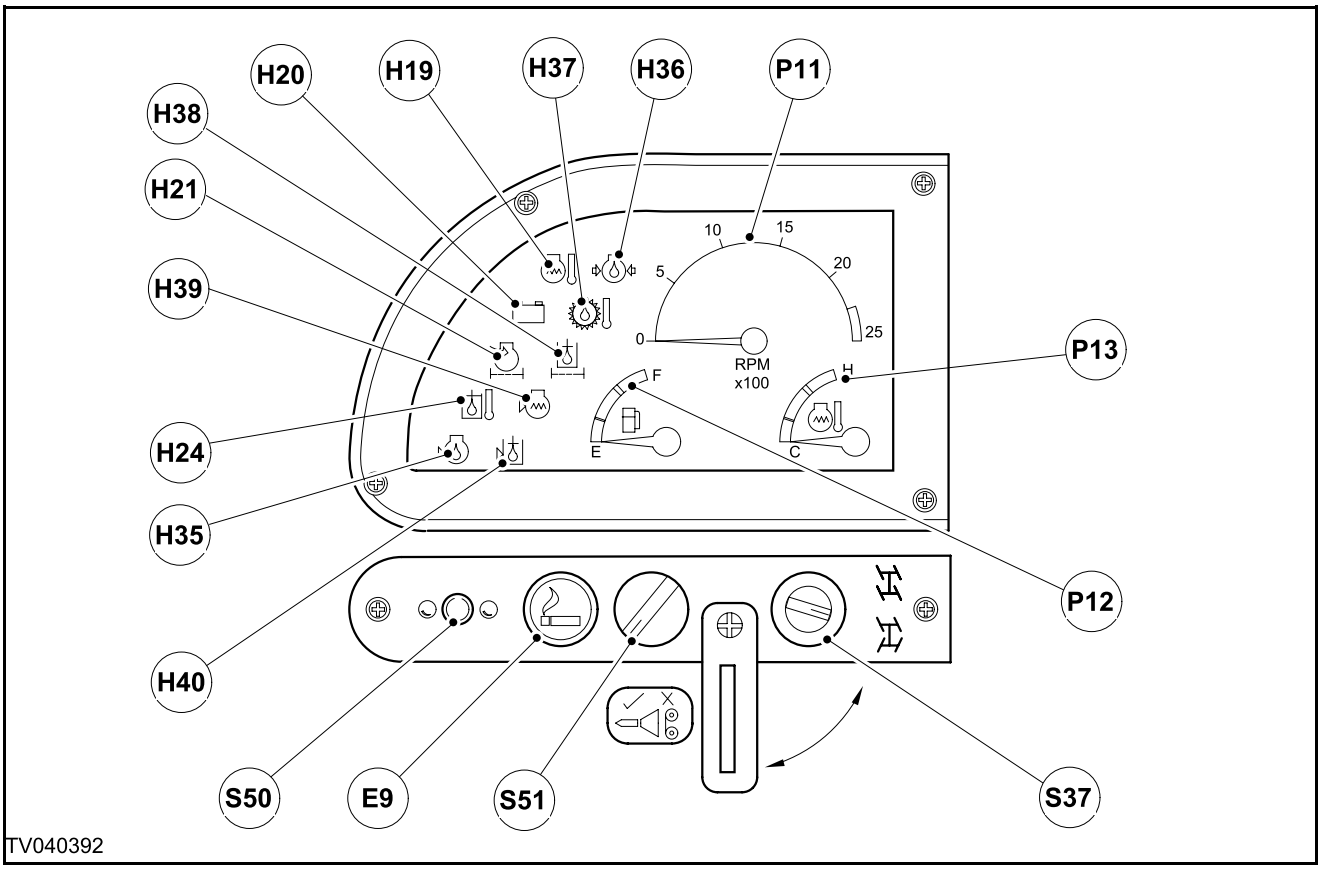
COMPONENT LOCATIONS — SIDE CONSOLE
INSTRUMENTS AND CONTROLS

INSTRUMENTS

H19	Engine coolant warning lamp
H20	Alternator charge warning lamp
H21	Engine air filter pressure warning lamp
H24	Hydraulic oil temperature warning lamp
H35	Not used
H36	Engine oil pressure warning lamp
H37	Transmission oil temperature warning light
H38	Hydraulic oil filter pressure warning lamp
H39	Not used
H40	Not used
P11	Engine tachometer
P12	Fuel level gauge
P13	Engine coolant temperature gauge

SWITCHES

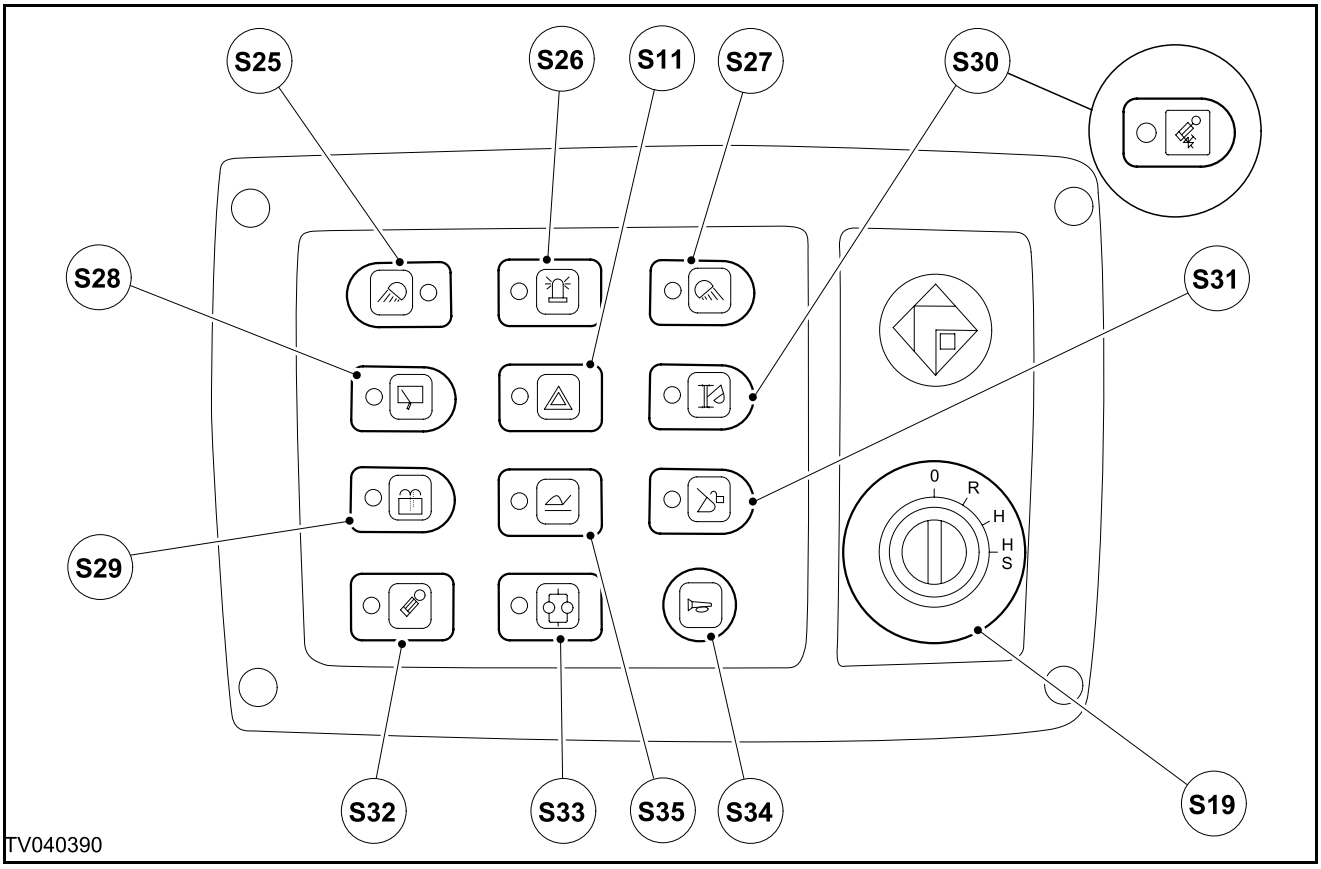
S37	** Four wheel steer (4WS) switch
S50	** 4WS re-alignment switch
S51	Backhoe auxiliary hydraulics switch (optional)
S19	Ignition switch
E9	Cigar lighter


H20
H19
H37
H36
P11
H38
H21
H39
P13
H24
H35
P12
H40
S50
E9
S51
S37
10
15
5
20
0
25
RPM
x100
F
E
H
C
TV040392

COMPONENT LOCATIONS — SIDE CONSOLE INSTRUMENTS AND CONTROLS

SWITCHES

S11	Hazard warning switch	Including ON/OFF Indicator lamp		
S25	Front worklight switch	Including ON/OFF Indicator lamp		
S26	Rotating beacon switch	Including ON/OFF Indicator lamp		
S27	Rear worklight switch	Including ON/OFF Indicator lamp		
S28	Rear wiper switch	Including ON/OFF Indicator lamp		
S29	Rear washer switch	Including ON/OFF Indicator lamp		
S30	Backhoe boom unlocking switch *Sideshift unlocking switch	Including ON/OFF Indicator lamp		
S31	Backhoe quick attach switch	Including ON/OFF Indicator lamp		
S32	** Hydraulic enable switch	Including ON/OFF Indicator lamp		
S33	Unloader valve	Including ON/OFF Indicator lamp		
S34	Rear horn switch	Including ON/OFF Indicator lamp		
S35	** Return to dig switch	Including ON/OFF Indicator lamp		
S19	Ignition switch	0 R H HS	= = = =	“OFF” Ignition “ON” Pre-Heat Start


S25
S26
S11
S27
S30
S28
S31
S29
S32
S33
S35
S34
S19
0
R
H
H
S
TV040390

COMPONENT LOCATIONS — ROPS SIDE CONSOLE INSTRUMENTS AND CONTROLS

CONTROLS

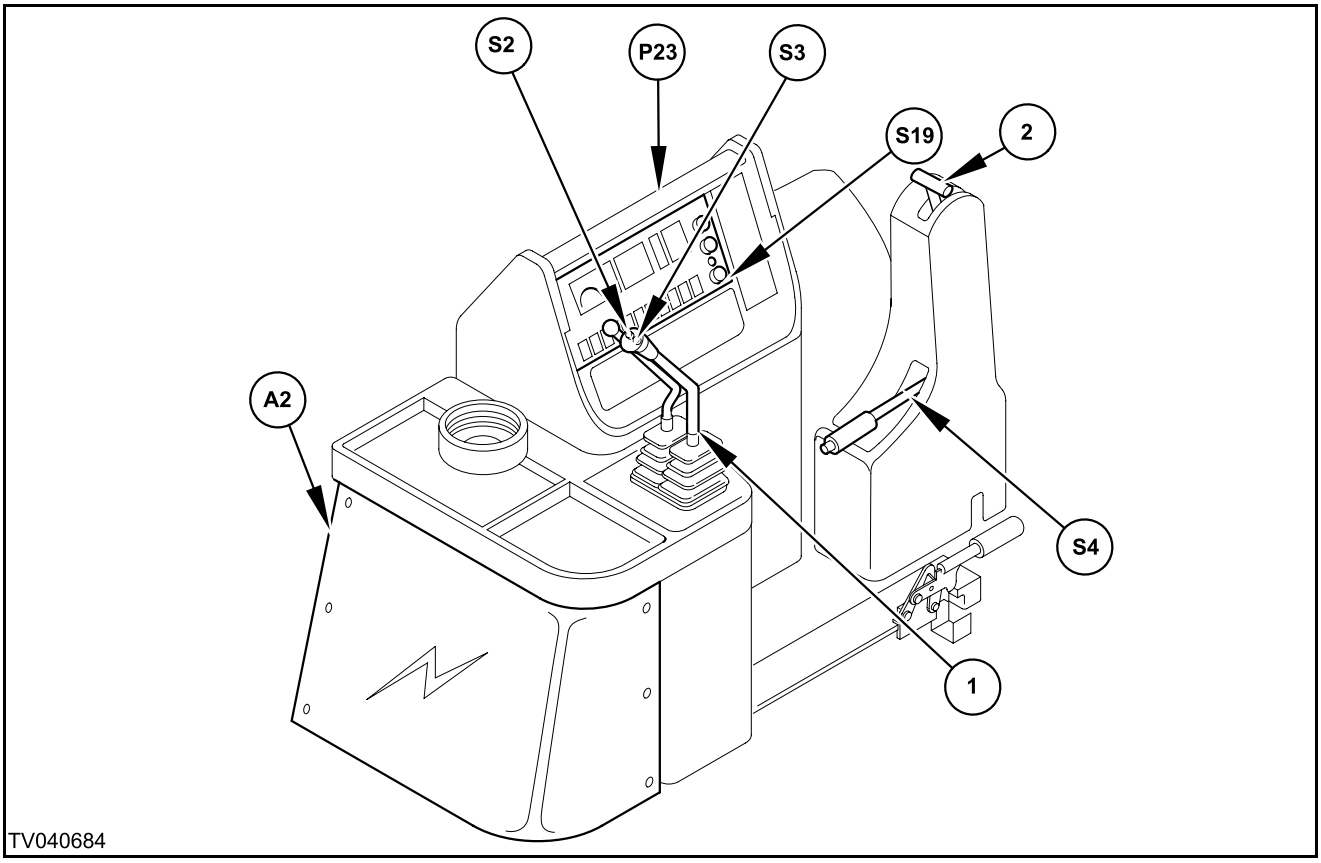
1	Loader lever	
2	Engine hand throttle	

INSTRUMENTS

P23	Side console instrument panel	
A2	Fuse board cover	

SWITCHES

S2	Unloader valve switch	
S3	Transmission de-clutch switch	
S4	Handbrake switch	
S19	Ignition switch	0 = “OFF” R = Ignition “ON” H = Pre-Heat HS = Start


S2
P23
S3
S19
2
A2
S4
1
TV040684

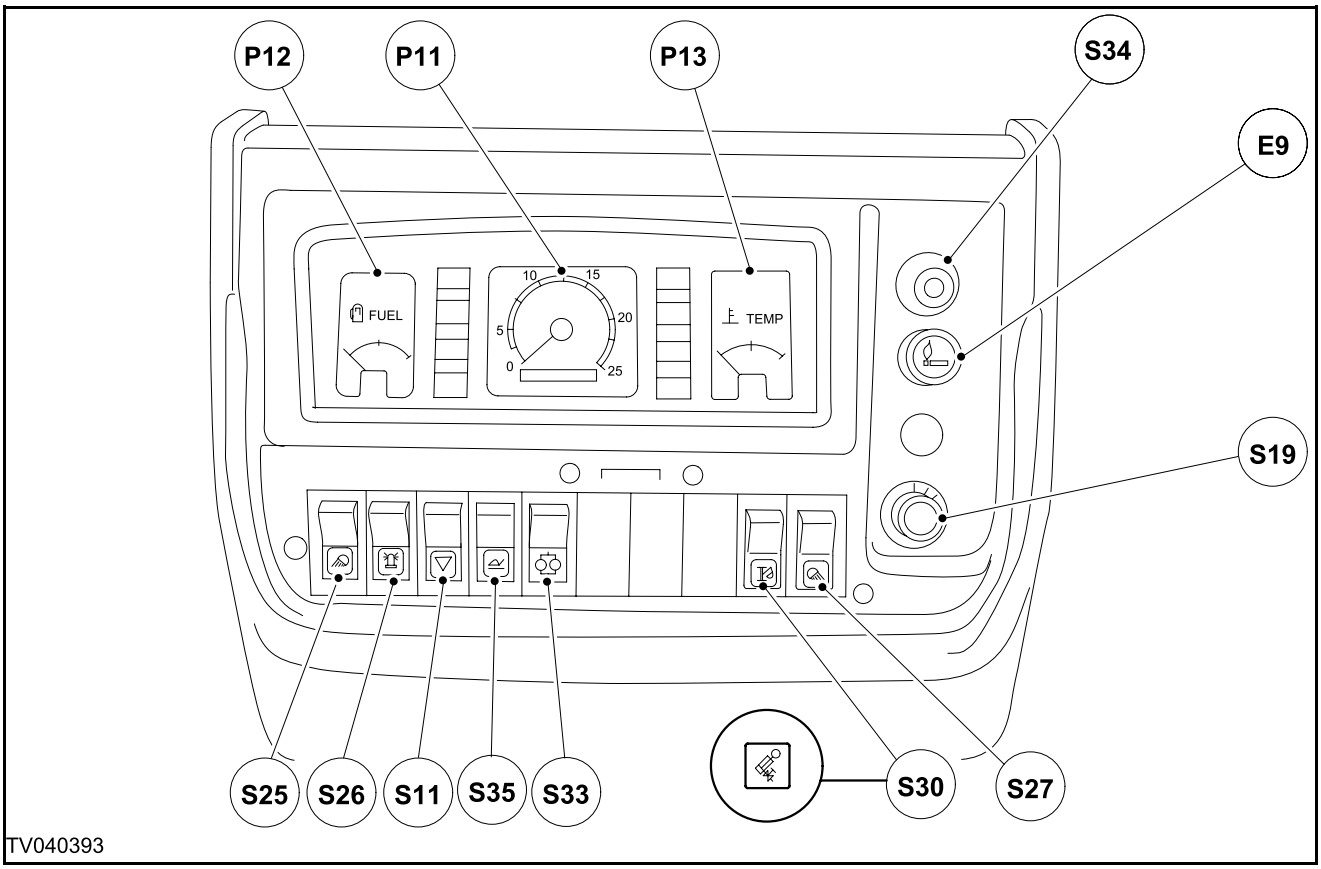
COMPONENT LOCATIONS — ROPS SIDE CONSOLE INSTRUMENTS AND CONTROLS

INSTRUMENTS

p11	Engine tachometer	
P12	Fuel level gauge	
P13	Engine coolant temperature gauge	

SWITCHES

S11	Hazard warning switch	Including ON/OFF Indicator lamp
S25	Front worklight switch	Including ON/OFF Indicator lamp
S26	Rotating beacon switch	Including ON/OFF Indicator lamp
S27	Rear worklight switch	Including ON/OFF Indicator lamp
S30	Backhoe boom unlocking switch * Sideshift unlocking switch	Including ON/OFF Indicator lamp
S33	Hydraulic pump flow switch	Including ON/OFF Indicator lamp
S34	Rear horn switch	Including ON/OFF Indicator lamp
S35	** Return to dig switch	Including ON/OFF Indicator lamp
S19	Ignition switch	0 = “OFF” R = Ignition “ON” H = Pre-Heat HS = Start
E9	Cigar lighter	


P12
P11
P13
S34
E9
S19
FUEL
TEMP
0
5
10
15
20
25
S25
S26
S11
S35
S33
S30
S27
TV040393

WIRING DIAGRAMS — POWER SUPPLY

BHJ0902TG

WIRING DIAGRAM — POWER SUPPLY SYNCHROSHUTTLE

Components

A2	Fuse and relay board
G1	Battery
G2	Alternator
H20	Alternator charge warning lamp
M1	Starter motor
P3	Side console instrument display
P11	Engine tachometer
S1	Battery isolation switch
S8	Forward / Reverse switch
S19	Ignition key switch

Relays

K28	Ignition relay
K29	Starter relay

Connectors

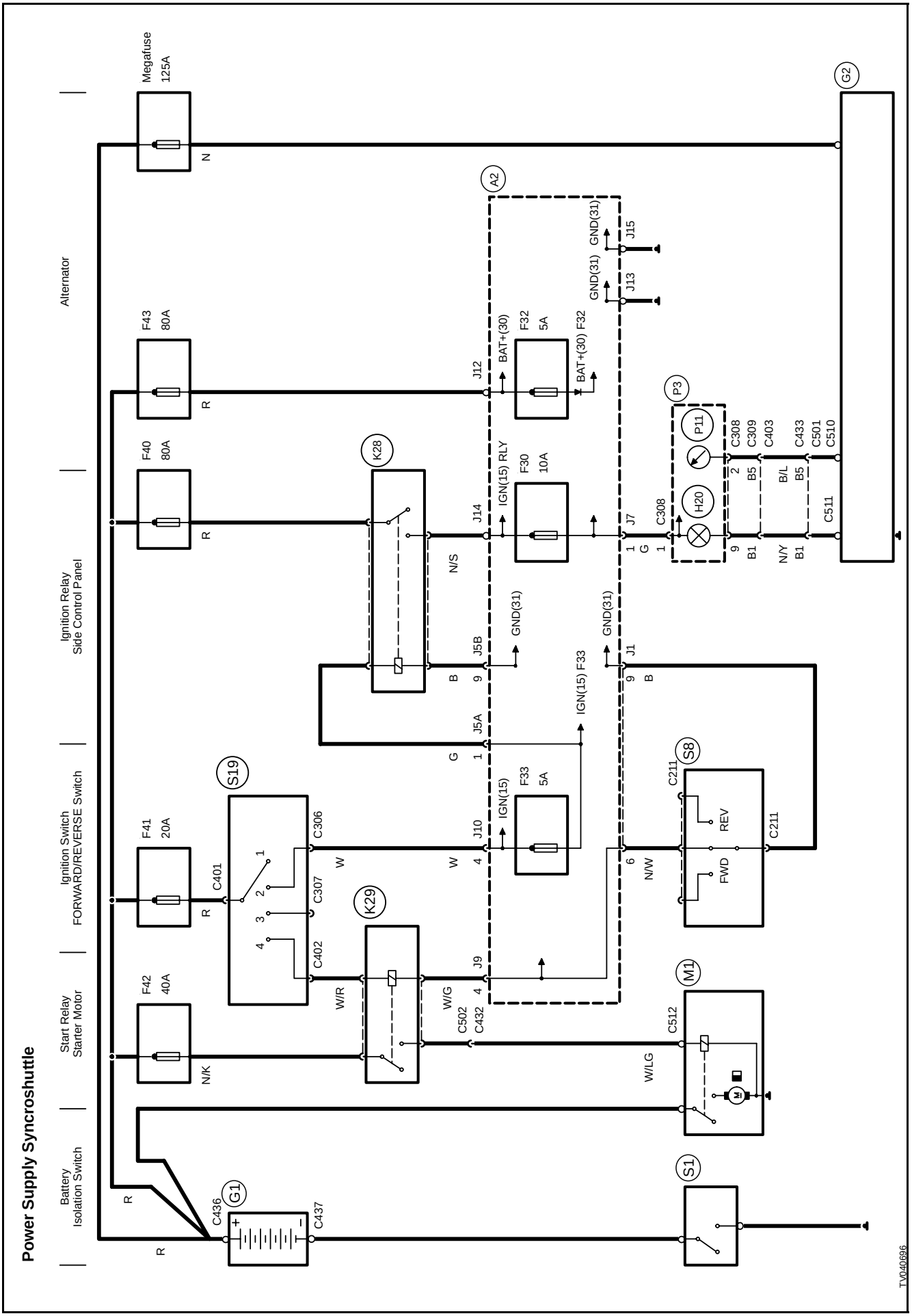
C211	Direction lever forward / Reverse selector switch connector
C306	Ignition switch connector (pin 2)
C307	Ignition switch connector (pin 3)
C308	Side console instruments / Warning lamp indicator
C309	Intermediate connector (to 403)
C401	Ignition switch connector (pin 1)
C402	Ignition switch connector (pin 4)
C436	Battery positive eyelet connection
C437	Battery negative eyelet connection
C501	Intermediate connector (to 433)
C502	Intermediate connector (to 432)
C510	Alternator eyelet (phase terminal)
C511	Alternator eyelet (warning light)
C512	Starter motor connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Power Supply Syncroshuttle
Battery Isolation Switch
Start Relay Starter Motor
Ignition Switch FORWARD/REVERSE Switch
Ignition Relay Side Control Panel
Alternator
Megafuse 125A
F43 80A
F40 80A
F41 20A
F42 40A
F32 5A
F30 10A
F33 5A
IGN(15) RLY
BAT+(30)
GND(31)
IGN(15)
K28
K29
S19
S8
S1
M1
G1
G2
A2
P3
P11
H20
C436
C437
C306
C307
C402
C401
C502
C432
C512
C211
C308
C309
C403
C433
C501
C510
C511
J12
J14
J5B
J5A
J9
J10
J7
J1
J15
J13
N
R
N/S
W
W/R
W/G
N/K
W/LG
N/W
N/Y
B/L
B
G
TV040696

WIRING DIAGRAM — POWER SUPPLY POWERSHIFT

Components

A2	Fuse and relay board
G1	Battery
G2	Alternator
H20	Alternator charge warning lamp
M1	Starter motor
P3	Side console panel
P11	Engine tachometer
S1	Battery isolation switch
S8	Transmission control lever
S19	Ignition key switch

Relays

K28	Ignition relay
K29	Starter relay

Connectors

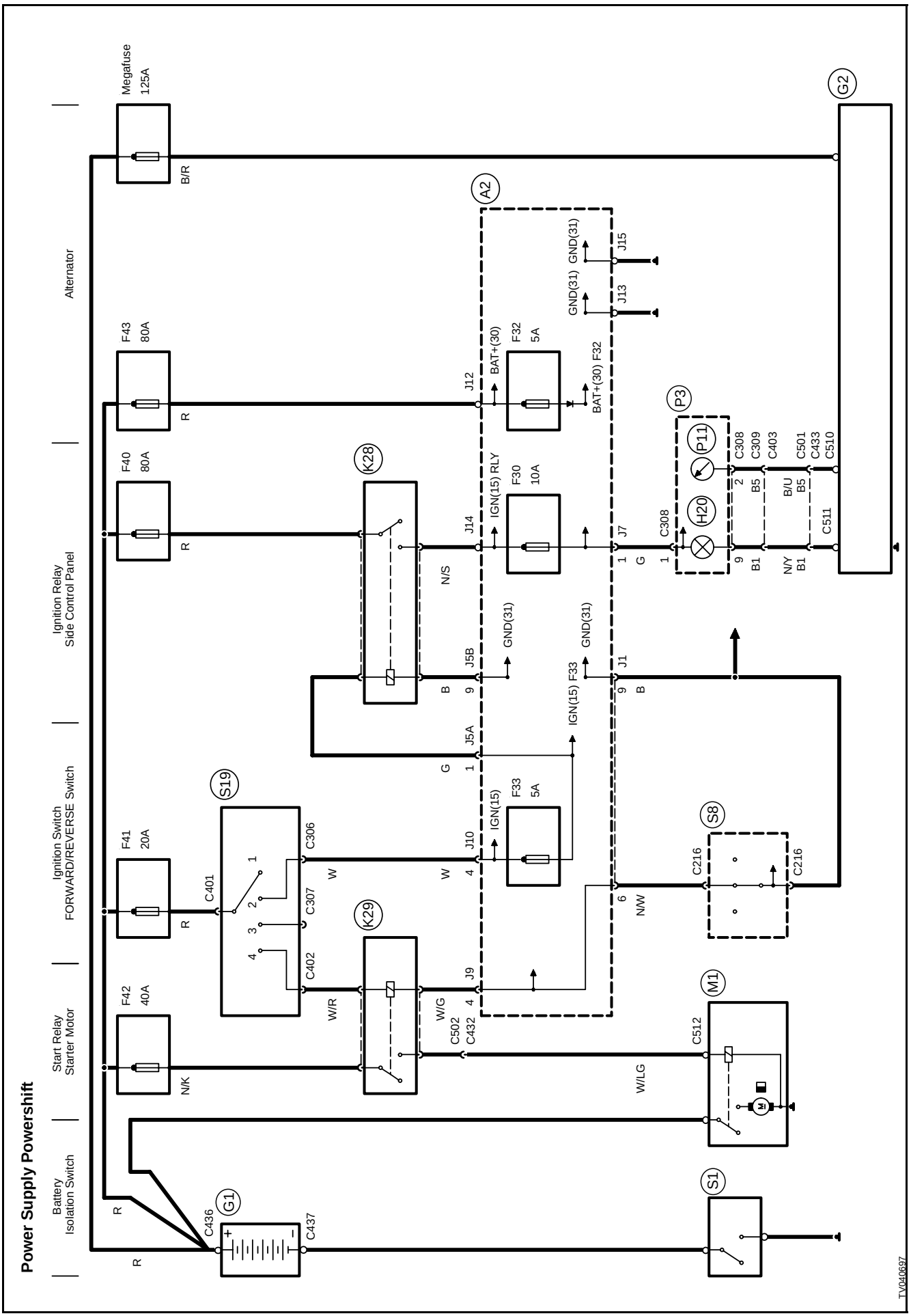
C216	Transmission control lever switch connector
C306	Ignition switch connector (pin 2)
C307	Ignition switch connector (pin 3)
C308	Side console instruments / Warning lamp indicator
C309	Intermediate connector (to 403)
C401	Ignition switch connector (pin 1)
C402	Ignition switch connector (pin 4)
C436	Battery positive eyelet connection
C437	Battery negative eyelet connection
C501	Intermediate connector (to 433)
C502	Intermediate connector (to 432)
C510	Alternator eyelet (phase terminal)
C511	Alternator eyelet (warning light)
C512	Starter motor connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Power Supply Powershift
Battery Isolation Switch
Start Relay Starter Motor
Ignition Switch FORWARD/REVERSE Switch
Ignition Relay Side Control Panel
Alternator
Megafuse 125A
F43 80A
F40 80A
F41 20A
F42 40A
F32 5A
F30 10A
F33 5A
K28
K29
S19
S8
S1
M1
G1
G2
A2
P3
P11
H20
IGN(15) RLY
IGN(15)
BAT+(30)
GND(31)
TV040697

WIRING DIAGRAMS — ENGINE

BHJ0902TH

WIRING DIAGRAM — ENGINE

Components

A2	Fuse and relay board
Y1	Fuel shut off solenoid
Y2	Fuel enrichment solenoid
Y25	Fuel lift pump
R1	Engine glow plugs
S19	Ignition key switch

Relays

K30	Glow plug relay
K31	Fuel pump relay

Connectors

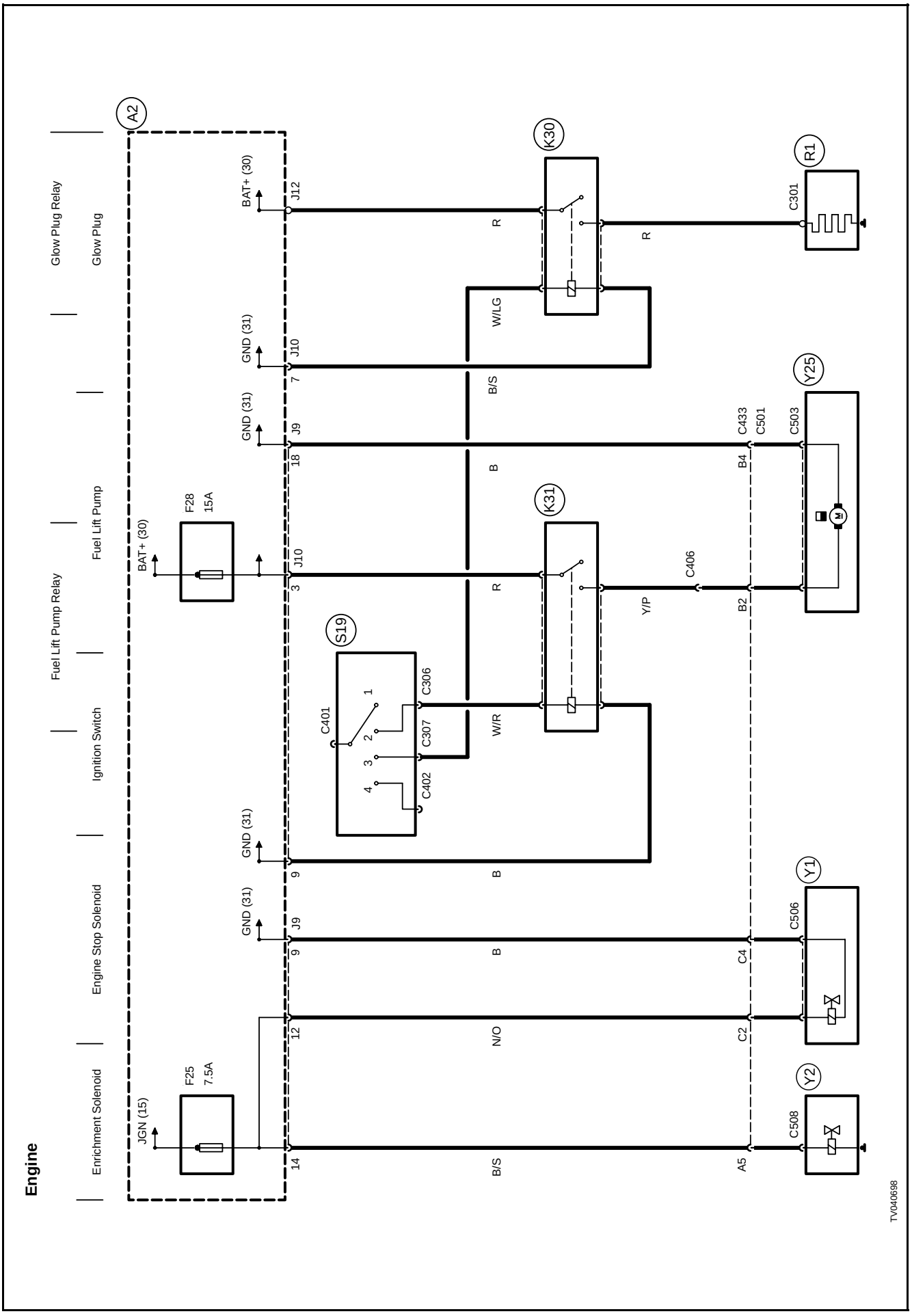
C301	Engine glow plug connector
C306	Ignition switch connector (pin 2)
C307	Ignition switch connector (pin 3)
C401	Ignition switch connector (pin 1)
C402	Ignition switch connector (pin 4)
C501	Intermediate connector (to 433)
C503	Fuel lift pump connector
C506	Engine stop solenoid connector
C508	Fuel enrichment sensor connector
C512	Starter motor connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Engine
Enrichment Solenoid
Engine Stop Solenoid
Ignition Switch
Fuel Lift Pump Relay
Fuel Lift Pump
Glow Plug
Glow Plug Relay
A2
JGN (15)
F25
7.5A
BAT+ (30)
F28
15A
GND (31)
J12
J10
J9
C301
C306
C307
C402
C401
C406
C433
C501
C503
C506
C508
C4
C2
C5
B4
B2
A5
14
12
9
7
3
18
R1
K30
K31
S19
Y1
Y2
Y25
R
W/LG
B/S
B
W/R
Y/P
N/O
TV040698

WIRING DIAGRAMS — TRANSMISSION

BHJ0902TJ

WIRING DIAGRAM — SYNCHROSHUTTLE

Components

A2	Fuse and relay board
Y7	Forward solenoid
Y8	Reverse solenoid
S22	De-clutch switch (Gear lever)
S3	De-clutch switch (Loader lever)
S8	Direction lever (Forward / Reverse)

Relays

K23	Forward solenoid relay
K24	Reverse solenoid relay
K27	Neutral relay

Connectors

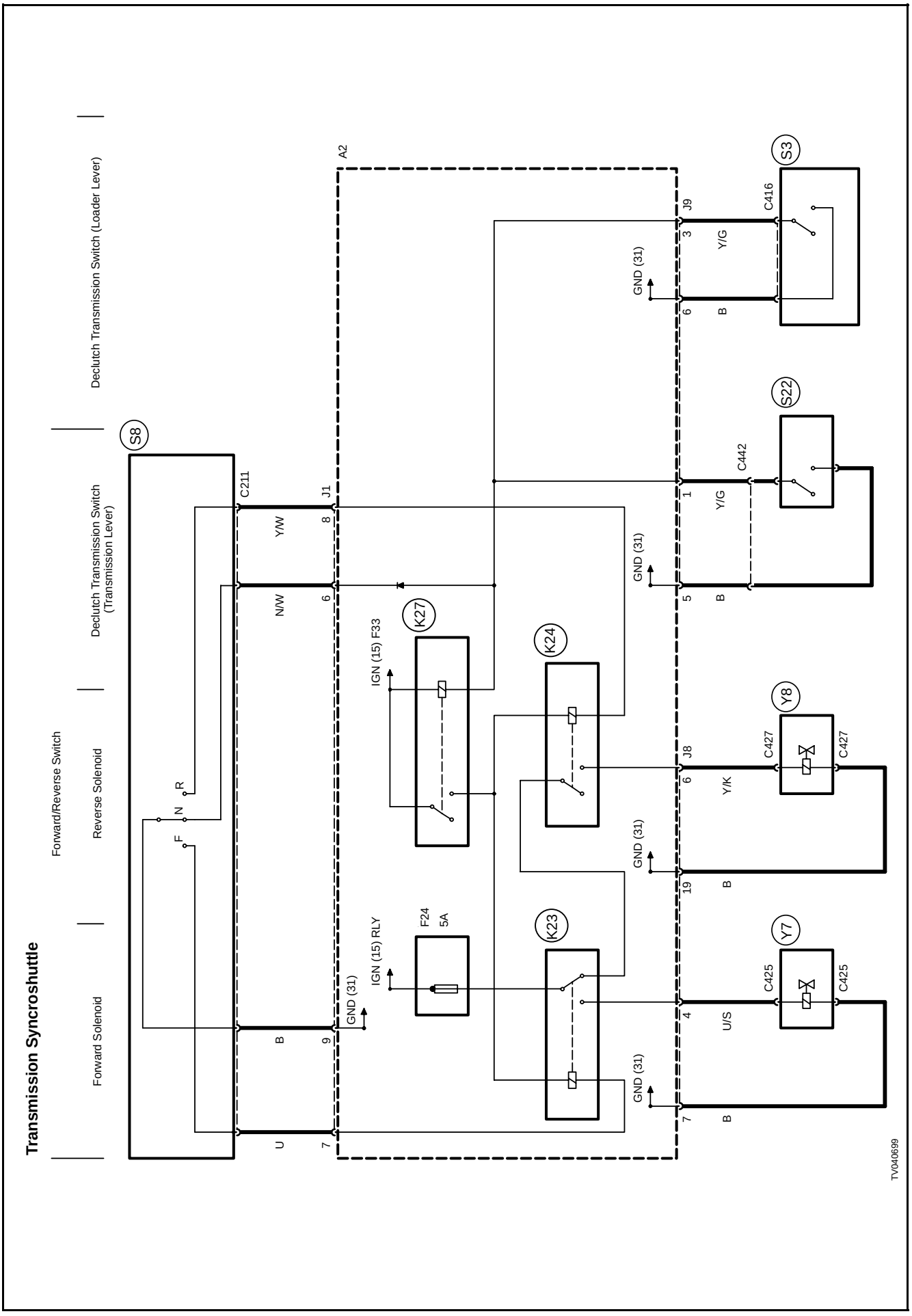
C211	Direction lever connector (Forward / Reverse)
C416	De-clutch switch connector (Loader lever)
C427	Reverse solenoid
C425	Forward solenoid connector
C442	De-clutch switch connector (Gear lever)

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Transmission Syncroshuttle
Forward Solenoid
Reverse Solenoid
Forward/Reverse Switch
Declutch Transmission Switch (Transmission Lever)
Declutch Transmission Switch (Loader Lever)
S8
C211
J1
A2
Y/W
N/W
B
U
F
N
R
IGN (15) F33
IGN (15) RLY
F24
5A
K27
K24
K23
GND (31)
J9
C416
S3
Y/G
J8
C427
Y8
Y/K
C442
S22
C425
Y7
U/S
TV040699

WIRING DIAGRAM — POWERSHIFT

Components

A2	Fuse and relay board
Y40	Control valve transmission
APC71	Transmission controller
S3	De-clutch (loader lever)
S8	Transmission control lever

Connectors

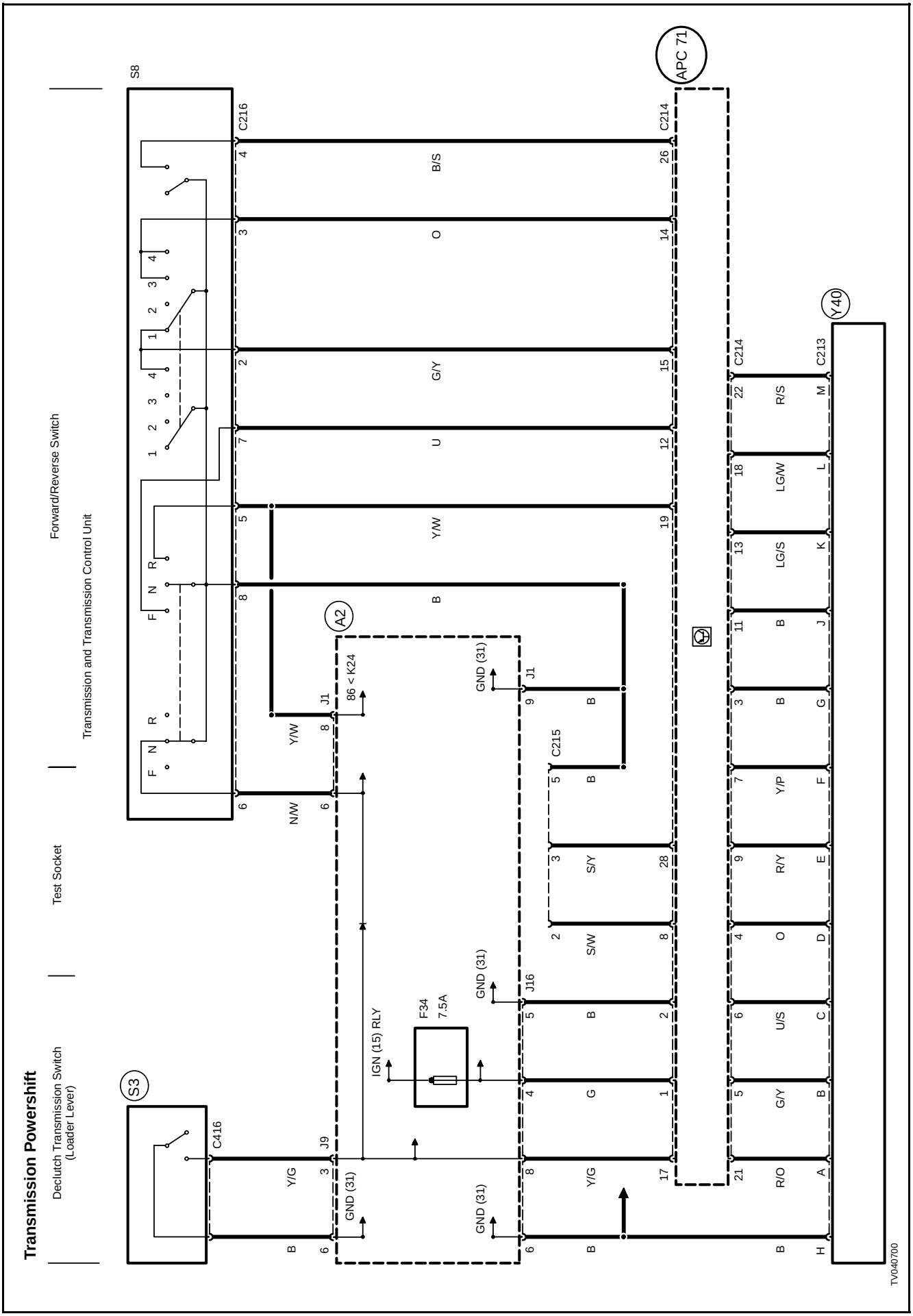
C213	Transmission connector
C214	Transmission controller connector
C215	Transmission controller test socket
C216	Transmission control lever connector
C416	De-clutch switch connector (Loader lever)

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Transmission Powershift
Declutch Transmission Switch (Loader Lever)
Test Socket
Transmission and Transmission Control Unit
Forward/Reverse Switch
S3
S8
C416
C216
C214
APC 71
A2
Y40
C213
J9
J1
J16
C215
F34 7.5A
IGN (15) RLY
GND (31)
86 < K24
Y/G
N/W
Y/W
B/S
O
G/Y
U
B
S/Y
S/W
G
R/O
U/S
Y/P
R/Y
R/S
LG/W
LG/S
TV040700

WIRING DIAGRAMS — DIFFERENTIAL LOCK

BHJ0902TK

WIRING DIAGRAM — 4WD DIFFERENTIAL LOCK SYNCHROSHUTTLE

Components

A2	Fuse and relay board
Y14	Differential lock solenoid
Y9	4WD solenoid
S5	Brake light switch
S12	4WD switch (optional)
S21	Differential lock switch
S24	Front console switch pack
S52	2WD/4WD and 2WB/4WB switch

Relays

K25	4WD Relay

Connectors

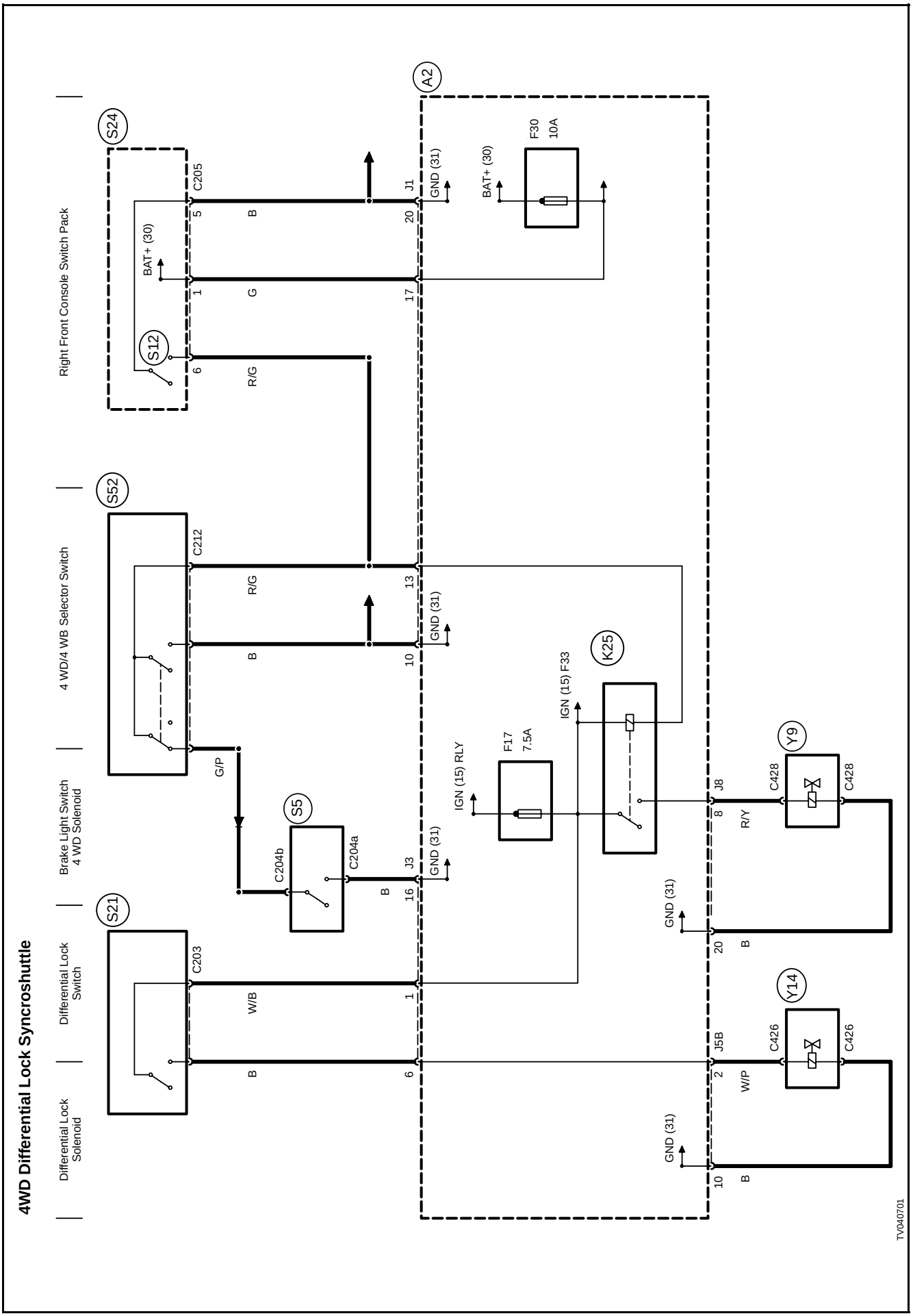
C203	Transmission connector
C204	Brake light switch connector
C205	Transmission control lever connector
C212	2WD/4WD position switch connector
C426	Differential lock solenoid connector
C428	4WD solenoid connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


4WD Differential Lock Syncroshuttle
Differential Lock Solenoid
Differential Lock Switch
Brake Light Switch 4 WD Solenoid
4 WD/4 WB Selector Switch
Right Front Console Switch Pack
S21
S5
S52
S12
S24
A2
K25
Y14
Y9
C203
C204b
C204a
C212
C205
C426
C428
J3
J5B
J8
J1
F30 10A
F17 7.5A
BAT+ (30)
GND (31)
IGN (15) RLY
IGN (15) F33
W/B
G/P
R/G
G
R/Y
W/P
TV040701

WIRING DIAGRAM — 4WD DIFFENTIAL LOCK POWERSHIFT

Components

A2	Fuse and relay board
Y9	4WD solenoid
S5	Brake light switch
S12	4WD switch (not used)
S21	Differential lock switch
S24	Front console switch pack
S52	2WD/4WD position switch
APC71	Transmission controller

Connectors

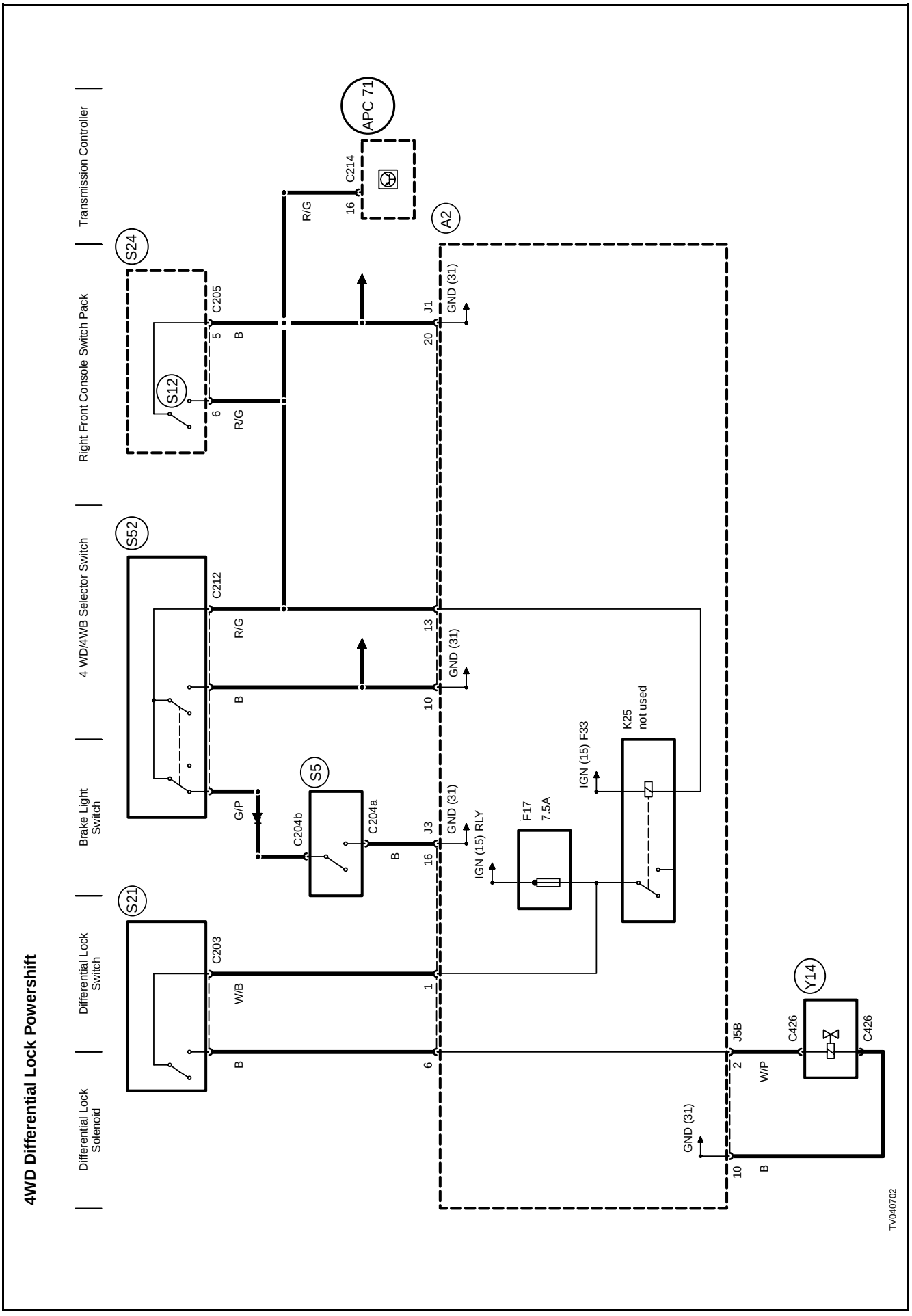
C203	Transmission connector
C204	Brake light switch connector
C205	Transmission control lever connector
C212	2WD/4WD position switch connector
C214	Transmission controller connector
C426	Differential lock solenoid connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


4WD Differential Lock Powershift
Differential Lock Solenoid
Differential Lock Switch
Brake Light Switch
4 WD/4WB Selector Switch
Right Front Console Switch Pack
Transmission Controller
S21
S52
S5
S12
S24
APC 71
A2
Y14
C203
C212
C204b
C204a
C205
C214
C426
C426
J3
J1
J5B
W/B
R/G
G/P
B
W/P
GND (31)
IGN (15) RLY
IGN (15) F33
F17
7.5A
K25
not used
TV040702

WIRING DIAGRAMS — STEERING

BHJ0902TL

WIRING DIAGRAM — STEER MODE (4WS)

Components

A2	Fuse and relay board
B20	Front axle proximity switch
B21	Rear axle proximity switch
H30	4WS reset LED (front)
H31	4WS reset LED (rear)
Y27	4WS solenoid
Y28	Crab solenoid
S37	4WS selection switch
S50	4WS re-alignment indicator switch

Relays

K33	4WS Relay board

Connectors

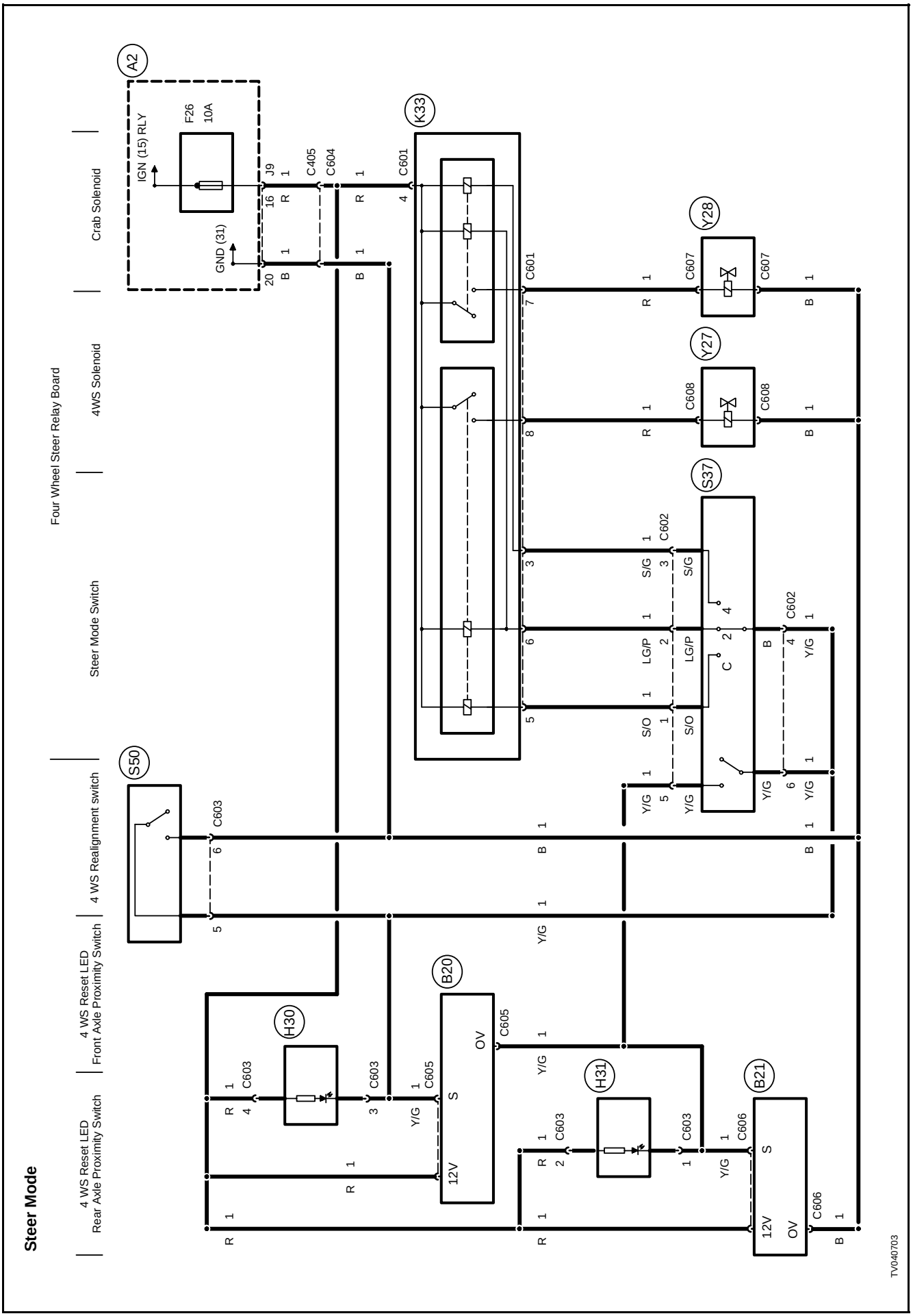
C405	Intermediate connector (to C605)
C601	4WS Relay board
C602	4WS selection switch connector
C603	4WS re-alignment indicator switch
C604	Intermediate connector (to C405)
C605	Front axle proximity switch connector
C606	Rear axle proximity switch connector
C607	4WS solenoid connector
C608	Crab solenoid connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Steer Mode
4 WS Reset LED Rear Axle Proximity Switch
4 WS Reset LED Front Axle Proximity Switch
4 WS Realignment switch
Steer Mode Switch
4WS Solenoid
Crab Solenoid
Four Wheel Steer Relay Board
A2
IGN (15) RLY
F26
10A
GND (31)
J9
C405
C604
C601
K33
Y28
Y27
S37
S50
C603
C602
C607
C608
H30
H31
B20
B21
C605
C606
OV
12V
S
TV040703

WIRING DIAGRAMS — CONSOLE PANELS

BHJ0902TM

WIRING DIAGRAM — FRONT CONSOLE PANEL SYNCHROSHUTTLE

Components

A2	Fuse and relay board
B6	Speed sensor (Optional)
H42	Parking brake warning lamp
H43	Main beam indicator lamp
H44	Neutral position indicator lamp
H45	Glow plug indicator lamp
H47	Direction indicator lamp
H48	Engine fault lamp
P2	Front console panel
P3	Side console panel
P10	Speedometer (Optional)
S4	Handbrake switch
S8	Direction lever (Forward / Reverse)
S19	Ignition key switch

Relays

K32	Auxiliary relay

Connectors

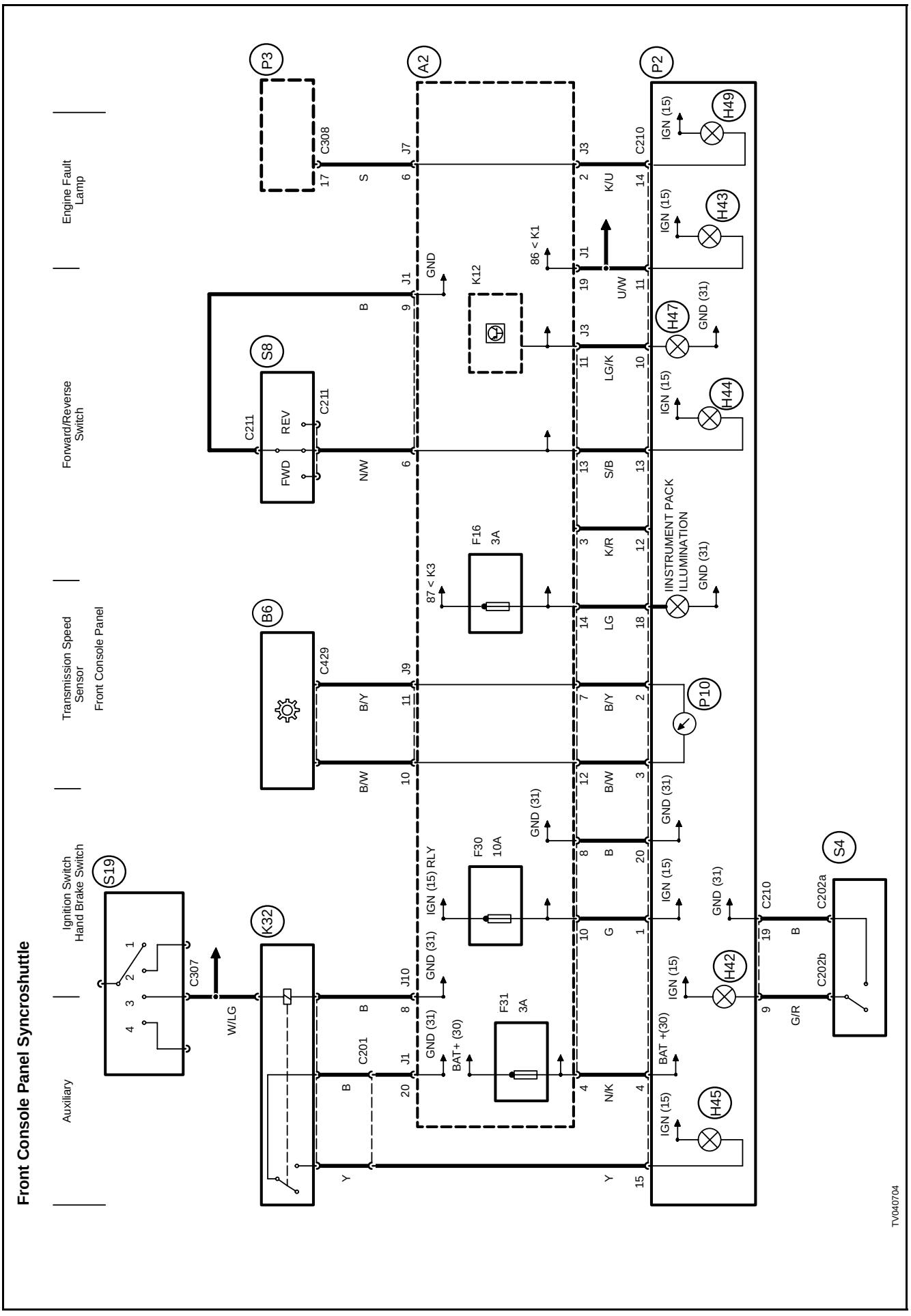
C201	Intermediate connector (to C302)
C202a/b	Handbrake switch connector
C210	Front console panel connector
C211	Direction lever (Forward / Reverse) connector
C307	Ignition switch connector (pin 3)
C308	Side console panel connector
C429	Speed sensor connector (optional)

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Front Console Panel Syncroshuttle
Auxiliary
Ignition Switch Hand Brake Switch
Transmission Speed Sensor
Front Console Panel
Forward/Reverse Switch
Engine Fault Lamp
S19
K32
B6
S8
P3
A2
P2
S4
P10
H49
H43
H47
H44
H42
H45
K12
F16 3A
F30 10A
F31 3A
C307
C308
C429
C211
C201
C210
C202a
C202b
W/LG
N/W
B/Y
B/W
LG
LG/K
S/B
K/R
U/W
K/U
N/K
G/R
IGN (15) RLY
BAT+ (30)
GND (31)
IGN (15)
BAT +(30)
86 < K1
87 < K3
INSTRUMENT PACK ILLUMINATION
TV040704

WIRING DIAGRAM — FRONT CONSOLE PANEL POWERSHIFT

Components

A2	Fuse and relay board
APC71	Transmission controller
H42	Parking brake warning lamp
H43	Main beam indicator lamp
H44	Neutral position indicator lamp
H45	Glow plug indicator lamp
H47	Direction indicator lamp
H48	Float lamp
H49	Engine fault lamp
P2	Front console panel
P3	Side console panel
P10	Speedometer (optional)
S4	Handbrake switch
S8	Direction lever (Forward / Reverse)
S19	Ignition key switch

Relays

K12	Indicator / Flasher unit
K32	Auxiliary relay

Connectors

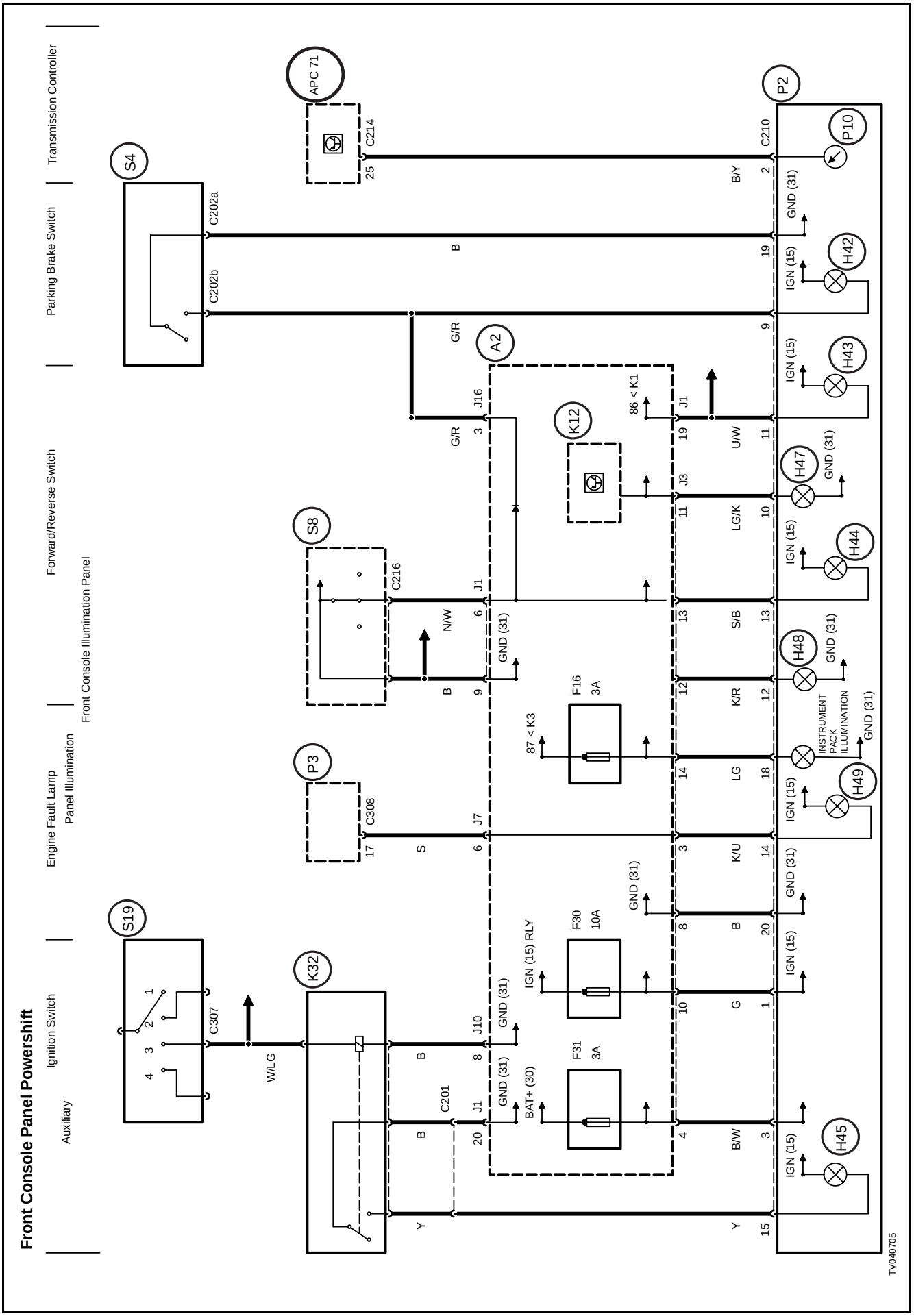
C201	Intermediate connector (to C302)
C202a/b	Handbrake switch connector
C210	Front console panel connector
C214	Transmission controller (APC71) connector
C216	Transmission control lever connector
C307	Ignition switch connector (pin 3)
C308	Side console panel connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Front Console Panel Powershift
Ignition Switch
Auxiliary
Engine Fault Lamp
Panel Illumination
Forward/Reverse Switch
Front Console Illumination Panel
Parking Brake Switch
Transmission Controller
S19
S4
S8
P3
P2
P10
K32
K12
A2
APC 71
C307
C202a
C202b
C216
C308
C214
C210
C201
W/LG
B
G/R
N/W
S
B/Y
U/W
LG/K
S/B
K/R
LG
K/U
G
B/W
Y
J10
J16
J1
J7
J3
86 < K1
87 < K3
F16
3A
F30
10A
F31
3A
IGN (15) RLY
BAT+ (30)
GND (31)
IGN (15)
H42
H43
H47
H44
H48
H49
H45
INSTRUMENT PACK ILLUMINATION
TV040705

WIRING DIAGRAM — SIDE CONSOLE PANEL

Components

A2	Fuse and relay board
B1	Engine air filter pressure switch
B2	Engine coolant temperature sensor
B3	Engine oil pressure switch
B4	Hydraulic oil filter pressure switch
B5	Transmission oil temperature switch
P3	Side console panel
P4	Fuel tank level sensor
P12	Fuel level gauge
P13	Engine coolant temperature gauge
H19	Engine coolant warning lamp
H21	Engine air filter pressure warning lamp
H36	Engine oil pressure warning lamp
H37	Transmission oil temperature warning lamp
H38	Hydraulic oil filter warning lamp

Connectors

C308	Side console panel connector
C403	Intermediate connector (to C309)
C419	Fuel tank level sensor connector
C434	Hydraulic oil filter (eyelet) connection
C443	Transmission oil temperature switch connector
C502	Intermediate connector (to C432)
C504	Air filter pressure switch connector
C505	Oil pressure switch connector
C509	Coolant temperature sensor connector

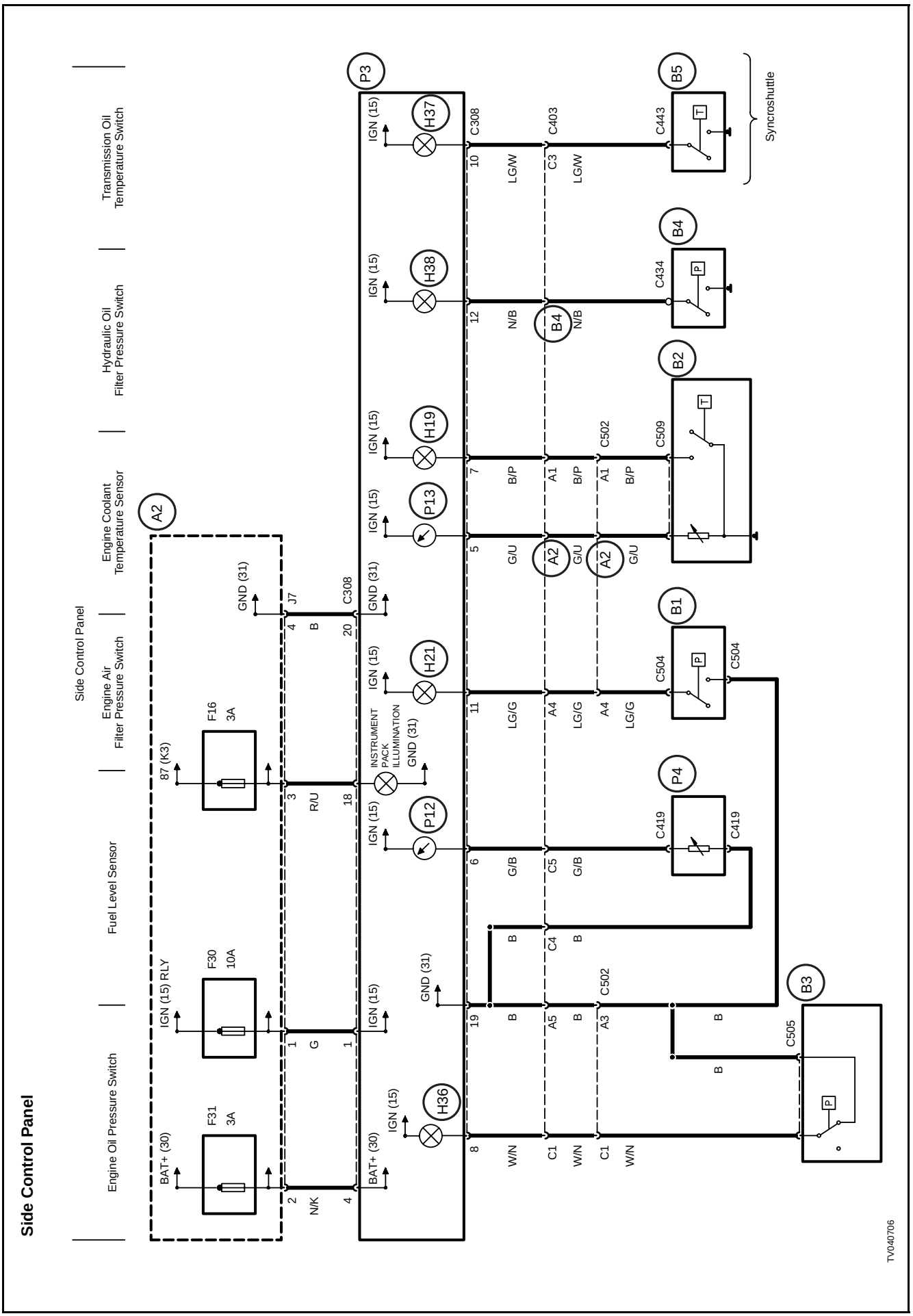
Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information

Side Control Panel



WIRING DIAGRAMS — LIGHTING

BHJ0902TN

WIRING DIAGRAM — ILLUMINATION FRONT

Components

A2	Fuse and relay board
E10	Left hand dipped beam light
E11	Left hand main beam light
E12	Left hand side light
E14	Right hand dipped beam light
E15	Right hand main beam light
E16	Right hand side light
S7	Direction indicator / Lights / Front horn switch

Relays

K1	Main beam headlight relay
K2	Dippped beam light relay
K3	Side light/Number plate light/Console illumination relay

Connectors

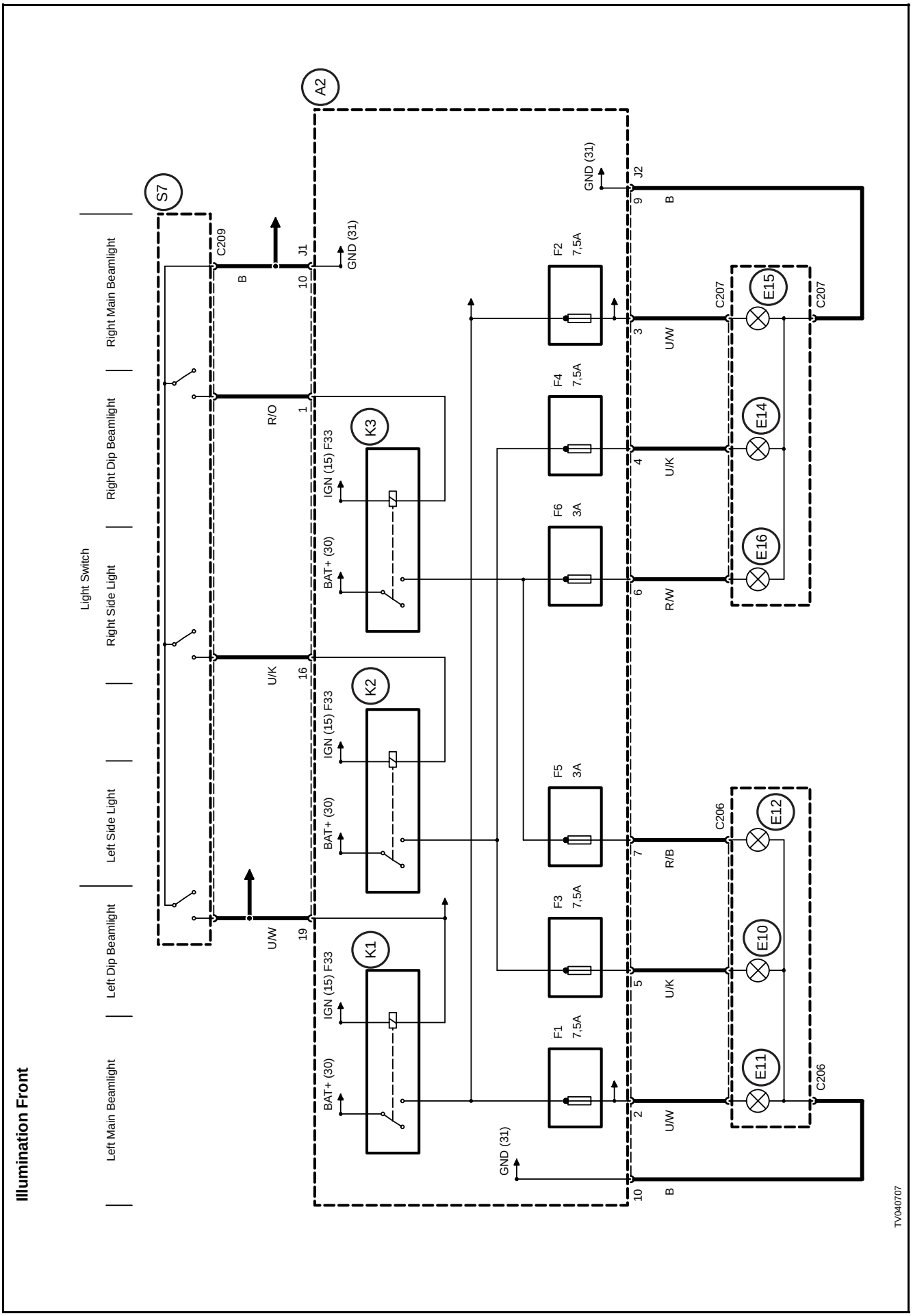
C206	Left hand front light connector
C207	Right hand front light connector
C209	Light switch connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Illumination Front
Light Switch
Left Main Beamlight
Left Dip Beamlight
Left Side Light
Right Side Light
Right Dip Beamlight
Right Main Beamlight
S7
A2
C209
J1
J2
GND (31)
BAT+ (30)
IGN (15) F33
K1
K2
K3
F1 7,5A
F2 7,5A
F3 7,5A
F4 7,5A
F5 3A
F6 3A
C206
C207
E10
E11
E12
E14
E15
E16
U/W
U/K
R/O
R/B
R/W
B
TV040707

WIRING DIAGRAM — ILLUMINATION REAR

Components

A2	Fuse and relay board
E1	Left hand brake light
E3	Left hand rear side light
E4	Right hand brake light
E6	Right hand rear side light
E7	Registration plate light
E8	Registration plate light
S5	Brake light switch
S7	Direction indicator / Lights / Front horn switch

Relays

K3	Side light / Number plate light / Console illumination relay
K4	Brake light relay

Connectors

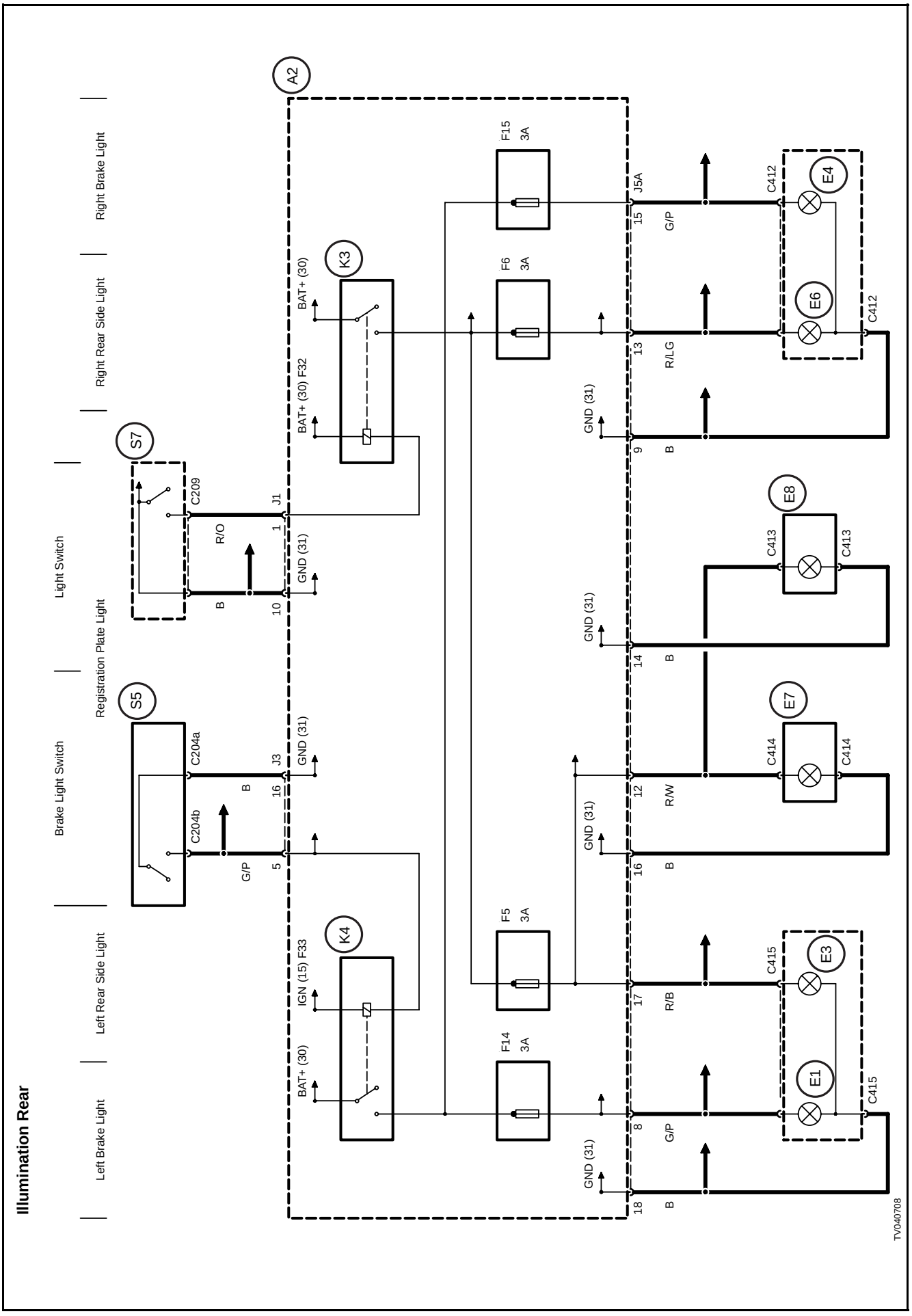
C204a/b	Brake light switch connector
C209	Light switch connector
C412	Right hand rear light cluster connector
C413	Rear number plate light connector
C414	Rear number plate light connector
C415	Left hand rear light cluster connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Illumination Rear
Left Brake Light
Left Rear Side Light
Brake Light Switch
Registration Plate Light
Light Switch
Right Rear Side Light
Right Brake Light
A2
S5
S7
K3
K4
C204a
C204b
C209
J1
J3
J5A
C412
C413
C414
C415
E1
E3
E4
E6
E7
E8
F5 3A
F6 3A
F14 3A
F15 3A
BAT+ (30)
BAT+ (30) F32
IGN (15) F33
GND (31)
R/O
G/P
R/LG
R/W
R/B
TV040708

WIRING DIAGRAM —DIRECTION INDICATORS WITH CABIN

Components

A2	Fuse and relay board
E2	Left hand rear indicator light
E5	Right hand rear indicator light
E13	Left hand front indicator light
E17	Right hand front indicator light
H47	Direction indicator lamp
P2	Front console panel
S7	Direction indicator / Lights / Front horn switch
S20	Side console switch pack

Relays

K5	Hazard enable relay
K6	Hazard light relay
K12	Direction indicator flasher unit

Connectors

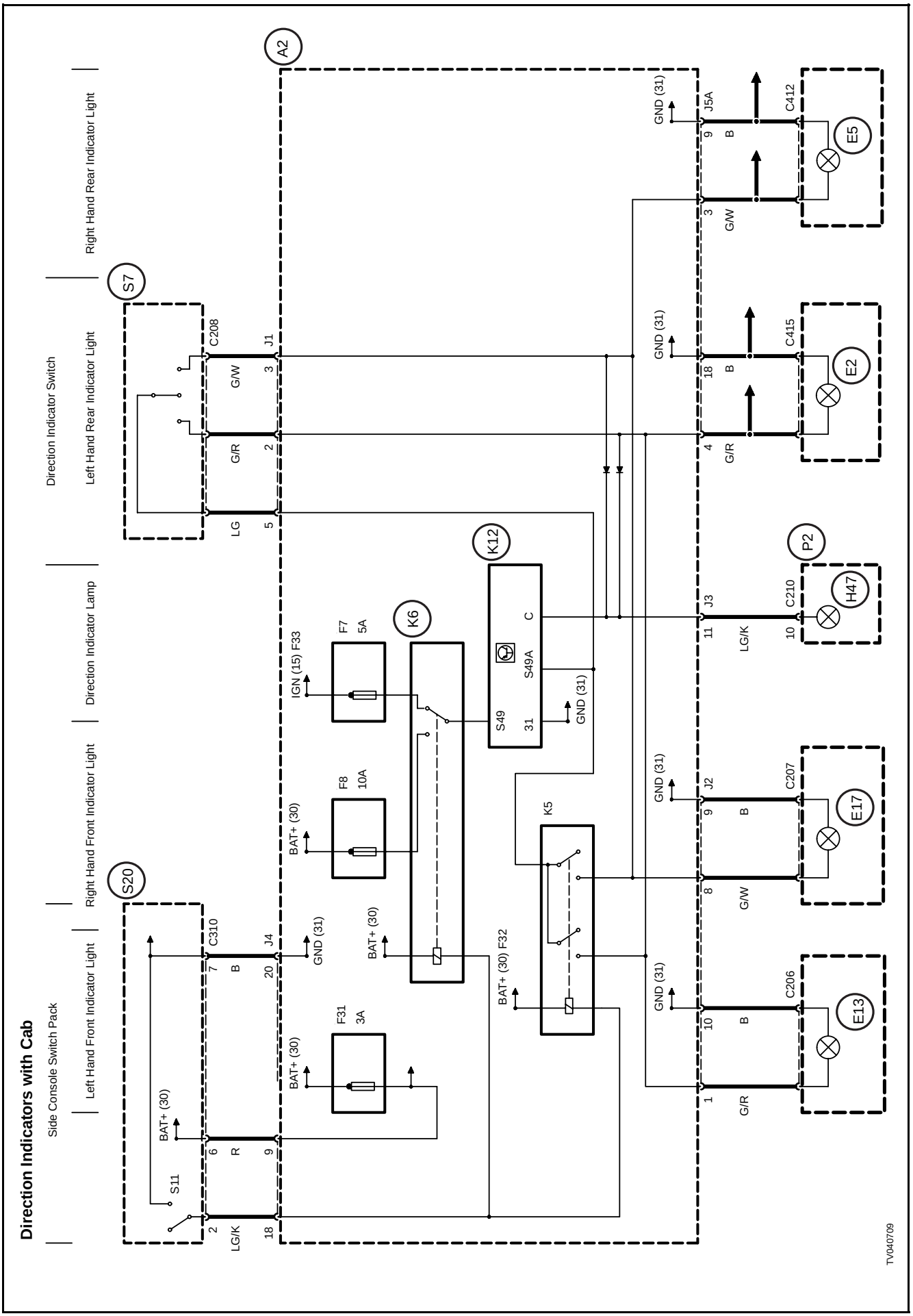
C206	Left hand front light connector
C207	Right hand front light connector
C208	Direction indicator / Front horn switch connector
C210	Front console panel connector
C310	Side console switch pack connector
C412	Right hand rear light connector
C415	Left hand rear light connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Direction Indicators with Cab
Side Console Switch Pack
Left Hand Front Indicator Light
Right Hand Front Indicator Light
Direction Indicator Lamp
Direction Indicator Switch
Left Hand Rear Indicator Light
Right Hand Rear Indicator Light
A2
S20
S11
C310
J4
S7
C208
J1
K6
K12
K5
F7 5A
F8 10A
F31 3A
IGN (15) F33
BAT+ (30)
BAT+ (30) F32
GND (31)
S49
S49A
C
31
J3
C210
P2
H47
J5A
C412
E5
C415
E2
J2
C207
E17
C206
E13
LG/K
R
B
G/R
G/W
LG
TV040709

WIRING DIAGRAM — DIRECTION INDICATORS WITHOUT CABIN (ROPS)

Components

A2	Fuse and relay board
E2	Left hand rear indicator light
E5	Right hand rear indicator light
E13	Left hand front indicator light
E17	Right hand front indicator light
H47	Direction indicator lamp
S7	Direction indicator / Lights / Front horn switch
S11	Hazard warning switch

Relays

K5	Hazard enable relay
K6	Hazard light relay
K12	Direction indicator flasher unit

Connectors

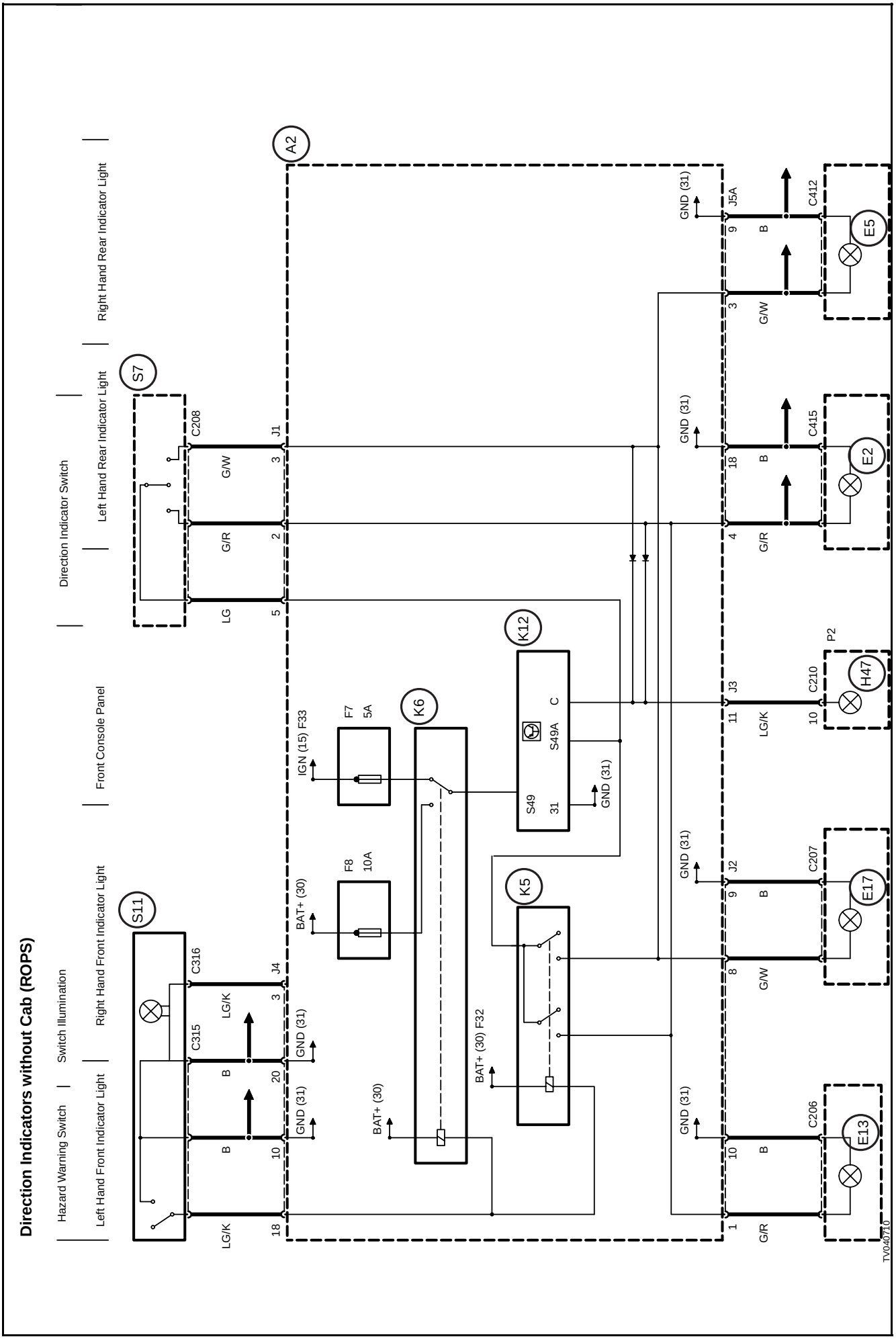
C206	Left hand front light connector
C207	Right hand front light connector
C208	Direction indicator / Front horn switch connector
C210	Front console panel connector
C315	Hazard switch connector
C316	Hazard switch illumination connector
C412	Right hand rear light connector
C415	Left hand rear light connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Direction Indicators without Cab (ROPS)
Hazard Warning Switch
Switch Illumination
Left Hand Front Indicator Light
Right Hand Front Indicator Light
Front Console Panel
Direction Indicator Switch
Left Hand Rear Indicator Light
Right Hand Rear Indicator Light
A2
S11
S7
K6
K12
K5
F7 5A
F8 10A
IGN (15) F33
BAT+ (30)
BAT+ (30) F32
GND (31)
S49
S49A
31
C316
C315
C208
C210
C207
C206
C412
C415
J4
J1
J3
J2
J5A
P2
H47
E5
E2
E17
E13
LG/K
G/W
G/R
LG
B
TV040710

WIRING DIAGRAM — OPTIONAL ROOF REAR LIGHTS (ROPS)

Components

A2	Fuse and relay board
E35	Left hand brake light
E36	Right hand brake light
E37	Left hand side light
E38	Right hand side light
H39	Left hand rear indicator light
H40	Right hand rear indicator light

Connectors

C112	Intermediate connector (to C405)
C114	Right hand rear light connector
C119	Left hand rear light connector
C405	Intermediate connector (to C112)

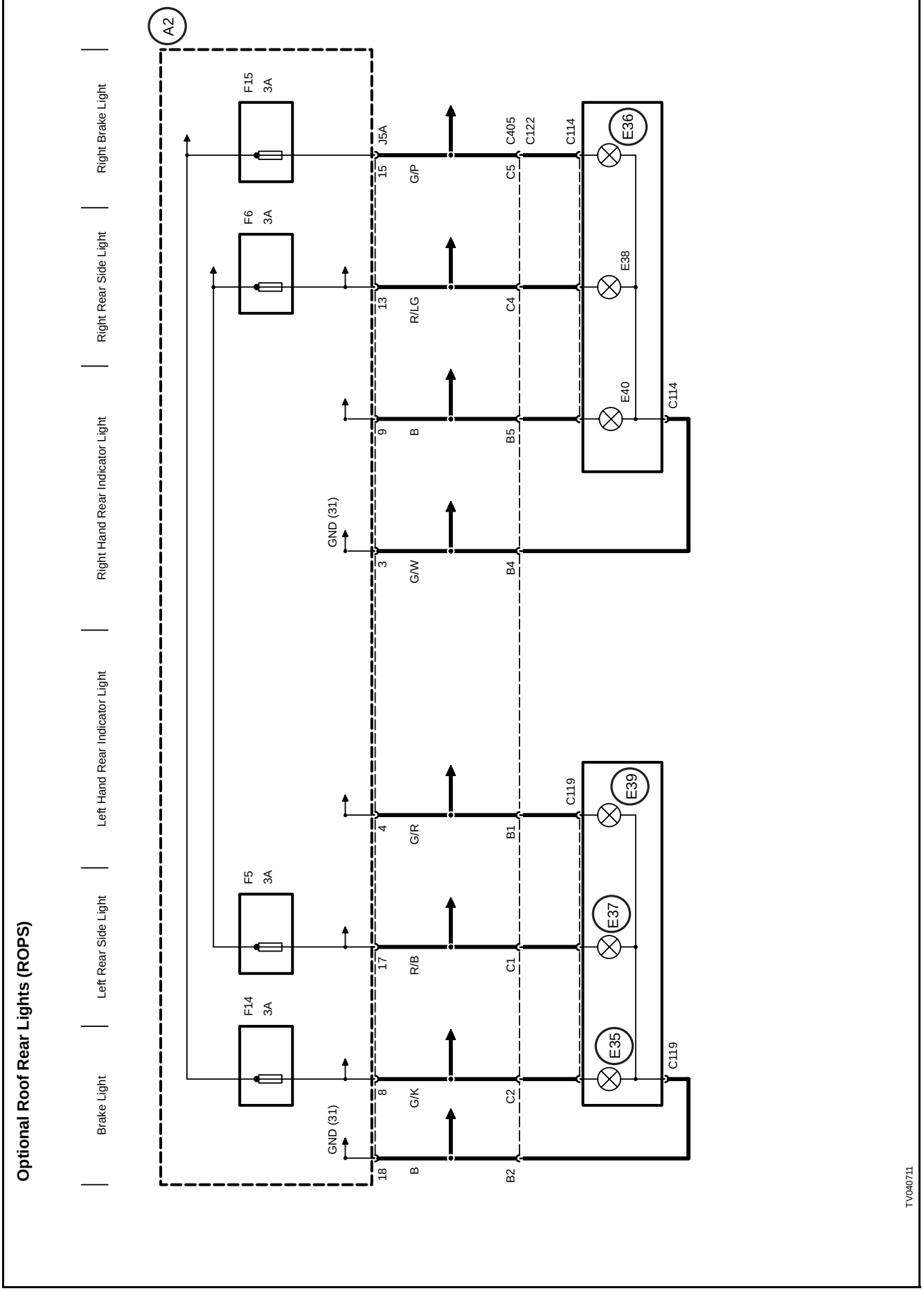
Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information

Optional Roof Rear Lights (ROPS)



WIRING DIAGRAM — WORKLIGHTS WITH CABIN

Components

A2	Fuse and relay board
E18	Left hand front worklight
E19	Left hand front worklight
E20	Right hand front worklight
E21	Right hand front worklight
E25	Left hand rear worklight (outer)
E26	Left hand rear worklight (inner)
E27	Right hand rear worklight (inner)
E28	Right hand rear worklight (outer)
S20	Side console switch pack
S25	Front worklight switch
S27	Rear worklight switch

Relays

K13	Front worklight relay
K14	Rear worklight relay

Connectors

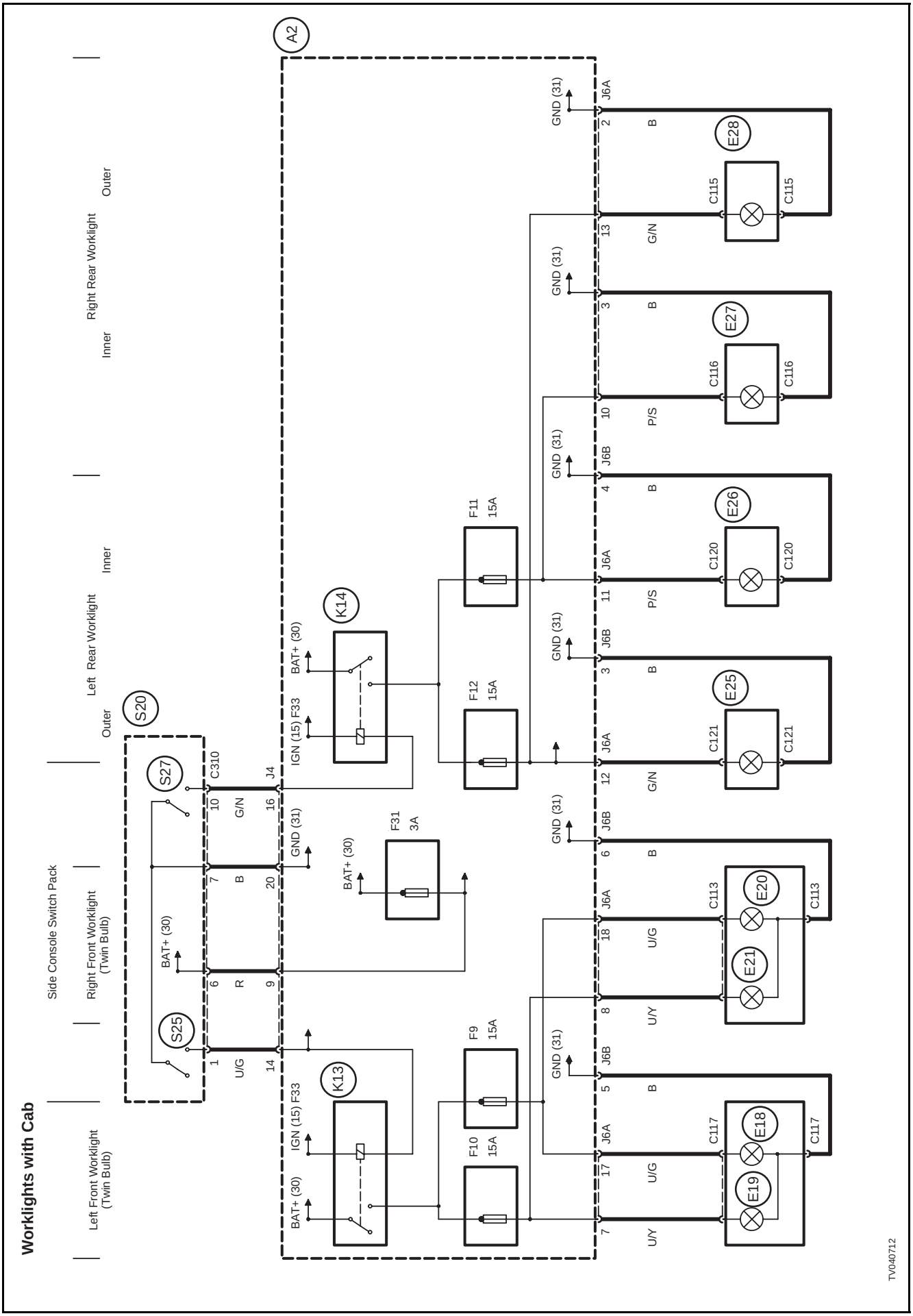
C113	Right hand front worklight connector
C115	Right hand rear worklight connector (outer)
C116	Right hand rear worklight connector (inner)
C117	Left hand front worklight connector
C120	Left hand rear worklight connector (inner)
C121	Left hand rear worklight connector (outer)
C310	Side console switch pack connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Worklights with Cab
Side Console Switch Pack
Left Front Worklight (Twin Bulb)
Right Front Worklight (Twin Bulb)
Left Rear Worklight
Outer
Inner
Right Rear Worklight
Inner
Outer
A2
S20
S27
S25
C310
J4
BAT+ (30)
IGN (15) F33
GND (31)
K13
K14
F9 15A
F10 15A
F11 15A
F12 15A
F31 3A
J6A
J6B
C113
C115
C116
C117
C120
C121
E18
E19
E20
E21
E25
E26
E27
E28
U/G
U/Y
G/N
P/S
B
R
TV040712

WIRING DIAGRAM — WORKLIGHTS WITHOUT CABIN (ROPS)

Components

A2	Fuse and relay board
E18	Left hand front worklight
E19	Left hand front worklight
E20	Right hand front worklight
E21	Right hand front worklight
E25	Left hand rear worklight (outer)
E26	Left hand rear worklight (inner)
E27	Right hand rear worklight (inner)
E28	Right hand rear worklight (outer)
S25	Front worklight switch
S27	Rear worklight switch

Relays

K13	Front worklight relay
K14	Rear worklight relay

Connectors

C113	Right hand front worklight connector
C115	Right hand rear worklight connector (outer)
C116	Right hand rear worklight connector (inner)
C117	Left hand front worklight connector
C120	Left hand rear worklight connector (inner)
C121	Left hand rear worklight connector (outer)
C311	Front worklight switch connector
C312	Front worklight switch illuminator connector
C323	Rear worklight switch connector
C324	Rear worklight switch illumination connector

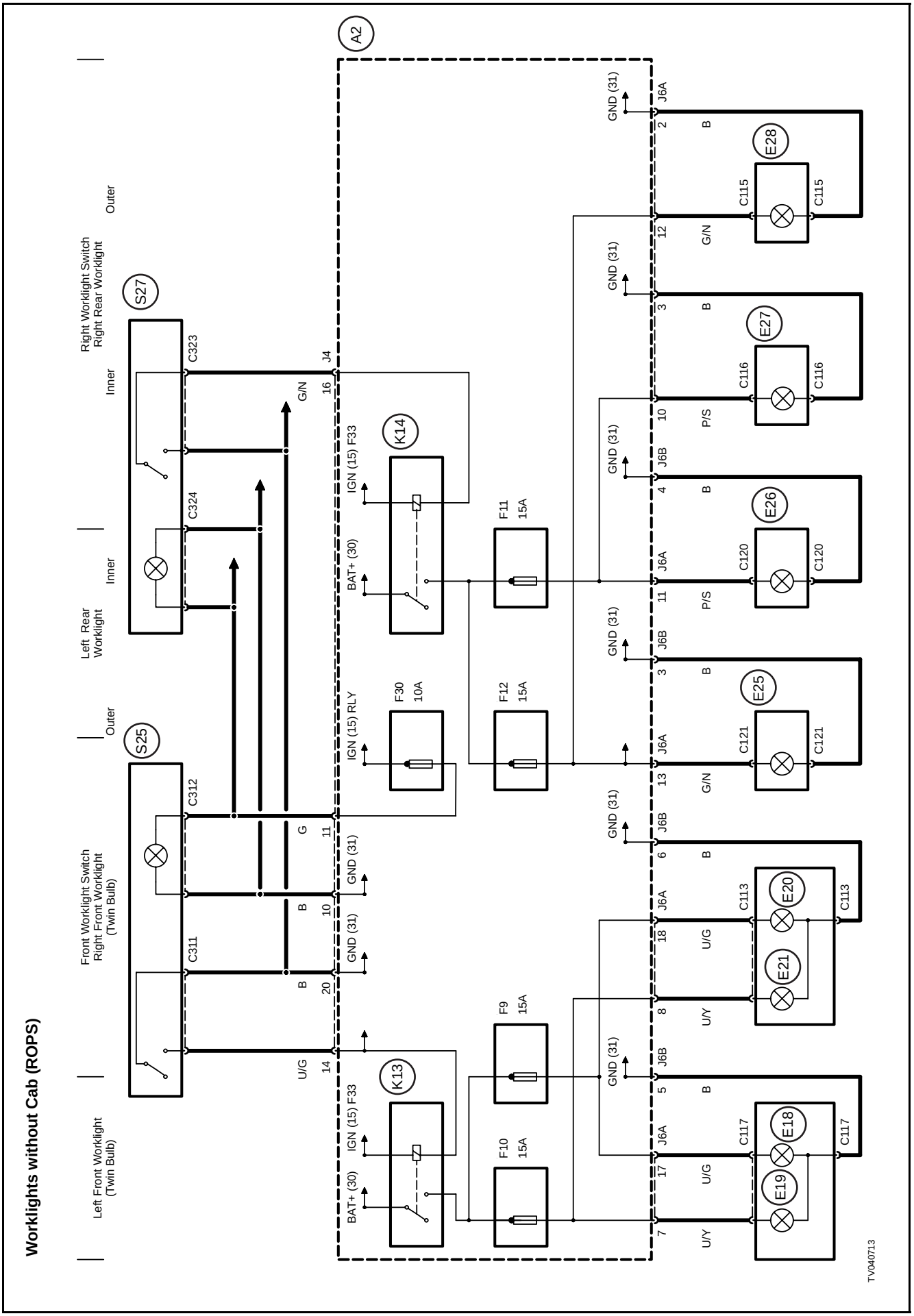
Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information

Worklights without Cab (ROPS)



WIRING DIAGRAMS — WARNING FUNCTIONS

BHJ0902TP

WIRING DIAGRAM — WARNING FUNCTIONS WITH CABIN

Components

A2	Fuse and relay board
E22	Right front beacon
E23	Left rear beacon
H1	Front horn
H2	Rear horn
H3	Reverse alarm (optional)
S7	Direction indicator / Lights / Front horn switch
S20	Side console switch pack
S26	Rotating beacon switch
S34	Rear horn switch

Relays

K11	Front / Rear horn relay
K15	Rotating beacon relay

Connectors

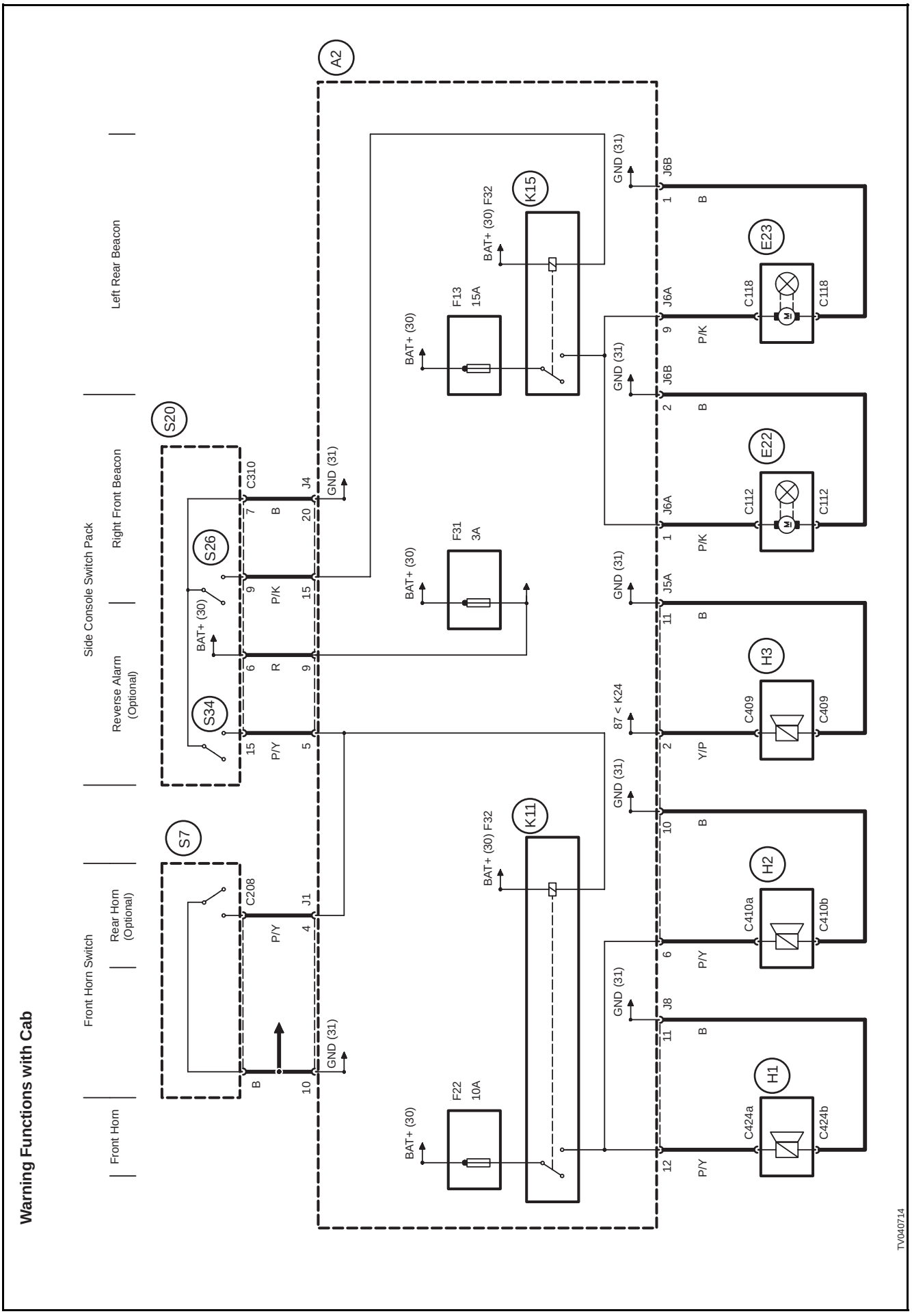
C112	Right front beacon connector
C118	Left rear beacon connector
C208	Direction indicator / Front horn connector
C310	Side switch pack connector
C409	Reverse alarm connector
C410a/b	Rear horn connections
C424a/b	Front horn connections

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Warning Functions with Cab
Front Horn
Front Horn Switch
Rear Horn (Optional)
Reverse Alarm (Optional)
Side Console Switch Pack
Right Front Beacon
Left Rear Beacon
A2
S7
S20
S26
S34
K11
K15
F22 10A
F31 3A
F13 15A
BAT+ (30)
BAT+ (30) F32
GND (31)
87 < K24
C208
C310
J1
J4
J5A
J6A
J6B
J8
H1
H2
H3
E22
E23
C424a
C424b
C410a
C410b
C409
C112
C118
P/Y
P/K
R
Y/P
B
TV040714

WIRING DIAGRAM — WARNING FUNCTIONS WITHOUT CABIN (ROPS)

Components

A2	Fuse and relay board
E22	Right front beacon
E23	Left rear beacon
H1	Front horn
H2	Rear horn
H3	Reverse alarm (optional)
S7	Direction indicator / Lights / Front horn switch
S26	Rotating beacon switch
S34	Rear horn switch

Relays

K11	Front / Rear horn relay
K15	Rotating beacon relay

Connectors

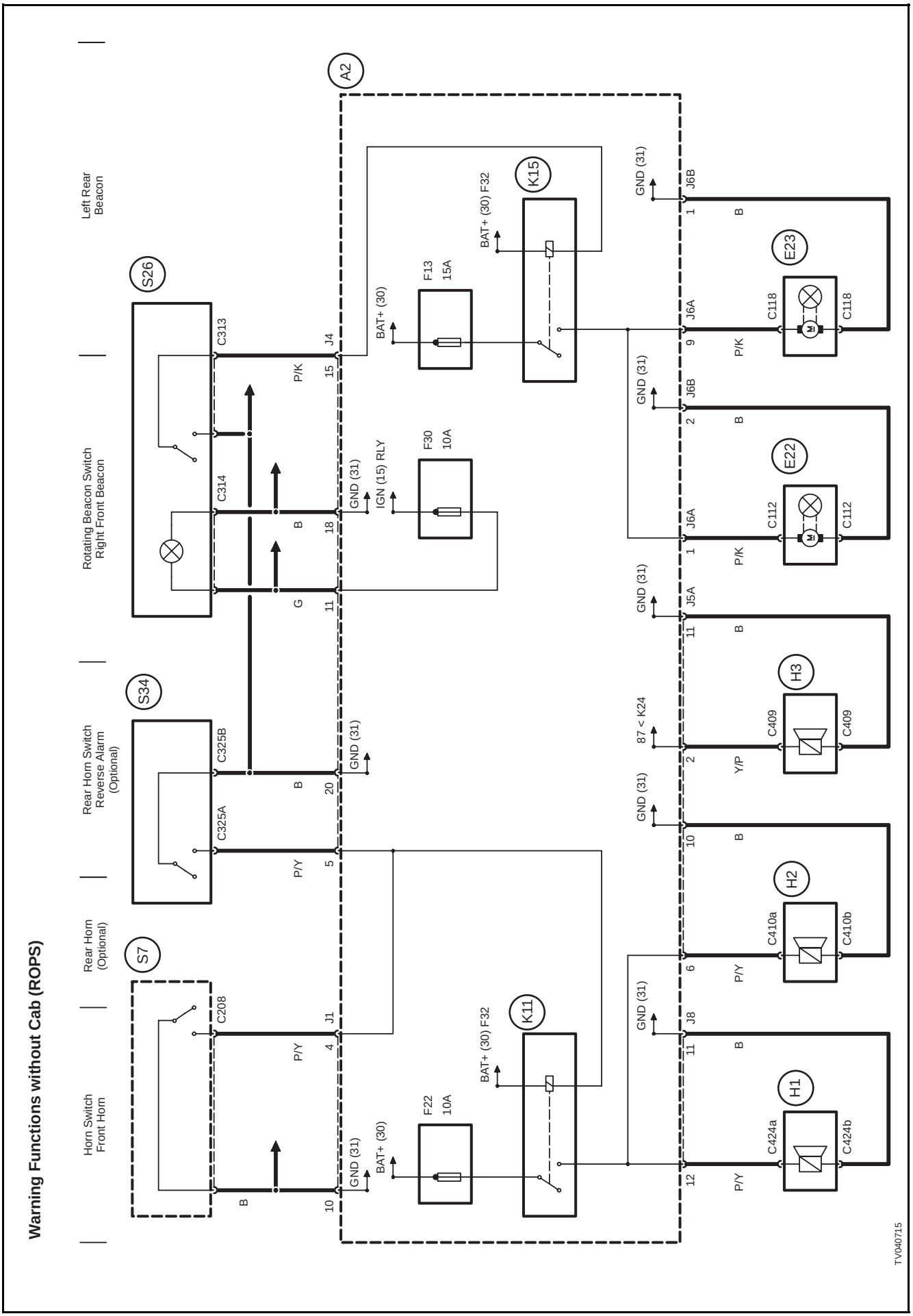
C112	Right front beacon connector
C118	Left rear beacon connector
C208	Direction indicator / Front horn connector
C313	Front / Rear beacon switch connector
C314	Front / rear beacon switch illumination connector
C325	Horn switch connector
C409	Reverse alarm connector
C410a/b	Rear horn connections
C424a/b	Front horn connections

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Warning Functions without Cab (ROPS)
Horn Switch Front Horn
Rear Horn (Optional)
Rear Horn Switch Reverse Alarm (Optional)
Rotating Beacon Switch Right Front Beacon
Left Rear Beacon
S7
S34
S26
A2
C208
C325A
C325B
C313
C314
J1
J4
P/Y
P/K
B
G
4
5
20
15
18
11
10
F22 10A
F30 10A
F13 15A
BAT+ (30)
IGN (15) RLY
GND (31)
K11
K15
BAT+ (30) F32
87 < K24
J8
J5A
J6A
J6B
Y/P
Y/IP
C410a
C410b
C424a
C424b
C409
C112
C118
H1
H2
H3
E22
E23
TV0040715

WIRING DIAGRAMS — OPERATORS ENVIRONMENT

BHJ0902TQ

WIRING DIAGRAM — WIPER WASH

Components

A2	Fuse and relay board
M2	Front wiper motor
M3	Rear wiper motor
M4	Front washer pump motor
M5	Rear washer pump motor
S9	Front washer switch
S10	Front wiper switch
S20	Side console switch pack
S24	Right front console switch pack
S28	Rear wiper switch
S29	Rear washer switch

Relays

K7	Front wiper relay
K8	Rear wiper relay
K9	Front washer relay
K10	Rear washer relay

Connectors

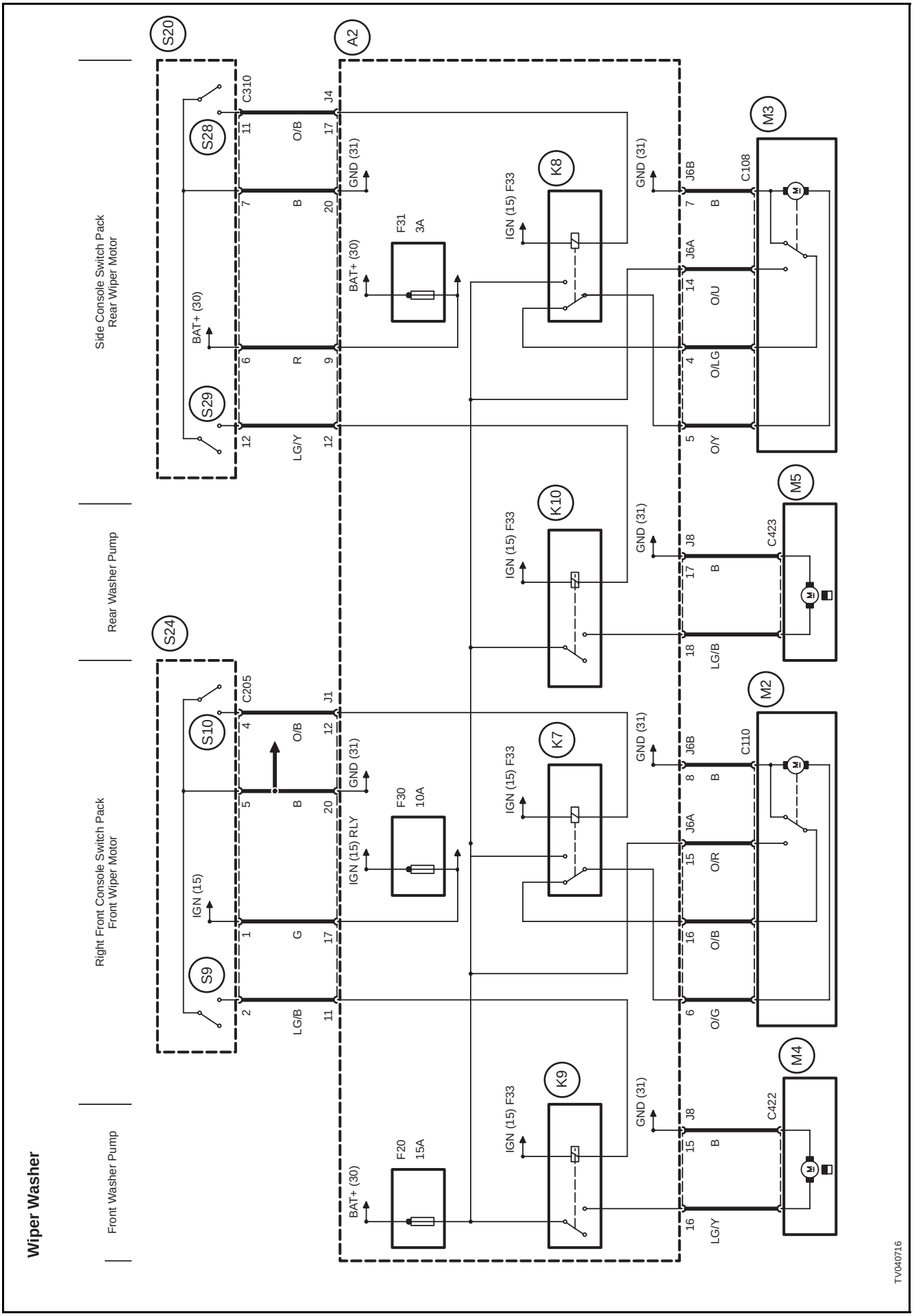
C108	Rear wiper motor connector
C110	Front wiper motor connector
C205	Right front console switch pack connector
C310	Side console switch pack connector
C422	Front windscreen washer motor connector
C423	Rear windscreen washer motor connector
C409	Reverse alarm connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Wiper Washer
Front Washer Pump
Right Front Console Switch Pack
Front Wiper Motor
Rear Washer Pump
Side Console Switch Pack
Rear Wiper Motor
S20
S28
S29
S24
S10
S9
A2
C310
C205
J4
J1
O/B
LG/Y
G
LG/B
R
B
BAT+ (30)
IGN (15)
IGN (15) RLY
GND (31)
F31
3A
F30
10A
F20
15A
K8
K7
K10
K9
IGN (15) F33
M3
M2
M5
M4
C108
C110
C423
C422
J6B
J6A
J8
O/U
O/LG
O/Y
O/R
O/G
LG/B
LG/Y
TV040716

WIRING DIAGRAM — INTERIOR ILLUMINATION SWITCH PACK

Components

A2	Fuse and relay board
A5	Radio
E9	Cigar lighter
E24	Interior light
S20	Side console switch pack
S24	Right front console switch pack

Connectors

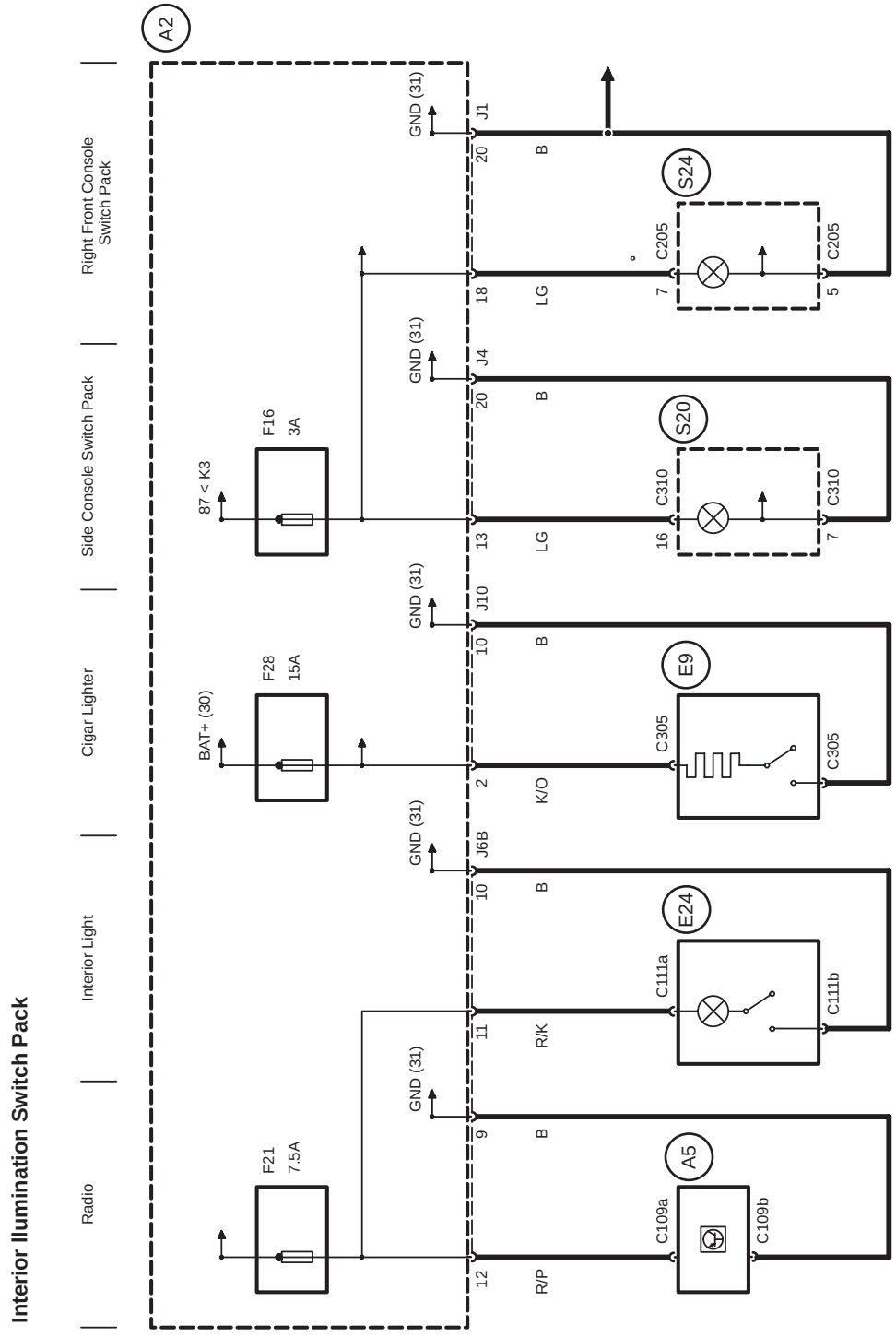
C109a/b	Radio connections
C111a/b	Interior light connections
C205	Right front console switch pack connector
C305	Cigar lighter connector
C310	Side console switch pack connector
C422	Front windscreen washer motor connector
C423	Rear windscreen washer motor connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Interior Illumination Switch Pack
Radio
Interior Light
Cigar Lighter
Side Console Switch Pack
Right Front Console Switch Pack
A2
GND (31)
J1
20
B
S24
C205
7
5
18
LG
J4
S20
C310
16
13
87 < K3
F16
3A
J10
E9
C305
10
2
BAT+ (30)
F28
15A
J6B
E24
C111a
C111b
11
R/K
K/O
A5
C109a
C109b
9
12
R/P
F21
7.5A
TV040717

WIRING DIAGRAM — HEATING AND AIR CONDITIONING

Components

A2	Fuse and relay board
Y10	Air conditioning compressor
E31	Heater unit
S36	Air conditioning switch
S40	Heater switch

Connectors

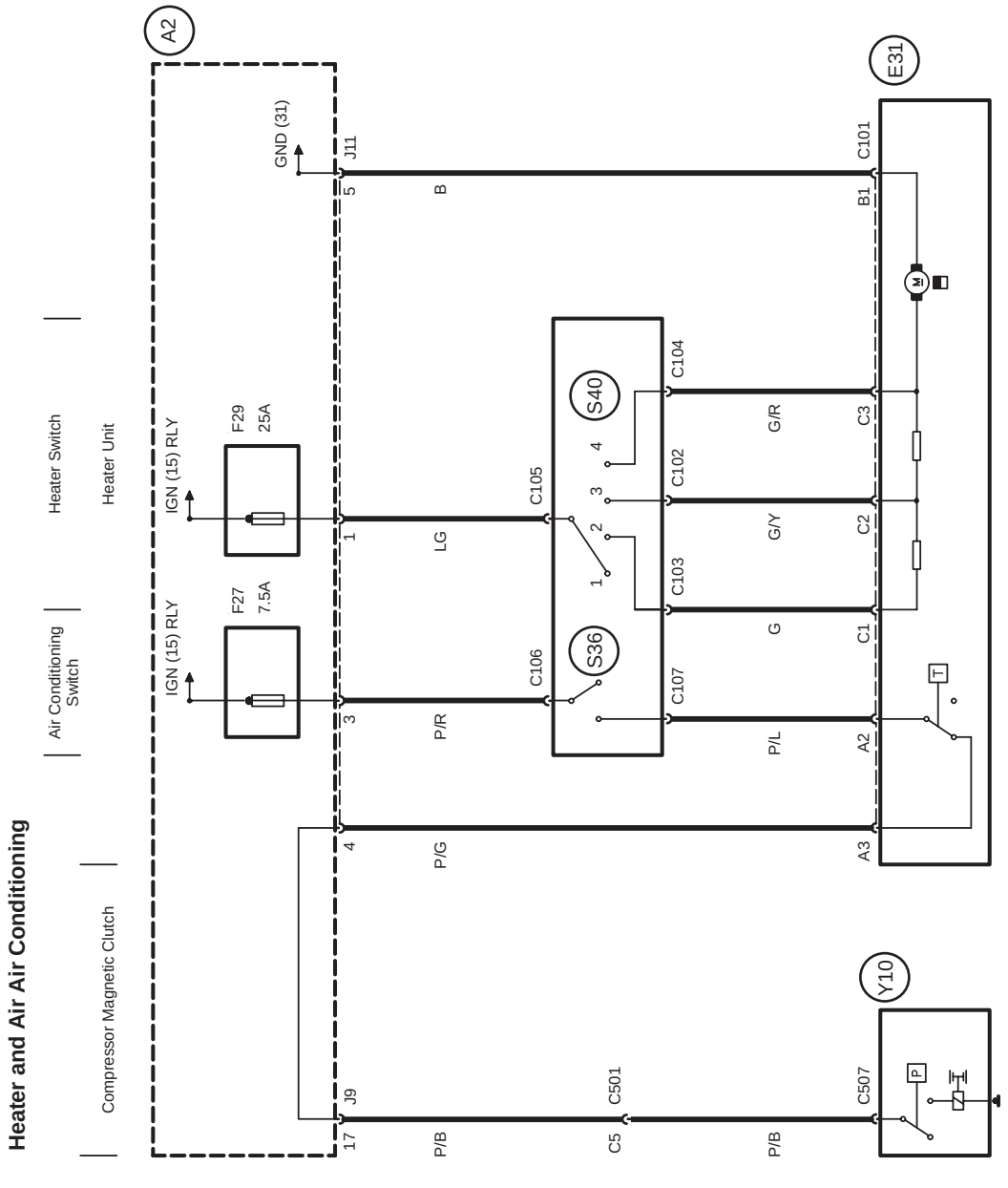
C101	Heater unit connector
C102	Heater switch connector
C103	Heater switch connector
C104	Heater switch connector
C105	Heater switch connector
C106	Air conditioning switch connector
C107	Air conditioning switch connector
C507	Air conditioning compressor connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Heater and Air Air Conditioning
Compressor Magnetic Clutch
Air Conditioning Switch
Heater Unit
Heater Switch
A2
GND (31)
J11
5
B
IGN (15) RLY
F29
25A
1
LG
C105
S40
4
3
2
1
C104
C102
C103
G/R
G/Y
G
C3
C2
C1
E31
C101
B1
M
IGN (15) RLY
F27
7.5A
3
P/R
C106
S36
C107
P/L
A2
T
4
P/G
A3
Y10
J9
17
P/B
C501
C5
C507
P
P/B
TV040718

WIRING DIAGRAMS — HYDRAULIC SYSTEMS

BHJ0902TR

WIRING DIAGRAM — RIDE CONTROL AND HOSE BURST

Components

A2	Fuse and relay board
B12	Hose burst pressure switch
Y5	Ride control solenoid
Y6	Ride control solenoid
Y23	Hose burst solenoid
Y24	Hose burst solenoid
S14	Ride control switch
S24	Right front console switch pack

Relays

K17	Ride control solenoid relay
K18	Hose burst relay

Connectors

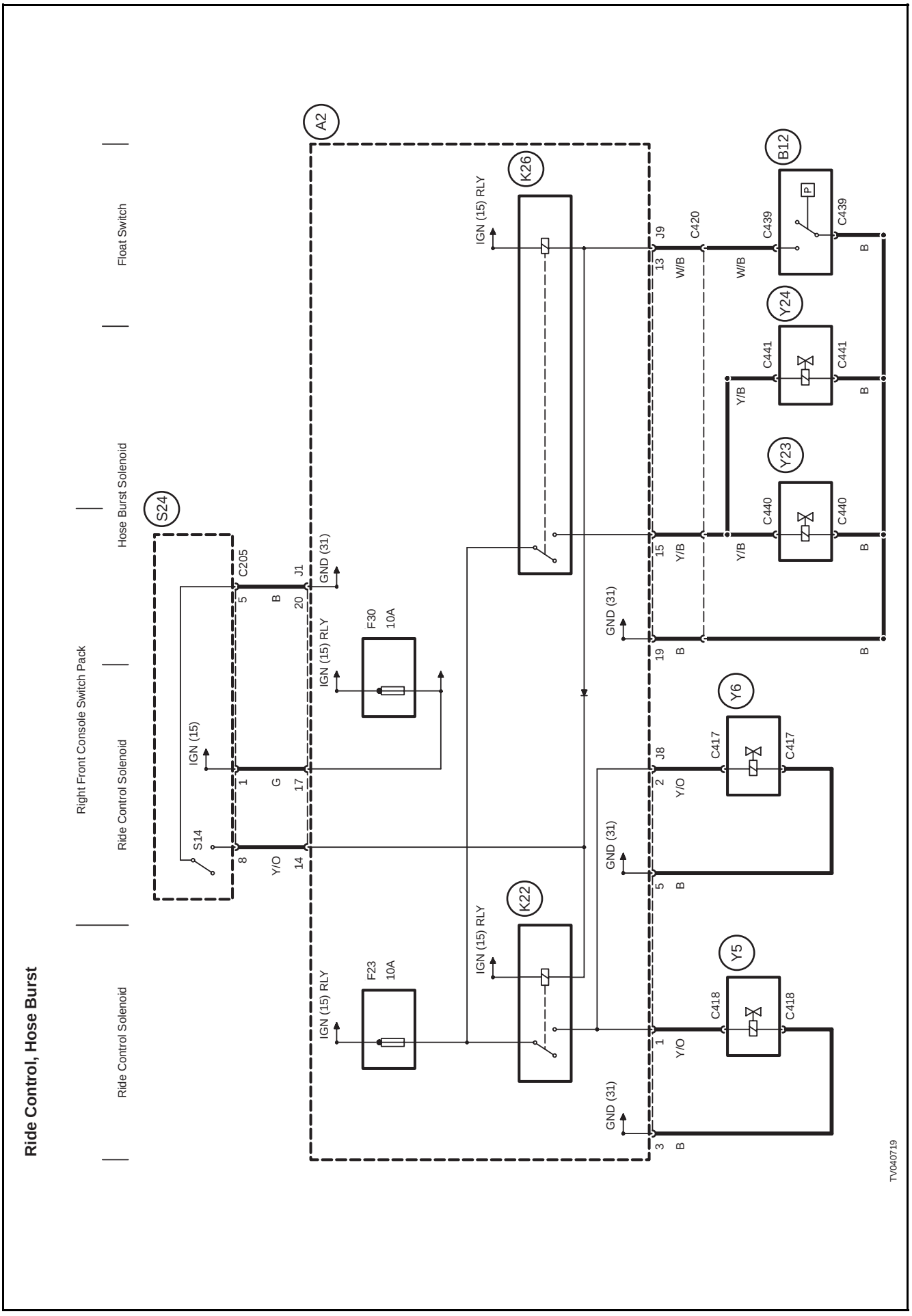
C205	Right front console switch pack connector
C417	Ride control connector
C418	Ride control connector
C420	Hose burst intermediate connector
C439	Hose burst pressure switch connector
C440	Hose burst solenoid connector
C441	Hose burst solenoid connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Ride Control, Hose Burst
Right Front Console Switch Pack
Ride Control Solenoid
Hose Burst Solenoid
Ride Control Solenoid
Float Switch
A2
S24
S14
C205
J1
IGN (15)
GND (31)
IGN (15) RLY
F30
10A
F23
10A
K26
K22
J9
C420
J8
C417
C418
C439
C441
C440
B12
Y24
Y23
Y6
Y5
W/B
Y/B
Y/O
B
TV040719

WIRING DIAGRAM — LOADER WITH CABIN

Components

A2	Fuse and relay board
B7	Return to dig sensor
Y3	Loader valve solenoid
Y13	Return to dig solenoid
S2	Loader valve switch
S20	Side console switch pack
S33	Hydraulic pump flow switch
S35	Return to dig switch

Relays

K19	Return to dig relay
K20	Un-loader relay

Connectors

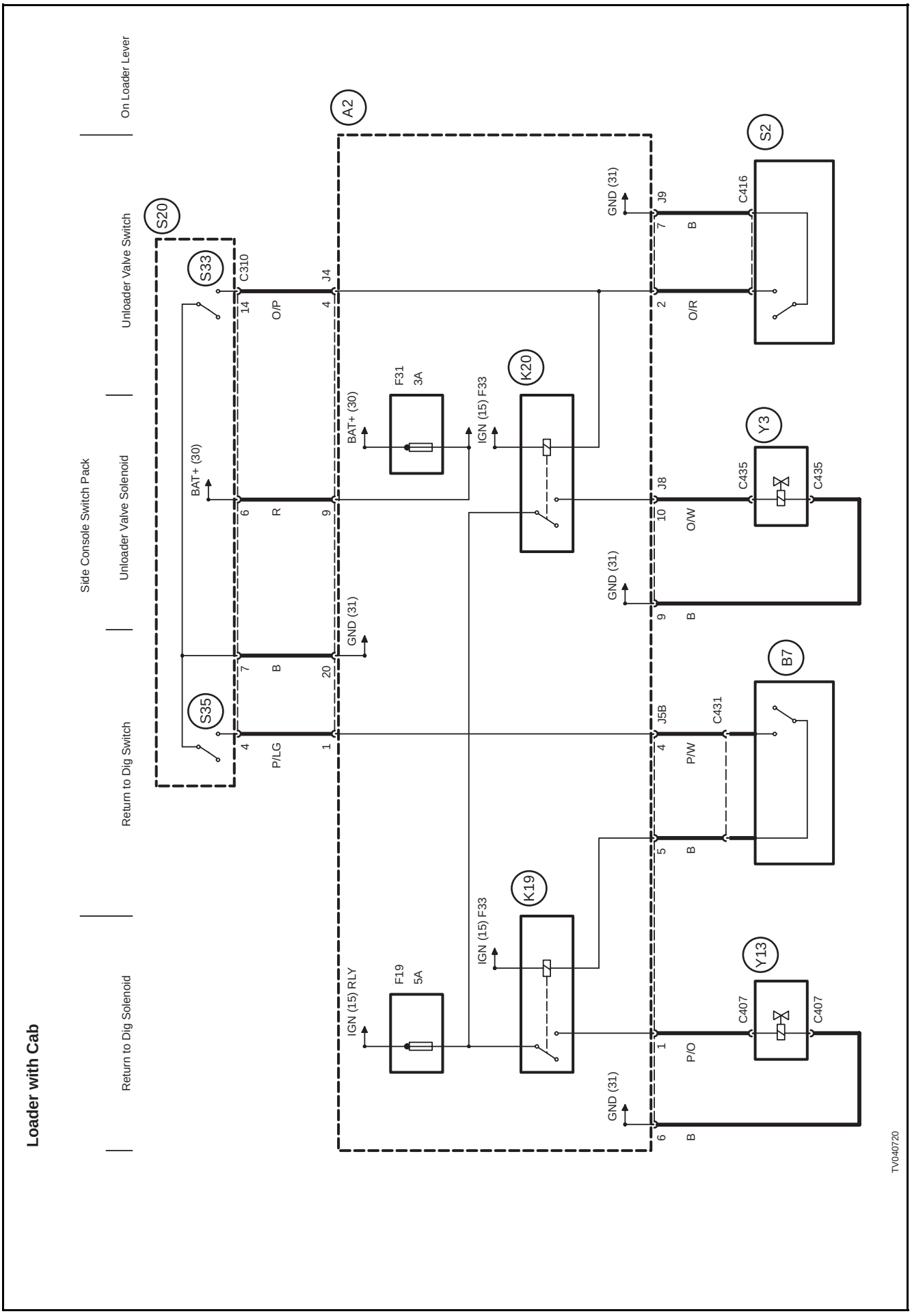
C310	Side console switch pack connector
C407	Return to dig solenoid connector
C416	Hose burst intermediate connector
C431	Return to dig sensor connector
C435	Loader valve solenoid connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Loader with Cab
Side Console Switch Pack
Return to Dig Solenoid
Return to Dig Switch
Unloader Valve Solenoid
Unloader Valve Switch
On Loader Lever
A2
S20
S33
S35
S2
Y3
B7
Y13
K19
K20
F19
5A
F31
3A
C310
C416
C435
C431
C407
J4
J9
J8
J5B
BAT+ (30)
IGN (15) RLY
IGN (15) F33
GND (31)
O/P
O/R
O/W
P/W
P/O
P/LG
R
B
TV040720

WIRING DIAGRAM — LOADER, RETURN TO DIG WITHOUT CABIN (ROPS)

Components

A2	Fuse and relay board
B7	Return to dig sensor
Y3	Loader valve solenoid
Y13	Return to dig solenoid
S2	Loader valve switch
S33	Hydraulic pump flow switch
S35	Return to dig switch

Relays

K19	Return to dig relay
K20	Un-loader relay

Connectors

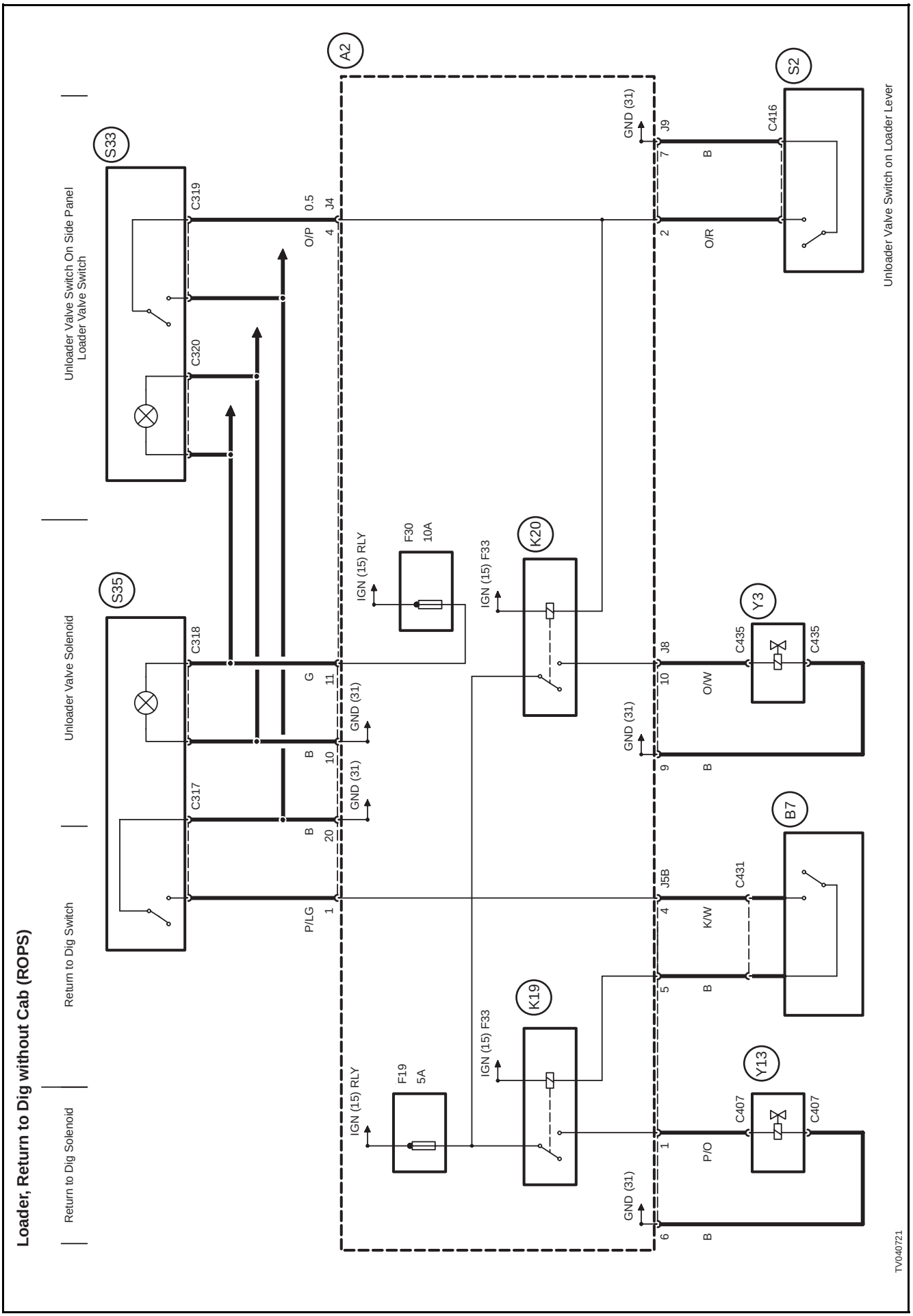
C317	Return to dig switch
C318	Return to dig switch illumination connector
C319	Hydraulic pump flow switch connector
C320	Hydraulic pump flow switch illumination connector
C407	Return to dig solenoid connector
C416	Loader valve switch connector
C431	Return to dig sensor connector
C435	Loader valve solenoid connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Loader, Return to Dig without Cab (ROPS)
Return to Dig Solenoid
Return to Dig Switch
Unloader Valve Solenoid
Unloader Valve Switch On Side Panel
Loader Valve Switch
Unloader Valve Switch on Loader Lever
A2
S33
S35
S2
C319
C320
C318
C317
C416
C435
C431
C407
J4
J9
J8
J5B
F30
10A
F19
5A
K20
K19
Y3
Y13
B7
IGN (15) RLY
IGN (15) F33
GND (31)
O/P
O/R
O/W
K/W
P/O
P/LG
G
B
TV040721

WIRING DIAGRAM — QUICK ATTACH AND CHANGE OVER WITH CABIN

Components

A2	Fuse and relay board
Y4	Loader quick attach solenoid
Y11	Sideshift clamp solenoid
Y12	Bucket quick attach solenoid
Y26	Change over valve
S15	Loader quick attach switch
S20	Side console switch pack
S24	Right front console switch pack
S30	Backhoe boom unlock switch
S31	Backhoe quick attach switch
S51	Change over selector switch

Relays

K17	Clamp relay
K18	Bucket quick attach relay
K21	Loader quick attach relay

Connectors

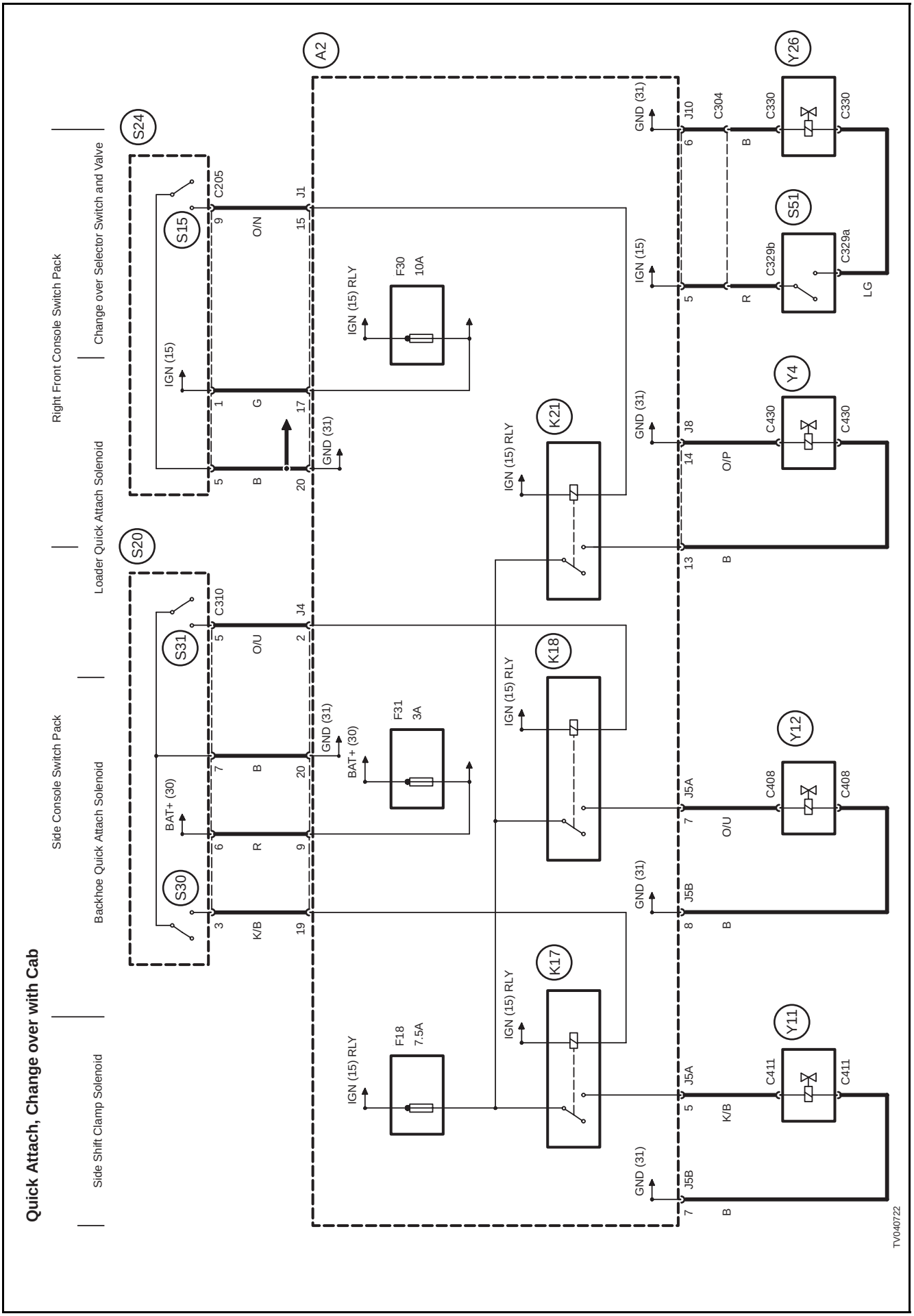
C205	Right front console switch pack
C304	Change over valve connector
C321	Connector
C322	Sideshift / Centremount switch illumination connector
C326	Backhoe quick attach switch connector
C327	Backhoe quick attach switch illumination connector
C329a/b	Change over selector switch connector
C330	Change over valve connector
C408	Bucket quick attach solenoid connector
C411	Sideshift clamp solenoid connector
C430	Loader quick attach solenoid connector

Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information


Quick Attach, Change over with Cab
Side Console Switch Pack
Backhoe Quick Attach Solenoid
Side Shift Clamp Solenoid
Right Front Console Switch Pack
Loader Quick Attach Solenoid
Change over Selector Switch and Valve
A2
S24
S15
S20
S31
S30
C205
C310
J1
J4
J10
J8
J5A
J5B
C304
C330
C329b
C329a
C430
C408
C411
S51
Y26
Y4
Y12
Y11
K21
K18
K17
F30
10A
F31
3A
F18
7.5A
IGN (15)
IGN (15) RLY
BAT+ (30)
GND (31)
O/N
O/U
O/P
K/B
G
R
B
LG
TV040722

WIRING DIAGRAM — QUICK ATTACH AND CHANGE OVER WITHOUT CABIN (ROPS)

Components

A2	Fuse and relay board
Y4	Loader quick attach solenoid
Y11	Sideshift clamp solenoid
Y12	Bucket quick attach solenoid
Y26	Change over valve
S15	Loader quick attach switch
S24	Right front console switch pack
S30	Backhoe boom unlock switch
S31	Backhoe quick attach switch
S51	Change over selector switch

Relays

K17	Clamp relay
K18	Bucket quick attach relay
K21	Loader quick attach relay

Connectors

C205	Right front console switch pack
C304	Change over valve connector
C321	Connector
C322	Sideshift / Centremount switch illumination connector
C326	Backhoe quick attach switch connector
C327	Backhoe quick attach switch illumination connector
C329a/b	Change over selector switch connector
C330	Change over valve connector
C408	Bucket quick attach solenoid connector
C411	Sideshift clamp solenoid connector
C430	Loader quick attach solenoid connector

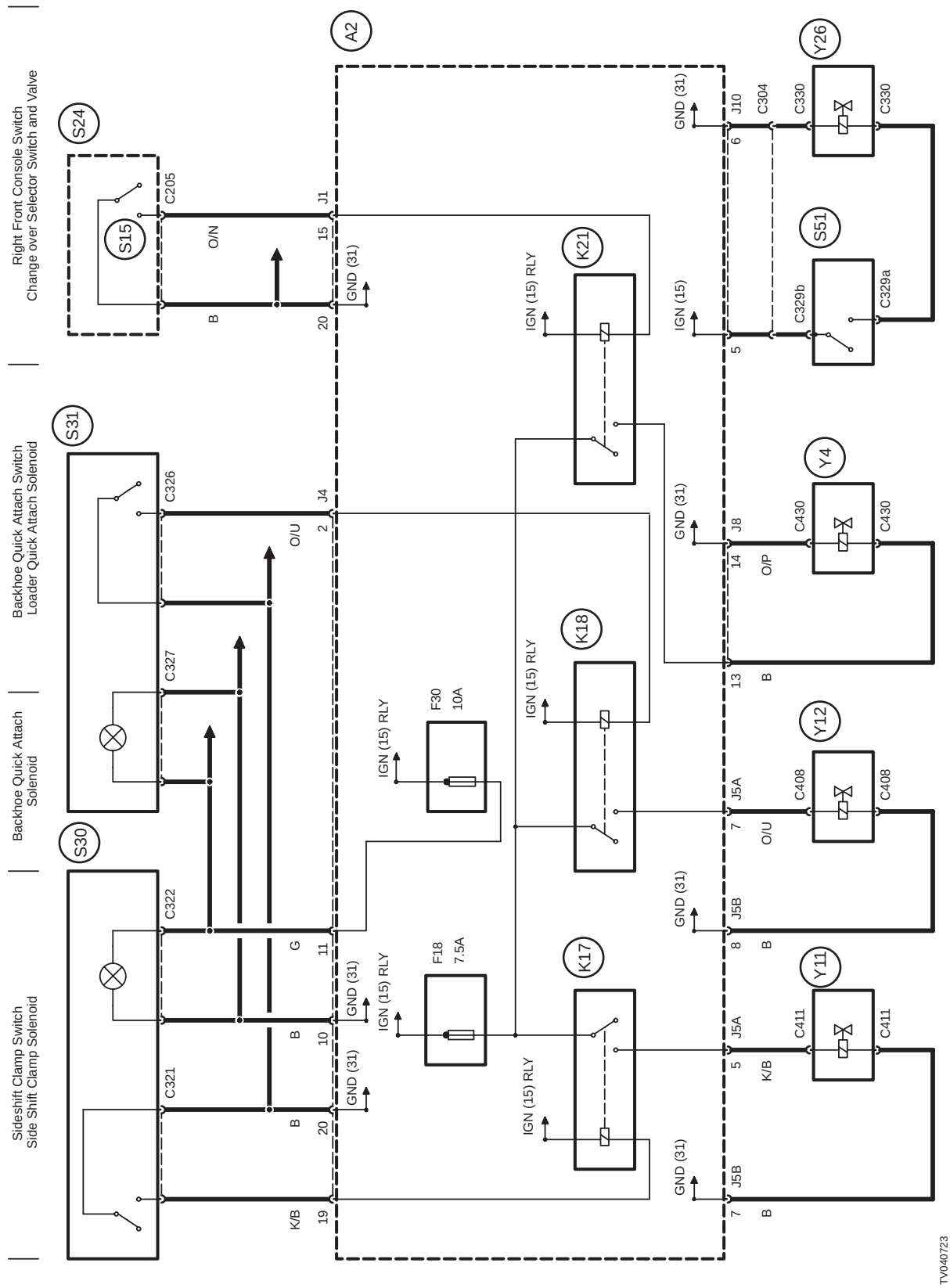
Fuses

Refer to Fuse and Relay identification numbers

Fuse board connections (J)

Refer to Fuse board connector information

Quick Attach, Change over without Cab



WIRING DIAGRAMS — SERVO LEVER CONTROL

BHJ0902TS

WIRING DIAGRAM — SERVO LEVER CONTROL

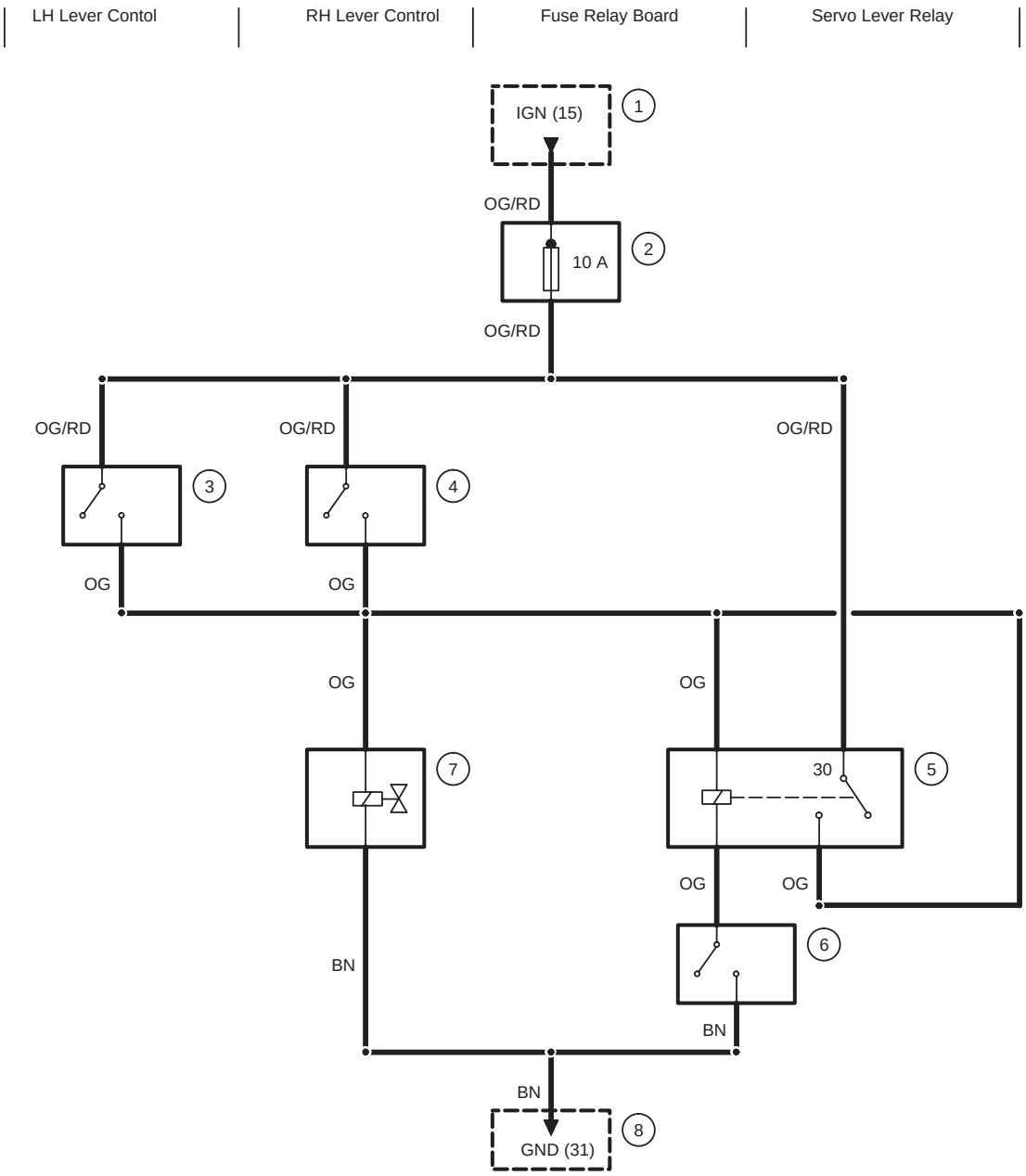
Components

1	Fuse and relay board
2	Fuse
3	Left-hand side control lever
4	Right-hand side control lever
6	Servo arm switch
7	Servo Control valve
8	Fuse and relay board

Relays

5	Servo Lever R elay

Servo Lever Control



TV074060

CONNECTOR LOCATIONS

BHJ0902TF

CONNECTOR LOCATIONS — CHASSIS HARNESS SYNCHROSHUTTLE

Components

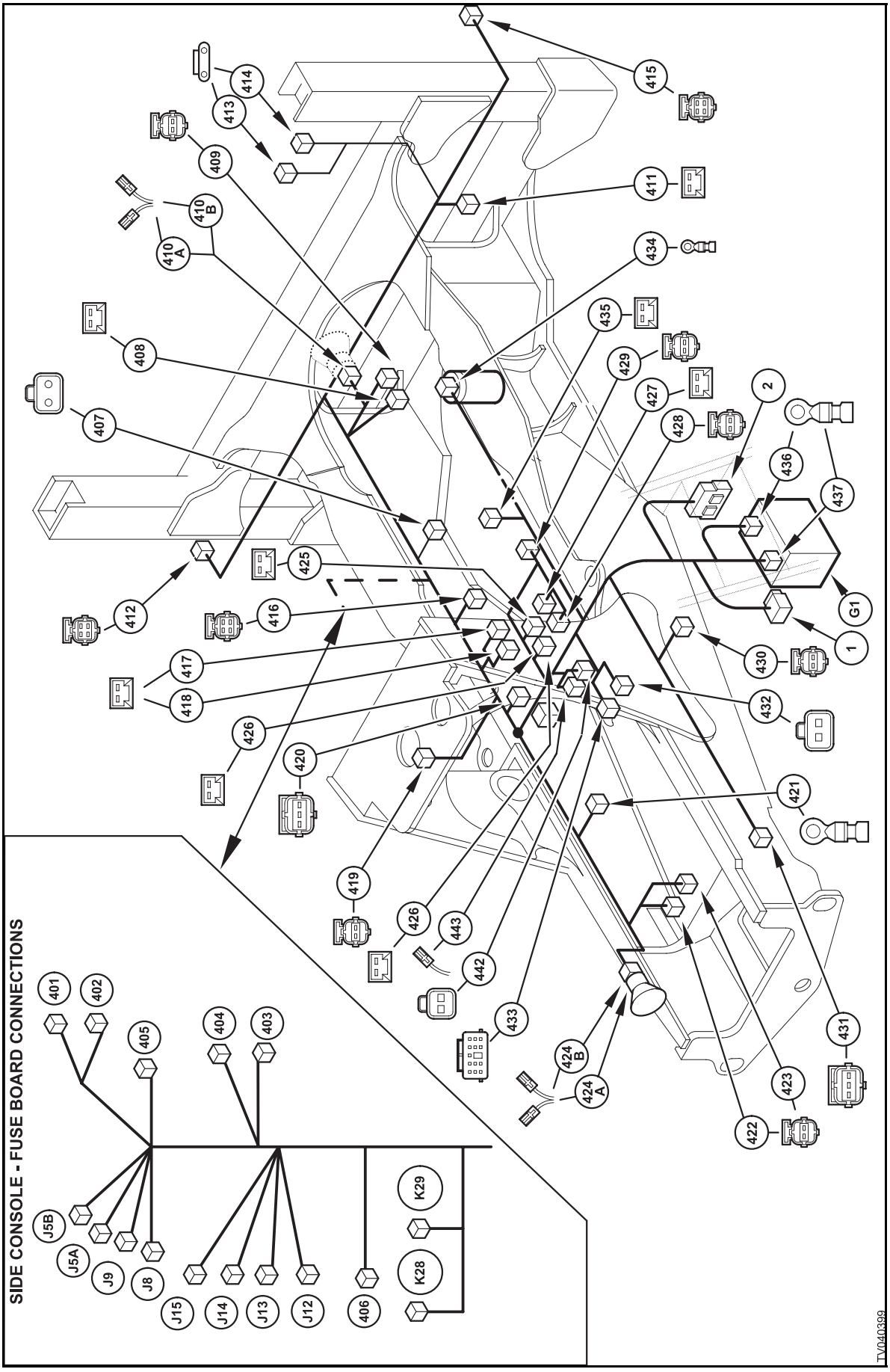
1	Mega fuse 125 amp	
G1	Battery	
2	Auxiliary fuse box	
J5a	18 way	Fuse board connector
J5b	12 way	Fuse board connector
J8	20 way	Fuse board connector
J9	20 way	Fuse board connector
J12	Eyelet	Fuse board connection
J13	Eyelet	Fuse board connection
J14	Eyelet	Fuse board connection
J15	Eyelet	Fuse board connection

Relays

K28	Ignition relay
K29	Starter relay

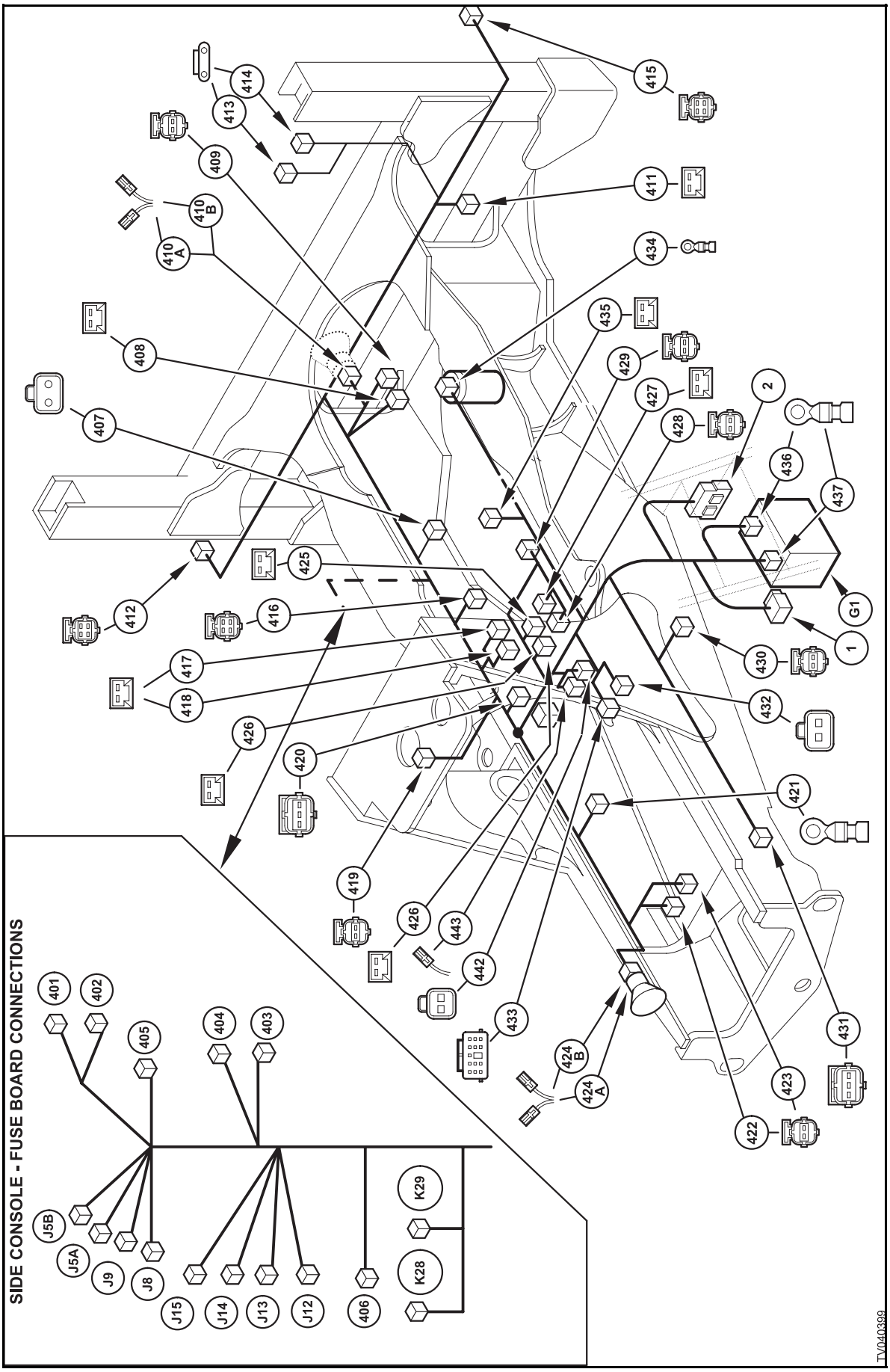
Connectors

C401	Ignition switch (pin 1)
C402	Ignition switch (pin 4)
C403	Intermediate connector (to IG C309)
C404	Intermediate connector (to UC C122)
C405	Intermediate connector (to 4WS C604)
C406	Intermediate connector (to IG C303)
C407	Return to dig solenoid connector
C408	Quick attach solenoid connector (optional)
C409	Reverse alarm connector (optional)
C410a/b	Rear horn connections (optional)
C411	** Sideshift clamp connector
C412	Right hand rear light cluster connector
C413	Rear number plate light connector
C414	Rear number plate light connector
C415	Left hand rear light cluster connector
C416	Transmission de-clutch / Un-loader switch connector
C417	Ride control connector


SIDE CONSOLE - FUSE BOARD CONNECTIONS
401
402
405
404
403
J5B
J5A
J9
J8
J15
J14
J13
J12
406
K29
K28
TV/040389

Connectors (continued)

C418	Ride control connector
C419	Fuel tank lever sensor connector
C420	Hose-burst (optional)
C421	Alternator eyelet connection
C422	Front windscreen washer motor connector
C423	Rear windscreen washer motor connector
C424a/b	Front horn connector
C425	Forward solenoid connector
C426	Differential lock solenoid connector
C427	Reverse solenoid connector
C428	Four wheel drive solenoid connector
C429	Speed sensor connector (optional)
C430	Front quick attach connector (optional)
C431	Bucket return to dig potentiometer (intermediate) connector
C432	Intermediate connector (to EN C502)
C433	Intermediate connector (to EN C501)
C434	Hydraulic oil filter eyelet connection
C435	Loader valve solenoid connector
C436	Battery positive eyelet connection
C437	Battery negative eyelet connection
C443	Transmission oil temperature connector
C442	Transmission dump solenoid connector


SIDE CONSOLE - FUSE BOARD CONNECTIONS
401
402
405
404
403
J5B
J5A
J9
J8
J15
J14
J13
J12
406
K29
K28
TV0040389

CONNECTOR LOCATIONS — CHASSIS HARNESS POWERSHIFT AND FOUR WHEEL STEER

Components

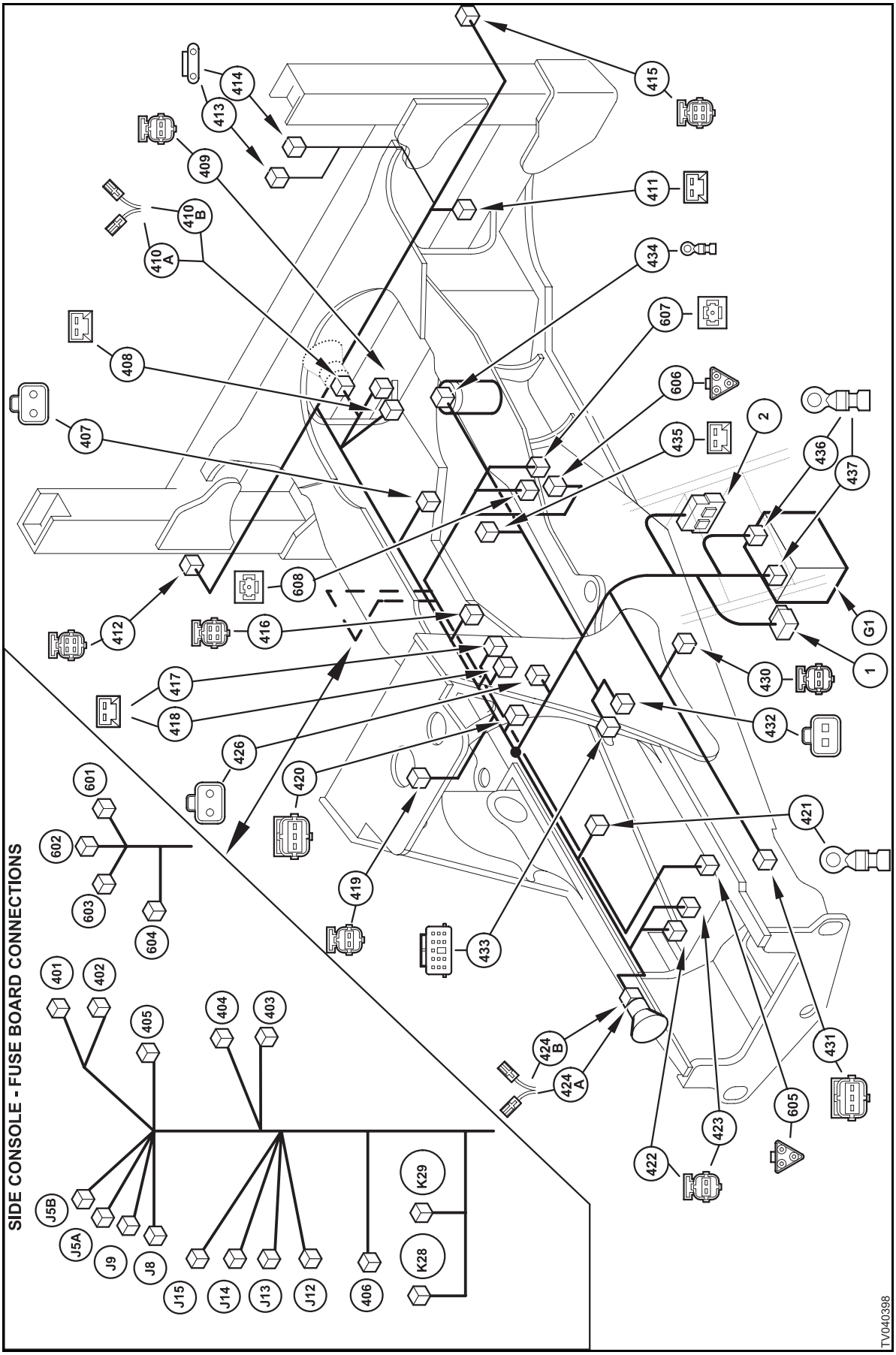
1	Mega fuse 125 amp	
G1	Battery	
2	Auxiliary fuse box	
J5a	18 way	Fuse board connector
J5b	12 way	Fuse board connector
J8	20 way	Fuse board connector
J9	20 way	Fuse board connector
J12	Eyelet	Fuse board connection
J13	Eyelet	Fuse board connection
J14	Eyelet	Fuse board connection
J15	Eyelet	Fuse board connection

Relays

K28	Ignition relay
K29	Starter relay

Connectors

C401	Ignition switch (pin 1)
C402	Ignition switch (pin 4)
C403	Intermediate connector (to IG C309)
C404	Intermediate connector (to UC C122)
C405	Intermediate connector (to 4WS C604)
C406	Intermediate connector (to IG C303)
C407	Return to dig solenoid connector
C408	Quick attach solenoid connector (optional)
C409	Reverse alarm connector (optional)
C410a/b	Rear horn connections (optional)
C411	** Sideshift clamp connector
C412	Right hand rear light cluster connector
C413	Rear number plate light connector
C414	Rear number plate light connector
C415	Left hand rear light cluster connector
C416	Transmission de-clutch / Un-loader switch connector
C417	Ride control connector

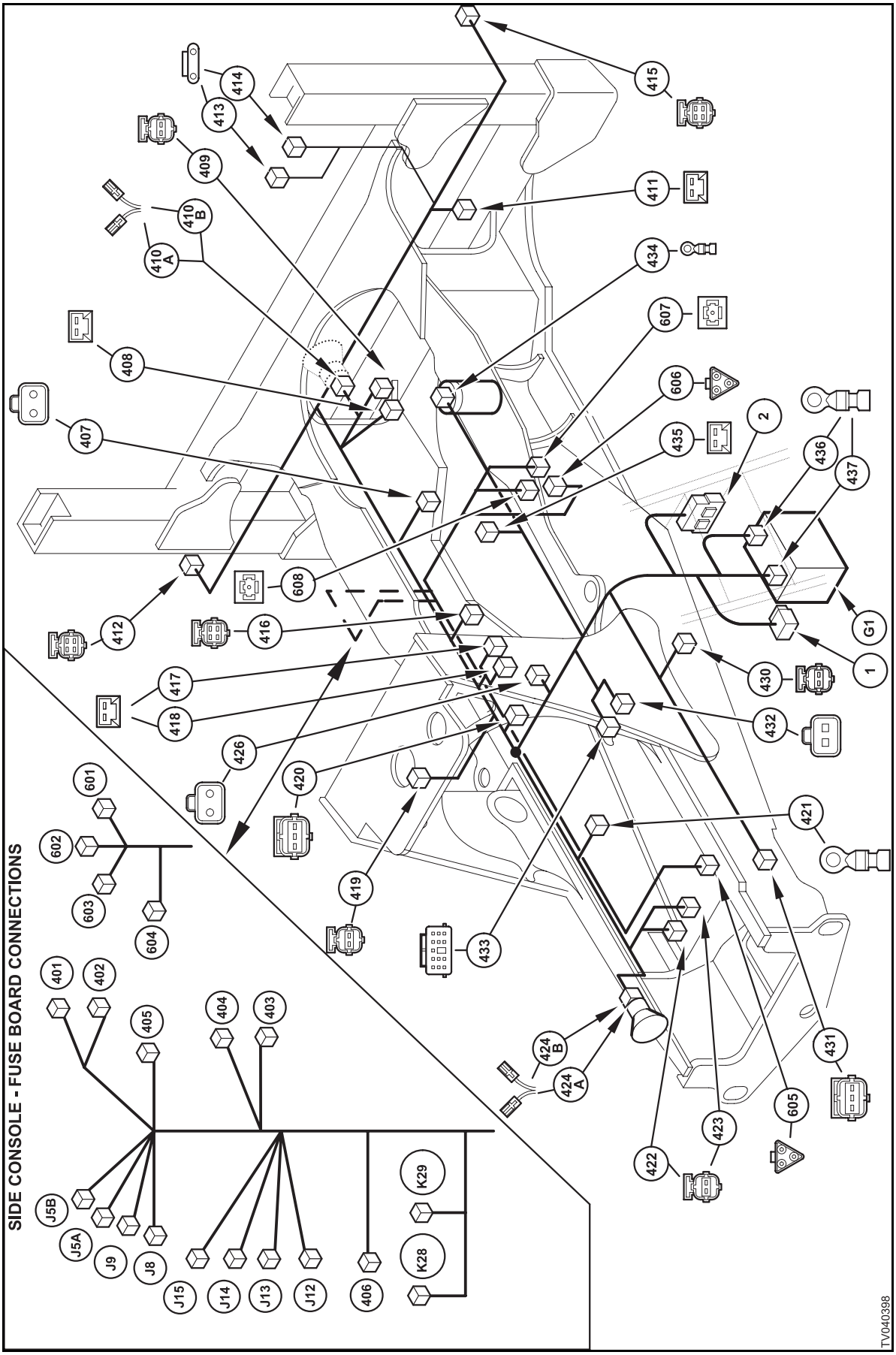

SIDE CONSOLE - FUSE BOARD CONNECTIONS
J5B
J5A
J9
J8
J15
J14
J13
J12
406
K29
K28
401
402
405
404
403
601
602
603
604
TV040398

Connectors (continued)

C418	Ride control connector
C419	Fuel tank lever sensor connector
C420	Hose-burst intermediate connector (optional)
C421	Alternator eyelet connection
C422	Front windscreen washer motor connector
C423	Rear windscreen washer motor connector
C424a/b	Front horn connector
C430	Front quick attach connector (optional)
C431	Bucket return to dig potentiometer (intermediate) connector
C432	Intermediate connector (to EN C502)
C433	Intermediate connector (to EN C501)
C434	Hydraulic oil filter eyelet connection
C435	Loader valve solenoid connector
C436	Battery positive eyelet connection
C437	Battery negative eyelet connection

Four wheel steer connectors

C601	4WS relay board
C602	4WS selection switch connector
C603	4WS reset switch
C604	Intermediate connector (to C405)
C605	Front axle proximity switch connector
C606	Rear axle proximity switch connector
C607	4WS solenoid connector
C608	Crab solenoid connector


SIDE CONSOLE - FUSE BOARD CONNECTIONS
J5B
J5A
J9
J8
J15
J14
J13
J12
406
K29
K28
401
402
405
404
403
601
602
603
604
TV040398

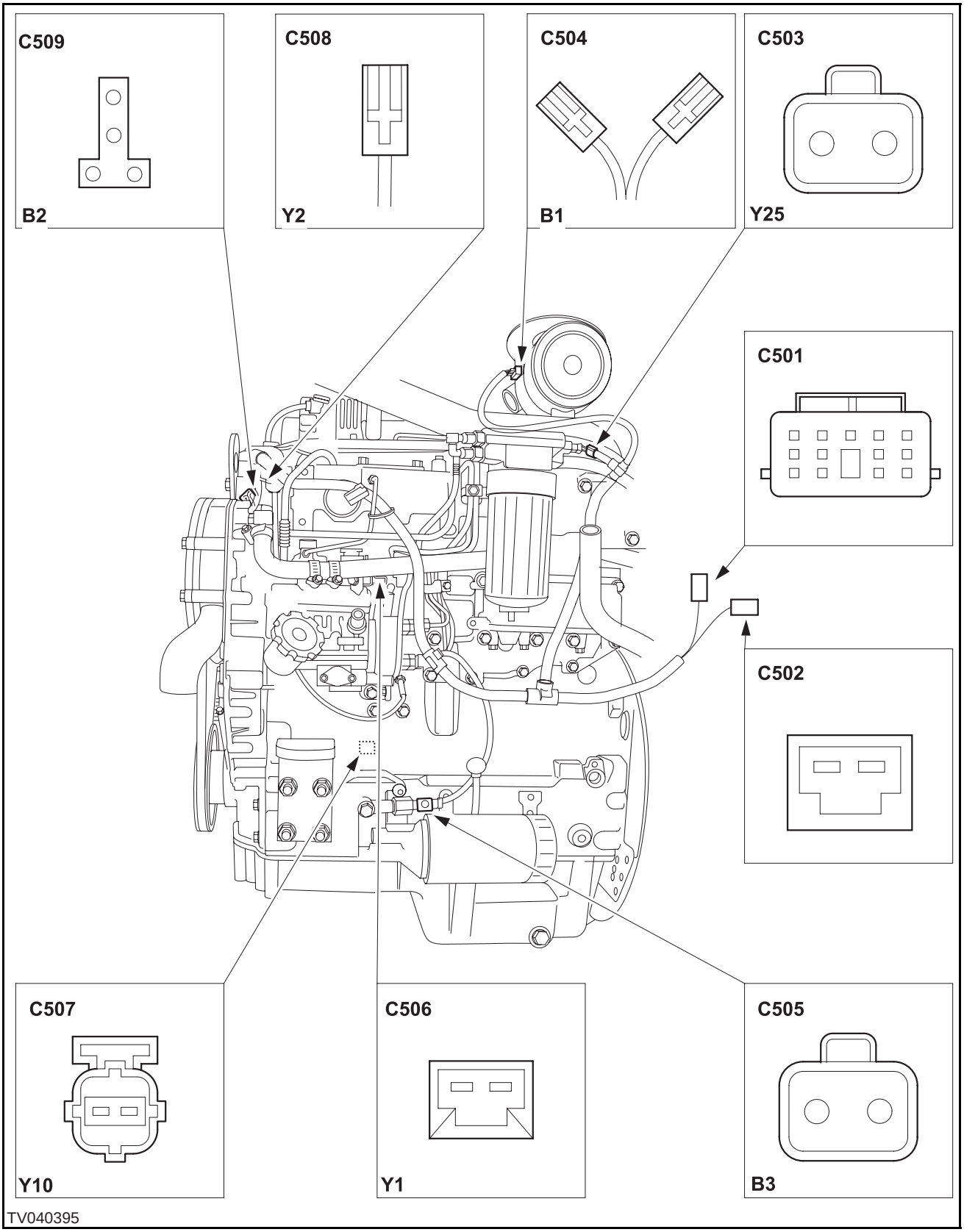
CONNECTOR LOCATIONS — ENGINE HARNESS

Connectors

C501	Intermediate connector (to C433)
C502	Intermediate connector (to C432)
C503	Fuel lift pump connector
C504	Air filter pressure switch connector
C505	Oil pressure switch connector
C506	Engine stop solenoid connector
C507	Air conditioning compressor clutch connector
C508	Fuel enrichment sensor connector
C509	Coolant temperature sensor connector
C510	Alternator eyelet (phase terminal)
C511	Alternator eyelet (warning light)
C512	Starter motor connector

Component

B1	Air filter pressure switch
B2	Coolant temperature sensor
B3	Oil pressure switch
Y1	Engine stop solenoid
Y2	Fuel enrichment sensor
Y10	Air conditioning compressor (optional)
Y25	Fuel lift pump
G2	Alternator (phase terminal)
G2	Alternator (warning light)
M1	Starter motor

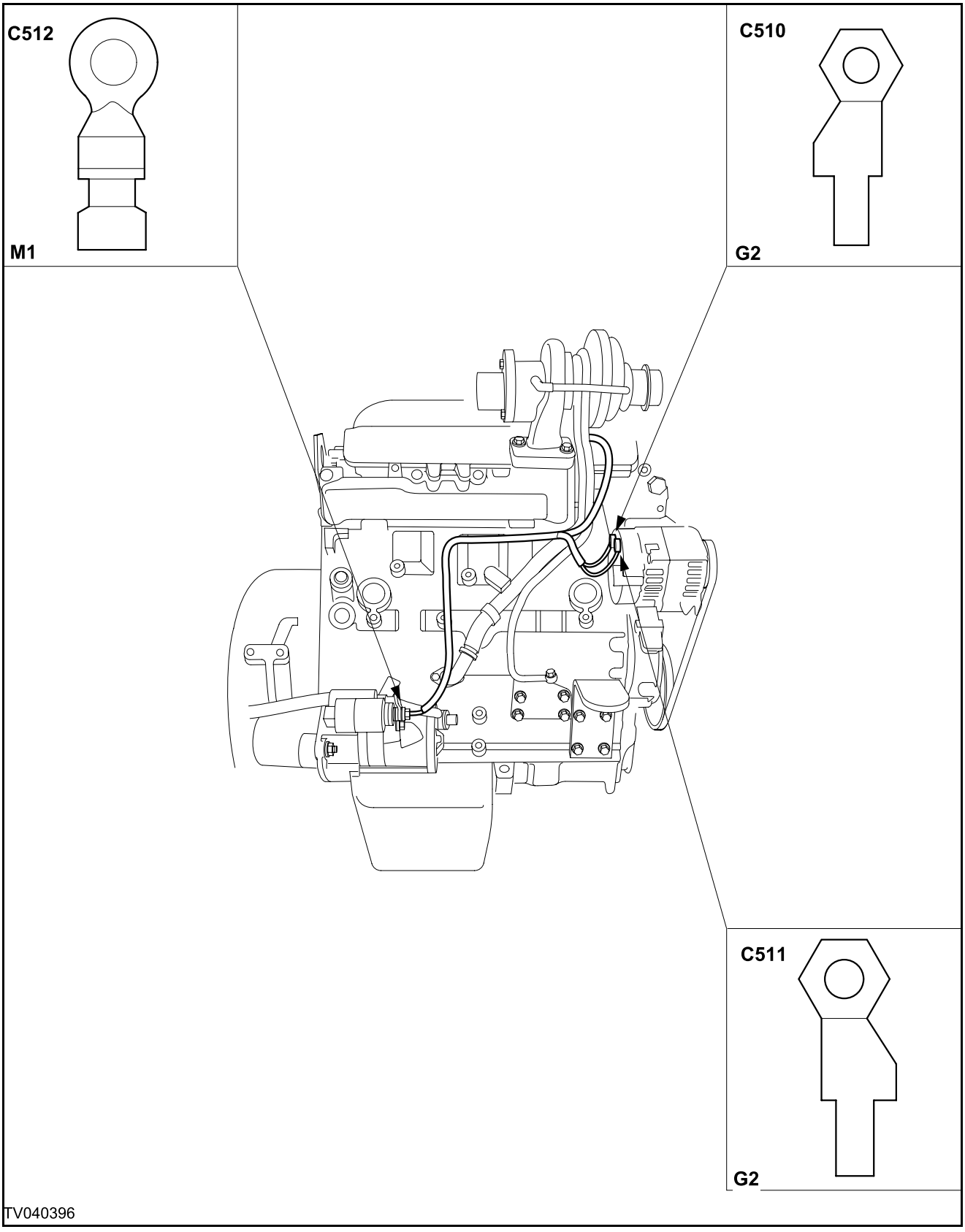

C509
B2
C508
Y2
C504
B1
C503
Y25
C501
C502
C507
Y10
C506
Y1
C505
B3
TV040395

Connectors

C501	Intermediate connector (to C433)
C502	Intermediate connector (to C432)
C503	Fuel lift pump connector
C504	Air filter pressure switch connector
C505	Oil pressure switch connector
C506	Engine stop solenoid connector
C507	Air conditioning compressor clutch connector
C508	Fuel enrichment sensor connector
C509	Coolant temperature sensor connector
C510	Alternator eyelet (phase terminal)
C511	Alternator eyelet (warning light)
C512	Starter motor connector

Component

B1	Air filter pressure switch
B2	Coolant temperature sensor
B3	Oil pressure switch
Y1	Engine stop solenoid
Y2	Fuel enrichment sensor
Y10	Air conditioning compressor (optional)
Y25	Fuel lift pump
G2	Alternator (phase terminal)
G2	Alternator (warning light)
M1	Starter motor


C512
M1
C510
G2
C511
G2
TV040396

CONNECTOR LOCATIONS — FRONT CONSOLE CABIN LOWER HARNESS

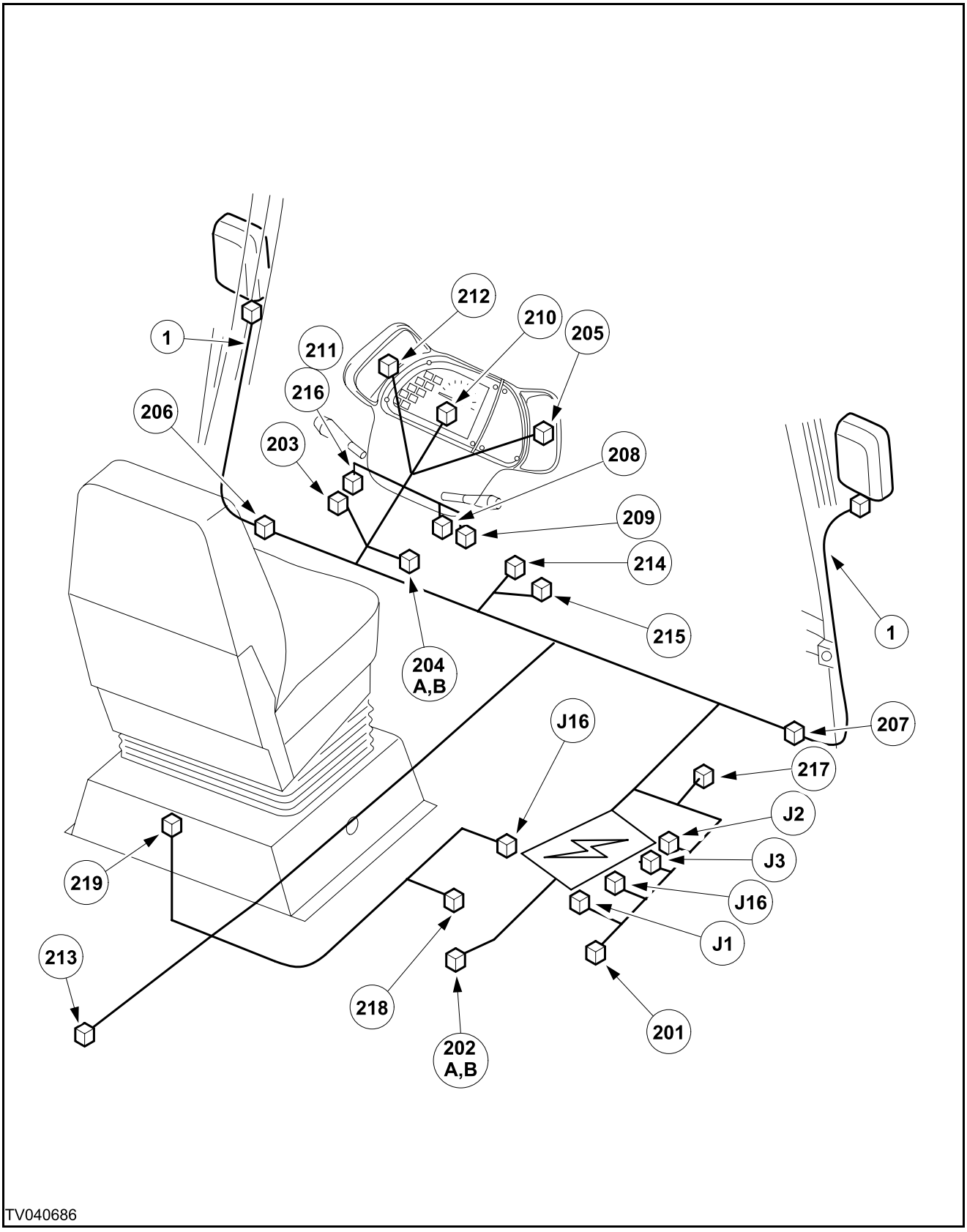
1	Headlamp extension harness	
J1	20 way	Fuse board connector
J2	12 way	Fuse board connector
J13	16 way	Fuse board connector
J16	8 way	Fuse board connector

Connectors

C201	Intermediate connector (to C302)
C202 a/b	Handbrake switch connector
C203	Differential lock switch connector
C204 a/b	Brake light switch connector
C205	Right front console switch pack connector
C206	Left hand front light connector
C207	Right hand front light connector
C208	Direction indicator / Horn switch connector
C209	Light switch connector
C210	Front console instrument connector
C211	Direction lever (FWD/REV) switch connector (Synchroshuttle)
** C216	Transmission control lever switch connector (Powershift)
C212	Four wheel brake switch connector
C213	Transmission connector (Powershift)
C214	Transmission controller APC71 (Powershift)
C215	Transmission test probe (Powershift)
C217	Air seat intermediate connector (to C218)

Air Suspension seat harness

J16	Fuse board connector
C218	Intermediate connector (to C217)
C219	Air seat motor connector


212
210
205
1
211
216
206
203
208
209
214
215
1
204
A,B
J16
207
217
J2
J3
219
J16
J1
213
218
201
202
A,B
TV040686

CONNECTOR LOCATIONS — SIDE CONSOLE IGNITION HARNESS

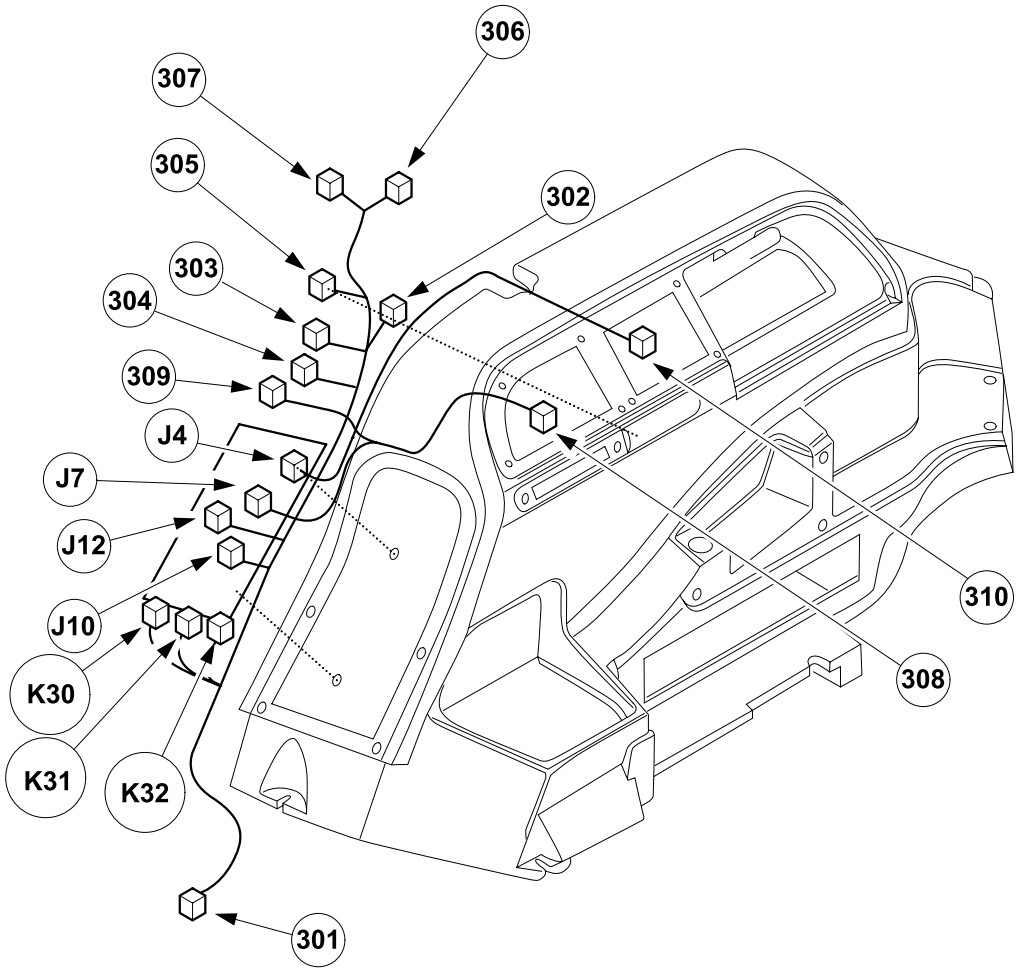
J4	20 way	Fuse board connector
J7	8 way	Fuse board connector
J10	12 way	Fuse board connector
J12	Eyelet	Fuse board connection

Connectors

C301	Engine glow plug connector (to engine)
C302	Intermediate connector (to C201)
C303	Intermediate connector (to C406)
C304	Change over valve connector (optional)
C305	Cigar lighter connector
C306	Ignition switch connector (pin 2)
C307	Ignition switch connector (pin 3)
C308	Side console instruments connector
C309	Intermediate connector (to C403)
C310	Side switch pack connector

Relays

K30	Glow plug relay
K31	Fuel pump relay
K32	Auxiliary relay



TV040685

CONNECTOR LOCATIONS — ROPS SIDE CONSOLE IGNITION HARNESS

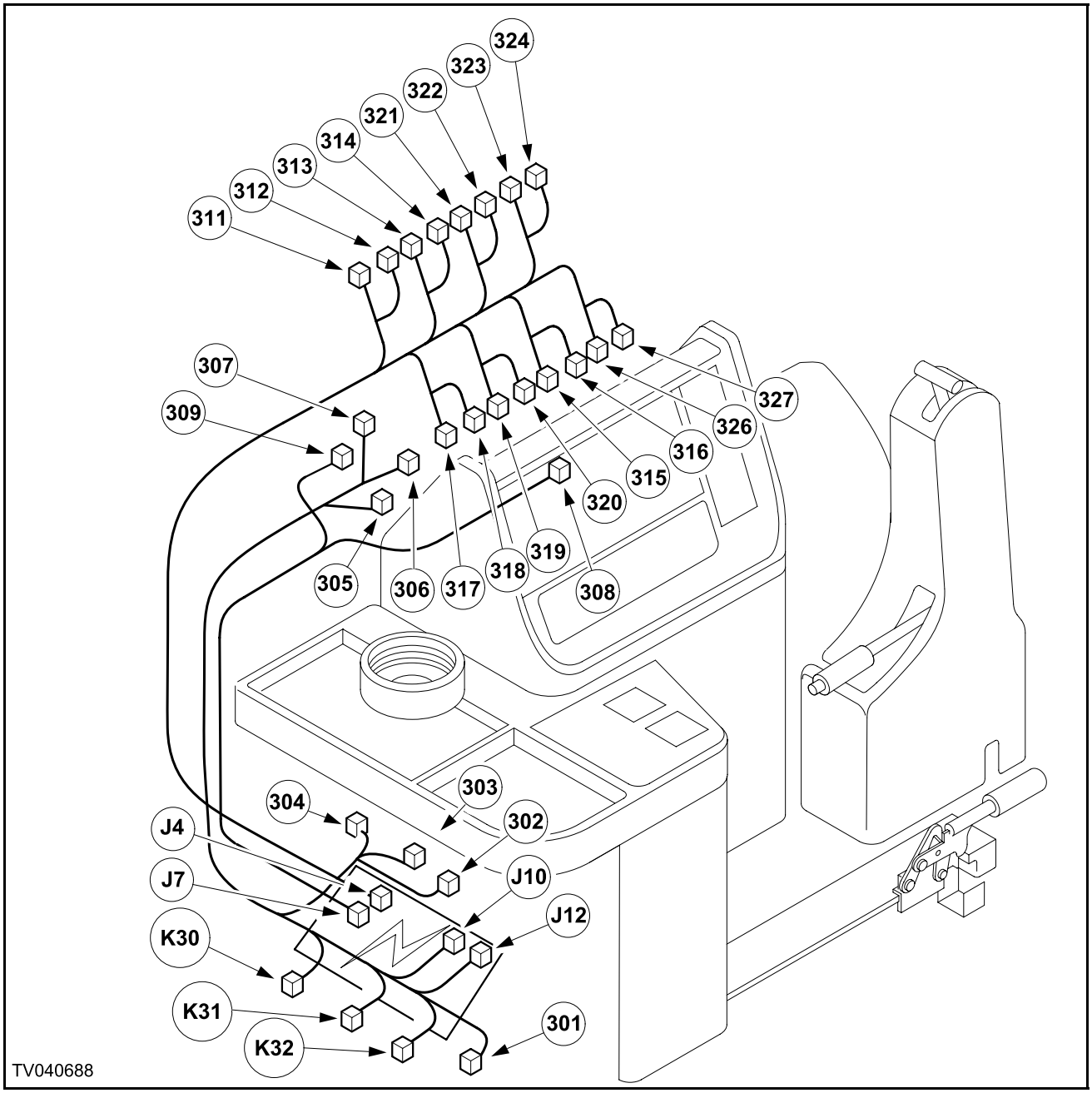
J4	20 way	Fuse board connector
J7	8 way	Fuse board connector
J10	12 way	Fuse board connector
J12	Eyelet	Fuse board connection

Connectors

C301	Engine glow plug connector (to engine)
C302	Intermediate connector (to C201)
C303	Intermediate connector (to C406)
C304	Change over valve connector (optional)
C305	Cigar lighter connector
C306	Ignition switch connectors (Pin 2)
C307	Ignition switch connectors (Pin 3)
C308	Side console instrument / Warning lamps
C309	Intermediate connector (to C403)
C310	Side switch pack connector
C311	Front worklight switch connector
C312	Front worklight switch illumination connector
C313	Front / Rear beacon switch connector
C314	Front / Rear beacon switch illumination connector
C315	Hazard switch connector
C316	Hazard switch illumination connector
C317	Return to dig switch connector
C318	Return to dig switch illumination connector
C319	Pump dump switch connector
C320	Pump dump switch illumination connector
C321	Sideshift switch connector * Centremount switch connector
C322	Sideshift / Centremount switch illumination connector
C323	Rear work lamp switch connector
C324	Rear work lamp switch illumination connector
C325	Horn switch connector
C326	Quick attach switch connector
C327	Quick attach switch illumination connector

Relays

K30	Glow plug relay
K31	Fuel pump relay
K32	Auxiliary relay


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312
311
307
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327
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316
315
320
319
318
317
306
305
308
303
304
302
J4
J7
J10
J12
K30
K31
K32
301
TV040688

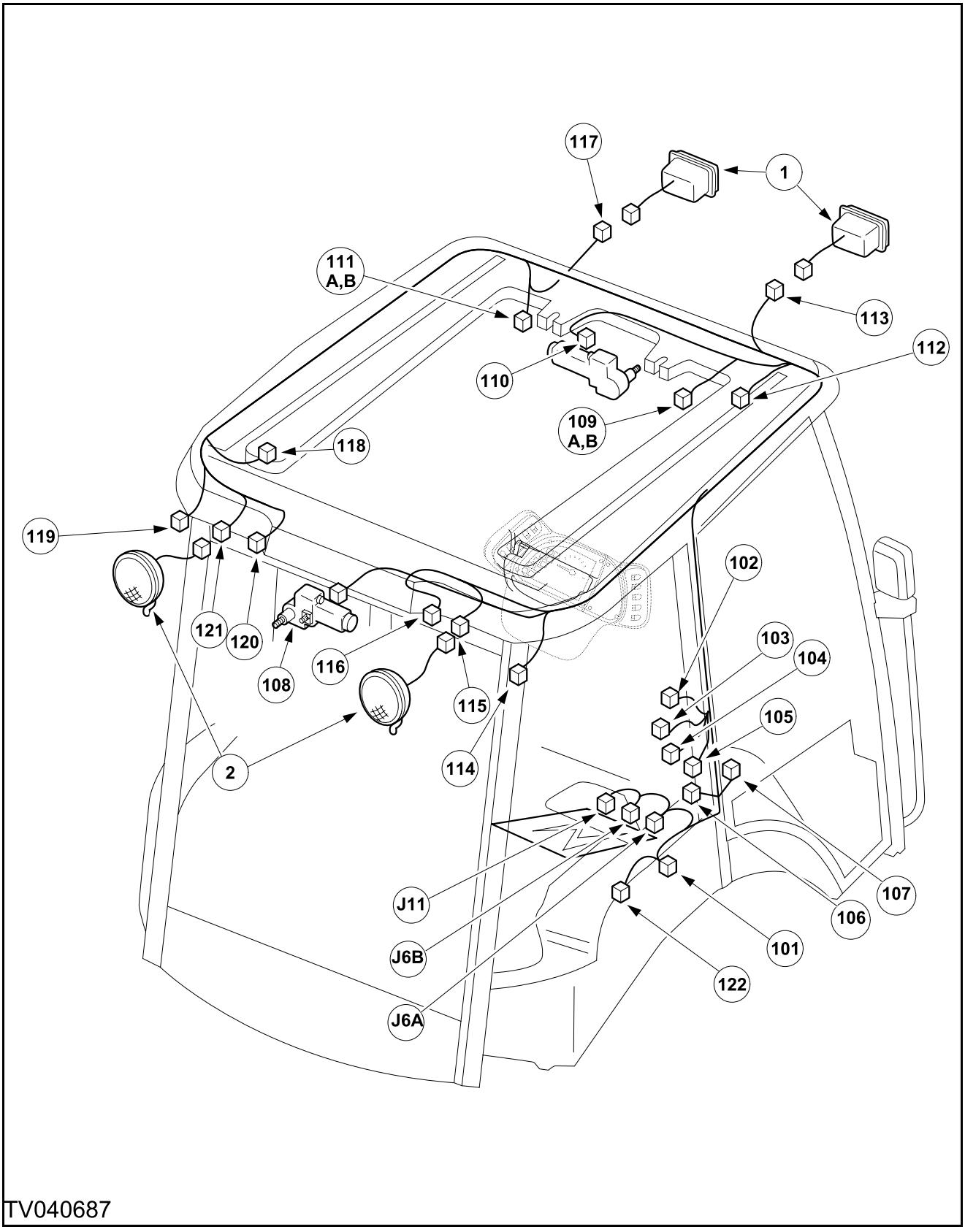
CONNECTOR LOCATIONS — CABIN UPPER HARNESS

1	Front worklights
2	Rear worklights

J6a	18 way	Fuse board connector
J6b	12 way	Fuse board connector
J11	7 way	Fuse board connector

Connectors

C101	Intermediate connector Heating / Air conditioning unit
C102	Heater switch connector
C103	Heater switch connector
C104	Heater switch connector
C105	Heater switch connector
C106	Air conditioning connector
C107	Air conditioning connector
C108	Rear wiper motor connector
C109 a/b	Radio connectors
C110	Front wiper motor connector
C111 a/b	Interior light connectors
C112	Front beacon connector
C113	Right hand front worklight connector
C114	Right hand rear light cluster connector
C115	Right hand rear outer worklight connector
C116	Right hand rear inner worklight connector (optional)
C117	Left hand front worklight connector
C118	Rear beacon connector
C119	Left hand rear light cluster connector
C120	Left hand rear inner worklight connector (optional)
C121	Left hand rear outer worklight connector
C122	Intermediate connector (to C404)


117
1
111
A,B
113
112
110
109
A,B
118
119
102
103
104
105
121
120
116
108
115
114
2
J11
J6B
J6A
107
106
101
122

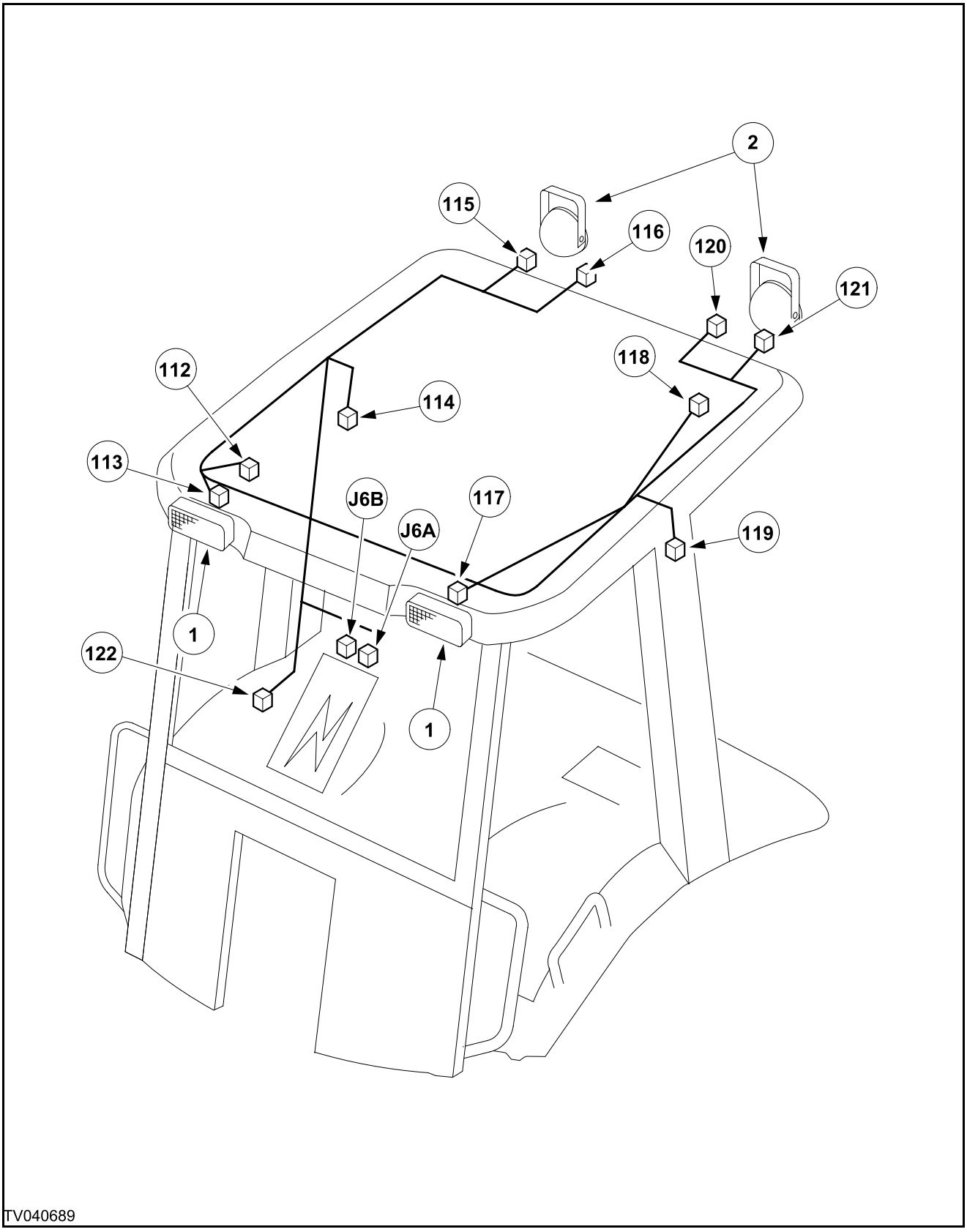
TV040687

CONNECTOR LOCATIONS — ROPS CABIN UPPER HARNESS

1	Front worklights	
2	Rear worklights	
J6a	18 way	Fuse board connector
J6b	12 way	Fuse board connector

Connectors

C112	Front beacon connector
C113	Right hand front worklight connector
C114	Right hand rear light cluster connector
C115	Right hand rear outer worklight connector
C116	Right hand rear inner worklight connector (optional)
C117	Left hand front worklight connector
C118	Rear beacon connector
C119	Left hand rear light cluster connector
C120	Left hand rear inner worklight connector (optional)
C121	Left hand rear outer worklight connector
C122	Intermediate connector (to C404)



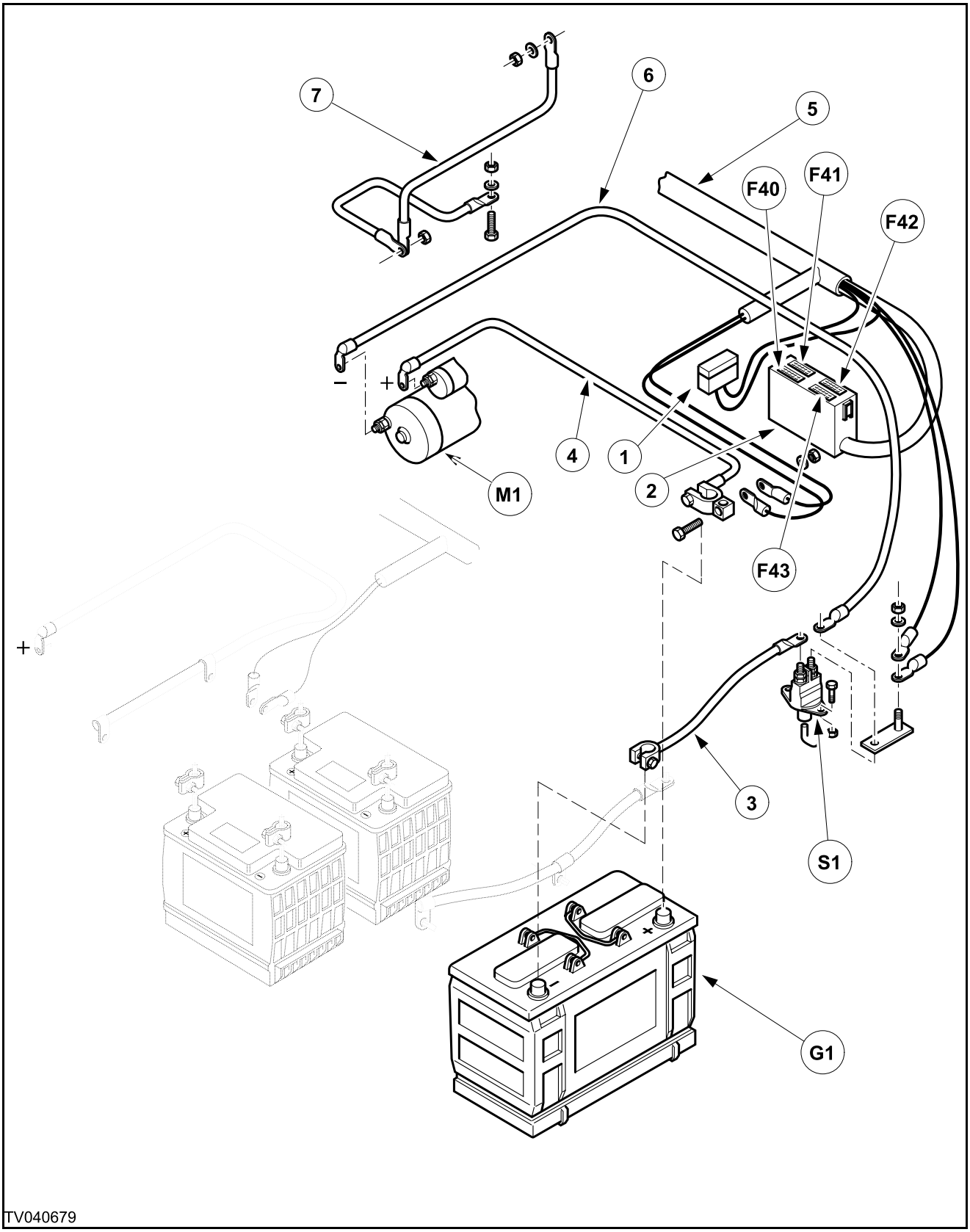
TV040689

CONNECTOR LOCATIONS — BATTERY HARNESS

M1	Starter motor
G1	Battery
S1	Battery isolation switch
1	125 Amp Mega fuse
2	Auxiliary fuse box
3	Battery cable negative
4	Battery cable positive (starter motor)
5	Chassis harness
6	Battery cable negative (starter motor)
7	Ground cables

Fuses

F40	80 Amp Ignition cabin fuse
F41	20 Amp Ignition switch fuse
F42	40 Amp Starter relay fuse
F43	80 Amp Relay fuse board


7
6
5
F40
F41
F42
M1
4
1
2
F43
3
S1
G1
TV040679

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CHASSIS AND BODYWORK

K10
SECTION

REMOVAL AND INSTALLATION — REAR FENDER K10–01–1
REMOVAL AND INSTALLATION — HARDNOSE / TOOL BOX K10–01–3
REMOVAL AND INSTALLATION — HOOD K10–01–5
REMOVAL AND INSTALLATION — FRONT FENDER K10–01–7
SPECIFICATIONS — CHASSIS AND BODYWORK K10–01–9

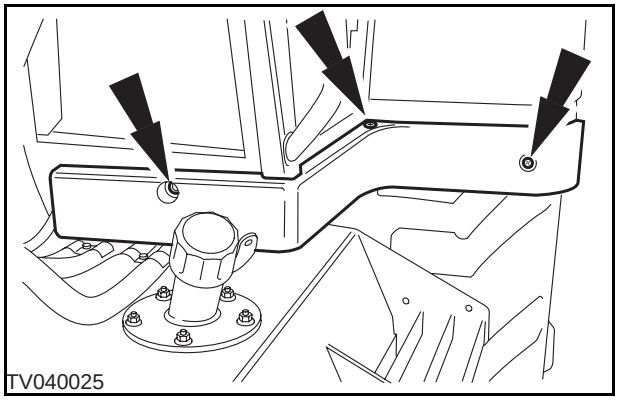
REMOVAL AND INSTALLATION — REAR FENDER

BHK1001RA

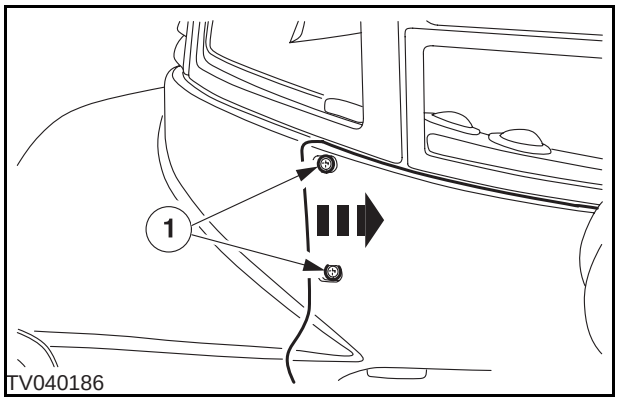
Operation: **Removing and Installing the Rear Fender**	*Job Code:* **10 12 13 xx**		
None	Standard tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the cab lower front trim panel.

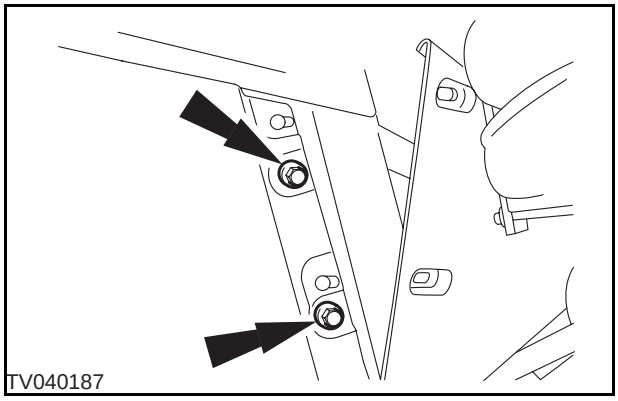

TV040025

3. Remove the cab left-hand side rear trim panel retaining screws and position it to one side.



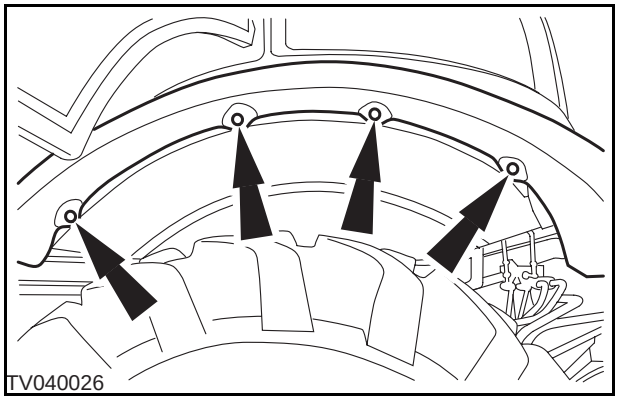
TV040186

4. Remove the rear fender rear retaining bolts.


TV040187

Note:
- Assistance may be required.

5. Remove the rear fender.



Installation

Note:
- After installation on machines with four-wheel steer facility, operate the four-wheel steer system. Make sure the rear wheels do not foul the rear fender.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION — HARDNOSE / TOOL BOX

BHK1001RB

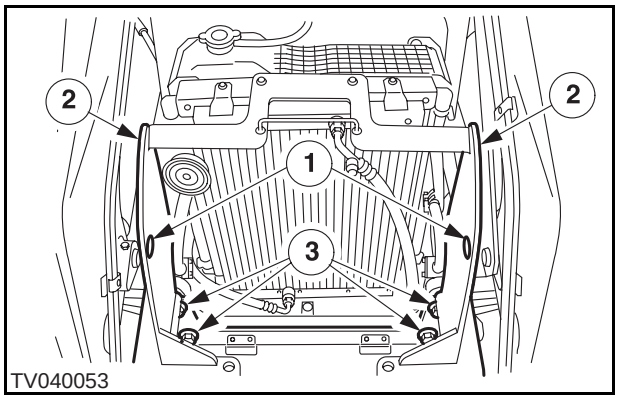
Operation: **Removing and Installing the Hardnose / Tool Box**	*Job Code:* **10 14 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Open the hood.

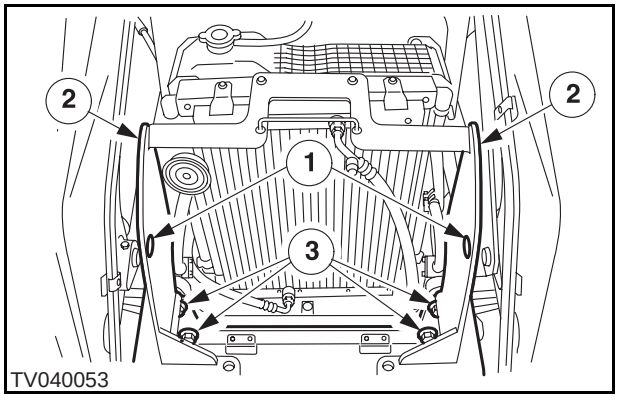
   ⚠ Warning:
   - **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

3. Using suitable lifting equipment, support the front tool box (1).
4. Remove the front tool box upper retaining bolts (2).
5. Remove the tool box lower retaining bolts and remove the tool box (3).



Installation

1. To install, reverse the removal procedure.
2. Tighten (2) to 58Nm (43 lb.ft).
3. Tighten (3) to 240Nm (177 lb.ft).



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REMOVAL AND INSTALLATION — HOOD

BHK1001RC

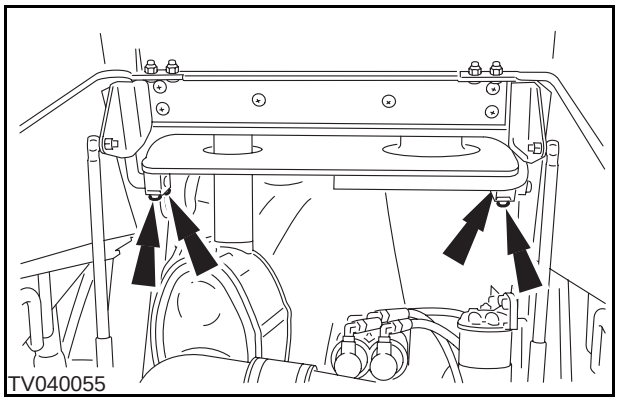
Operation: **Removing and Installing the Hood**	*Job Code:* **10 02 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Open the hood.

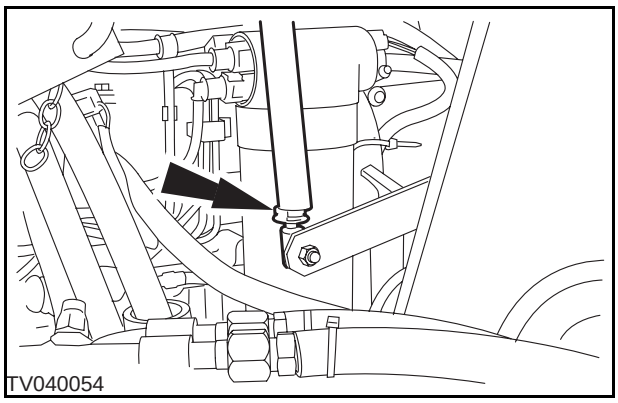
⚠ Warning:
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

3. Using suitable lifting equipment, support the hood.
4. Remove the hood pivot retaining bolts.


TV040055

Note:
- Position the telescopic strut clear of the hood.

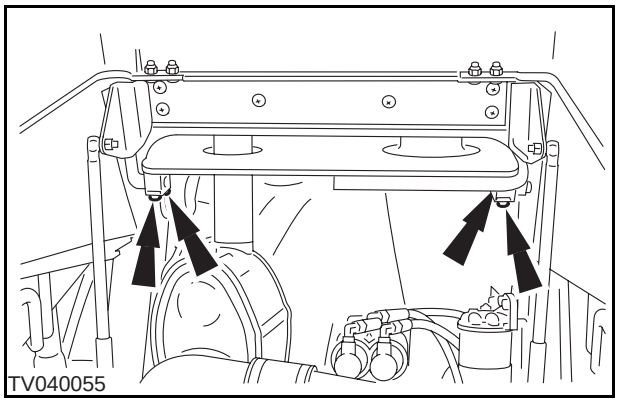
5. Detach the hood telescopic struts and remove the hood. Left-hand side shown, right-hand side similar.


TV040054

Installation

1. To install, reverse the removal procedure.

2. Tighten to 11Nm (8 lb.ft).



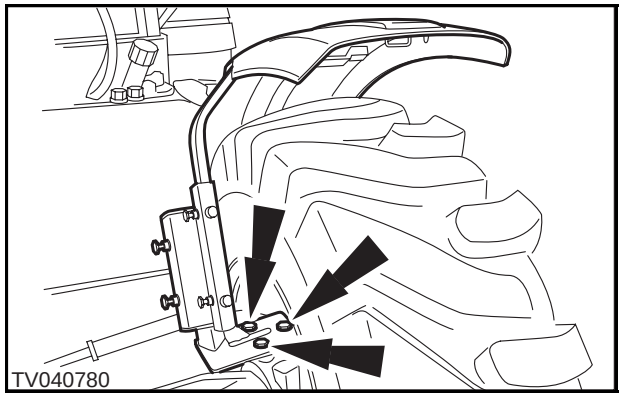
REMOVAL AND INSTALLATION — FRONT FENDER

BHK1001RD

Operation: **Removing and Installing the Front Fender**	*Job Code:* **10 11 13 xx**		
None	Standard tools		

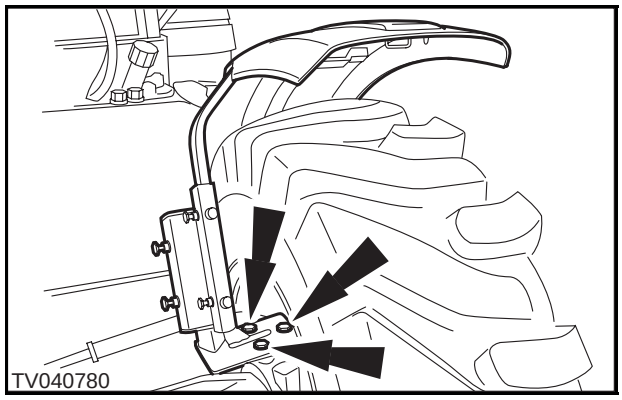
Removal

1. Position the loader bucket flat on the ground.
2. Remove the front fender.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 190Nm (140 lb.ft).



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SPECIFICATIONS — CHASSIS AND BODYWORK

BHK1001SA

Torque Values

Description	Nm	Lb.ft
Front Fender Retaining Bolts	190	140
Rear Fender Retaining Bolts	28	21
Hood Retaining Bolts	11	8
Hardnose/Toolbox to Chassis Retaining Bolts	240	177
Hardnose/Toolbox Upper Retaining Bolts	58	43

FRONT AXLE AND STEER SYSTEM

L11
SECTION

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DISASSEMBLY AND ASSEMBLY — EPICYCLIC REDUCTION GEAR GROUP L11–02–19
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DISASSEMBLY AND ASSEMBLY — AXLE HOUSING GROUP L11–02–33
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GENERAL PROCEDURE — STEERING ANGLE ADJUSTMENT L11–02–63
GENERAL PROCEDURE — DRAINING AND FILLING THE FRONT AXLE HOUSING OIL L11–02–65
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SPECIFICATIONS — FOUR-WHEEL DRIVE FRONT AXLE L11–02–69
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DIAGNOSING AND TESTING — FOUR-WHEEL STEER FRONT AXLE.....L11–03–3
REMOVAL AND INSTALLATION — FOUR-WHEEL STEER FRONT AXLE L11–03–9
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DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL SUPPORT GROUP (FOUR-WHEEL STEER)..... L11–03–37
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GENERAL PROCEDURE — TOE-IN ADJUSTMENT (FOUR-WHEEL STEER) L11–03–63
GENERAL PROCEDURE — STEERING ANGLE ADJUSTMENT (FOUR-WHEEL STEER) L11–03–65
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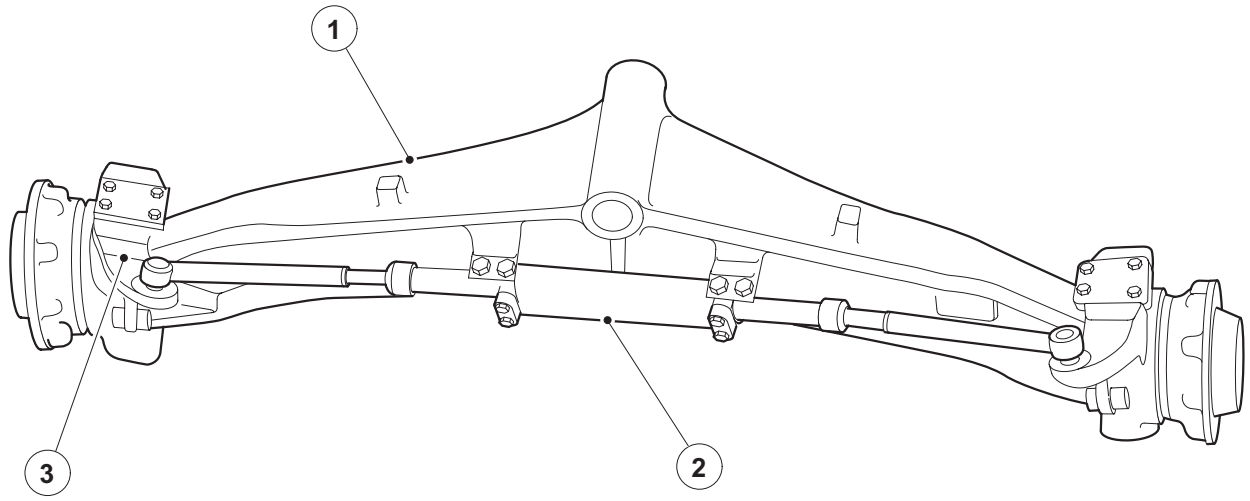
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DESCRIPTION AND OPERATION — TWO-WHEEL DRIVE FRONT AXLE

BHL1101OA

General Description



TV40984

1	Axle Beam Group
2	Steering Cylinder Group
3	Wheel Hub Group

The axle described in this manual consists of the following groups:

- AXLE BEAM GROUP: load-bearing structure of the axle.
- STEERING CYLINDER GROUP: steering cylinder parts with adjusting system.
- WHEEL HUB GROUP: wheel support parts.

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DIAGNOSING AND TESTING — TWO-WHEEL DRIVE FRONT AXLE

BHL1101TA

Problem	Possible Cause	Action
Axle beam body bent	• Vehicle overloaded.	• REPLACE axle beam body.
	• Vehicle accident.	• REPLACE axle beam body.
	• Load bump.	• REPLACE axle beam body.
Worn out or pitted bearings	• Insufficient lubrication.	• REPLACE bearings.
	• Contaminated grease.	• REPLACE bearings.
	• Excessive use.	• REPLACE bearings.
	• Normal wear out.	• REPLACE bearings.
Grease leakage from seals	• Insufficient lubrication.	• REPLACE the gasket or seal and matching surface if damaged.
	• Wheel hub seal assembled incorrectly.	• REPLACE the gasket or seal and matching surface if damaged.
	• Seal lip damaged.	• REPLACE the gasket or seal and matching surface if damaged.
	• Contaminated oil.	• REPLACE the gasket or seal and matching surface if damaged.

Axle Problem and Diagnosis

Problem	Possible Cause	Action
Noise while driving	• Worn out bearings.	• REPLACE.
	• Wheel hub bearings insufficient lubrication.	• ADD grease.
	• Poor or wrong lubricant.	• REPLACE.
Constant noise	• Worn out bearings.	• REPLACE.

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REMOVAL AND INSTALLATION — TWO-WHEEL DRIVE FRONT AXLE

BHL1101RA

Operation: **Removing and Installing the Two-Wheel Drive Front Axle**	*Job Code:* **11 24 13 xx**		
Suitable transmission jack	Standard tools		

Removal

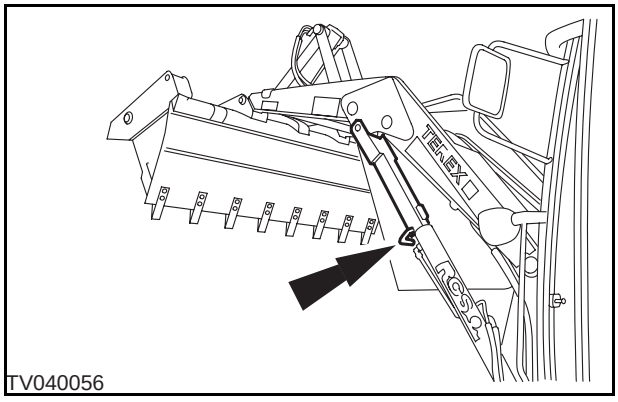
1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

   Note:
   - Support the machine under the front chassis.

   Note:
   - Make a note of the position of any hydraulic hoses prior to disconnection to aid installa-tion.

   Note:
   - Always Install blanking plugs to avoid con-tamination.

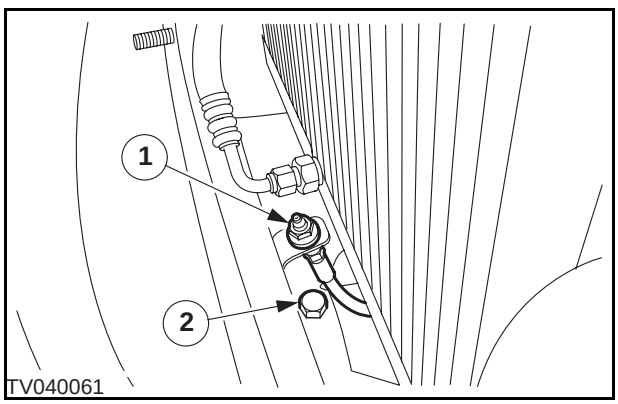
2. Remove the hardnose / tool box. For additional information, refer to Section K10-01 HARDNOSE / TOOLBOX, PAGE K10–01–3 .
3. Raise the front loader to full height and install the safety stop.



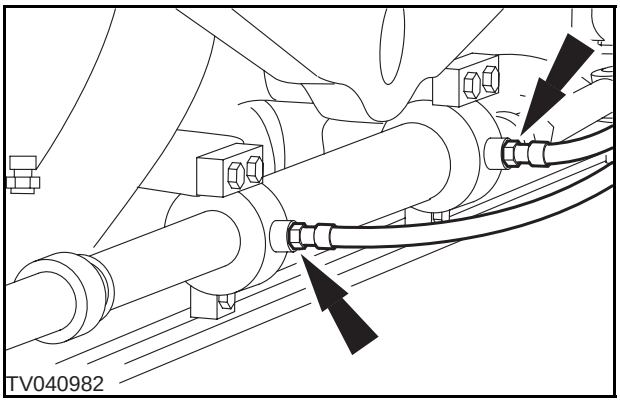
4. Roll the loader bucket fully forward.
5. Detach the front axle pivot pin grease point (1).

   Note:
   - Discard the locking nut.

6. Remove the front axle pivot pin retaining bolt (2).



7. Disconnect the power steering supply pipes.

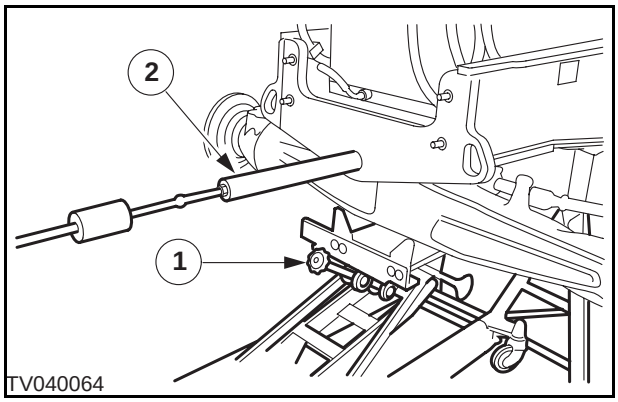


⚠ Warning:
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

⚠ Warning:
- **Secure the front axle to the transmission jack. Failure to follow this instruction may result in personal injury**

Note:
- Mark the axle pivot pin before removal to aid installation.

8. Using a suitable transmission jack (1), support the front axle.
9. Using a suitable slide hammer (2), remove the front axle pivot pin and remove the front axle.



Installation

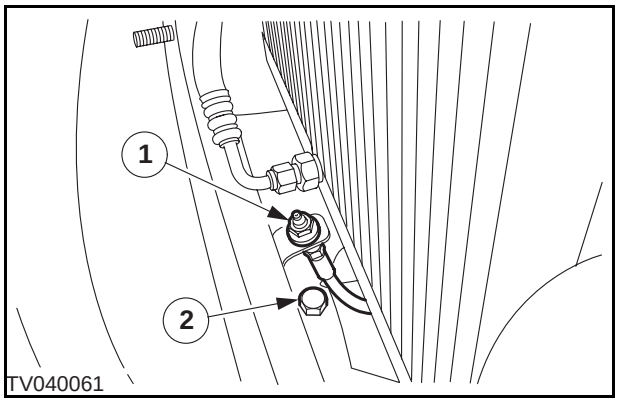
Note:
- Remove any dirt or burrs before installing the front axle pivot pin.

1. To install, reverse the removal procedure.

Note:
- Install a new locking nut.

2. Tighten (2) to 98Nm (73 lb.ft).
3. Check and adjust the hydraulic oil level as required.

4. Operate the steering from full left-hand lock to full right-hand lock and check for correct operation.



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REMOVAL AND INSTALLATION — STEERING CYLINDER GROUP

BHL1101RB

Operation: **Removing and Installing the Steering Cylinder Group**	*Job Code:* **11 20 13 xx**		
Suitable lifting equipment	Standard tools		

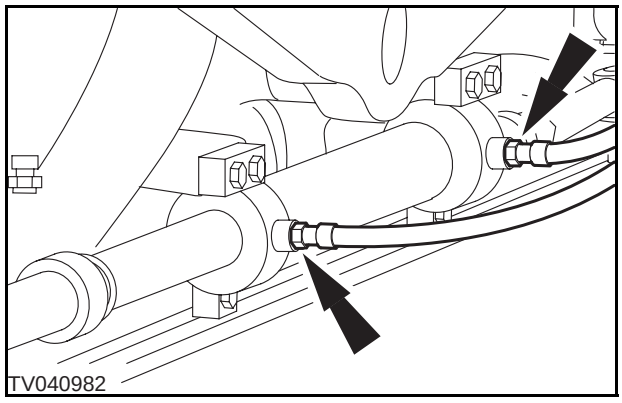
Removal

1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

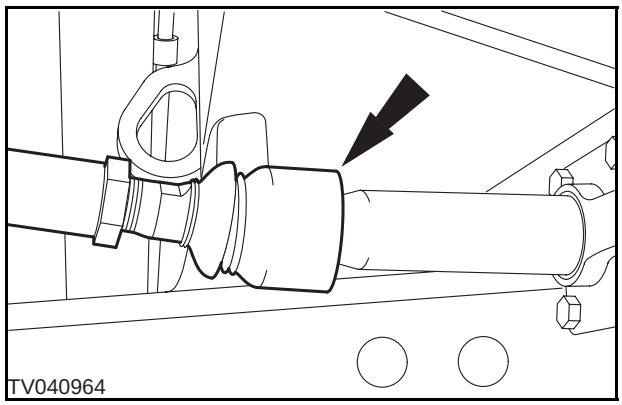
   Note:
   - Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

   Note:
   - Always Install blanking plugs to avoid contamination.

2. Disconnect the power steering supply pipes.


TV040982

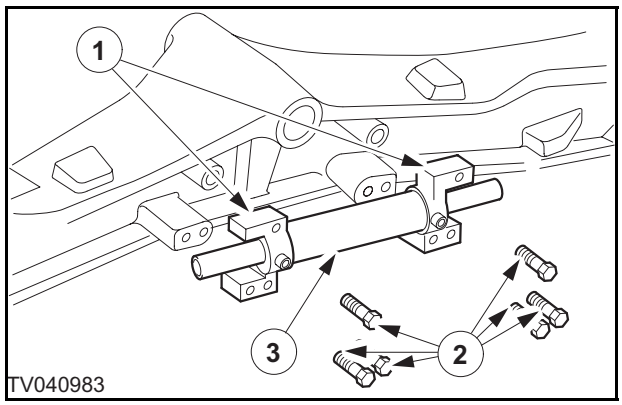
3. Disconnect the inner track rod end from the steering cylinder group (both sides).


TV040964

⚠ **Warning:**

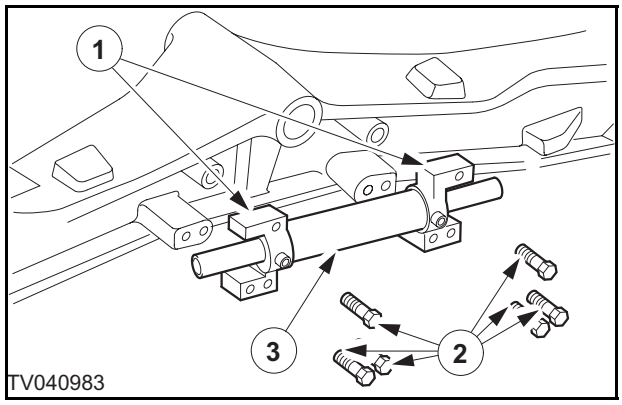
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

4. Remove the steering cylinder group retaining bolts (2) from the cylinder heads (1). Using a soft faced hammer, remove the steering cylinder group (3).

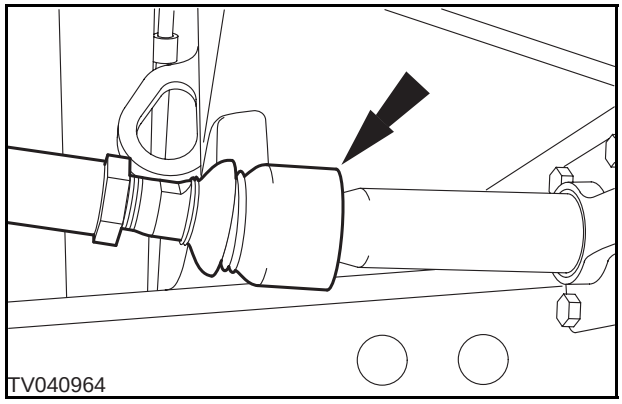


Installation

1. To install, reverse the removal procedure.
2. Thoroughly clean and de-grease the axle beam/cylinder heads (1) mating surfaces. Apply Loctite 638 to the axle beam/cylinder head mating surfaces.
3. Apply Loctite 270 to the threads of the retaining bolts (2).
4. Tighten (2) to 335Nm (247 lb.ft).



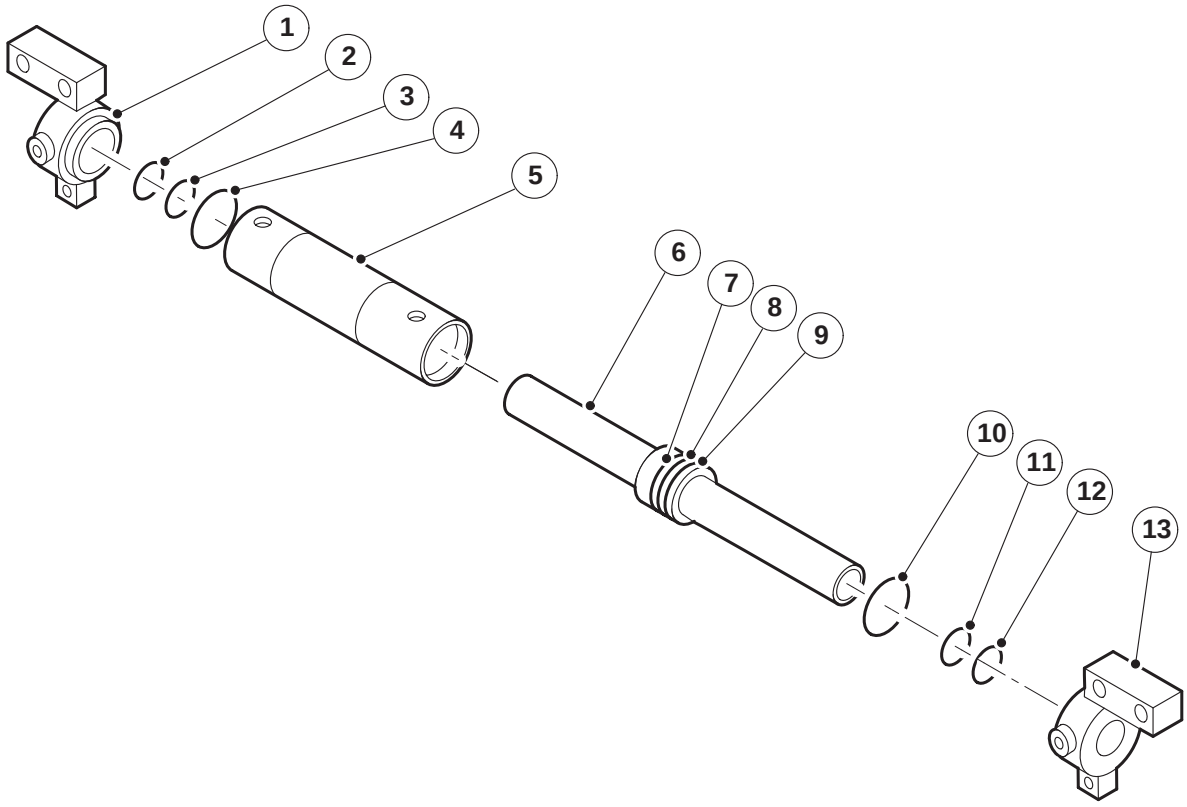
5. Check and adjust the hydraulic oil level as required.
6. Tighten the tie rod joint to 300Nm (221 lb.ft).



DISASSEMBLY AND ASSEMBLY — STEERING CYLINDER GROUP

BHL1101DA

Operation: **Disassembly and Assembly of the Steering Cylinder Group**	*Job Code:* **11 20 17 xx**		
Suitable lifting equipment	Standard tools, Piston ring compressor		



TV040978

1	Cylinder Head
2	Wiper Seal
3	Sealing Ring
4	O-Ring
5	Cylinder
6	Piston Rod Assembly
7	Back-up Seal
8	Piston Sealing Ring
9	Back-up Seal
10	O-Ring
11	Sealing Ring
12	Wiper Seal
13	Cylinder Head

Disassembly

⚠ Warning:
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ Caution:
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (5) in a vice.
3. Remove the cylinder heads (1) and (13) from the steering cylinder group.
4. Remove the piston rod assembly (6) from the cylinder (5).
5. Remove the sealing rings (3) and (11), wiper seals (2) and (12) and the O-rings (4) and (10) from the cylinder heads (1) and (13).
6. Remove the back-up seal (7), piston sealing ring (8) and back-up seal (9) from the piston rod assembly (6).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the back-up seal (7), piston sealing ring (8) and back-up seal (9) on the piston rod assembly (6).
2. Install the O-rings (4) and (10), wiper seals (2) and (12) and the sealing rings (3) and (11) into the cylinder heads (1) and (13).
3. Lubricate the inside of the cylinder (5) and the piston rod assembly (6) with clean oil. Use a piston ring compression tool to hold the new back-up seals (7) and (9) and the piston sealing ring (8) in place.

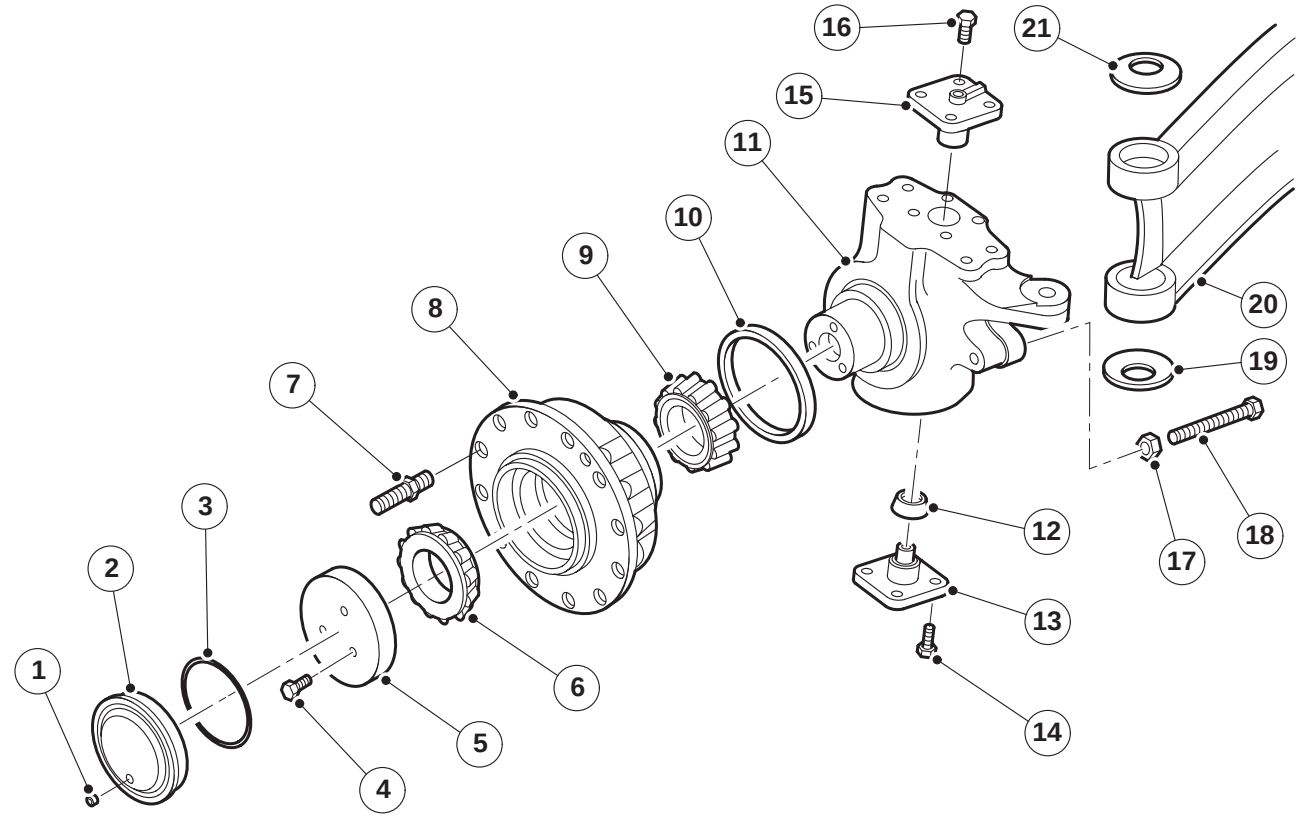
⚠ Caution:
- **Be careful not to damage the back-up seals and piston sealing ring.**

4. Install the piston rod assembly into the cylinder (5) until the compression tool is pushed off the piston rod assembly.
5. Install the cylinder heads (1) and (13) on the steering cylinder group.

DISASSEMBLY AND ASSEMBLY — WHEEL HUB GROUP

BHL1101DB

Operation: **Disassembly and Assembly of the Wheel Hub Group**	*Job Code:* **11 08 17 xx**		
Suitable lifting equipment	Standard tools, Ball joint separator, CA715491, CA715504, CA715085		



TV040969

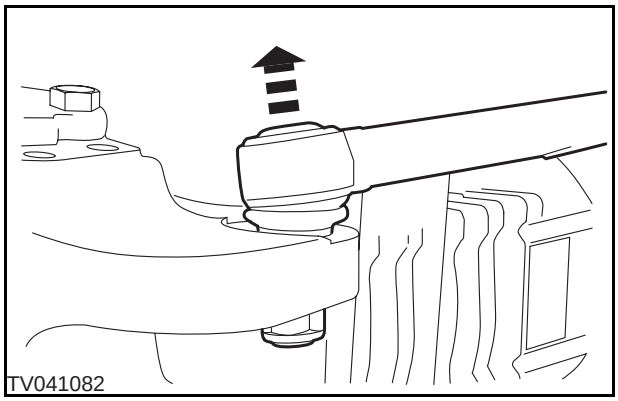
1	Plug
2	Wheel Hub Cover
3	O-Ring
4	Retaining Bolt
5	Thrust Washer
6	Taper Roller Bearing
7	Stud
8	Wheel Hub
9	Taper Roller Bearing
10	Oil Seal
11	Swivel Housing
12	Cone
13	Lower Kingpin
14	Retaining Bolt
15	Upper Kingpin
16	Retaining Bolt
17	Lock Nut
18	Steering Angle Adjustment Bolt
19	Belleville washers
20	Axle
21	Belleville Washers

Disassembly

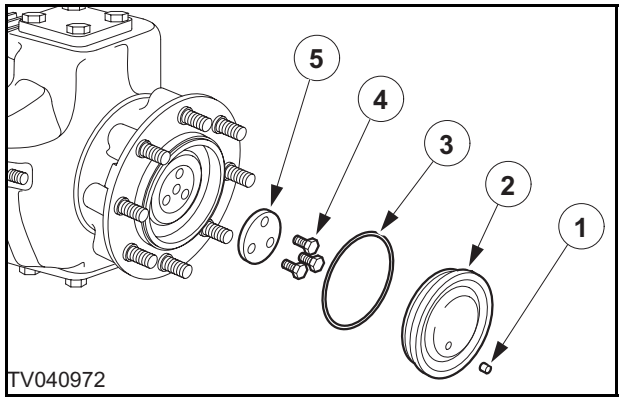
1. Remove the wheel. For additional information, refer to M12-01 FRONT WHEEL, PAGE M12–01–3 .

   ⚠ Caution:
   - **Leave the tie rod end nut on the tie rod end a few turns to prevent damage to the stud while using the ball joint separator.**

2. Loosen the tie rod end nut and using a suitable ball joint separator, disconnect the tie rod assembly from the swivel housing.


TV041082

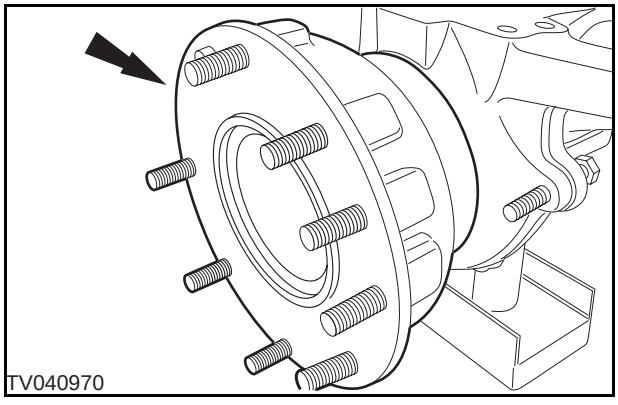
3. Remove the plug (1).
4. Using a suitable extractor or lever, remove the wheel hub cover (2).
5. Remove and discard the O-ring (3).
6. Remove the wheel hub retaining bolts (4).
7. Remove the thrust washer (5).



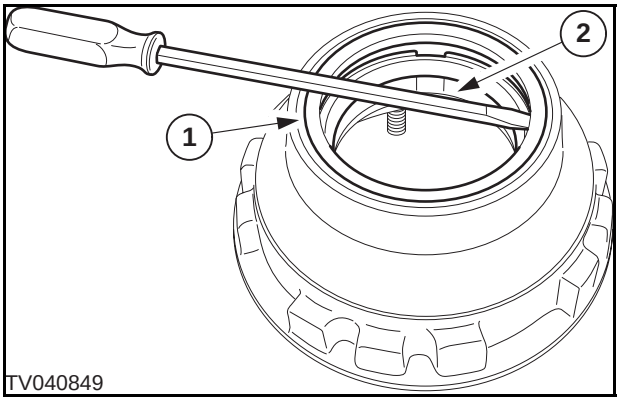
TV040972

8. Using a suitable soft faced hammer, remove the front axle hub.

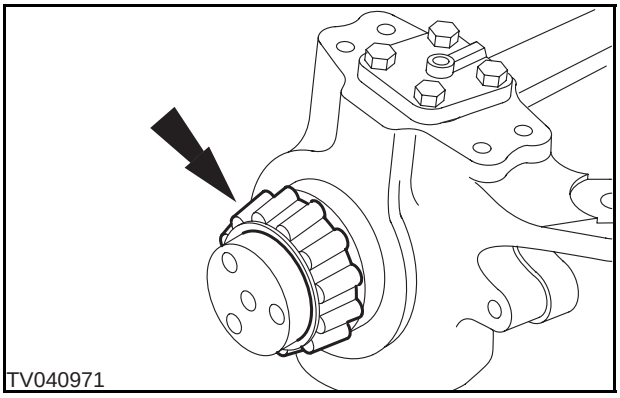
   Note:
   - Recover the outer taper roller bearing.


TV040970

9. Using a suitable lever, remove and discard the hub oil seal (1).
10. Using a suitable drift, remove the inner and outer taper roller bearing cones (2).



11. Using a suitable puller, remove the inner taper roller bearing.



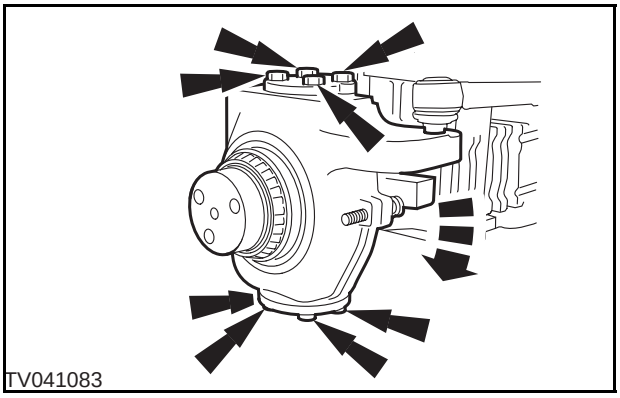
⚠ **Warning:**

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

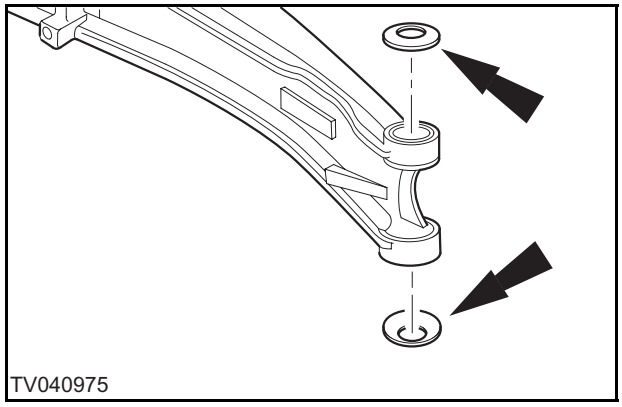
Note:

- Using suitable lifting equipment, support the swivel housing assembly .

12. Remove the upper and lower kingpin retaining bolts and remove the kingpins.
13. Remove the swivel housing assembly.

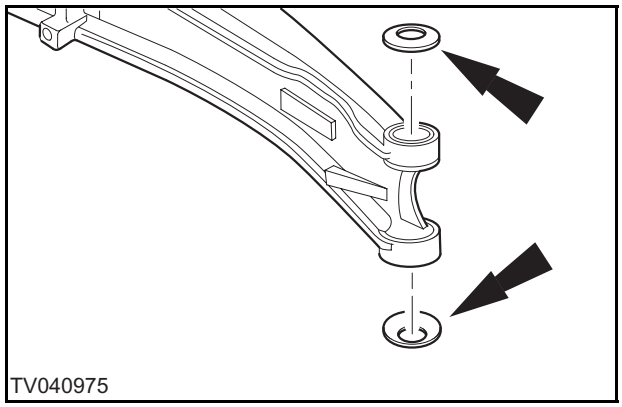


14. Remove the belleville washers.



Assembly

1. Lubricate the kingpin seats with suitable grease. For additional information, refer to SPECIFICATIONS, PAGE L11–01–27 in this section.
2. Install the belleville washers.



⚠ Warning:

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:

- Using suitable lifting equipment, support the swivel housing assembly .

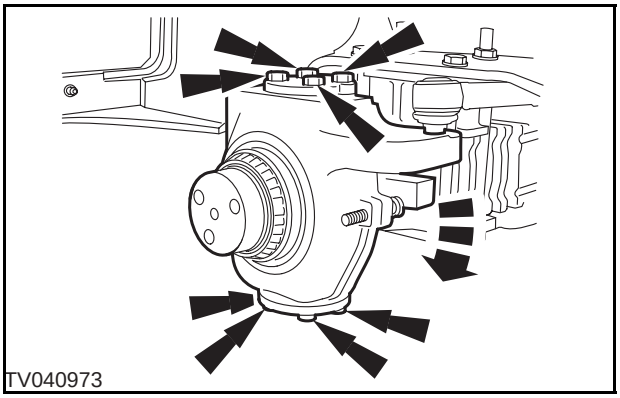
3. Install the swivel housing assembly.

Note:

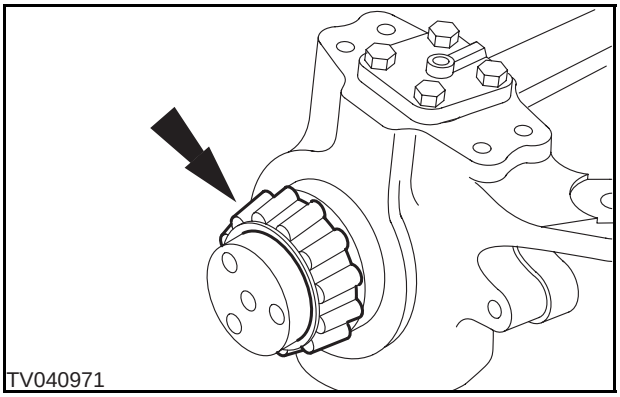
- Make sure the belleville washers do not move from their seats.

4. Install the upper and lower kingpins and kingpin retaining bolts.
5. Tighten the lower kingpin retaining bolts to 190Nm (140 lb.ft).
6. Tighten the upper kingpin retaining bolts to 120Nm (89 lb.ft).

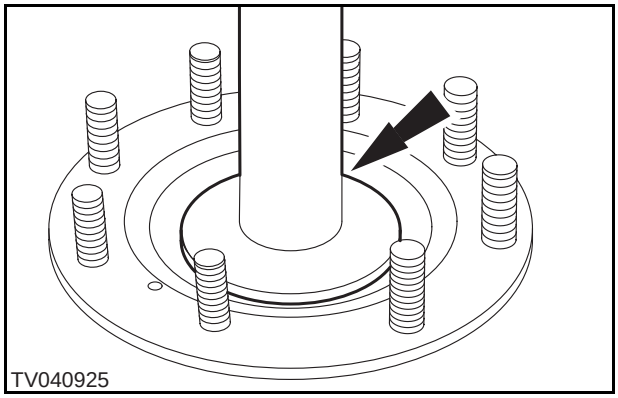
7. Lubricate the upper and lower kingpins with suitable grease. For additional information, refer to SPECIFICATIONS, PAGE L11–01–27 in this section.


TV040973

8. Lubricate the taper roller bearing with suitable grease. For additional information, refer to SPECIFICATIONS, PAGE L11–01–27 in this section.
9. Using the special tool **CA715491 — Driver for taper roller bearing** , install the inner taper roller bearing.

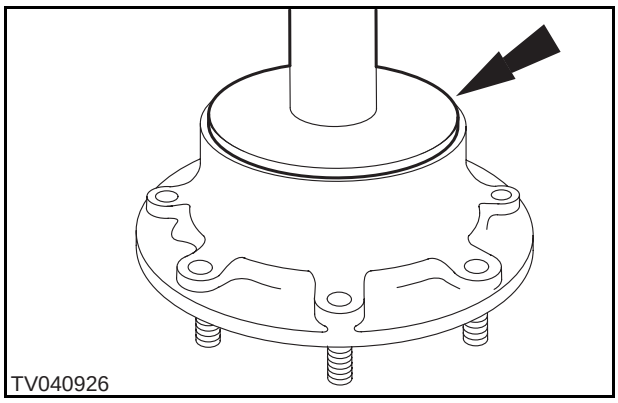

TV040971

10. Using a suitable hydraulic press and the special tools **CA715504 — Driver for the inner taper roller bearing cone** and **CA715085 — Driver for the outer taper roller bearing cone** , install the inner and outer taper roller bearing cones.

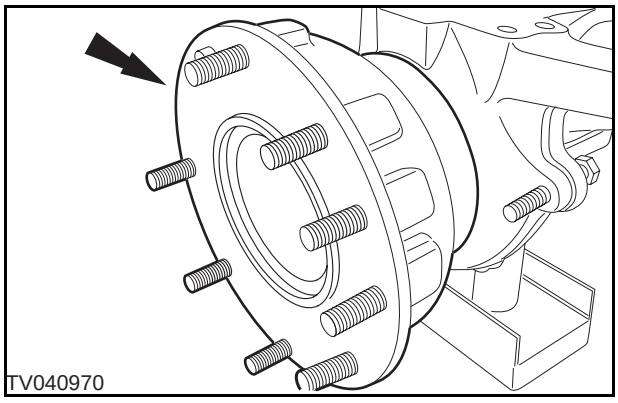

TV040925

Note:
- Lubricate the oil seal with a light grease.

11. Using the special tool **CA715525 — Driver for oil seal** , install a new hub oil seal.

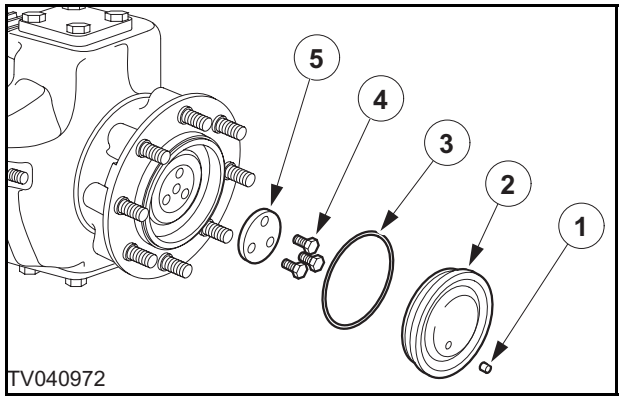

TV040926

12. Fill the wheel hub with 0.25 Kg of suitable grease. For additional information, refer to SPECIFICATIONS, PAGE L11–01–27 in this section.
13. Install the front axle hub and the outer taper roller bearing.


TV040970

Note:
- Lubricate the O-ring with a light grease.

14. Install the thrust washer (5).
15. Apply Loctite 270 to the wheel hub retaining bolts (4) and install the wheel hub retaining bolts (4).
16. Tighten (4) to 120Nm (89 lb.ft).
17. Install a new O-ring (3).
18. Install the wheel hub cover (2).
19. Install the plug (1) in the wheel hub cover (2).
20. Tighten (1) to 25Nm (18 lb.ft).



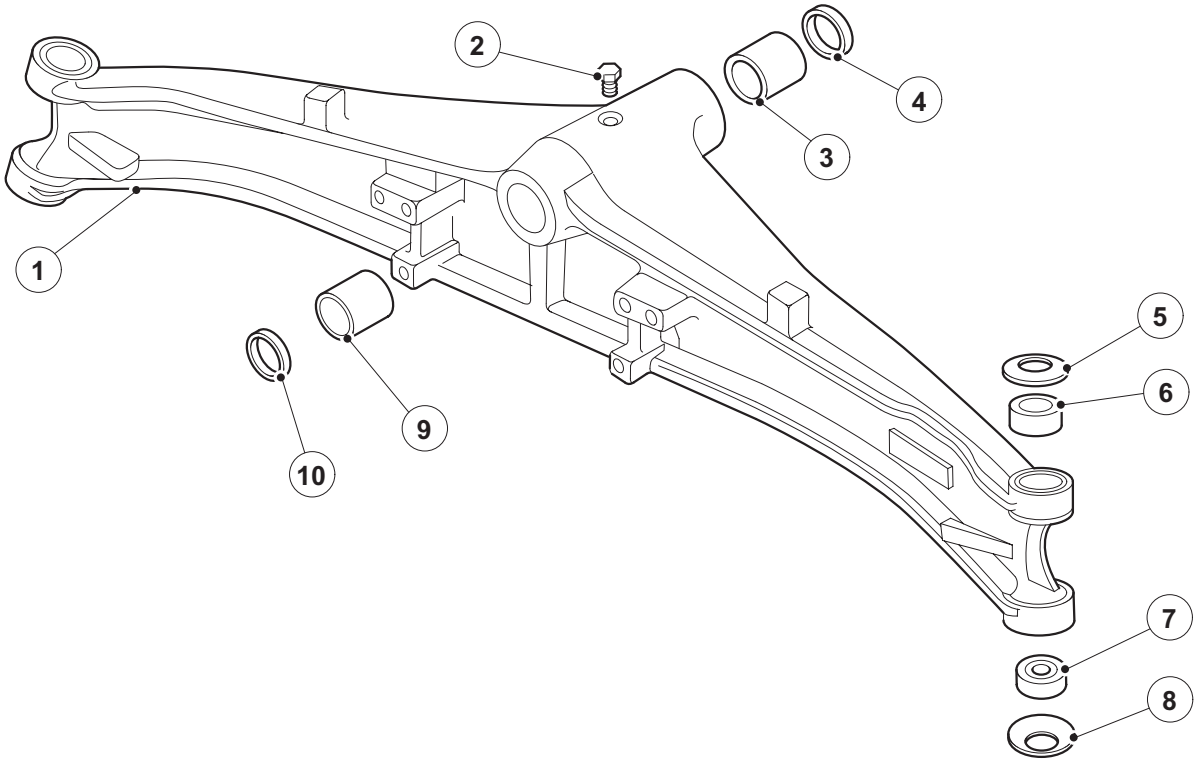
TV040972

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DISASSEMBLY AND ASSEMBLY — AXLE BEAM GROUP

BHL1101DD

Operation: **Disassembly and Assembly of the Axle Beam Group**	*Job Code:* **11 07 17 xx**		
None	Standard tools, CA715448, CA715451, CA715549, CA715164		

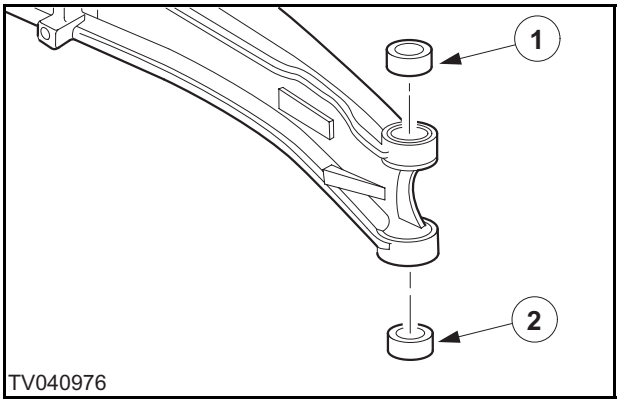


TV040974

1	Axle Beam
2	Plug
3	Bush
4	Oil Seal
5	Belleville Washer
6	Kingpin Bush
7	Ball Bearing Cup
8	Belleville Washers
9	Bush
10	Oil Seal

Disassembly

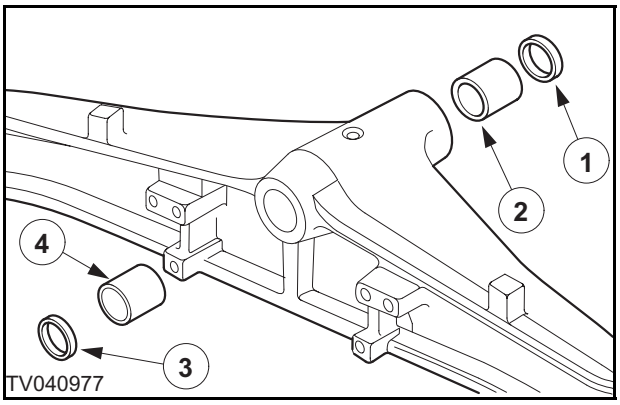
1. Remove the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE L11–01–13 in this section.
2. Using a suitable extractor, remove the upper king pin bush (1) and the ball bearing cup (2) from the king pin housings (both sides).



3. Remove and discard the oil seals (1) and (3) from the axle beam.

   ⚠ **Caution:**
   - **Be careful not to damage the bush housing.**

4. Remove and discard the bushes (2) and (4) from the axle beam.

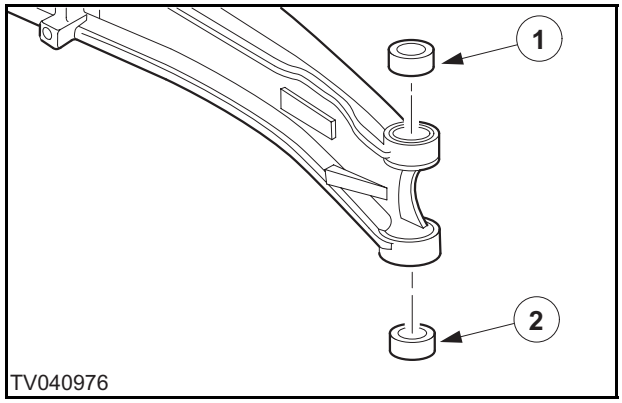


Assembly

Note:
- To make the assembly easier, it is advisable to cool the upper bushings and the lower ball bearing cups at a temperature lower than –100°C.

1. Using the special tool **CA715448 — Driver for upper kingpin bush** , install the bush (1) in the upper kingpin seat (both sides).

2. Using the special tool **CA715451 — Driver for lower kingpin ball bearing cup** , install the ball bearing cup (2) in the lower kingpin seat (both sides).

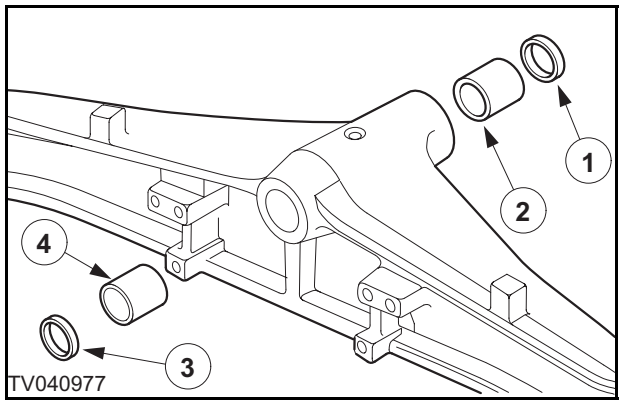


Note:
- To make the assembly easier, it is advisable to cool the bushings at a temperature lower than –100°C.

3. Using the special tool **CA715549 — Driver for bush** , install the bushes (2) and (4) in the axle beam.

Note:
- Lubricate the oil seal with a light grease.

4. Using the special tool **CA715164 — Driver for oil seal** , install the oil seals (1) and (3) in the axle beam.



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GENERAL PROCEDURE — TOE-IN ADJUSTMENT

BHL1101GA

Operation: **General Procedure Toe-in Adjustment**	*Job Code:* **11 13 01 xx**		
None	Standard tools, Two one-metre-long bars		

General Procedure

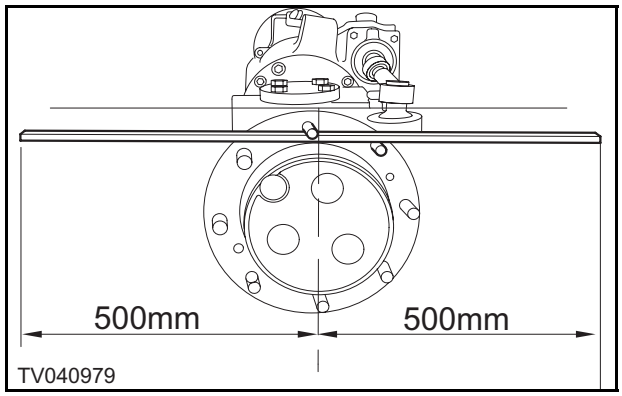
The toe-in of the front wheels must be between 12 and 24mm toe-in as measured 500mm from the centre of the wheel hub.

To check the exact value of the toe-in setting, proceed as follows.

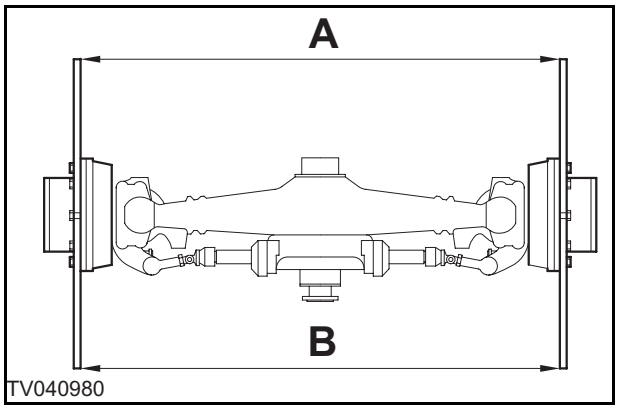
1. With the front wheels in the central position, remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

   Note:
   - The bars must be fixed flat against the wheel hub flange and have an equal distance from the centre of the wheel hub.

2. Install two equal one-metre-long bars to the wheel side of the wheel hubs and lock in place with two wheel retaining nuts.



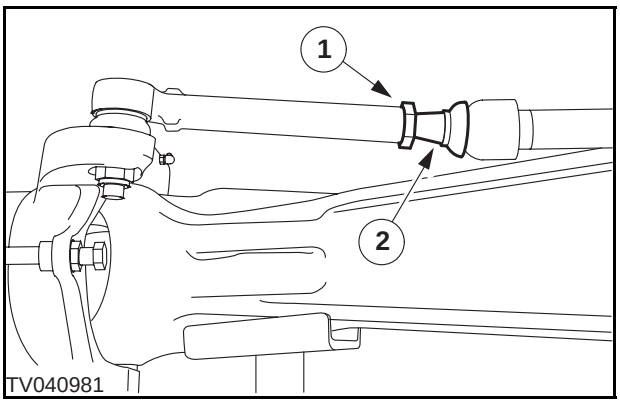
3. Measure the distance (A) between the ends of the two bars.
4. Measure the distance (B) between the ends of the two bars.
5. The distance (A) must be 12 to 24mm less than distance (B).



Note:

- Make sure the same number of threads are visible at the end of the left-hand and right-hand inner track rod end ball joints.

6. If it is necessary to correct the toe-in adjustment. Loosen the lock nut (1) on the left-hand and the right-hand side. Turn the inner track rod end ball joints (2) equally to achieve the specified toe-in adjustment.
7. Tighten (1) to 120Nm (86 lb.ft).



SPECIFICATIONS — TWO-WHEEL DRIVE FRONT AXLE

BHL1101SA

Special Tools

Tool No.	Description
CA119033	Interchangeable Handle
CA715085	Driver for Bearing Cone
CA715164	Driver for Oil Seal
CA715448	Driver for Bush
CA715549	Driver for Bush
CA715451	Driver for Ball Bearing Cup
CA715491	Driver for Bearing
CA715504	Driver for Bearing Cone
CA715525	Driver for Hub Seal

Torque Values

Description	Nm	Lb.ft
Wheel	180	133
Wheel Hub Cover Plug	25	18
Wheel Hub	120	89
Upper Kingpin	120	89
Lower Kingpin	190	140
Grease Nipple	8	6
Tie-Rod End	165	122
Tie-Rod Locking Nut	120	89
Swivel Joint	300	221
Steering Cylinder	335	247

General Specifications

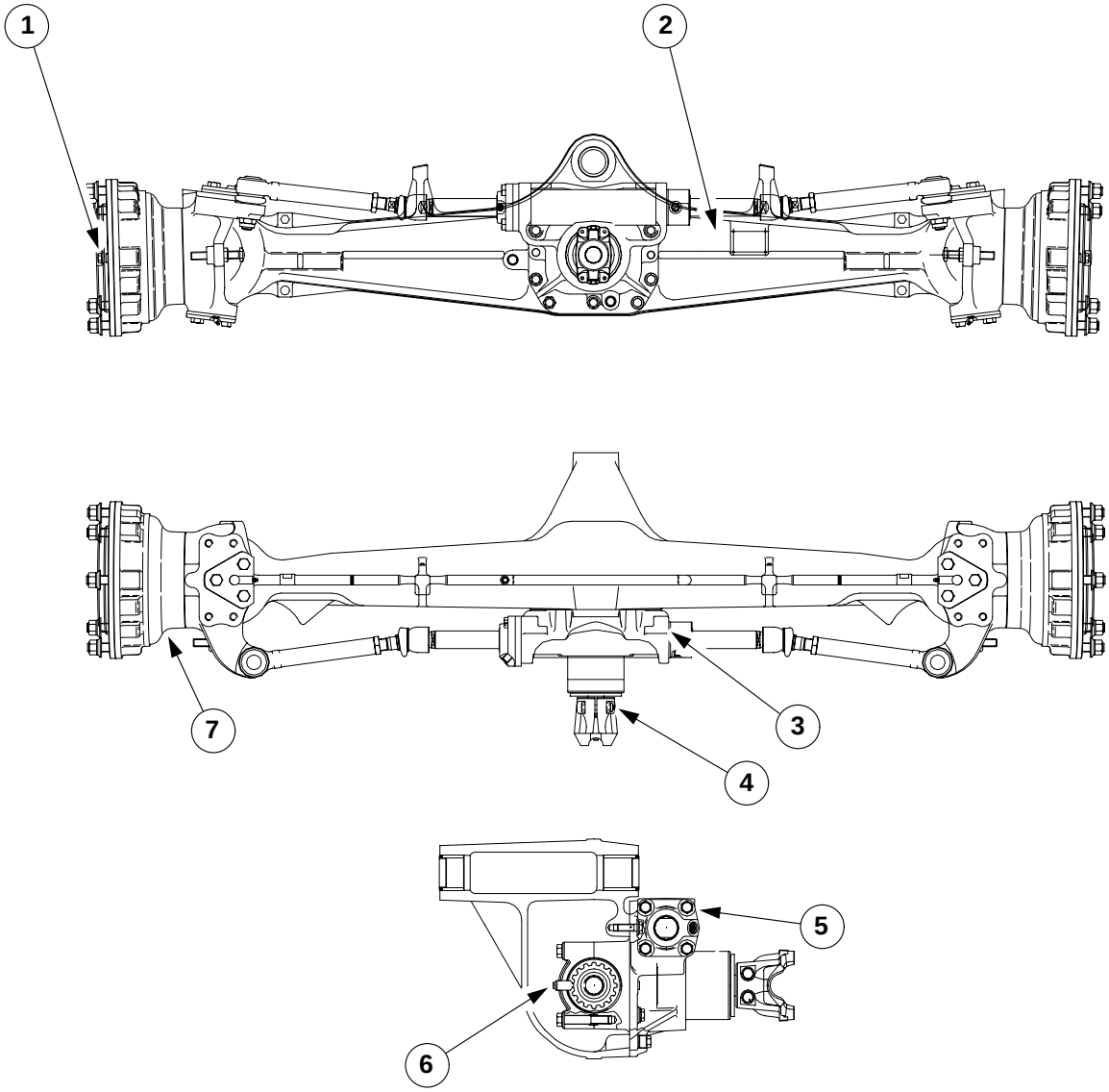
Description	Value
Dry Weight	179 Kg
Steering Angle	Max. 56°30’ ± 1°30’
Toe-in	12–24mm
Wheel Hub Grease Each Side	0.25 Kg
Grease Type	AGIP GREASE 33FD AGIP MU/EP2 (Kingpin only)

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DESCRIPTION AND OPERATION — FOUR-WHEEL DRIVE FRONT AXLE

BHL1102OA

General Description



TV040947

1	Epicyclic Reduction Gear Group
2	Axle Housing Group
3	Differential Support Group
4	Pinion Group
5	Steering Cylinder Group
6	Differential Group
7	Wheel Hub Group

The axle described in this manual consists of the following groups:

- WHEEL HUB GROUP: wheel support parts containing the epicyclic reduction gears.
- EPICYCLIC REDUCTION GEAR GROUP: planetary carrier with reduction/transmission parts.
- AXLE HOUSING GROUP: load-bearing shell structure of the axle.

- DIFFERENTIAL SUPPORT GROUP: differential housing with crown wheel gear adjusting system.
- DIFFERENTIAL GROUP: differential parts with crown wheel gear.
- PINION GROUP: pinion with adjusting and support parts.
- STEERING CYLINDER GROUP: steering cylinder parts with adjusting system.

DIAGNOSING AND TESTING — FOUR-WHEEL DRIVE FRONT AXLE

BHL1102TA

Problem	Possible Cause	Action
Ring gear tooth broken at the outer side	• Excessive gear load compared to the design specification.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Incorrect gear adjustment (excessive backlash).	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Pinion nut loosened.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
Ring gear tooth broken on the inside	• Load bump.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Incorrect gear adjustment (insufficient backlash).	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Pinion nut loosened.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
Pinion or ring gear teeth worn	• Insufficient lubrication.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
	• Contaminated oil.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.

Problem	Possible Cause	Action
Pinion or ring gear teeth worn (continued)	• Incorrect lubrication or depleted additives.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
	• Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
Overheated ring and pinion teeth. Check if gear teeth are showing signs of wear.	• Prolonged functioning at high temperatures.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Incorrect lubrication.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Low oil level.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
Pinion teeth pitting	• Excessive use.	• REPLACE bevel gear set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE bevel gear set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Axle beam body bent	• Vehicle overloaded.	• REPLACE axle beam body.
	• Vehicle accident.	• REPLACE axle beam body.
	• Load bump.	• REPLACE axle beam body.

Problem	Possible Cause	Action
Worn out or pitted bearings	• Insufficient lubrication.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive use.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Normal wear out.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Pinion nut loosened.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Oil leakage from gaskets and seals	• Prolonged functioning at high temperature of the oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Oil gasket assembled incorrectly.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Seal lip damaged.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.

Problem	Possible Cause	Action
Excessive wearing out of input flange spline	• Heavy use.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
	• Pinion nut loosened.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
	• Pinion axle backlash.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
Fatigue failure of pinion teeth. See if the fracture line is well defined (wave lines, beach lines)	• Heavy use.	• REPLACE bevel gear set.
	• Continuous overload.	• REPLACE bevel gear set.
Pinion and ring teeth breakage	• Crash load of differential components.	• CHECK and/or REPLACE other differential components.
Side gear spline worn out. Replace all scratched washers (Excessive backlash)	• Excessive use.	• REPLACE differential gear group. • REPLACE half shaft if required.
Thrust washer surface worn out or scratched	• Insufficient lubrication.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0,1 mm thickness lower than the new ones.
	• Incorrect lubrication.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0,1 mm thickness lower than the new ones.
	• Contaminated oil.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0,1 mm thickness lower than the new ones.

Problem	Possible Cause	Action
Inner diameter of tapered roller bearing worn out	• Excessive use.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive pinion axial backlash.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
Bent or broken half shaft	• Vehicle intensively operated or overloaded.	• REPLACE half shaft.
Half shaft broken at wheel side	• Wheel support loosened.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.
	• Beam body bent.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.

Axle Problem and Diagnosis

Problem	Possible Cause	Action
Noise while driving	• Excessive backlash between pinion and ring gear.	• ADJUST.
	• Worn out pinion and gear ring.	• REPLACE.
	• Worn out pinion bearings.	• REPLACE.
	• Pinion bearings loosened.	• ADJUST.
	• Excessive axial pinion backlash.	• ADJUST.
	• Worn out differential bearings.	• REPLACE.
	• Differential bearings loosened.	• ADJUST.
	• Ring gear out of roundness.	• REPLACE.
	• Low Lubricant level.	• OIL level.
	• Poor or wrong lubricant.	• REPLACE.
	• Bent half shaft.	• REPLACE.
Noise whilst driving in neutral	• Noise coming from axle is usually heard when vehicle moves in neutral gear but is not loud.	• REPLACE or ADJUST (see above).
	• Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed.	• REPLACE.
	• Pinion or input flange worn out.	• ADJUST.
Intermittent noise	• Ring gear damaged.	• REPLACE bevel gear set.
	• Differential box bolts loosened.	• TIGHTEN to torque.
Constant noise	• Ring gear teeth or pinion damaged.	• REPLACE bevel gear set.
	• Worn out bearings.	• REPLACE.
	• Pinion spline worn out.	• REPLACE.
	• Bent half shaft.	• REPLACE.
Noise while steering	• Worn out differential gears.	• REPLACE.
	• Worn out differential box or spider.	• REPLACE.
	• Differential thrust washers worn out.	• REPLACE.
	• Half shaft spline worn out.	• REPLACE.

REMOVAL AND INSTALLATION — FOUR-WHEEL DRIVE FRONT AXLE

BHL1102RA

Operation: **Removing and Installing the Four-Wheel Drive Front Axle**	*Job Code:* **11 24 13 xx**		
Suitable transmission jack	Standard tools		

Removal

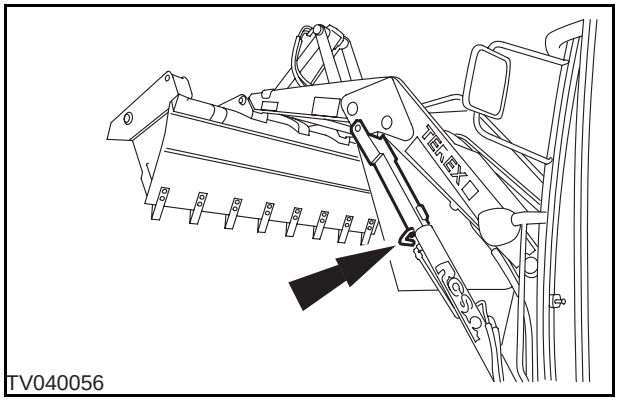
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

Note:
- Support the machine under the front chassis.

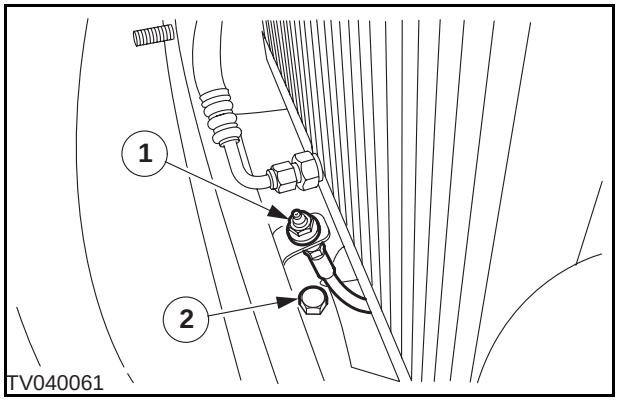
2. Remove the hardnose / tool box. For additional information, refer to Section K10-01 HARDNOSE / TOOLBOX, PAGE K10–01–3 .
3. Raise the front loader to full height and install the safety stop.
4. Roll the loader bucket fully forward.



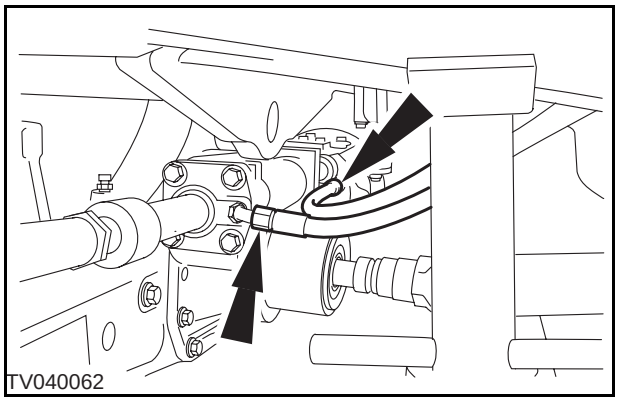
5. Detach the front axle pivot pin grease point (1).

Note:
- Discard the locking nut.

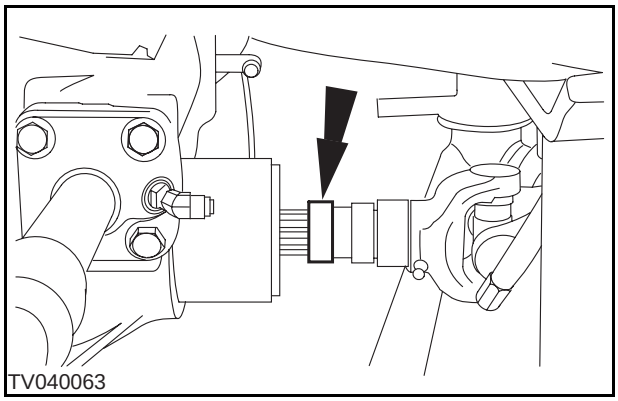
6. Remove the front axle pivot pin retaining bolt (2).



7. Disconnect the power steering supply pipes.


TV040062

8. Loosen the propeller shaft locking ring.


TV040063

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

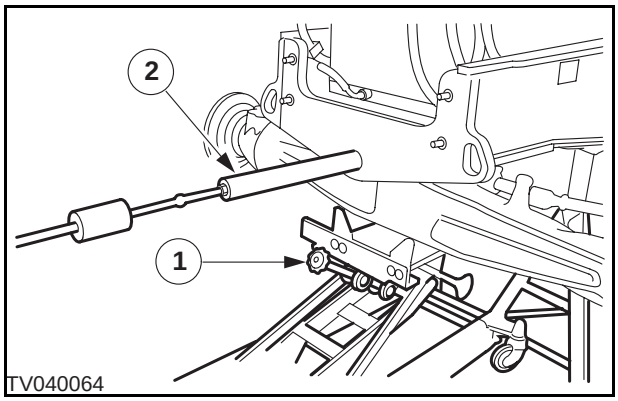
⚠ **Warning:**
- **Secure the front axle to the transmission jack. Failure to follow this instruction may result in personal injury**

Note:
- Mark the axle pivot pin before removal to aid installation.

9. Using a suitable transmission jack (1), support the front axle.

Note:
- Secure the propeller shaft to one side when removing the front axle.

Using a suitable slide hammer (2), remove the front axle pivot pin and remove the front axle.



TV040064

Installation

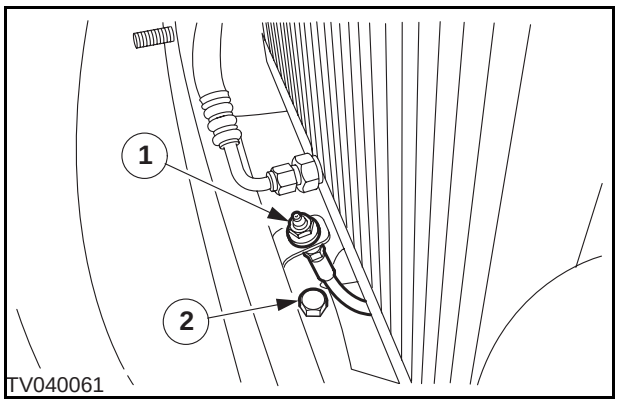
Note:
- Remove any dirt or burrs before installing the front axle pivot pin.

Note:
- Make sure the propeller shaft is aligned with the front axle differential shaft when raising the axle into position.

1. To install, reverse the removal procedure.

Note:
- Install a new locking nut.

2. Tighten (2) to 98Nm (72 lb.ft).



3. Check and adjust the hydraulic oil level as required.
4. Operate the steering from full left-hand lock to full right-hand lock and check for correct operation.

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REMOVAL AND INSTALLATION — STEERING CYLINDER GROUP

BHL1102RC

Operation: **Removing and Installing the Steering Cylinder Group**	*Job Code:* **11 20 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

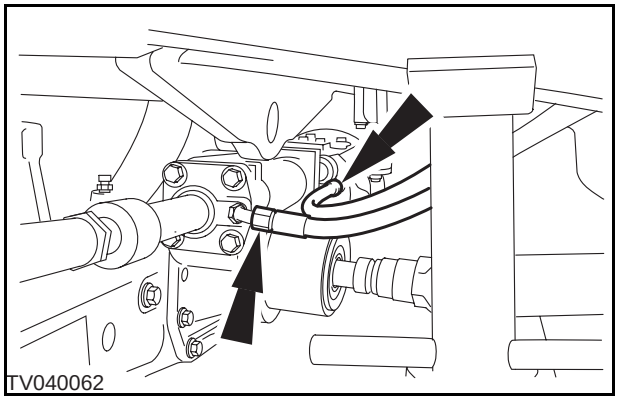
Note:
- Make a note of the position of any hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

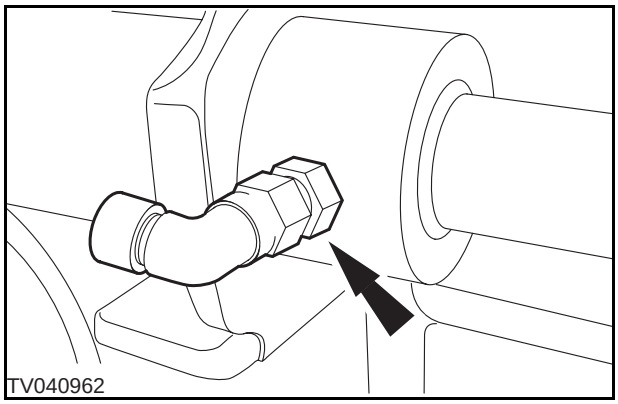
1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

Note:
- Support the machine under the front chassis.

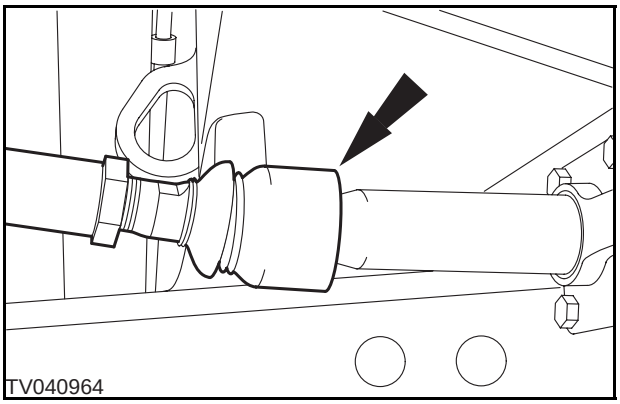
2. Disconnect the power steering supply pipes.


TV040062

3. Remove the union from the steering cylinder group.


TV040962

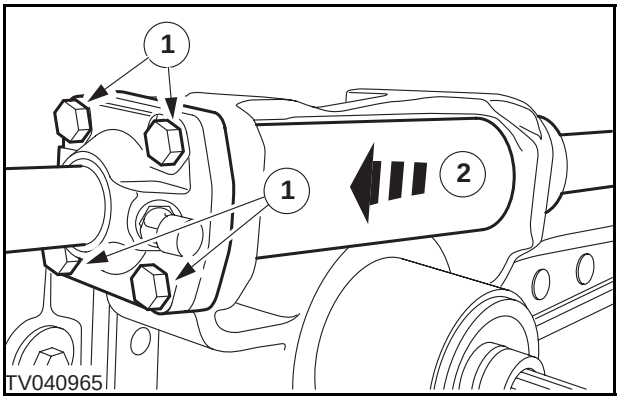
4. Disconnect the inner track rod end from the steering cylinder group (both sides).



⚠ **Warning:**

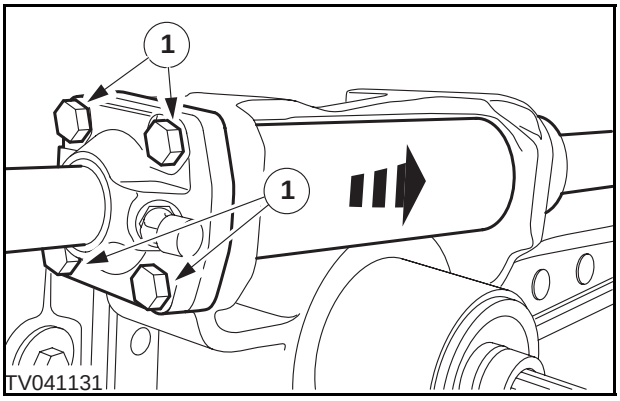
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

5. Remove the steering cylinder group retaining bolts (1), and remove the steering cylinder group (2).

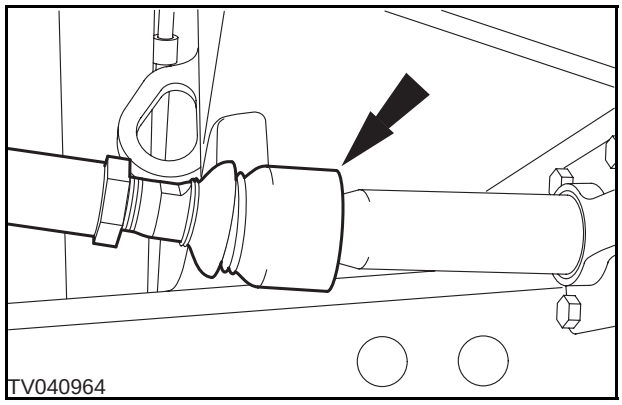


Installation

1. To install, reverse the removal procedure.
2. Tighten (1) to 120Nm (89 lb.ft).



3. Tighten to 300Nm (221 lb.ft).



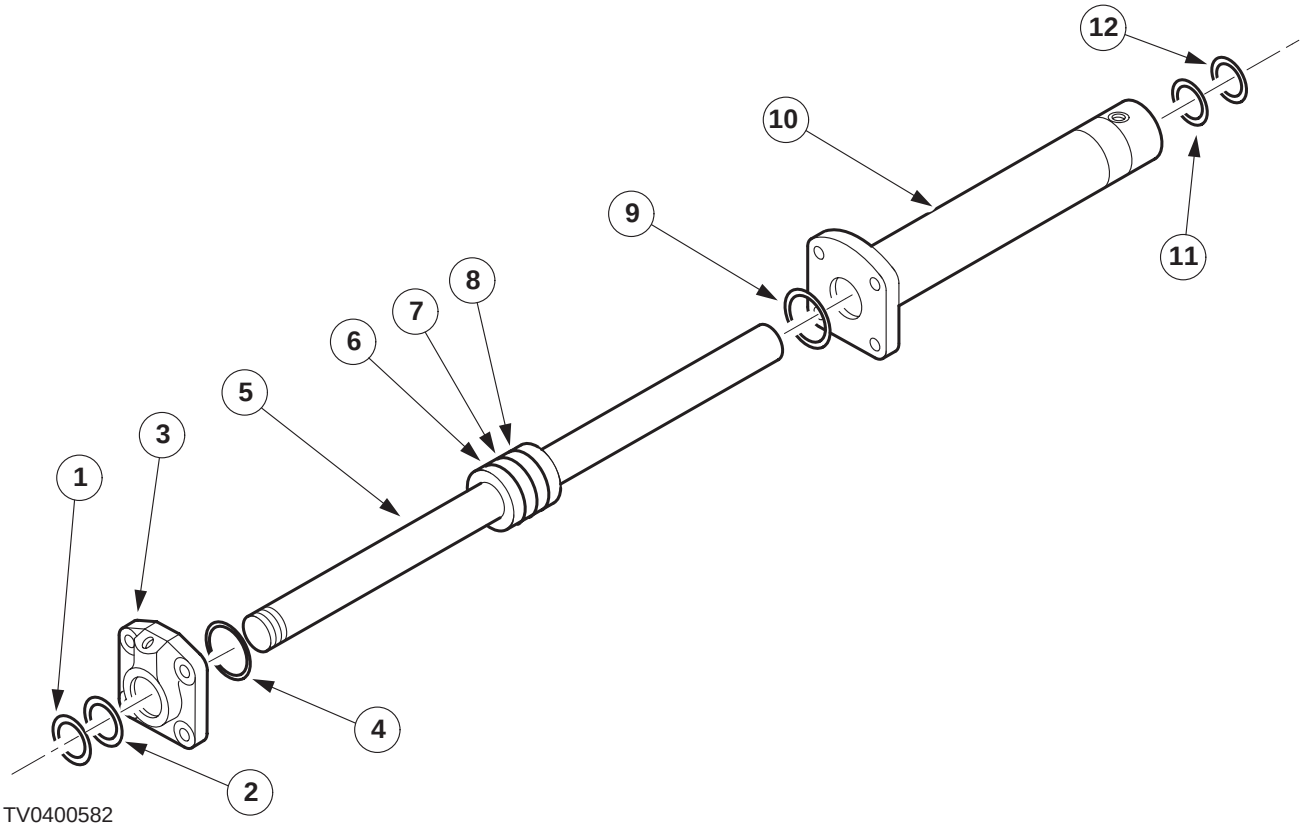
4. Check and adjust the hydraulic oil level as required.
5. Operate the steering from full left-hand lock to full right-hand lock and check for correct operation.

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DISASSEMBLY AND ASSEMBLY — STEERING CYLINDER GROUP

BHL1102DA

Operation: **Disassembly and Assembly of the Steering Cylinder Group**	*Job Code:* **11 20 17 xx**		
None	Standard tools, Suitable piston ring compression tool		



TV0400582

1	Wiper Seal
2	Sealing Ring
3	Flange
4	O-Ring
5	Piston Rod Assembly
6	Back-up Seal
7	Piston Sealing Ring
8	Back-up Seal
9	O-Ring
10	Cylinder
11	Sealing Ring
12	Wiper Seal

Disassembly

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (10) in a soft jawed vice.
3. Remove the flange (3) from the steering cylinder group.
4. Remove the piston rod assembly (5) from the cylinder (10).
5. Remove the wiper seal (1), sealing ring (2) and the O-ring (4) from the flange (3).
6. Remove the back-up seal (6), piston sealing ring (7) and back-up seal (8) from the piston rod assembly (5).
7. Remove the O-ring (9), sealing ring (11) and the wiper seal (12) from the cylinder (10).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (12), sealing ring (11) and the O-ring (9) to the cylinder (10).
2. Install the back-up seal (8), piston sealing ring (7) and the back-up seal (6) to the piston rod assembly (5).
3. Install the O-ring (4), sealing ring (2) and the wiper seal (1) to the flange (3).
4. Lubricate the inside of the cylinder (10) and the piston rod assembly (5) with clean oil. Use a piston ring compression tool to hold the new back-up seals (6),(8) Piston Sealing Ring (7) in place.

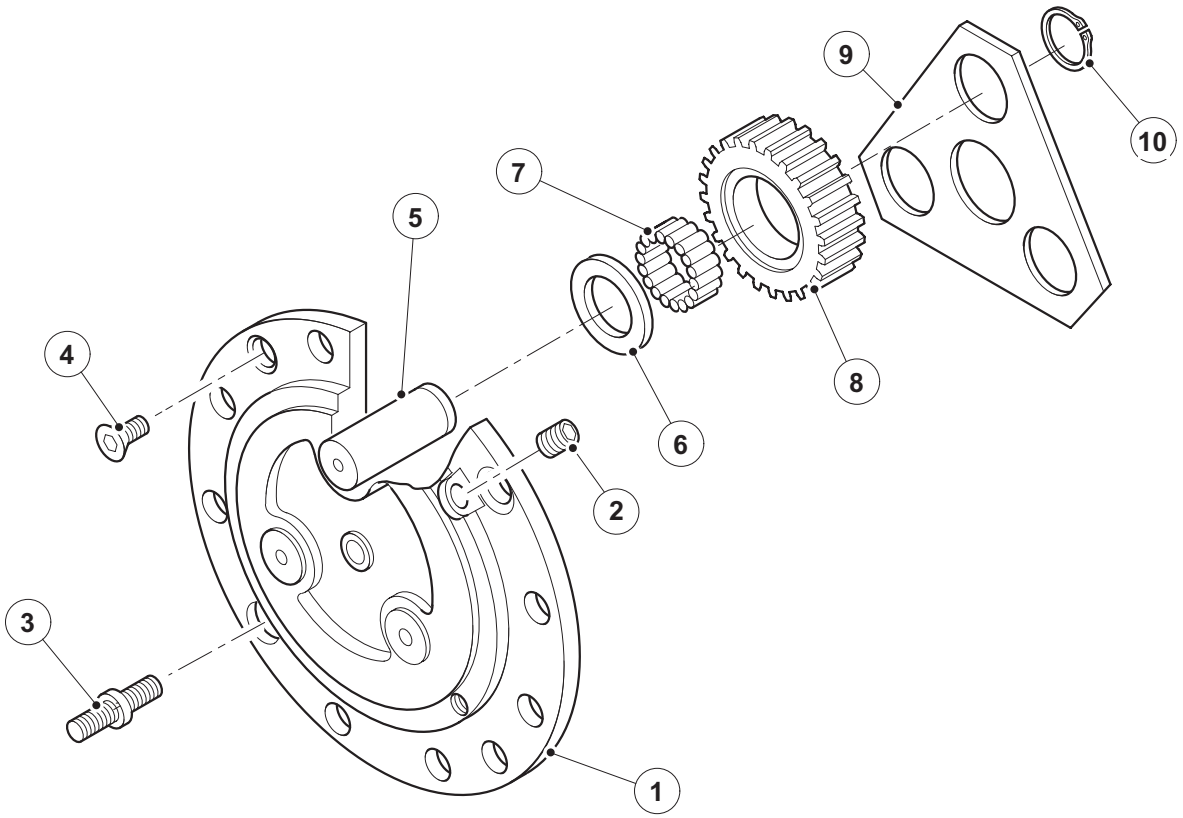
⚠ **Caution:**
- **Be careful not to damage the back-up seals and piston sealing ring.**

5. Start the cylinder (10) onto the piston rod assembly (5). Push the cylinder onto the piston rod (5) assembly until the compression tool is pushed off the piston rod assembly.
6. Install the flange (3) onto the steering cylinder group.

DISASSEMBLY AND ASSEMBLY — EPICYCLIC REDUCTION GEAR GROUP

BHL1102DB

Operation: **Disassembly and Assembly of the Epicyclic Reduction Gear Group**	*Job Code:* **11 05 17 xx**		
None	Standard tools		

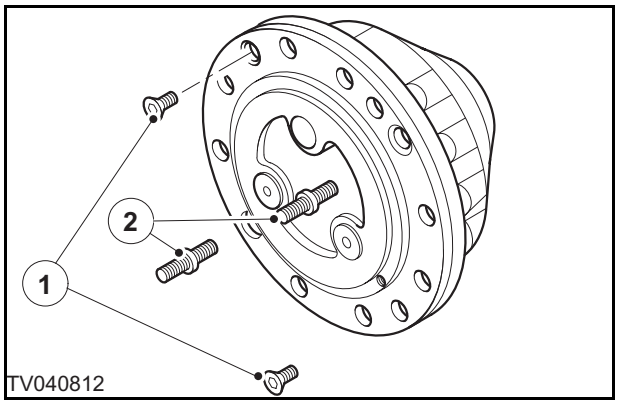


TV040598

1	Epicyclic Reduction Gear Carrier
2	Drain/Refill Plug
3	Retaining Stud
4	Retaining Screw
5	Pin
6	Washer
7	Needle Bearings
8	Epicyclic Reduction Gear
9	Triangular plate
10	Circlip

Disassembly

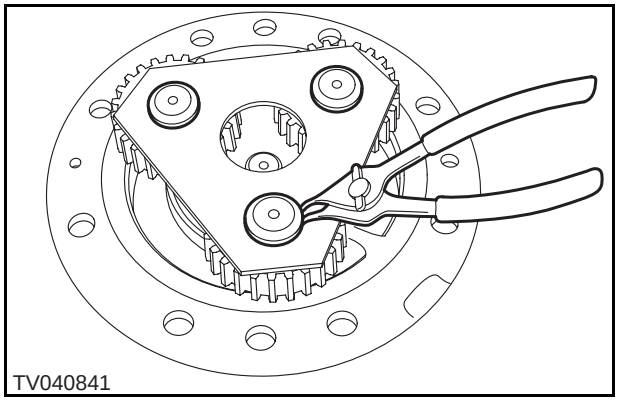
1. Remove the wheel. For additional information, refer to M12-01 FRONT WHEEL, PAGE M12–01–3 .
2. Drain the hub oil. For additional information, refer to DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67 in this section.
3. Remove the epicyclic reduction gear retaining screws (1), and studs (2) and remove the epicyclic reduction gear.



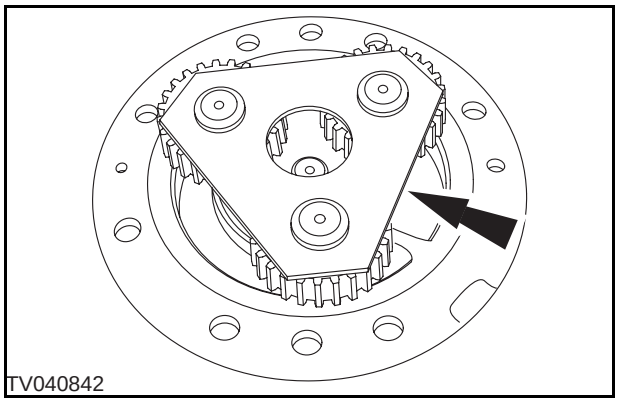
Note:

- On disassembly of the epicyclic reduction gear clean the contact surfaces of the epicyclic reduction gear and wheel hub and check it for excess wear.

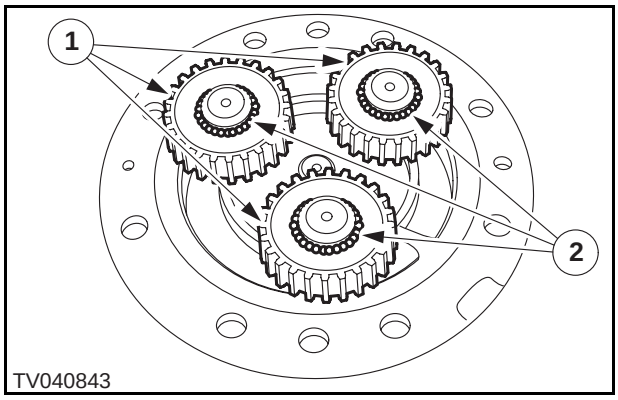
4. Using suitable circlip pliers, remove the epicyclic reduction gear retaining circlips.



5. Remove the epicyclic reduction gear triangular plate.



6. Remove the epicyclic reduction gears (1).
7. Recover the needle roller bearings (2).



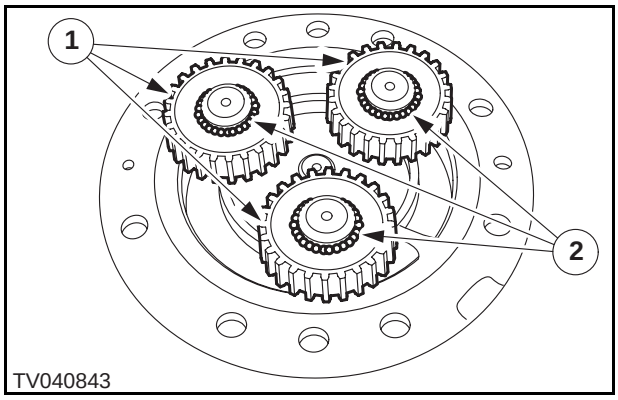
Assembly

Note:
- When installing new epicyclic reduction gears, install new needle bearings.

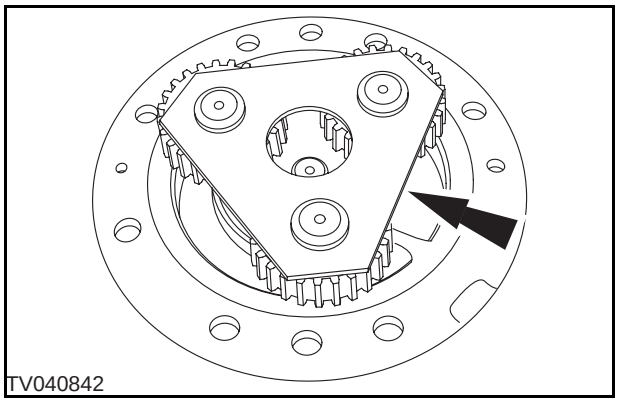
1. Install the epicyclic reduction gears (1).

Note:
- Use a suitable light greese to aid installation.

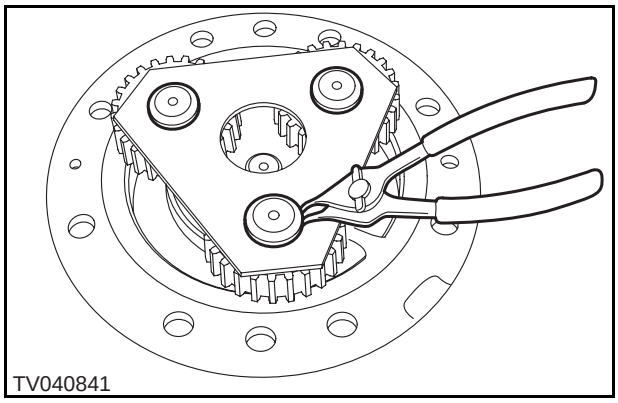
2. Install the needle roller bearings (2).



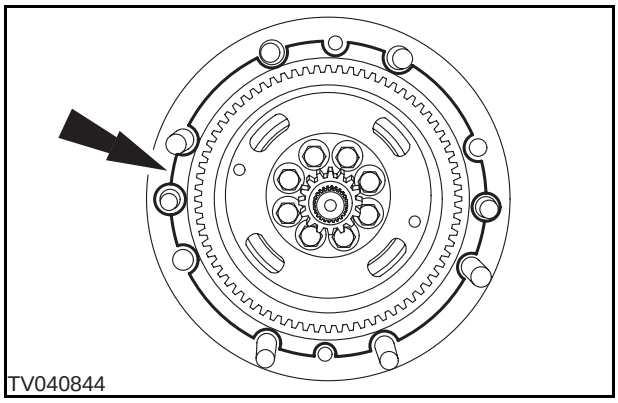
3. Install the epicyclic reduction gear triangular plate.



4. Install the epicyclic reduction gear retaining circlips.


TV040841

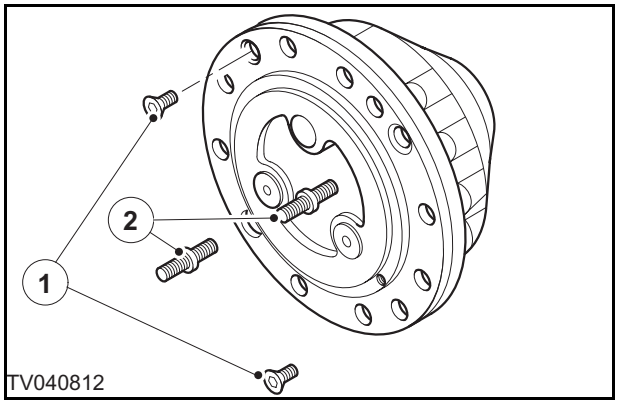
5. Clean and degrease the mating surfaces. Apply a bead of suitable sealant following the the pattern shown. For additional information, refer to SPECIFICATIONS, PAGE L11–01–27 in this section.


TV040844

6. Install the epicyclic reduction gear to the wheel hub.

   Note:
   - Before installing the epicyclic reduction gear retaining studs, apply approved sealant (Loctite 542) to the studs.

7. Install the epicyclic reduction gear retaining screws (1), and studs (2).
8. Tighten (1) to 70Nm (52 lb.ft).
9. Tighten (2) to 80Nm (59 lb.ft).
10. Fill the hub with oil. For additional information, refer to DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67 in this section.
11. Install the wheel. For additional information, refer to M12-01 FRONT WHEEL, PAGE M12–01–3 .

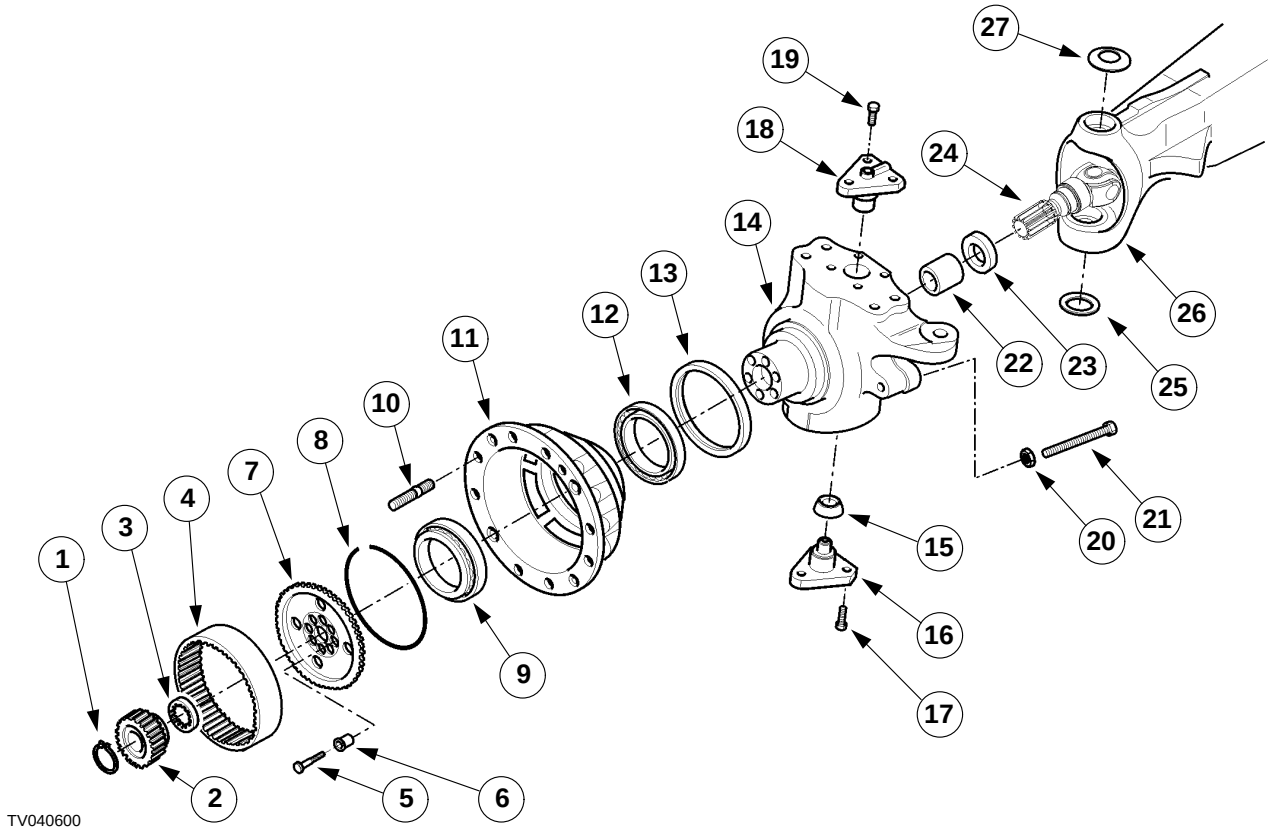


TV040812

DISASSEMBLY AND ASSEMBLY — WHEEL HUB GROUP

BHL1102DC

Operation: **Disassembly and Assembly of the Wheel Hub Group**	*Job Code:* **11 05 17 xx**		
Suitable lifting equipment	Standard tools, Ball joint separator, Ca715026, Ca715027, Ca119143		



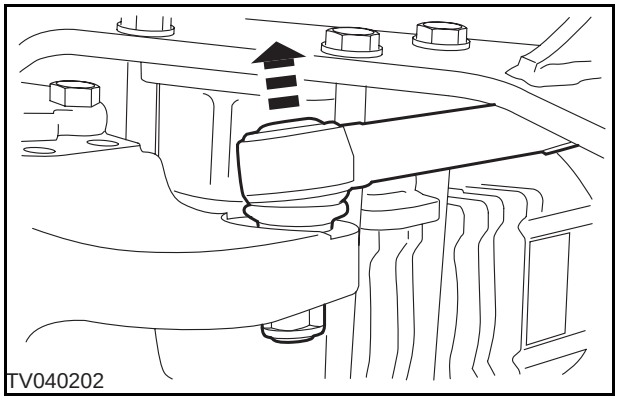
1	Circlip
2	Sun Gear
3	Universal-Joint Shaft Washer
4	Epicylic Ring Gear
5	Retaining Bolt
6	Center Bushes
7	Epicylic Hub
8	Steel Lock Ring
9	Taper Roller Bearing
10	Stud
11	Wheel Hub
12	Taper Roller Bearing
13	Oil Seal
14	Swivel Housing
15	Cone
16	Lower Kingpin
17	Retaining Bolt
18	Upper Kingpin
19	Retaining Bolt
20	Lock Nut
21	Steering Angle Adjustment Bolt
22	Bush
23	Oil seal
24	Universal-Joint Shaft End
25	Belleville washers
26	Axle
27	Belleville Washers

Disassembly

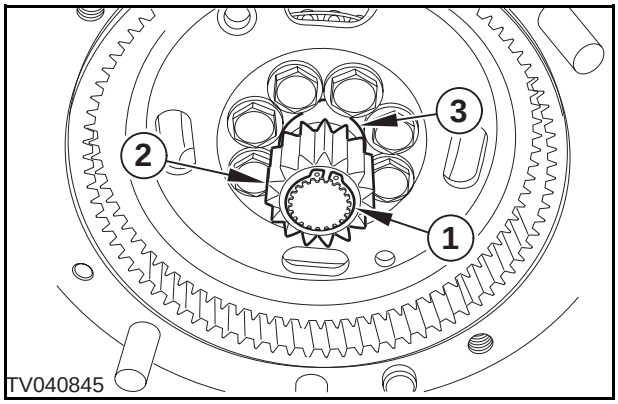
1. Remove the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE L11–03–15 in this section.

⚠ **Caution:**
- **Leave the tie rod end nut on the tie rod end a few turns to prevent damage to the stud while using the ball joint separator.**

2. Using a suitable ball joint separator, disconnect the tie rod assembly from the wheel hub.

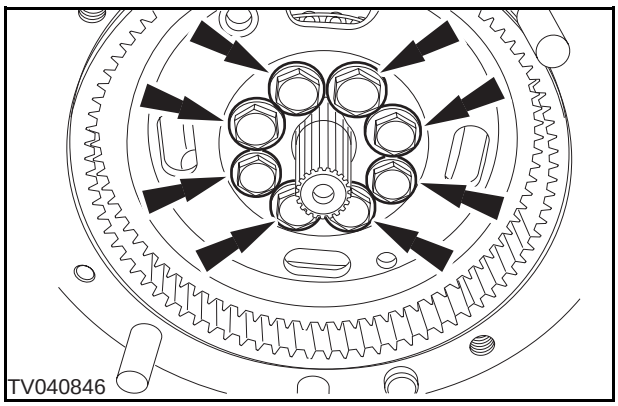

TV040202

3. Remove the lock ring (1), sun gear (2) and spacer (3) from the double Universal-joint shaft.

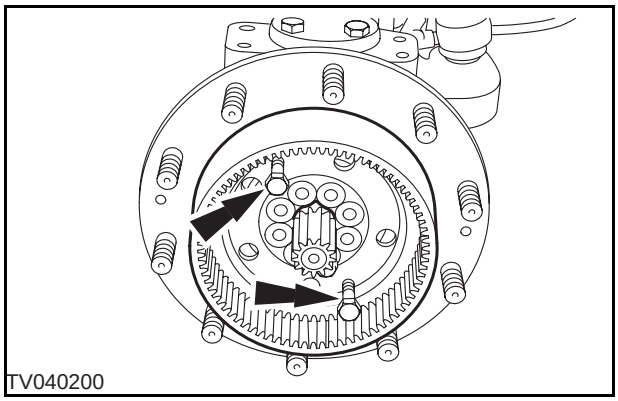


TV040845

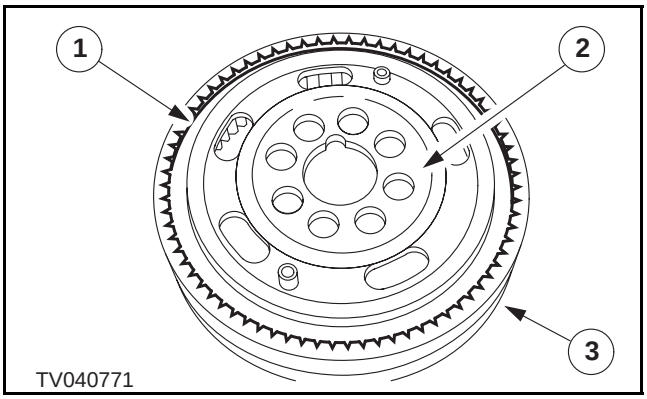
4. Remove the wheel hub retaining bolts.


TV040846

5. Using two hub retaining bolts, extract the epicyclic group.


TV040200

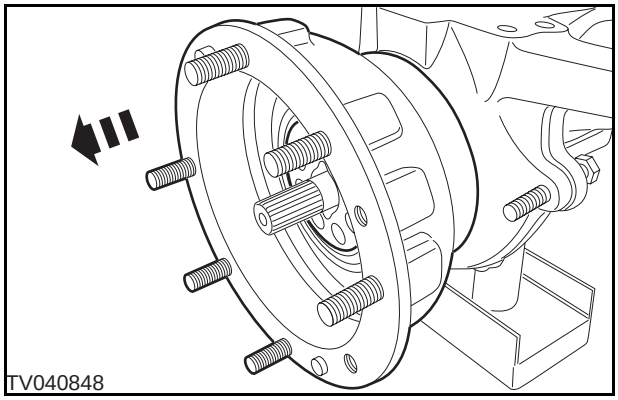
6. Remove the snap ring (1) and remove the epicyclic gear hub (2) from the epicyclic ring gear (3).
7. Using the special tool **CA715027 — Driver for bush** remove the wheel hub centering bushes.



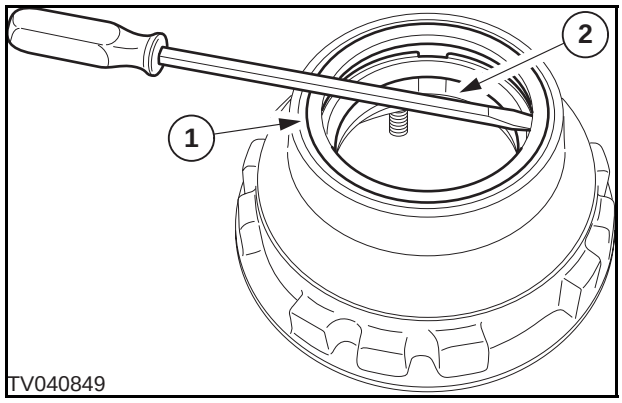
TV040771

8. Using a suitable soft faced hammer, remove the front axle hub.

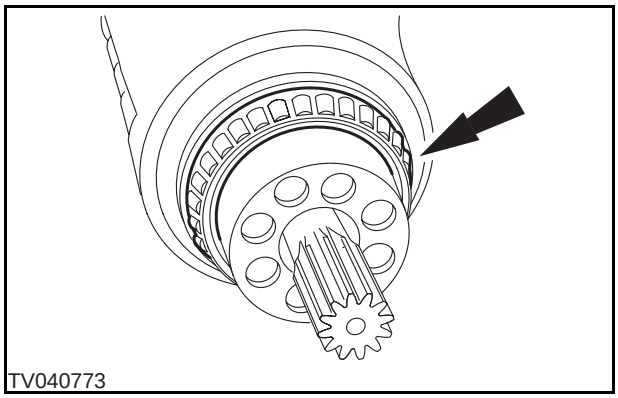
Note:
- Recover the outer taper roller bearing.


TV040848

9. Using a suitable lever, remove and discard the hub seal (1).
10. Recover the outer taper roller bearing. Using a suitable drift, remove the inner and outer taper roller bearing cones (2).



11. Using a suitable puller, remove the inner taper roller bearing.



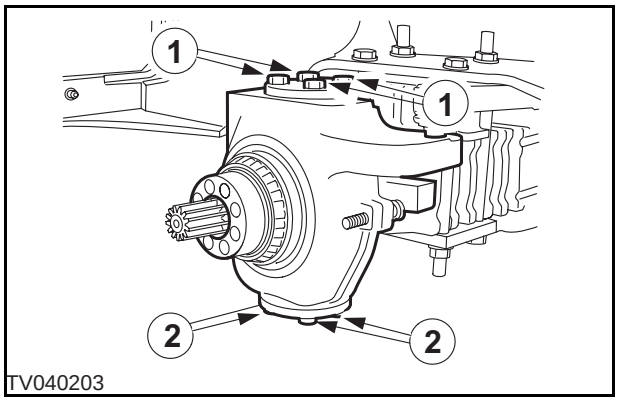
⚠ **Warning:**

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

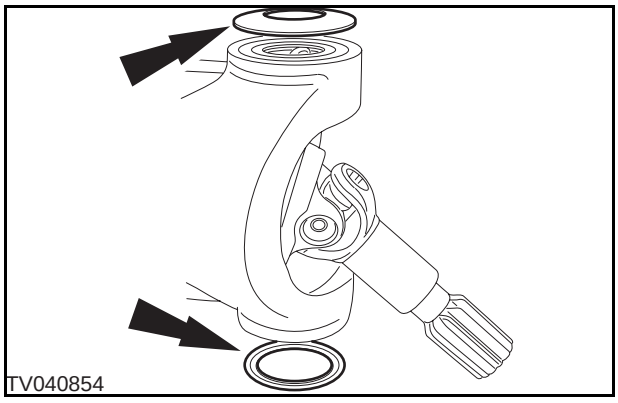
Note:

- Using suitable lifting equipment, support the wheel hub assembly .

12. Remove the upper (1) and lower (2) kingpin retaining bolts and remove the kingpins.
13. Remove the swivel hub assembly.



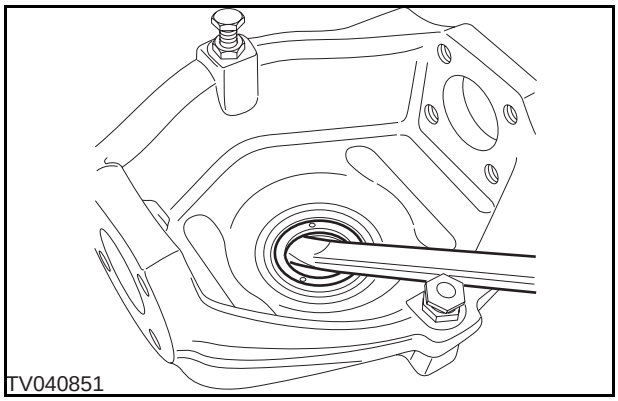
14. Remove the swivel thrust washers. Note the orientation to aid installation.


TV040854

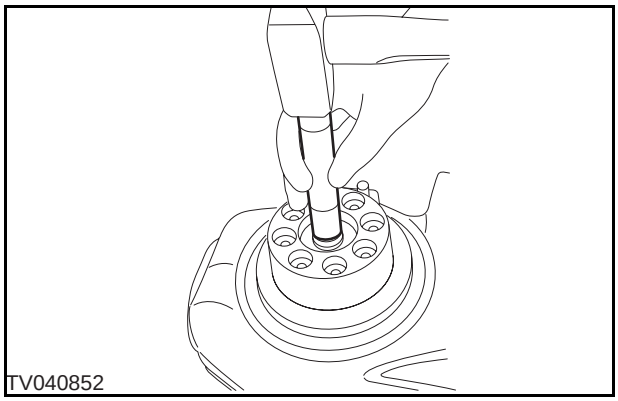
Note:
- Position the swivel hub on a suitable flat surface.

15. Using a suitable lever, remove the oil seal.
16. Using a suitable lever, remove the oil seal.

Note:
- Discard the oil seal.


TV040851

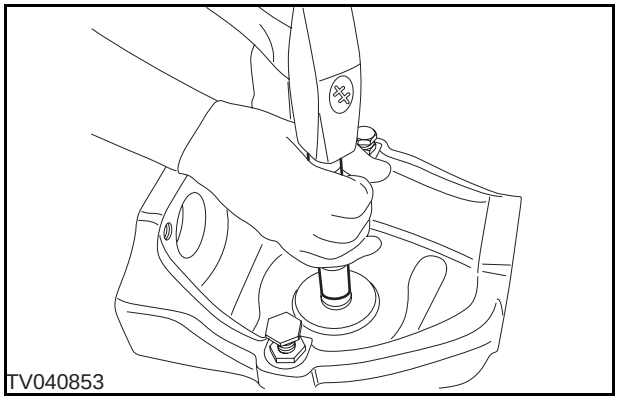
17. Using a suitable drift, remove the swivel housing bush.


TV040852

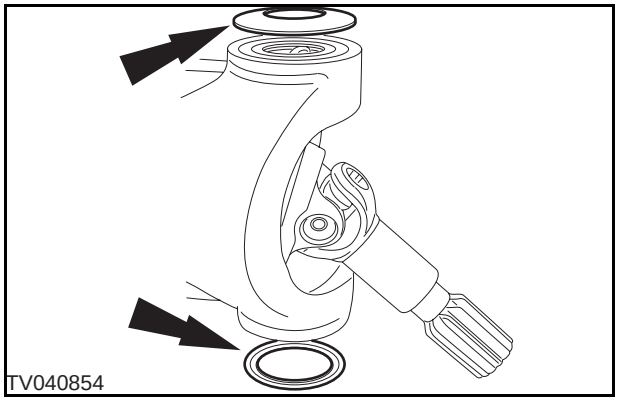
Assembly

1. Using the special tool **CA119043 — Driver for bush** , install the bush.

2. Using the special tool **CA119117 — Driver for oil seal** , install the oil seal.


TV040853

3. Install the swivel thrust washers.


TV040854

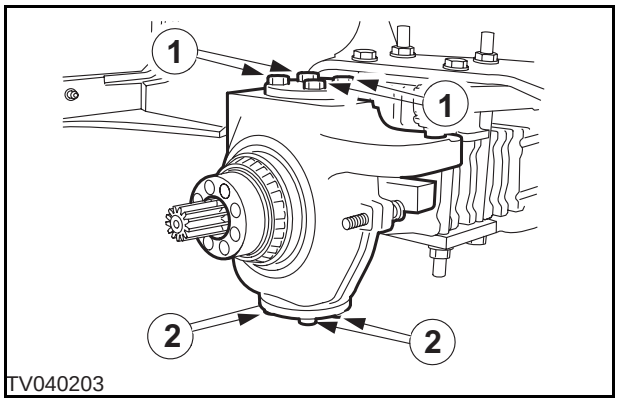
⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:
- Using suitable lifting equipment, support the swivel hub assembly .

4. Install the swivel hub assembly.

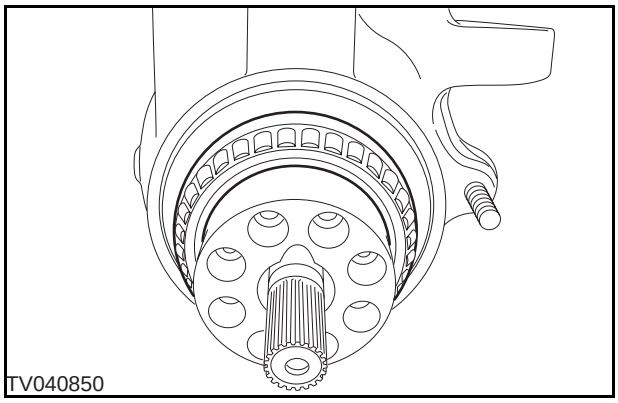
Note:
- Make sure the double universal-joint shaft is fully installed into the axle housing.

5. Install the upper (1) and lower (2) kingpins and kingpin retaining bolts.
6. Tighten to 190Nm (140 lb.ft).

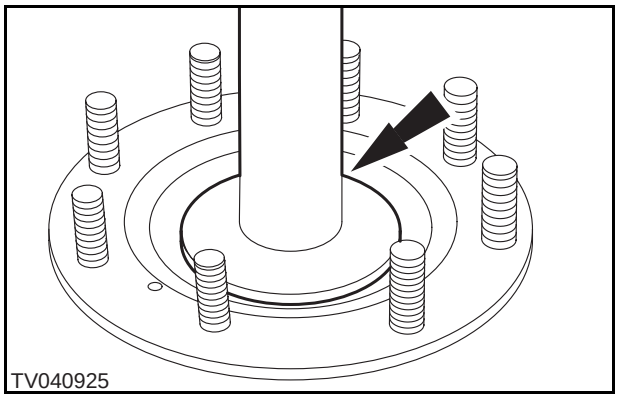


TV040203

7. Install the inner taper roller bearing.

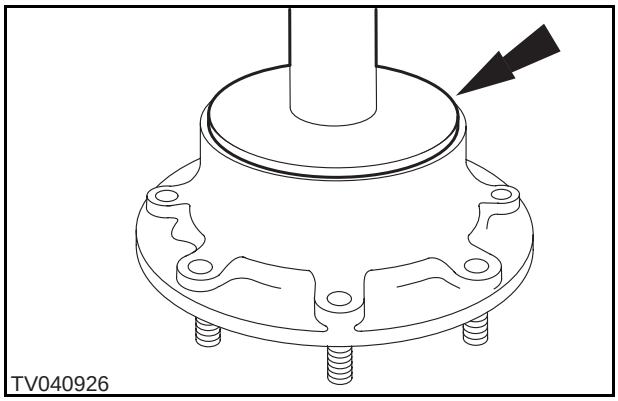

TV040850

8. Using a suitable hydraulic press and the special tool **CA715026 — Driver for bearing race** , install the inner and outer taper roller bearing cones.

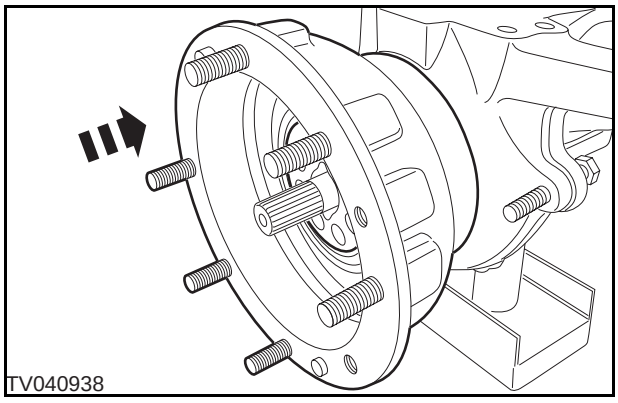

TV040925

Note:
- Lubricate the oil seal with a light grease.

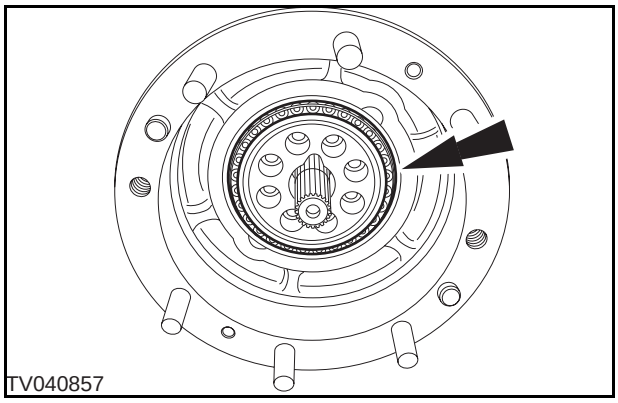
9. Using the special tool **CA119143 — Driver for oil seal** , install a new hub oil seal.


TV040926

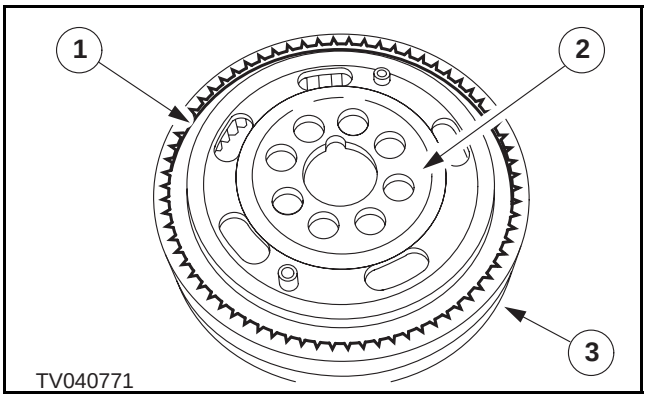
10. Install the front axle hub.


TV040938

11. Install the outer taper roller bearing.

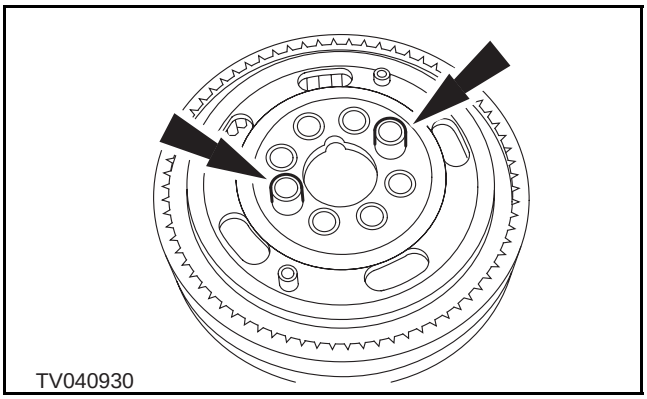


12. Install the epicyclic hub (2) to the epicyclic ring gear (3) and install the snap ring (1).

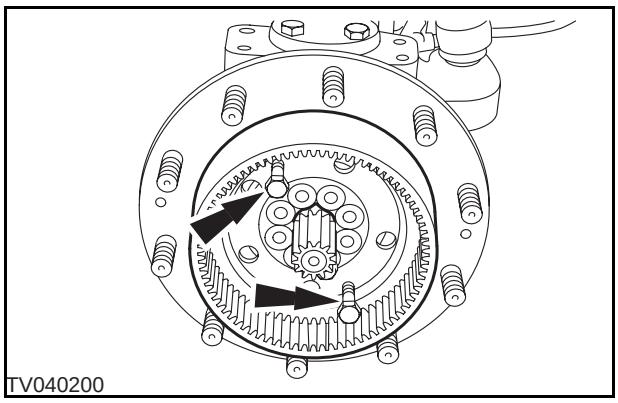


Note:
- Install two bushes slightly higher that the hub surface level to be used as dowel pins.

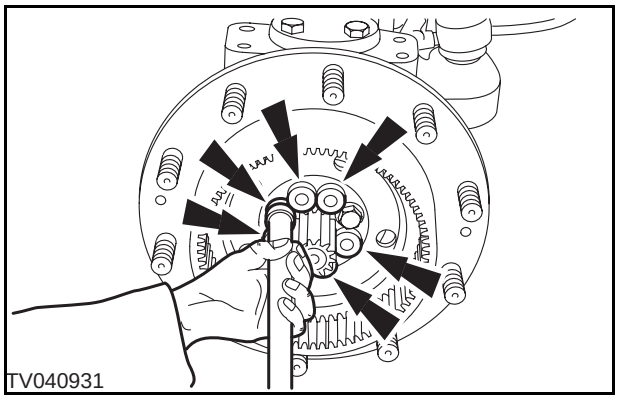
13. Using the special tool **CA715027 — Driver for bush** partially install the hub centering bushes.



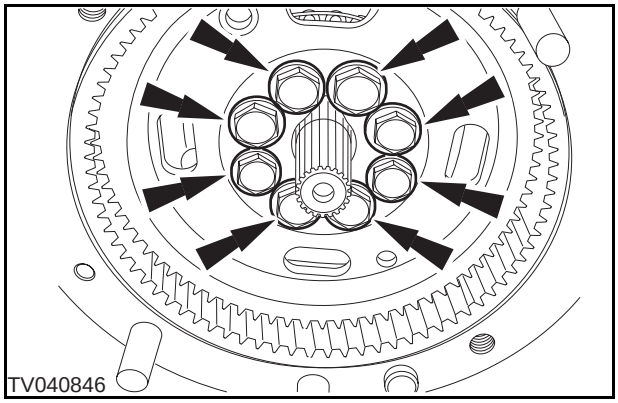
14. Assemble the epicyclic group on the front wheel hub using the two protruding centering bushes as dowel pins.



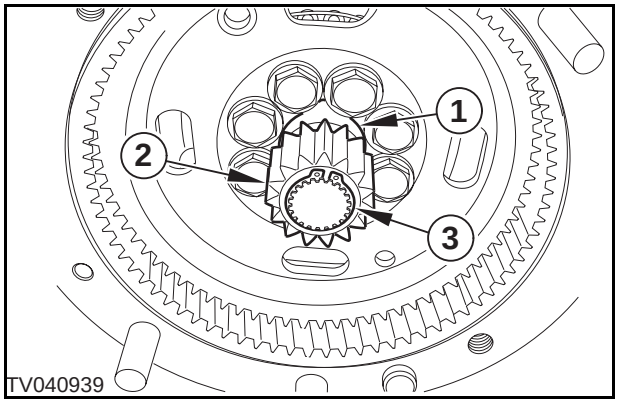
15. Using the special tool **CA715027 — Driver for bush** , install the remaining centering bushes.



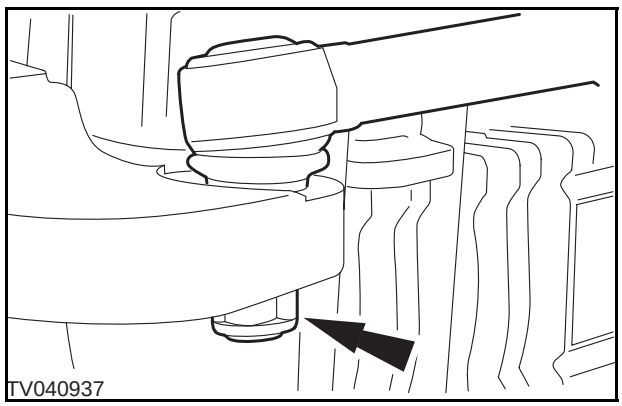
16. Install the epicyclic hub retaining bolts.
17. Tighten to 230Nm (170 lb.ft).



18. Install the spacer (1), sun gear (2) and circlip (3) onto the double universal-joint shaft.



19. Install the track rod end into the wheel hub.
20. Tighten to 220Nm (162 lb.ft).
21. Install the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE L11–03–15 in this section.



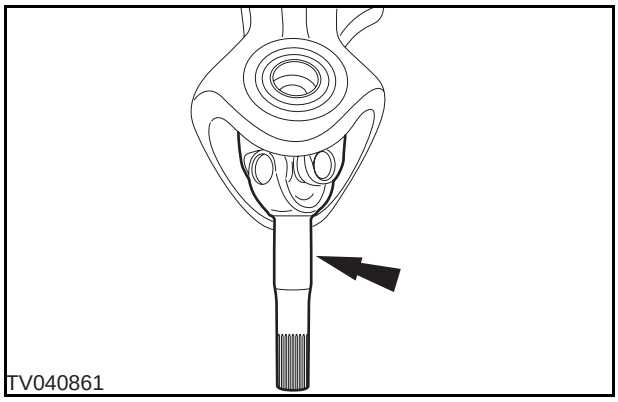
DISASSEMBLY AND ASSEMBLY — AXLE HOUSING GROUP

BHL1102DD

Operation: **Disassembly and Assembly of the Axle Housing Group**	*Job Code:* **11 07 17 xx**		
None	Standard tools, CA715034, CA715505, CA715163, CA715164, CA715701		

Disassembly

1. Remove the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE L11–02–23 in this section.
2. Drain the axle oil into a suitable container. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL, PAGE L11–02–65 in this section.
3. Remove the two double Universal-Joints from the axle housing (both sides).

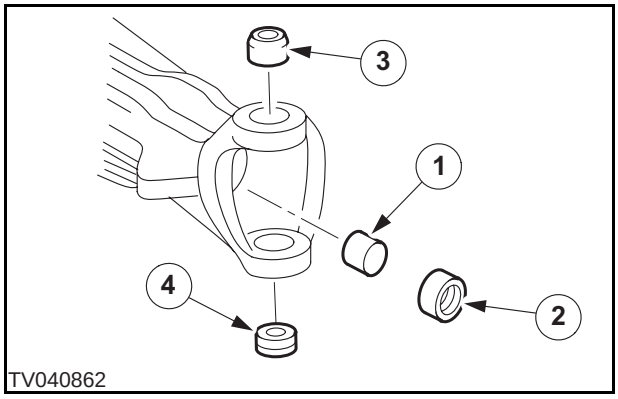

TV040861

4. Remove the oil seal (2) from the axle housing (both sides).

   Note:
   - Discard the oil seal rings.

   ⚠ **Caution:**
   - **Be careful not to damage the bush housing.**

5. Remove the bushes (1) from the axle housing (both sides).
6. Using a suitable extractor remove the upper king pin bush (3) and the ball bearing cup (4) from the king pin housings (both sides).



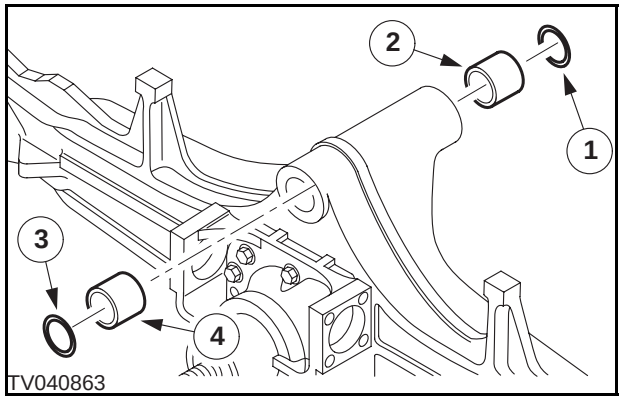
TV040862

7. Remove the oil seals (1) and (3) from the axle housing.

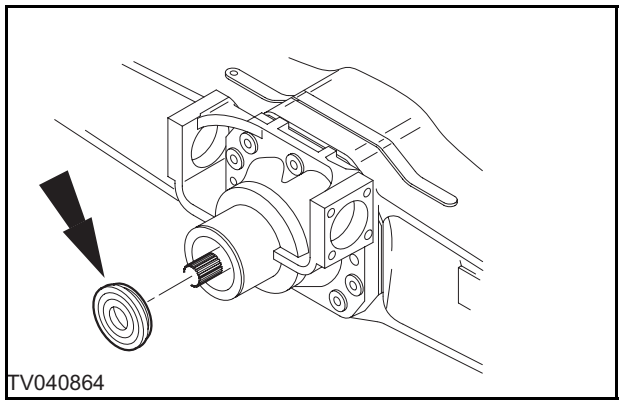
   Note:
   - Discard the oil seals.

8. Remove the bushes (2) and (4) from the axle housing.

   ⚠ **Caution:**
   - **Be careful not to damage the bush housing.**

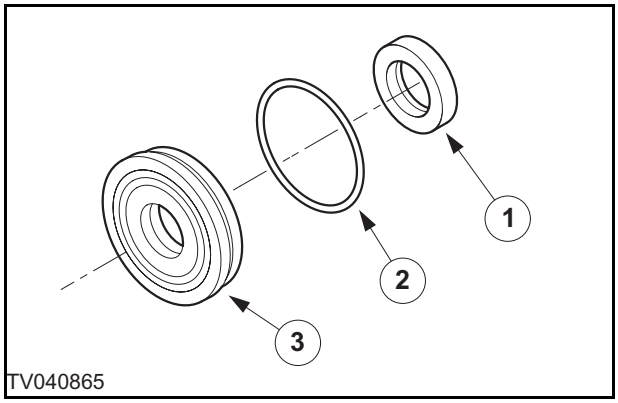


9. Using a suitable lever, remove the cover from the differential support .



10. Remove the oil seal (1) and the O-ring (2) from the cover (3).

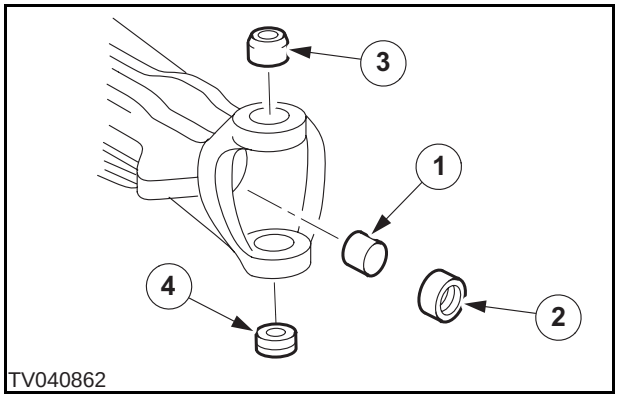
    Note:
    - Discard the oil seals.



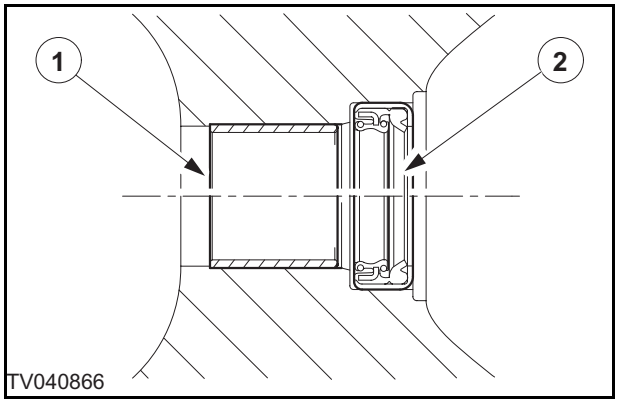
Assembly

Note:
- Install new oil seals.

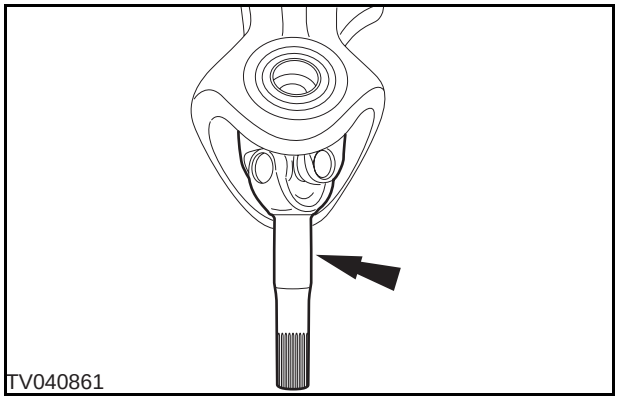
1. Using the special tool **CA715034** , install the king pin bush (3) in the axle housing (both sides).
2. Using the special tool **CA175034 - Driver** , install the ball bearing cup (4) in the axle housing (both sides).
3. Using the special tool **CA715505 - Driver** , install the bush (1) and the oil seal (2).



4. Install the bush (1) and the oil seal (2) as shown.



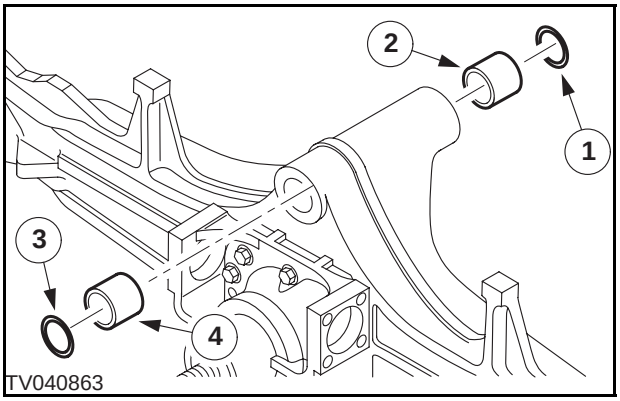
5. Install the two double Universal-Joints into the axle housing (both sides).



6. Using the special tool **CA715163 - Driver** install the bushes (2) and (4) on the axle housing.

   Note:
   - Lubricate the oil seal with a light grease.

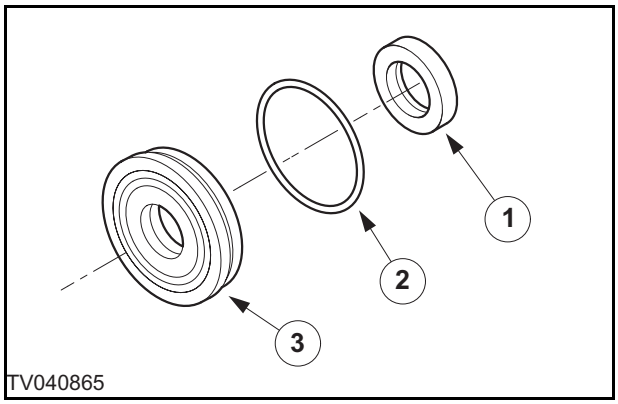
   Using the special tool **CA715164 - Driver** install the oil seals (2) and (3) on the axle housing.



TV040863

   Note:
   - Lubricate the oil seal with a light grease.

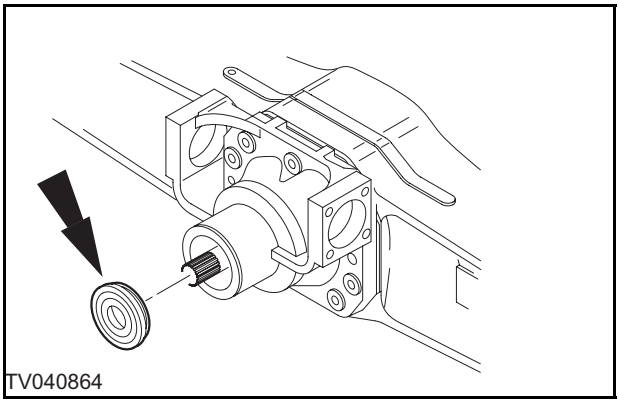
7. Using the special tool **CA715701 - Driver** Install the oil seal (1) to the cover (8).
8. Install the O-ring seal (2) to the cover (3).



TV040865

   ⚠ Caution:
   - **Cover the pinion shaft spline to protect the oil seal from damage.**

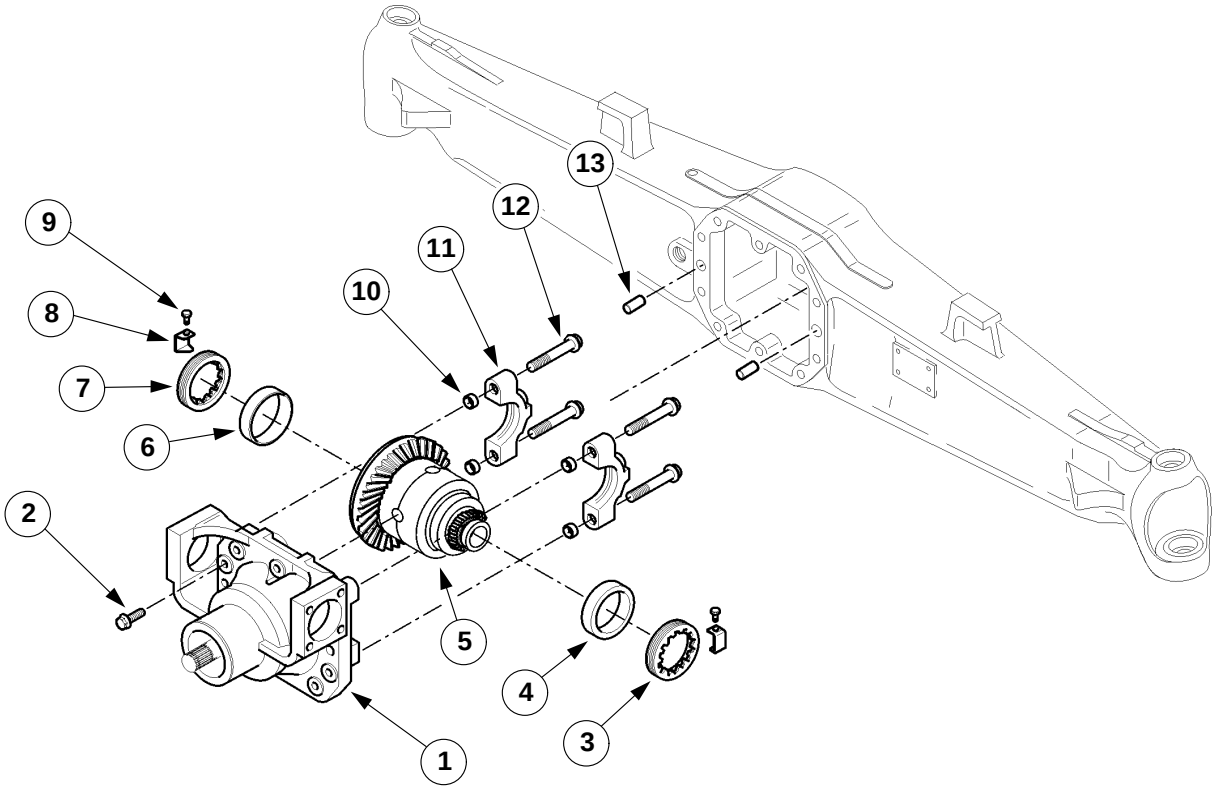
9. Install the cover to the axle housing.
10. Install the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE L11–02–23 in this section.
11. Fill the axle with oil. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL, PAGE L11–02–65 in this section.


TV040864

DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL SUPPORT GROUP

BHL1102DE

Operation: **Disassembly and Assembly of the Differential Support Group**	*Job Code:* **11 03 13 xx**		
Suitable lifting equipment	Standard tools, CA119030, CA715116		



TV040605

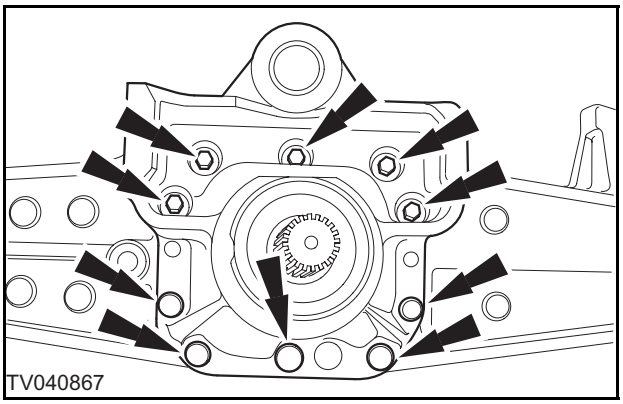
1	Differential Support
2	Retaining Bolt
3	Adjustment Nut
4	Taper Roller Bearing
5	Differential Assembly
6	Taper Roller Bearing
7	Adjustment Nut
8	Locking Tab
9	Retaining Bolt
10	Dowel
11	Differential Half-Collers
12	Retaining Bolt
13	Dowel

Disassembly

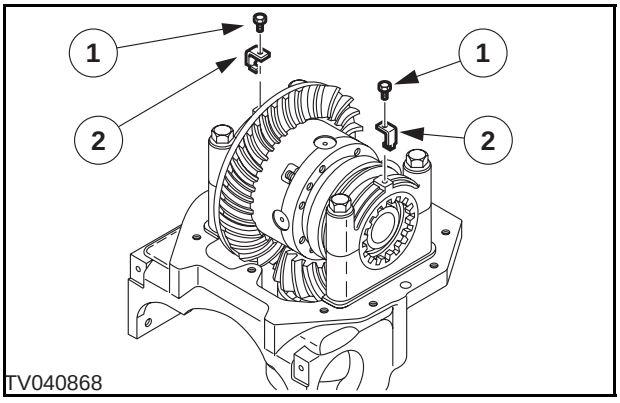
1. Remove the axle housing group. For additional information, refer to AXLE HOUSING GROUP, PAGE L11–02–33 in this section.

   ⚠ **Warning:**
   - **Support the differential support. Failure to follow this instruction may result in personal injury.**

2. Remove the differential support from the axle housing.

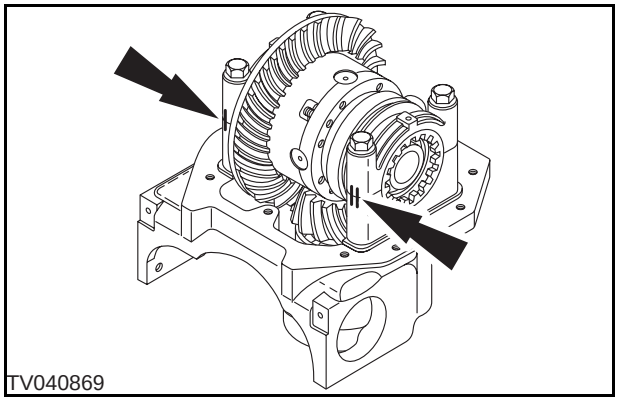

TV040867

3. Remove the locking tab retaining bolts (1) and remove the adjustment nut locking tabs (2).

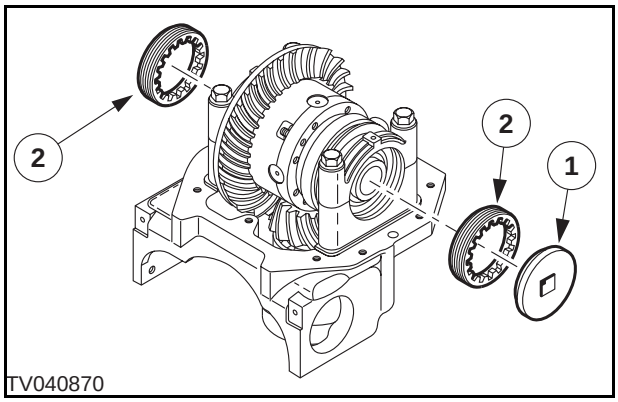


TV040868

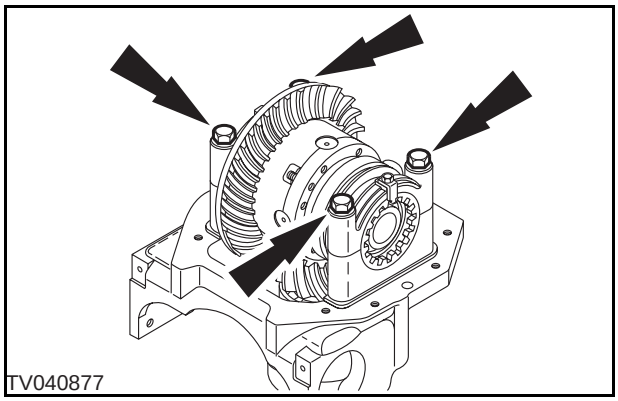
4. Mark the differential half-collers and the differential adjustment nuts to aid installation.


TV040869

5. Using the special tool **CA119030 — Wrench** (1), Remove the differential adjustment nuts (2).

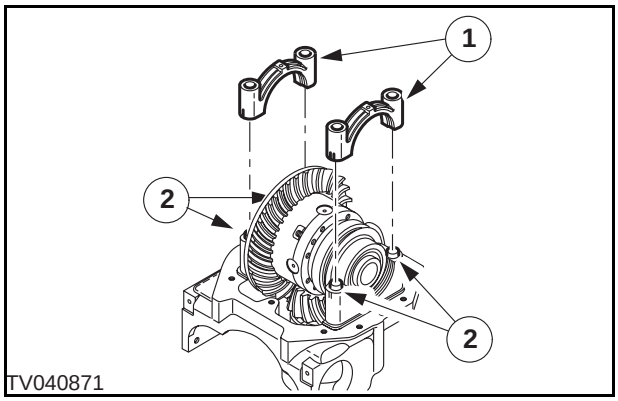


6. Remove the half-collers retaining bolts.



7. Remove the half–collers (1).

Note:
- Recover the half-coller dowels (2).

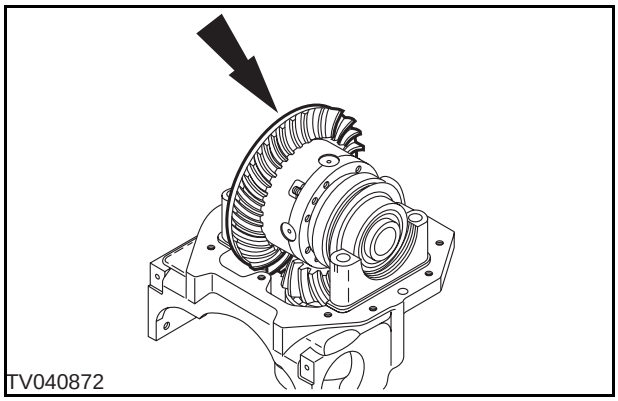


⚠ **Caution:**
- **If the taper roller bearings are not to be replaced, make sure the taper roller bearing and cone remain a matched pair.**

⚠ **Caution:**
- **Make a note of the differential position to aid installation.**

8. Remove the differential assembly.

Note:
- Recover the taper roller bearing cones.


TV040872

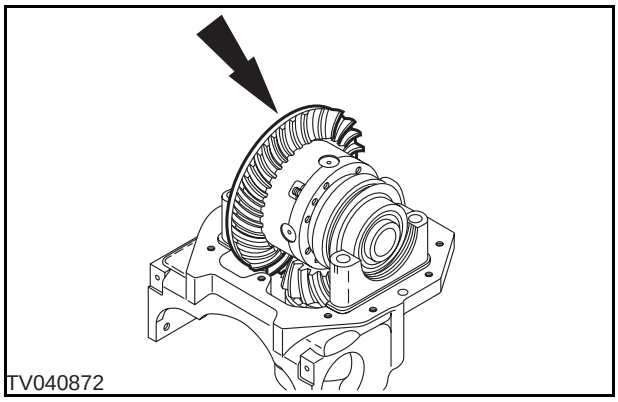
Assembly

1. Install the pinion shaft. For further information refer to PINION GROUP, PAGE L11–02–53 in this section.

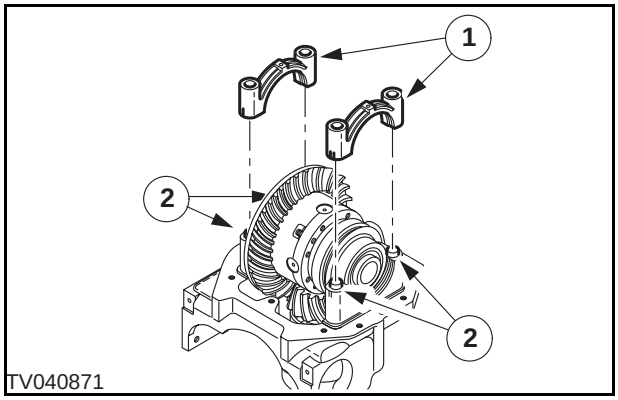
⚠ Caution:
- **Make sure the taper roller bearing and cone remain a matched pair.**

⚠ Caution:
- **Make sure the differential is installed in the correct orientation.**

2. Install the differential assembly.


TV040872

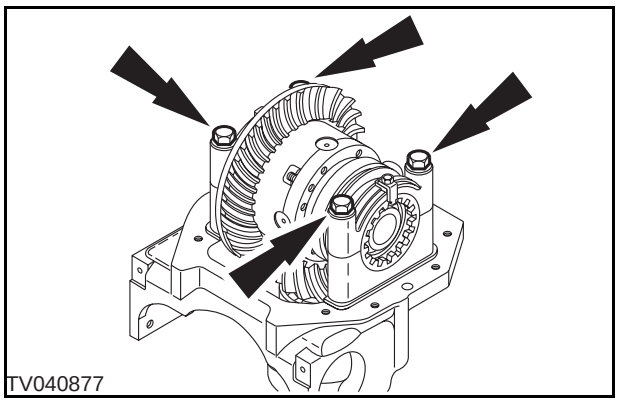
3. Install the half-coller dowels (2).
4. Install the half–collers (1).



TV040871

Note:
- Do not tighten at this stage.

5. Install the half-collers retaining bolts.

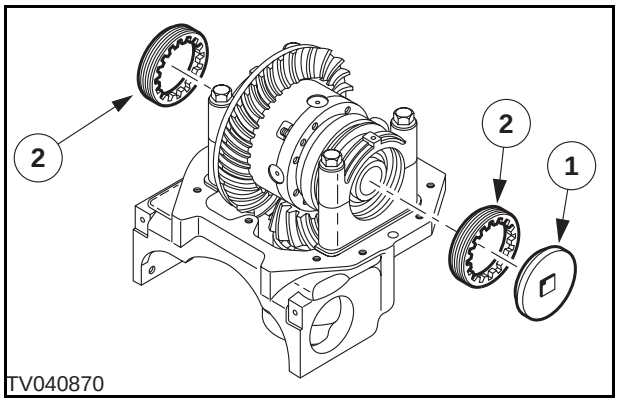

TV040877

⚠ **Caution:**
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

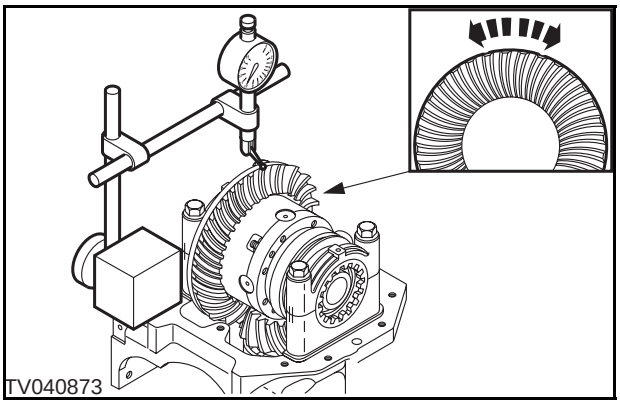
Note:
- Only tighten the differential adjustment nut until the bearing backlash is removed and nominal pre-load is achieved.

6. Using the special tool **CA119030 — Wrench** (1), Install the differential adjustment nuts (2).

Note:
- Using a suitable soft-faced hammer, settle the differential taper roller bearings.

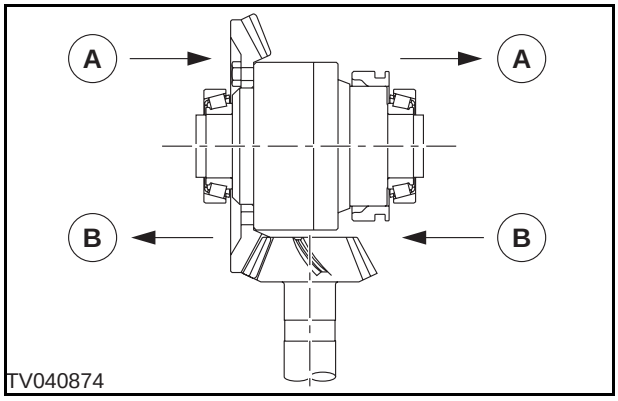


7. Lock the pinion shaft.
8. Using a suitable measuring device, measure the pinion to crown wheel backlash.
9. Repeat the measurement in a further two positions 120° apart and compare the average of the three values.
10. The pinion to crown wheel backlash should be within the following range:
0.18mm — 0.23mm



Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the nominal bearing pre-load and no free play.

11. Using the special tool **CA119030 — Wrench** , adjust the differential adjustment nuts until the correct pinion to crown wheel backlash is achieved.
    - **Measured backlash is greater than the specified range — (A)** , adjust the differential assembly closer to the pinion shaft by loosening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment nut equal amounts.
    - **Measured backlash is less than the specified range — (B)** , adjust the differential assembly away from the pinion shaft by tightening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment nut equal amounts.



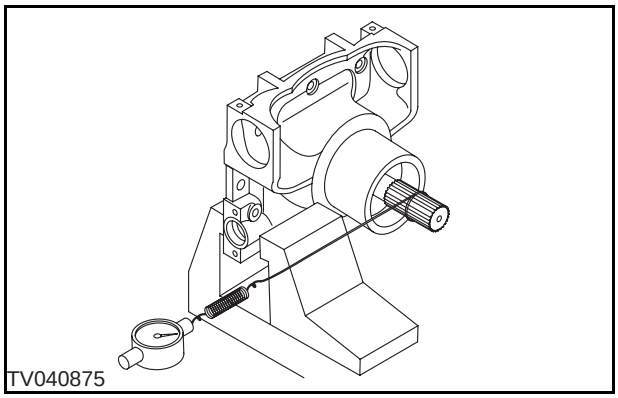
12. Once the correct pinion to crown wheel backlash is achieved, check that the differential taper roller bearings have no free play and no pre-load is evident.
13. Repeat steps 7 to 12 the whole sequence of the above mentioned operations until the indicated conditions are reached.

⚠ **Caution:**
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

Note:
- Using a suitable soft-faced hammer, settle the differential taper roller bearings.

Note:
- Rotate the differential assembly while tightening the adjustment nuts to seat the bearing rollers on their track.

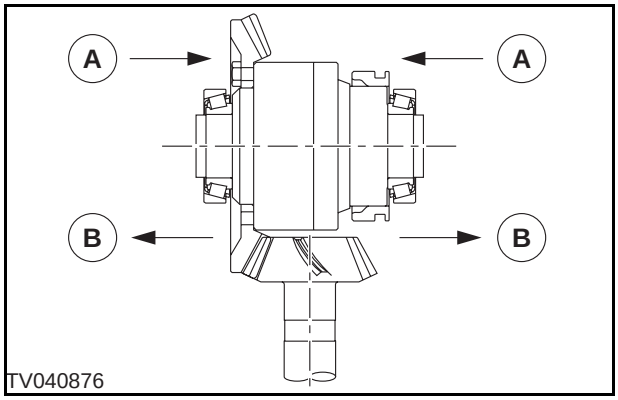
14. Using a suitable measuring device with the cord wound round the pinion shaft spline, measure the total rotational torque.


TV040875

15. The total rotational torque should be within the following range excluding breakaway torque.
    (4.3 + P) to (6.45 + P) daN
    P = Measured pinion shaft rotational torque. For additional information refer to PINION GROUP, PAGE L11–02–53 in this section.

Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the set backlash.

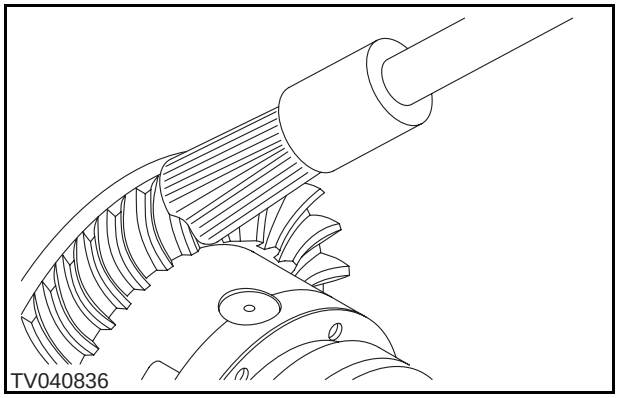
16. Using the special tool **CA119030 — Wrench** , adjust the differential adjustment nuts until the correct differential taper roller bearing pre-load is achieved.
    - **Total pre-load is less than the specified range — (A)** , increase the differential taper roller bearing pre-load by tightening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment equal amounts.
    - **Total pre-load is higher than the specified range — (B)** , decrease the differential taper roller bearing pre-load by loosening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment equal amounts.



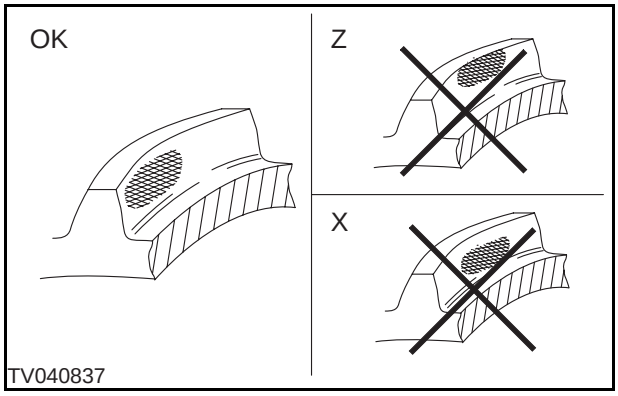
Testing After Adjustment

Note:
- The marking test should always be carried out on both sides of the crown wheel teeth.

17. To test the marks of the crown wheel teeth, paint the ring gear with engineer's blue.


TV040836

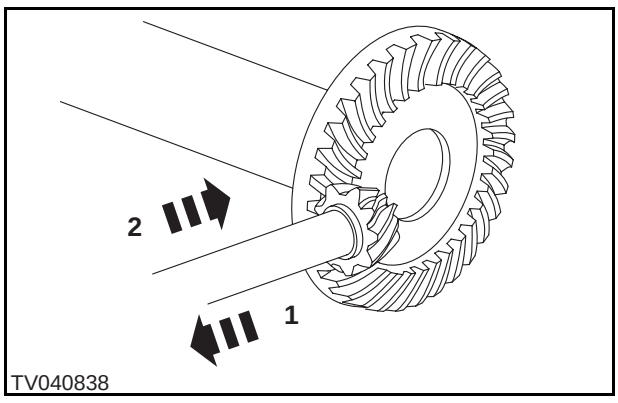
18. Check the contact pattern:
    OK = Correct contact — If the crown wheel is well adjusted, the mark on the teeth surfaces will be regular.
    Z = Excessive contact on the tooth tip — Adjust the pinion towards the crown wheel and then adjust the crown wheel away from the pinion in order to adjust the backlash.
    X = Excessive contact at the tooth base — Adjust the pinion away from the crown wheel and then adjust the crown wheel towards the pinion in order to adjust the backlash.



TV040837

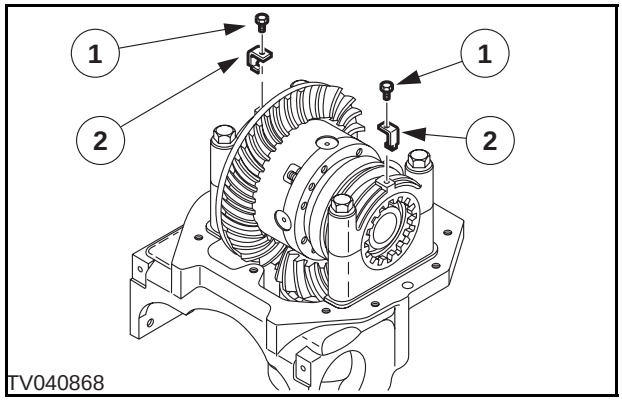
Movements to correct

19. Adjust as required:
    1 = move the pinion for type X contact adjustment.
    2 = move the pinion for type Z contact adjustment.

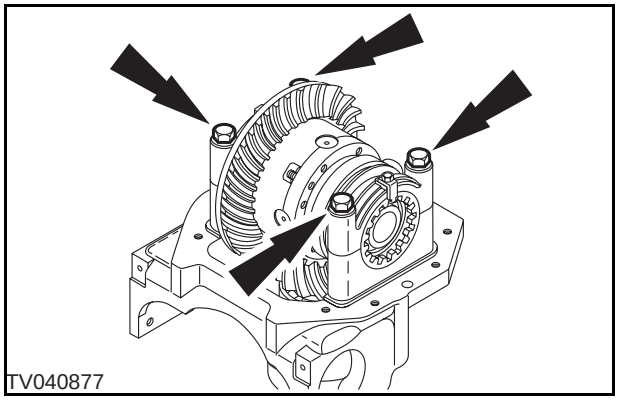


TV040838

20. Install the adjustment nut locking tabs (2) and install the locking tab retaining bolts (1).
21. Tighten to 13Nm (10 lb.ft).



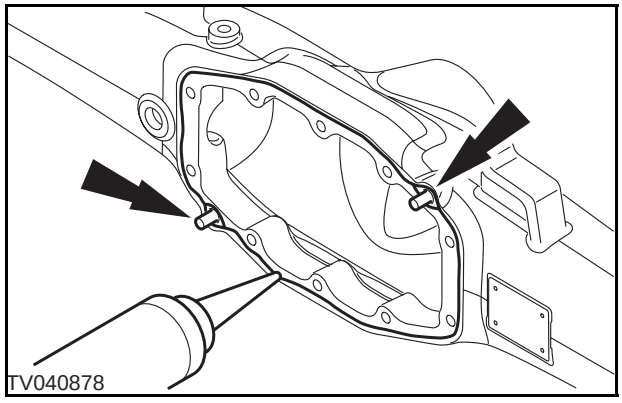
22. Tighten the half-collers retaining bolts to 266Nm (196 lb.ft).



Note:

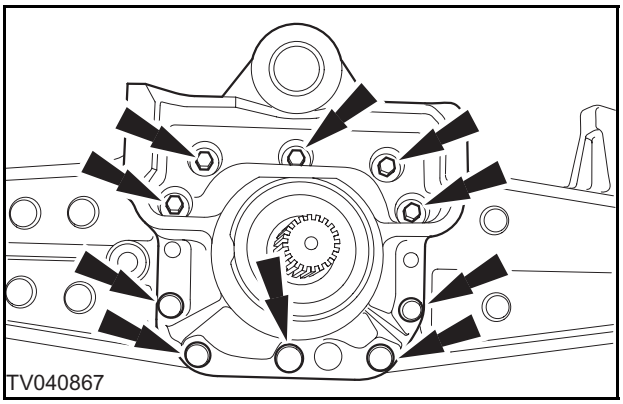
- Make sure the two dowel pins are installed into the axle housing.

23. Thoroughly clean and de-grease the mating surfaces. Apply a bead of sealant following the pattern shown.



24. Install the differential support onto the axle housing.
25. Tighten to 169Nm (125 lb.ft).

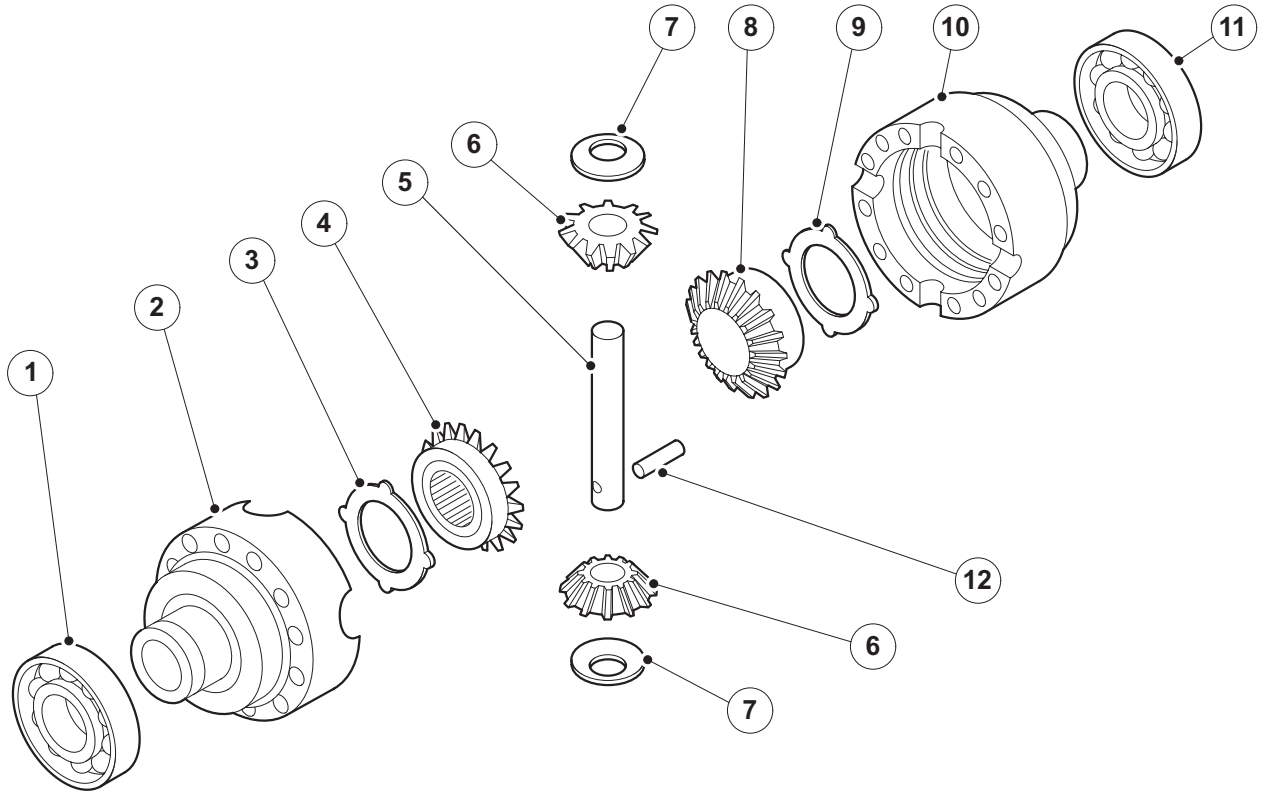
26. Install the axle housing group. For additional information, refer to AXLE HOUSING GROUP, PAGE L11–02–33 in this section.


TV040867

DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL GROUP

BHL1102DF

Operation: **Disassembly and Assembly of the Differential Group**	*Job Code:* **11 03 17 xx**		
None	Standard tools, Suitable puller		

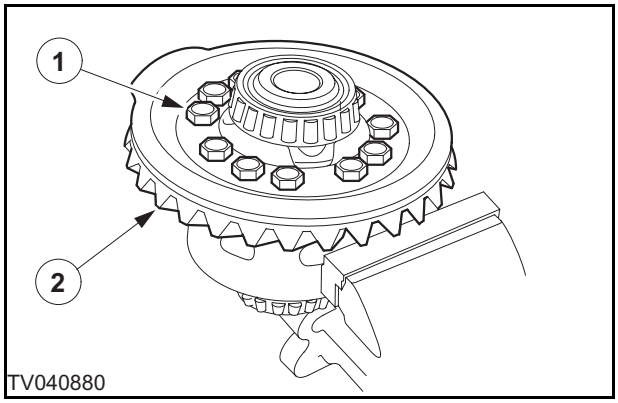


TV0400879

1	Taper Roller Bearing
2	Housing
3	Thrust Plate
4	Sun Gear
5	Planetary Shaft
6	Planetary Gear
7	Thrust Washer
8	Sun Gear
9	Thrust Plate
10	Housing
11	Taper Roller Bearing
12	Locking Pin

Disassembly

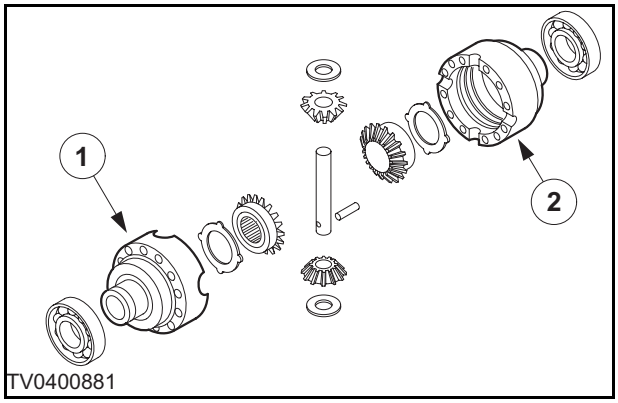
1. Remove the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–02–37 in this section.
2. Position the differential in a suitable vice.
3. Remove the crown wheel retaining bolts (1) and remove the crown wheel (2).



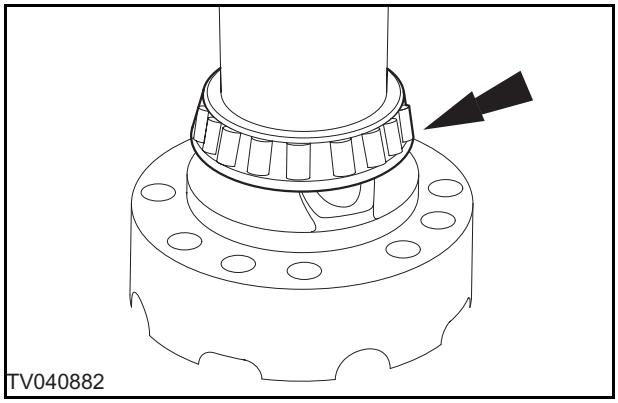
⚠ **Caution:**
- **Make sure the internal differential components remain with the bottom housing.**

Note:
- Mark the differential carrier prior to disassembly to aid installation.

4. Remove the housing (1) from the housing (2).
5. Disassemble all of the internal differential components.
6. Check for wear of the components. Replace as necessary.

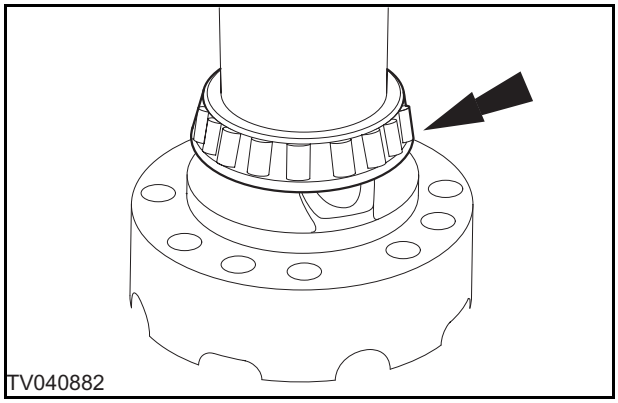


7. Using a suitable bearing puller remove the taper roller bearings from the housings.

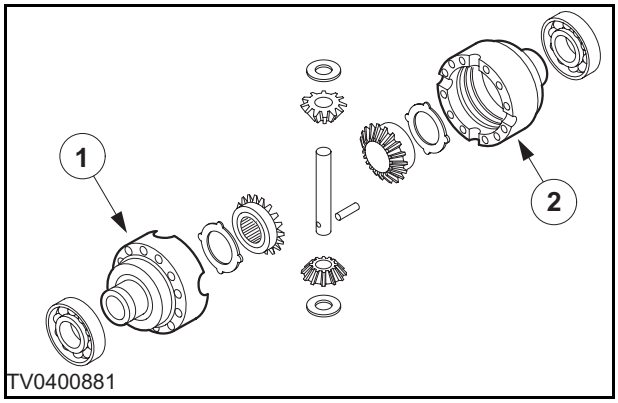


Assembly

1. Using the special tool **CA119230 — Driver** , install the taper roller bearings on the housings.


TV040882

2. Install the internal differential components into the bottom housing.
3. Install the housing (1) onto the housing (2).

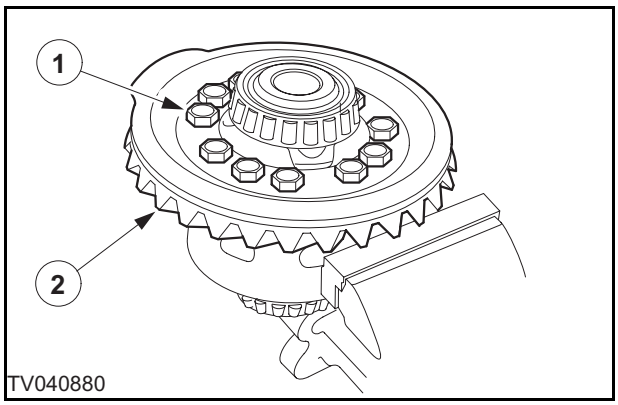


TV0400881

Note:

- Before installing the crown wheel retaining bolts, apply approved sealant (Loctite 270) to the bolts.

4. Install the crown wheel (2).
5. Tighten (1) to 95Nm (70 lb.ft).
6. Install the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–02–37 in this section.



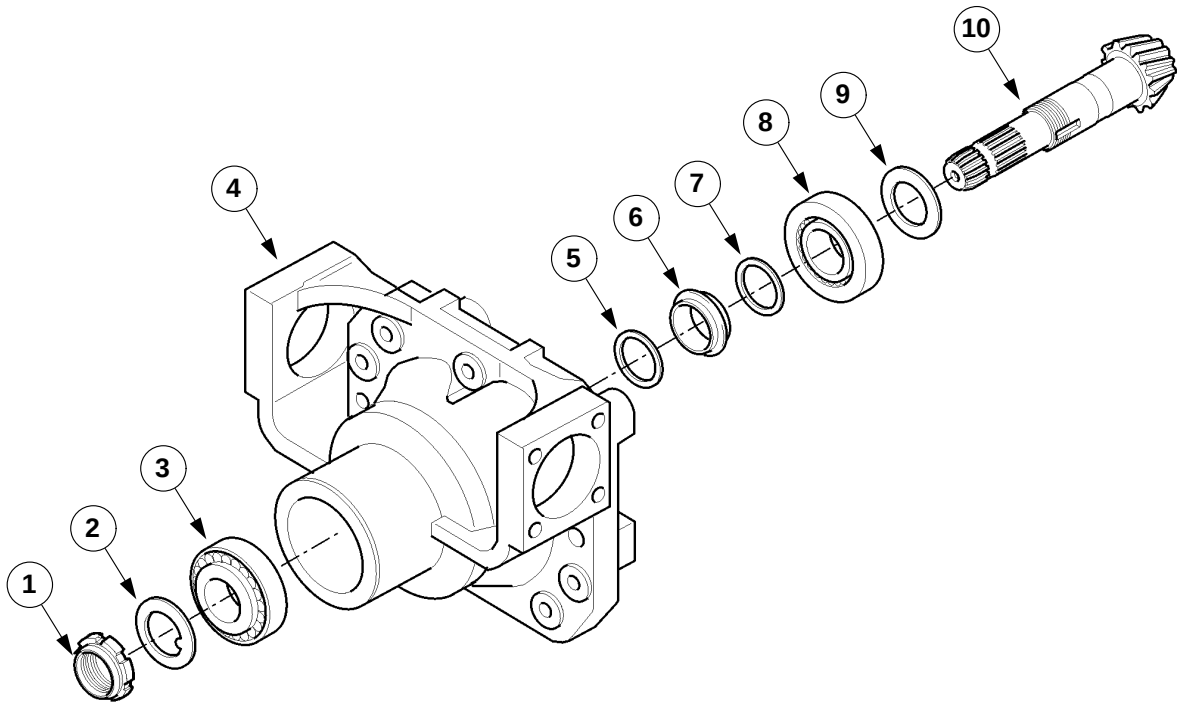
TV040880

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DISASSEMBLY AND ASSEMBLY — PINION GROUP

BHL1102DG

Operation: **Disassembly and Assembly of the Pinion Group**	*Job Code:* **11 09 17 xx**		
None	Standard tools, CA119099, CA715170, CA119225, CA715023, CA119182. CA119226, CA715179		



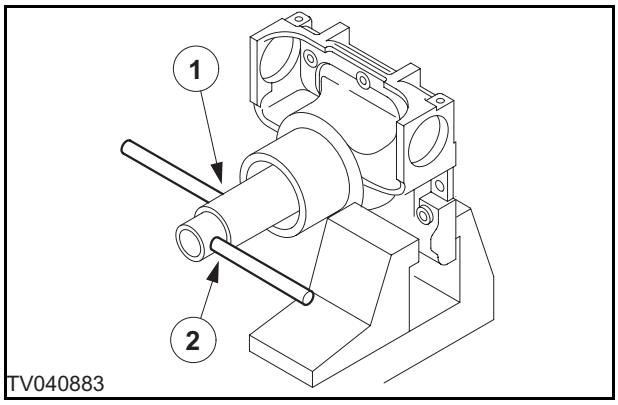
TV040603

1	Pinion Shaft Retaining Nut
2	Retaining Lock Washer
3	Taper Roller Bearing
4	Differential Support
5	Washer
6	Collapsable Spacer
7	Washer
8	Taper Roller Bearing
9	Adjustment Shim
10	Pinion Shaft

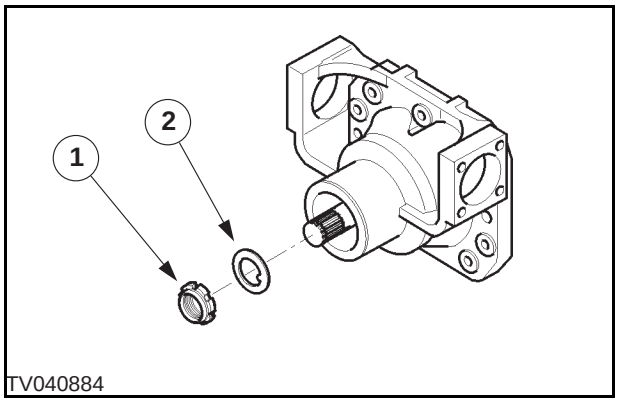
Disassembly

1. Remove the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–02–37 in this section.

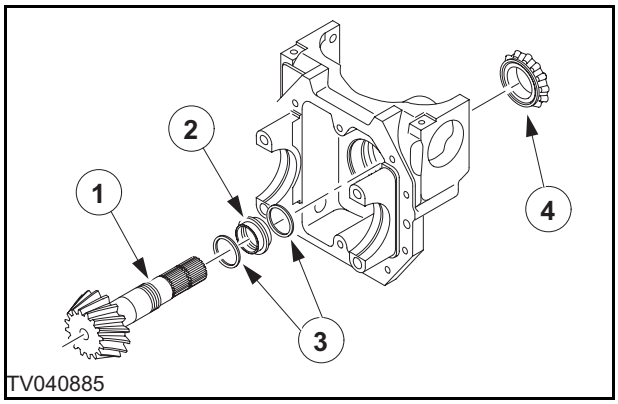
2. Position the differential support group in a suitable vice.
3. Using the special tools **CA119099 — Wrench** (1) and **CA715170 — Wrench** (2) release the pinion shaft retaining nut.



4. Remove and discard the pinion shaft retaining nut (1).
5. Remove the retaining lock washer (2).

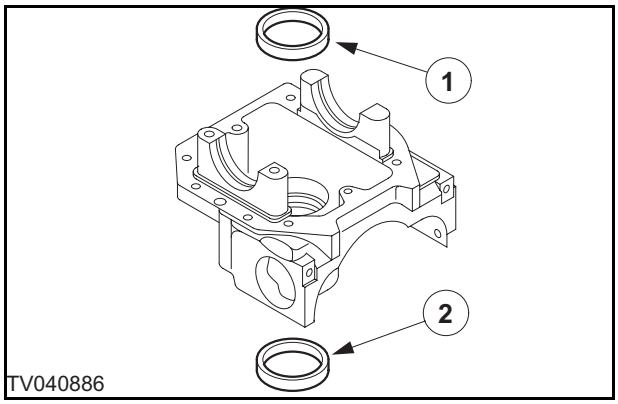


6. Using a suitable soft faced hammer, remove the pinion shaft (1).
7. Remove and discard the collapsable spacer (2).
8. Recover the washers (3) and taper roller bearing (4).

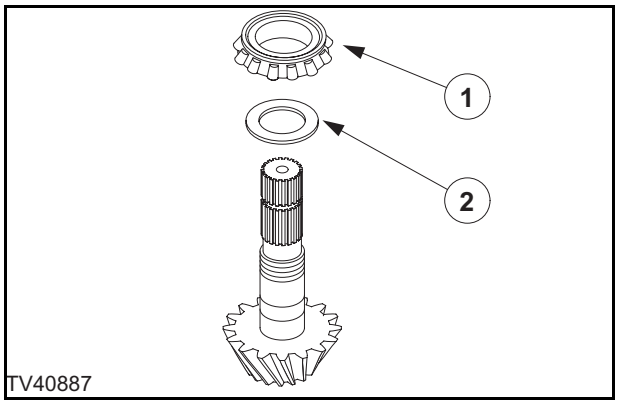


9. Place the differential support on a suitable flat surface.

10. Using a suitable drift, remove the taper roller bearing cones (1) and (2).



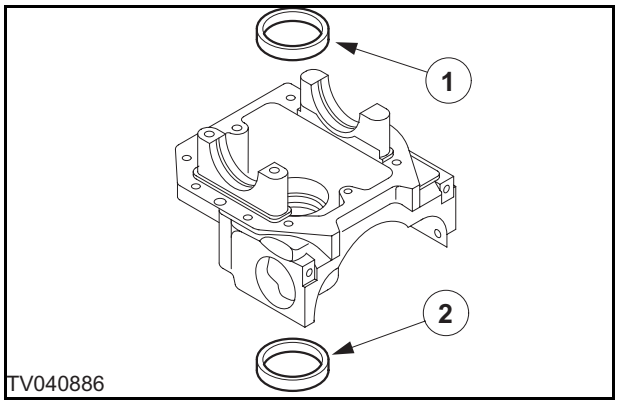
11. Using a suitable bearing puller, remove the taper roller bearing (1).
12. Recover the adjustment shim (2).



13. Check all pinion components for wear. Replace as necessary.

Assembly

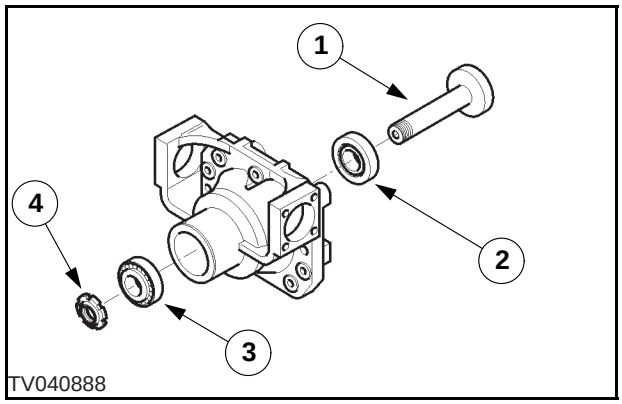
1. Place the differential support on a suitable flat surface.
2. Using the special tool **CA119225 — Driver** , install the taper roller bearing cones (1) and (2).



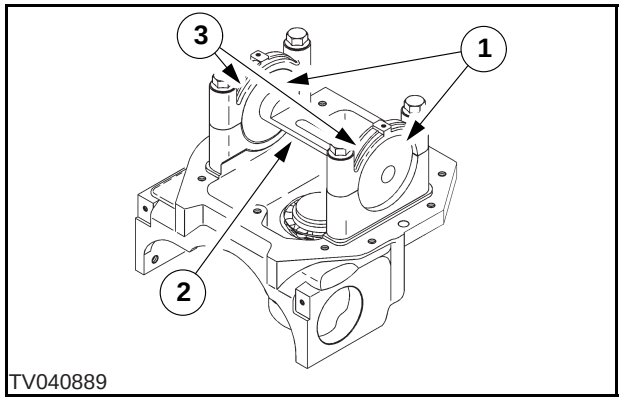
3. Install the special tool **CA715023 — false pinion** (1) with the pinion shaft taper roller bearings (2) and (3).

   ⚠ **Caution:**
   - **Do not over-tighten.**

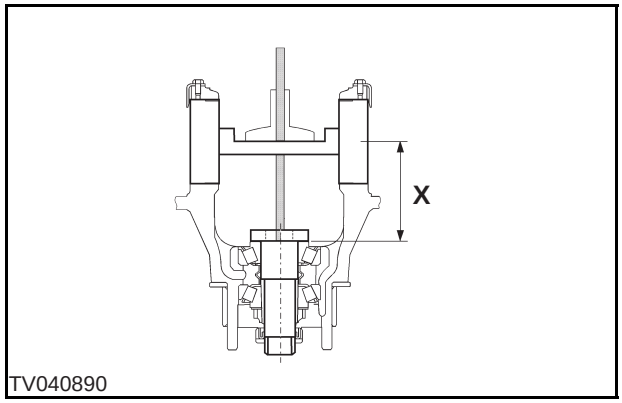
4. Install the pinion shaft retaining nut (4).
5. Tighten until the free play is eliminated.



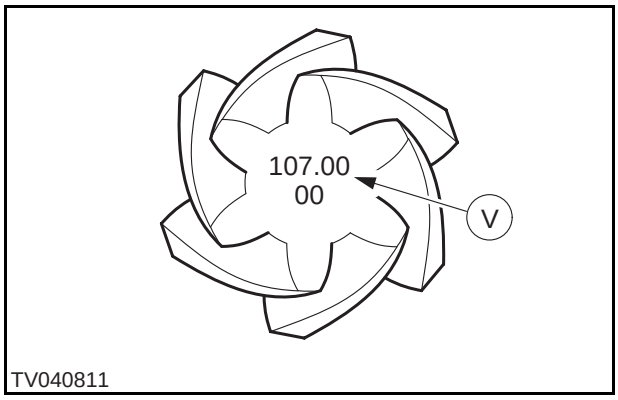
6. Install the special tools **CA119182 — false differential bearings** (1) and **CA119226 — false differential shaft** (2) into the differential support.
7. Secure the special tools into position with the differential half-collers (3).



8. Using a suitable depth gauge, measure through the false differential shaft (CA119226) **This measurement is "X"** .
   X = The distance between the axis of the differential taper roller bearings and the point at which the pinion head is supported, or base of the bearing.

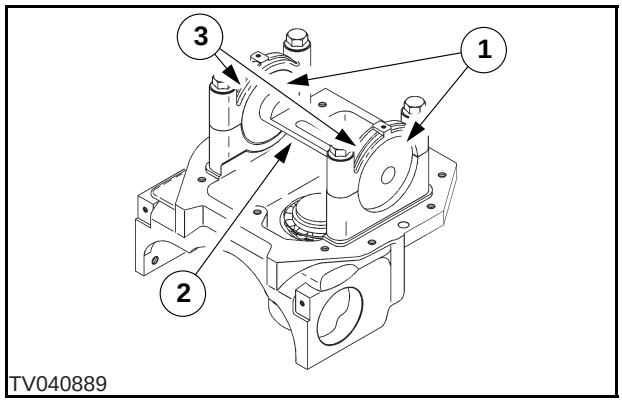


9. Determine the pinion shaft position adjustment shim **"S"** as follows:
   subtract the value **"V"** (requested conical distance) from the calculated value **"X"** .
   S = X — V
   Example: Shim thickness **S** = 109.9 – 107.00 = 2.9mm.
   Shim thickness **"S"** = 2.9mm.



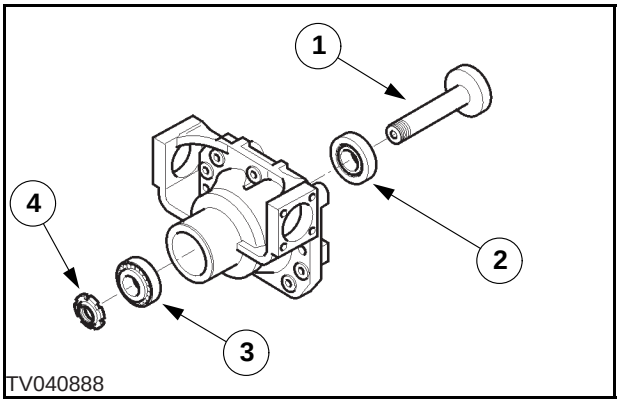
SHIM RANGE										
Thickness (mm)	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4

10. Remove the differential half-collers (3).
11. Remove the special tools **CA119182 — false differential bearings** (1) and **CA119226 — false differential shaft** (2) from the differential support.

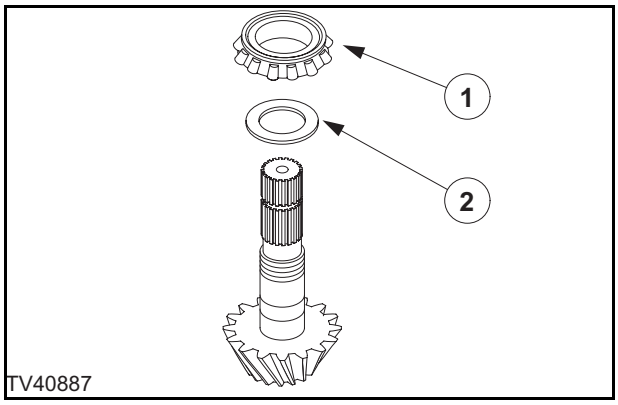


12. Remove the pinion shaft retaining nut (4).

13. Remove the special tool **CA715023 — false pinion** (1) with the pinion shaft taper roller bearings (2) and (3).

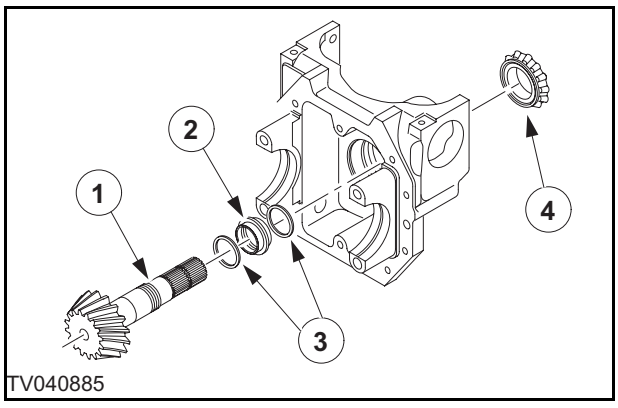


14. Install the pinion shaft position adjustment shim (2) with chamfer against the gear.
15. Using a suitable hydraulic press and the special tool **CA715179 — Driver** install the rear taper roller bearing (1).



⚠ **Caution:**
- **Always install a new collapsable spacer.**

16. Install the pinion shaft (1), new collapsable spacer (2) and the washers (3) into the differential support.
17. Using the special tool **CA715179 — Driver** , install the taper roller bearing (4).

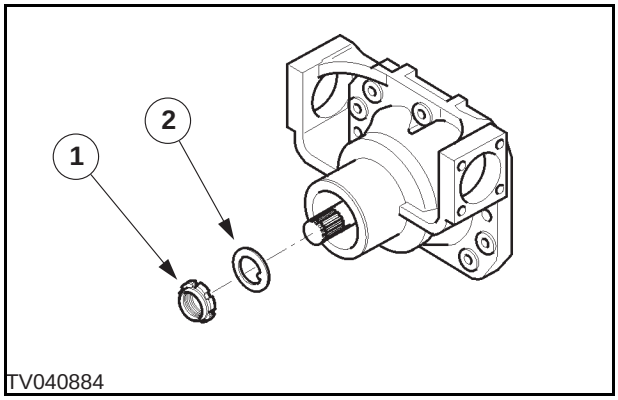


18. Install a new retaining lock washer (2).

⚠ Caution:
- **Always install a new pinion shaft retaining nut.**

Note:
- Do not tighten at this stage.

19. Install a new pinion shaft retaining nut (1).



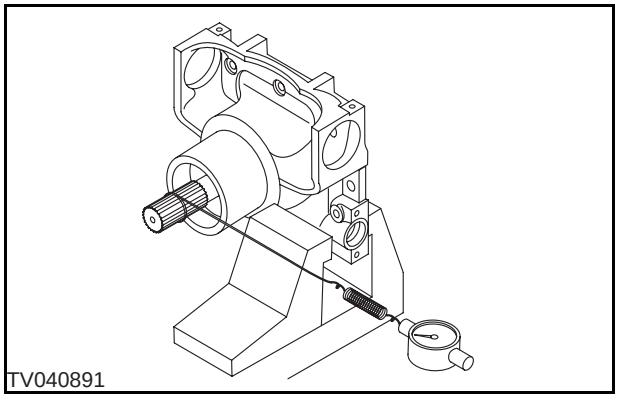
TV040884

⚠ Caution:
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

Note:
- Using a suitable soft faced hammer, settle the pinion shaft bearings.

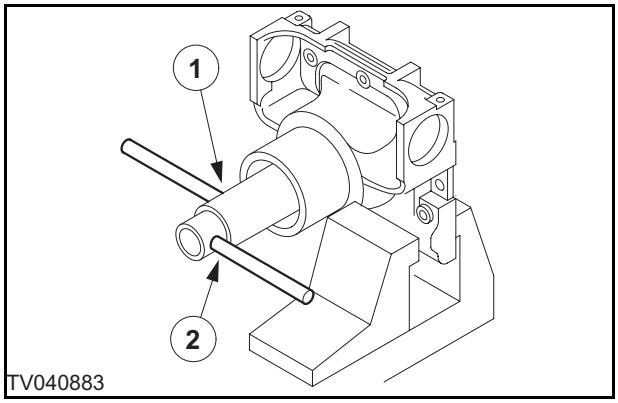
Note:
- Rotate the pinion shaft several times to settle the pinion shaft bearings, before measuring the pinion shaft rotational torque.

20. Using a suitable measuring device with the cord wound round the pinion shaft spline, measure the pinion shaft rotational torque.
21. The rotational torque should be within the following range excluding breakaway torque.
    9.2 to 13.7 daN


TV040891

⚠ **Caution:**
- **If the stated rotational torque range is exceeded the collapsable spacer must be replaced and the procedure repeated.**

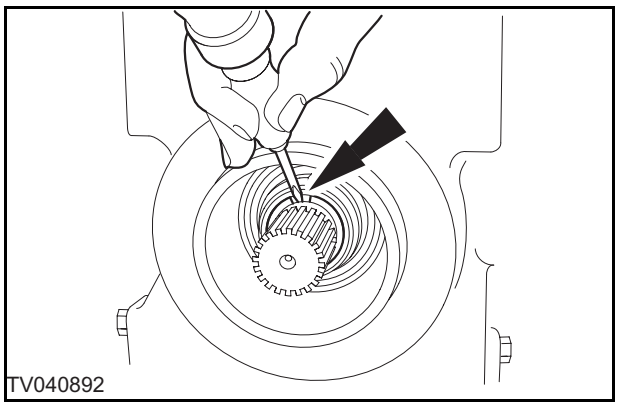
22. The adjustment is carried out by increasing the pinion shaft retaining nut torque setting gradually using the special tools **CA119099 — Wrench** (1) and **CA715170 — Wrench** (2), being careful not to exceed the stated range.



23. Once the correct rotational torque is achieved, secure the pinion shaft retaining nut.

Note:
- Do not install a new pinion shaft oil seal at this stage.

24. Install the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–02–37 in this section.



GENERAL PROCEDURE — TOE-IN ADJUSTMENT

BHL1102GA

Operation: **General Procedure Toe-in Adjustment**	*Job Code:* **11 13 01 xx**		
None	Standard tools, Two one-metre-long bars		

General Procedure

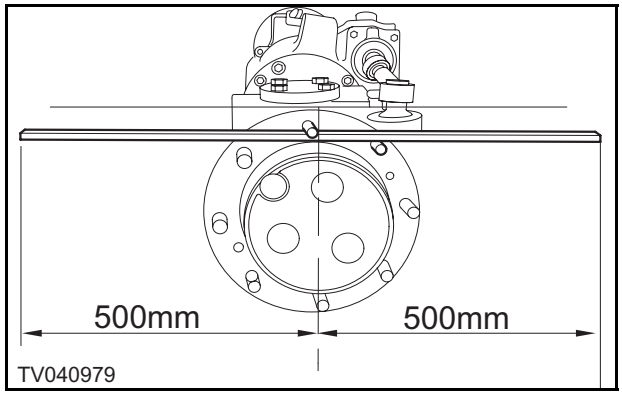
The toe-in of the front wheels must be between 0 and 5mm toe-in as measured 500mm from the centre of the wheel hub.

To check the exact value of the toe-in setting, proceed as follows.

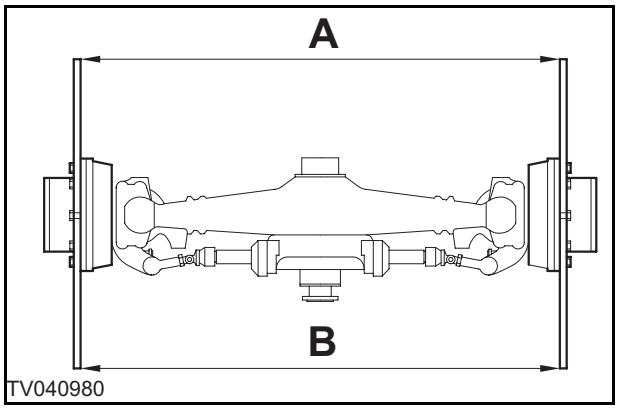
1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

   Note:
   - The bars must be fixed flat against the wheel hub flange and have an equal distance from the centre of the wheel hub.

2. Install two equal one-metre-long bars to the wheel side of the wheel hubs and lock in place with two wheel retaining nuts.



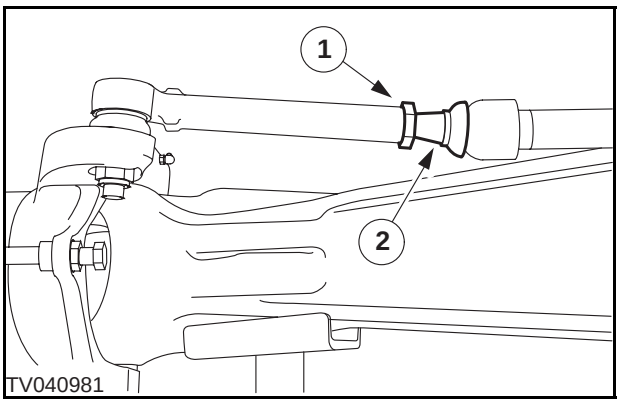
3. Measure the distance (A) between the ends of the two bars.
4. Measure the distance (B) between the ends of the two bars.
5. The distance (A) must be 0 to 5mm less than distance (B).



Note:

- Make sure the same number of threads are visible at the end of the left-hand and right-hand inner track rod end ball joints.

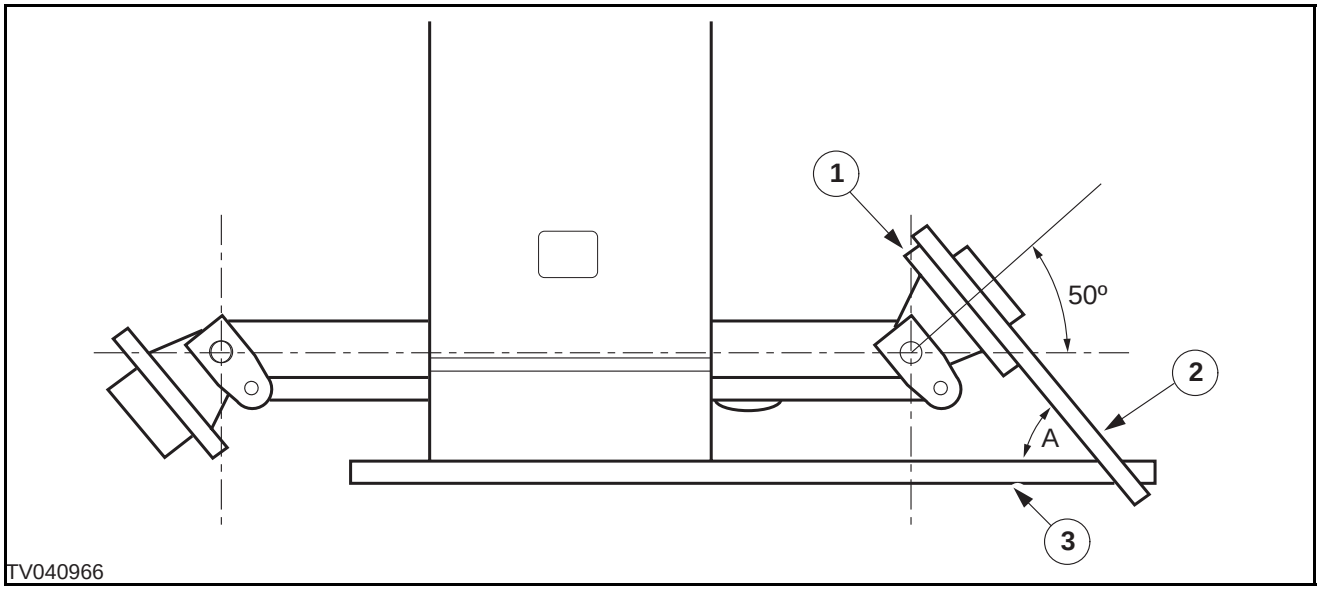
6. If it is necessary to correct the toe-in adjustment. Loosen the lock nut (1) on the left-hand and the right-hand side. Turn the inner track rod end ball joints (2) equally to achieve the specified toe-in adjustment.
7. Tighten (1) to 120Nm (89 lb.ft).



GENERAL PROCEDURE — STEERING ANGLE ADJUSTMENT

BHL1102GB

General Procedure



1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

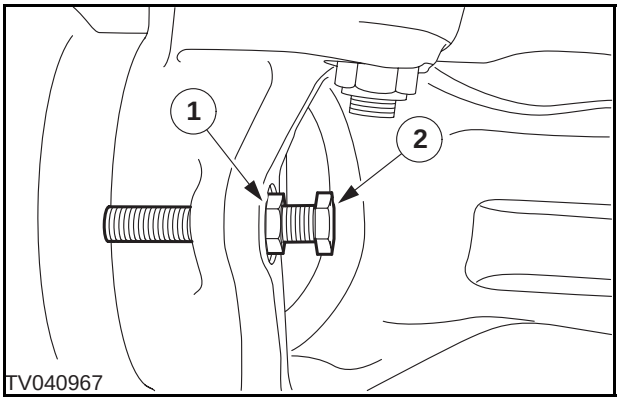
   Note:
   - Support the machine under the front chassis.

2. Turn the steering wheel until the front wheel hubs are on full left-hand lock.
3. Place a straight edge (3) against the axle input flange or against the machine hardnose. Make sure the straight edge is parallel with the axle centre-line.
4. Place a second straight edge (2) against the wheel hub flange (1).

   ⚠ Caution:
   - **Make sure the steering angle does not exceed 52 degrees. Failure to follow this instruction may result in excessive wear to the drive shaft universal joints.**

5. Measure the angle (A) at which both straight edges intersect. Subtract angle A from 90 degrees to give the steering lock.
   Angle A = 40
   Steering angle 90 – 40 = 50 degrees.
6. Adjust the left-hand stop for maximum left steering lock and right-hand stop for maximum right steering lock.
7. Loosen the lock nut (1) and adjust the steering stop adjuster bolt (2) until the bolt head touches the steering stop. Tighten the lock nut (1) to 150Nm.

8. Turn the steering wheel until the front wheel hubs are on full right-hand lock and repeat the procedure for the right-hand side.



GENERAL PROCEDURE — DRAINING AND FILLING THE FRONT AXLE HOUSING OIL

BHL1102GC

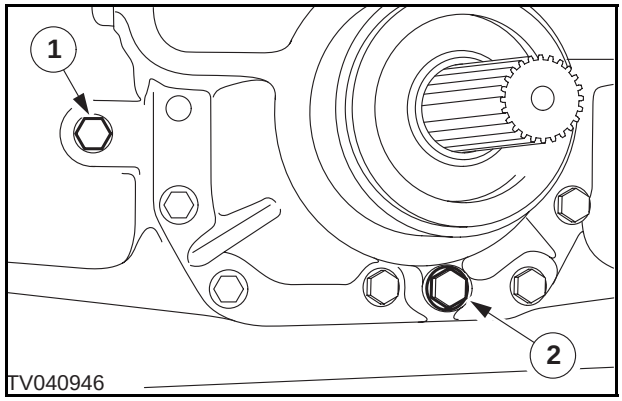
Operation: **Draining and Filling the Front Axle Housing Oil**	*Job Code:* **11 07 09 xx**		
None	Standard tools		

Draining

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Loosen the refill plug (1) to release any pressure.
3. Remove the drain plug (2) and drain the oil into a suitable container.

Filling

1. Install the drain plug (2) and tighten to 60Nm (44 lb.ft).
2. Fill with oil until the refill hole (1) level is reached.
3. Install the refill plug (1) and tighten to 60Nm (44 lb.ft).



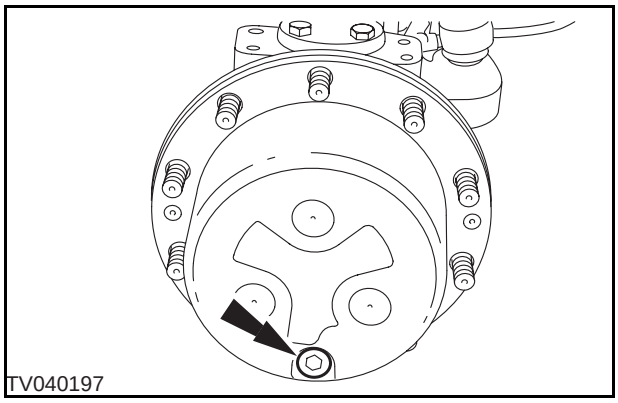
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GENERAL PROCEDURE — DRAINING AND FILLING THE HUB OIL

BHL1102GD

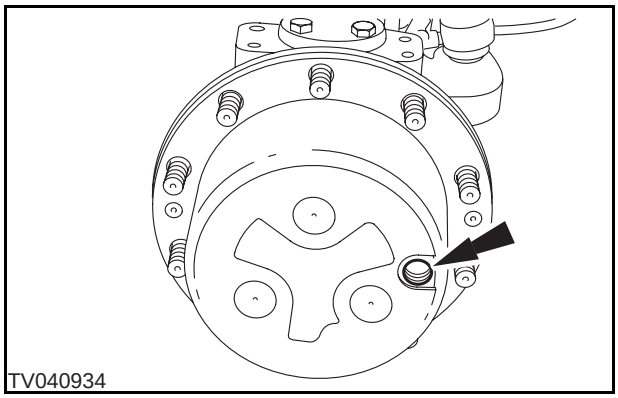
Draining

1. Position the hub until the drain/refill plug is positioned at the top. Loosen the drain plug to release any pressure.
2. Position the hub until the drain/refill plug is positioned at the bottom. Remove the drain/refill plug and drain the hub oil into a suitable container.


TV040197

Filling

1. Position the hub until the drain/refill plug is at the 3 o'clock position. Fill with oil until the drain/refill hole level is reached.
2. Install the drain/refill plug and tighten to 60Nm (44 lb.ft).


TV040934

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SPECIFICATIONS — FOUR-WHEEL DRIVE FRONT AXLE

BHL1102SA

Special Tools

Tool No.	Description
CA119030	Wrench
CA119033	Interchangeable Handle
CA119043	Driver
CA119099	Wrench for Lock Nut
CA715026	Driver for Bearing Race
CA715027	Driver for Bush
CA119117	Driver
CA119143	Driver
CA119182	False Differential Box
CA119225	Driver
CA119226	False Differential Box
CA119230	Driver
CA715023	False Pinion
CA715034	Driver
CA715035	Driver
CA715163	Driver
CA715164	Driver
CA715170	Wrench
CA715179	Driver
CA715505	Driver
CA715506	Driver
CA715701	Driver

Torque Values

Description	Nm	Lb.ft
Epicyclic Reduction Hub	80	59
Wheel Hub	230	170
Axle Drain/Fill Plugs	60	44
Wheel Studs	70	52
King Pin	190	140
Crown Wheel	95	70
Grease Nipple	8	6
Differential Adjustment Nut Locking Tabs	13	10
Differential Housing	169	125
Differential Half Collers	266	196
Breather	10	7
Blanking Plug	25	18
Steering Cylinder	120	89
Swivel Joint	300	221
Tie-Rod Locking Nut	250	184
Tie-Rod End	220	162
Steering Angle Adjustment Locking Nut	150	111

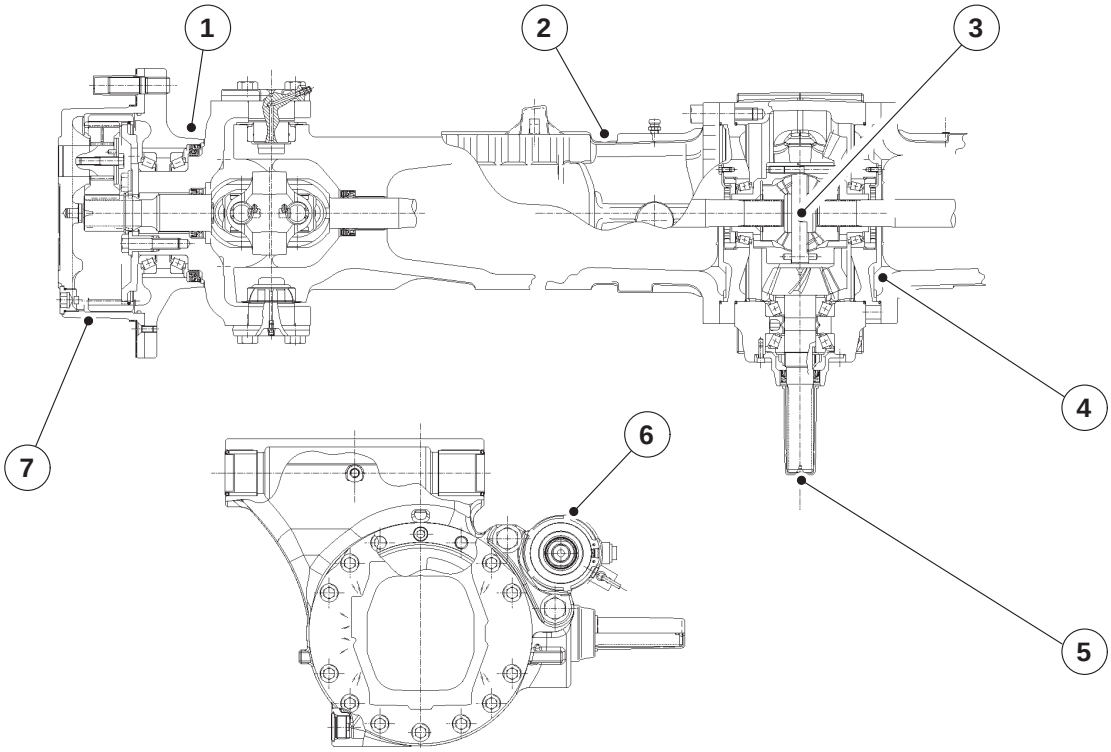
General Specifications

Description	Value
Crown Wheel Gear Ratio	2.133/1
Epicyclic Reduction Gear Ratio	6.00/1
Total Ratio	12.80/1
Dry Weight	303 Kg
Input Rotation	Clockwise (C.W.)
Steering Angle	55° 0–2mm
Toe-in	0–5mm
Crown Wheel / Pinion Backlash	0.18 – 0.23mm
Pinion Shaft Bearing Pre-Load “P”	“P” = 9.2 – 13.7 daN
Total Pinion/Differential Bearing Pre-load	(4.3 + P) — (6.45 + P) daN
Axle Housing Oil Capacity	6.5 Litres
Epicyclic Reduction Hub Oil Capacity	1.0 Litre
Oil Type (Use recommended oil enriched in Additives)	API GL5 (for possible alternatives see – GENERAL INFORMATION – FLUIDS AND LUBRICANTS at the start of this manual).
Grease Type	TECNOLUBE SEAL PLOYMER 400/L (DIN = KHER1R ISO-I-XMR-XM2) AGIP MU/EP2 (King pin only)
Sealant	Silastic 732

DESCRIPTION AND OPERATION — FOUR-WHEEL STEER FRONT AXLE

BHL1103OA

General Description



TV041104

1	Wheel Hub Group
2	Axle Beam Group
3	Differential Group
4	Differential Support Group
5	Pinion Group
6	Steering Cylinder Group
7	Epicyclic Reduction Gear Group

The axle described in this manual consists of the following groups:

- WHEEL HUB GROUP: wheel support parts containing the epicyclic reduction gears.
- AXLE BEAM GROUP: load-bearing shell structure of the axle.
- DIFFERENTIAL GROUP: differential parts with crown wheel gear.
- DIFFERENTIAL SUPPORT GROUP: differential housing with crown wheel gear adjusting system.
- PINION GROUP: pinion with adjusting and support parts.
- STEERING CYLINDER GROUP: steering cylinder parts with adjusting system.
- EPICYCLIC REDUCTION GEAR GROUP: planetary carrier with reduction/transmission parts.

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DIAGNOSING AND TESTING — FOUR-WHEEL STEER FRONT AXLE

BHL1103TA

Problem	Possible Cause	Action
Ring gear tooth broken at the outer side	• Excessive gear load compared to the one foreseen.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Incorrect gear adjustment (excessive backlash).	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Pinion nut loosened.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
Ring gear tooth broken side	• Load bump.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Incorrect gear adjustment (insufficient backlash).	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Pinion nut loosened.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
Pinion or ring gear teeth worn	• Insufficient lubrication.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
	• Contaminated oil.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.

Problem	Possible Cause	Action
Pinion or ring gear teeth worn (continued)	• Incorrect lubrication or depleted additives.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
	• Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
Overheated ring and pinion teeth. Check if gear teeth have faded.	• Prolonged functioning at high temperatures.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Incorrect lubrication.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Low oil level.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
Pinion teeth pitting	• Excessive use.	• REPLACE bevel gear set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE bevel gear set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Axle beam body bent	• Vehicle overloaded.	• REPLACE axle beam body.
	• Vehicle’s accident.	• REPLACE axle beam body.
	• Load bump.	• REPLACE axle beam body.

Problem	Possible Cause	Action
Worn out or pitted bearings	• Insufficient lubrication.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive use.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Normal wear out.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Pinion nut loosened.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Oil leakage from gaskets and seals	• Prolonged functioning at high temperature of the oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Oil gasket assembled incorrectly.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Seal lip damaged.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.

Problem	Possible Cause	Action
Excessive wearing out of input flange spline	• Heavy use.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.

Problem	Possible Cause	Action
	• Pinion nut loosened.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
	• Pinion axle backlash.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
Fatigue failure of pinion teeth. See if the fracture line is well defined (wave lines, beach lines)	• Heavy use.	• REPLACE bevel gear set.
	• Continuous overload.	• REPLACE bevel gear set.
Pinion and ring teeth breakage	• Crash load of differential components.	• CHECK and/or REPLACE other differential components.
Side gear spline worn out. Replace all scratched washers (Excessive backlash)	• Excessive use.	• REPLACE differential gear group. • REPLACE half shaft if required.
Thrust washer surface worn out or scratched	• Insufficient lubrication.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0.1 mm thickness lower than the new ones.
	• Incorrect lubrication.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0.1 mm thickness lower than the new ones.
	• Contaminated oil.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0.1 mm thickness lower than the new ones.

Problem	Possible Cause	Action
Inner diameter of tapered roller bearing worn out	• Excessive use.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive pinion axial backlash.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.

Problem	Possible Cause	Action
	• Insufficient lubrication.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
Bent or broken half shaft	• Vehicle intensively operated or overloaded.	• REPLACE half shaft.
Half shaft broken at wheel side	• Wheel support loosened.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.
	• Beam body bent.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.

Axle Problem and Diagnosis

Problem	Possible Cause	Action
Noise while driving	• Excessive backlash between pinion and ring gear.	• ADJUST.
	• Worn out pinion and gear ring.	• REPLACE.
	• Worn out pinion bearings.	• REPLACE.
	• Pinion bearings loosened.	• ADJUST.
	• Excessive axial pinion backlash.	• ADJUST.
	• Worn out differential bearings.	• REPLACE.
	• Differential bearings loosened.	• ADJUST.
	• Ring gear out of roundness.	• REPLACE.
	• Low Lubricant level.	• OIL level.
	• Poor or wrong lubricant.	• REPLACE.
	• Bent half shaft.	• REPLACE.
Noise whilst driving in neutral	• Noise coming from axle is usually heard when vehicle moves in neutral gear but is not loud.	• REPLACE or ADJUST (see above).
	• Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed.	• REPLACE.
	• Pinion or input flange worn out.	• ADJUST.
Intermittent noise	• Ring gear damaged.	• REPLACE bevel gear set.
	• Differential box bolts loosened.	• TIGHTEN to torque.
Constant noise	• Ring gear teeth or pinion damaged.	• REPLACE bevel gear set.

Problem	Possible Cause	Action
	• Worn out bearings.	• REPLACE.
	• Pinion spline worn out.	• REPLACE.
	• Bent half shaft.	• REPLACE.
Noise while steering	• Worn out differential gears.	• REPLACE.
	• Worn out differential box or spider.	• REPLACE.
	• Differential thrust washers worn out.	• REPLACE.
	• Half shaft spline worn out.	• REPLACE.

REMOVAL AND INSTALLATION — FOUR-WHEEL STEER FRONT AXLE

BHL1103RA

Operation: **Removing and Installing the Four-Wheel Drive Front Axle (Four-Wheel Steer)**	*Job Code:* **11 24 13 xx**		
Suitable transmission jack	Standard tools		

Removal

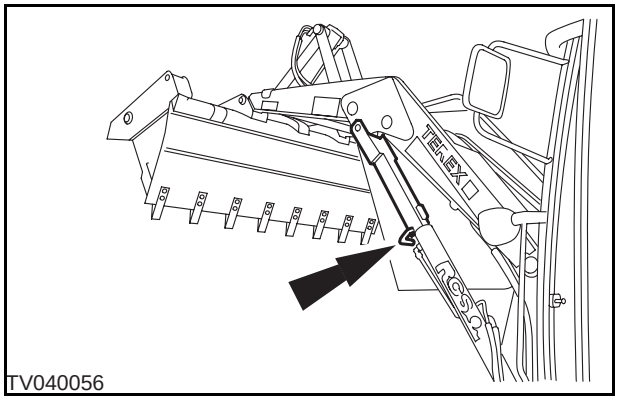
Note:
- Make a note of the position of any hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

Note:
- Support the machine under the front chassis.

2. Remove the hardnose/tool box. For additional information, refer to Section K10-01 HARDNOSE/TOOLBOX, PAGE K10–01–3 .
3. Raise the front loader to full height and install the safety stop.
4. Roll the loader bucket fully forward.

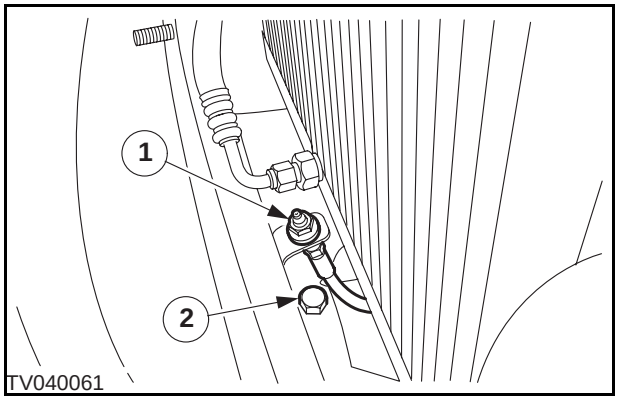


TV040056

5. Remove the front axle pivot pin grease point (1).

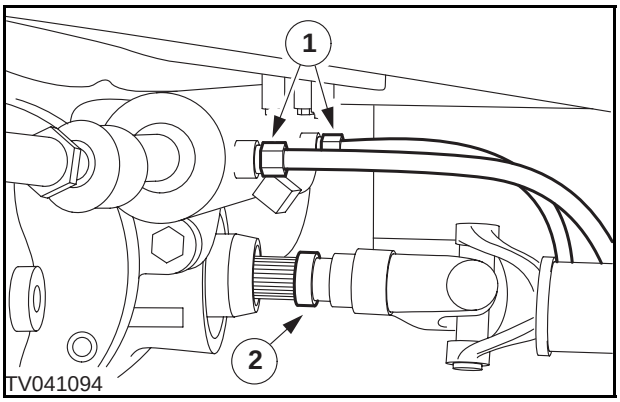
Note:
- Discard the locking nut.

6. Remove the front axle pivot pin retaining bolt (2).



TV040061

7. Disconnect the power steering supply pipes (1).
8. Loosen the propeller shaft locking ring (2).



⚠ Warning:

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

⚠ Warning:

- **Secure the front axle to the transmission jack. Failure to follow this instruction may result in personal injury.**

Note:

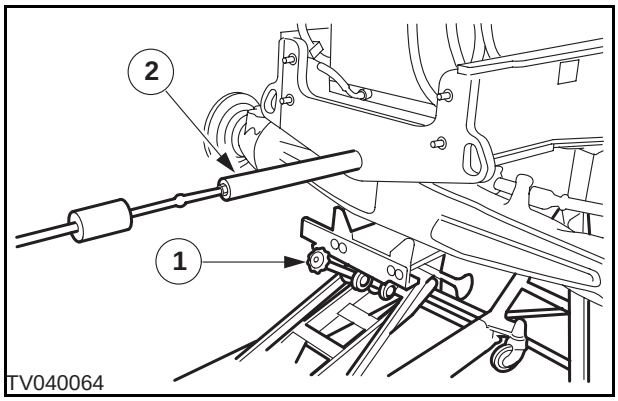
- Mark the axle pivot pin before removal to aid installation.

9. Using a suitable transmission jack (1), support the front axle.

Note:

- Secure the propeller shaft to one side when removing the front axle.

Using a suitable slide hammer (2), remove the front axle pivot pin and remove the front axle.



Installation

Note:

- Remove any dirt or burrs before installing the front axle pivot pin.

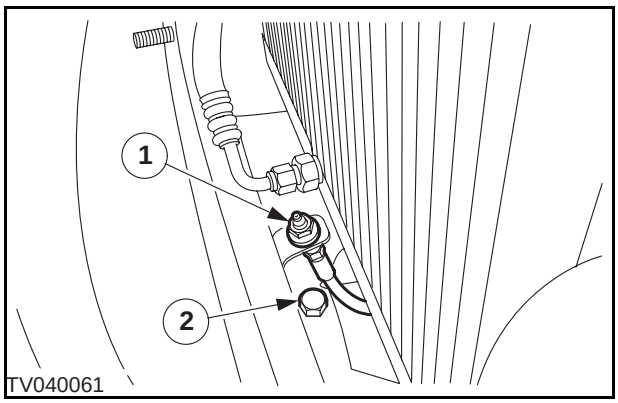
Note:

- Make sure the propeller shaft is aligned with the front axle differential shaft when raising the axle into position.

1. To install, reverse the removal procedure.

Note:
- Install a new locking nut.

2. Tighten (2) to 98Nm (72 lb.ft).
3. Check and adjust the hydraulic oil level as required.
4. Operate the steering from full left-hand lock to full right-hand lock and check for correct operation.

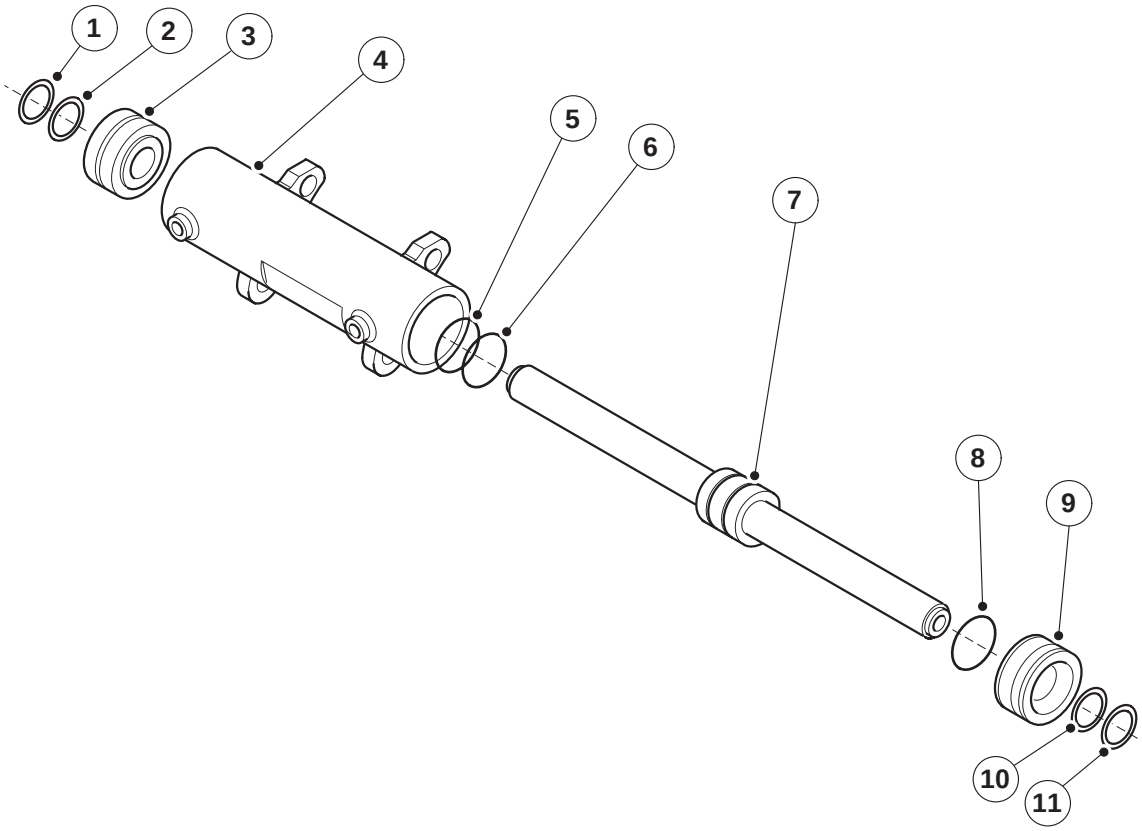


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DISASSEMBLY AND ASSEMBLY — STEERING CYLINDER GROUP (FOUR-WHEEL STEER)

BHL1103DA

Operation: **Disassembly and Assembly of the Steering Cylinder Group (Four-Wheel Steer)**	*Job Code:* **11 20 17 xx**		
None	Standard tools, Suitable piston ring compression tool		



TV041095

1	Wiper Seal
2	Sealing Ring
3	Cylinder Head
4	Cylinder
5	O-ring
6	O-ring
7	Piston Rod Assembly
8	Back-up Seal
9	Cylinder Head
10	Sealing Ring
11	Wiper Seal

Disassembly

⚠ **Warning:**

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (4) in a soft jawed vice.
3. Remove the cylinder heads (3) and (9) from the steering cylinder group.
4. Remove the piston rod assembly (7) from the cylinder (4).
5. Remove the wiper seal (1), sealing ring (2) from the cylinder head (3).
6. Remove the wiper seal (11), sealing ring (10) from the cylinder head (9).
7. Remove the back-up seal (5), piston sealing ring (6) and back-up seal (8) from the piston rod assembly (5).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- Lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the back-up seal (8), piston sealing ring (6) and the back-up seal (5) to the piston rod assembly (7).
2. Install the O-ring (4), sealing ring (2) and the wiper seal (1) to the cylinder head (5).
3. Lubricate the inside of the cylinder (10) and the piston rod assembly (5) with clean oil. Use a piston ring compression tool to hold the new back-up seals (6),(8) Piston Sealing Ring (7) in place.

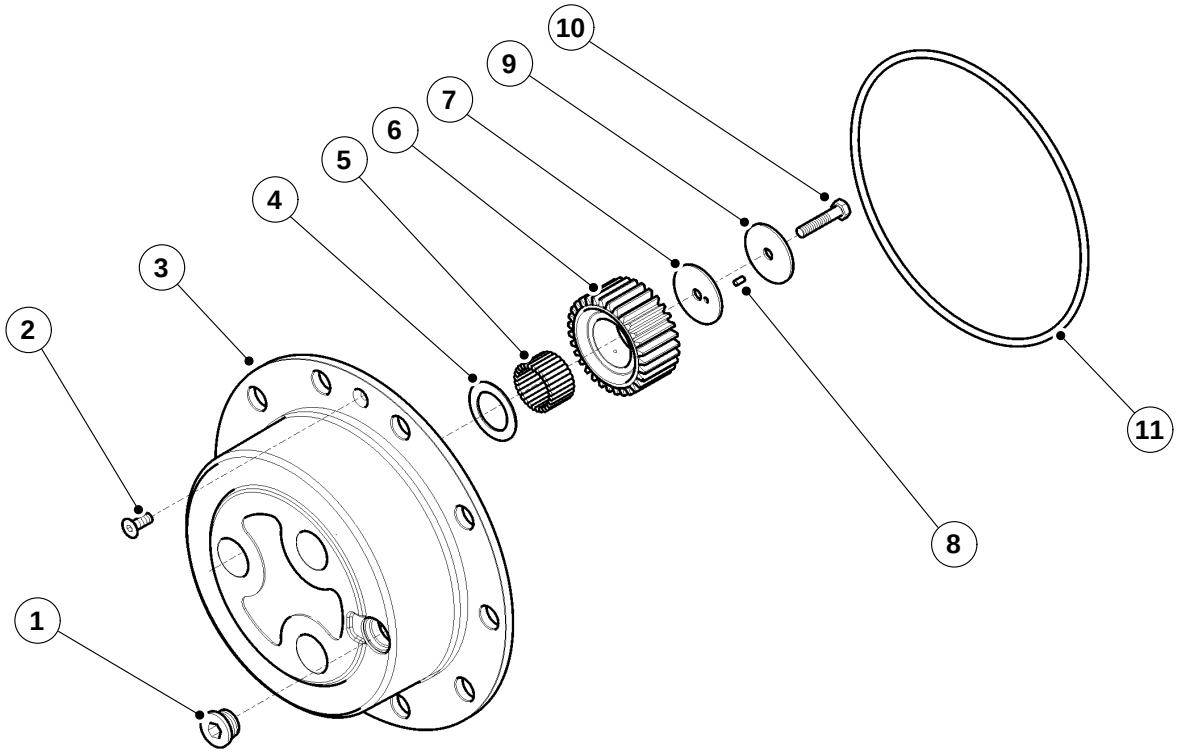
⚠ **Caution:**
- **Be careful not to damage the back-up seals and piston sealing ring.**

4. Start the cylinder (10) onto the piston rod assembly (5). Push the cylinder onto the piston rod (5) assembly until the compression tool is pushed off the piston rod assembly.
5. Install the wiper seal (1), sealing ring (2) to the cylinder head (3).
6. Install the wiper seal (11), sealing ring (10) to the cylinder head (9).
7. Install the cylinder heads (3) and (9) onto the steering cylinder group.

DISASSEMBLY AND ASSEMBLY — EPICYCLIC REDUCTION GEAR GROUP (FOUR-WHEEL STEER)

BHL1103DB

Operation: **Disassembly and Assembly of the Epicyclic Reduction Gear Group**	*Job Code:* **11 05 17 xx**		
None	Standard tools Suitable container		



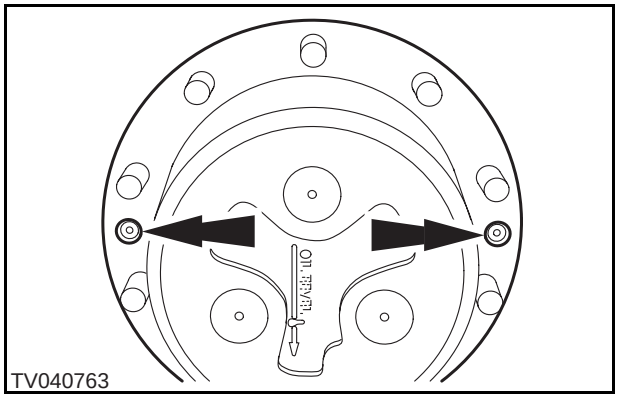
TV041092

1	Drain Plug
2	Retaining Screw
3	Epicyclic Reduction Gear Carrier
4	Thrust Washer
5	Needle Roller Bearings
6	Epicyclic Gear
7	Washer
8	Dowel Pin
9	Washer
10	Retaining Bolt
11	O-Ring

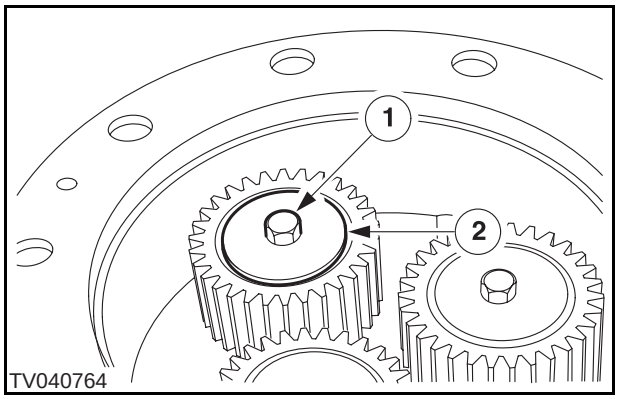
Disassembly

1. Remove the front wheel. For additional information, refer to M12-01 FRONT WHEEL, PAGE M12–01–5 .
2. Drain the hub oil. For additional information, refer to L11-02 DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67
3. Remove the epicyclic reduction gear carrier.

   Note:
   - Remove and discard the O-ring oil seal.

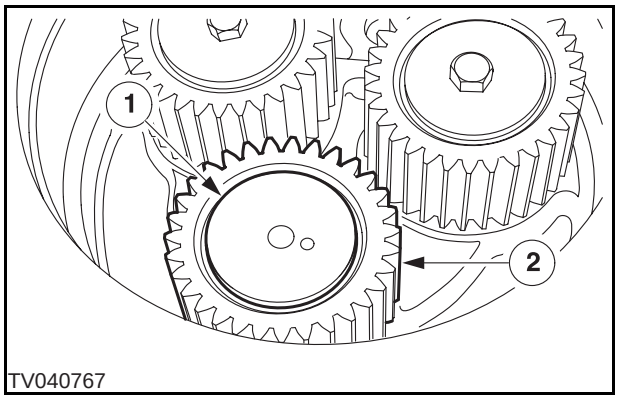


4. Remove the epicyclic gear retaining bolt (1) and washer (2).

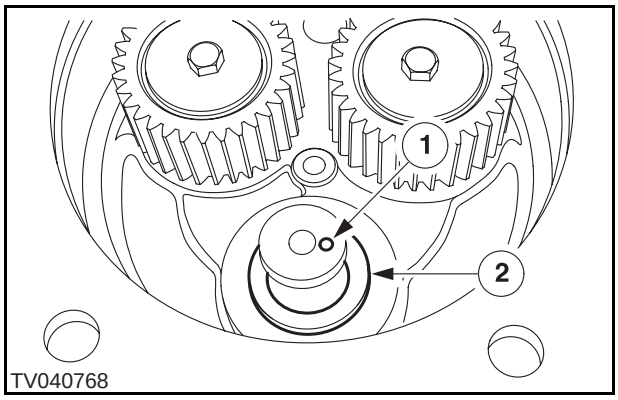


5. Remove the locating washer (1) and the epicyclic gear (2).

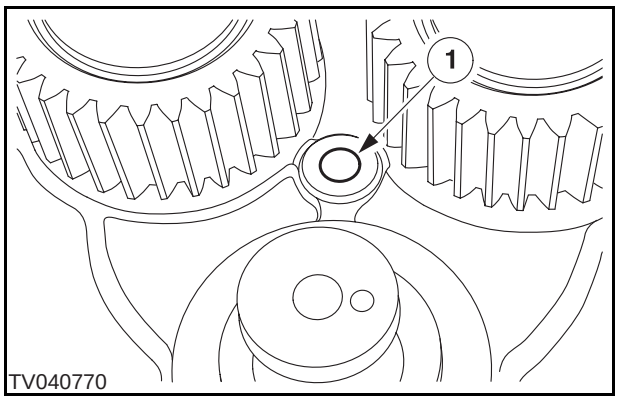
   Note:
   - Recover the set of needle roller bearings and the needle roller bearings spacers.



6. Remove the locating pin (1) and the wear washer (2).
7. Repeat steps 4 to 6 to remove the remaining epicyclic gears.
8. If the pinion pins are damaged, a new epicyclic reduction gear carrier assembly should be installed.

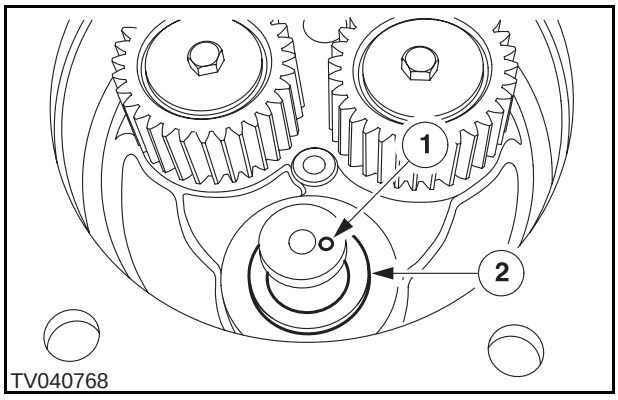


9. If the half-shaft stop (1) is damaged, a new epicyclic reduction gear carrier assembly should be installed.

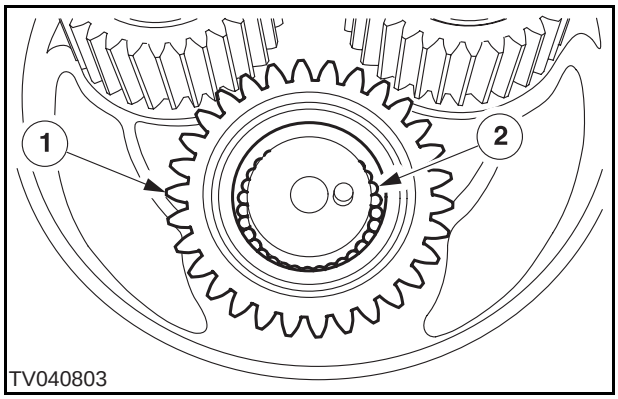


Assembly

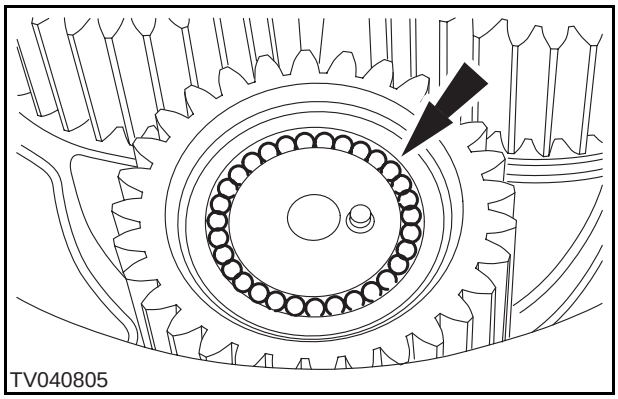
1. Install the wear washer (2) and the locating pin (1).



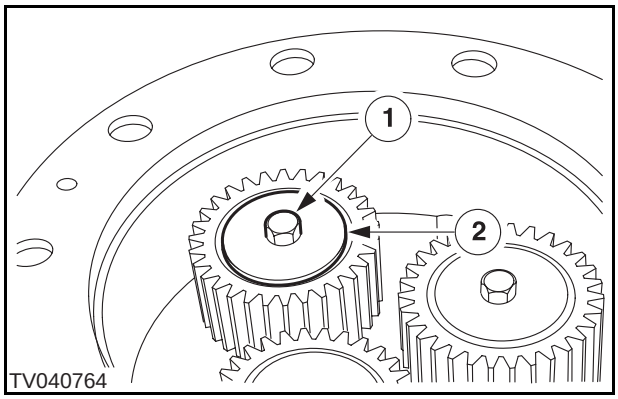
2. Install the epicyclic gear (1) and the set of needle roller bearings (2).



3. Install the locating washer.



4. Install the washer (2) and epicyclic gear retaining bolt (1).
5. Tighten (1) to 79Nm (58 lb.ft).

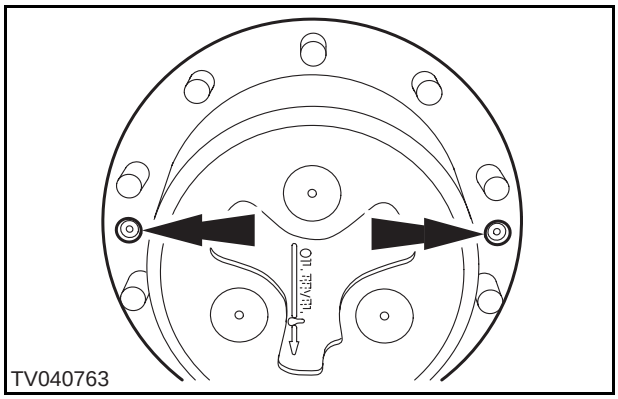


6. Repeat steps 1 to 5 to install the remaining epicyclic gears.

   Note:
   - Install a new O-ring oil seal.

7. Install the epicyclic reduction gear carrier.

8. Tighten to 25Nm (18 lb.ft).



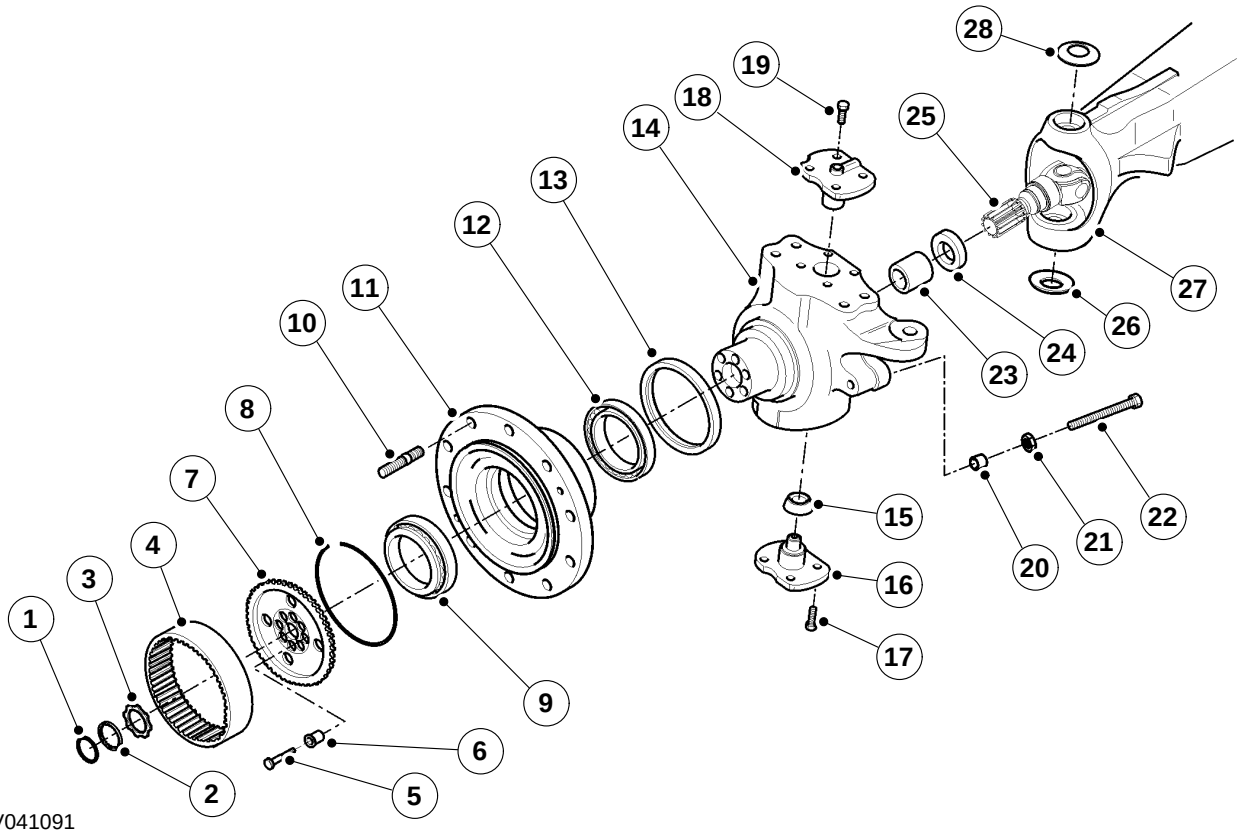
9. Fill the hub with oil. For additional information, refer toL11-02 DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67 .
10. Install the front wheel. For additional information, refer toM12-01 FRONT WHEEL, PAGE M12–01–5 .

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DISASSEMBLY AND ASSEMBLY — FRONT WHEEL HUB GROUP (FOUR-WHEEL STEER)

BHL1103DC

Operation: **Disassembly and Assembly of the Front Wheel Hub Group (Four-Wheel Steer)**	*Job Code:* **11 08 17 xx**		
Suitable lifting equipment	Standard tools, Ball joint separator, CA715026, CA715027, CA119143 CA119117 CA119087		

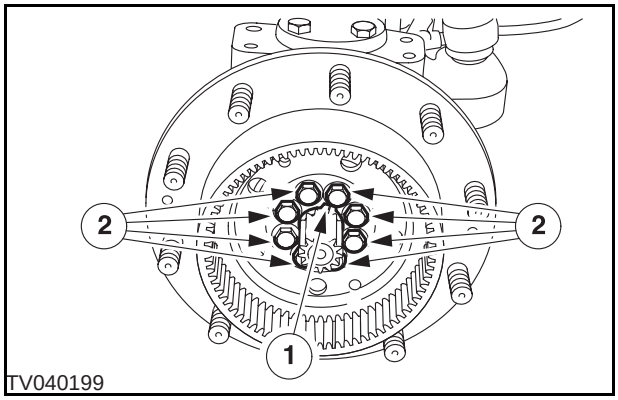


TV041091

1	Lock Ring
2	Universal-Joint Shaft Washer
3	Universal-Joint Shaft Washer
4	Epicylic Ring Gear
5	Retaining Bolt
6	Centre Bushes
7	Epicylic Hub
8	Steel Lock Ring
9	Taper Roller Bearing
10	Stud
11	Wheel Hub
12	Taper Roller Bearing
13	Oil Seal
14	Swivel Housing
15	Cone
16	Lower Kingpin
17	Retaining Bolt
18	Upper Kingpin
19	Retaining Bolt
20	Bush
21	Lock Nut
22	Steering Angle Adjustment Bolt
23	Bush
24	Oil Seal
25	Universal-Joint Shaft End
26	Belleville Washers
27	Axle
28	Belleville Washers

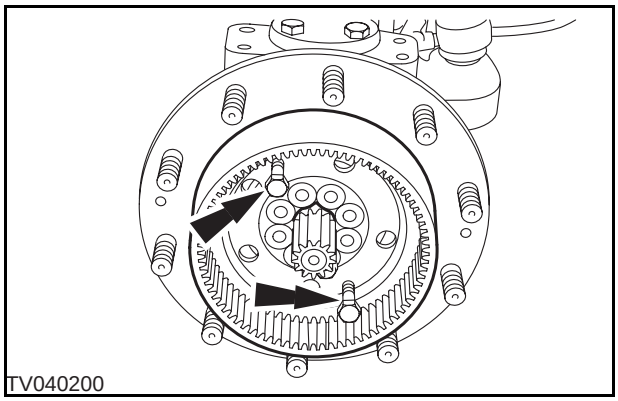
Disassembly

1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–5 .
2. Remove the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE N13–04–15 in this section.
3. Remove the wheel carrier circlip and spacers (1).
4. Remove the wheel carrier retaining bolts (2).

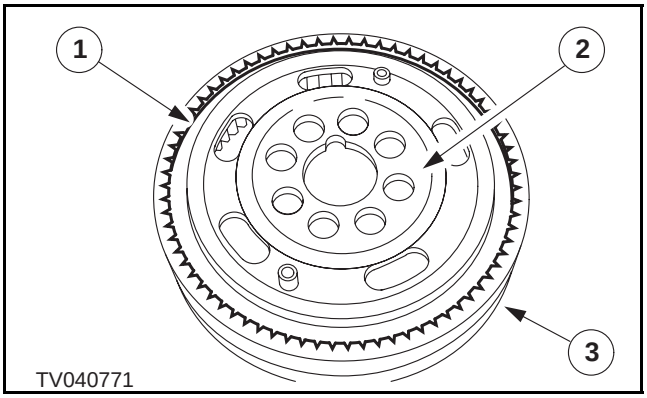


TV040199

5. Using 2 wheel carrier retaining bolts, extract the wheel carrier.

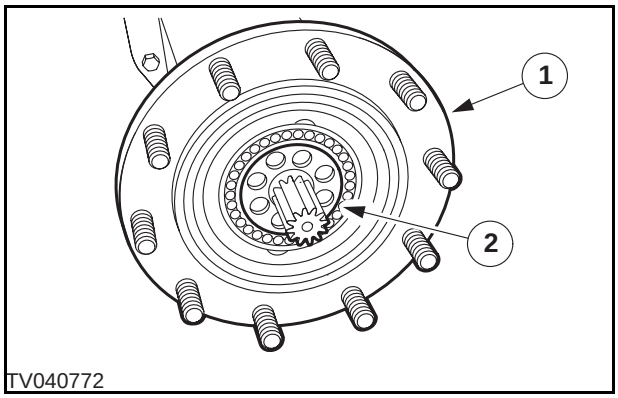

TV040200

6. Remove the snap ring (1) and remove the epicyclic gear hub (2) from the epicyclic ring gear (3).



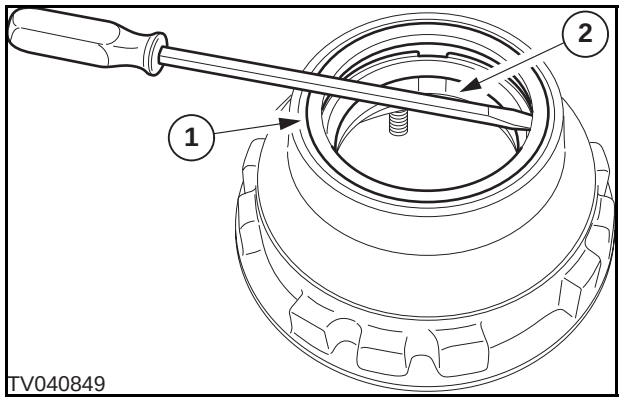
TV040771

7. Using a suitable soft faced hammer, remove the front axle hub (1) and the outer roller bearing (2).



TV040772

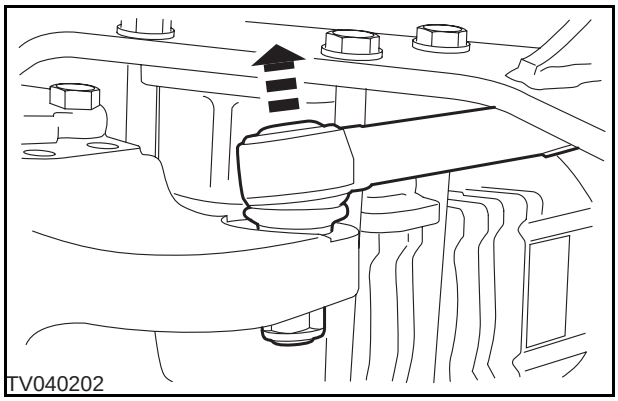
8. Using a suitable lever, remove and discard the hub oil seal (1).
9. Recover the outer taper roller bearing. Using a suitable drift, remove the inner and outer taper roller bearings (2).



TV040849

⚠ **Caution:**
- **Leave the tie rod end nut on the tie rod end a few turns to prevent damage to the stud while using the ball joint separator.**

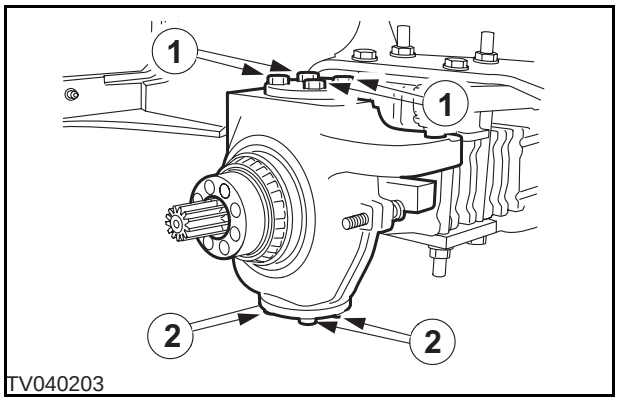
10. Remove the retaining nut and using a suitable ball joint separator, detach the tie rod assembly from the wheel hub.


TV040202

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

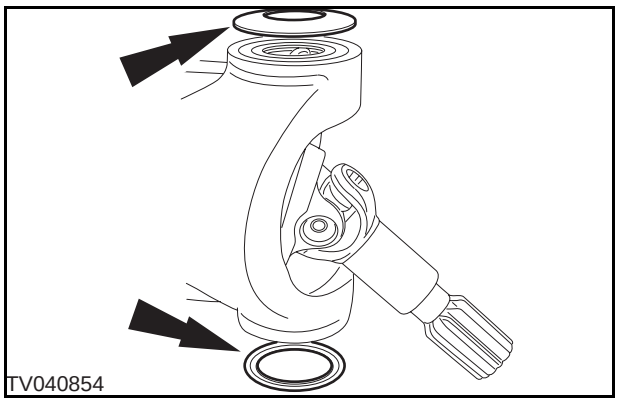
Note:
- Using suitable lifting equipment, support the wheel hub assembly .

11. Remove the upper (1) and lower (2) kingpin retaining bolts and remove the kingpins.
12. Remove the swivel hub assembly.



TV040203

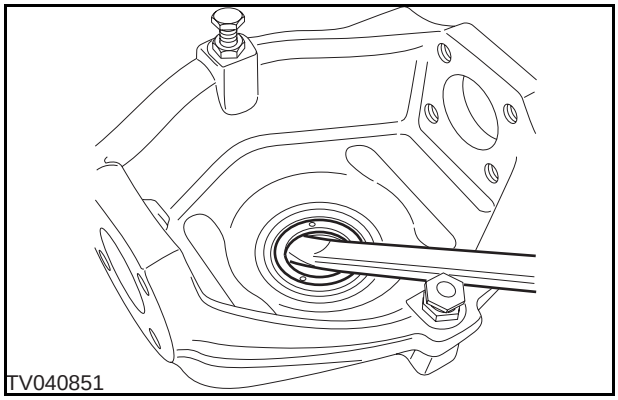
13. Remove the swivel thrust washers. Note the orientation to aid installation.


TV040854

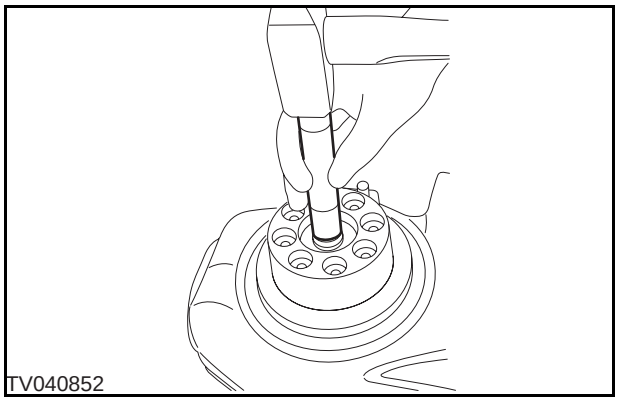
Note:
- Position the swivel hub on a suitable flat surface

14. Using a suitable lever, remove the oil seal.
15. Using a suitable lever, remove the oil seal.

Note:
- Discard the oil seal.

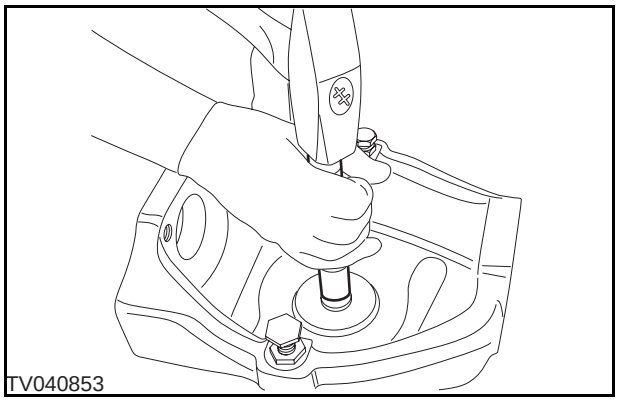

TV040851

16. Using a suitable drift, remove the swivel housing bush.

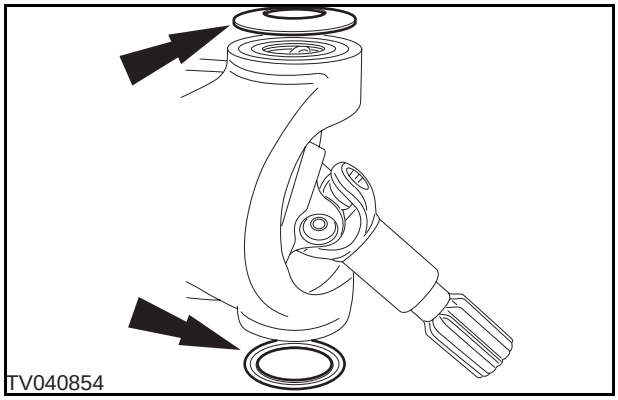

TV040852

Assembly

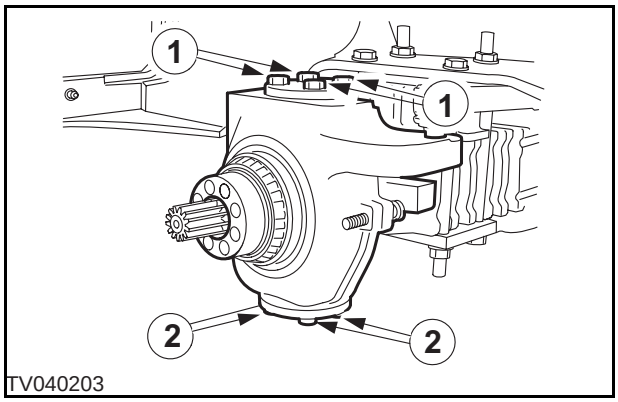
1. Using the special tool **CA715108 — Driver** , install the swivel housing bush.
2. Using the special tool **CA119117 — Driver for oil seal** , install the oil seal.


TV040853

3. Install the swivel thrust washers.

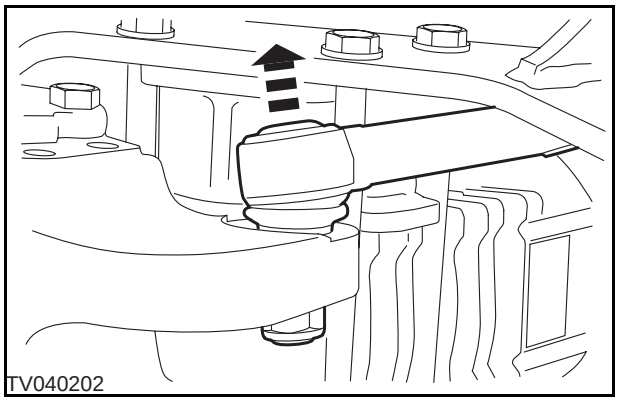

TV040854

4. Install the front hub carrier.
5. Tighten to 300Nm (221 lb.ft).

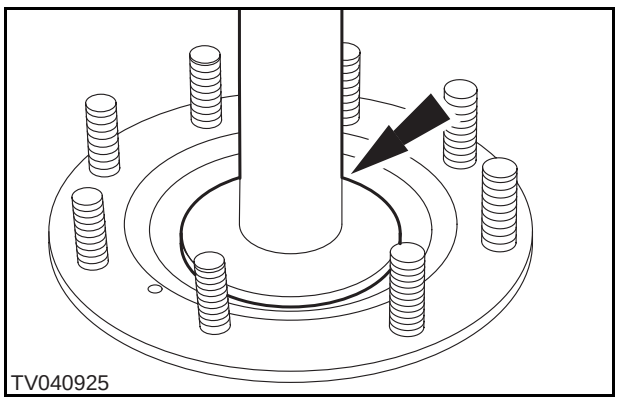


TV040203

6. Install the tie rod end.

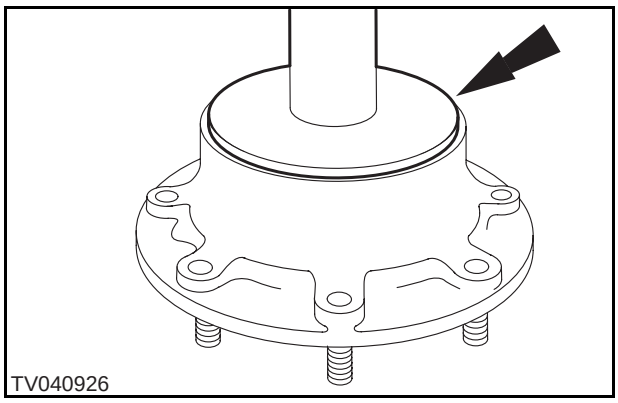

TV040202

7. Using a suitable hydraulic press and the special tool **CA715026 — Driver for bearing race** , install the inner and outer taper roller bearing cones.

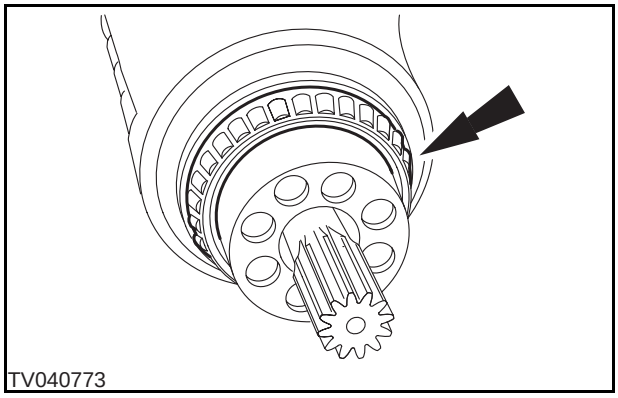

TV040925

Note:
- Lubricate the oil seal with a light grease.

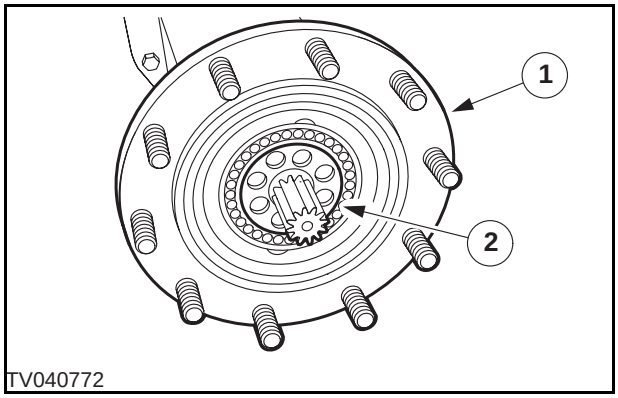
8. Using the special tool **CA119087 — Driver for oil seal** , install a new hub seal.



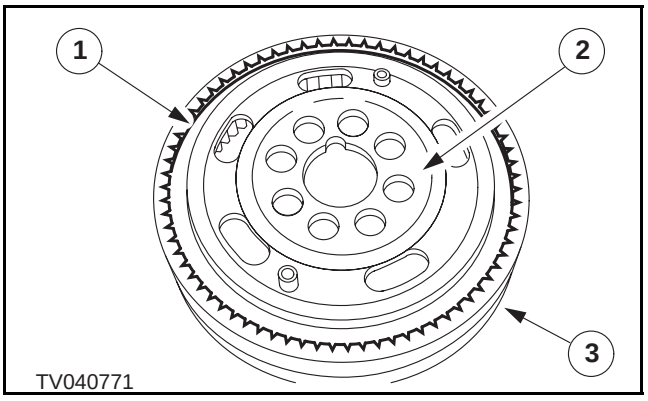
9. Install the inner taper roller bearing.



10. Install the front axle hub (1).
11. Install the outer taper roller bearing (2).

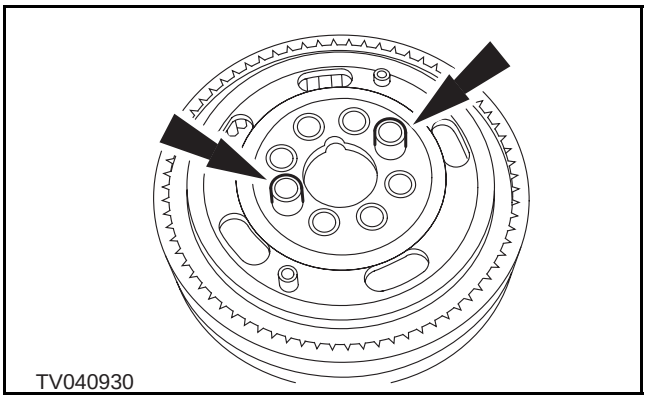


12. Install the epicyclic hub (2) to the epicyclic ring gear (3) and install the snap ring (1).

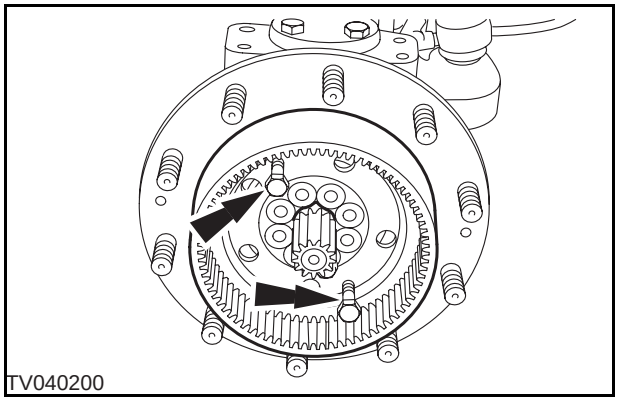


Note:
- Install two bushes slightly higher that the hub surface level to be used as dowel pins.

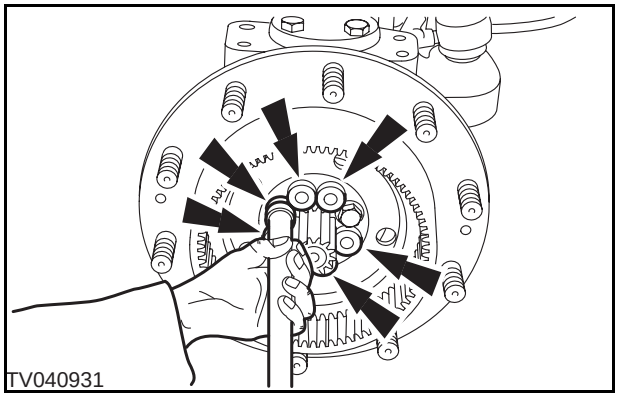
13. Using the special tool **CA715027 — Driver for bush** partially install the hub centering bushes.


TV040930

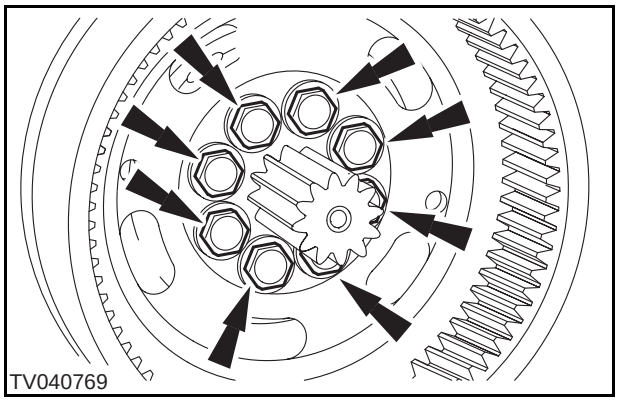
14. Assemble the epicyclic group on the front wheel hub using the two protruding centering bushes as dowel pins.


TV040200

15. Using the special tool **CA715027 — Driver for bush** , fully install the remaining centering bushes.


TV040931

16. Install the front wheel hub retaining bolts and tighten to 230Nm (170 lb.ft).



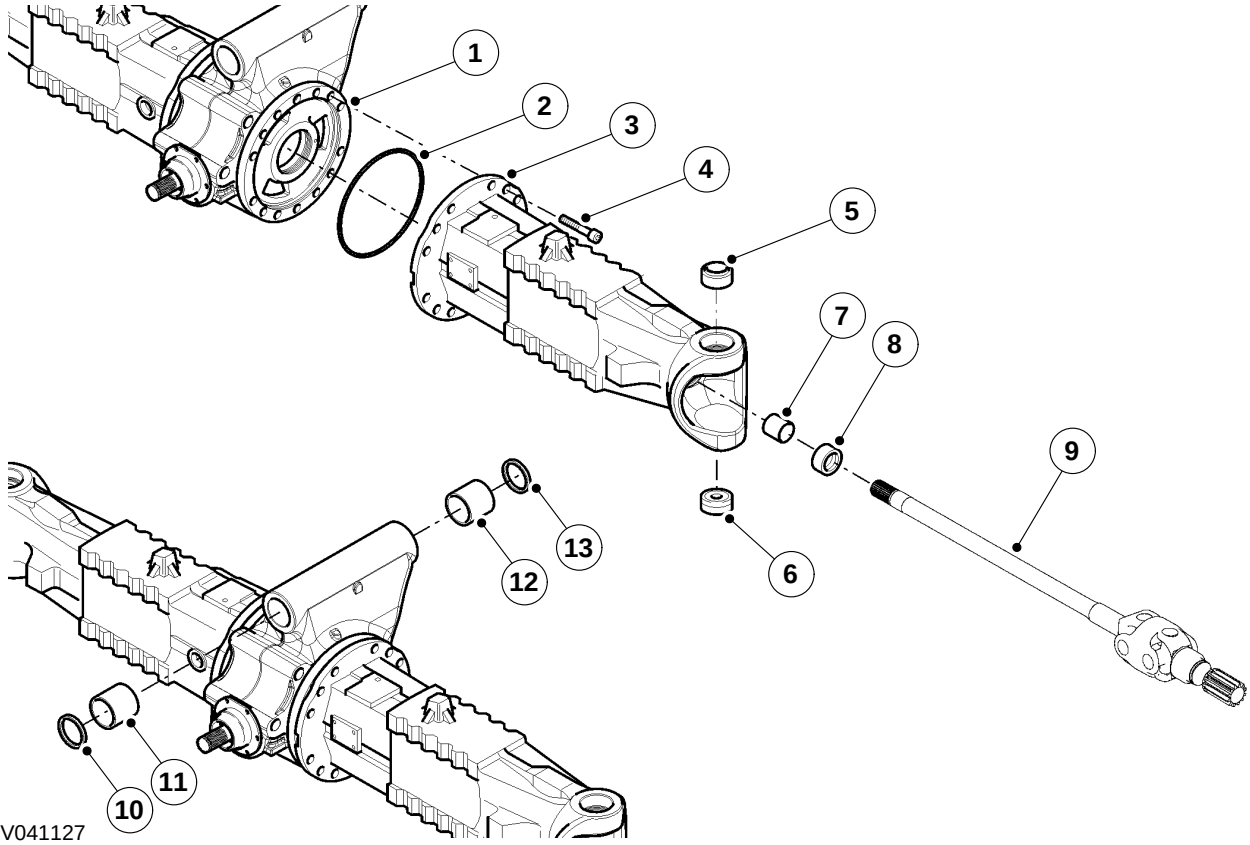
17. Install the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE N13–04–15 in this section.
18. Install the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–5 .

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DISASSEMBLY AND ASSEMBLY — AXLE BEAM GROUP (FOUR-WHEEL STEER)

BHL1103DD

Operation: **Disassembly and Assembly of the Axle Beam Trumpets and Brake Group**	*Job Code:* **11 07 17 xx**		
Suitable lifting equipment	Standard tools, CA715386, CA715387 CA715034 CA715505		

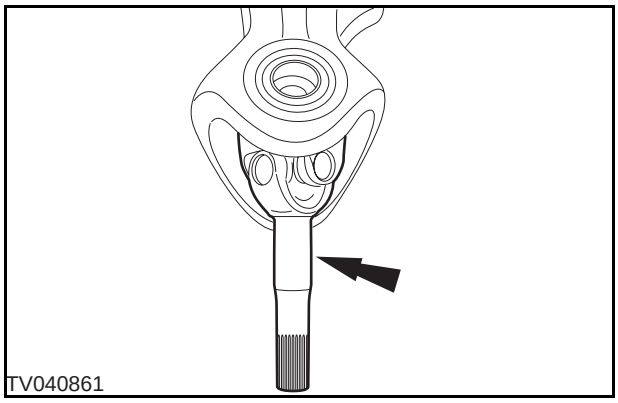


1	Central Body
2	O-Ring
3	Axle Beam
4	Retaining Bolts
5	Upper King Pin Bush
6	Ball Bearing Bush
7	Bush
8	Sealing Ring
9	Universal Joint
10	Sealing Ring
11	Bushe
12	Bushe
13	Sealing Ring

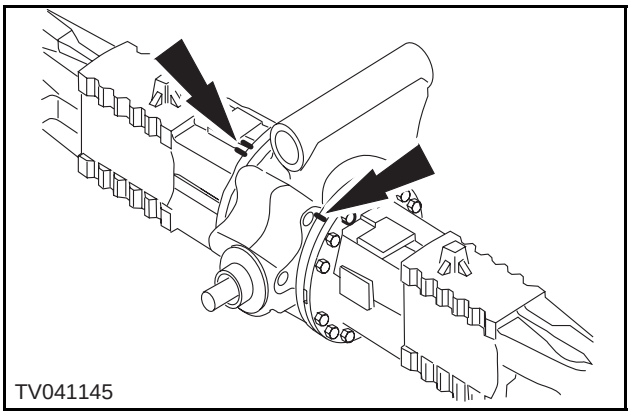
Disassembly

1. Remove the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE N13–04–19 in this section.

2. Drain the axle oil into a suitable container. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL in this section.
3. Remove the two double universal joints from the axle beam trumpets (both sides).



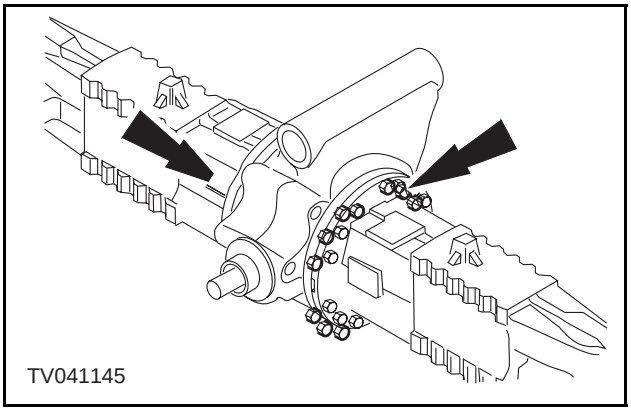
4. Mark the axle beam trumpet prior to disassembly to aid installation.



⚠ **Warning:**
- **Support the axle beam trumpet. Failure to follow this instruction may result in personal injury.**

5. Remove the axle beam trumpet retaining bolts and remove the axle beam trumpet (both sides).

Note:
- Remove and discard the O-rings.

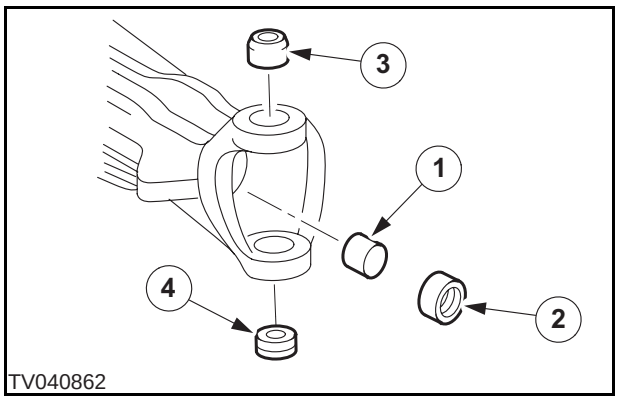


6. Remove the oil seal (2) from the axle beam trumpet (both sides).

Note:
- Discard the oil seal rings.

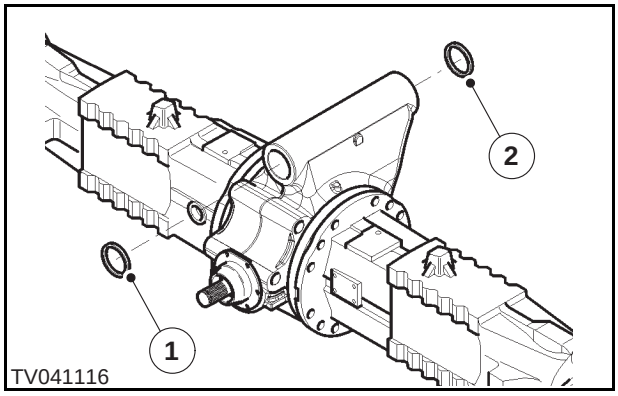
⚠ **Warning:**
- **Be careful not to damage the bush housing.**

7. Remove the bushes (1) from the axle beam trumpet housing (both sides).
8. Using a suitable extractor remove the upper king pin bush (3) and the ball bearing cup (4) from the king pin housing (both sides).



9. Remove the sealing rings (1) and (2) from the central body.

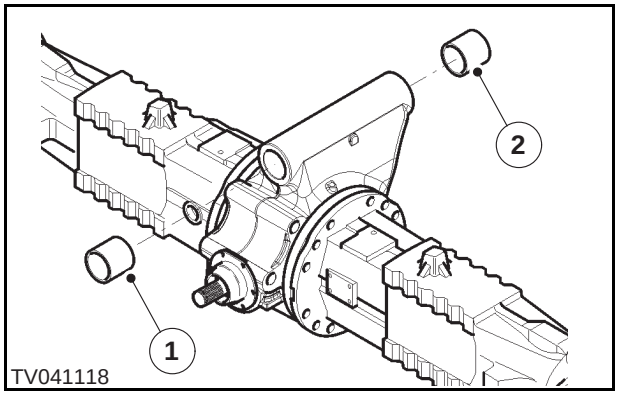
Note:
- Discard the oil seal rings.



⚠ **Caution:**
- **Take care not to damage the bush housing.**

10. Remove the bushes (1) and (2) from the axle central body.

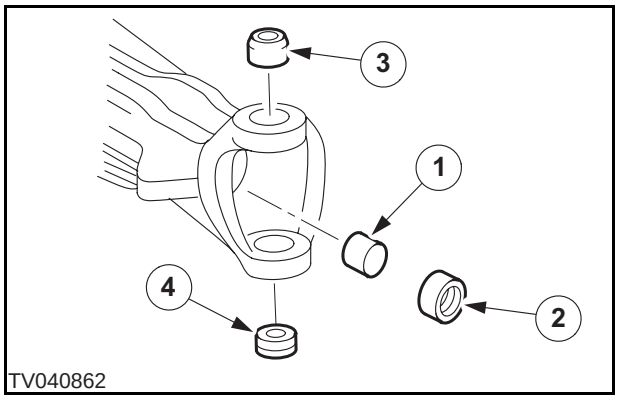
Note:
- Discard the oil seal rings.



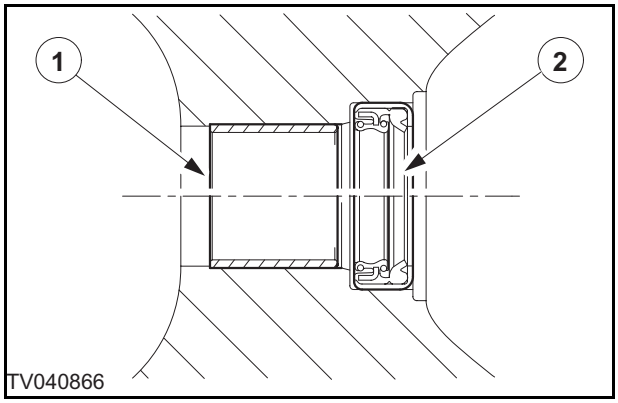
Assembly

Note:
- Install new oil seals.

1. Using the special tool **CA715034** , install the king pin bush (3) in the axle housing (both sides).
2. Using the special tool **CA715034** , install the ball bearing cup (4) in the axle housing (both sides).
3. Using the special tool **CA715505** , install the bush (1) and the oil seal (2).



4. Install the bush (1) and the oil seal (2) as shown.

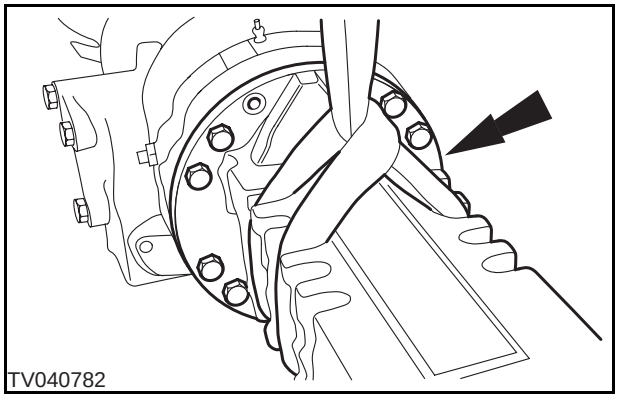


⚠ Warning:
- **Support the axle beam trumpet. Failure to follow this instruction may result in personal injury.**

Note:
- Install a new axle beam trumpet O-ring.

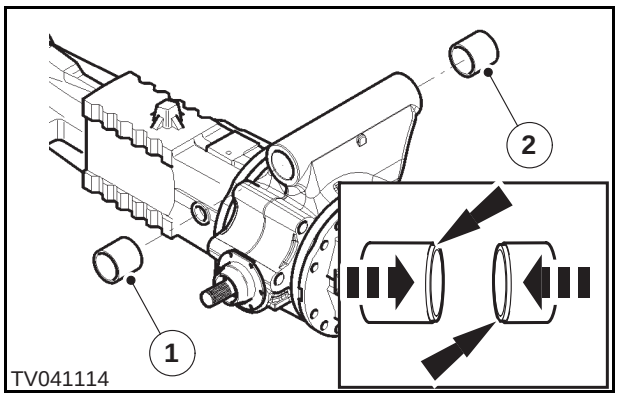
Note:
- Rear axle shown.

5. Install the axle beam trumpet.
6. Tighten to 130Nm (96 lb.ft).

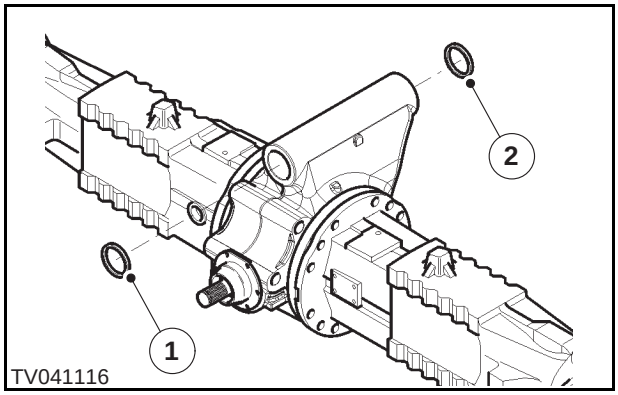


Note:
- Install the bushes with the machined edges facing in.

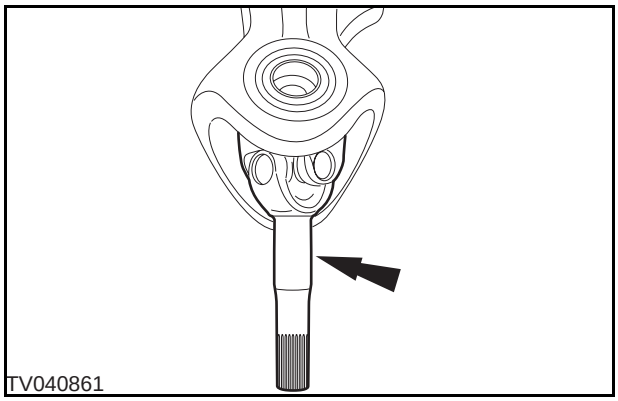
7. Using the special tool **CA715163 — Driver for bush** install the bushes (1) and (2) in the axle central body.



8. Using the special tool **CA715164 — Driver for bush** install the sealing rings (1) and (2) in the axle central body.



9. Install the two double Universal-Joints into the axle beam trumpet housing (both sides).



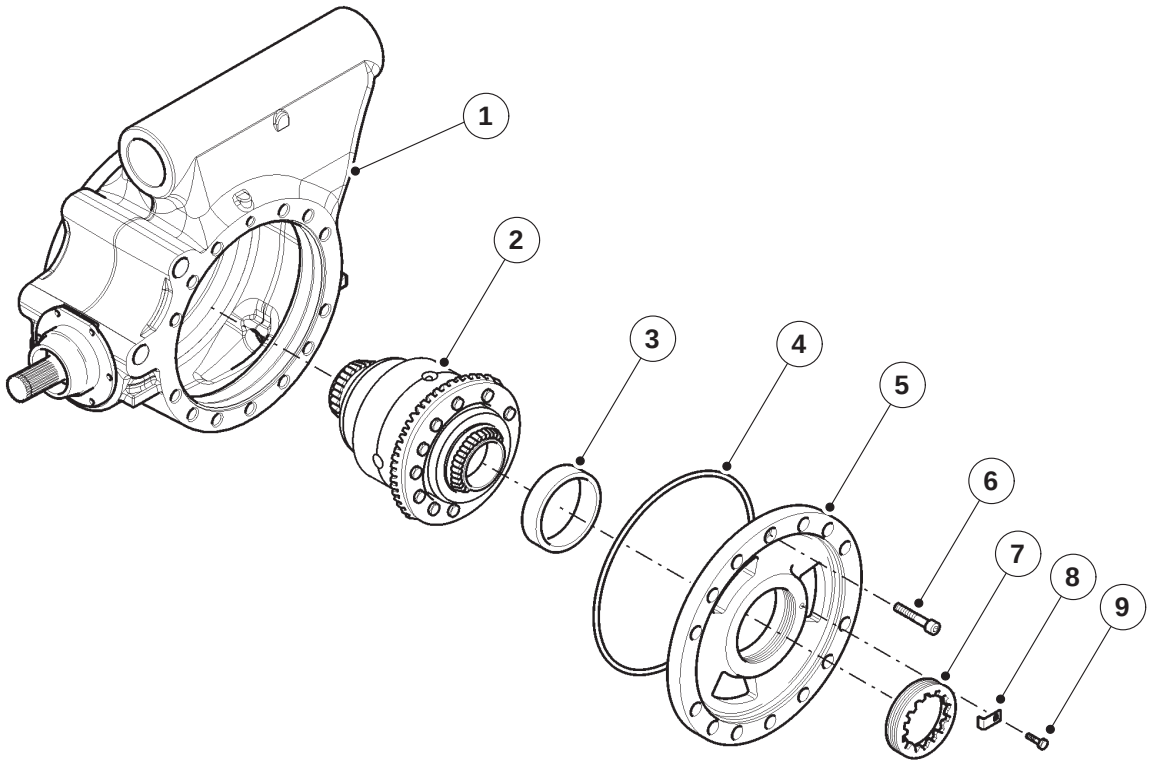
10. Fill the axle with oil. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL in this section.
11. Install the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE N13–04–19 in this section.

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DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL SUPPORT GROUP (FOUR-WHEEL STEER)

BHL1103DE

Operation: **Disassembly and Assembly of the Differential Support Group**	*Job Code:* **11 03 13 xx**		
Suitable lifting equipment	Standard tools, CA715386, CA715387, CA715034, CA715505, CA119030, CA715456, CA715116.		



TV041112

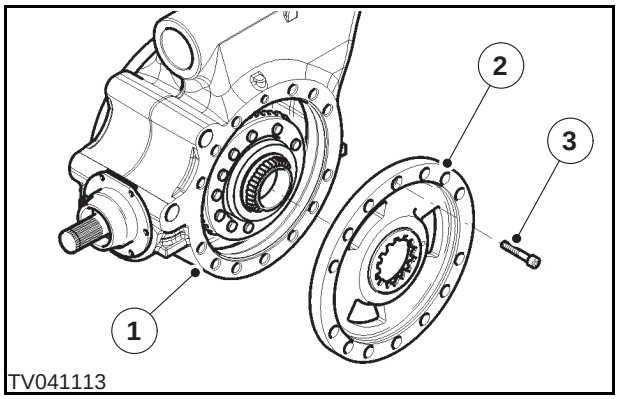
1	Central Body
2	Differential Group
3	Bearing Cup
4	O-Ring
5	Differential Support
6	Retaining Bolt
7	Adjuster Ring Nut
8	Adjuster Ring Nut Retainer
9	Retaining Screw

Disassembly

1. Remove the axle beam group. For additional information, refer to AXLE BEAM GROUP, PAGE N13–04–19 in this section.

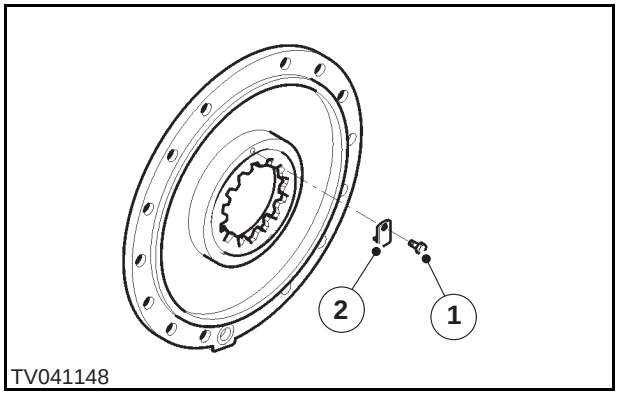
2. Remove the retaining bolt (6) and remove the differential support (5) from the central body (1).

   Note:
   - Remove and discard the O-ring.



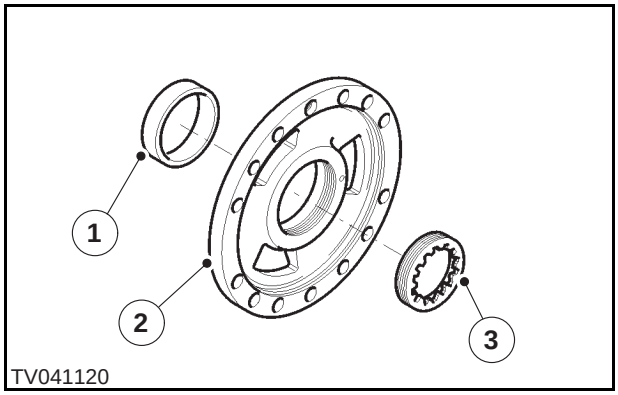
TV041113

3. Remove the retaining screw (1) and remove adjuster ring nut retainer (2).



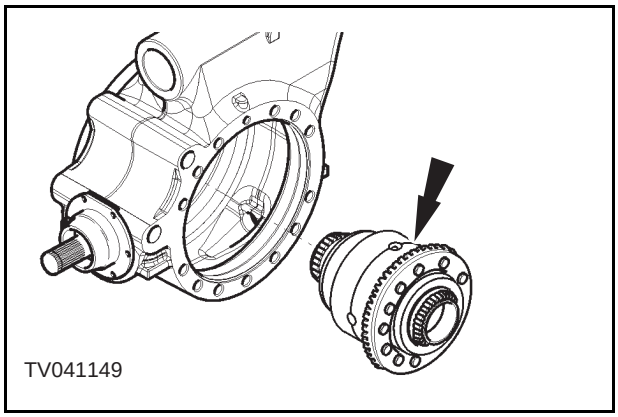
TV041148

4. Using the special tool **CA119030 - Wrench** , remove the adjuster ring nut retainer (7) from the differential support (5).
5. Remove the bearing cup (6) from the differential support (5).



TV041120

6. Remove the differential group (2).


TV041149

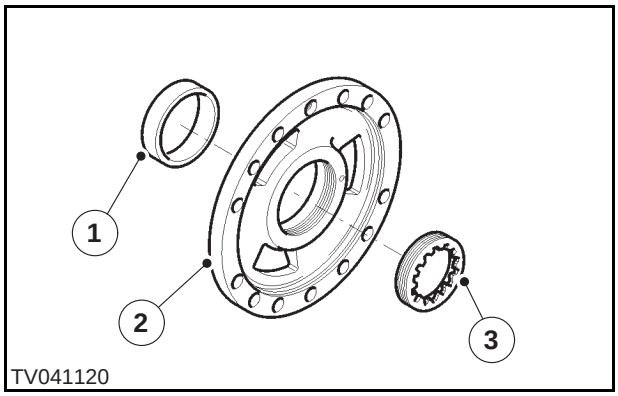
Assembly

Note:
- Some of the following pictures may not show exactly your axle, but the indicated operations are correct.

Note:
- It is important to begin the assembly on the left side of the central body to make possible the assembly of the differential support.

Note:
- Install a new O-ring into the differential support.

1. Using special tool **CA715299 — Driver** , install the bearing cup (1) to the left differential support (2).
2. Using the special tool **CA119030 — Wrench** , install the adjuster ring nut (3) into the left differential support (2).

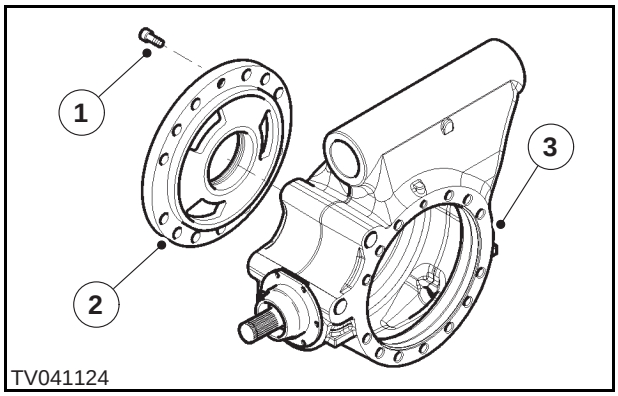


TV041120

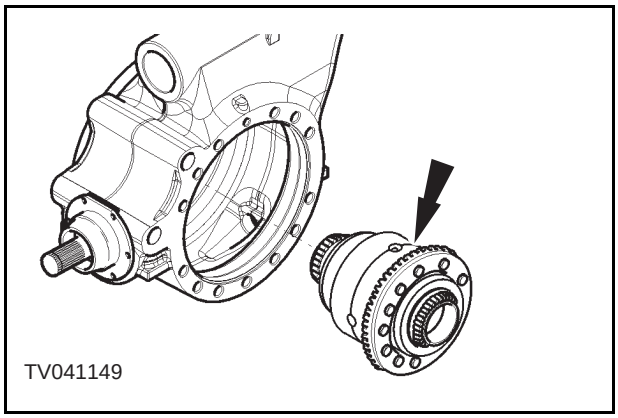
⚠ **Caution:**
- **Secure the differential support with at least three retaining bolts. Failure to follow this instruction may result in damage to the axle.**

3. Assemble the left differential support (2) to the central body (3).

4. Tighten (6) to 95Nm (70 lb.ft).



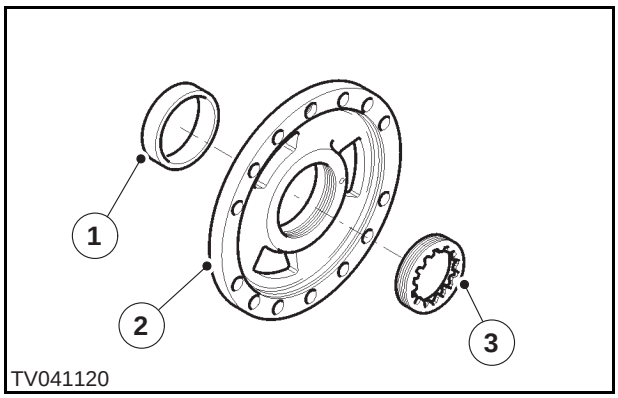
5. Install the differential to the central body



Note:
- Install a new O-ring into the differential support.

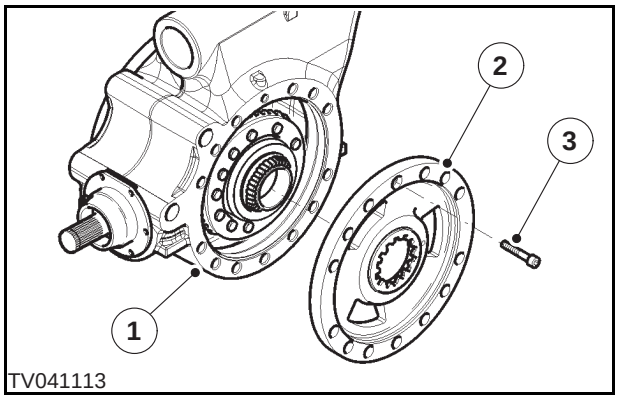
6. Using the special tool **CA715299 — Driver** install the baring cup (1) to the right differential support.
7. Using the special tool **CA119030 — Wrench** , install the adjuster bring nut (3) into the right differential support (2).

⚠ **Caution:**
- **Secure the differential support with at least three retaining bolts. Failure to follow this instruction may result in damage to the axle.**



8. Assemble the right differential into the central body (1).

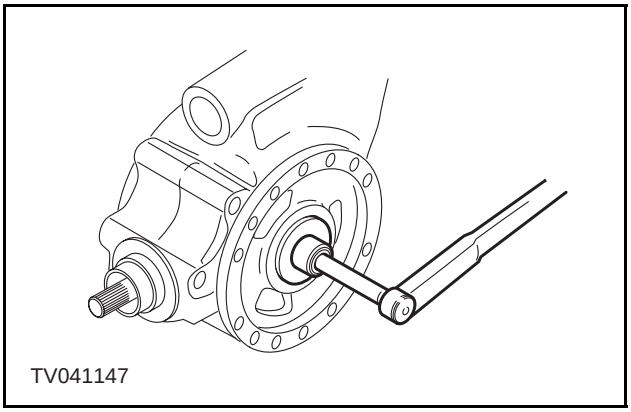
9. Assemble the right differential support (5) into the central body (1).



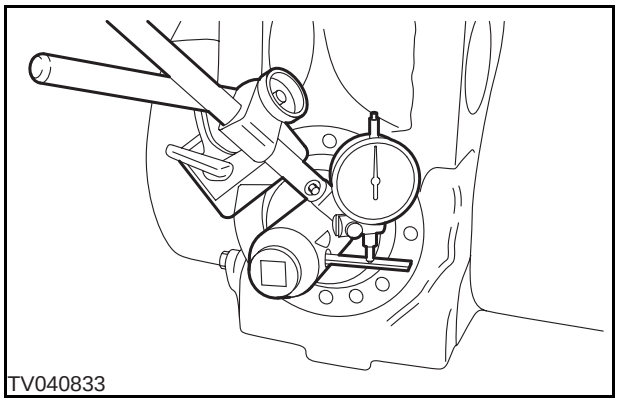
TV041113

Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the nominal bearing pre-load and no free play.

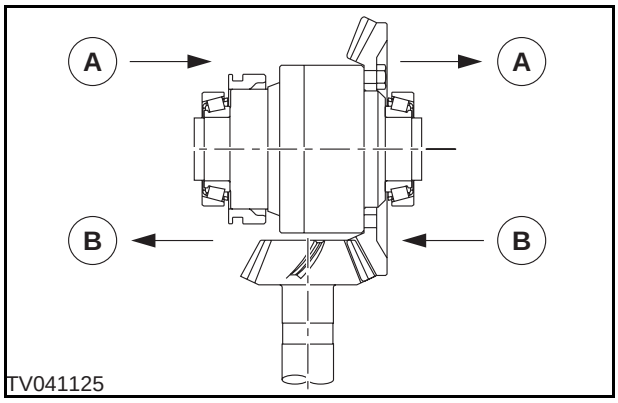
10. Using the special tool **CA119030 — Wrench** , adjust the differential adjustment nuts until the correct pinion to crown wheel backlash is achieved.


TV041147

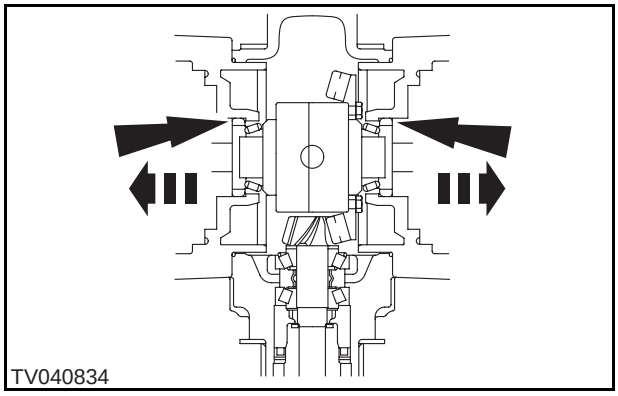
11. Using a suitable measuring device and special tool **CA715456 — Kit for backlash measurement** , measure the pinion to crown wheel backlash.
12. The pinion to crown wheel backlash should be within the following range:
0.18mm – 0.23mm


TV040833

13.
- **Measured backlash is greater than the specified range — (A)** , adjust the differential assembly closer to the pinion shaft by loosening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment nut equal amounts.
- **Measured backlash is less than the specified range — (B)** , adjust the differential assembly away from the pinion shaft by tightening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment nut equal amounts.



14. Once the correct pinion to crown wheel backlash is achieved, check that the differential taper roller bearings have no free play and no pre-load is evident.
15. Repeat steps 10 to 13 of the whole sequence of the above mentioned operations, until the indicated conditions are reached.



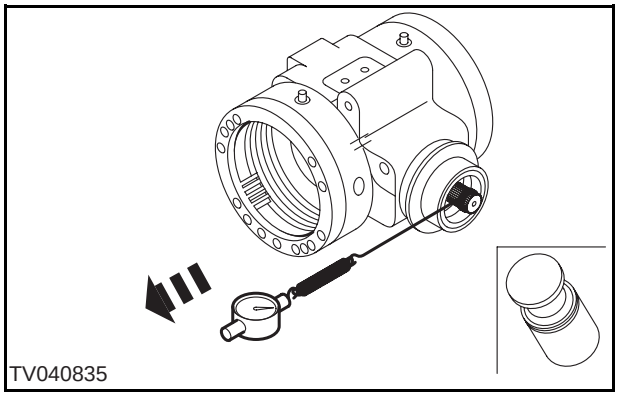
16. Install the special tool **CA715116 — Measurement** onto the pinion shaft.

⚠ **Caution:**
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

Note:
- Using a suitable soft-faced hammer, settle the differential taper roller bearings.

Note:
- Rotate the differential assembly while tightening the adjustment nuts to seat the bearing rollers on their track.

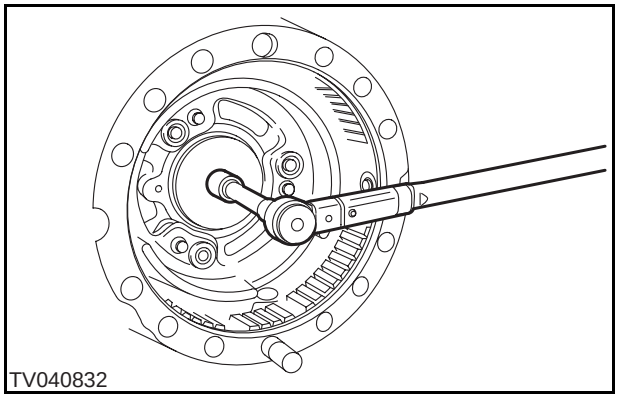
17. Using a suitable measuring device (with the cord wound on the 104.6 mm diameter of the special tool **CA715780 — measurement**), measure the total rotational torque.


TV040835

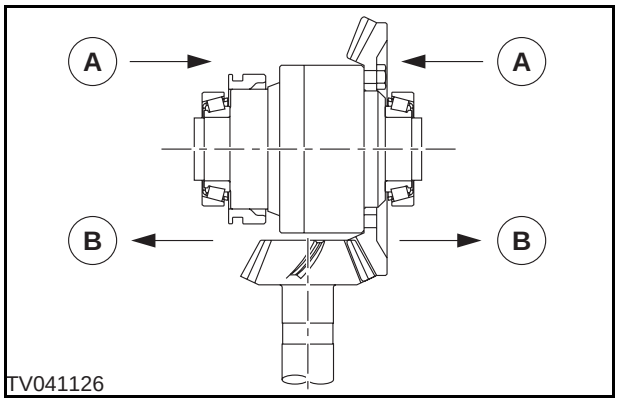
18. The total rotational torque should be within the following range excluding breakaway torque.
(6.14 + P) to (9.16 + P) N
P = Measured pinion shaft rotational torque. For additional information refer to PINION GROUP, PAGE L11–02–53 in this section.

Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the set backlash.

19. Using the special tool **CA119030 — Wrench for differential housing lock nut** , adjust the differential adjustment nuts until the correct differential taper roller bearing pre-load is achieved.


TV040832

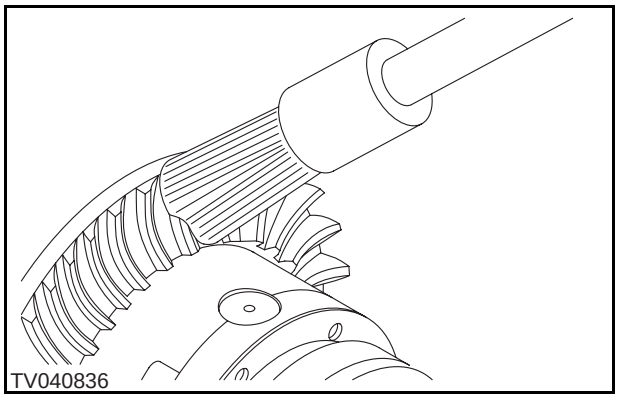
20.
- **Total pre-load is less than the specified range — (A)** , increase the differential taper roller bearing pre-load by tightening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment equal amounts.
- **Total pre-load is higher than the specified range — (B)** , decrease the differential taper roller bearing pre-load by loosening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment equal amounts.



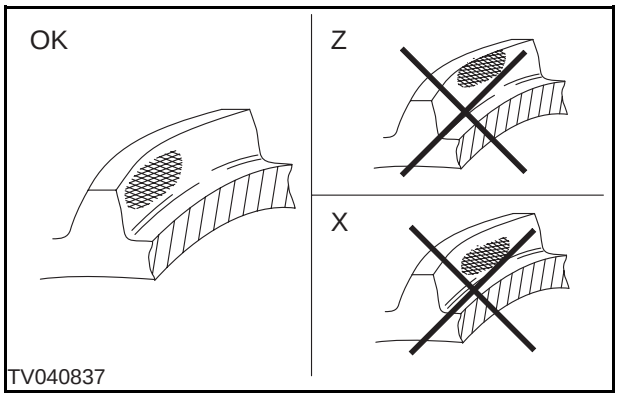
Testing After Adjustment

Note:
- The marking test should always be carried out on both sides of the crown wheel teeth.

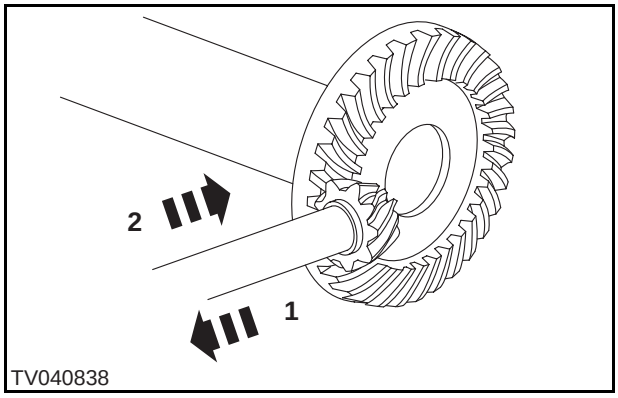
21. To test the marks of the crown wheel teeth, paint the ring gear with red lead paint.



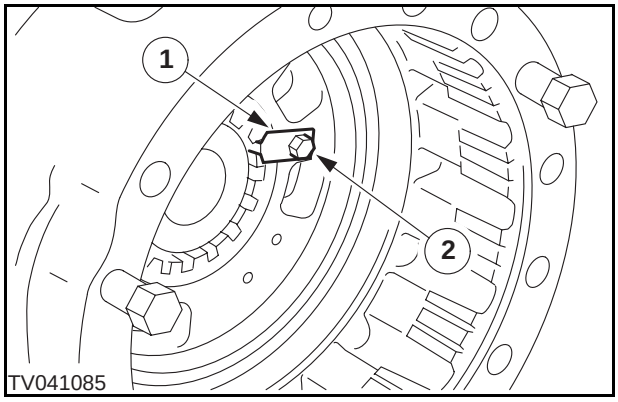
22. Check the contact pattern:
    OK = Correct contact — If the crown wheel is well adjusted, the mark on the teeth surfaces will be regular.
    Z = Excessive contact on the tooth tip — Adjust the pinion towards the crown wheel and then adjust the crown wheel away from the pinion in order to adjust the backlash.
    X = Excessive contact at the tooth base — Adjust the pinion away from the crown wheel and then adjust the crown wheel towards the pinion in order to adjust the backlash.



23. **Movements to correct**
    Adjust as required:
    1 = move the pinion for type X contact adjustment.
    2 = move the pinion for type Z contact adjustment.



24. Lock the differential adjustment nuts in position with the locking tabs (1) and secure with the retaining bolts (2).
25. Tighten to 13Nm (10 lb.ft).

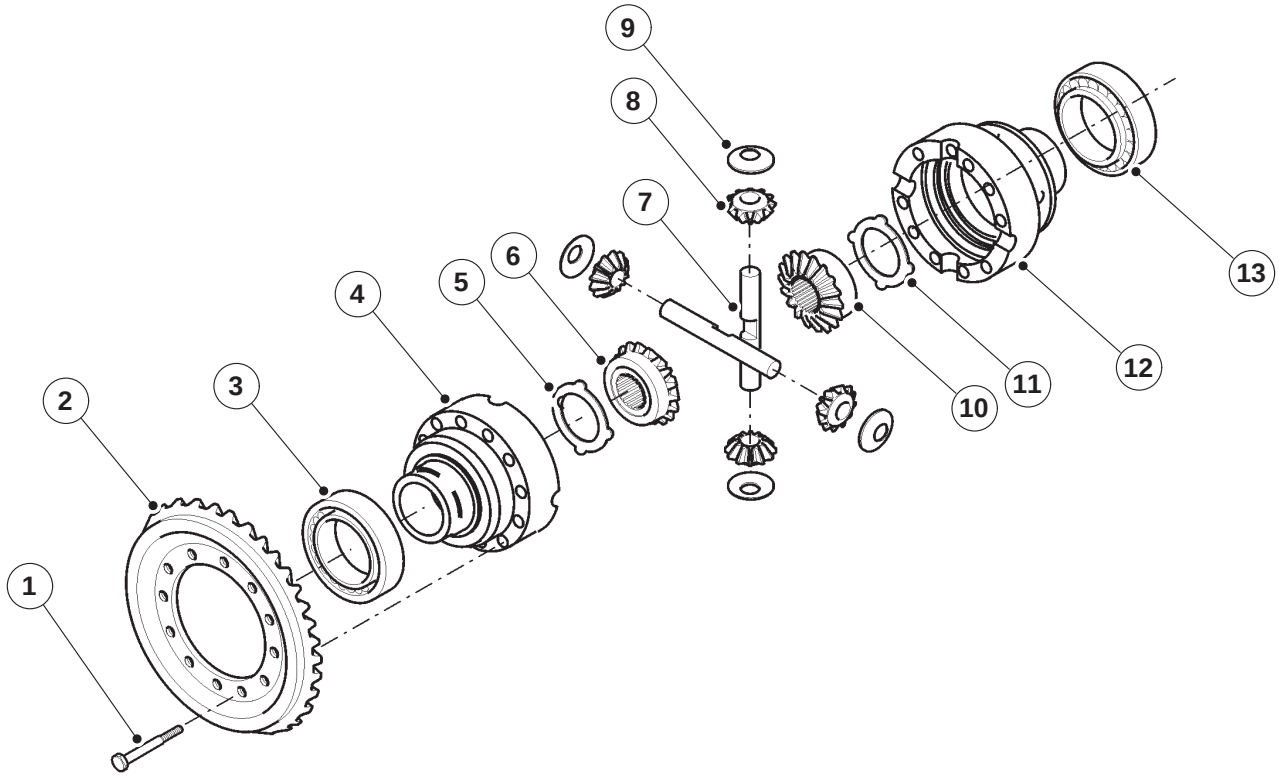


26. Fill the axle with oil. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL in this section.
27. Install axle beam group. For additional information, refer to AXLE BEAM GROUP, PAGE N13–04–19 in this section.

DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL GROUP (FOUR-WHEEL STEER)

BHL1103DF

Operation: **Disassembly and Assembly of the Differential Group**	*Job Code:* **11 03 17 xx**		
None	Standard tools, CA715133		



TV041111

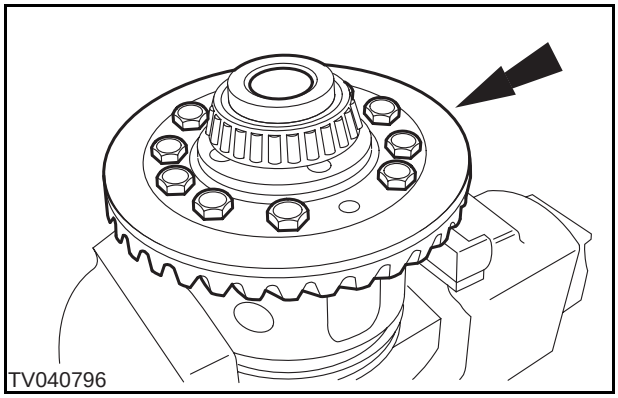
1	Retaining Bolts
2	Bevel Gear Crown
3	Taper Roller Bearing
4	Housing
5	Thrust Plate
6	Sun Gear
7	Planetary Shaft
8	Planetary Gear
9	Thrust Washer
10	Sun Gear
11	Thrust Plate
12	Housing
13	Taper Roller Bearing

Disassembly

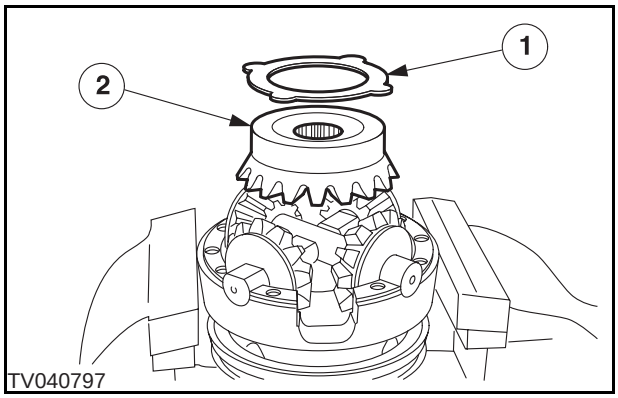
1. Disassemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.
2. Position the differential in a suitable vice.

Note:
- Mark the differential carrier prior to disassembly to aid installation.

3. Remove the crown wheel.

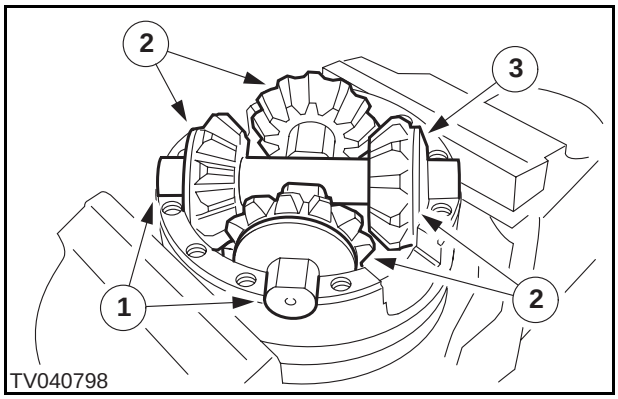


4. Remove the thrust plate (1) and sun gear (2).

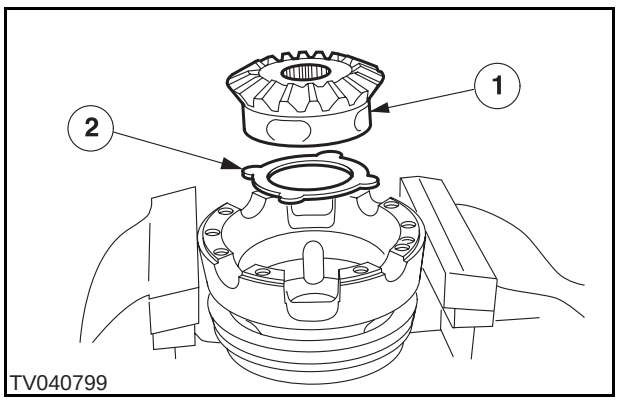


5. Remove the planetary shafts (1) and the planetary gears (2).

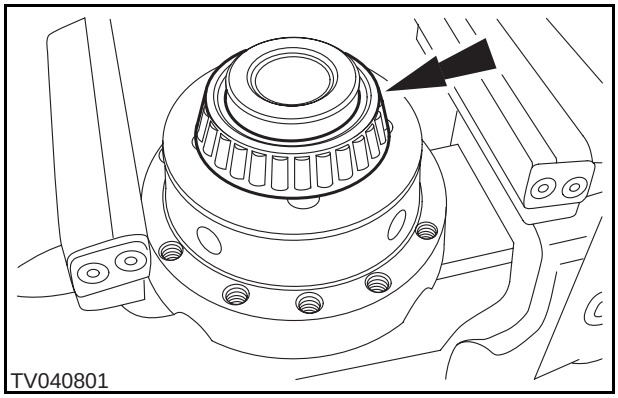
Note:
- Recover the thrust washers (3).



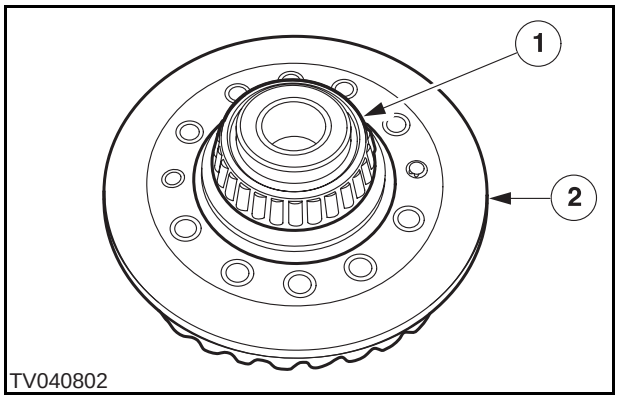
6. Remove the sun gear (1) and thrust plate (2).



7. Remove the snap ring (1).
8. Using a suitable puller, remove the right-hand side taper roller bearing.


TV040801

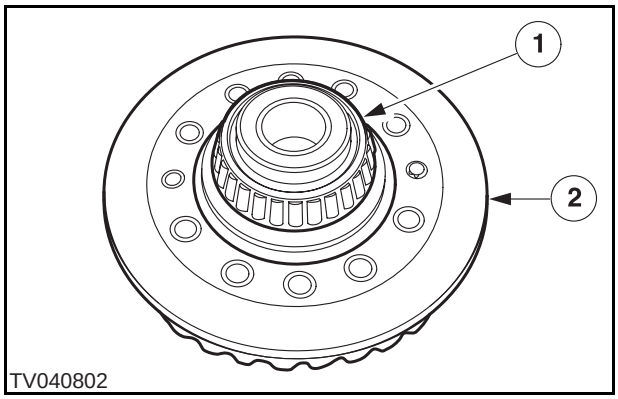
9. Using a suitable puller, remove the left-hand side taper roller bearing (1) and the crown wheel (2).



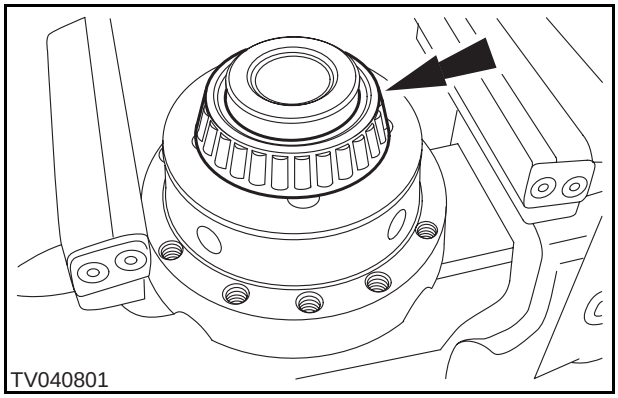
TV040802

Assembly

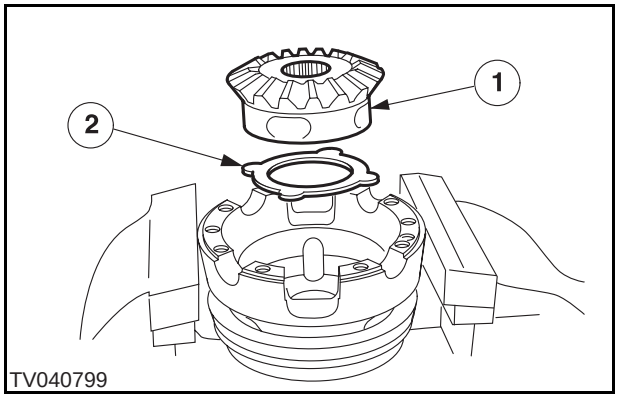
1. Using a suitable hydraulic press and the special tool **CA715133 — Driver for bearing** , install the left-hand side differential taper roller bearing (1) and the crown wheel assembly (2).



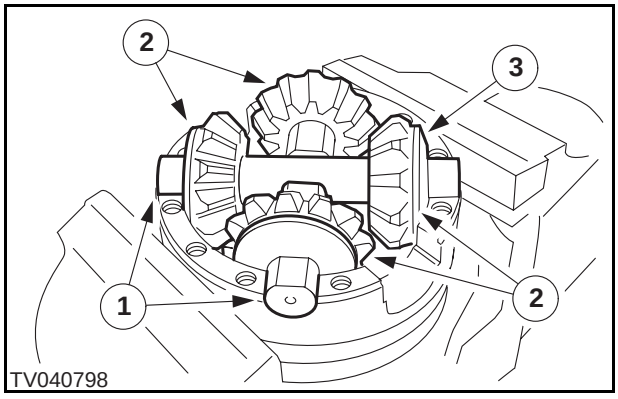
2. Using a suitable hydraulic press and the special tool **CA715133 — Driver for bearing** , install the right-hand side differential taper roller bearing.



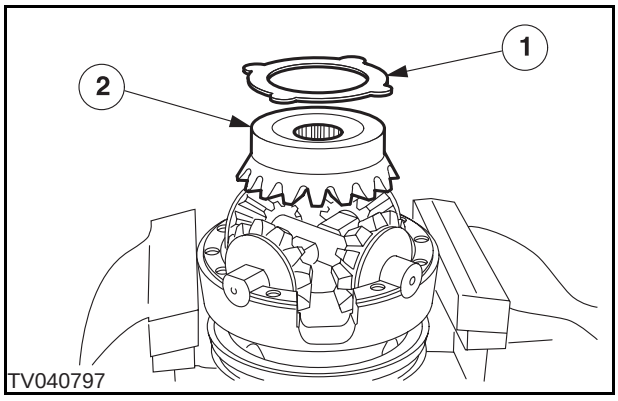
3. Install the thrust washer (2) and the sun gear (1).



4. Install the Planetary shafts (1), planetary gears (2) and the trust washers (3).



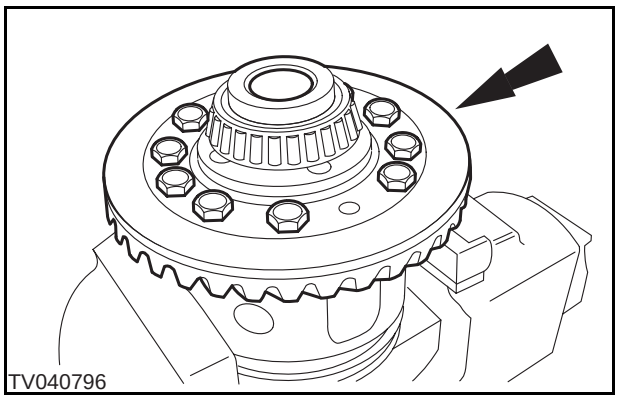
5. Install the sun gear (2) and the thrust washer (1).



6. Install the crown wheel.

   Note:
   - Before installing the crown wheel retaining bolts, apply approved sealant (Loctite 270) to the bolt.

7. Tighten to 155Nm (114 lb.ft).
8. Assemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.

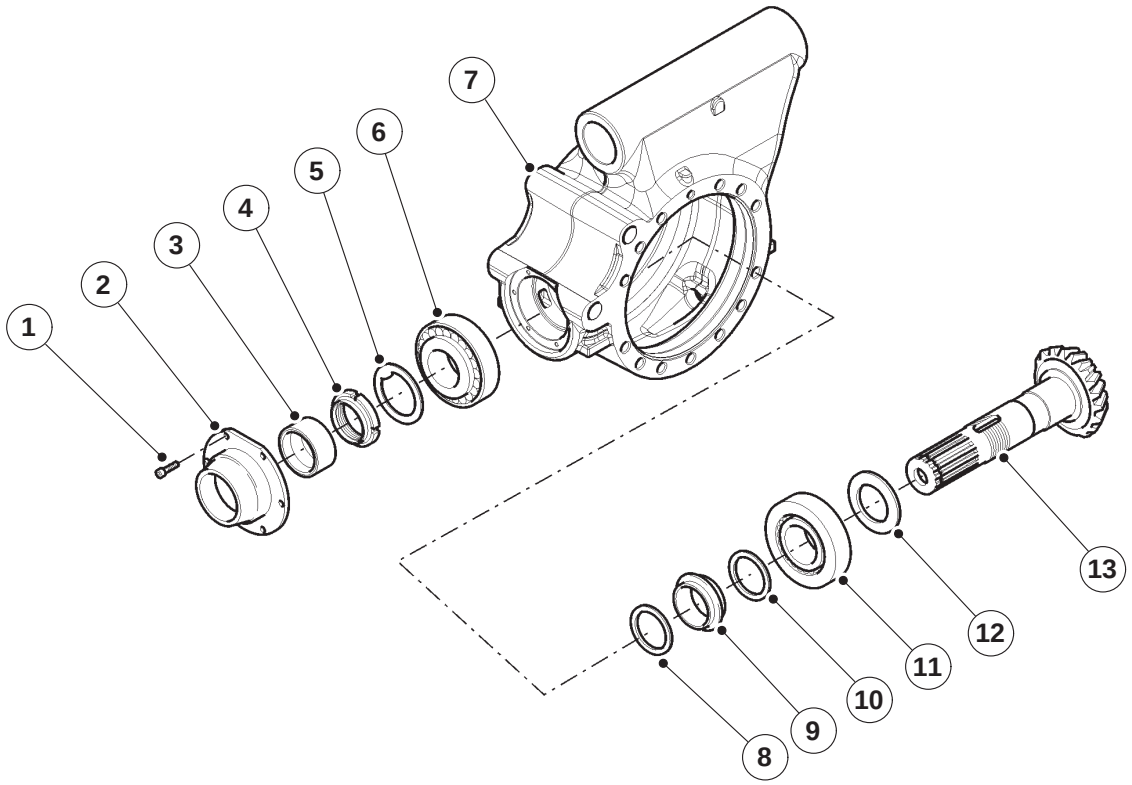


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DISASSEMBLY AND ASSEMBLY — PINION GROUP (FOUR-WHEEL STEER)

BHL1103DG

Operation: **Disassembly and Assembly of the Pinion Group**	*Job Code:* **11 09 17 xx**		
None	Standard tools, CA119099, CA715022, CA715380, CA715128, CA715388, CA715004, Suitable measuring device.		



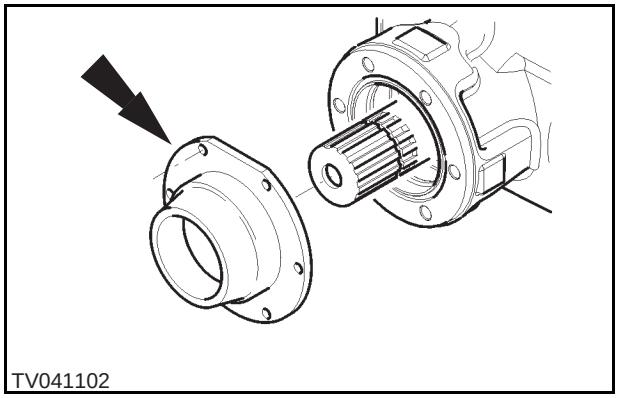
TV041101

1	Retaining screws
2	Flange
3	Sealing Ring
4	Lock Nut
5	Retaining Washer
6	Bearing
7	Differential Housing
8	Washer
9	Collapsible Spacer
10	Washer
11	Bearing
12	Shim
13	Pinion Shaft

Disassembly

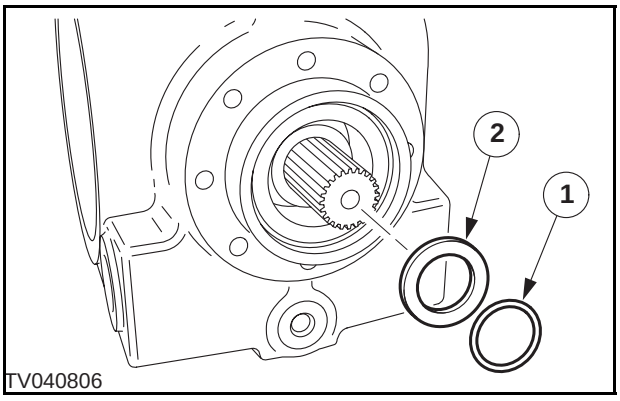
Note:
- Some of the following pictures may not show exactly your axle, but the indicated operations are correct.

1. Disassemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.
2. Remove and flange from the differential housing.


TV041102

3. Remove the O-ring (1) and the spacer (2).

Note:
- Discard the O-ring seal.

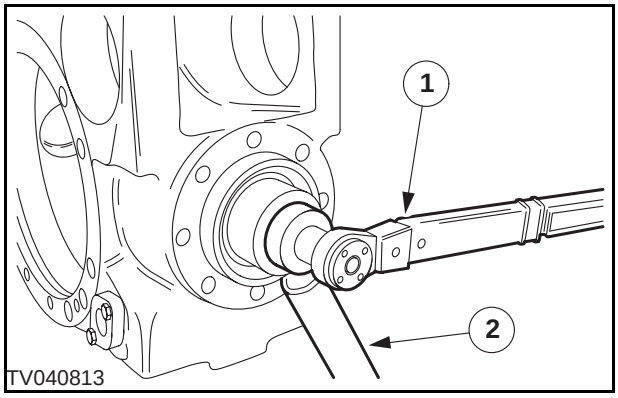


TV040806

⚠ **Caution:**
- **Release the pinion shaft retaining nut locking tabs. Failure to follow this instruction may result in damage to the machine.**

4. Using the special tools **CA119099 — Wrench for lock nut** and **CA715022 — Pinion shaft lock tool** , remove the pinion shaft retaining nut and washer.

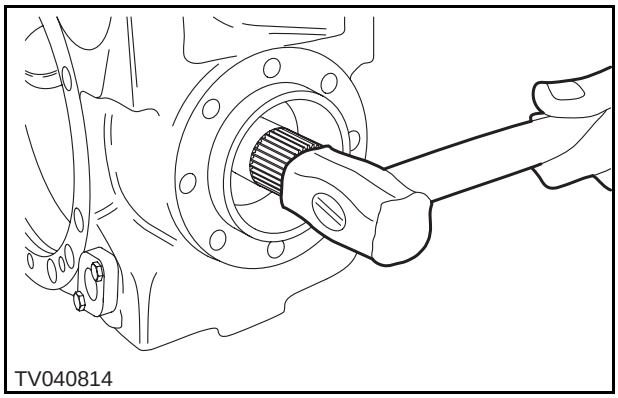
   Note:
   - Recover the lock washer.



TV040813

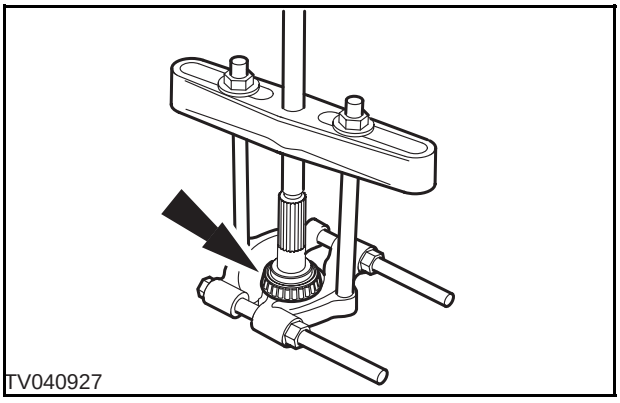
5. Using a suitable soft faced hammer, remove the pinion shaft from the differential housing.

   Note:
   - Recover the outer taper roller bearing, two washers and discard the elastic spacer.

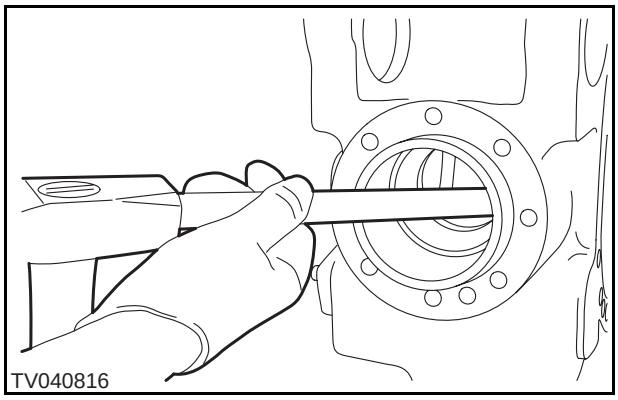

TV040814

6. Using a suitable puller, remove the taper roller bearing from the pinion shaft.

   Note:
   - Recover the pinion end float adjustment shim.


TV040927

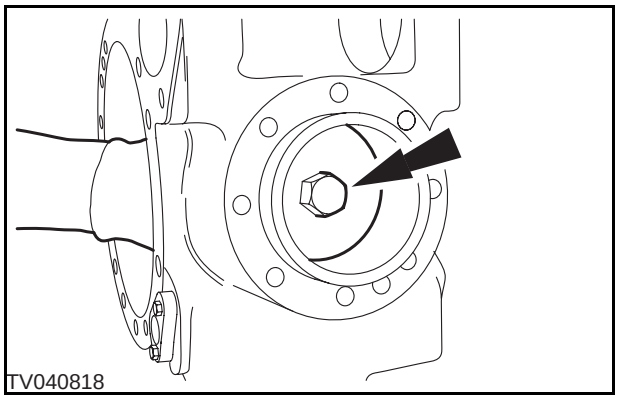
7. Using a suitable drift, remove the pinion shaft taper roller bearing cups from the differential housing.



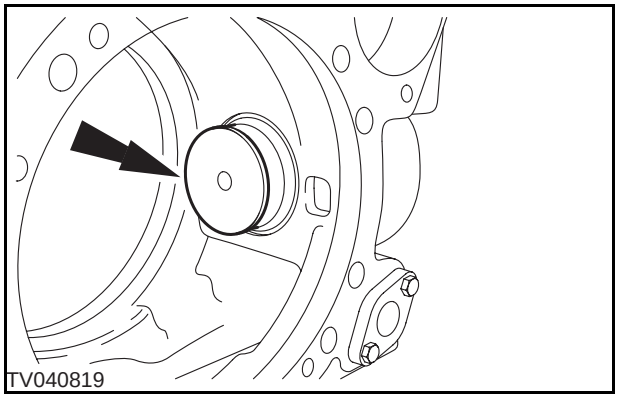
Assembly

Note:
- Some of the following pictures may not show exactly your axle, but the indicated operations are correct.

1. Using the special tool **CA715380 — Bearing races insertion kit** install the taper roller bearing cups into the differential housing.

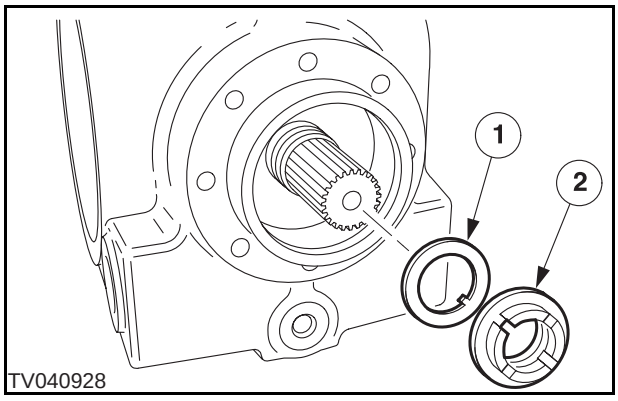

TV040818

2. Install the special tool **CA715128 — False pinion** with the pinion shaft taper roller bearings.


TV040819

⚠ **Caution:**
- **Do not overtighten.**

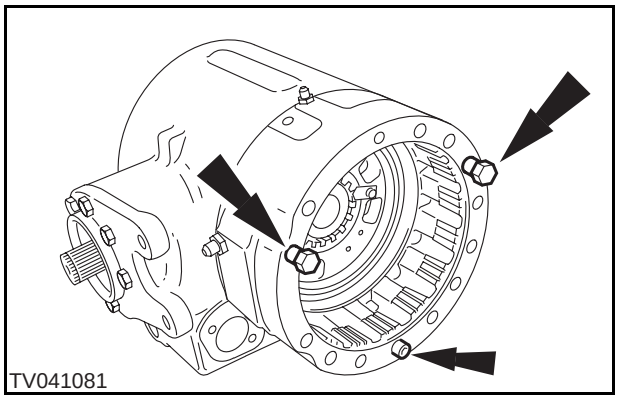
3. Install the lock washer (1) and the pinion shaft retaining nut (2).
4. Tighten until the free play is eliminated.



TV040928

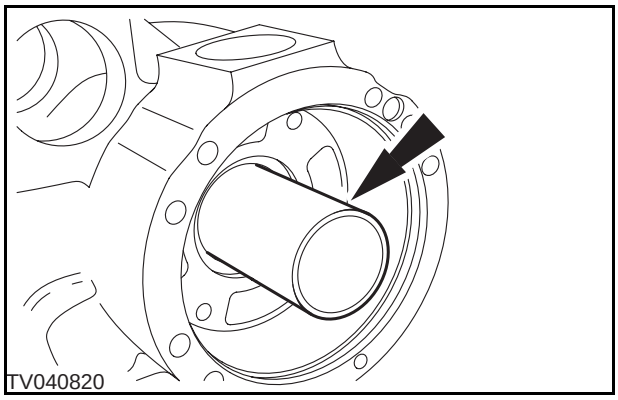
5. Install the left-hand side differential support with three retaining bolts 120° apart.
6. Tighten to 79Nm (58 lb.ft).

7. Repeat steps 5 and 6 for the right-hand side differential support.

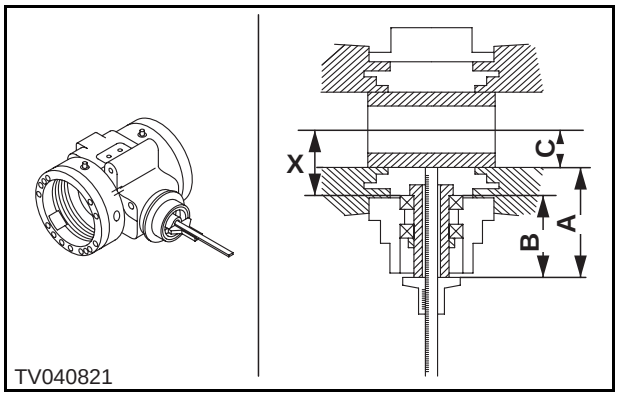

TV041081

Note:
- Ensure the false differential box is inserted in both differential supports.

8. Install the special tool **CA715388 — false differential box** into the differential housing.

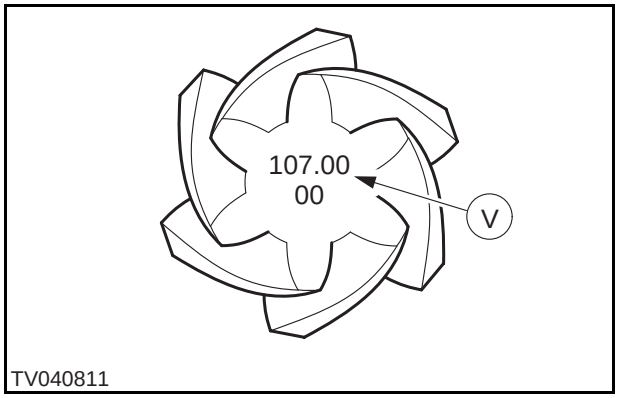

TV040820

9. Using a suitable depth gauge, measure through the false pinion **CA715128 — False pinion. This measurement is "A"** .
10. Determine the value **"X"** as follows:
    X = (conical distance to be measured)
    A = (measured value)
    B = 100mm
    C = 50mm
    X = (A + C) — B
    Example: **A** = 159.9mm
    therefore: **X** = (159.9 + 50) – 100mm
    X = 109.9mm



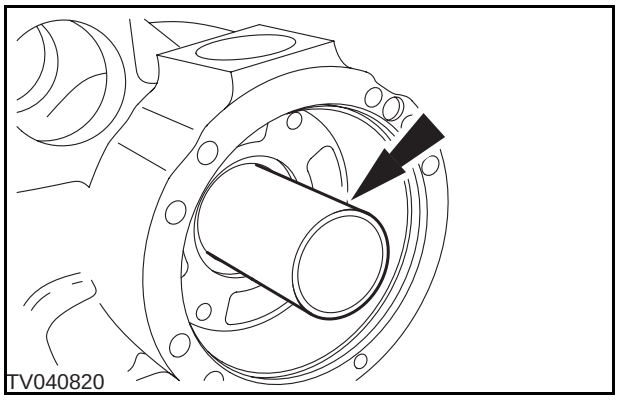
TV040821

11. Determine the pinion shaft position adjustment shim **"S"** as follows:
    subtract the value **"V"** (requested conical distance) from the calculated value **"X"** .
    S = X — V
    Example: Shim thickness **S** = 109.9 – 107.00 = 2.9mm.
    Shim thickness **"S"** = 2.9mm

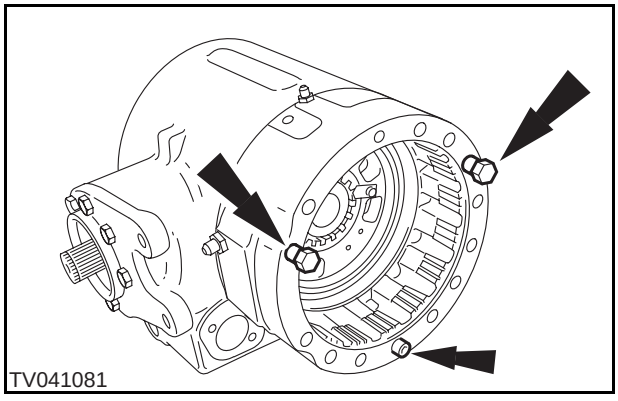


SHIM RANGE										
Th ickness (mm)	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4

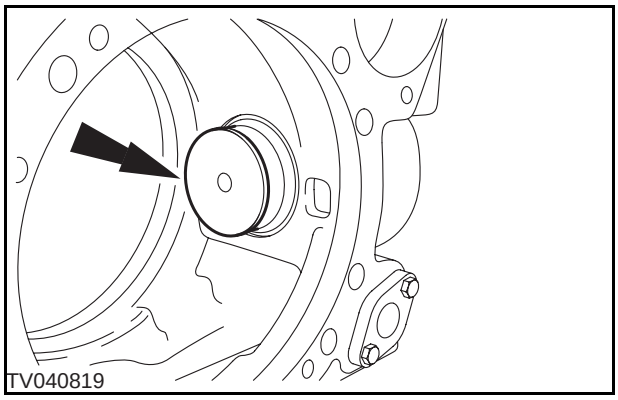
12. Remove the special tool **CA715388 — false differential box** from the differential housing.



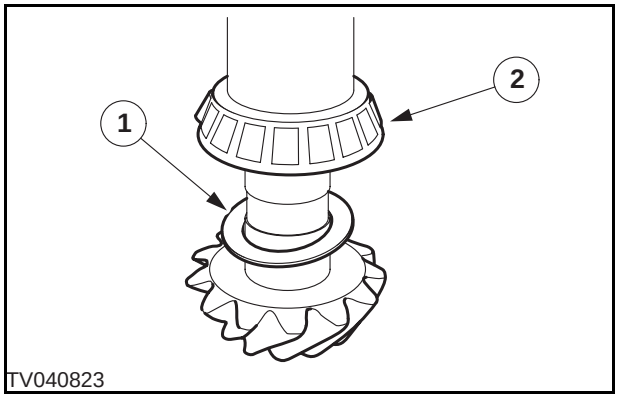
13. Remove the differential support (both sides).



14. Remove the special tool **CA715128 — False pinion** with the pinion shaft taper roller bearings.


TV040819

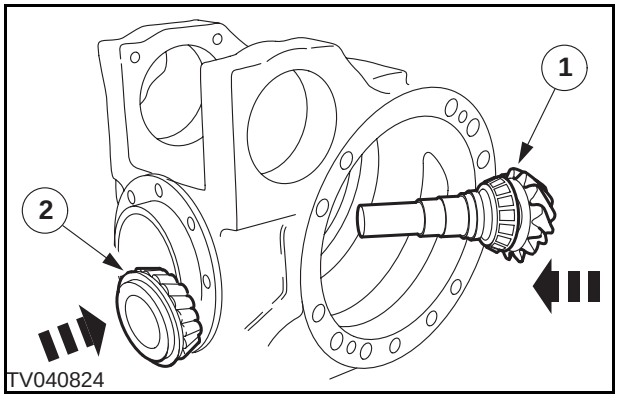
15. Install the pinion shaft adjustment shim (1) with chamfer against the gear.
16. Using a suitable hydraulic press and the special tool **CA715004 — Driver for bearing** install the rear taper roller bearing (2).



TV040823

Note:
- Always use a new elastic spacer.

17. Install the washers and the new elastic spacer onto the pinion shaft.
18. Install the pinion shaft assembly (1) and the front taper roller bearing (2) into the differential housing.

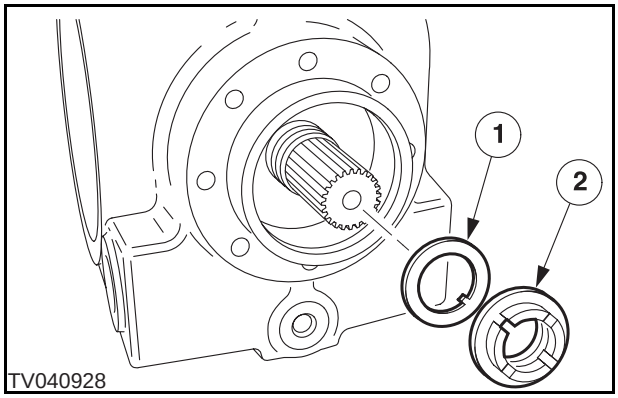


TV040824

19. Install a new lock washer (1).

Note:
- Do not tighten at this stage.

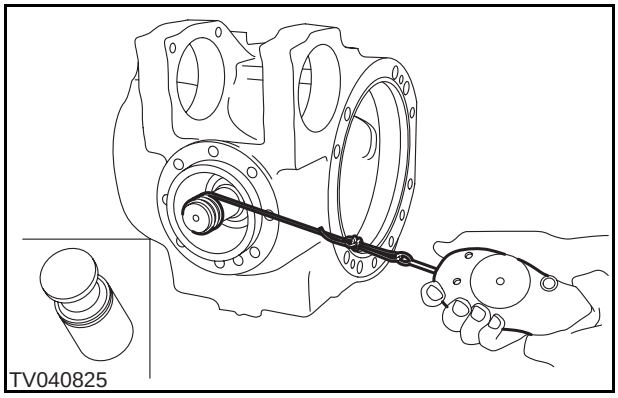
20. Install a new pinion shaft retaining nut (2).



21. Install the special tool **CA715116 — Measurement** onto the pinion shaft.

Note:
- Using a suitable soft faced hammer, settle the pinion shaft bearings.

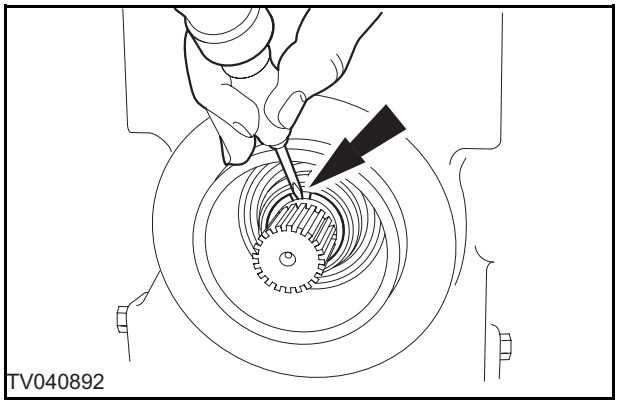
22. Using a suitable measuring device (with the cord wound on the special tool **CA715116 — measurement**), measure the pinion shaft rotational torque.
23. The rotational torque should be within the following range excluding breakaway torque.
9.2 to 13.7 daN



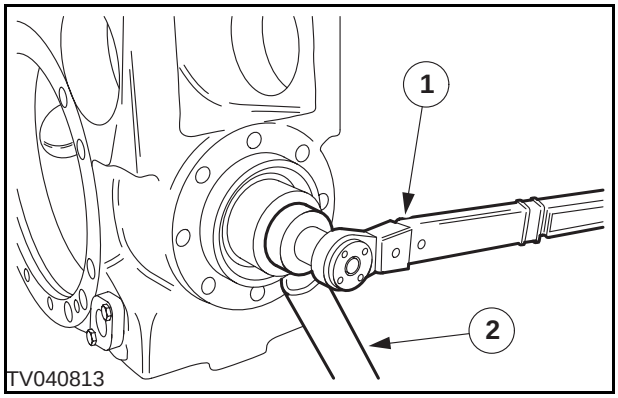
⚠ **Caution:**
- **If the stated rotational torque range is exceeded the elastic spacer must be replaced and the procedure repeated**

24. The adjustment is carried out by increasing the pinion shaft retaining nut torque setting gradually, being careful not to exceed the stated range.

25. Once the correct rotational torque is achieved, secure the pinion shaft retaining nut.

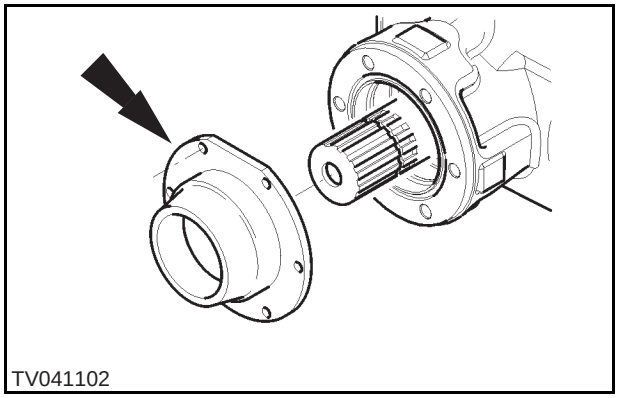

TV040892

26. Assemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.



TV040813

27. Install the flange onto the differential housing.


TV041102

GENERAL PROCEDURE — TOE-IN ADJUSTMENT (FOUR-WHEEL STEER)

BHL1103GA

Operation: **General Procedure Toe-in Adjustment**	*Job Code:* **11 13 01 xx**		
None	Standard tools, Two one-metre-long bars		

General Procedure

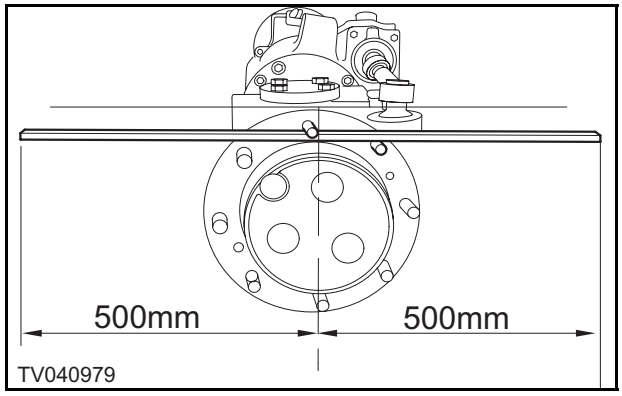
The toe-in of the front wheels must be between 0 and 5mm toe-in as measured 500mm from the centre of the wheel hub.

To check the exact value of the toe-in setting, proceed as follows.

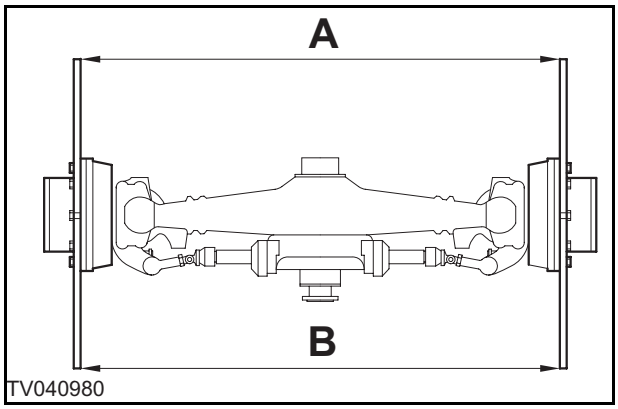
1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

   Note:
   - The bars must be fixed flat against the wheel hub flange and have an equal distance from the centre of the wheel hub.

2. Install two equal one-metre-long bars to the wheel side of the wheel hubs and lock in place with two wheel retaining nuts.



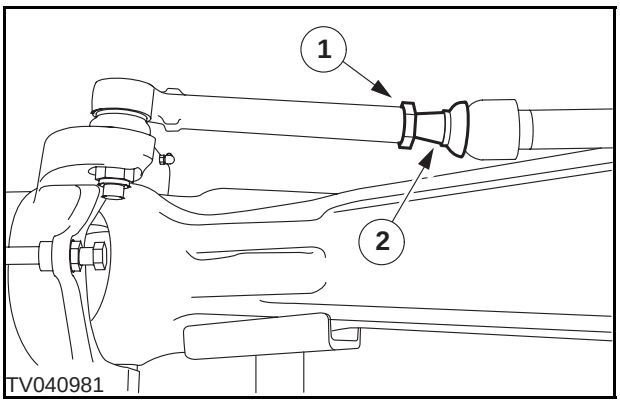
3. Measure the distance (A) between the ends of the two bars.
4. Measure the distance (B) between the ends of the two bars.
5. The distance (A) must be 0 to 5mm less than distance (B).



Note:

- Make sure the same number of threads are visible at the end of the left-hand and right-hand inner track rod end ball joints.

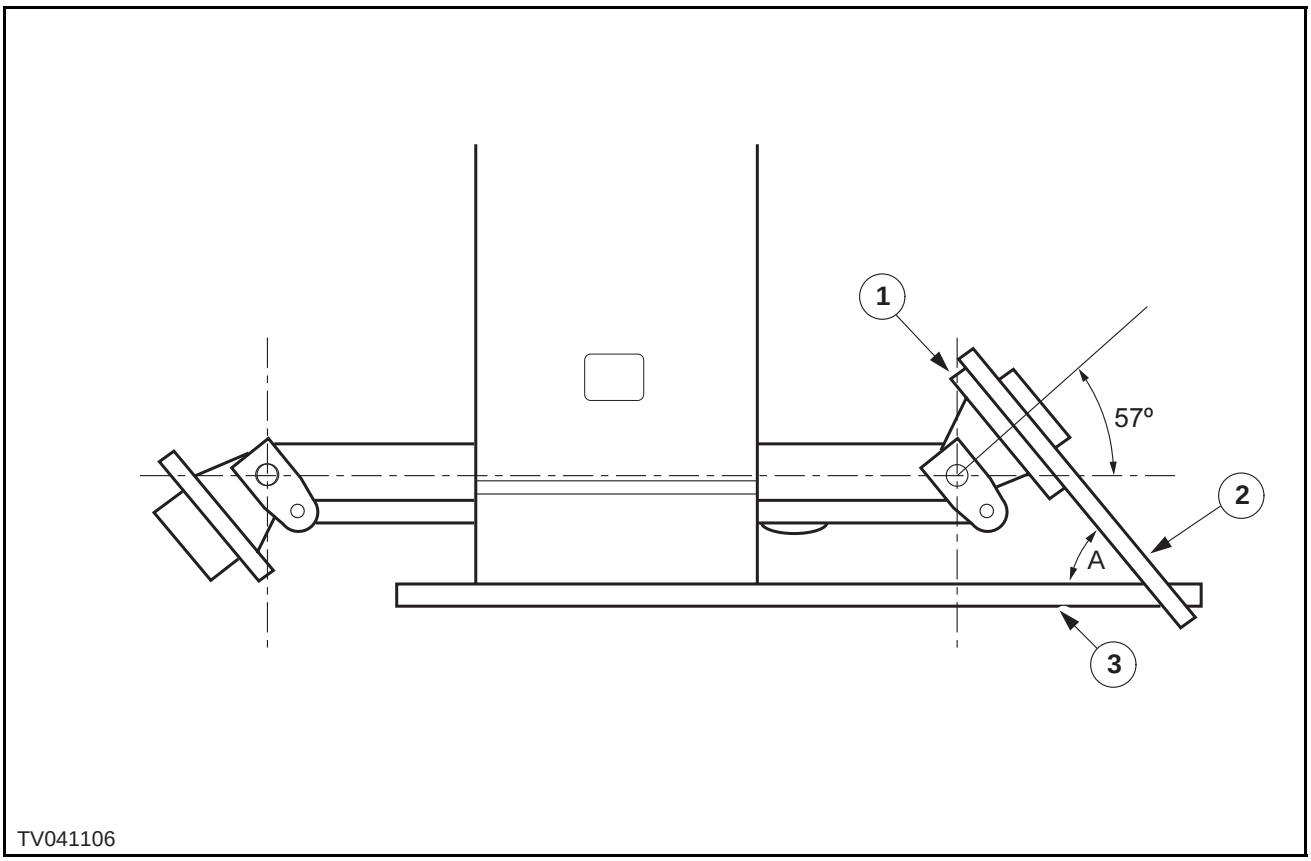
6. If it is necessary to correct the toe-in adjustment. Loosen the lock nut (1) on the left-hand and the right-hand side. Turn the inner track rod end ball joints (2) equally to achieve the specified toe-in adjustment.
7. Tighten (1) to 120Nm.



GENERAL PROCEDURE — STEERING ANGLE ADJUSTMENT (FOUR-WHEEL STEER)

BHL1103GB

General Procedure



TV041106

1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

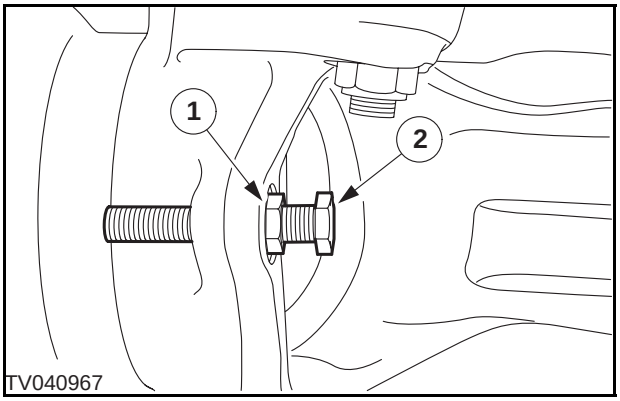
   Note:
   - Support the machine under the front chassis.

2. Turn the steering wheel until the front wheel hubs are on full left-hand lock.
3. Place a straight edge (3) against the axle input flange or against the machine hardnose. Make sure the straight edge is parallel with the axle centre-line.
4. Place a second straight edge (2) against the wheel hub flange (1).

   ⚠ **Caution:**
   - **Make sure the steering angle does not exceed 59 degrees. Failure to follow this instruction may result in excessive wear to the drive shaft universal joints.**

5. Measure the angle (A) at which both straight edges intersect. Subtract angle (A) from 90 degrees to give the steering lock.
   Angle (A) = 33 degrees
   Steering angle 90 – 33= 57 degrees.
6. Adjust the left-hand stop for maximum left steering lock and right-hand stop for maximum right steering lock.

7. Loosen the lock nut (1) and adjust the steering stop adjuster bolt (2) until the bolt head touches the steering stop.
8. Tighten the lock nut (1) to 150Nm.
9. Turn the steering wheel until the front wheel hubs are on full right-hand lock and repeat the procedure for the right-hand side.

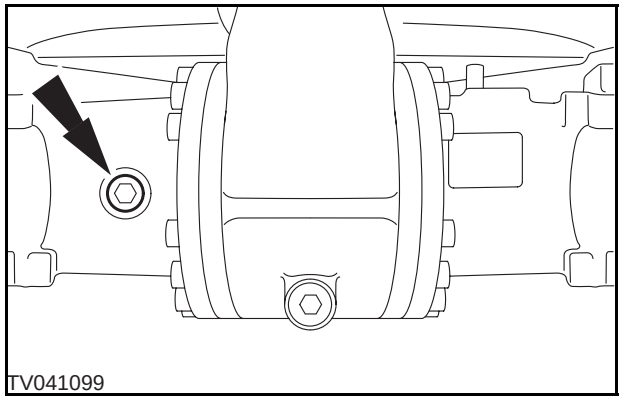


GENERAL PROCEDURE — DRAINING AND FILLING THE FRONT AXLE HOUSING OIL (FOUR-WHEEL STEER) BHL1103GC

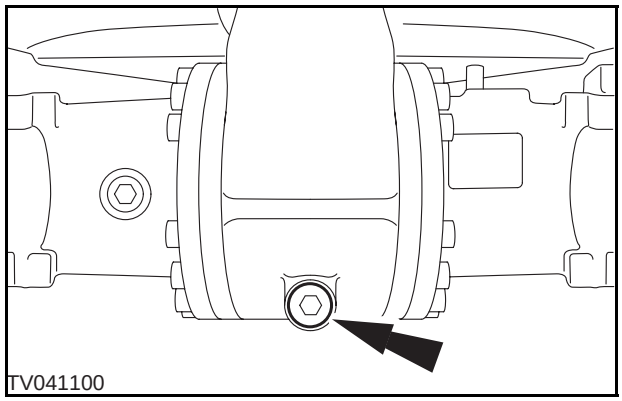
Operation: **Draining and filling the four wheel steer front axle housing oil**	*Job Code:* **11 07 09 xx**		
Suitable Container	Standard tools		

Draining

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Loosen the filler/level plug to release any pressure.

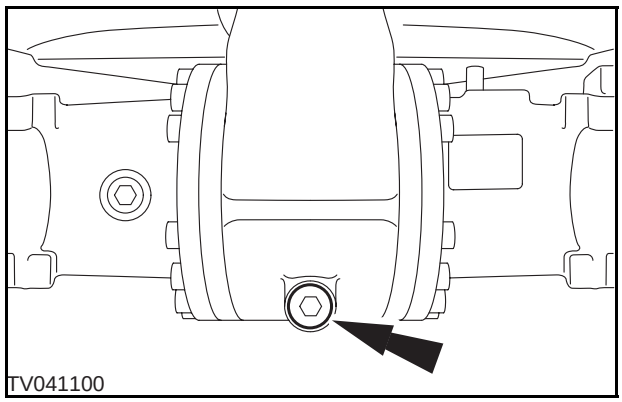

TV041099

3. Remove the drain plug and drain the oil into a suitable container.

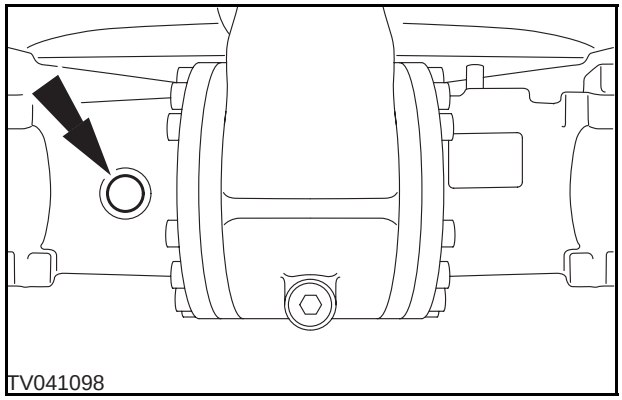

TV041100

Filling

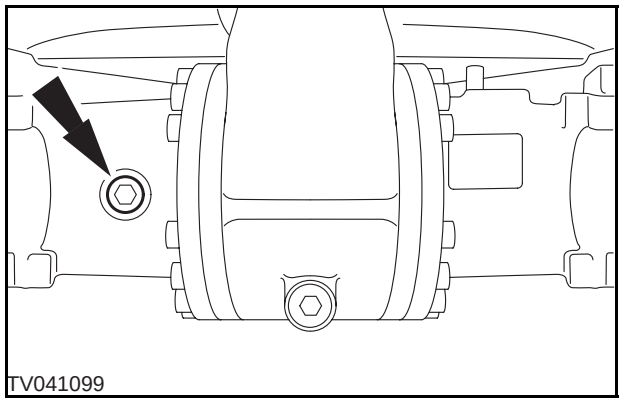
1. Install the drain plug and tighten to 60Nm.


TV041100

2. Fill with oil until the filler/level hole is reached.


TV041098

3. Install the filler/level plug and tighten to 60Nm.

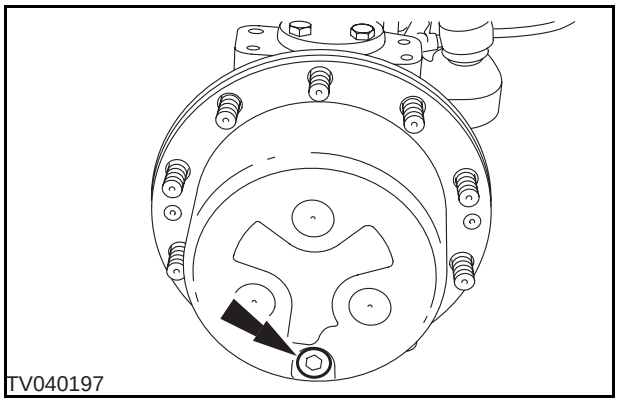

TV041099

GENERAL PROCEDURE — DRAINING AND FILLING THE HUB OIL (FOUR-WHEEL STEER)

BHL1103GD

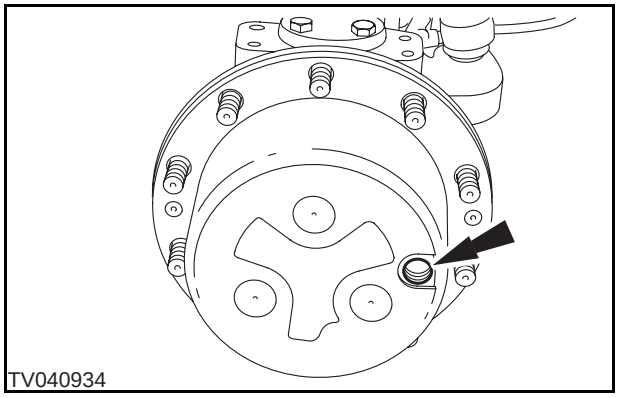
Draining

1. Position the hub until the drain/filler plug is positioned at the top. Loosen the drain plug to release any pressure.
2. Position the hub until the drain/filler plug is positioned at the bottom. Remove the drain/filler plug and drain the hub oil into a suitable container.


TV040197

Filling

1. Position the hub until the drain/filler plug is at the 3 o'clock position. Fill with oil until the drain/filler hole level is reached.
2. Install the drain/filler plug and tighten to 60Nm.


TV040934

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SPECIFICATIONS — FOUR WHEEL STEER FRONT AXLE

BHL1103SA

Special Tools

Tool No.	Description
CA119030	Wrench
CA119033	Interchangeable Handle
CA119043	Driver
CA119099	Wrench for Lock Nut
CA715026	Driver for Bearing Race
CA715027	Driver for Bush
CA119117	Driver
CA119143	Driver
CA119182	False Differential Box
CA119225	Driver
CA119226	False Differential Box
CA119230	Driver
CA715023	False Pinion
CA715034	Driver
CA715035	Driver
CA715163	Driver
CA715164	Driver
CA715170	Wrench
CA715179	Driver
CA715505	Driver
CA715506	Driver
CA715701	Driver

Torque Values

Description	Nm	Lb.ft
Epicyclic Reduction Hub	80	59
Wheel Hub	230	170
Axle Drain/Fill Plug	60	44
Axle Trumpet Housing	320	236
Wheel Stud	70	52
King Pin	190	140
Crown Wheel	95	70
Grease Nipple	8	6
Differential Adjustment Nut Locking Tab	13	10
Differential Housing	169	125
Differential Half Coller	266	196
Breather	10	7
Blanking Plug	25	18
Steering Cylinder	220	162
Swivel Joint	300	221
Tie-Rod Locking Nut	250	184
Tie-Rod End	260	162
Steering Angle Adjustment Locking Nut	150	111

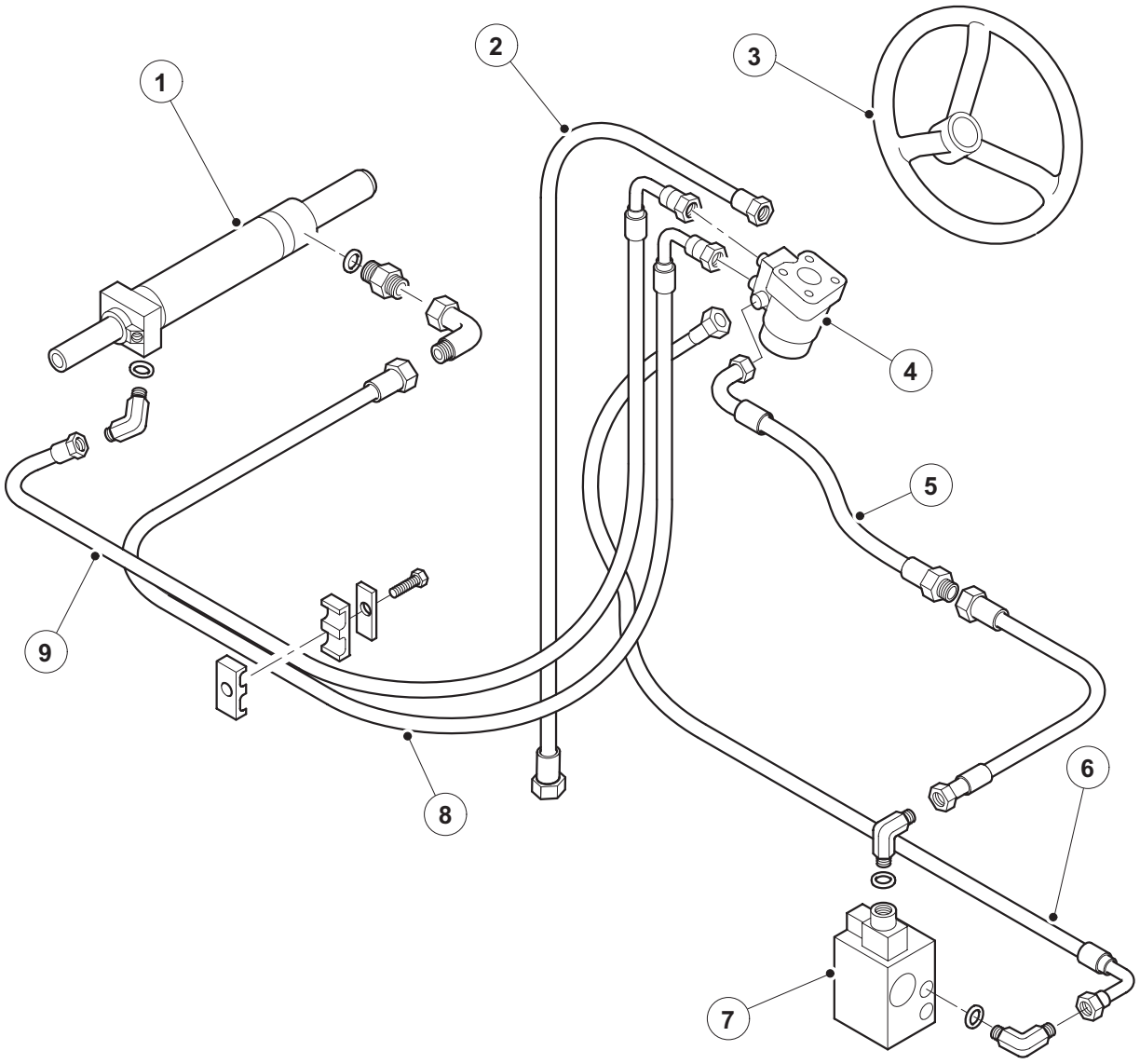
General Specifications

Description	Value
Bevel Gear Ratio	2.5/1
Epicyclic Reduction Gear Ratio	6.923/1
Total Ratio	17.307/1
Dry Weight	444 Kg
Input Rotation	Counter Clockwise (C.W.)
Steering Angle	33° 0–2mm
Toe-in	0–5mm
Crown Wheel / Pinion Backlash	0.18 – 0.23mm
Pinion Bearing Pre-Load “P” (measured on D=34.874mm without seals)	“P” = 9.18 – 13.77 daN
Total Pinion-Ring Gear Bearing Preloading	(4.3 + P) — (6.45 + P) daN
Axle Housing Oil Capacity	7.5 Litres
Epicyclic Reduction Hub Oil Capacity	1.5 Litre
Oil Type (Use recommended oil enriched in Additives)	API GL5 or MIL-L-2105 D (for possible alternatives see – GENERAL INFORMATION – FLUIDS AND LUBRICANTS at the start of this manual).
Grease Type	TECNOLUBE SEAL PLOYMER 400/L (DIN = KHER1R ISO-I-XMR-XM2) AGIP MU/EP2 (King pin only)
Sealant	Silastic 732

DESCRIPTION AND OPERATION — TWO-WHEEL STEER

BHL1104OA

Steering System Overview



TV040959

1	Front Steering Cylinder
2	Reservoir Hose
3	Steering Wheel
4	Orbitrol Steering Motor
5	Load Sensing Line
6	Steering Priority/Unloader Valve Hose
7	Steering Priority/Unloader Valve
8	Steering Cylinder Hose
9	Steering Cylinder Hose

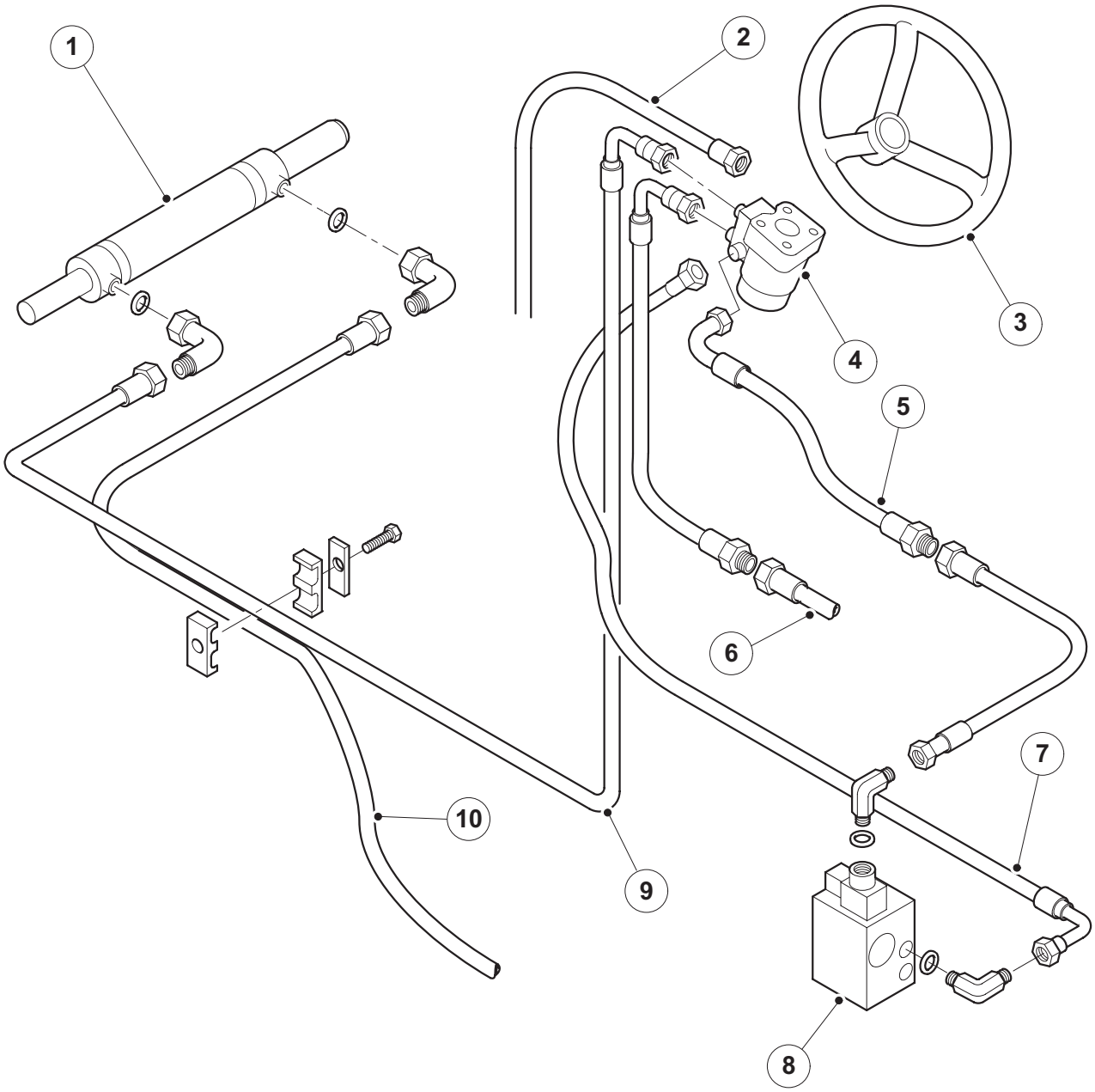
The two-wheel steering system consists primarily of a front steering cylinder (1), orbitrol steering motor (4) and a steering priority/unloader valve (6). Oil is supplied to the orbitrol steering motor (4) from the steering priority/unloader valve (8) through the hose (6). Hose (5) is used to sense when a steering request

is made to allow the steering to take priority over other hydraulic requests. When a steering request is made, the oil is supplied to the front steering cylinder (1) through the hose (9) (steering left) or hose (10) (steering right) to move the cylinder piston rod in the required direction. Excess oil is returned to the hydraulic oil reservoir through hose (2).

DESCRIPTION AND OPERATION — FOUR-WHEEL STEER

BHL1104OB

Steering System Overview



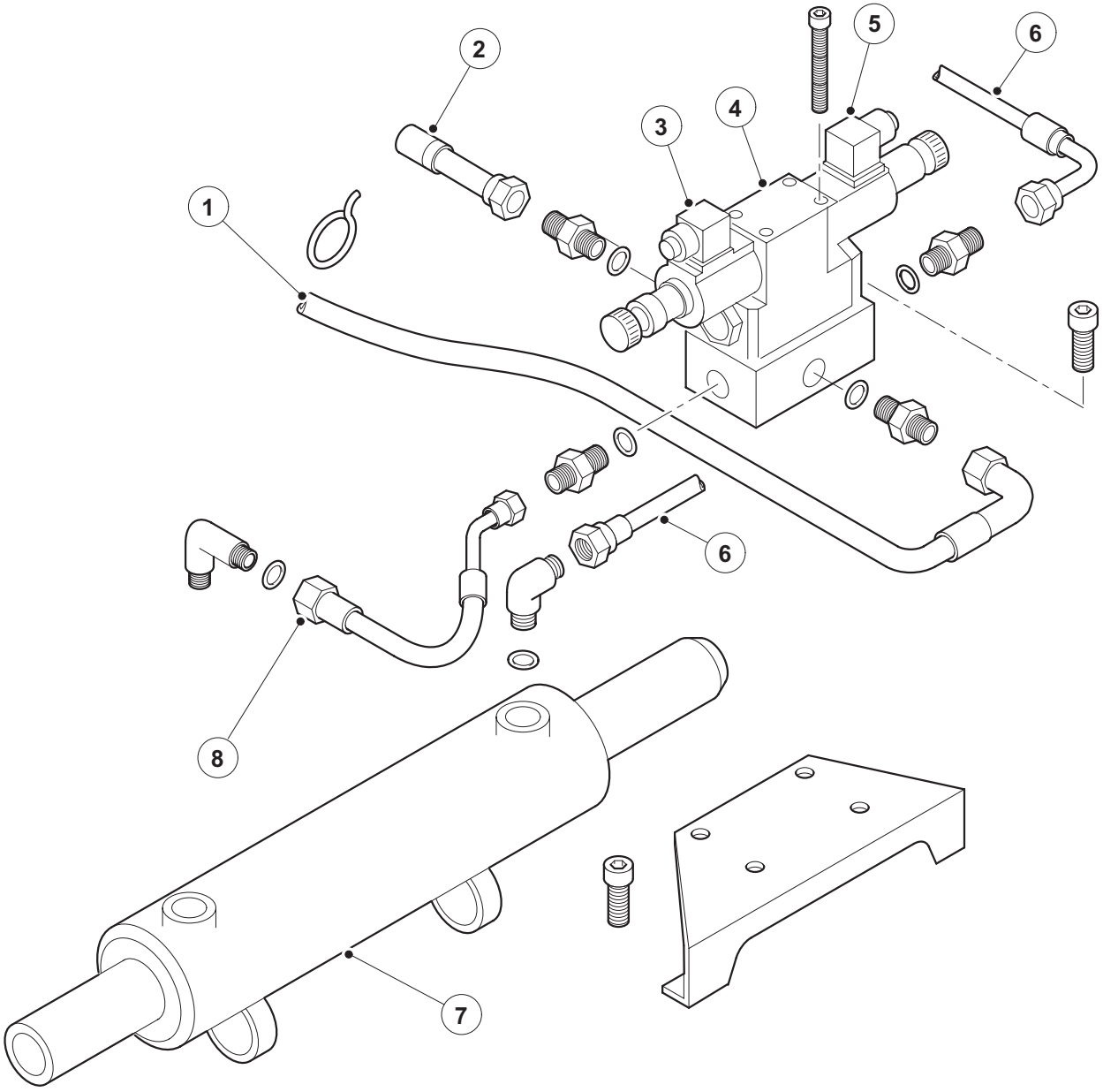
TV040960

1	Front Steering Cylinder
2	Reservoir Hose
3	Steering Wheel
4	Orbitrol Steering Motor
5	Load Sensing Line
6	Changeover Valve Hose
7	Steering Priority/Unloader Valve Hose
8	Steering Priority/Unloader Valve
9	Steering Cylinder Hose
10	Changeover Valve Hose

The four-wheel steering system consists primarily of a front steering cylinder (1), orbitrol steering motor (4), steering priority/unloader valve (8), rear hydraulic cylinder and a changeover valve (see changeover

valve overview). Oil is supplied to the orbitrol steering motor (4) from the steering priority/unloader valve (8) through the hose (7). Hose (5) is used to sense when a steering request is made to allow the steering to take priority over other hydraulic requests. When in two-wheel steer mode and a steering request is made, the oil is supplied to the front steering cylinder (1) through the hose (9) (steering left) or hose (10) (steering right) to move the cylinder piston rod. Hose (6) is linked directly to the changeover valve and when in two-wheel steer mode, the flow of oil is allowed to travel directly through the changeover valve and back to the front steering cylinder (1) through hose (10) therefore bypassing the rear steering cylinder and completing the circuit. The system also incorporates two proximity switches (one on each axle). These proximity switches enable the system to detect when the wheels are in the straight ahead position, allowing the system to avoid the rear wheels being locked when not aligned correctly.

Changeover Valve Overview

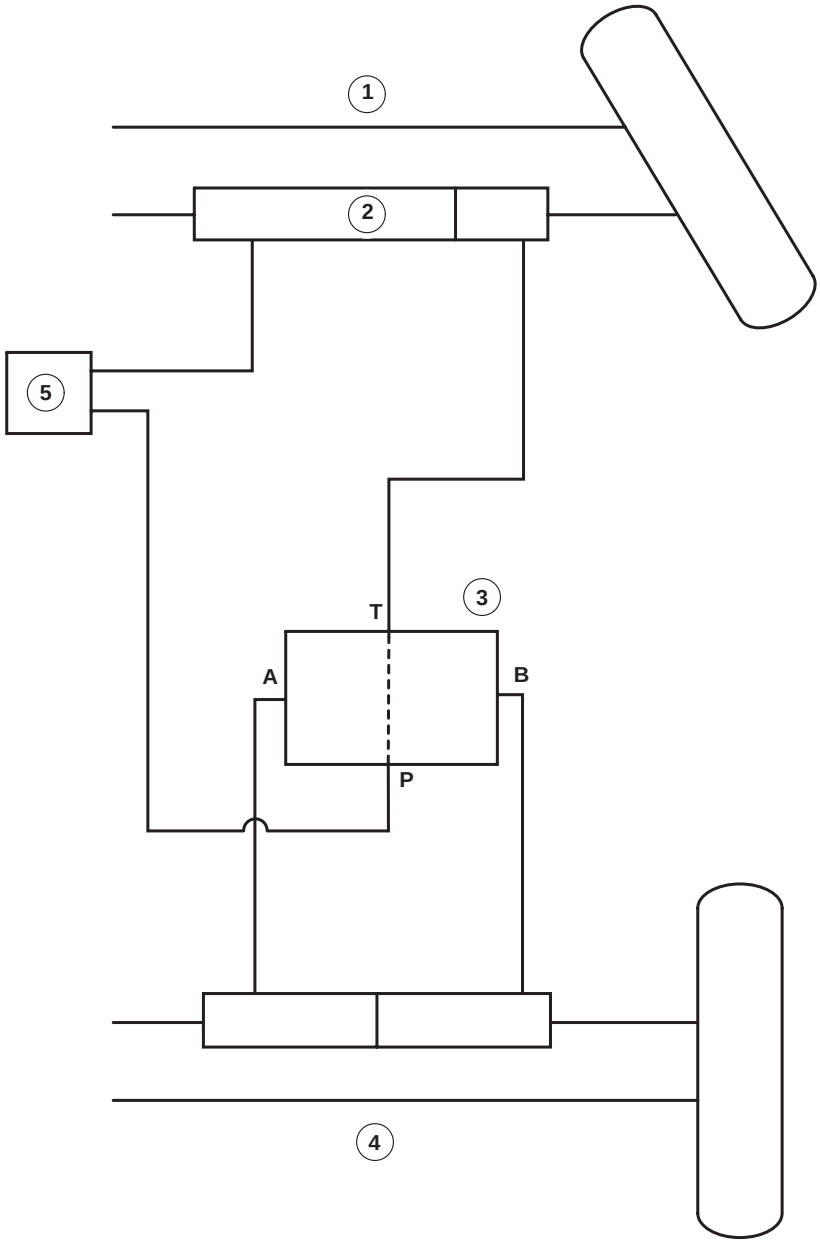


TV040961

1	Changeover Valve Hose
2	Changeover Valve Hose
3	Changeover Valve Solenoid
4	Changeover Valve Body
5	Changeover Valve Solenoid
6	Steering Cylinder Hose
7	Rear Steering Cylinder
8	Steering Cylinder Hose

The changeover valve is used to change the steering modes between two-wheel steer, four-wheel steer and crab steer. This is achieved by the use of two electrically controlled solenoids, which are installed to the changeover valve body. When activated, these solenoids actuate the valves in the changeover valve body and change the direction of the oil flowing through it depending on which steering mode is selected. Hose (2) is linked directly to the orbitrol steering motor while hose (1) is linked to the front steering cylinder.

2 Wheel Steer Operation

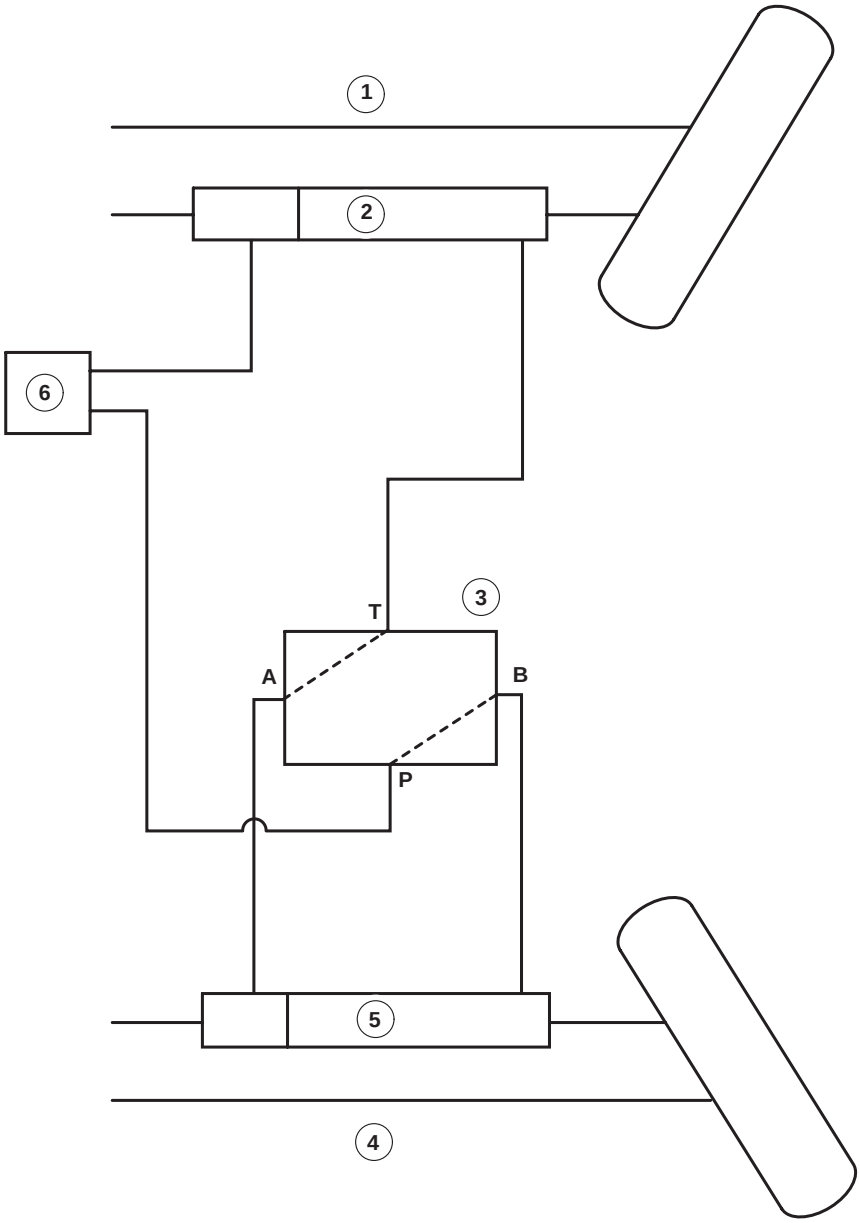


TV040954

1	Front Axle
2	Front Steering Cylinder
3	Changeover Valve
4	Rear Axle
5	Orbitrol Steering Motor

When two-wheel steer mode is selected, ports (A) and (B) of the changeover valve (3) are closed and will not allow oil to flow through them. The oil will be directed through port (P) to port (T). This will not allow any oil to flow to the rear steering cylinder, which is locked in the straight ahead position.

Four- Wheel Steer Operation

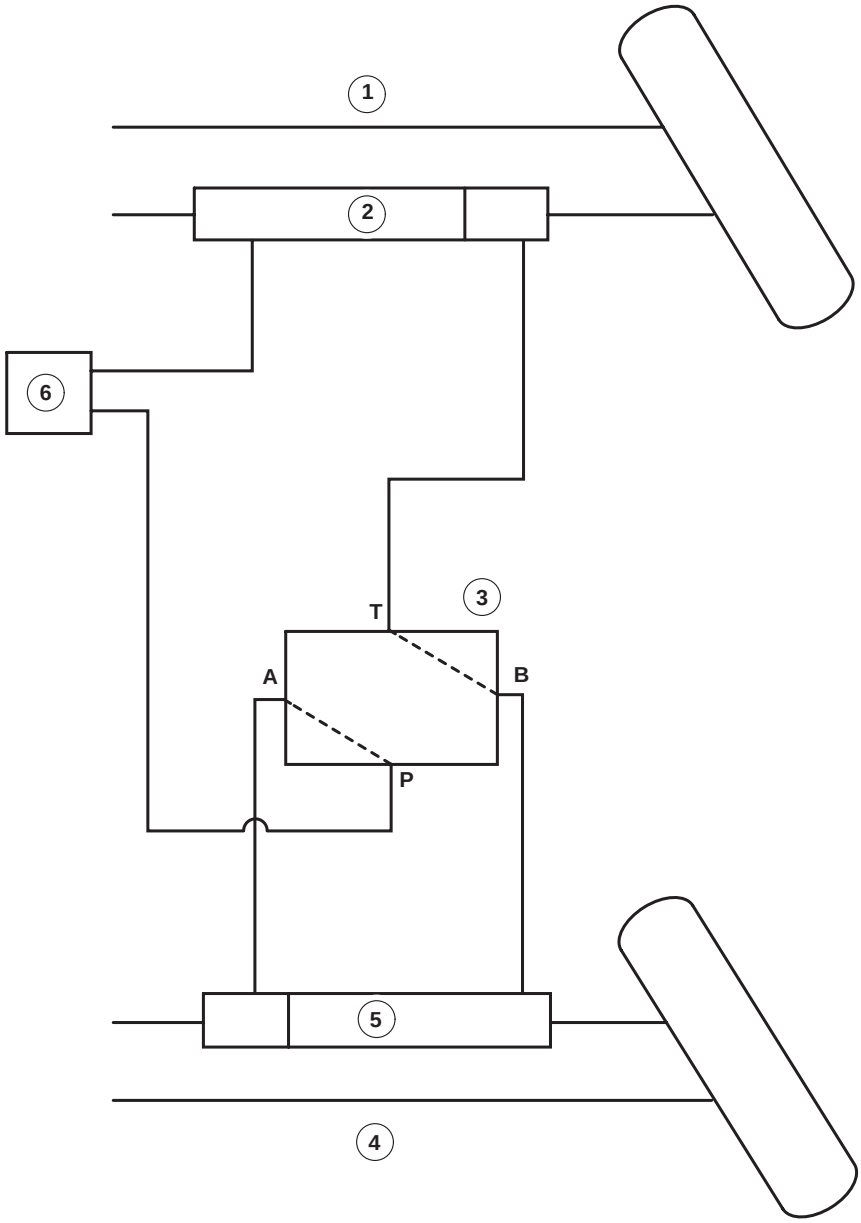


TV040955

1	Front Axle
2	Front Steering Cylinder
3	Changeover Valve
4	Rear Axle
5	Rear Steering Cylinder
6	Orbitrol Steering Motor

When four-wheel steer is selected, the solenoids on the changeover valve (3) are actuated and oil is not permitted to flow between port (P) and port (T) and is redirected. Ports (A) and (T) of the changeover valve now allow oil to flow between them. Ports (P) and (B) will also allow oil to flow between them. As an example, when the steering wheel is moved to the right the orbitrol steering motor will move the oil into port (P) and out of port (B) and into the rear steering cylinder (5). As the pressure moves the rear steering cylinder piston rod, oil is forced out from the steering cylinder and through port (A), out of port (T) and into the front steering cylinder. This system allows for proportional movement of the front and rear steering cylinders.

Crab Steer Operation



TV040956

1	Front Axle
2	Front Steering Cylinder
3	Changeover Valve
4	Rear Axle
5	Rear Steering Cylinder
6	Orbitrol Steering Motor

When crab steer is selected, the solenoids on the changeover valve (3) are actuated and redirect the flow of oil. Ports (P) and (A) of the changeover valve (3) now allow oil to flow between them. Ports (B) and (T) will also allow oil to flow between them. As an example, when the steering wheel is moved to the left the orbitrol steering motor will move the oil through the front steering cylinder (2). As the pressure moves the front steering cylinder piston rod, oil is forced out from the steering cylinder and through port (T) of the changeover valve, out of port (B) and into the rear steering cylinder piston rod. As the pressure in the rear steering cylinder (5) moves the piston rod, oil is forced out the opposite end of the steering cylinder and through port (A) of the changeover valve, out of port (P) and back to the orbitrol steering motor. This system allows for proportional movement of the front and rear steering cylinders.

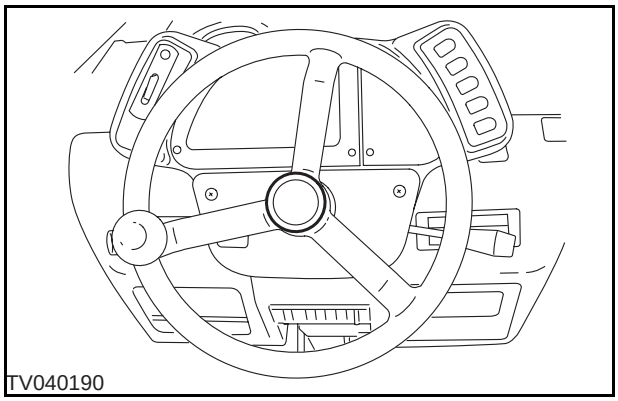
REMOVAL AND INSTALLATION — STEERING COLUMN

BHL1104RA

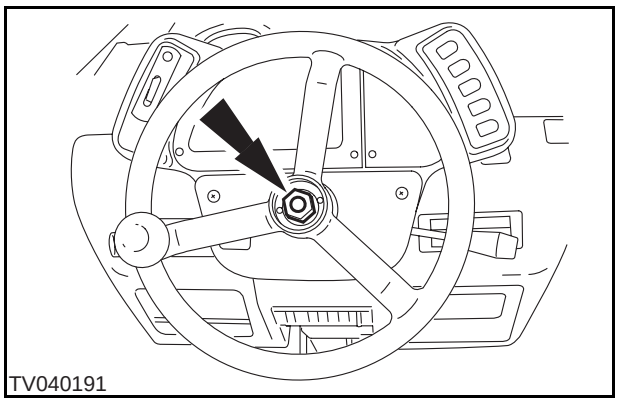
Operation: **Removing and Installing the Steering Column**	*Job Code:* **11 16 13 xx**		
None	Standard tools, Suitable steering wheel puller		

Removal

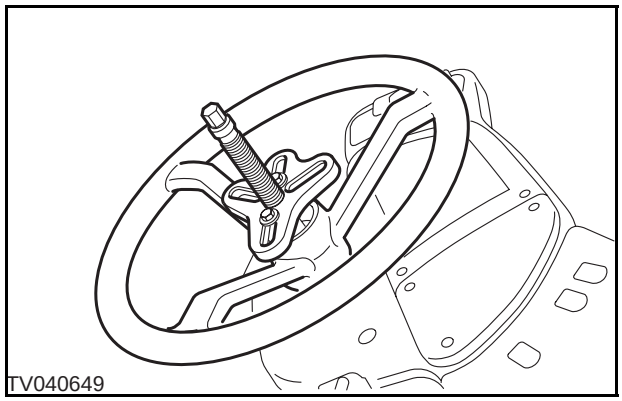
1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the steering wheel centre cap.


TV040190

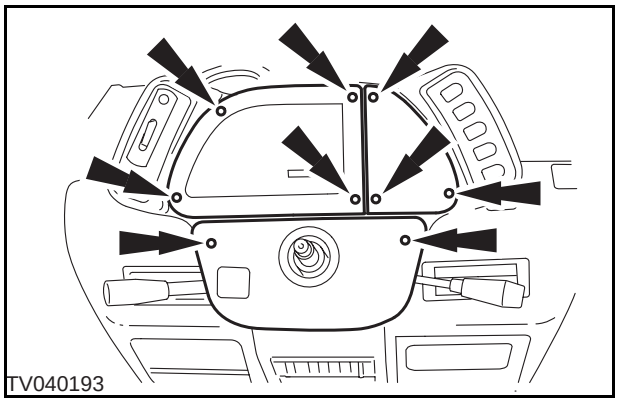
3. Remove the steering wheel retaining nut.


TV040191

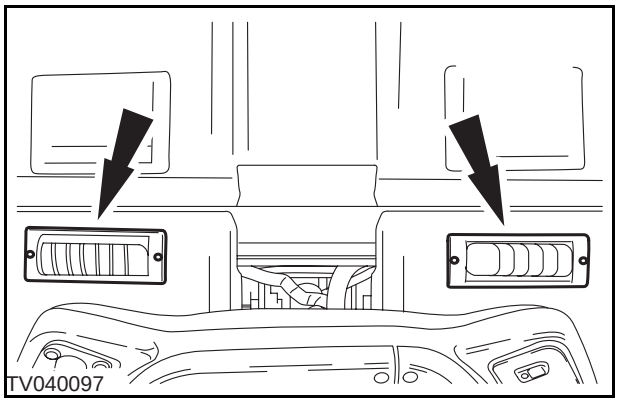
4. Using a suitable steering wheel puller, remove the steering wheel.


TV040649

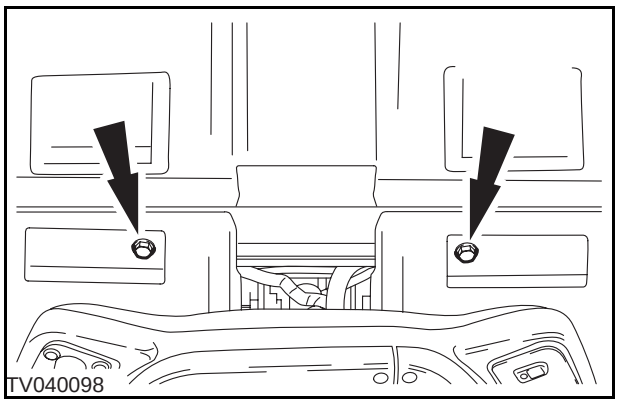
5. Remove the front instrument panel trim covers.



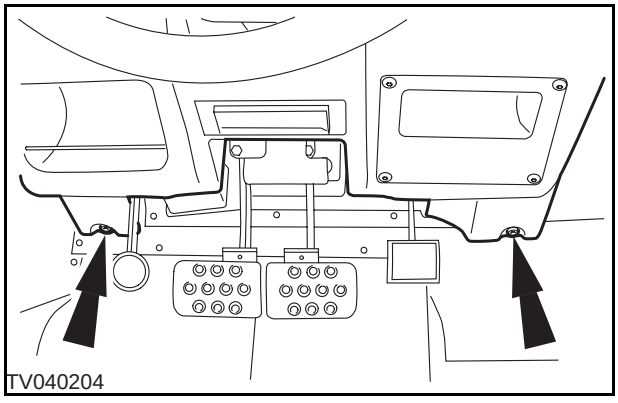
6. Remove the front console upper air vents.



7. Remove the front console upper retaining bolts.

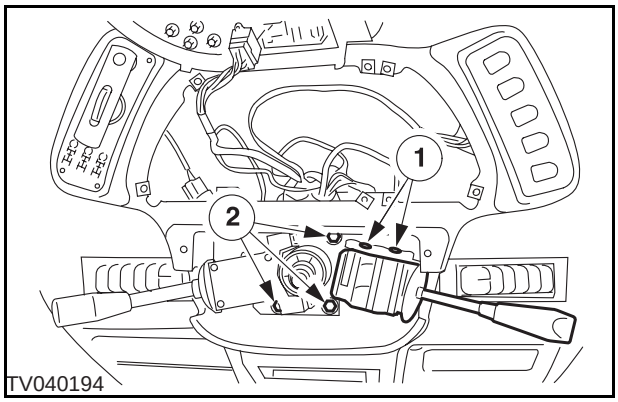


8. Remove the front console.

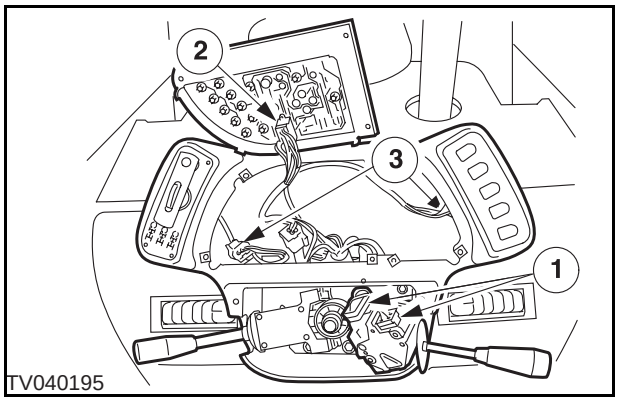


9. Detach the turn signal stalk (1).

10. Remove the front instrument panel retaining bolts (2).



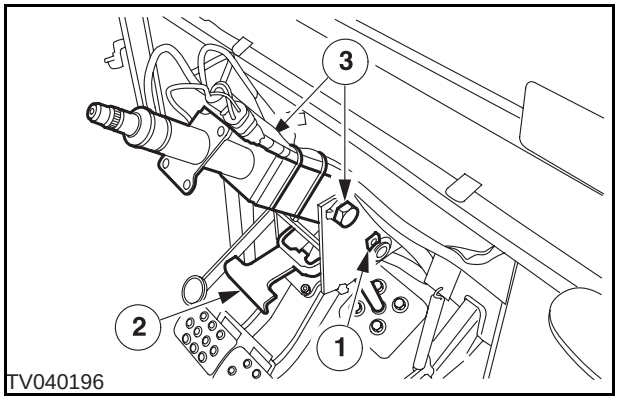
11. Remove the turn signal stalk (1)
12. Remove the front instrument cluster (2).
13. Disconnect the differential electrical connector and wiper electrical connectors and remove the front instrument panel (3).



14. Remove the tilt retaining clip and tilt pin (1)
15. Remove the steering column tilt bracket (2).

Note:
- Cut the cable ties.

16. Remove the steering column (3).



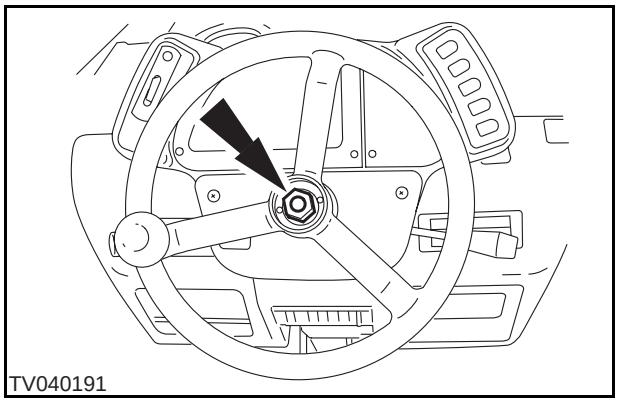
Installation

Note:
- The splines on the steering column may be fitted into the orbital control valve in any position. Make sure the splines are seated correctly.

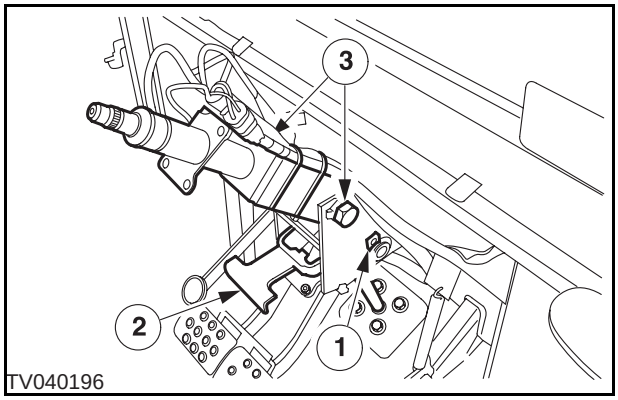
Note:
- Install new cable ties.

1. To install, reverse the removal procedure.

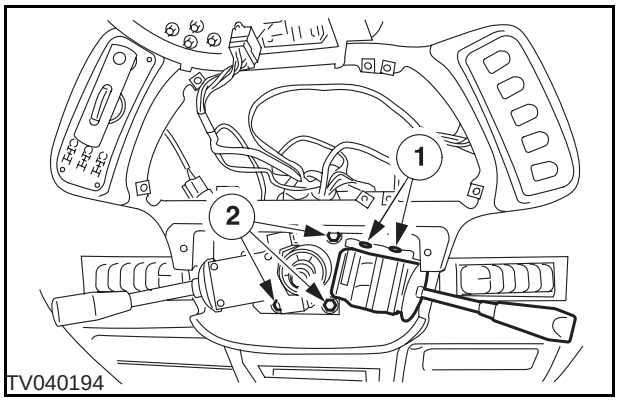
2. Tighten to 58Nm.



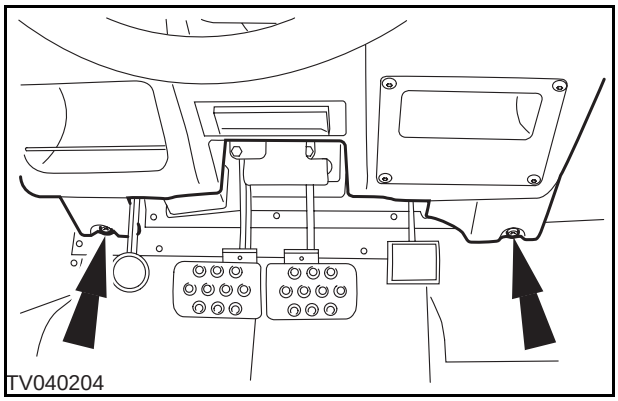
3. Tighten (3) to 55Nm



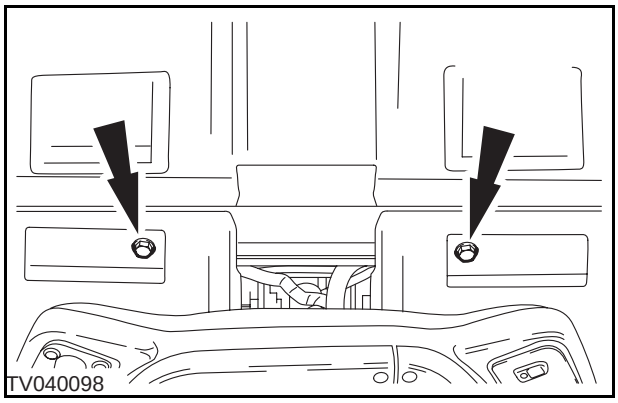
4. Tighten (2) to 28Nm



5. Tighten to 28Nm



6. Tighten to 28Nm



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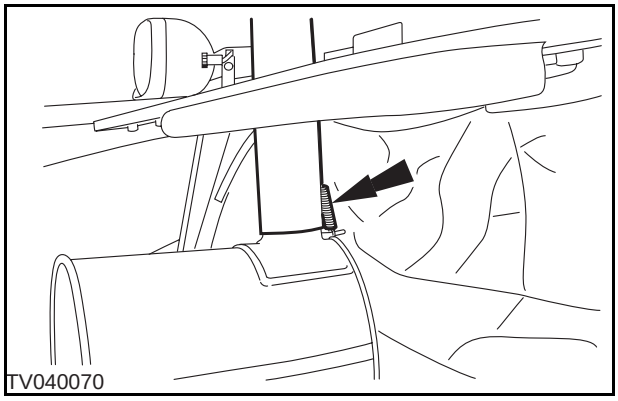
REMOVAL AND INSTALLATION — ORBITROL STEERING MOTOR UP TO 2007

BHL1104RB

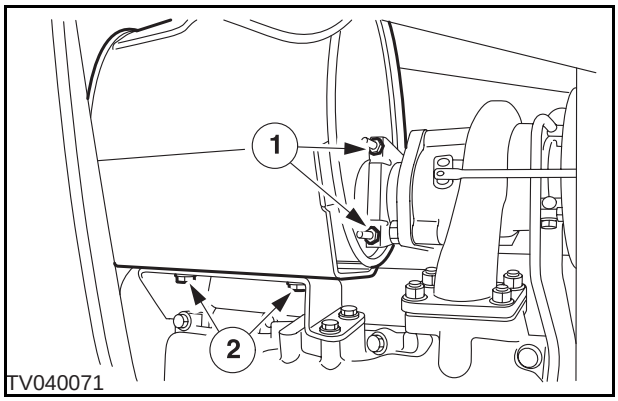
Operation: **Removing and Installing the Orbitrol Steering Motor**	*Job Code:* **11 19 13 xx**		
None	Standard tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the air cleaner. For additional information, refer to Section P14-01 AIR CLEANER, PAGE P14–01–33 .
3. Detach the exhaust stack spring and remove the exhaust stack.

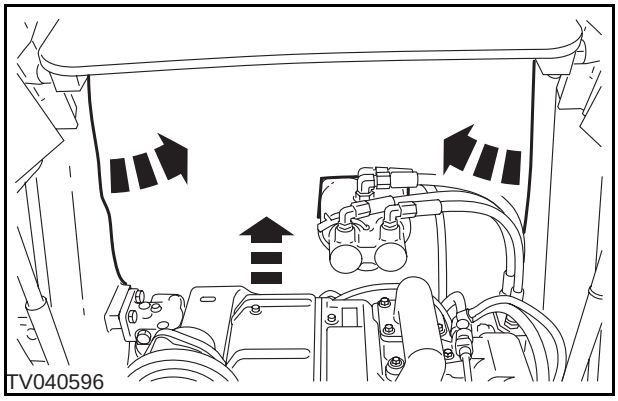

TV040070

4. Loosen the exhaust silencer clamp (1).
5. Remove the exhaust silencer (2).



TV040071

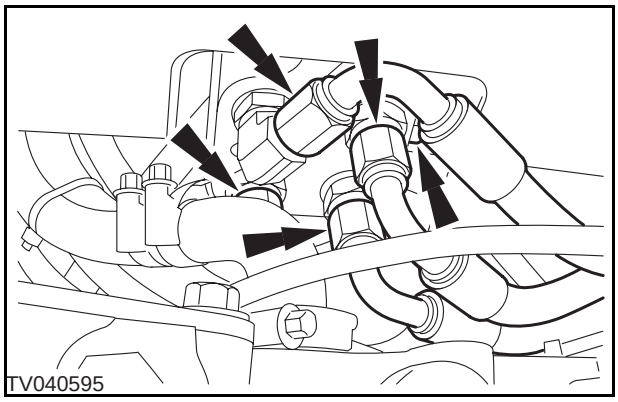
6. Position the engine bay sound proofing to one side, in order to gain access to the orbitrol steering motor.


TV040596

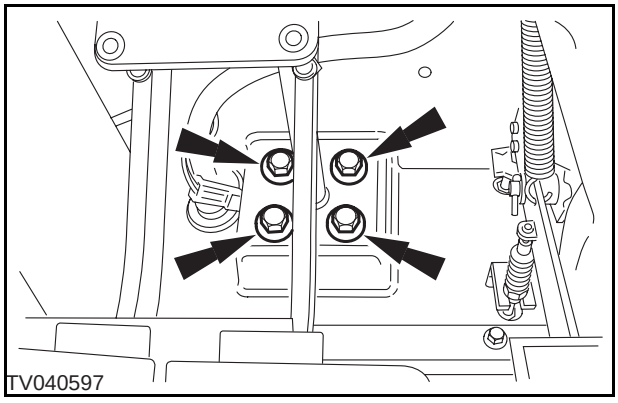
Note:
- Make a note of the position of the hydraulic hoses prior to disconnection, to aid installation.

7. Disconnect the hydraulic hoses from the orbitrol steering motor.

Note:
- Install blanking plugs to avoid contamination.

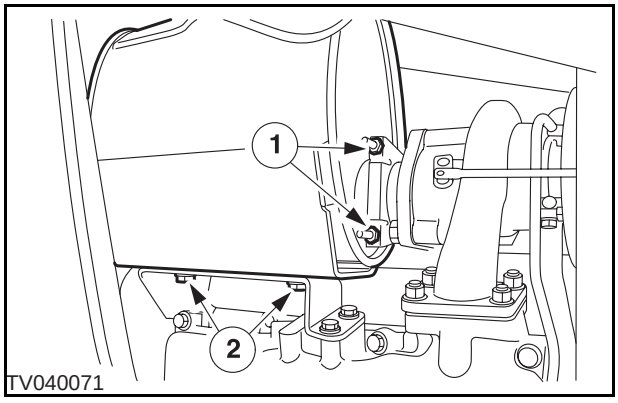

TV040595

8. Remove the orbitrol steering motor retaining bolts and remove the orbitrol steering motor.


TV040597

Installation

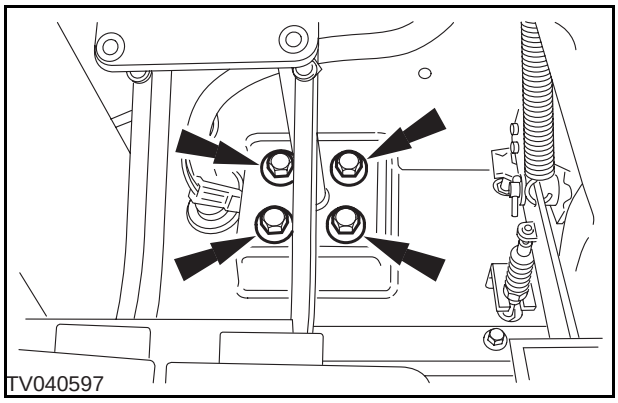
1. To install, reverse the removal procedure.
2. Tighten (2) to 58Nm



TV040071

3. Tighten 24Nm

4. Check and adjust the hydraulic oil level as required.


TV040597

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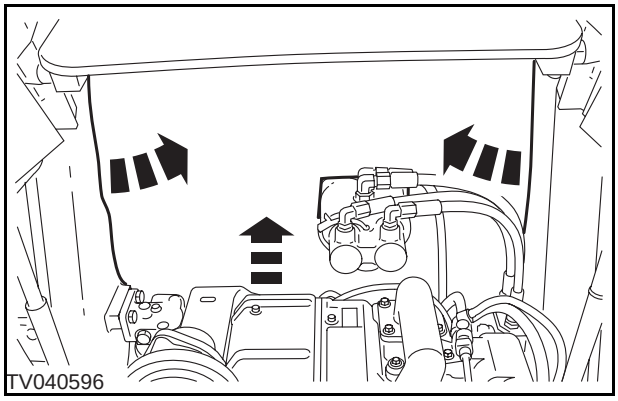
REMOVAL AND INSTALLATION — ORBITROL STEERING MOTOR 2007 ONWARDS

BHL1104RG

Operation: **Removing and Installing the Orbitrol Steering Motor**	*Job Code:* **11 19 13 xx**		
None	Standard tools		

Removal

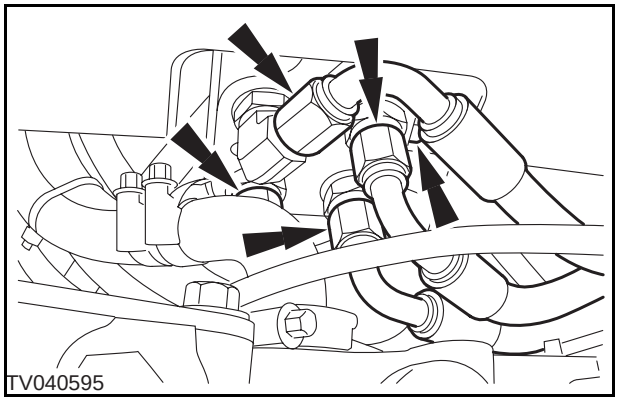
1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the air cleaner. For additional information, refer to Section P14-01 AIR CLEANER, PAGE P14–01–33 .
3. Remove the exhaust silencer. For additional information, refer to Section P14-01 EXHAUST, PAGE P14–01–37 .
4. Position the engine bay sound proofing to one side, in order to gain access to the orbitrol steering motor.


TV040596

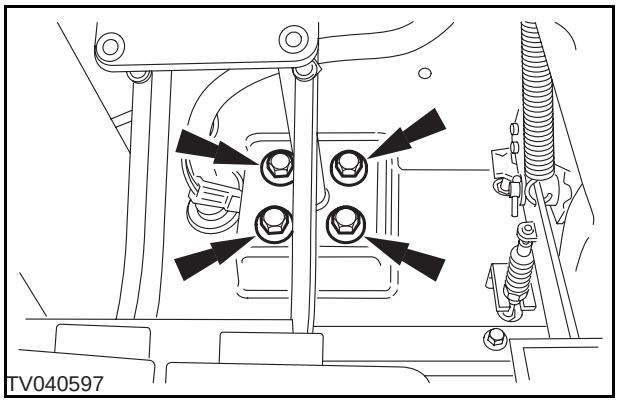
Note:
- Make a note of the position of the hydraulic hoses prior to disconnection, to aid installation.

5. Disconnect the hydraulic hoses from the orbitrol steering motor.

Note:
- Install blanking plugs to avoid contamination.

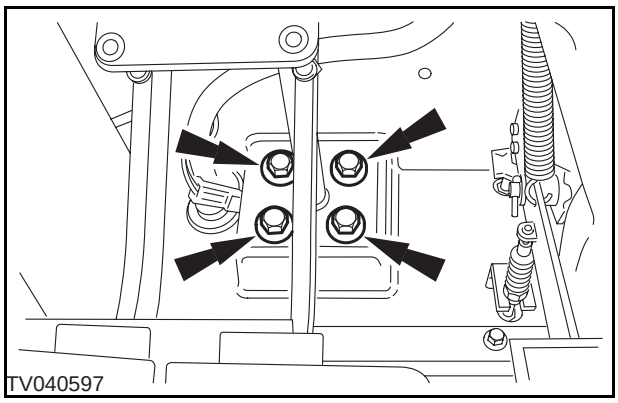

TV040595

6. Remove the orbitrol steering motor retaining bolts and remove the orbitrol steering motor.



Installation

1. To install, reverse the removal procedure.
2. Tighten 24Nm



3. Check and adjust the hydraulic oil level as required.

REMOVAL AND INSTALLATION — FOUR-WHEEL STEER (4WS) CHANGEOVER VALVE

BH1104RD

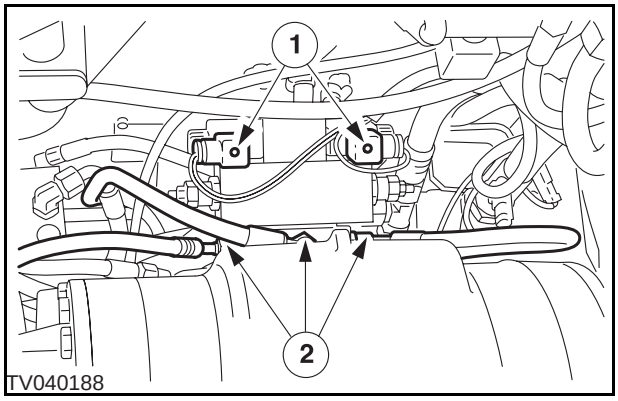
Operation: **Removing and Installing the Four-Wheel Steer Changeover Valve**	*Job Code:* **11 15 13 xx**		
None	Standard Tools		

Removal

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Disconnect the 4WS changeover valve solenoid valve electrical connectors (1).

   Note:
   - Install blanking plugs to avoid contamination.

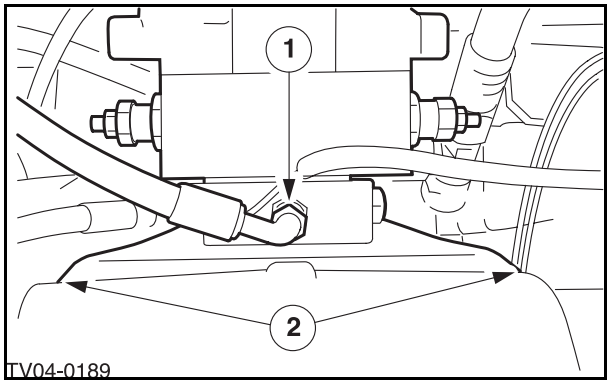
3. Disconnect the 4WS changeover valve hydraulic hoses (2).



TV040188

   Note:
   - Install blanking plugs to avoid contamination.

4. Disconnect the 4WS changeover valve hydraulic hose (1).
5. Remove the 4WS changeover valve (2).

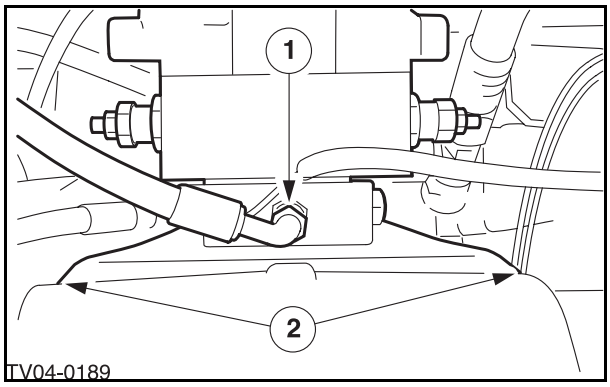


TV04-0189

Installation

1. To install, reverse the removal procedure.

2. Tighten (2) to, 28Nm.



REMOVAL AND INSTALLATION — TIE ROD END

BHL1104RF

Operation: **Removing and Installing the Tie Rod End**	*Job Code:* **11 13 13 xx**		
Suitable axle stands	Standard tools, Ball joint separator		

Removal

1. Remove the front wheel. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

   Note:
   - Support the machine under the front chassis.

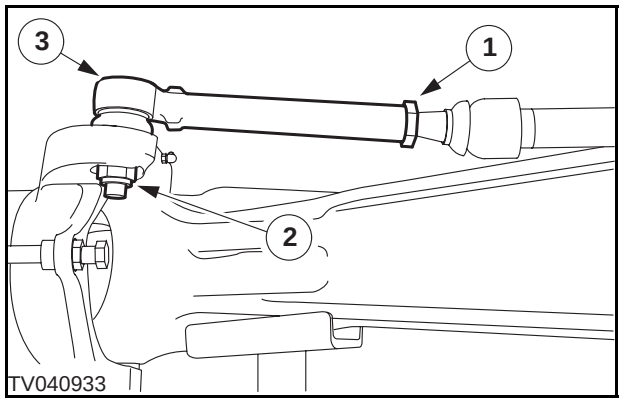
2. Loosen the tie rod end inner nut (1).

   ⚠ **Caution:**
   - **Leave the tie rod end nut on the tie rod end a few turns to prevent damage to the stud while using the ball joint separator.**

3. Using the ball joint separator, disconnect the tie rod assembly from the wheel hub (2).

   Note:
   - Make a note of the number of turns required to remove the tie rod end, to aid installation.

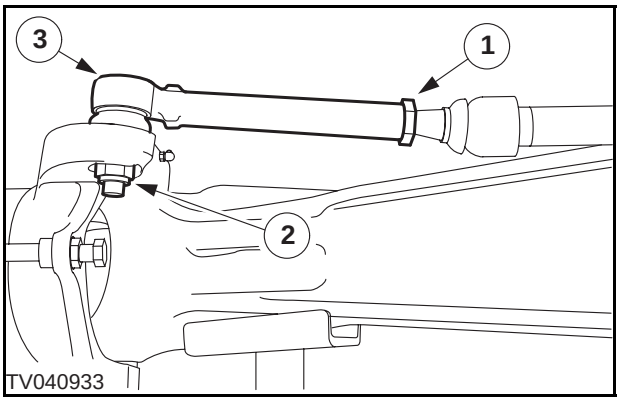
4. Remove the tie rod end.



Installation

1. Install a new outer tie rod end retaining nut. To install, reverse the removal procedure.
2. Check the toe-in alignment. For additional information, refer to section L11-02 TOE-IN ADJUSTMENT, PAGE L11–02–61
3. Tighten (1) to 250Nm

4. Tighten (2) to 220Nm



GENERAL PROCEDURE — FOUR-WHEEL STEER MISALIGNMENT CORRECTION

BHL1104GB

Correction

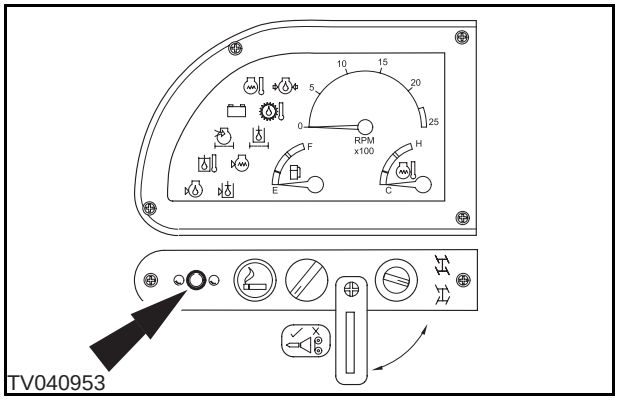
Note:
- To select four-wheel steer mode, turn the steering wheel until the front wheels are in the straight ahead position. This is indicated by the LEDs located either side of the steering reset button illuminating. Then select four-wheel steer mode.

Note:
- To select two-wheel steer mode when in four-wheel steer mode, select two-wheel steer mode and turn the steering wheel until the wheels are in the straight ahead position. This is indicated by the LEDs located either side of the steering reset button illuminating. Four-wheel steer will now disengage.

Note:
- To select crab steer mode, select crab mode and turn the steering wheel until the wheels are in the straight ahead position. This is indicated by the LEDs located either side of the steering reset button illuminating. Crab steer mode cannot be selected when in four-wheel steer mode and vice versa. Two-wheel steer must be engaged first.

Note:
- In the event of major misalignment between the front and rear wheels or the steering system becoming locked in four-wheel steer or crab steer, the following procedure must be carried out.

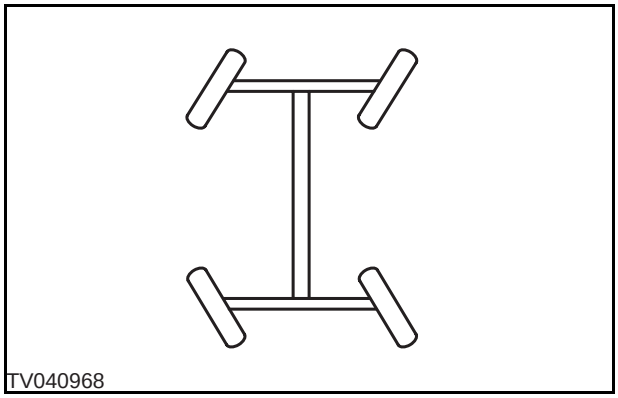
1. Turn the steering wheel until the rear wheels are on full lock.
2. Using the steering mode selector switch, select two–wheel steer mode.
3. Press and hold the steering reset button.



TV040953

4. Turn the steering wheel until the front wheels are on the opposite full lock to the rear wheels and release the steering reset button.
5. Using the steering mode selector switch, select four–wheel steer mode.
6. Press and hold the steering reset button.

7. Turn the steering wheel until the front wheels are in the straight ahead position and release the steering reset button.
8. Using the steering mode selector switch, select two–wheel steer mode.
9. Turn the steering wheel until the front wheels are in the straight to engage two-wheel steer mode.


TV040968

SPECIFICATIONS — STEERING

BHL1104SA

General Information

Steering Orbitrol	Closed Center Type
Make	Rexroth
Dispaced Oil per Revolution	160cc
MRV Setting Pressure	175bar (170min – 178max)
Antishock Valves Opening Pressure	240bar +/-5
MRV Adjustment	+1 Turn=+26.6bar
Antishock Valves Adjustment	+1 Turn=+105bar
Special Tool for Adjusting MRV / Rexroth P/N	E35/:36064
Special Tool for Adjusting AS Valves / Rexroth P/N	E35/:36949

Torque Values

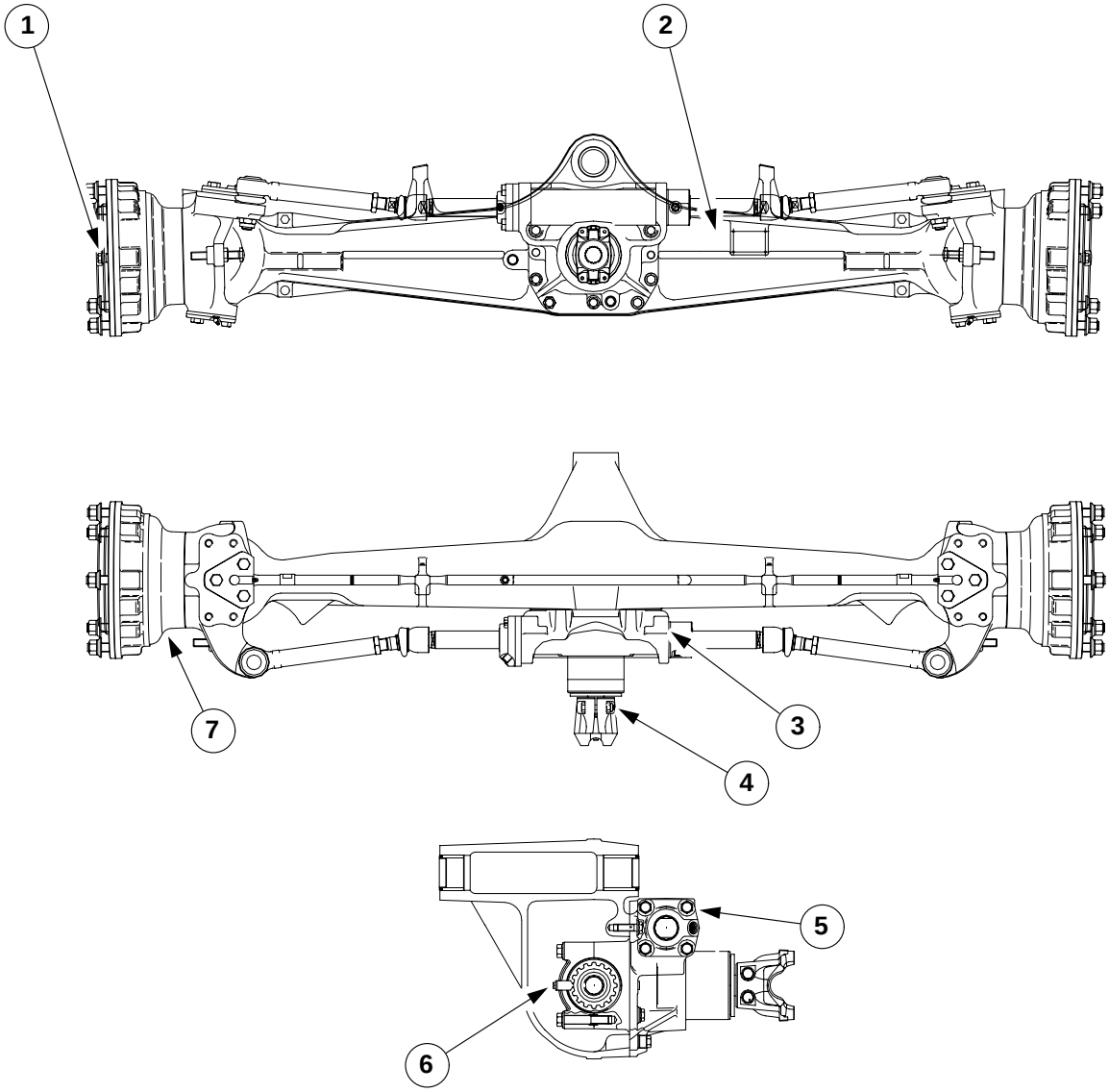
Description	Nm	Lb.ft
Steering Wheel Retaining Nut	58	43
Orbitrol Steering Motor Retaining Bolts	24	18
Steering Column Retaining Bolts	55	41
Front Console Upper Retaining Bolts	28	21
Front Console Lower Retaining Bolts	28	21
Front Instrument Panel Retaining Bolts	28	21
4WS Change Over Valve Retaining Bolts	28	21
Inner Tie Rod End	300	221
Outer tie Rod End	220	162

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DESCRIPTION AND OPERATION — FOUR-WHEEL DRIVE FRONT AXLE

BHL1105OA

General Description



TV040947

1	Epicyclic Reduction Gear Group
2	Axle Housing Group
3	Differential Support Group
4	Pinion Group
5	Steering Cylinder Group
6	Differential Group
7	Wheel Hub Group

The axle described in this manual consists of the following groups:

- WHEEL HUB GROUP: wheel support parts containing the epicyclic reduction gears.
- EPICYCLIC REDUCTION GEAR GROUP: planetary carrier with reduction/transmission parts.
- AXLE HOUSING GROUP: load-bearing shell structure of the axle.

- DIFFERENTIAL SUPPORT GROUP: differential housing with crown wheel gear adjusting system.
- DIFFERENTIAL GROUP: differential parts with crown wheel gear.
- PINION GROUP: pinion with adjusting and support parts.
- STEERING CYLINDER GROUP: steering cylinder parts with adjusting system.

DIAGNOSING AND TESTING — FOUR-WHEEL DRIVE FRONT AXLE

BHL1105TA

Problem	Possible Cause	Action
Ring gear tooth broken at the outer side	• Excessive gear load compared to the design specification.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Incorrect gear adjustment (excessive backlash).	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Pinion nut loosened.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
Ring gear tooth broken on the inside	• Load bump.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Incorrect gear adjustment (insufficient backlash).	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
	• Pinion nut loosened.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash.
Pinion or ring gear teeth worn	• Insufficient lubrication.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
	• Contaminated oil.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.

Problem	Possible Cause	Action
Pinion or ring gear teeth worn (continued)	• Incorrect lubrication or depleted additives.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
	• Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.	• REPLACE bevel gear set. • FOLLOW carefully the recommended operations for the adjustment of bevel gear set backlash. • USE correct lubricants, FILL to the right level and REPLACE according to the recommended intervals.
Overheated ring and pinion teeth. Check if gear teeth are showing signs of wear.	• Prolonged functioning at high temperatures.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Incorrect lubrication.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Low oil level.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bevel gear set. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
Pinion teeth pitting	• Excessive use.	• REPLACE bevel gear set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE bevel gear set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Axle beam body bent	• Vehicle overloaded.	• REPLACE axle beam body.
	• Vehicle accident.	• REPLACE axle beam body.
	• Load bump.	• REPLACE axle beam body.

Problem	Possible Cause	Action
Worn out or pitted bearings	• Insufficient lubrication.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive use.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Normal wear out.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Pinion nut loosened.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Oil leakage from gaskets and seals	• Prolonged functioning at high temperature of the oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Oil gasket assembled incorrectly.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Seal lip damaged.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.

Problem	Possible Cause	Action
Excessive wearing out of input flange spline	• Heavy use.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
	• Pinion nut loosened.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
	• Pinion axle backlash.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE bevel gear set if required.
Fatigue failure of pinion teeth. See if the fracture line is well defined (wave lines, beach lines)	• Heavy use.	• REPLACE bevel gear set.
	• Continuous overload.	• REPLACE bevel gear set.
Pinion and ring teeth breakage	• Crash load of differential components.	• CHECK and/or REPLACE other differential components.
Side gear spline worn out. Replace all scratched washers (Excessive backlash)	• Excessive use.	• REPLACE differential gear group. • REPLACE half shaft if required.
Thrust washer surface worn out or scratched	• Insufficient lubrication.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0,1 mm thickness lower than the new ones.
	• Incorrect lubrication.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0,1 mm thickness lower than the new ones.
	• Contaminated oil.	• USE correct lubrication and FILL to the right level. • REPLACE at intervals recommended. • REPLACED all scratched washers and those with 0,1 mm thickness lower than the new ones.

Problem	Possible Cause	Action
Inner diameter of tapered roller bearing worn out	• Excessive use.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive pinion axial backlash.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to the right level and REPLACE at recommended intervals.
Bent or broken half shaft	• Vehicle intensively operated or overloaded.	• REPLACE half shaft.
Half shaft broken at wheel side	• Wheel support loosened.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.
	• Beam body bent.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.

Axle Problem and Diagnosis

Problem	Possible Cause	Action
Noise while driving	• Excessive backlash between pinion and ring gear.	• ADJUST.
	• Worn out pinion and gear ring.	• REPLACE.
	• Worn out pinion bearings.	• REPLACE.
	• Pinion bearings loosened.	• ADJUST.
	• Excessive axial pinion backlash.	• ADJUST.
	• Worn out differential bearings.	• REPLACE.
	• Differential bearings loosened.	• ADJUST.
	• Ring gear out of roundness.	• REPLACE.
	• Low Lubricant level.	• OIL level.
	• Poor or wrong lubricant.	• REPLACE.
	• Bent half shaft.	• REPLACE.
Noise whilst driving in neutral	• Noise coming from axle is usually heard when vehicle moves in neutral gear but is not loud.	• REPLACE or ADJUST (see above).
	• Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed.	• REPLACE.
	• Pinion or input flange worn out.	• ADJUST.
Intermittent noise	• Ring gear damaged.	• REPLACE bevel gear set.
	• Differential box bolts loosened.	• TIGHTEN to torque.
Constant noise	• Ring gear teeth or pinion damaged.	• REPLACE bevel gear set.
	• Worn out bearings.	• REPLACE.
	• Pinion spline worn out.	• REPLACE.
	• Bent half shaft.	• REPLACE.
Noise while steering	• Worn out differential gears.	• REPLACE.
	• Worn out differential box or spider.	• REPLACE.
	• Differential thrust washers worn out.	• REPLACE.
	• Half shaft spline worn out.	• REPLACE.

REMOVAL AND INSTALLATION — FOUR-WHEEL DRIVE FRONT AXLE

BHL1105RA

Operation: **Removing and Installing the Four-Wheel Drive Front Axle**	*Job Code:* **11 24 13 xx**		
Suitable transmission jack	Standard tools		

Removal

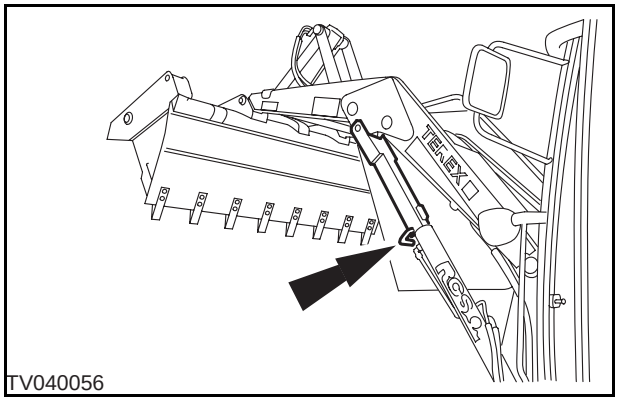
Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

Note:
- Support the machine under the front chassis.

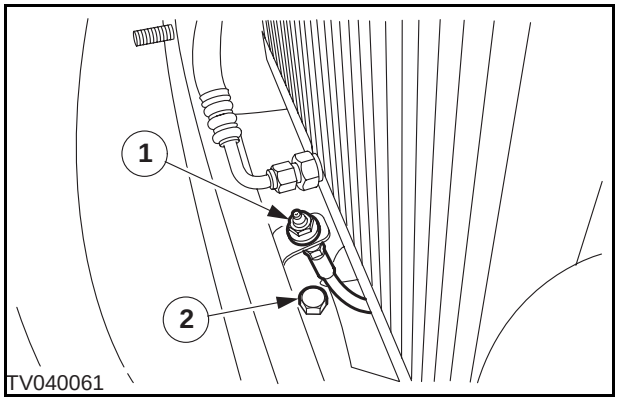
2. Remove the hardnose / tool box. For additional information, refer to Section K10-01 HARDNOSE / TOOLBOX, PAGE K10–01–3 .
3. Raise the front loader to full height and install the safety stop.
4. Roll the loader bucket fully forward.



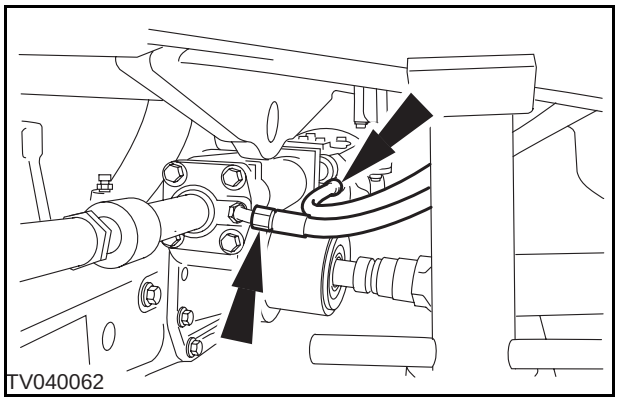
5. Detach the front axle pivot pin grease point (1).

Note:
- Discard the locking nut.

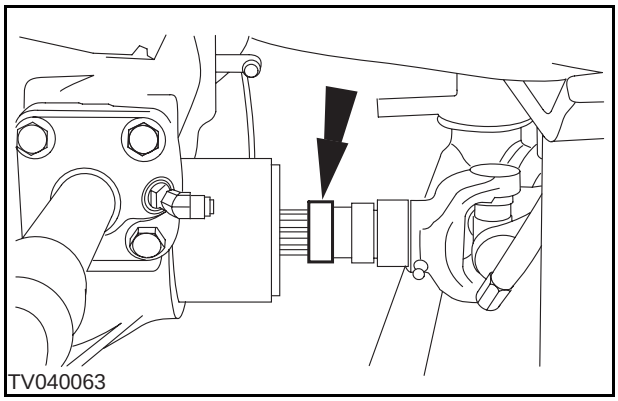
6. Remove the front axle pivot pin retaining bolt (2).



7. Disconnect the power steering supply pipes.


TV040062

8. Loosen the propeller shaft locking ring.


TV040063

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

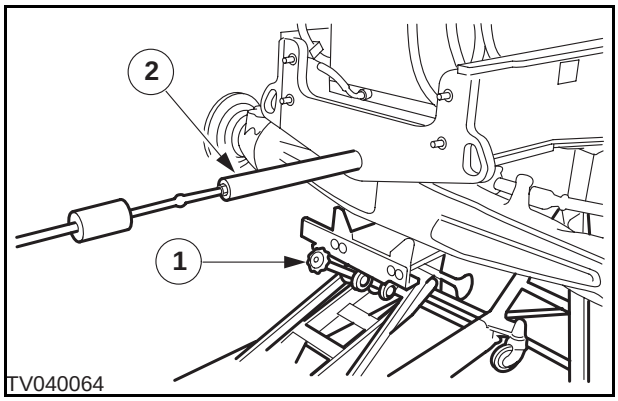
⚠ **Warning:**
- **Secure the front axle to the transmission jack. Failure to follow this instruction may result in personal injury**

Note:
- Mark the axle pivot pin before removal to aid installation.

9. Using a suitable transmission jack (1), support the front axle.

Note:
- Secure the propeller shaft to one side when removing the front axle.

Using a suitable slide hammer (2), remove the front axle pivot pin and remove the front axle.



TV040064

Installation

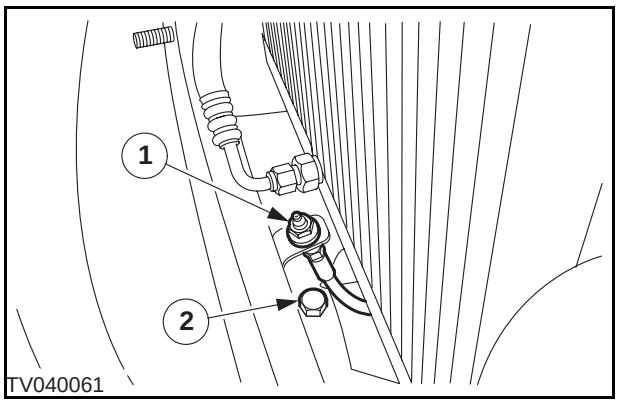
Note:
- Remove any dirt or burrs before installing the front axle pivot pin.

Note:
- Make sure the propeller shaft is aligned with the front axle differential shaft when raising the axle into position.

1. To install, reverse the removal procedure.

Note:
- Install a new locking nut.

2. Tighten (2) to 98Nm (72 lb.ft).



3. Check and adjust the hydraulic oil level as required.
4. Operate the steering from full left-hand lock to full right-hand lock and check for correct operation.

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REMOVAL AND INSTALLATION — STEERING CYLINDER GROUP

BHL1105RC

Operation: **Removing and Installing the Steering Cylinder Group**	*Job Code:* **11 20 13 xx**		
Suitable lifting equipment	Standard tools		

Removal

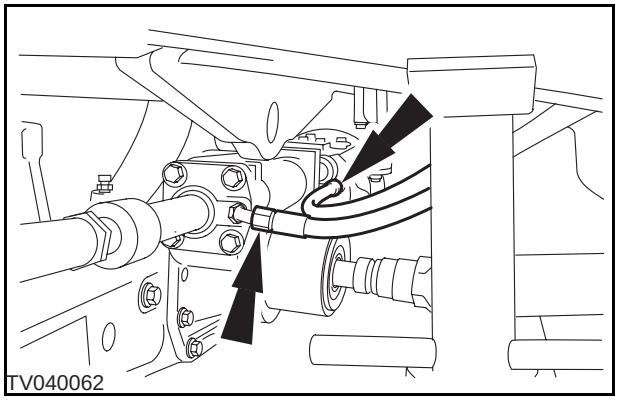
Note:
- Make a note of the position of any hoses prior to disconnection to aid installation.

Note:
- Always install blanking plugs to any open ports to avoid contamination.

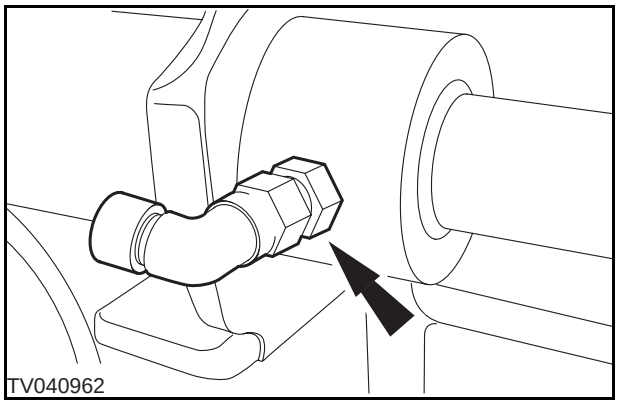
1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

Note:
- Support the machine under the front chassis.

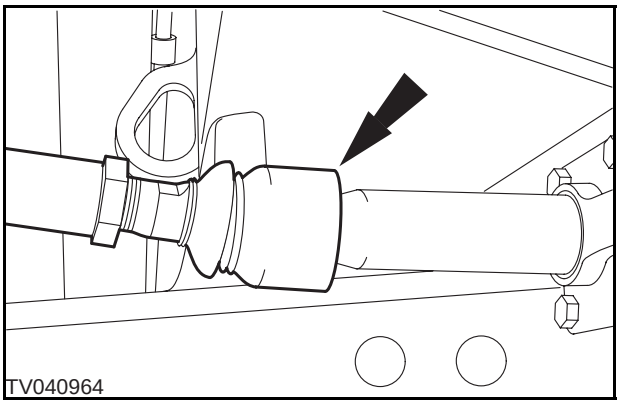
2. Disconnect the power steering supply pipes.


TV040062

3. Remove the union from the steering cylinder group.


TV040962

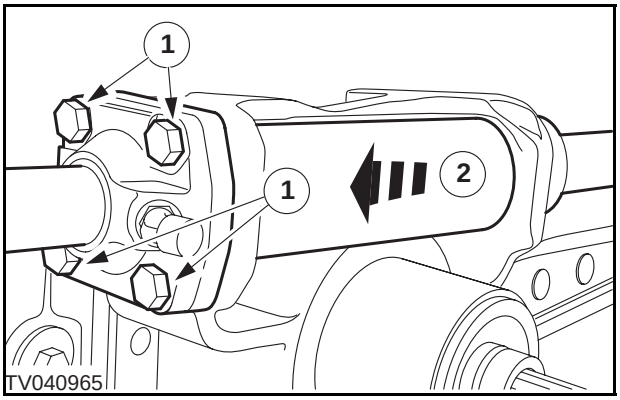
4. Disconnect the inner track rod end from the steering cylinder group (both sides).



⚠ **Warning:**

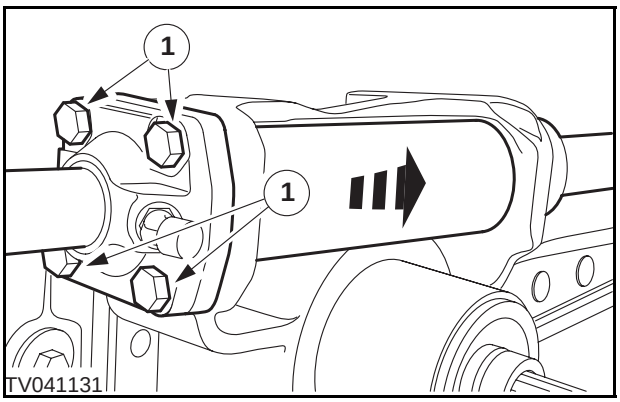
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

5. Remove the steering cylinder group retaining bolts (1), and remove the steering cylinder group (2).

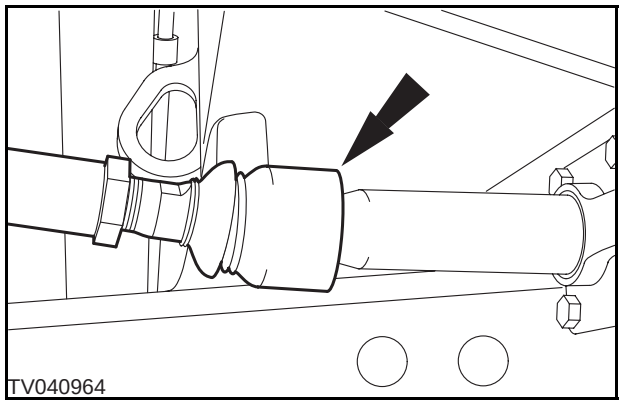


Installation

1. To install, reverse the removal procedure.
2. Tighten (1) to 120Nm (89 lb.ft).



3. Tighten to 300Nm (221 lb.ft).



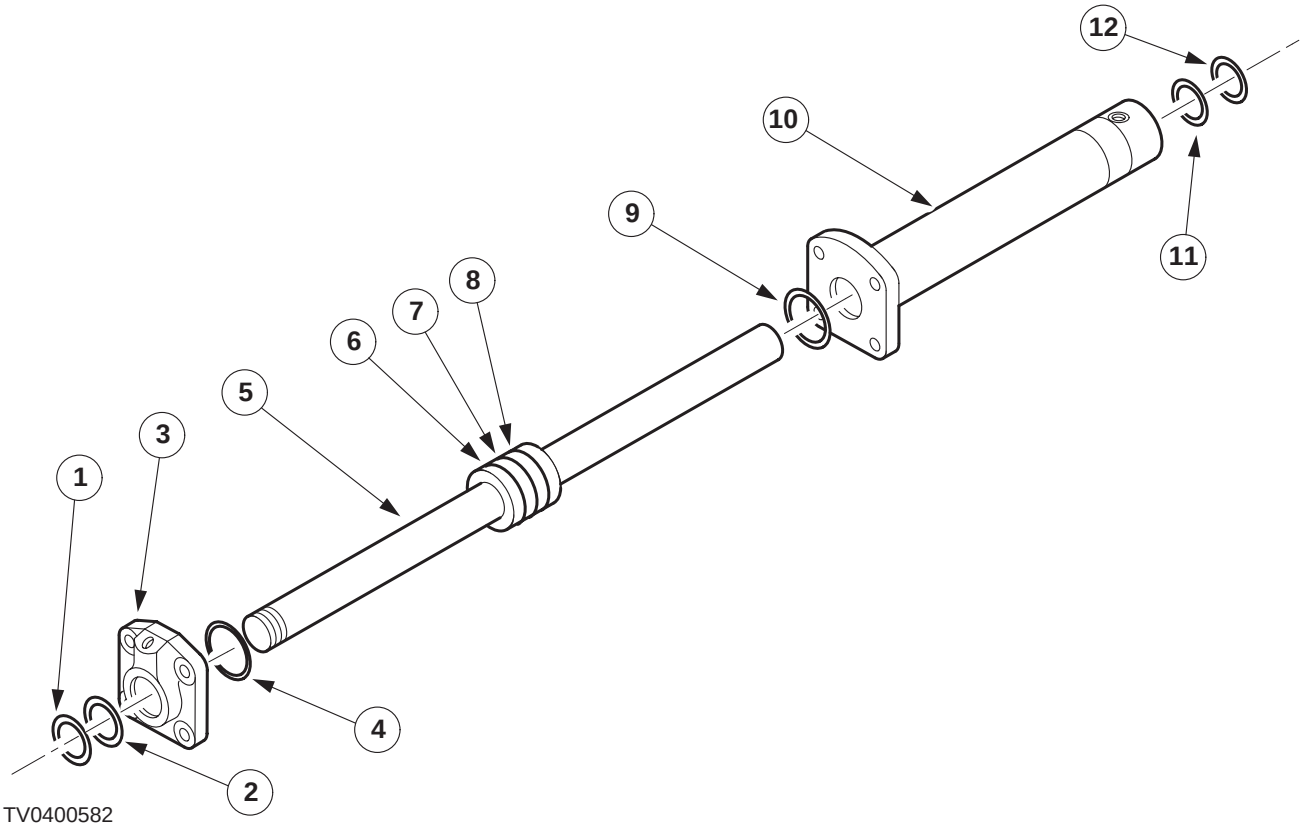
4. Check and adjust the hydraulic oil level as required.
5. Operate the steering from full left-hand lock to full right-hand lock and check for correct operation.

Note: This page intentionally left blank.

DISASSEMBLY AND ASSEMBLY — STEERING CYLINDER GROUP

BHL1105DA

Operation: **Disassembly and Assembly of the Steering Cylinder Group**	*Job Code:* **11 20 17 xx**		
None	Standard tools, Suitable piston ring compression tool		



TV0400582

1	Wiper Seal
2	Sealing Ring
3	Flange
4	O-Ring
5	Piston Rod Assembly
6	Back-up Seal
7	Piston Sealing Ring
8	Back-up Seal
9	O-Ring
10	Cylinder
11	Sealing Ring
12	Wiper Seal

Disassembly

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Clean the outside of the hydraulic cylinder.

⚠ **Caution:**
- **Be careful to prevent damage to the cylinder.**

2. Fasten the cylinder (10) in a soft jawed vice.
3. Remove the flange (3) from the steering cylinder group.
4. Remove the piston rod assembly (5) from the cylinder (10).
5. Remove the wiper seal (1), sealing ring (2) and the O-ring (4) from the flange (3).
6. Remove the back-up seal (6), piston sealing ring (7) and back-up seal (8) from the piston rod assembly (5).
7. Remove the O-ring (9), sealing ring (11) and the wiper seal (12) from the cylinder (10).

Assembly

Note:
- Install new O-ring seals, seals and rings.

Note:
- lubricate the new O-ring seals, seals and rings with clean oil.

1. Install the wiper seal (12), sealing ring (11) and the O-ring (9) to the cylinder (10).
2. Install the back-up seal (8), piston sealing ring (7) and the back-up seal (6) to the piston rod assembly (5).
3. Install the O-ring (4), sealing ring (2) and the wiper seal (1) to the flange (3).
4. Lubricate the inside of the cylinder (10) and the piston rod assembly (5) with clean oil. Use a piston ring compression tool to hold the new back-up seals (6),(8) Piston Sealing Ring (7) in place.

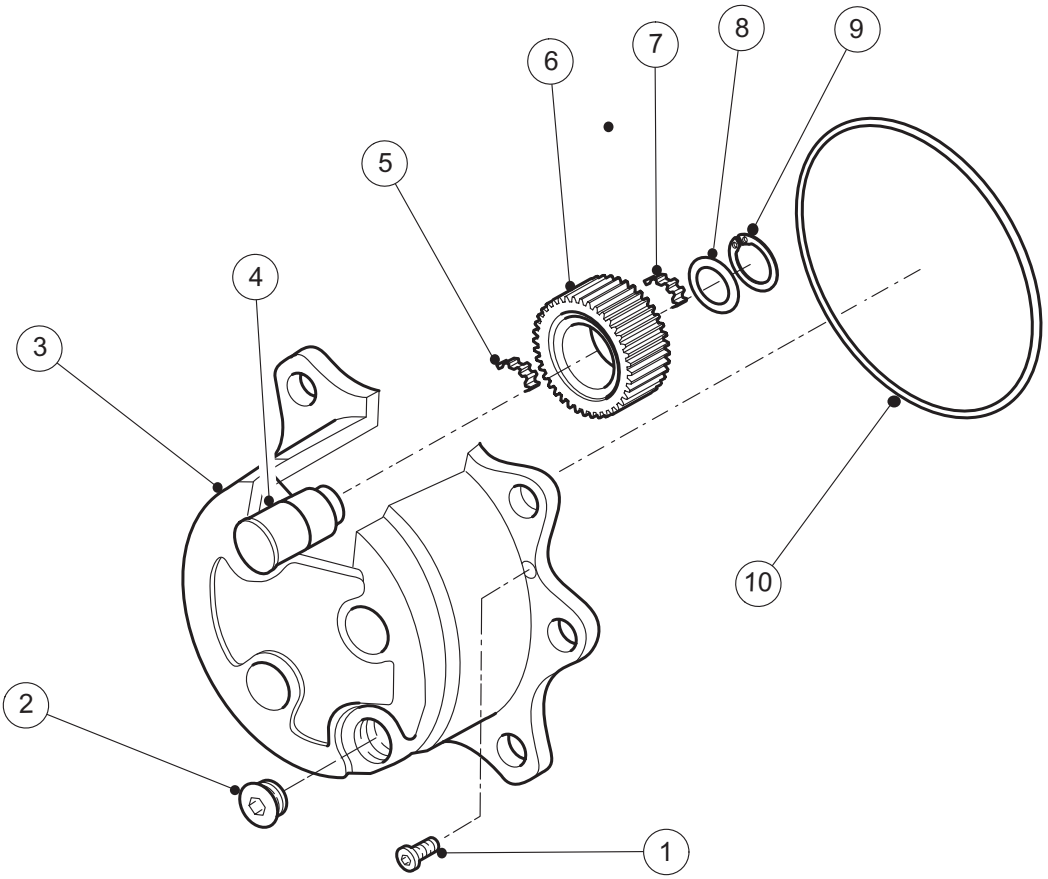
⚠ **Caution:**
- **Be careful not to damage the back-up seals and piston sealing ring.**

5. Start the cylinder (10) onto the piston rod assembly (5). Push the cylinder onto the piston rod (5) assembly until the compression tool is pushed off the piston rod assembly.
6. Install the flange (3) onto the steering cylinder group.

DISASSEMBLY AND ASSEMBLY — EPICYCLIC REDUCTION GEAR GROUP

BHL1105DB

Operation: **Disassembly and Assembly of the Epicyclic Reduction Gear Group**	*Job Code:* **xx xx xx xx**		
None	Standard tools		

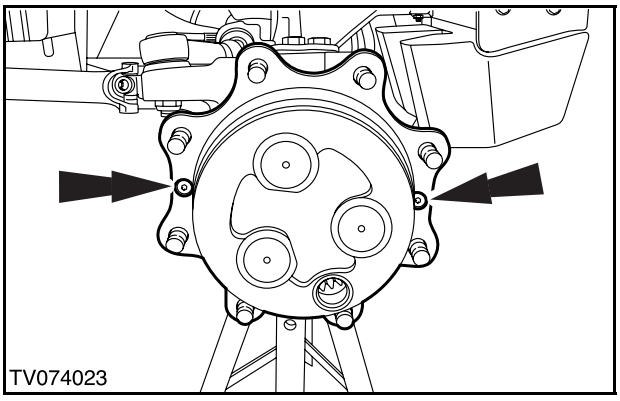


TV074022

1	Retaining Screw
2	Drain/Refill Plug
3	Epicyclic Reduction Gear Carrier
4	Pin
5	Needle Bearings
6	Planetary Gears
7	Needle Bearings
8	Washer
9	Cir-clip
10	O-ring seal

Disassembly

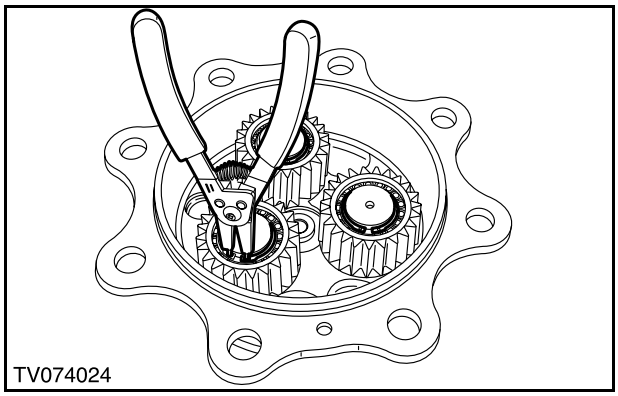
1. Remove the wheel. For additional information, refer to M12-01 FRONT WHEEL, PAGE M12–01–3 .
2. Drain the hub oil. For additional information, refer to DRAINING AND FILLING THE HUB OIL, PAGE L11–05–69 in this section.
3. Remove the epicyclic reduction gear retaining screws and remove the epicyclic reduction gear.


TV074023

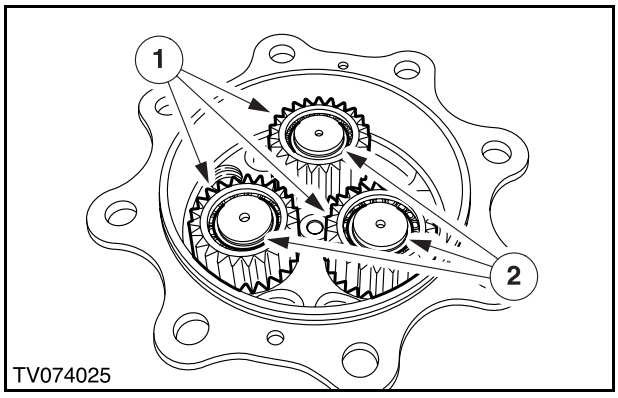
Note:

- On disassembly of the epicyclic reduction gear clean the contact surfaces of the epicyclic reduction gear and wheel hub and check it for excess wear.

4. Using suitable circlip pliers, remove the epicyclic reduction gear retaining circlips.


TV074024

5. Remove the epicyclic reduction gears (1).
6. Recover the needle roller bearings (2).



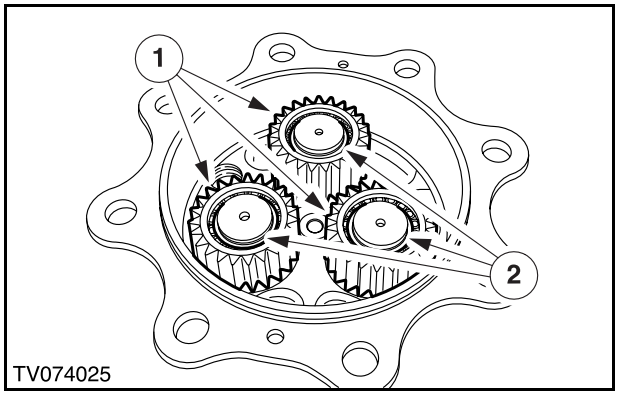
Assembly

Note:
- When installing new epicyclic reduction gears, install new needle bearings.

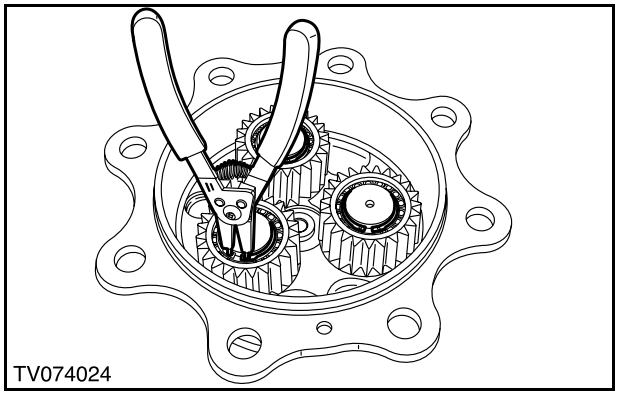
1. Install the epicyclic reduction gears (1).

Note:
- Use a suitable light greese to aid installation.

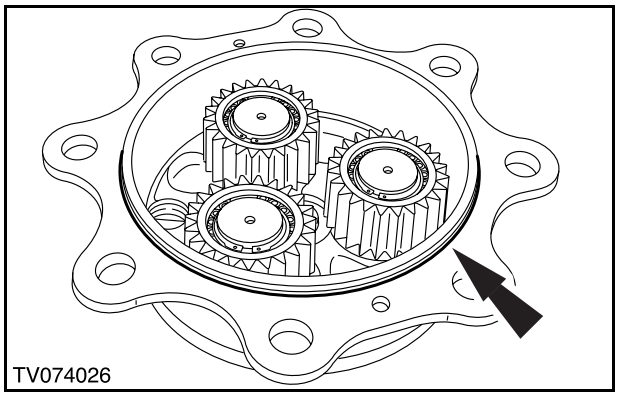
2. Install the needle roller bearings (2).



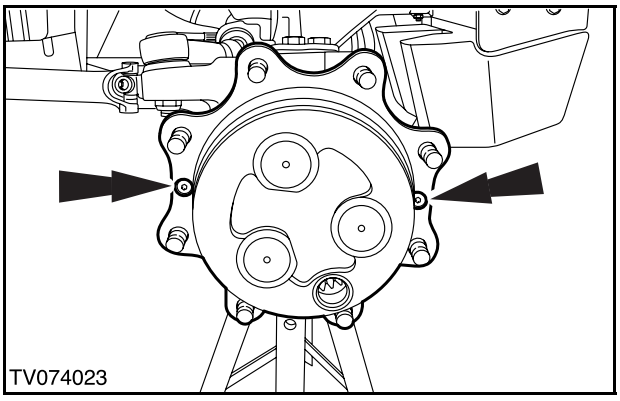
3. Install the epicyclic reduction gear retaining circlips.



4. Clean and degrease the mating surfaces install a new o-ring seal.



5. Install the epicyclic reduction gear to the wheel hub.
6. Install the epicyclic reduction gear retaining screws (1).
7. Tighten to 30Nm (22 lb.ft).

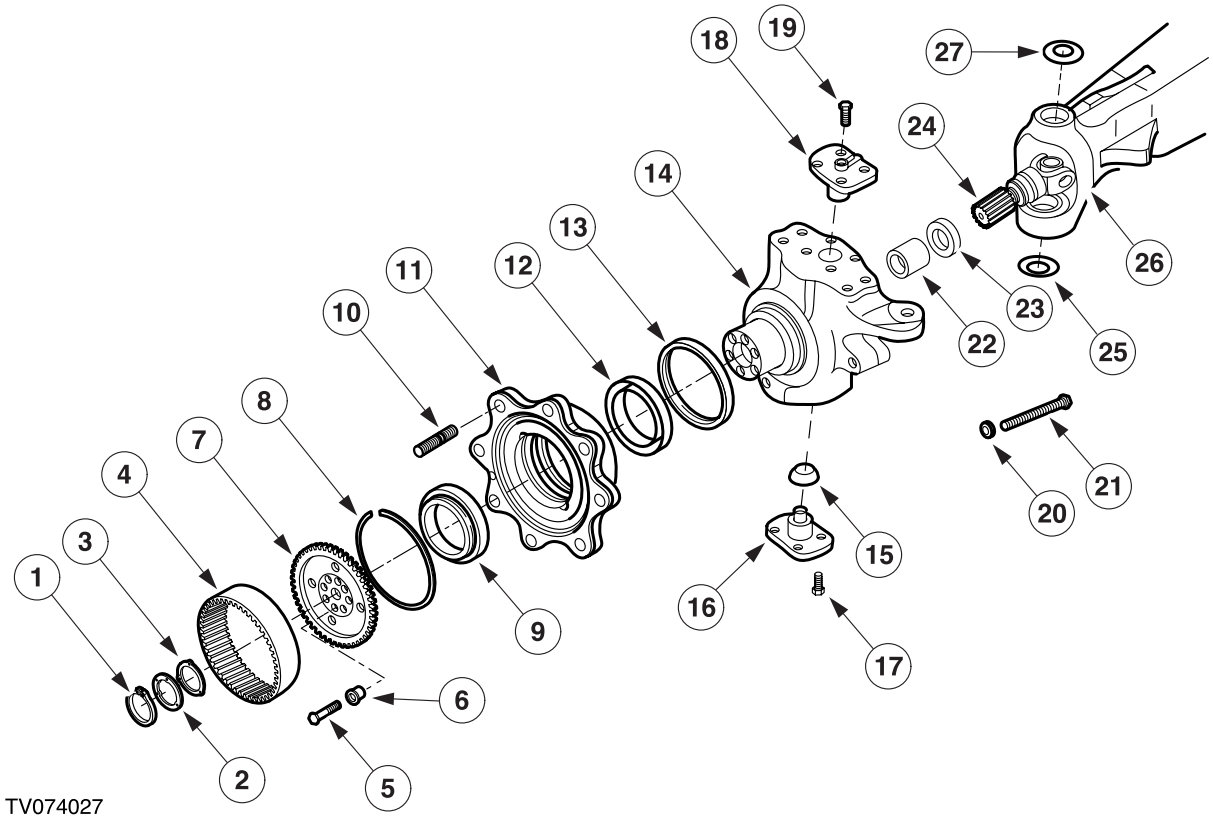


8. Fill the hub with oil. For additional information, refer to DRAINING AND FILLING THE HUB OIL, PAGE L11–05–69 in this section.
9. Install the wheel. For additional information, refer to M12-01 FRONT WHEEL, PAGE M12–01–3 .

DISASSEMBLY AND ASSEMBLY — WHEEL HUB GROUP

BHL1105DC

Operation: **Disassembly and Assembly of the Wheel Hub Group**	*Job Code:* **xx xx xx xx**		
Suitable lifting equipment	Standard tools, Ball joint separator, Ca715026, Ca715027, Ca119143		

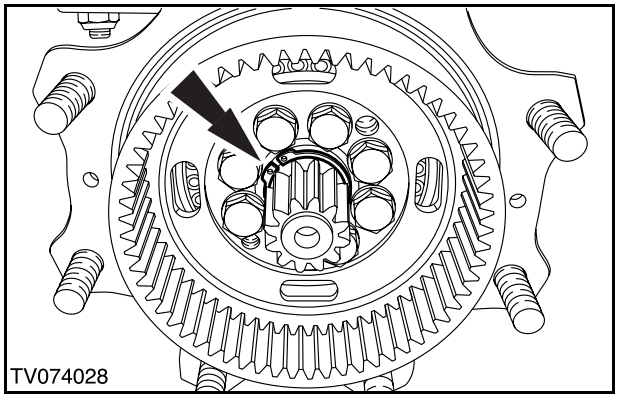


1	Circlip
2	Washer
3	Washer
4	Epicylic Ring Gear
5	Retaining Bolt
6	Centering bushes
7	Wheel carrier
8	Lock ring
9	Taper Roller Bearing
10	Stud
11	Wheel Hub
12	Taper Roller Bearing
13	Oil Seal
14	Swivel Housing
15	Cone
16	Lower Kingpin
17	Retaining Bolt
18	Upper Kingpin
19	Retaining Bolt
20	Lock Nut
21	Steering Angle Adjustment Bolt
22	Bush
23	Oil seal
24	Universal-Joint Shaft End
25	Belleville washers
26	Axle
27	Belleville Washers

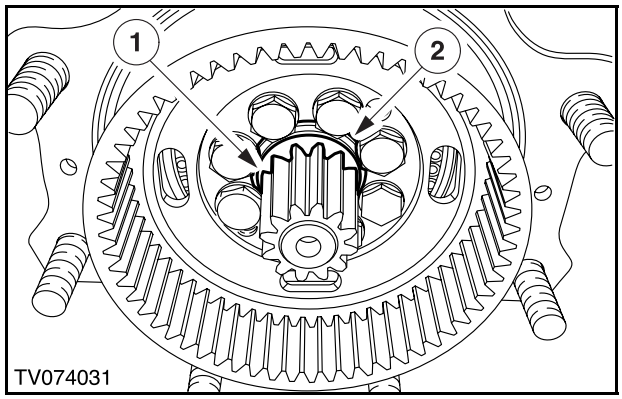
Disassembly

Note:
- Right-hand side shown, left-hand side similar.

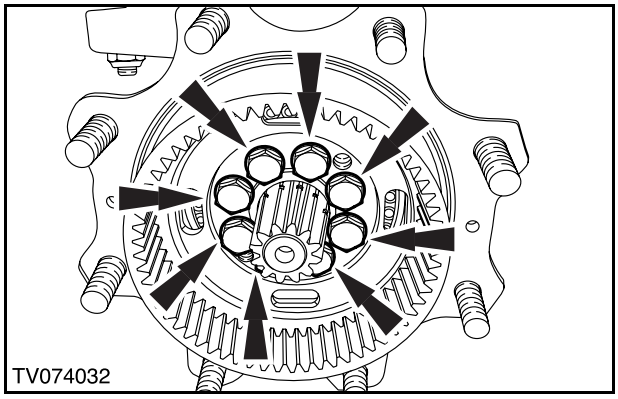
1. Remove the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE L11–03–15 in this section.
2. Remove the circlip.



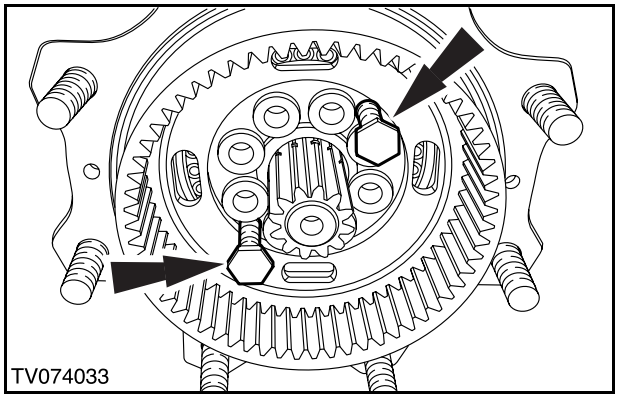
3. Remove the washer (1) and the spacer (2).



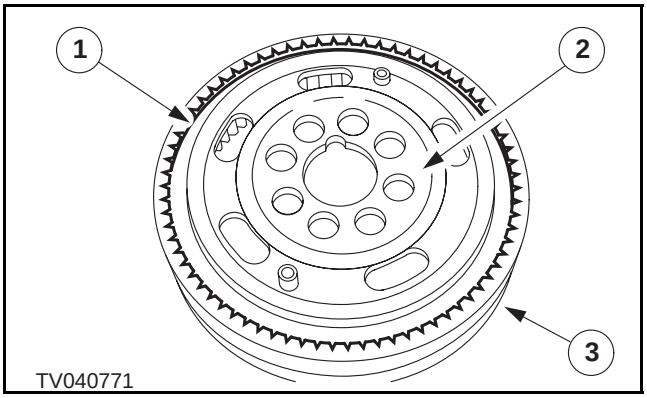
4. Remove the wheel hub retaining bolts.



5. Using two hub retaining bolts, extract the epicyclic group.

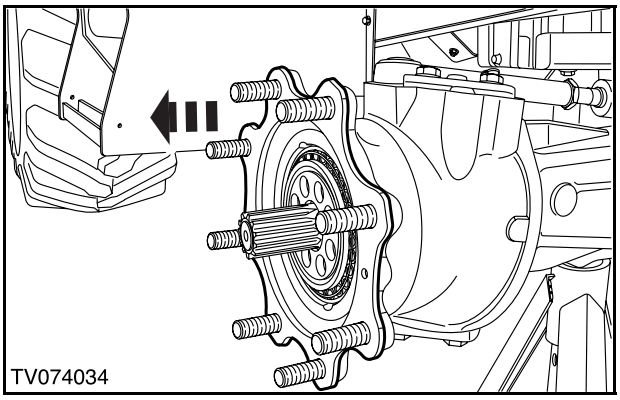


6. Remove the snap ring (1) and remove the epicyclic gear hub (2) from the epicyclic ring gear (3).
7. Using the special tool **CA715027 — Driver for bush** remove the wheel hub centering bushes.



8. Using a suitable soft faced hammer, remove the front axle hub.

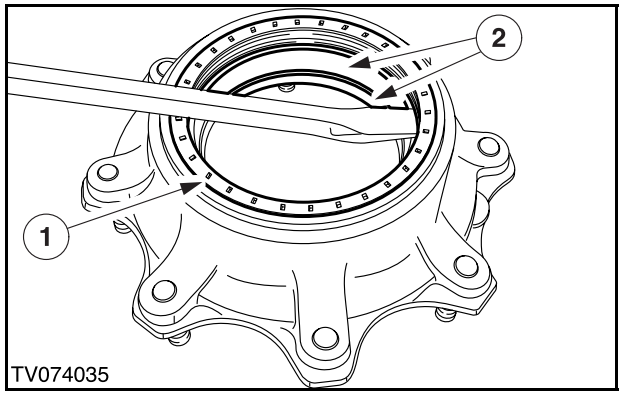
   Note:
   - Recover the outer taper roller bearing.



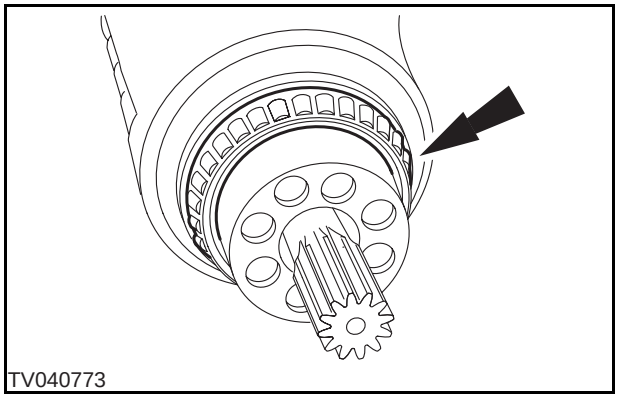
9. Using a suitable lever, remove the hub seal (1).

Note:
- Discard the oil seal.

10. Recover the outer taper roller bearing. Using a suitable drift, remove the inner and outer taper roller bearing cones (2).

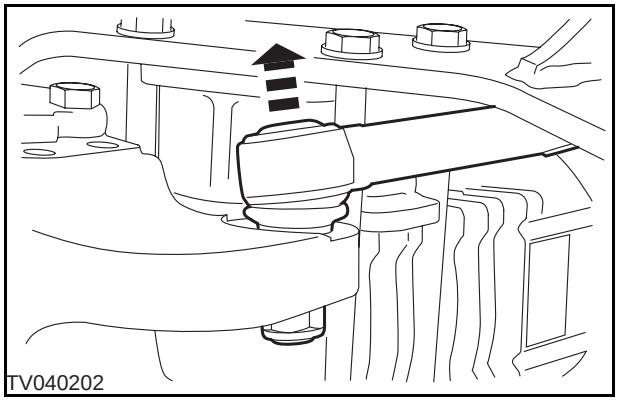


11. Using a suitable puller, remove the inner taper roller bearing.



⚠ **Caution:**
- **Leave the tie rod end nut on the tie rod end a few turns to prevent damage to the stud while using the ball joint separator.**

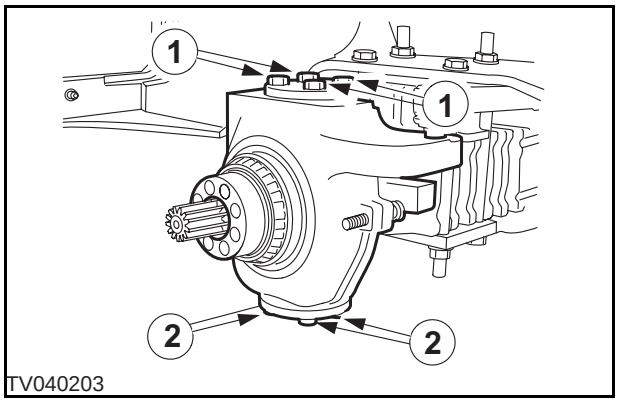
12. Using a suitable ball joint separator, disconnect the tie rod assembly from the wheel hub.



⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

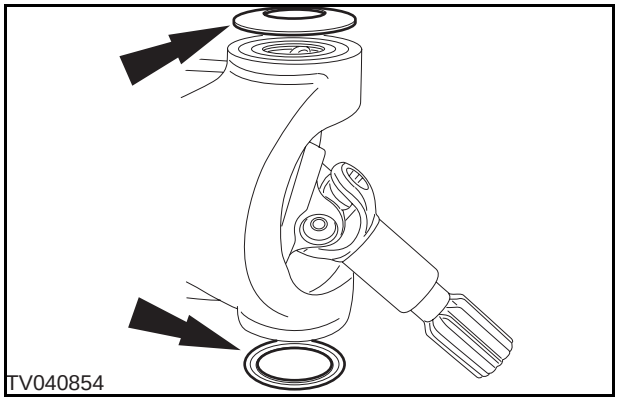
Note:
- Using suitable lifting equipment, support the wheel hub assembly .

13. Remove the upper (1) and lower (2) kingpin retaining bolts and remove the kingpins.
14. Remove the swivel hub assembly.



TV040203

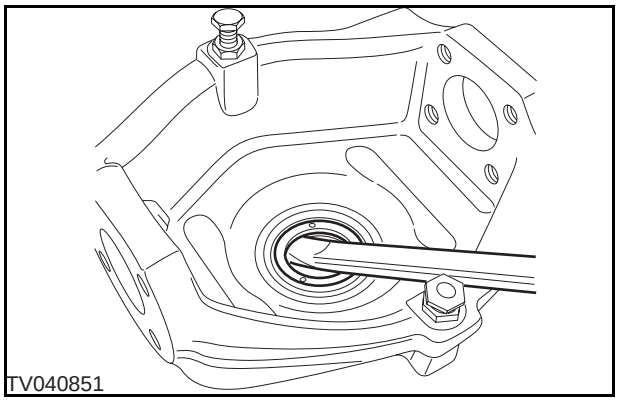
15. Remove the swivel thrust washers. Note the orientation to aid installation.


TV040854

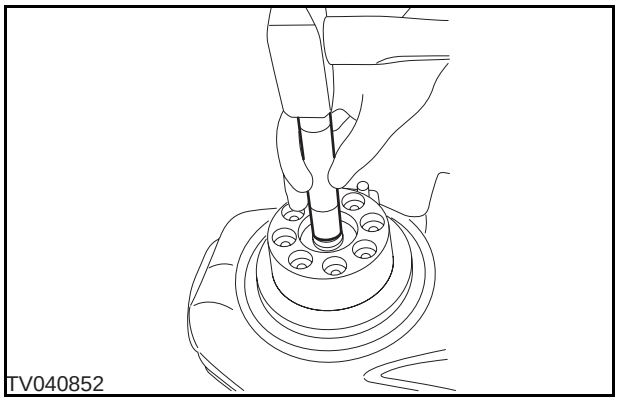
Note:
- Position the swivel hub on a suitable flat surface.

16. Using a suitable lever, remove the oil seal.

Note:
- Discard the oil seal.

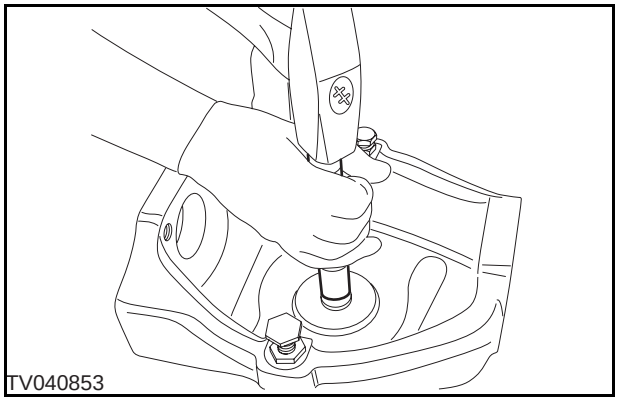

TV040851

17. Using a suitable drift, remove the swivel housing bush.

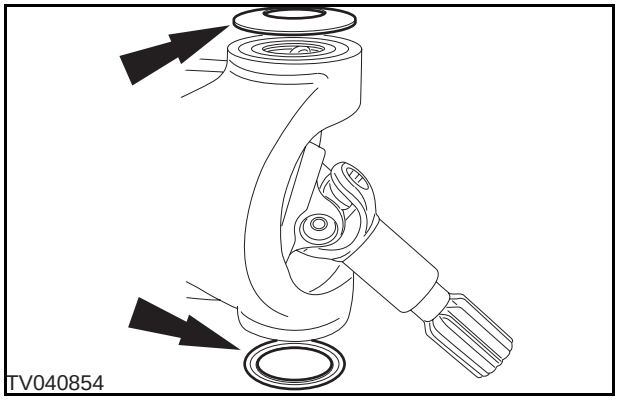

TV040852

Assembly

1. Using the special tool **CA119043 — Driver for bush** , install the bush.
2. Using the special tool **CA119117 — Driver for oil seal** , install the oil seal.


TV040853

3. Install the swivel thrust washers.


TV040854

⚠ **Warning:**

- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:

- Using suitable lifting equipment, support the swivel hub assembly .

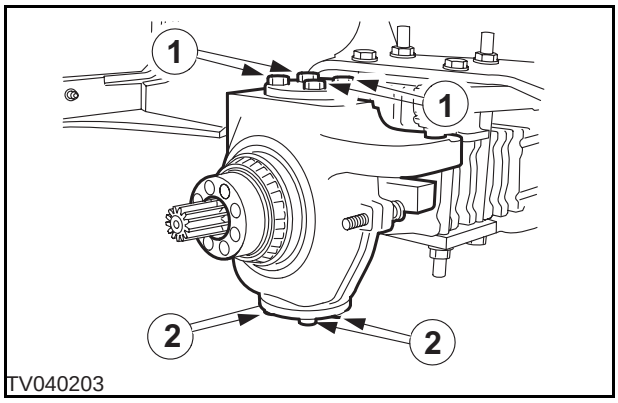
4. Install the swivel hub assembly.

Note:

- Make sure the double universal-joint shaft is fully installed into the axle housing.

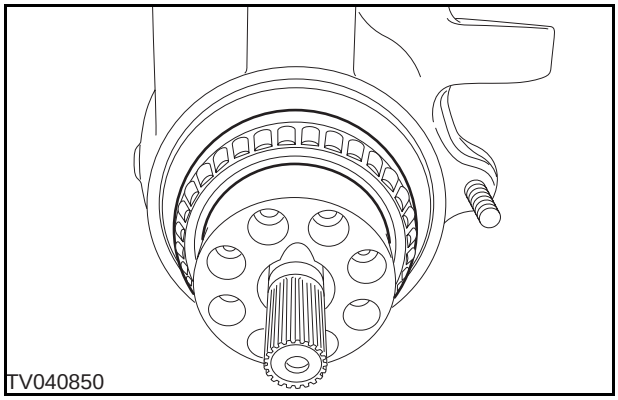
5. Install the upper (1) and lower (2) kingpins and kingpin retaining bolts.

6. Tighten to 190Nm (140 lb.ft).

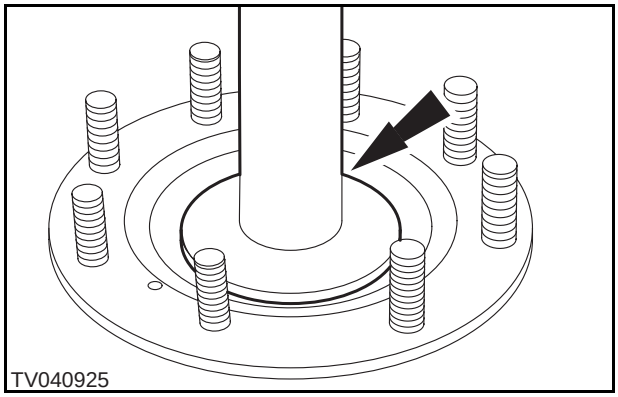


TV040203

7. Install the inner taper roller bearing.

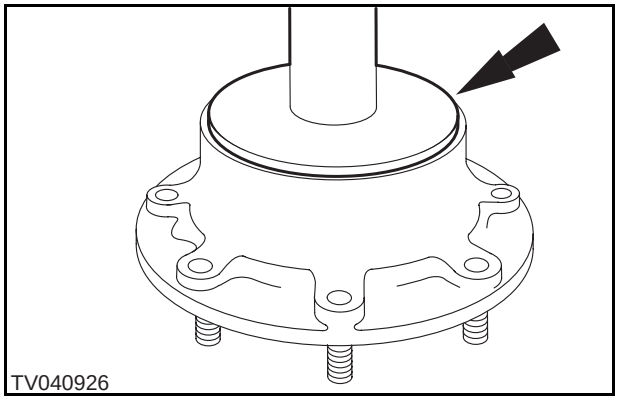

TV040850

8. Using a suitable hydraulic press and the special tool **CA715026 — Driver for bearing race** , install the inner and outer taper roller bearing cones.

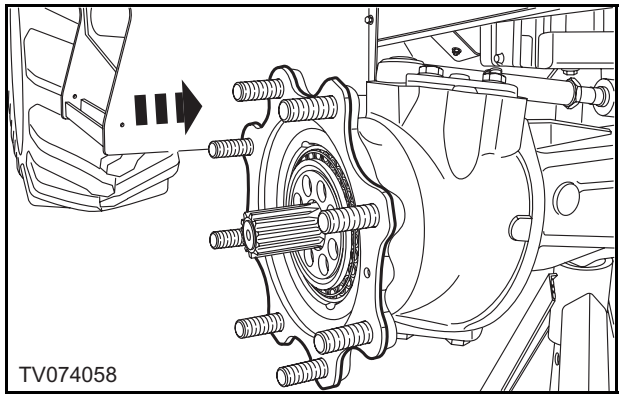

TV040925

Note:
- Lubricate the oil seal with a light grease.

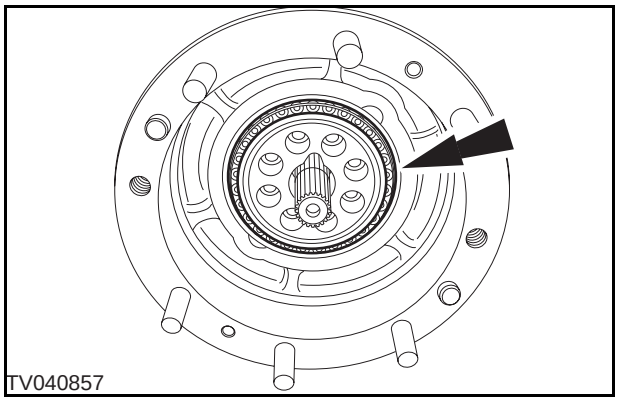
9. Using the special tool **CA119143 — Driver for oil seal** , install a new hub oil seal.


TV040926

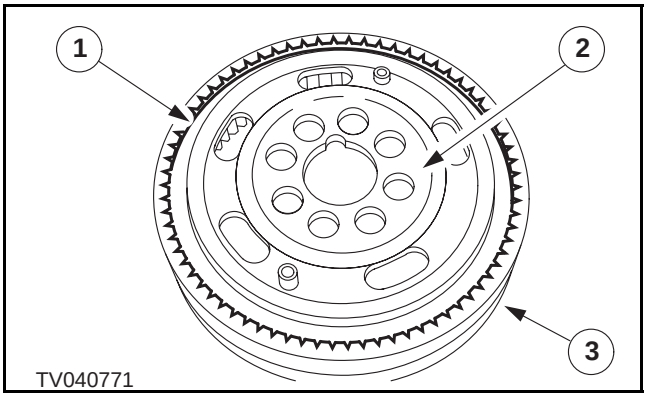
10. Install the front axle hub.



11. Install the outer taper roller bearing.



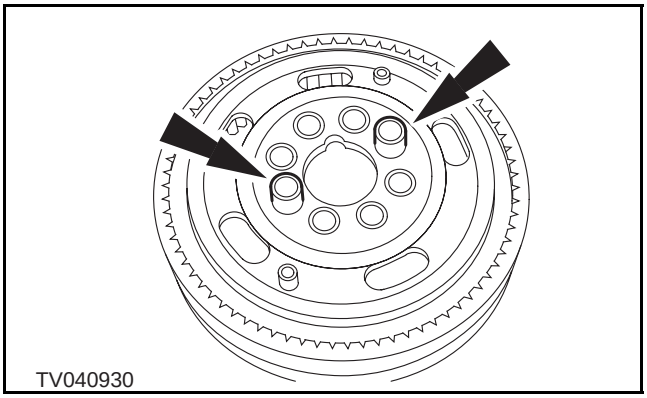
12. Install the epicyclic hub (2) to the epicyclic ring gear (3) and install the snap ring (1).



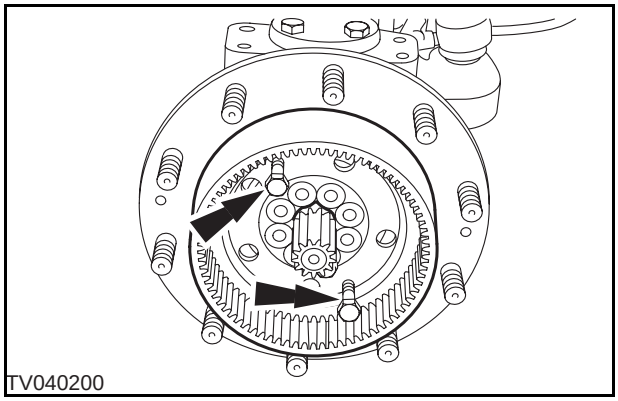
Note:

- Install two bushes slightly higher that the hub surface level to be used as dowel pins.

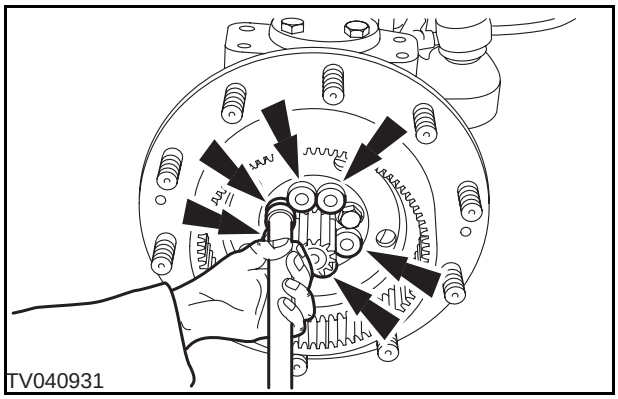
13. Using the special tool **CA715027 — Driver for bush** partially install the hub centering bushes.



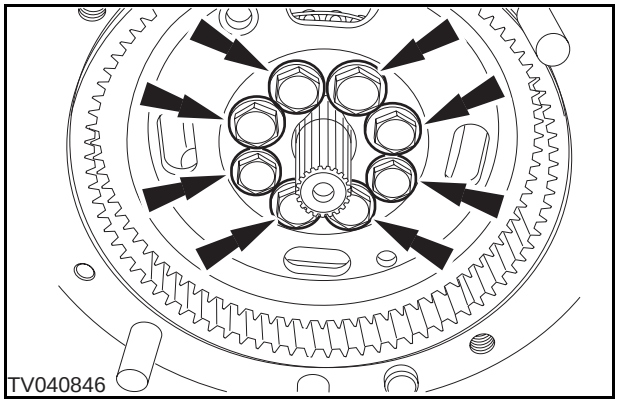
14. Assemble the epicyclic group on the front wheel hub using the two protruding centering bushes as dowel pins.


TV040200

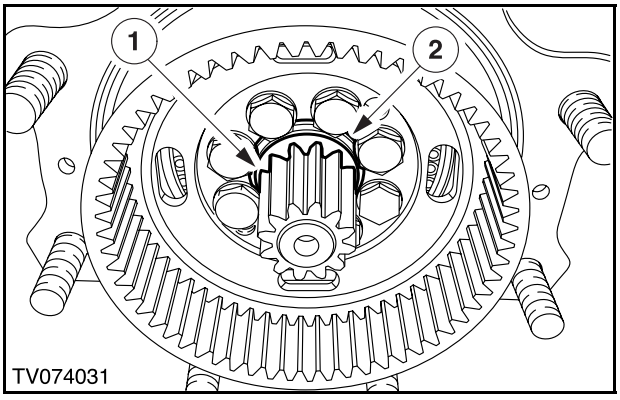
15. Using the special tool **CA715027 — Driver for bush** , install the remaining centering bushes.


TV040931

16. Install the epicyclic hub retaining bolts.
17. Tighten to 230Nm (170 lb.ft).

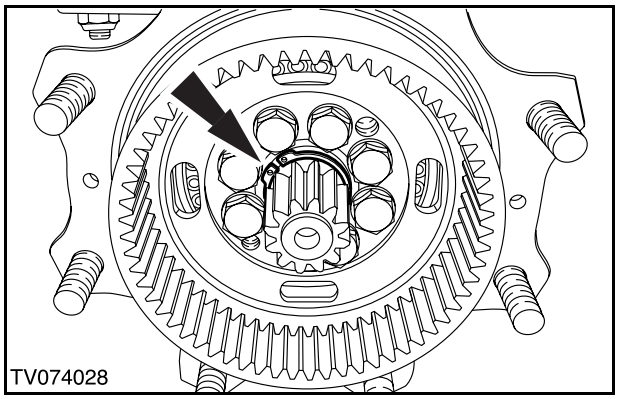

TV040846

18. Install the spacer (2) and the washer (1).

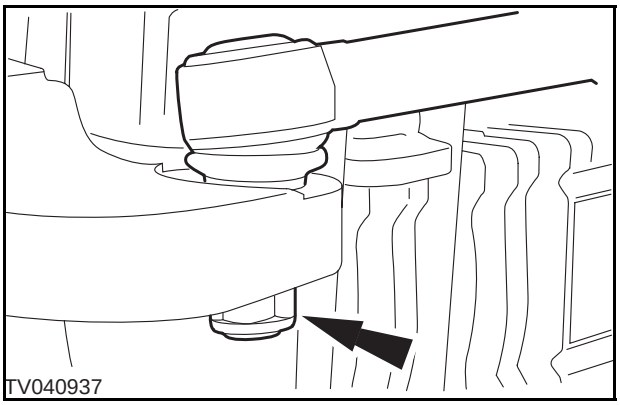


TV074031

19. Install the circlip.



20. Install the tie rod assembly onto the wheel hub.
21. Tighten to 250Nm (184lb.ft).



22. Install the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE L11–03–15 in this section.

Note: This page intentionally left blank.

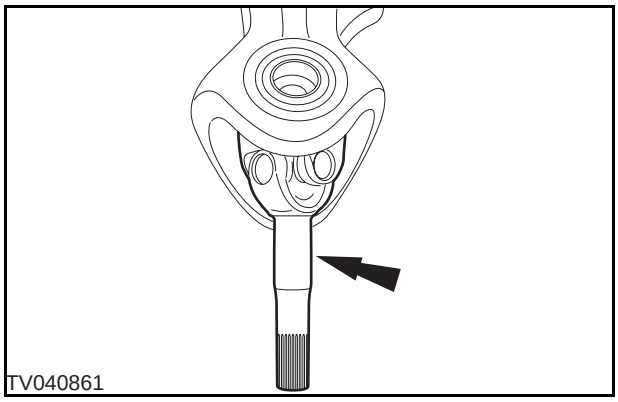
DISASSEMBLY AND ASSEMBLY — AXLE HOUSING GROUP

BHL1105DD

Operation: **Disassembly and Assembly of the Axle Housing Group**	*Job Code:* **11 07 17 xx**		
None	Standard tools, CA715034, CA715505, CA715163, CA715164, CA715701		

Disassembly

1. Remove the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE L11–05–23 in this section.
2. Drain the axle oil into a suitable container. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL, PAGE L11–05–67 in this section.
3. Remove the two double Universal-Joints from the axle housing (both sides).

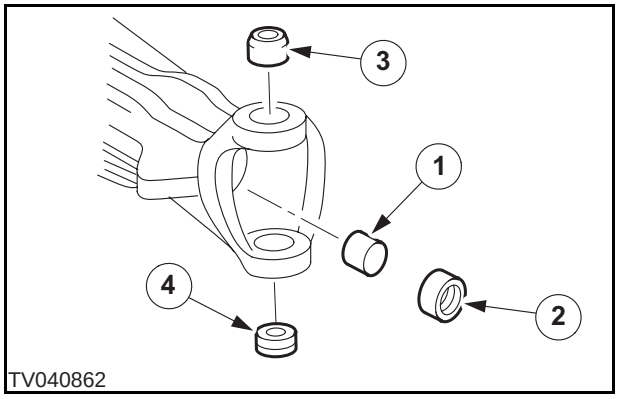

TV040861

4. Remove the oil seal (2) from the axle housing (both sides).

   Note:
   - Discard the oil seal rings.

   ⚠ **Caution:**
   - **Be careful not to damage the bush housing.**

5. Remove the bushes (1) from the axle housing (both sides).
6. Using a suitable extractor remove the upper king pin bush (3) and the ball bearing cup (4) from the king pin housings (both sides).



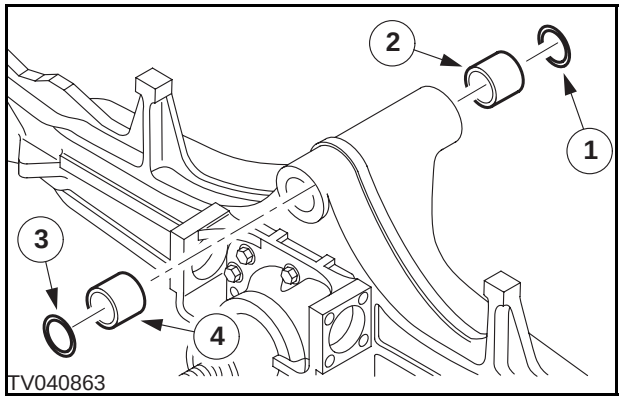
TV040862

7. Remove the oil seals (1) and (3) from the axle housing.

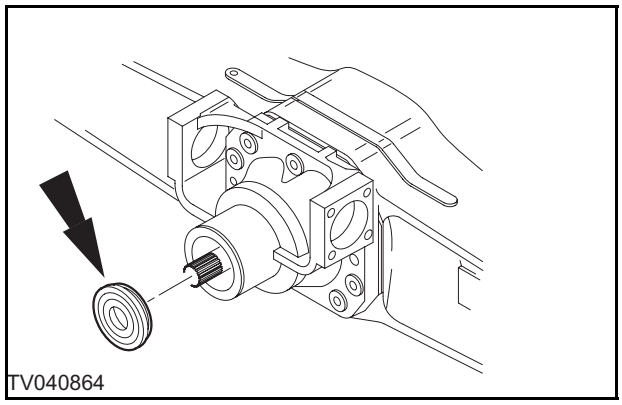
   Note:
   - Discard the oil seals.

8. Remove the bushes (2) and (4) from the axle housing.

   ⚠ **Caution:**
   - **Be careful not to damage the bush housing.**

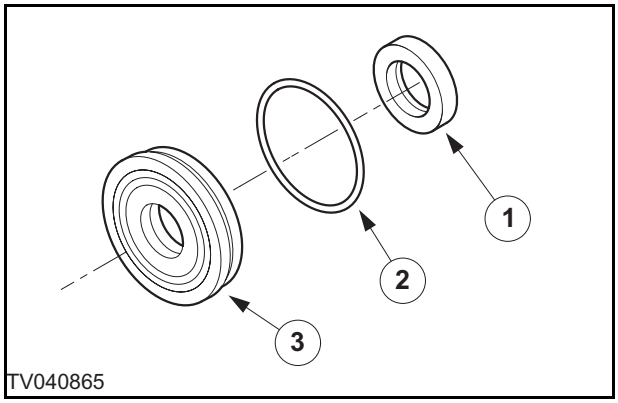


9. Using a suitable lever, remove the cover from the differential support .



10. Remove the oil seal (1) and the O-ring (2) from the cover (3).

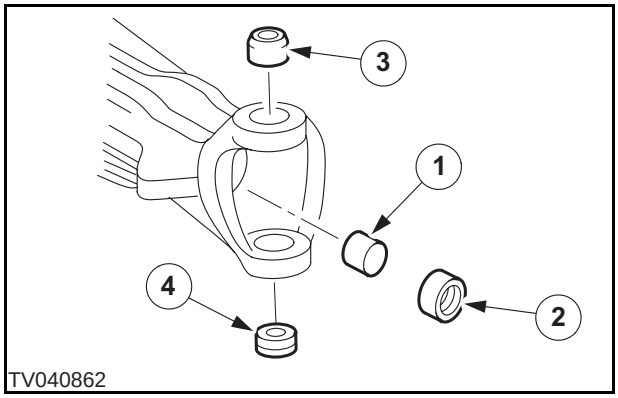
    Note:
    - Discard the oil seals.



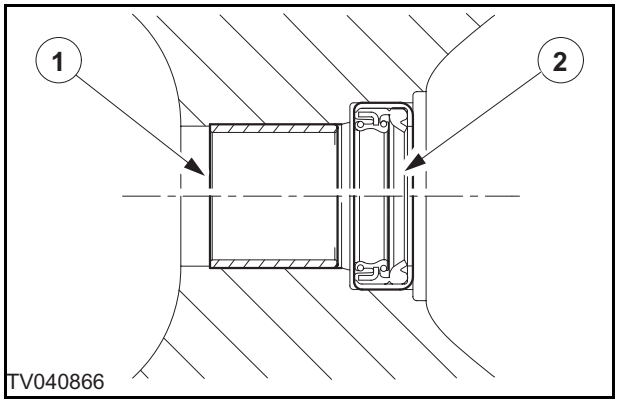
Assembly

Note:
- Install new oil seals.

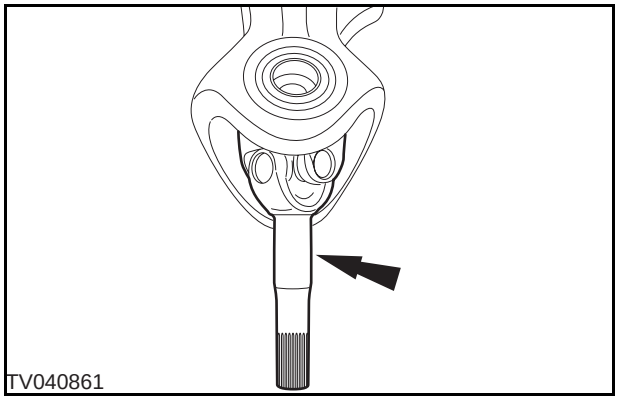
1. Using the special tool **CA715034** , install the king pin bush (3) in the axle housing (both sides).
2. Using the special tool **CA175034 - Driver** , install the ball bearing cup (4) in the axle housing (both sides).
3. Using the special tool **CA715505 - Driver** , install the bush (1) and the oil seal (2).



4. Install the bush (1) and the oil seal (2) as shown.



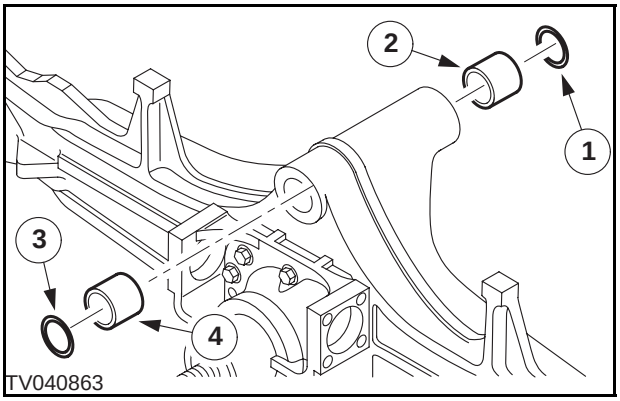
5. Install the two double Universal-Joints into the axle housing (both sides).



6. Using the special tool **CA715163 - Driver** install the bushes (2) and (4) on the axle housing.

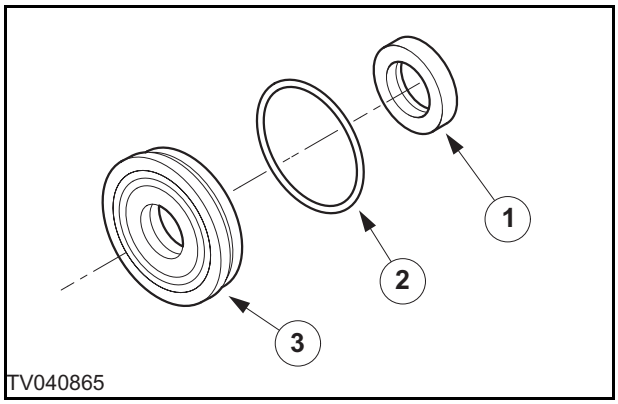
   Note:
   - Lubricate the oil seal with a light grease.

   Using the special tool **CA715164 - Driver** install the oil seals (2) and (3) on the axle housing.



   Note:
   - Lubricate the oil seal with a light grease.

7. Using the special tool **CA715701 - Driver** Install the oil seal (1) to the cover (8).
8. Install the O-ring seal (2) to the cover (3).



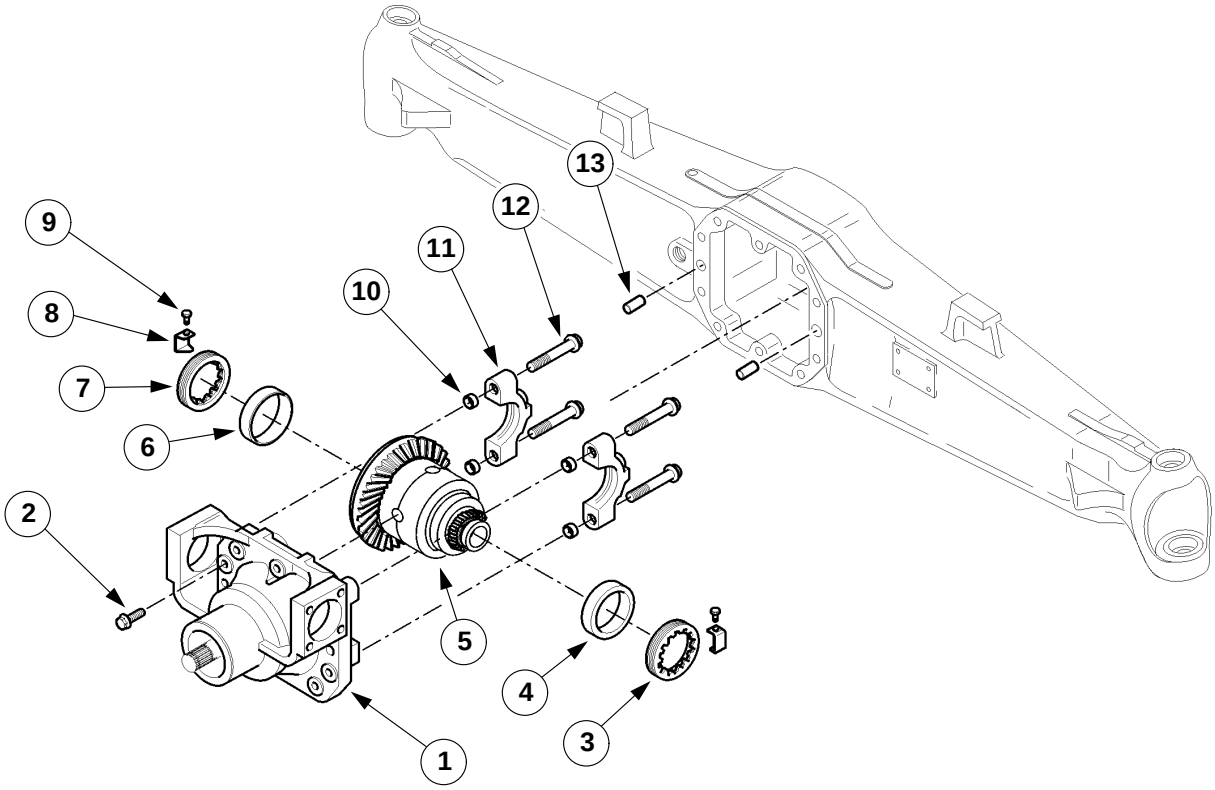
   ⚠ **Caution:**
   - **Cover the pinion shaft spline to protect the oil seal from damage.**

9. Install the cover to the axle housing.
10. Install the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE L11–05–23 in this section.
11. Fill the axle with oil. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL, PAGE L11–05–67 in this section.

DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL SUPPORT GROUP

BHL1105DE

Operation: **Disassembly and Assembly of the Differential Support Group**	*Job Code:* **11 03 13 xx**		
Suitable lifting equipment	Standard tools, CA119030, CA715116		



TV040605

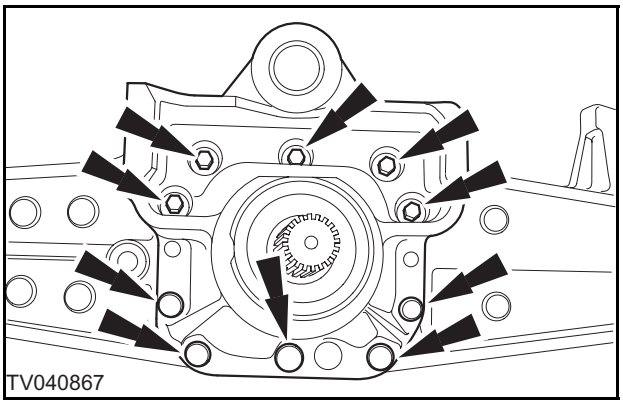
1	Differential Support
2	Retaining Bolt
3	Adjustment Nut
4	Taper Roller Bearing
5	Differential Assembly
6	Taper Roller Bearing
7	Adjustment Nut
8	Locking Tab
9	Retaining Bolt
10	Dowel
11	Differential Half-Collers
12	Retaining Bolt
13	Dowel

Disassembly

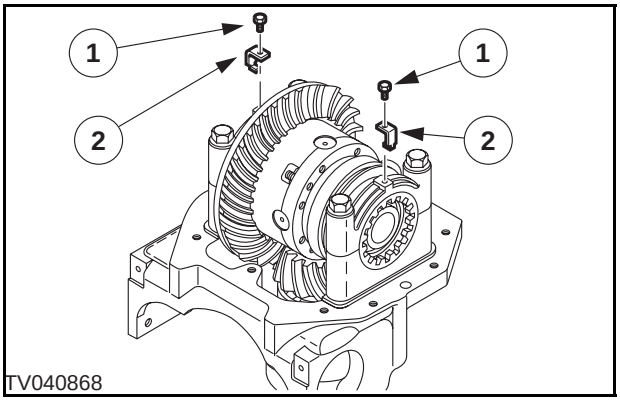
1. Remove the axle housing group. For additional information, refer to AXLE HOUSING GROUP, PAGE L11–05–35 in this section.

   ⚠ **Warning:**
   - **Support the differential support. Failure to follow this instruction may result in personal injury.**

2. Remove the differential support from the axle housing.

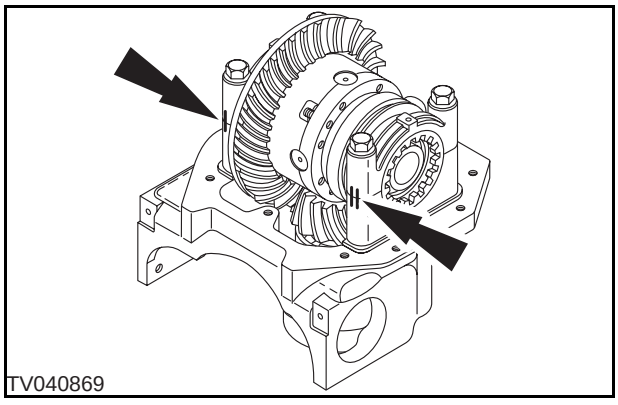

TV040867

3. Remove the locking tab retaining bolts (1) and remove the adjustment nut locking tabs (2).

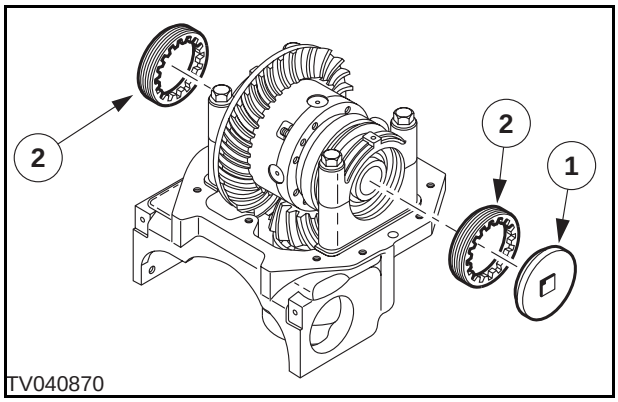


TV040868

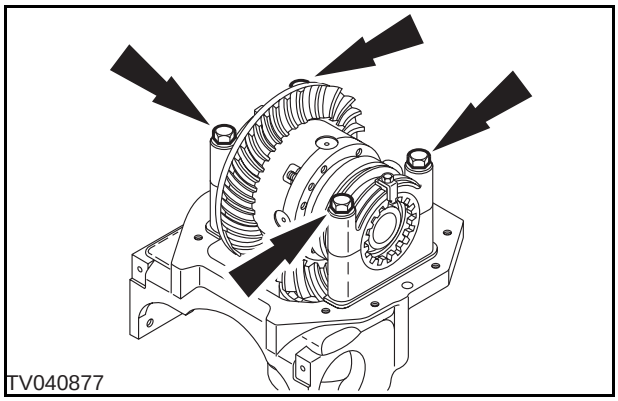
4. Mark the differential half-collers and the differential adjustment nuts to aid installation.


TV040869

5. Using the special tool **CA119030 — Wrench** (1), Remove the differential adjustment nuts (2).

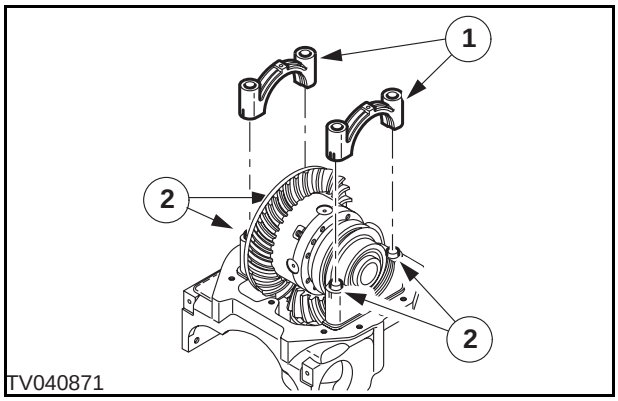


6. Remove the half-collers retaining bolts.



7. Remove the half–collers (1).

Note:
- Recover the half-coller dowels (2).

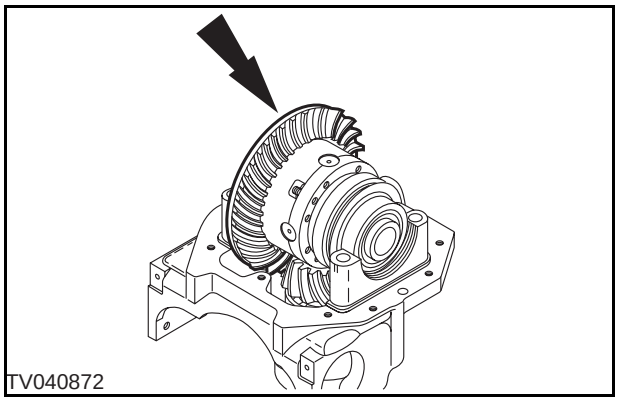


⚠ **Caution:**
- **If the taper roller bearings are not to be replaced, make sure the taper roller bearing and cone remain a matched pair.**

⚠ **Caution:**
- **Make a note of the differential position to aid installation.**

8. Remove the differential assembly.

Note:
- Recover the taper roller bearing cones.


TV040872

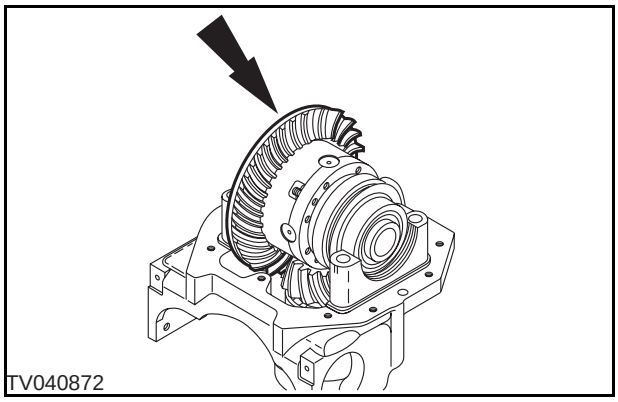
Assembly

1. Install the pinion shaft. For further information refer to PINION GROUP, PAGE L11–05–55 in this section.

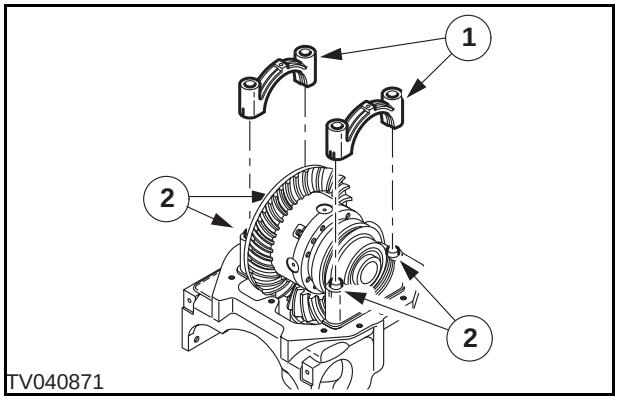
⚠ Caution:
- **Make sure the taper roller bearing and cone remain a matched pair.**

⚠ Caution:
- **Make sure the differential is installed in the correct orientation.**

2. Install the differential assembly.


TV040872

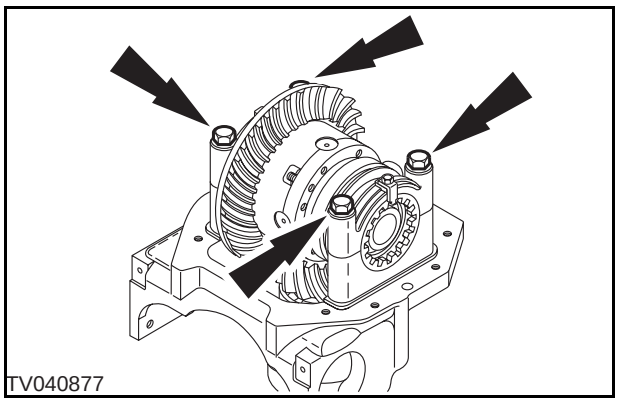
3. Install the half-coller dowels (2).
4. Install the half–collers (1).



TV040871

Note:
- Do not tighten at this stage.

5. Install the half-collers retaining bolts.

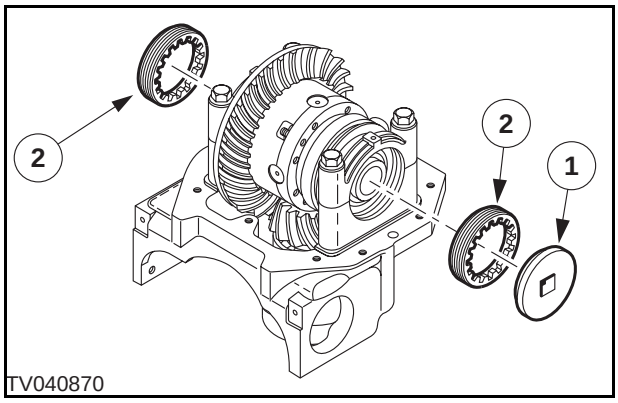

TV040877

⚠ **Caution:**
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

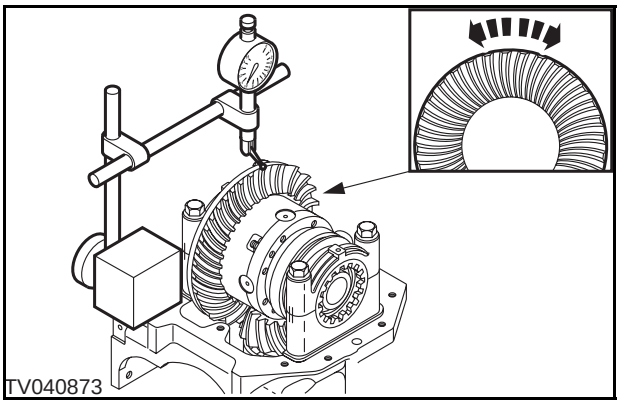
Note:
- Only tighten the differential adjustment nut until the bearing backlash is removed and nominal pre-load is achieved.

6. Using the special tool **CA119030 — Wrench** (1), Install the differential adjustment nuts (2).

Note:
- Using a suitable soft-faced hammer, settle the differential taper roller bearings.

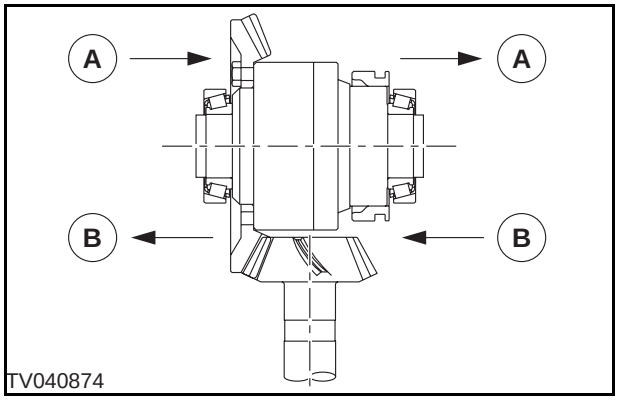


7. Lock the pinion shaft.
8. Using a suitable measuring device, measure the pinion to crown wheel backlash.
9. Repeat the measurement in a further two positions 120° apart and compare the average of the three values.
10. The pinion to crown wheel backlash should be within the following range:
0.18mm — 0.23mm



Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the nominal bearing pre-load and no free play.

11. Using the special tool **CA119030 — Wrench** , adjust the differential adjustment nuts until the correct pinion to crown wheel backlash is achieved.
    - **Measured backlash is greater than the specified range — (A)** , adjust the differential assembly closer to the pinion shaft by loosening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment nut equal amounts.
    - **Measured backlash is less than the specified range — (B)** , adjust the differential assembly away from the pinion shaft by tightening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment nut equal amounts.



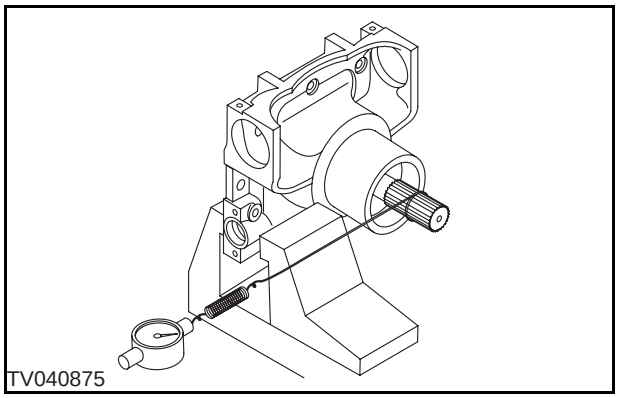
12. Once the correct pinion to crown wheel backlash is achieved, check that the differential taper roller bearings have no free play and no pre-load is evident.
13. Repeat steps 7 to 12 the whole sequence of the above mentioned operations until the indicated conditions are reached.

⚠ **Caution:**
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

Note:
- Using a suitable soft-faced hammer, settle the differential taper roller bearings.

Note:
- Rotate the differential assembly while tightening the adjustment nuts to seat the bearing rollers on their track.

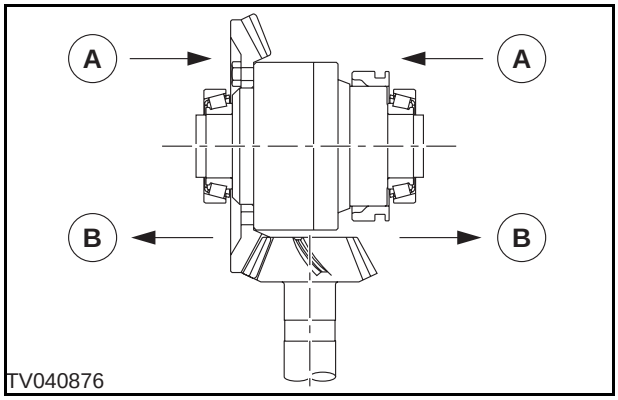
14. Using a suitable measuring device with the cord wound round the pinion shaft spline, measure the total rotational torque.


TV040875

15. The total rotational torque should be within the following range excluding breakaway torque.
    (4.3 + P) to (6.45 + P) daN
    P = Measured pinion shaft rotational torque. For additional information refer to PINION GROUP, PAGE L11–05–55 in this section.

Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the set backlash.

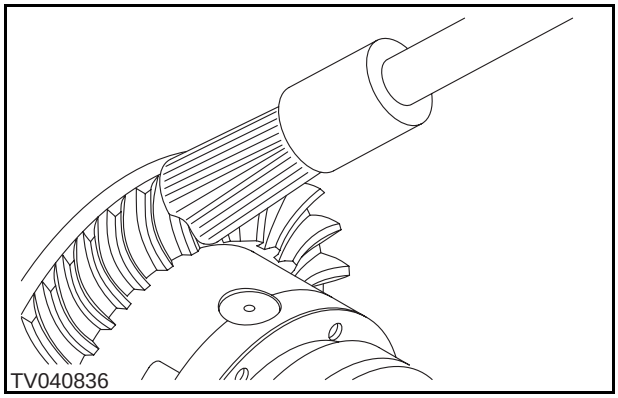
16. Using the special tool **CA119030 — Wrench** , adjust the differential adjustment nuts until the correct differential taper roller bearing pre-load is achieved.
    - **Total pre-load is less than the specified range — (A)** , increase the differential taper roller bearing pre-load by tightening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment equal amounts.
    - **Total pre-load is higher than the specified range — (B)** , decrease the differential taper roller bearing pre-load by loosening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment equal amounts.



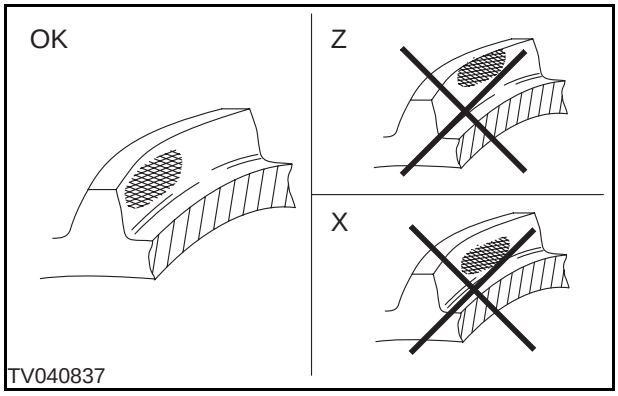
Testing After Adjustment

Note:
- The marking test should always be carried out on both sides of the crown wheel teeth.

17. To test the marks of the crown wheel teeth, paint the ring gear with engineer's blue.


TV040836

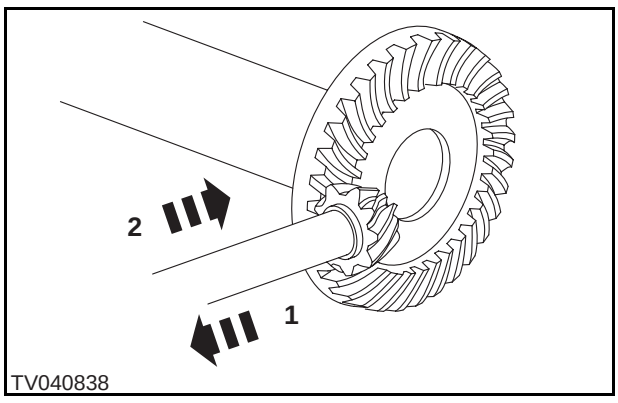
18. Check the contact pattern:
    OK = Correct contact — If the crown wheel is well adjusted, the mark on the teeth surfaces will be regular.
    Z = Excessive contact on the tooth tip — Adjust the pinion towards the crown wheel and then adjust the crown wheel away from the pinion in order to adjust the backlash.
    X = Excessive contact at the tooth base — Adjust the pinion away from the crown wheel and then adjust the crown wheel towards the pinion in order to adjust the backlash.



TV040837

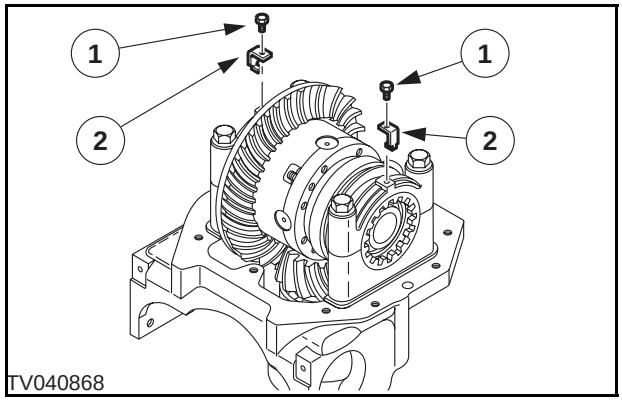
Movements to correct

19. Adjust as required:
    1 = move the pinion for type X contact adjustment.
    2 = move the pinion for type Z contact adjustment.

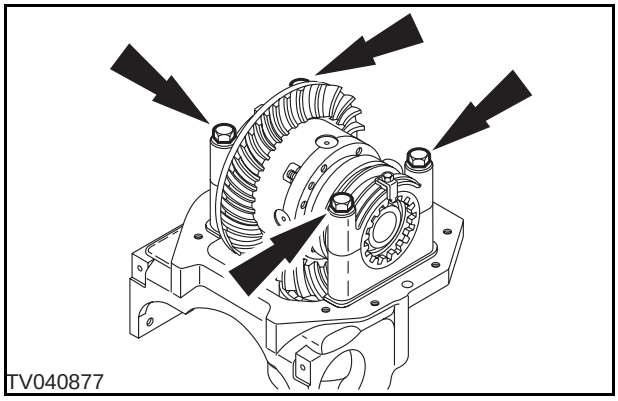


TV040838

20. Install the adjustment nut locking tabs (2) and install the locking tab retaining bolts (1).
21. Tighten to 13Nm (10 lb.ft).



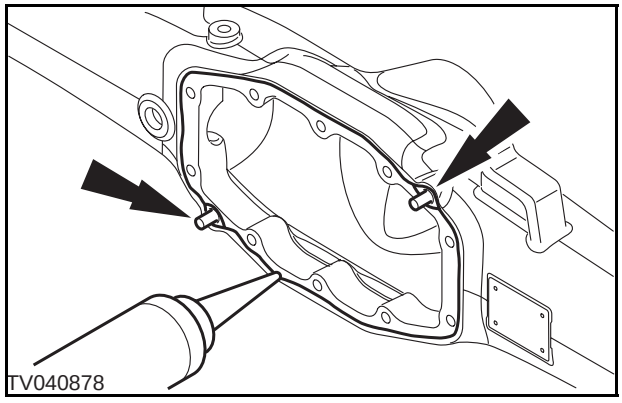
22. Tighten the half-collers retaining bolts to 266Nm (196 lb.ft).



Note:

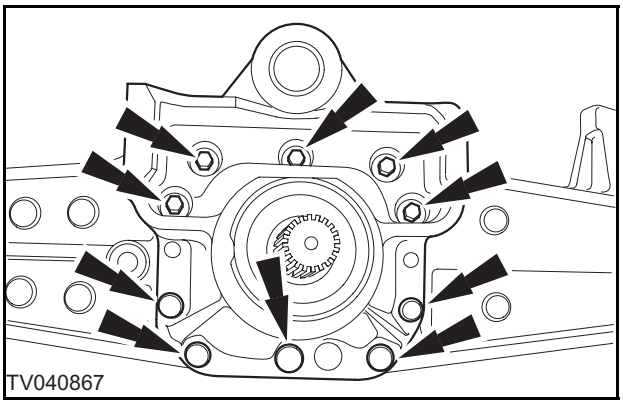
- Make sure the two dowel pins are installed into the axle housing.

23. Thoroughly clean and de-grease the mating surfaces. Apply a bead of sealant following the pattern shown.



24. Install the differential support onto the axle housing.
25. Tighten to 169Nm (125 lb.ft).

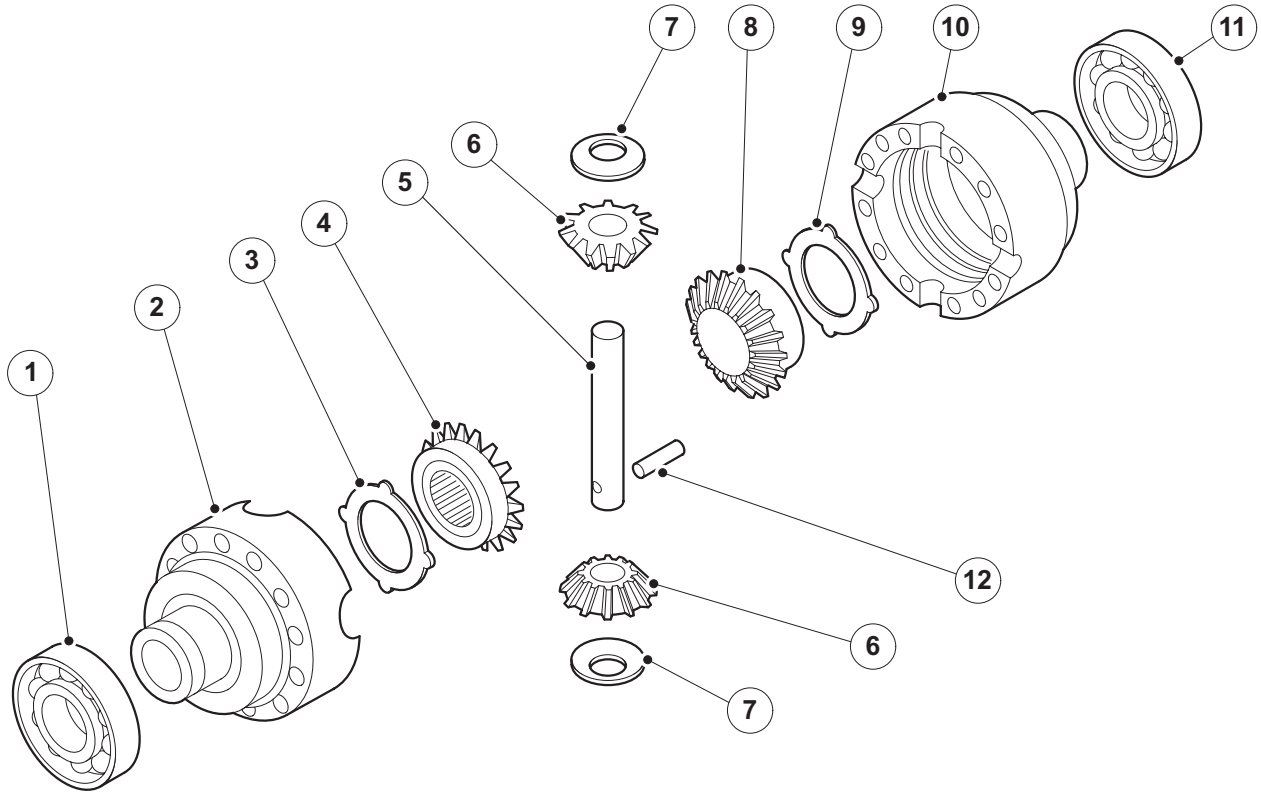
26. Install the axle housing group. For additional information, refer to AXLE HOUSING GROUP, PAGE L11–05–35 in this section.


TV040867

DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL GROUP

BHL1105DF

Operation: **Disassembly and Assembly of the Differential Group**	*Job Code:* **11 03 17 xx**		
None	Standard tools, Suitable puller		

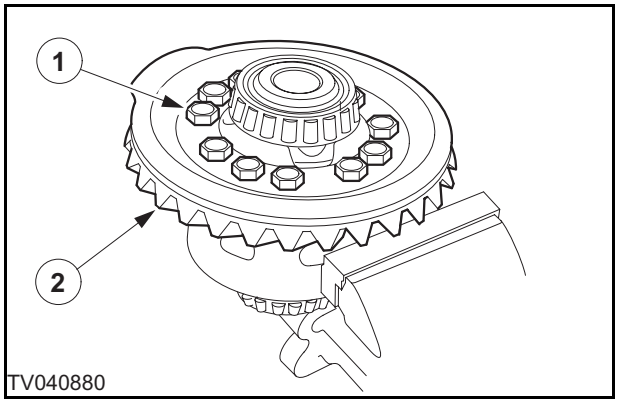


TV0400879

1	Taper Roller Bearing
2	Housing
3	Thrust Plate
4	Sun Gear
5	Planetary Shaft
6	Planetary Gear
7	Thrust Washer
8	Sun Gear
9	Thrust Plate
10	Housing
11	Taper Roller Bearing
12	Locking Pin

Disassembly

1. Remove the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–05–39 in this section.
2. Position the differential in a suitable vice.
3. Remove the crown wheel retaining bolts (1) and remove the crown wheel (2).



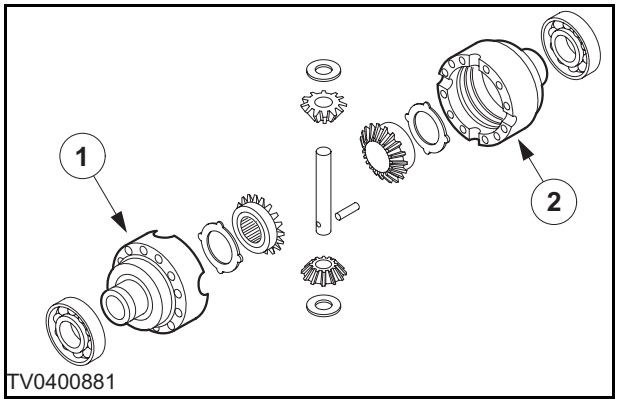
⚠ **Caution:**

- **Make sure the internal differential components remain with the bottom housing.**

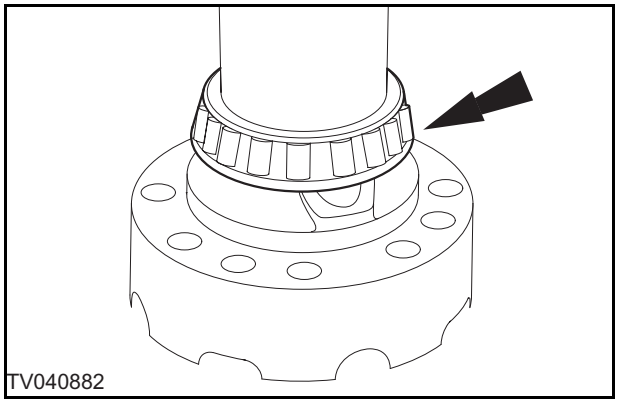
Note:

- Mark the differential carrier prior to disassembly to aid installation.

4. Remove the housing (1) from the housing (2).
5. Disassemble all of the internal differential components.
6. Check for wear of the components. Replace as necessary.

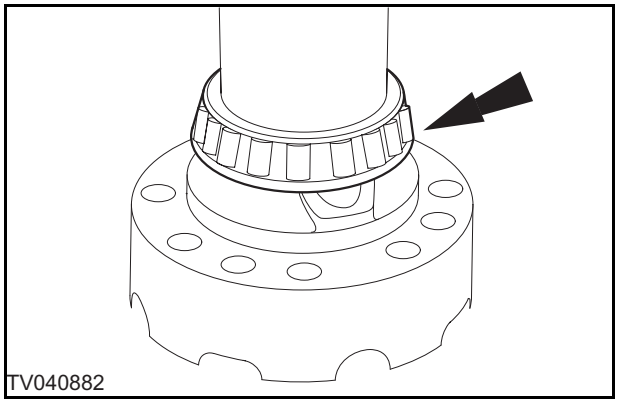


7. Using a suitable bearing puller remove the taper roller bearings from the housings.

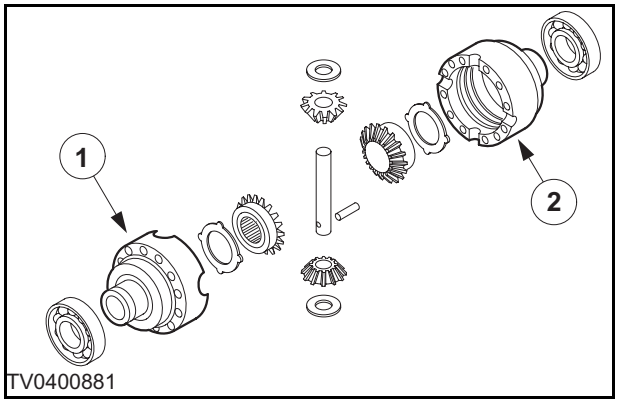


Assembly

1. Using the special tool **CA119230 — Driver** , install the taper roller bearings on the housings.


TV040882

2. Install the internal differential components into the bottom housing.
3. Install the housing (1) onto the housing (2).

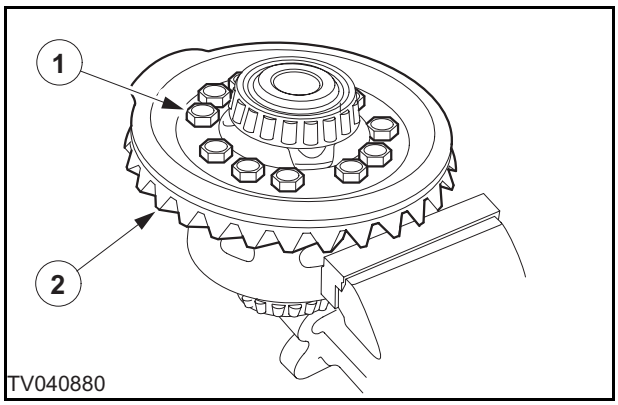


TV0400881

Note:

- Before installing the crown wheel retaining bolts, apply approved sealant (Loctite 270) to the bolts.

4. Install the crown wheel (2).
5. Tighten (1) to 95Nm (70 lb.ft).
6. Install the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–05–39 in this section.



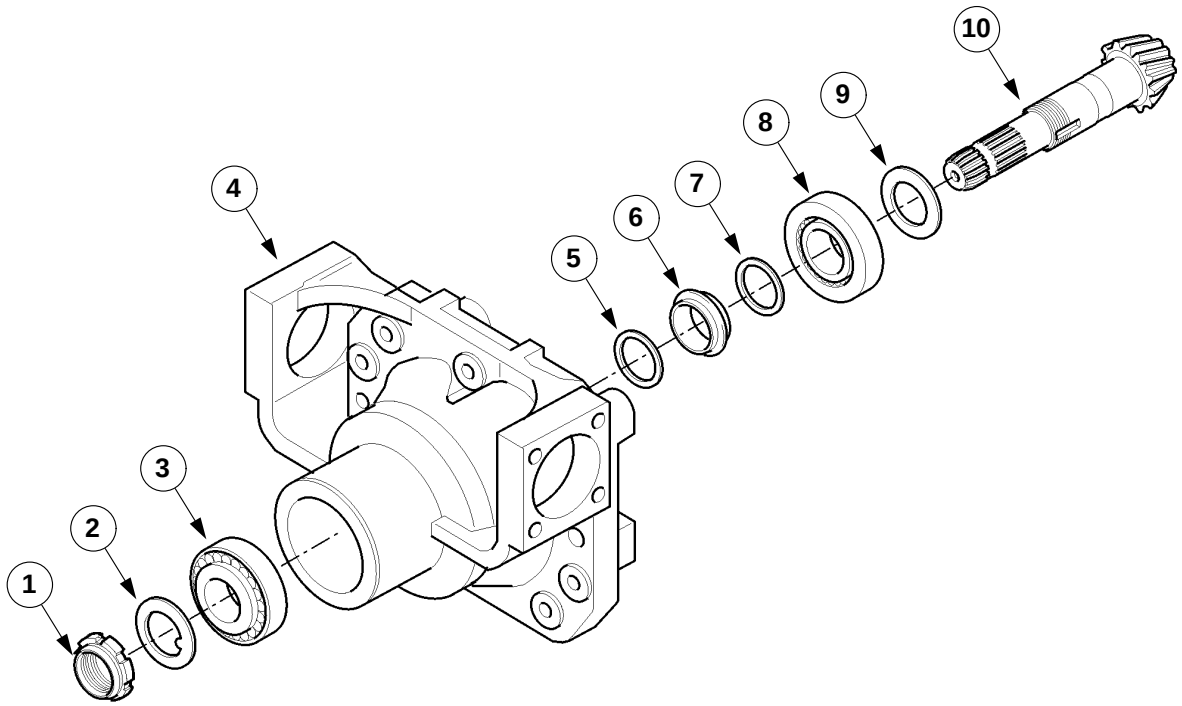
TV040880

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DISASSEMBLY AND ASSEMBLY — PINION GROUP

BHL1105DG

Operation: **Disassembly and Assembly of the Pinion Group**	*Job Code:* **11 09 17 xx**		
None	Standard tools, CA119099, CA715170, CA119225, CA715023, CA119182. CA119226, CA715179		



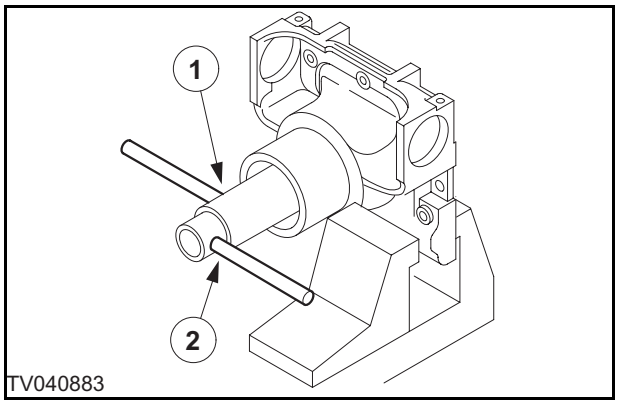
TV040603

1	Pinion Shaft Retaining Nut
2	Retaining Lock Washer
3	Taper Roller Bearing
4	Differential Support
5	Washer
6	Collapsable Spacer
7	Washer
8	Taper Roller Bearing
9	Adjustment Shim
10	Pinion Shaft

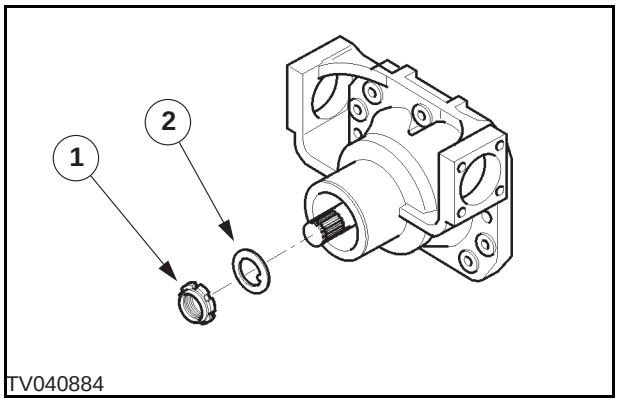
Disassembly

1. Remove the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–05–39 in this section.

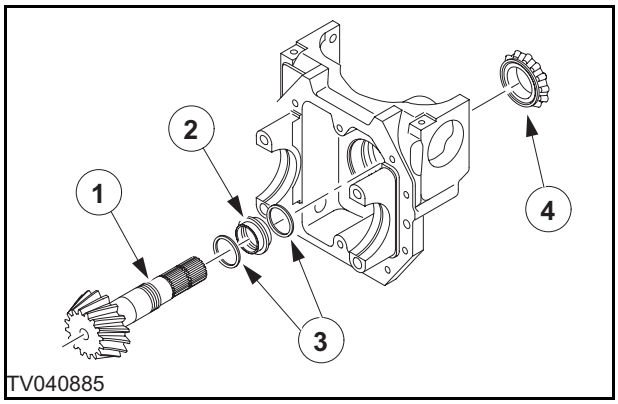
2. Position the differential support group in a suitable vice.
3. Using the special tools **CA119099 — Wrench** (1) and **CA715170 — Wrench** (2) release the pinion shaft retaining nut.



4. Remove and discard the pinion shaft retaining nut (1).
5. Remove the retaining lock washer (2).

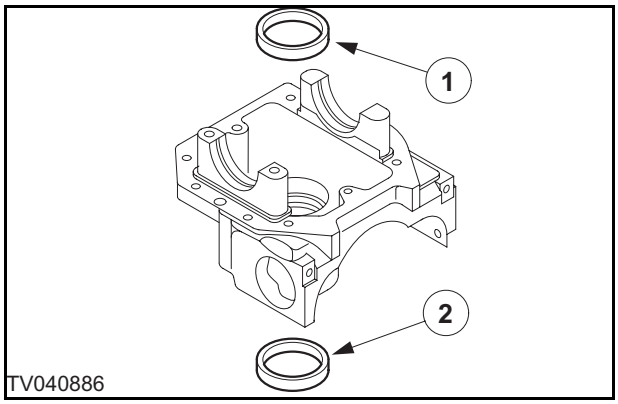


6. Using a suitable soft faced hammer, remove the pinion shaft (1).
7. Remove and discard the collapsable spacer (2).
8. Recover the washers (3) and taper roller bearing (4).

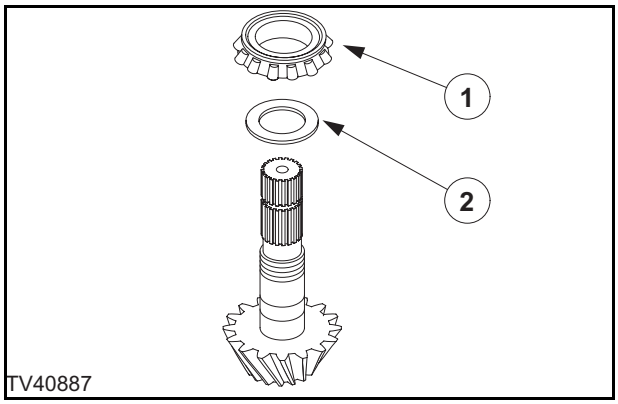


9. Place the differential support on a suitable flat surface.

10. Using a suitable drift, remove the taper roller bearing cones (1) and (2).



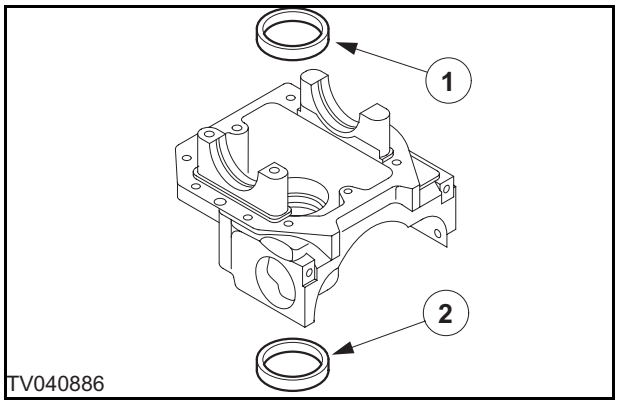
11. Using a suitable bearing puller, remove the taper roller bearing (1).
12. Recover the adjustment shim (2).



13. Check all pinion components for wear. Replace as necessary.

Assembly

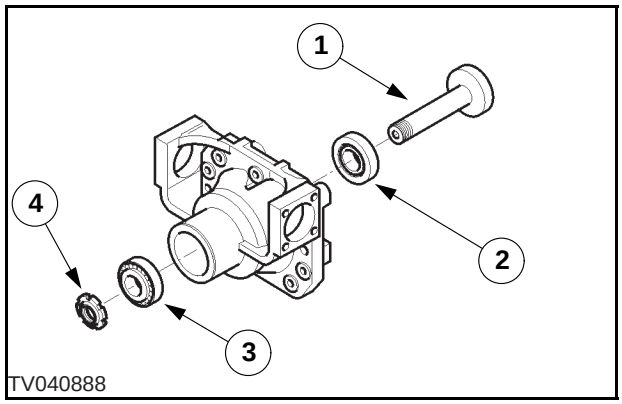
1. Place the differential support on a suitable flat surface.
2. Using the special tool **CA119225 — Driver** , install the taper roller bearing cones (1) and (2).



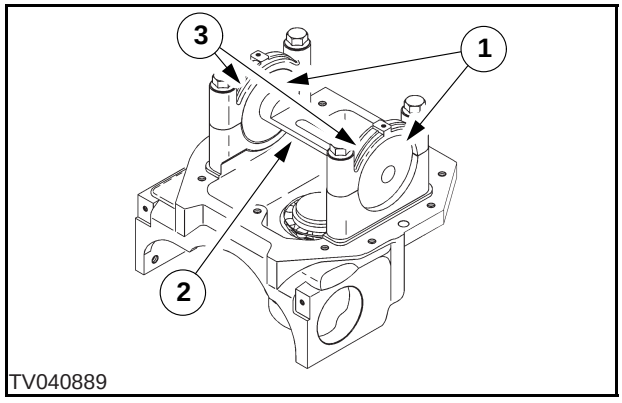
3. Install the special tool **CA715023 — false pinion** (1) with the pinion shaft taper roller bearings (2) and (3).

   ⚠ **Caution:**
   - **Do not over-tighten.**

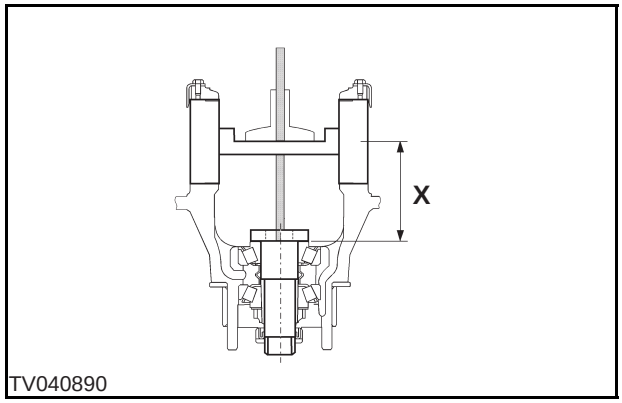
4. Install the pinion shaft retaining nut (4).
5. Tighten until the free play is eliminated.



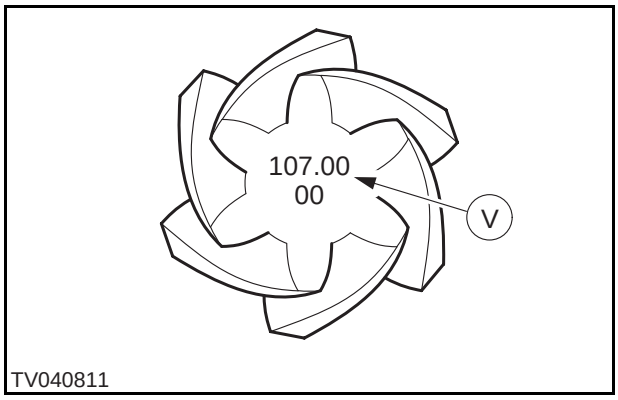
6. Install the special tools **CA119182 — false differential bearings** (1) and **CA119226 — false differential shaft** (2) into the differential support.
7. Secure the special tools into position with the differential half-collers (3).



8. Using a suitable depth gauge, measure through the false differential shaft (CA119226) **This measurement is "X"** .
   X = The distance between the axis of the differential taper roller bearings and the point at which the pinion head is supported, or base of the bearing.

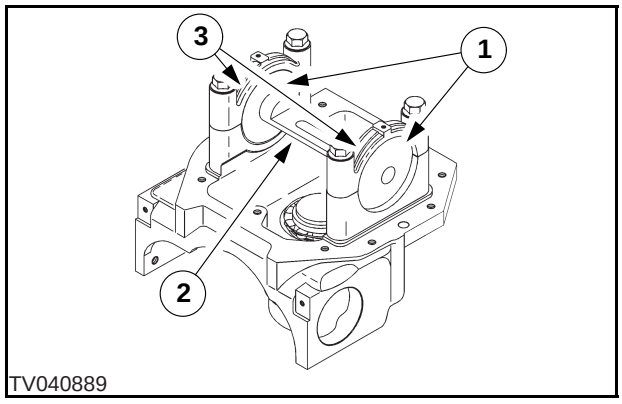


9. Determine the pinion shaft position adjustment shim **"S"** as follows:
   subtract the value **"V"** (requested conical distance) from the calculated value **"X"** .
   S = X — V
   Example: Shim thickness **S** = 109.9 – 107.00 = 2.9mm.
   Shim thickness **"S"** = 2.9mm.



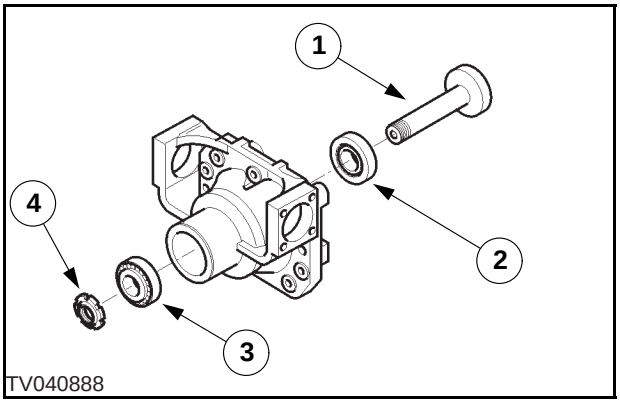
SHIM RANGE										
Thickness (mm)	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4

10. Remove the differential half-collers (3).
11. Remove the special tools **CA119182 — false differential bearings** (1) and **CA119226 — false differential shaft** (2) from the differential support.

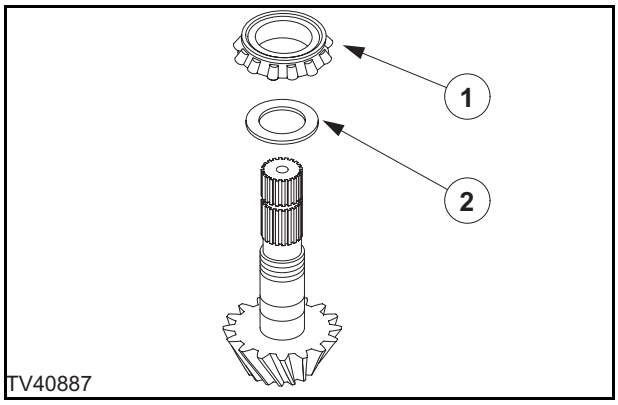


12. Remove the pinion shaft retaining nut (4).

13. Remove the special tool **CA715023 — false pinion** (1) with the pinion shaft taper roller bearings (2) and (3).

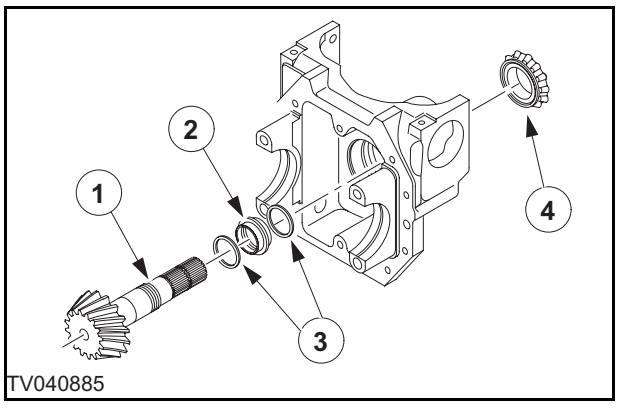


14. Install the pinion shaft position adjustment shim (2) with chamfer against the gear.
15. Using a suitable hydraulic press and the special tool **CA715179 — Driver** install the rear taper roller bearing (1).



⚠ **Caution:**
- **Always install a new collapsable spacer.**

16. Install the pinion shaft (1), new collapsable spacer (2) and the washers (3) into the differential support.
17. Using the special tool **CA715179 — Driver** , install the taper roller bearing (4).

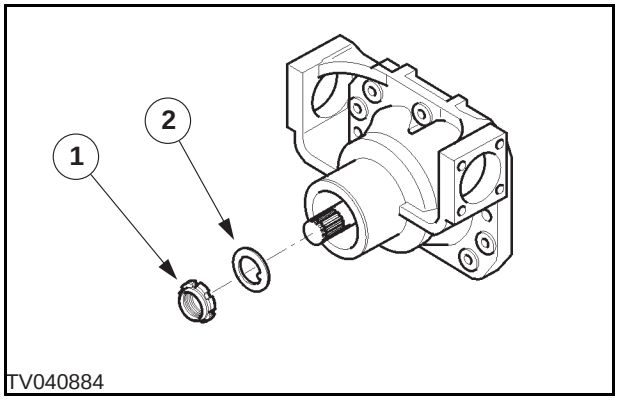


18. Install a new retaining lock washer (2).

⚠ Caution:
- **Always install a new pinion shaft retaining nut.**

Note:
- Do not tighten at this stage.

19. Install a new pinion shaft retaining nut (1).



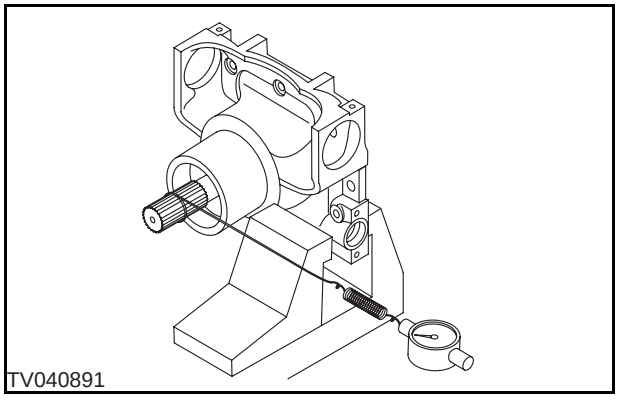
TV040884

⚠ Caution:
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

Note:
- Using a suitable soft faced hammer, settle the pinion shaft bearings.

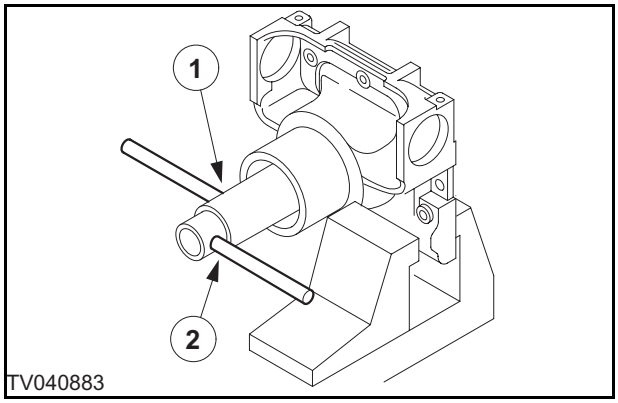
Note:
- Rotate the pinion shaft several times to settle the pinion shaft bearings, before measuring the pinion shaft rotational torque.

20. Using a suitable measuring device with the cord wound round the pinion shaft spline, measure the pinion shaft rotational torque.
21. The rotational torque should be within the following range excluding breakaway torque.
    9.2 to 13.7 daN


TV040891

⚠ **Caution:**
- **If the stated rotational torque range is exceeded the collapsable spacer must be replaced and the procedure repeated.**

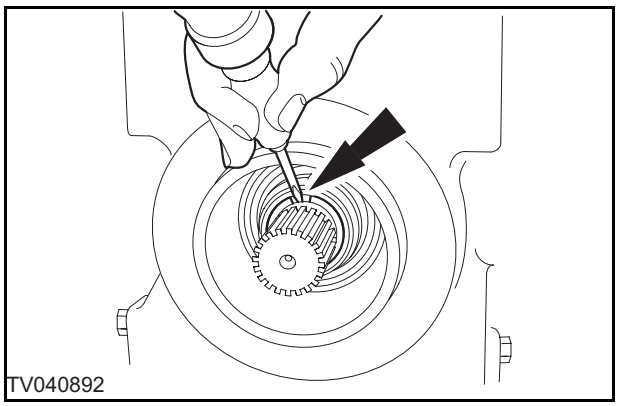
22. The adjustment is carried out by increasing the pinion shaft retaining nut torque setting gradually using the special tools **CA119099 — Wrench** (1) and **CA715170 — Wrench** (2), being careful not to exceed the stated range.



23. Once the correct rotational torque is achieved, secure the pinion shaft retaining nut.

Note:
- Do not install a new pinion shaft oil seal at this stage.

24. Install the differential support group. For additional information, refer to DIFFERENTIAL SUPPORT GROUP, PAGE L11–05–39 in this section.



GENERAL PROCEDURE — TOE-IN ADJUSTMENT

BHL1105GA

Operation: **General Procedure Toe-in Adjustment**	*Job Code:* **11 13 01 xx**		
None	Standard tools, Two one-metre-long bars		

General Procedure

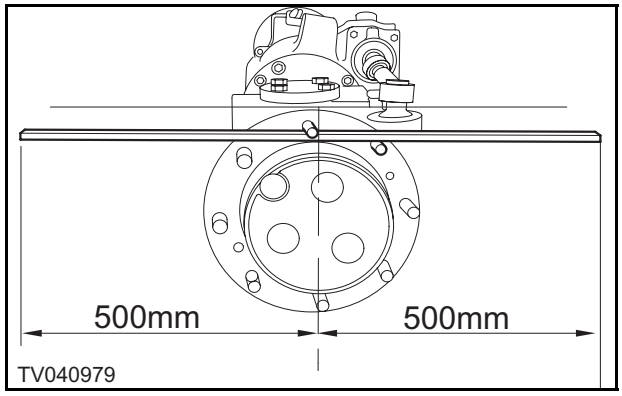
The toe-in of the front wheels must be between 0 and 5mm toe-in as measured 500mm from the centre of the wheel hub.

To check the exact value of the toe-in setting, proceed as follows.

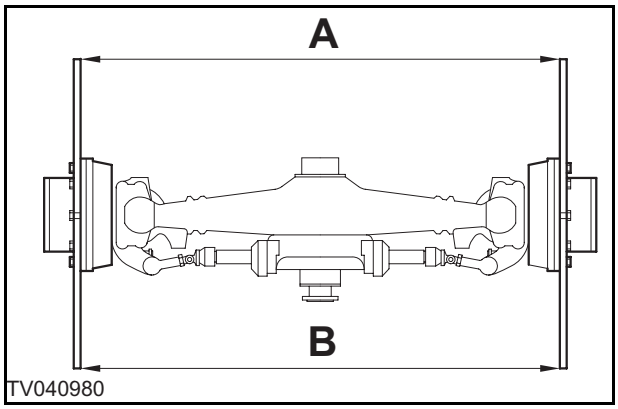
1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

   Note:
   - The bars must be fixed flat against the wheel hub flange and have an equal distance from the centre of the wheel hub.

2. Install two equal one-metre-long bars to the wheel side of the wheel hubs and lock in place with two wheel retaining nuts.



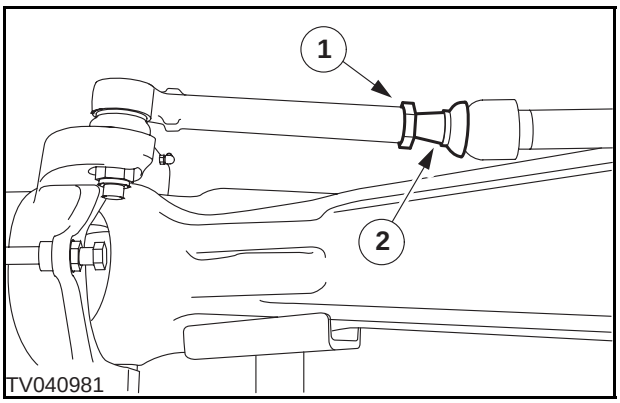
3. Measure the distance (A) between the ends of the two bars.
4. Measure the distance (B) between the ends of the two bars.
5. The distance (A) must be 0 to 5mm less than distance (B).



Note:

- Make sure the same number of threads are visible at the end of the left-hand and right-hand inner track rod end ball joints.

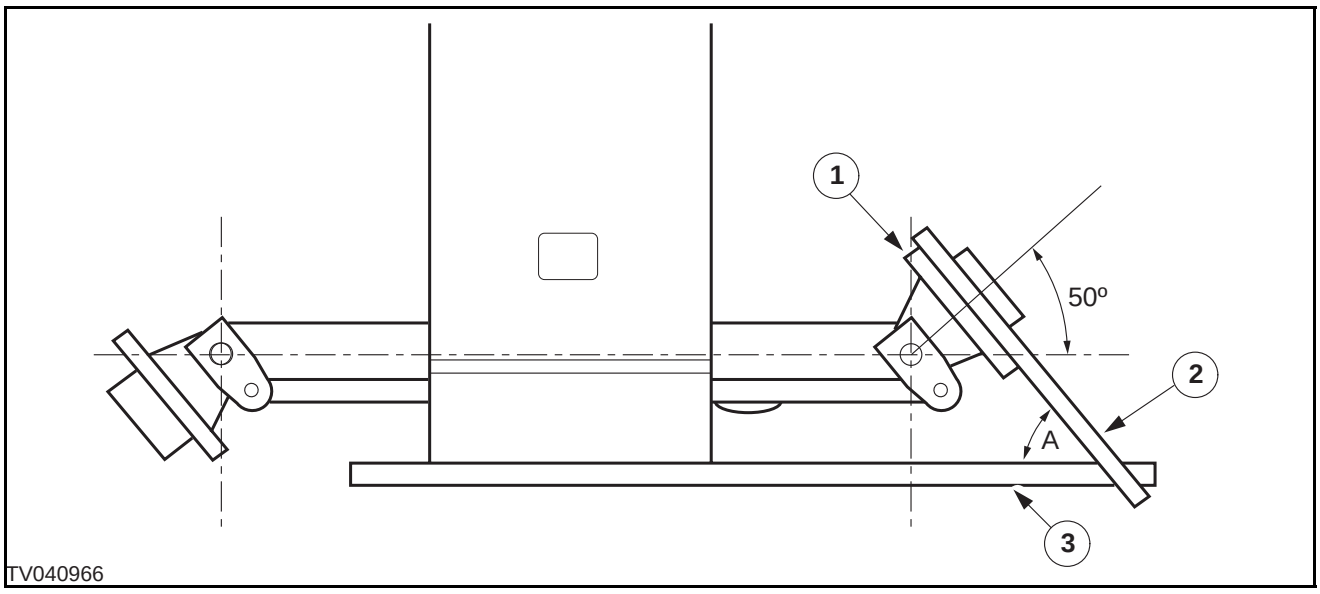
6. If it is necessary to correct the toe-in adjustment. Loosen the lock nut (1) on the left-hand and the right-hand side. Turn the inner track rod end ball joints (2) equally to achieve the specified toe-in adjustment.
7. Tighten (1) to 120Nm (89 lb.ft).



GENERAL PROCEDURE — STEERING ANGLE ADJUSTMENT

BHL1105GB

General Procedure



1. Remove the front wheels. For additional information, refer to Section M12-01 FRONT WHEEL, PAGE M12–01–3 .

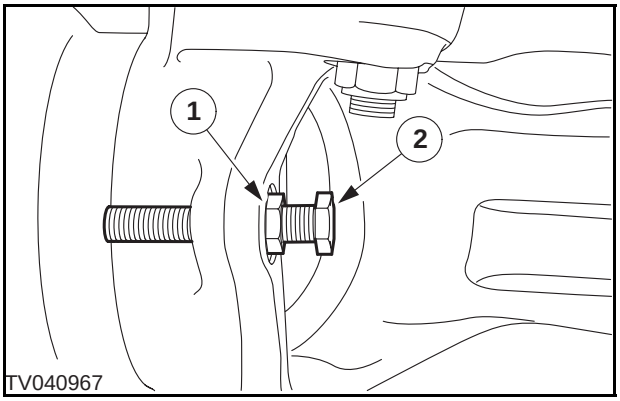
   Note:
   - Support the machine under the front chassis.

2. Turn the steering wheel until the front wheel hubs are on full left-hand lock.
3. Place a straight edge (3) against the axle input flange or against the machine hardnose. Make sure the straight edge is parallel with the axle centre-line.
4. Place a second straight edge (2) against the wheel hub flange (1).

   ⚠ Caution:
   - **Make sure the steering angle does not exceed 52 degrees. Failure to follow this instruction may result in excessive wear to the drive shaft universal joints.**

5. Measure the angle (A) at which both straight edges intersect. Subtract angle A from 90 degrees to give the steering lock.
   Angle A = 40
   Steering angle 90 – 40 = 50 degrees.
6. Adjust the left-hand stop for maximum left steering lock and right-hand stop for maximum right steering lock.
7. Loosen the lock nut (1) and adjust the steering stop adjuster bolt (2) until the bolt head touches the steering stop. Tighten the lock nut (1) to 150Nm.

8. Turn the steering wheel until the front wheel hubs are on full right-hand lock and repeat the procedure for the right-hand side.



GENERAL PROCEDURE — DRAINING AND FILLING THE FRONT AXLE HOUSING OIL

BHL1105GC

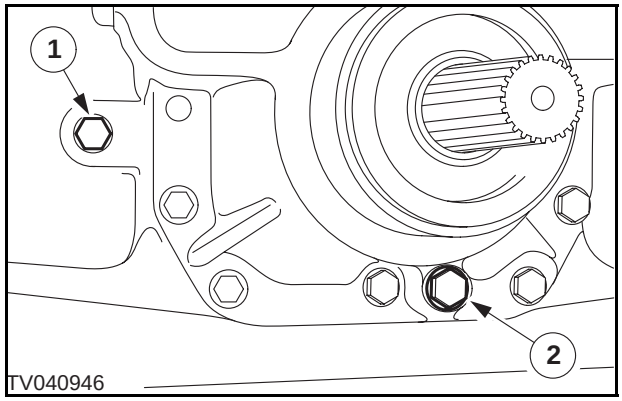
Operation: **Draining and Filling the Front Axle Housing Oil**	*Job Code:* **11 07 09 xx**		
None	Standard tools		

Draining

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Loosen the refill plug (1) to release any pressure.
3. Remove the drain plug (2) and drain the oil into a suitable container.

Filling

1. Install the drain plug (2) and tighten to 60Nm (44 lb.ft).
2. Fill with oil until the refill hole (1) level is reached.
3. Install the refill plug (1) and tighten to 60Nm (44 lb.ft).



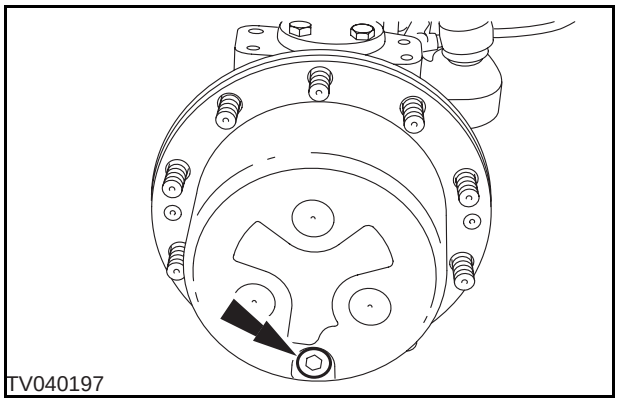
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GENERAL PROCEDURE — DRAINING AND FILLING THE HUB OIL

BHL1105GD

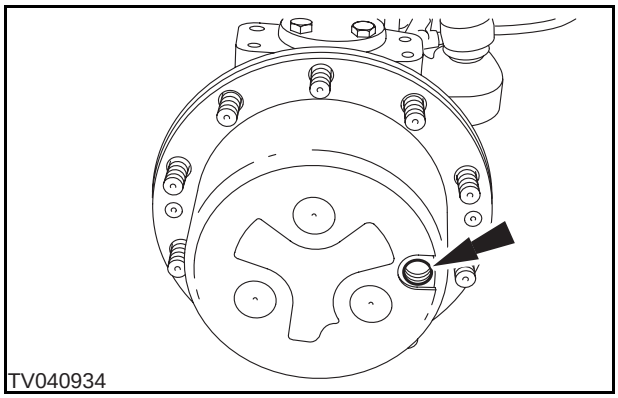
Draining

1. Position the hub until the drain/refill plug is positioned at the top. Loosen the drain plug to release any pressure.
2. Position the hub until the drain/refill plug is positioned at the bottom. Remove the drain/refill plug and drain the hub oil into a suitable container.


TV040197

Filling

1. Position the hub until the drain/refill plug is at the 3 o'clock position. Fill with oil until the drain/refill hole level is reached.
2. Install the drain/refill plug and tighten to 60Nm (44 lb.ft).


TV040934

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SPECIFICATIONS — FOUR-WHEEL DRIVE FRONT AXLE

BHL1105SA

Special Tools

Tool No.	Description
CA119030	Wrench
CA119033	Interchangeable Handle
CA119043	Driver
CA119099	Wrench for Lock Nut
CA715026	Driver for Bearing Race
CA715027	Driver for Bush
CA119117	Driver
CA119143	Driver
CA119182	False Differential Box
CA119225	Driver
CA119226	False Differential Box
CA119230	Driver
CA715023	False Pinion
CA715034	Driver
CA715035	Driver
CA715163	Driver
CA715164	Driver
CA715170	Wrench
CA715179	Driver
CA715505	Driver
CA715506	Driver
CA715701	Driver

Torque Values

Description	Nm	Lb.ft
Epicyclic Reduction Hub	80	59
Wheel Hub	230	170
Axle Drain/Fill Plugs	60	44
Wheel Studs	70	52
King Pin	190	140
Crown Wheel	95	70
Grease Nipple	8	6
Differential Adjustment Nut Locking Tabs	13	10
Differential Housing	169	125
Differential Half Collers	266	196
Breather	10	7
Blanking Plug	25	18
Steering Cylinder	120	89
Swivel Joint	300	221
Tie-Rod Locking Nut	250	184
Tie-Rod End	220	162
Steering Angle Adjustment Locking Nut	150	111

General Specifications

Description	Value
Crown Wheel Gear Ratio	2.133/1
Epicyclic Reduction Gear Ratio	6.00/1
Total Ratio	12.80/1
Dry Weight	303 Kg
Input Rotation	Clockwise (C.W.)
Steering Angle	55° 0–2mm
Toe-in	0–5mm
Crown Wheel / Pinion Backlash	0.18 – 0.23mm
Pinion Shaft Bearing Pre-Load “P”	“P” = 9.2 – 13.7 daN
Total Pinion/Differential Bearing Pre-load	(4.3 + P) — (6.45 + P) daN
Axle Housing Oil Capacity	6.5 Litres
Epicyclic Reduction Hub Oil Capacity	1.0 Litre
Oil Type (Use recommended oil enriched in Additives)	API GL5 (for possible alternatives see – GENERAL INFORMATION – FLUIDS AND LUBRICANTS at the start of this manual).
Grease Type	TECNOLUBE SEAL PLOYMER 400/L (DIN = KHER1R ISO-I-XMR-XM2) AGIP MU/EP2 (King pin only)
Sealant	Silastic 732

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WHEELS AND TYRES

M12
SECTION

SAFETY PRECAUTIONS — WHEELS AND TYRES.....M12–01–1
REMOVAL AND INSTALLATION — FRONT WHEEL.....M12–01–3
REMOVAL AND INSTALLATION — REAR WHEEL M12–01–5
REMOVAL AND INSTALLATION — INNER TUBE M12–01–7
REMOVAL AND INSTALLATION — TYRE M12–01–11
SPECIFICATIONS — WHEELS AND TYRES M12–01–13

SAFETY PRECAUTIONS — WHEELS AND TYRES

BHM1201IA

Wheels and Tyres

- **NEVER** re-inflate a tyre that has been run flat or seriously underinflated without removing and checking for tyre, tube or rim damage.
- **NEVER** rework, weld, heat or braze rims.
- **NEVER** install tubes that are buckled or creased.
- **NEVER** use a tube in a casing larger or smaller than that for which the tube was designed by the manufacturer.
- **NEVER** hit the tyre or rim with a hammer.
- **NEVER** mount a tyre on a rim where any parts show cracks, damage, or have been repaired by welding or brazing.
- **ALWAYS** use specialised tools, as recommended by tyre suppliers, for mounting and demounting of tyres.
- **ALWAYS** inspect inside of tyres for loose cords, cuts, penetrating objects, or other carcass damage. Repairable damage should be repaired before installing the tube. Tyres with irreparable damage must be discarded.
- **ALWAYS** clean and inspect rims.
- **ALWAYS** check rim diameter to ensure it exactly matches the rim diameter moulded on the tyre.
- **ALWAYS** inspect the inside of the tyre for dirt, liquids, or foreign material and remove before installing the tube.
- **ALWAYS** use new tubes in new tyres.
- **ALWAYS** check to ensure the tube is clean before installing in the tyre.
- **ALWAYS** lubricate with approved tyre mounting lubricant. Never use anti-freeze, silicones or petroleum-based lubricants.
- **ALWAYS** use an extension hose with a gauge and a clip-on chuck so that the operator may stand aside during inflation.
- **ALWAYS** inspect valve cores and sealing cap for proper air retention. Replace damaged or leaky cores or caps.
- **ALWAYS** inflate tyre to the tyre manufacturer's recommended cold operating pressure.

PREPARATION

Before mounting a tyre on a used rim, ensure the flange area (particularly the bead seat area) is clean and smooth. Remove any build-up of rust, corrosion or old rubber with a chisel or wire brush.

Thoroughly inspect the inside of the casing for damage or foreign material. Ensure that both tyre and tube are completely dry, as moisture deteriorates the cord fabric of the tyre and may result in eventual failure of the tyre.

Lubricate both beads with a thin solution of vegetable oil soap in water, or equivalent rubber lubricant recommended for this requirement. (**NEVER** use petroleum-based solutions or silicones).

Wheel Nuts

If a wheel is removed and replaced for puncture repair or any other reason, the wheel nuts must be tightened to the torques given in the Specifications Section of this manual and checked daily until stabilised.

⚠ Warning:

- **Many machines use special wheel nuts and washers, which must never be substituted by a standard wheel nut. When fitted, always use the special washers under the rear wheel nuts. If either the nut or washers are lost they must only be replaced with genuine Aftercare parts.**

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REMOVAL AND INSTALLATION — FRONT WHEEL

BHM1201RA

Operation: **Removing and Installing the Front Wheel**	*Job Code:* **12 04 13 xx**		
Suitable axle stands Suitable lifting equipment	Standard tools		

Removal

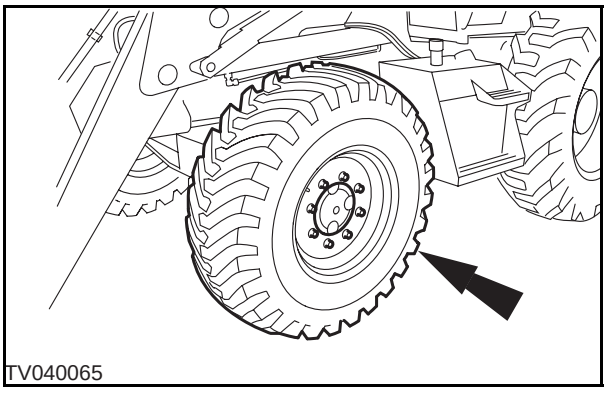
1. Park the machine on firm level ground.
2. Loosen the front wheel retaining nuts.
3. Use the loader to raise the front wheels of the ground.

   ⚠ **Warning:**
   - **Use suitable axle stands to support the machine. Failure to follow this instruction may result in personal injury.**

4. Support the machine under the front chassis.
5. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
6. Remove the front wheel retaining nuts.

   ⚠ **Warning:**
   - **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

7. Using suitable lifting equipment, remove the front wheel.


TV040065

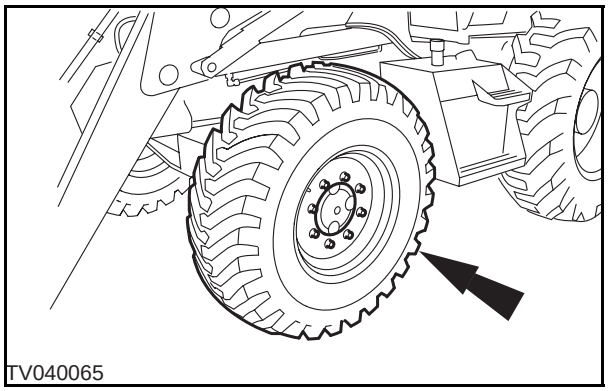
Installation

⚠ **Caution:**
- **If the wheel retaining nuts or washers are lost they must only be replaced with genuine Aftercare parts.**

  When a wheel is installed the wheel nuts must be tightened to the correct torque value and checked daily until stabilized.

1. To install, reverse the removal procedure.
2. Tighten to 300 Nm (222 lb.ft).

3. For 970 / 980 machines, tighten to 600 Nm (444 lb.ft).


TV040065

REMOVAL AND INSTALLATION — REAR WHEEL

BHM1201RB

Operation: **Removing and Installing the Rear Wheel**	*Job Code:* **12 05 13 xx**		
Suitable axle stands Suitable lifting equipment	Standard tools		

Removal

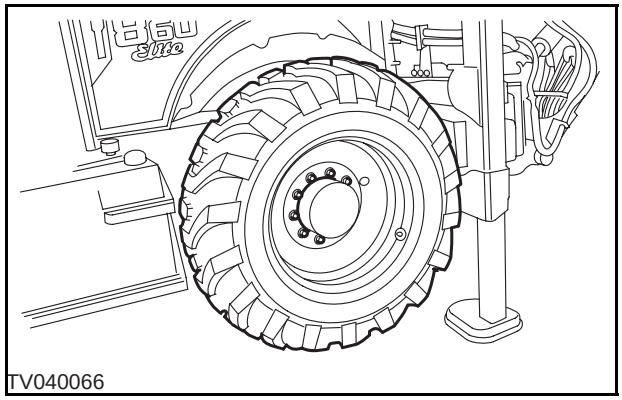
1. Park the machine on firm level ground.
2. Loosen the rear wheel retaining nuts.
3. Use the stabiliser leg to raise the rear wheel of the ground.

   ⚠ **Warning:**
   - **Use suitable axle stands to support the machine. Failure to follow this instruction may result in personal injury.**

4. Support the machine under the rear chassis.
5. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
6. Remove the rear wheel retaining nuts.

   ⚠ **Warning:**
   - **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

7. Using suitable lifting equipment, remove the rear wheel.


TV040066

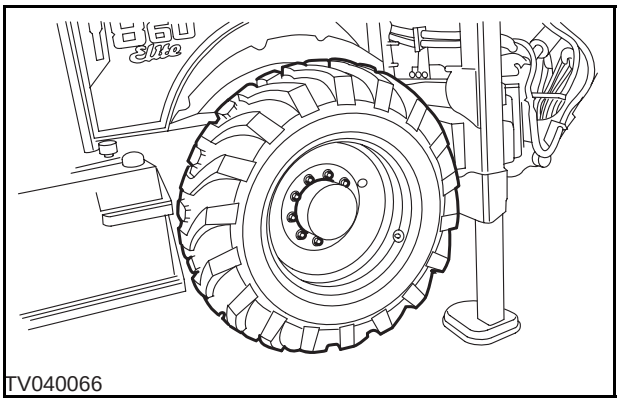
Installation

⚠ **Caution:**
- **If the wheel retaining nuts or washers are lost they must only be replaced with genuine Aftercare parts.**

  When a wheel is installed the wheel nuts must be tightened to the correct torque value and checked daily until stabilised.

1. To install, reverse the removal procedure.

2. Tighten to 600 Nm (444 lb.ft).


TV040066

REMOVAL AND INSTALLATION — INNER TUBE

BHM1201RC

Operation: **Removing and Installing the Inner Tube**	*Job Code:* **N/A**		
None	Bead unseating tool, Tyre lever, Standard tools		

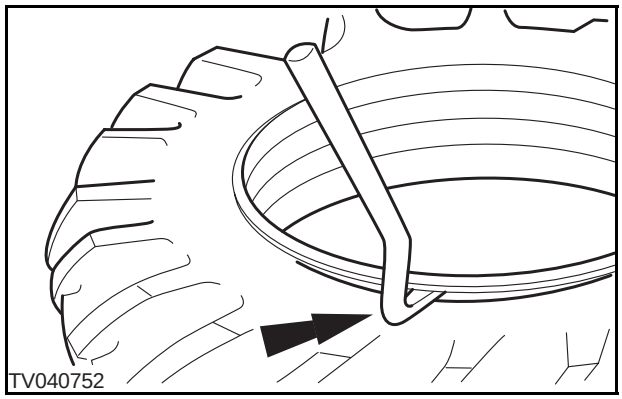
Removal

⚠ Warning:
- **Refer to** SAFETY PRECAUTIONS – WHEELS AND TYRES **in this section.**

1. Remove the wheel. For additional information, refer to FRONT WHEEL, PAGE M12–01–3 or REAR WHEEL, PAGE M12–01–5 in this section.
2. Lay the wheel on the ground with the valve uppermost.
3. Deflate the tyre by removing the valve core.
4. Remove the valve retaining nut.

⚠ Caution:
- **Take care not to damage the rim or tyre.**

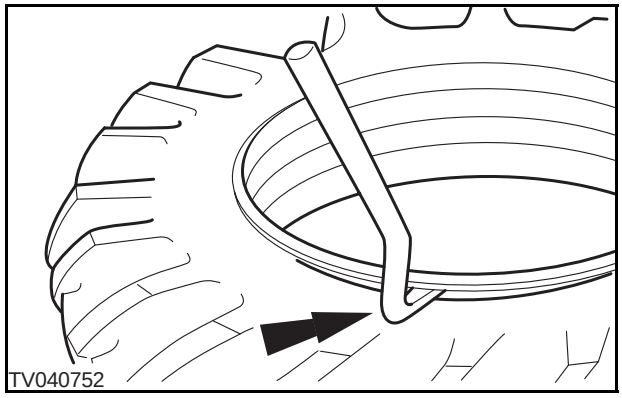
5. Drive the bead unseating tool between the tyre and the rim and release the bead from the rim.


TV040752

6. Turn the wheel over and lay flat on the ground.

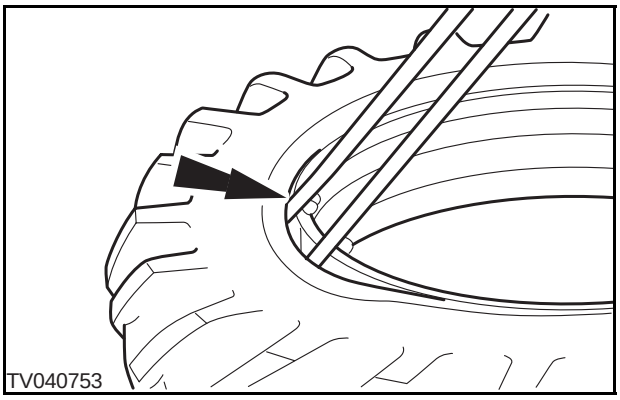
⚠ Caution:
- **Take care not to damage the rim or tyre.**

7. Drive the bead unseating tool between the tyre and the rim and release the bead from the rim.
8. Using a suitable solution of soap and water or an approved lubricant, lubricate the rim, tyre and base of the tube.


TV040752

Note:
- Begin at the valve location.

9. Using suitable tyre levers, pry the tyre from the rim using small bites of the tyre levers, ensuring the bead on the opposite side is fully located in the rim well.



10. Position the wheel in the vertical position and remove the inner tube.

Installation

⚠ Caution:
- **Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for debris or damage.**

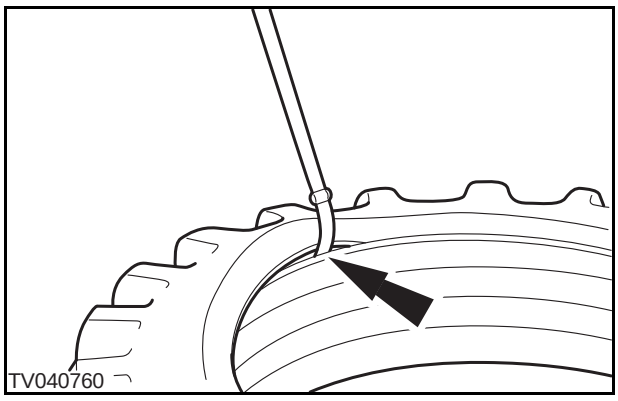
1. To install, reverse the removal procedure, but note the following:

Note:
- When the inner tube is installed, adding a small amount of air will assist in preventing the tyre from pinching the inner tube.

2. Install the inner tube until it is correctly aligned in the tyre. Place the tube in the tyre with the valve located through the valve hole in the rim. Refit the valve retaining nut, finger tight.

Note:
- A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help fitment.

3. Install the tyre, starting opposite the valve location taking small bites with long tyre levers and keeping the fixed part of the bead fully located in the well.



⚠ **Warning:**
- **Never stand over the assembly when inflating, remote control inflation equipment should be used. Failure to follow this instruction may result in personal injury.**

⚠ **Caution:**
- **Care must be taken not to pinch the tube when fitting.**

⚠ **Warning:**
- **If the beads fail to seat correctly at the recommended pressure, the tube may be pinched. Do not increase the pressure but remove the valve core and release the tyre from the rim. Lubricate the tyre, bead and rim then re-inflate at the recommended pressure. Repeat process until both beads are properly seated. When seating beads, inflation beyond the recommended pressure may break the bead or rim with explosive force, sufficient to cause serious physical injury or death. Inspect both sides of the tyre to ensure both beads are evenly seated. If not, completely deflate the tyre and repeat the complete remounting procedure. Failure to follow these instructions may result in personal injury.**

4. Centre the tyre on the rim and inflate.
5. Remove the valve core and completely deflate the tyre.
6. Refit the valve core and inflate to recommended pressure.

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REMOVAL AND INSTALLATION — TYRE

BHM1201RD

Operation: **Removing and Installing the Tyre**	*Job Code:* **N/A**		
None	Bead unseating tool, Tyre lever, Standard tools		

Removal

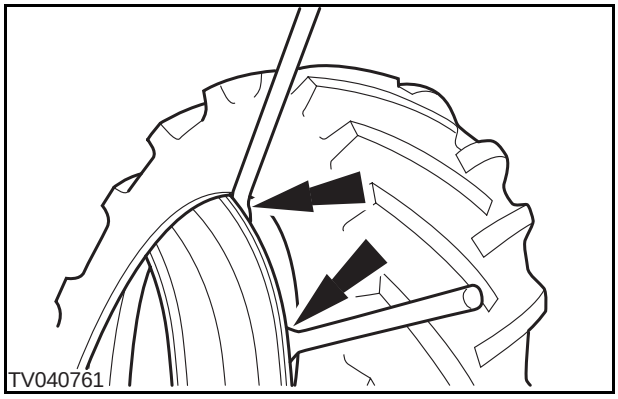
⚠ Warning:
- **Refer to** SAFETY PRECAUTIONS – WHEELS AND TYRES **in this section.**

1. Remove the wheel. For additional information, refer to FRONT WHEEL, PAGE M12–01–3 or REAR WHEEL, PAGE M12–01–5 in this section.
2. Remove the inner tube. For additional information, refer to INNER TUBE, PAGE M12–01–7 in this section.

⚠ Caution:
- **Take care not to damage the rim or tyre.**

Note:
- A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help removal.

3. Position the wheel in a vertical position and using suitable tyre levers, pry the tyre off the rim using small bites of the tyre levers.

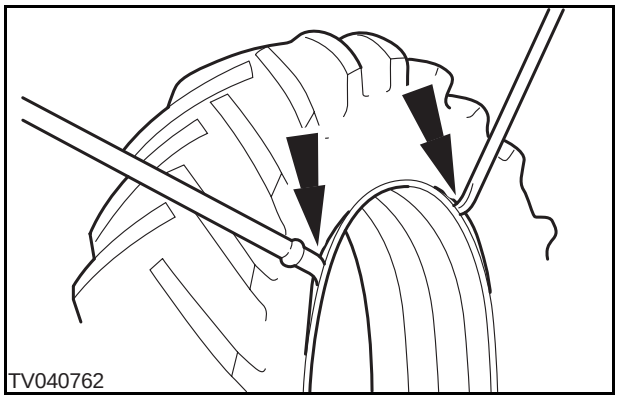

TV040761

Installation

⚠ Caution:
- **Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for debris or damage.**

1. To install, reverse the removal procedure, but note the following:
2. Place the rim on the ground, lubricate the bead and rim and place the tyre on the rim.

3. Using long tyre levers, refit the tyre.



⚠ **Warning:**
- **Never stand over the assembly when inflating, remote control inflation equipment should be used. Failure to follow this instruction may result in personal injury.**

⚠ **Caution:**
- **Care must be taken not to pinch the tube when fitting.**

⚠ **Warning:**
- **If the beads fail to seat correctly at the recommended pressure, the tube may be pinched. Do not increase the pressure but remove the valve core and release the tyre from the rim. Lubricate the tyre, bead and rim then re-inflate at the recommended pressure. Repeat process until both beads are properly seated. When seating beads, inflation beyond the recommended pressure may break the bead or rim with explosive force, sufficient to cause serious physical injury or death. Inspect both sides of the tyre to ensure both beads are evenly seated. If not, completely deflate the tyre and repeat the complete remounting procedure. Failure to follow these instructions may result in personal injury.**

4. Inflate the tyre to the recommended pressure.

SPECIFICATIONS — WHEELS AND TYRES

BHM1201SA

Torque Values

Description	Nm	Lb.ft
Front Wheel Retaining Nut	300	221
Rear wheel Retaining Nut	600	442
Front and Rear wheel Retaining Nut 970 / 980 machines	600	442

DRIVETRAIN AND BRAKES

N13
SECTION

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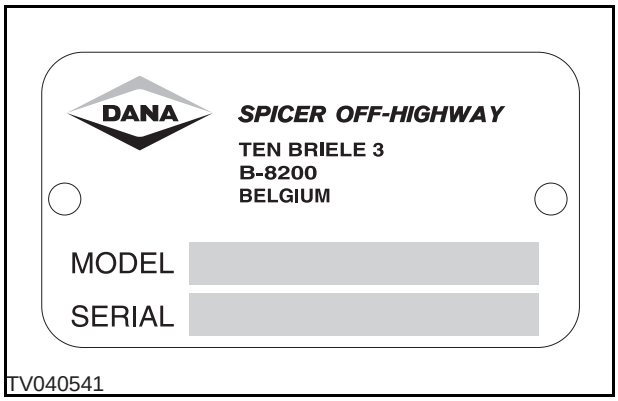
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DESCRIPTION AND OPERATION — POWERSHIFT TRANSMISSION

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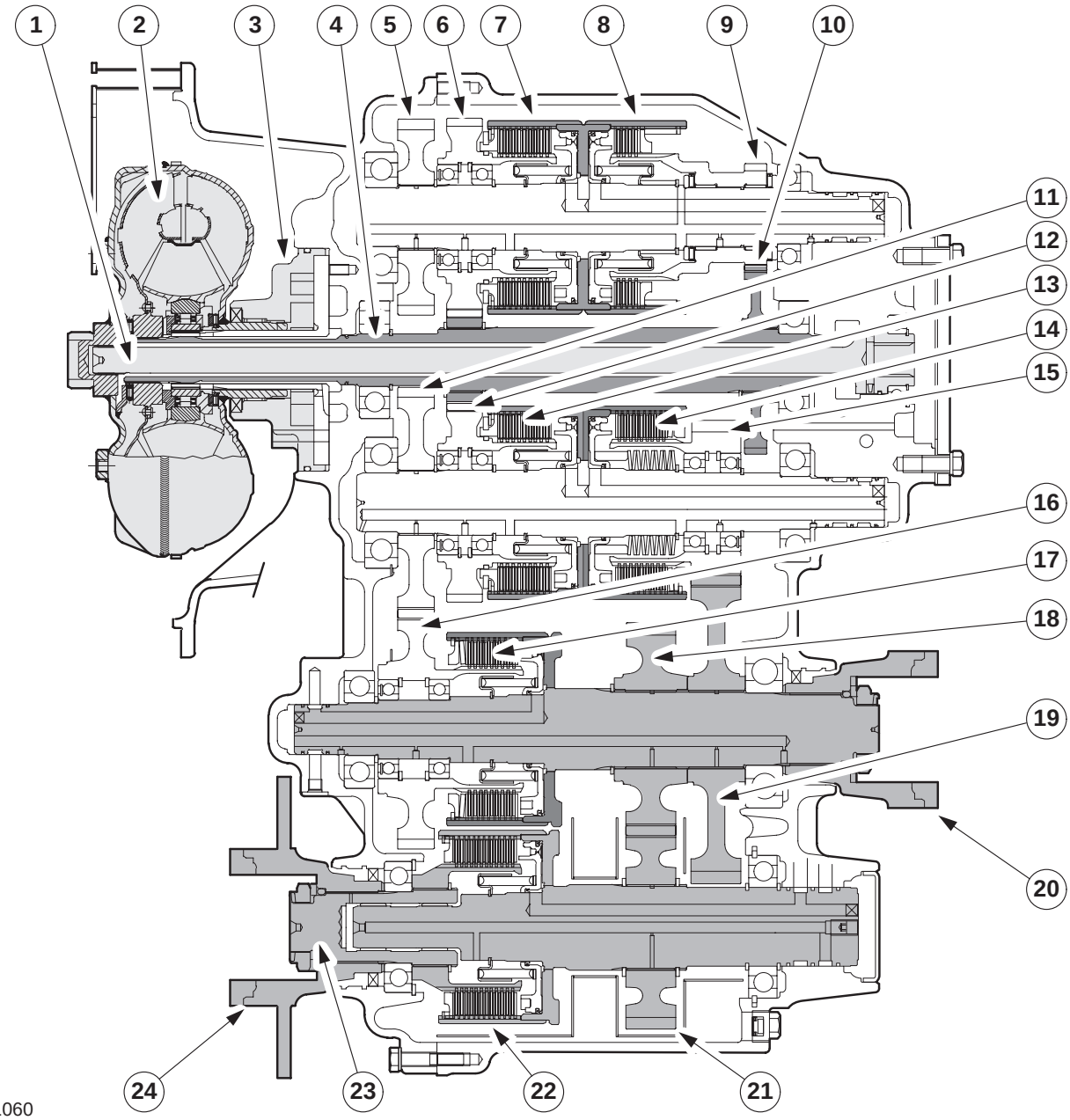
Identification Of The Unit

- Model and type of the unit
- Unit serial number



TV040541

Schematic View Powershift Transmission

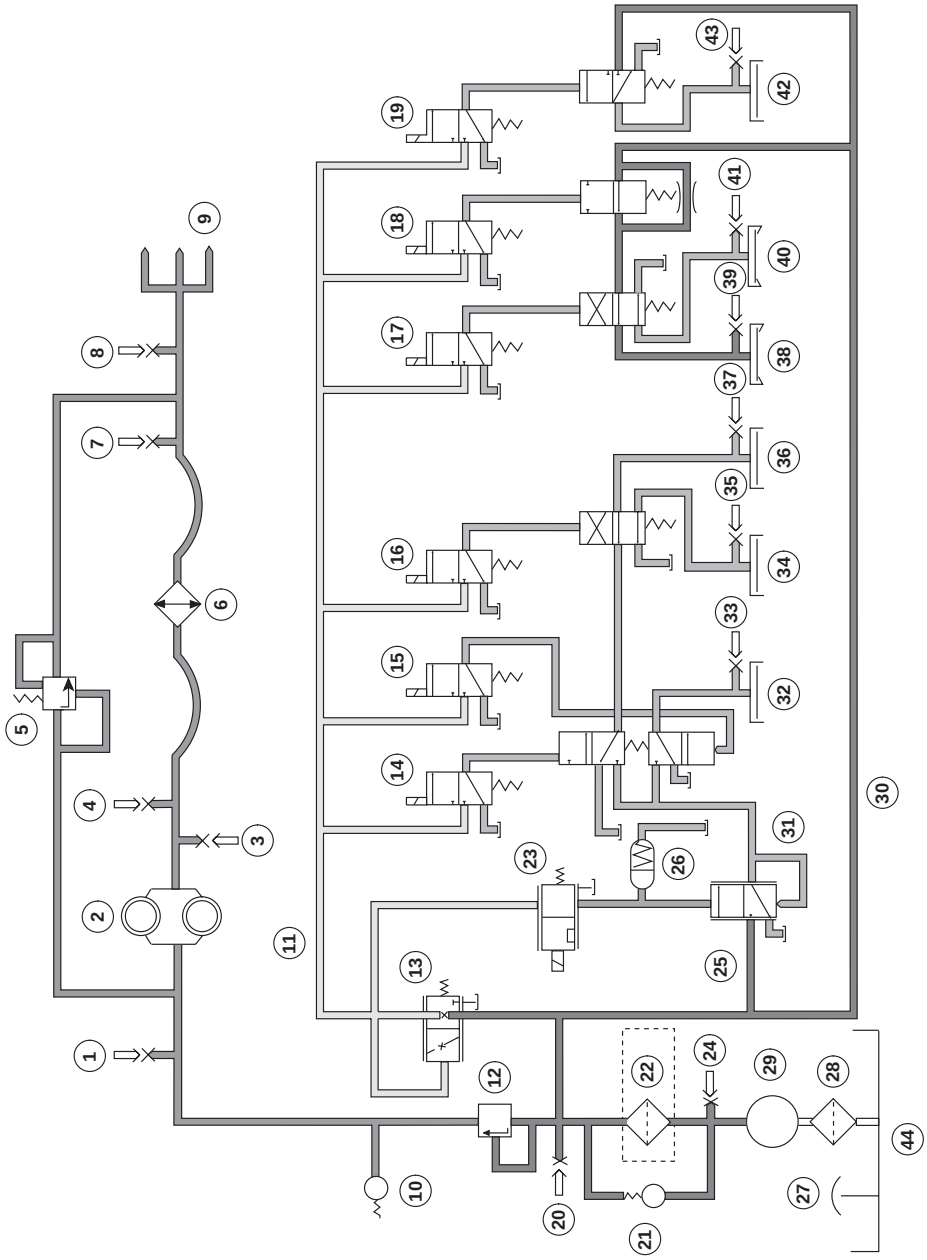


TV041060

1	Charging Pump / Input Drive Shaft
2	Torque Converter
3	Charge Pump
4	Input Shaft
5	Forward Driven Gear
6	Forward Low Gear
7	Forward Low Clutch
8	Forward High Cluth
9	Forward High Clutch Gear
10	Forward High Drive Gear
11	Reverse Driven Gear
12	Forward Low Clutch Gear
13	Reverse Clutch
14	1st Clutch
15	1st Clutch Gear
16	2nd Clutch Gear
17	2nd Clutch
18	Lower Output Drive Gear
19	Upper Output Gear
20	Rear Output Flange
21	Lower Output Flange
22	Axle Disconnect (Four-Wheel Drive) Clutch
23	Disconnect Shaft
24	Front Output Flange

Transmission Hydraulic Circuit

Neutral and 2nd Clutch Engaged



TV040542

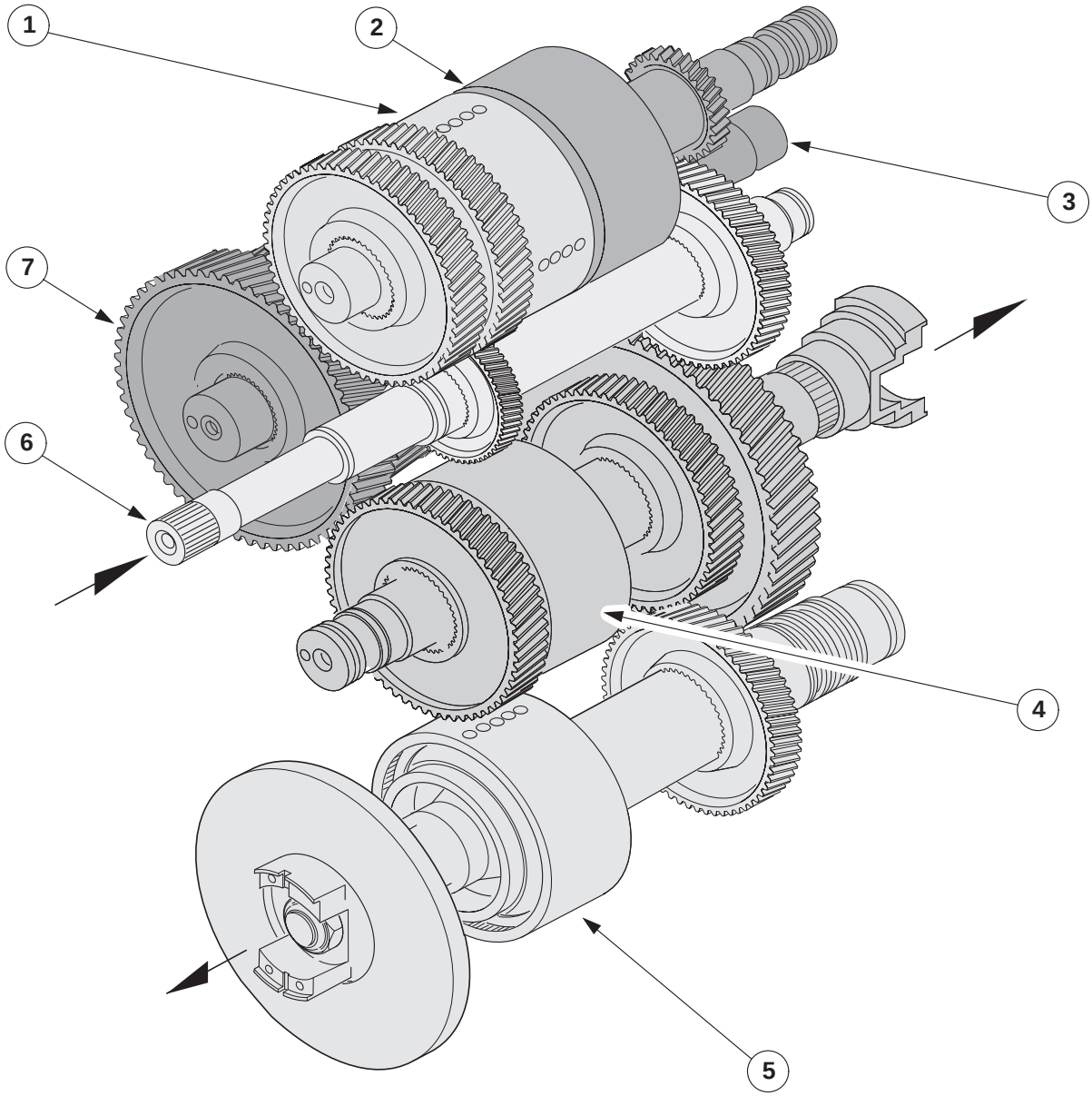
1	Pressure Test Port — Torque Converter In
2	Torque Converter
3	Temperature Test Port — Torque Converter Out To Oil Cooler
4	Pressure Test Port — Torque Converter Out To Oil Cooler
5	Torque Converter By-Pass Valve — Pressure Difference 4 Bar (58 PSI)
6	Transmission Oil Cooler
7	Temperature Test Port — Oil Cooler Out To Lubrication
8	Pressure Test Port — From Oil Cooler (Lubrication Pressure)
9	Transmission Lubrication

10	Safety Valve — 10 Bar (145 PSI) Cracking Pressure
11	Solenoid Pressure — 5 Bar (73 PSI)
12	Pressure Regulating Valve — 20 Bar (290 PSI)
13	Pressure Reducer to 5.5 Bar (80 PSI)
14	Neutral/Forward Solenoid
15	Neutral/Reverse Solenoid
16	High/Low Solenoid
17	2nd/1st Solenoid
18	Range Modulation Solenoid
19	Axle Disconnect (Four-Wheel Drive) Solenoid
20	Pressure Test Port — Regulated Pressure

21	Oil Filter By-Pass Valve — Pressure Difference 4.3 Bar (62 PSI)
22	Oil Filter
23	Electronic Controlled Modulation Valve — (5.5 to 0 Bar (80 to 0 PSI)
24	Pressure Test Port — Pressure Before the Oil Filter
25	Pressure Booster — 0–5.5 to 0–20 Bar (0–80 to 0–290 PSI)
26	Accumulator
27	Air Breather
28	Suction Oil Strainer
29	Charging Pump
30	Clutch Pressure — 20 Bar (290 PSI)
31	Modulated Pressure — 0 to 20 Bar (290 PSI)
32	Reverse Clutch
33	Pressure Test Port — Reverse Clutch
34	Forward Low Clutch
35	Pressure Test Port — Forward Low Clutch
36	Forward High Clutch
37	Pressure Test Port — Forward High Clutch
38	2nd Clutch
39	Pressure Test Port — 2nd Clutch
40	1st Clutch
41	Pressure Test Port — 1st Clutch
42	Axle Disconnect (Four-Wheel Drive) Clutch
43	Pressure Test Port — Axle Disconnect (Four-Wheel Drive) Clutch
44	Transmission Sump

The transmission and torque converter function together through a common hydraulic system.
The charging pump (29) draws oil through the suction oil strainer (28) and directs it to the oil filter (22).
Protecting the filter from system pressure in excess of 4.3 Bar (62 PSI) is a by-pass valve (21).
A pressure regulating valve (12) maintains the pressure for the control valve and clutches at 20 bar (290 PSI) and excess oil is returned to the torque converter circuit.
The torque converter is protected from pressures over 10 bar (145 PSI) by a safety valve (10).
After leaving the torque converter, the oil flows through the oil cooler (6) then on to lubricate and cool the transmission bearings and clutches. The oil drains back to the transmission sump (44) under gravity.
A torque converter by-pass valve (5) will open if the pressure difference across the torque converter and oil cooler is greater than 4 bar (58 PSI), assisting start up from cold and protecting from high RPM).

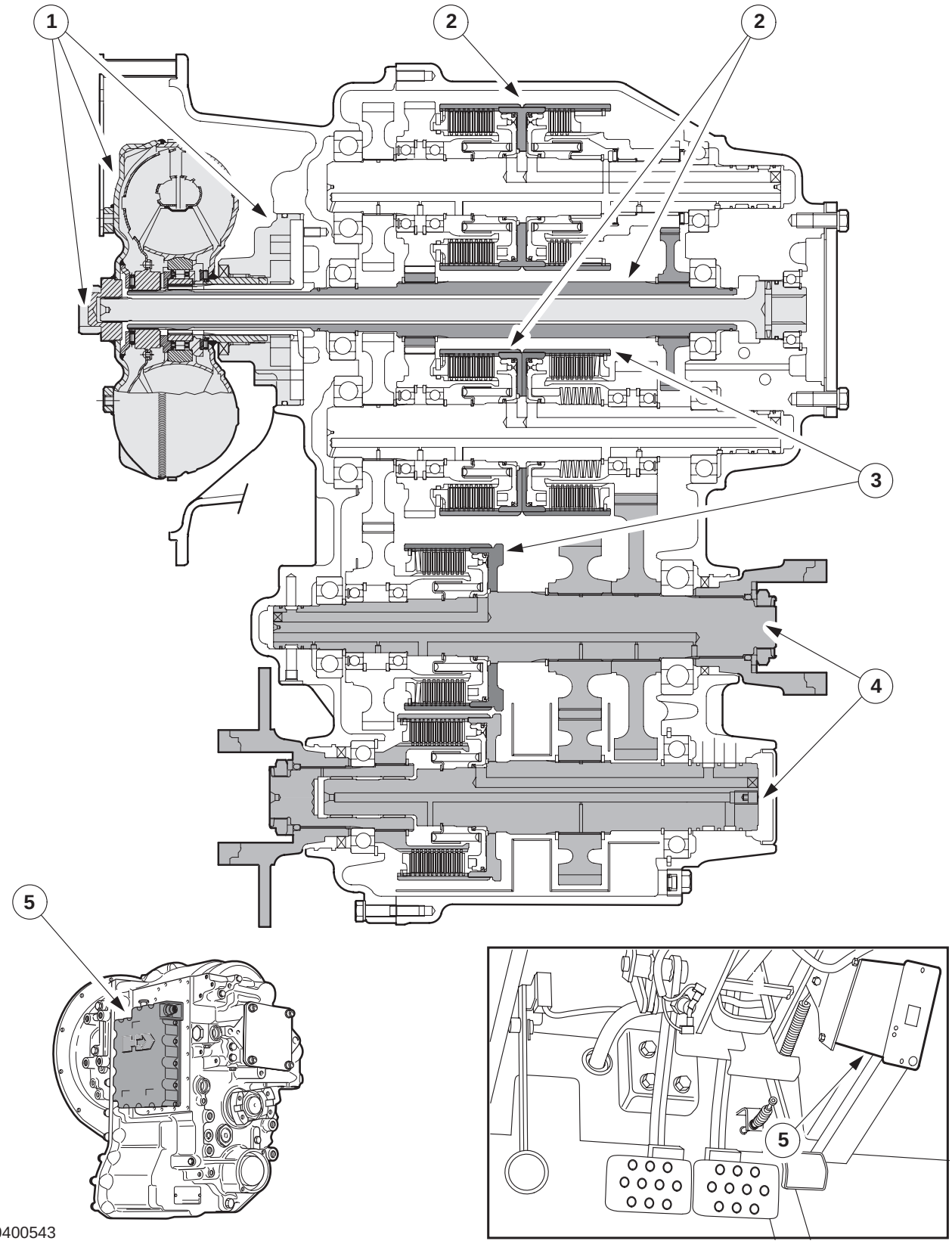
Gear and Clutch Layout



TV040558

1	Forward Low Clutch
2	Forward High Clutch
3	1st Clutch
4	2nd Clutch
5	Axle Disconnect (Four-Wheel Drive) Clutch
6	Input Drive Shaft
7	Reverse Clutch

The transmission is composed of five main assemblies.

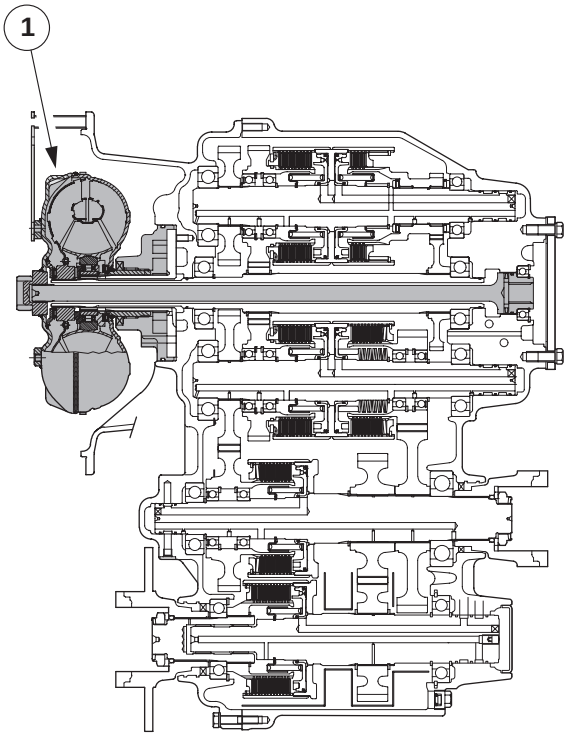


TV0400543

1	The torque converter and charging pump drive section
2	The input or directional clutches
3	The range clutches
4	The output section
5	The transmission controls

Transmission Assembly and Controls

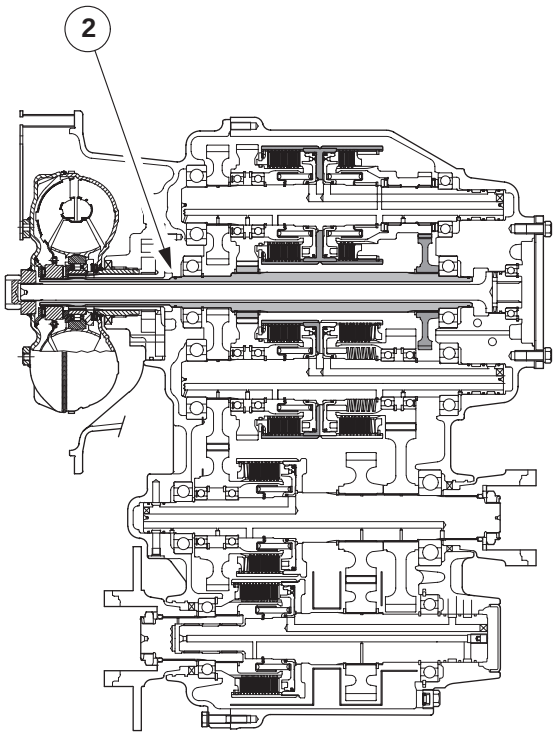
1. The Torque Converter and Charging Pump Drive Section



TV040547

Engine power is transmitted from the engine flywheel to the impeller through the impeller cover.
This element is the charging pump portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump in that it picks up fluid at its centre and discharges at its outer diameter.
The torque converter turbine is mounted opposite the impeller and is connected to the turbine shaft or directional clutch shaft. This element receives fluid at its outer diameter and discharges at its centre.
The reaction member of the torque converter is located between and at the centre of the inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and changes its direction to allow correct entry for recirculation into the impeller element.
This recirculation will make the converter multiply torque.
The torque multiplication in function of the balding (impeller, turbine and reaction member) and the torque converter output speed (turbine speed). The torque converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall).
Therefore we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing. In the impeller cover a splined shaft is installed which runs inside and through the turbine shaft to drive a hydraulic pump which is fitted at the back of the transmission. Since the shaft is connected to the centre of the impeller cover, the hydraulic pump speed will be the same as engine speed.
The rear side of the impeller cover has a tanged drive which drives the transmission charging pump located in the converter housing. The transmission charging pump speed is also the same as the engine speed.

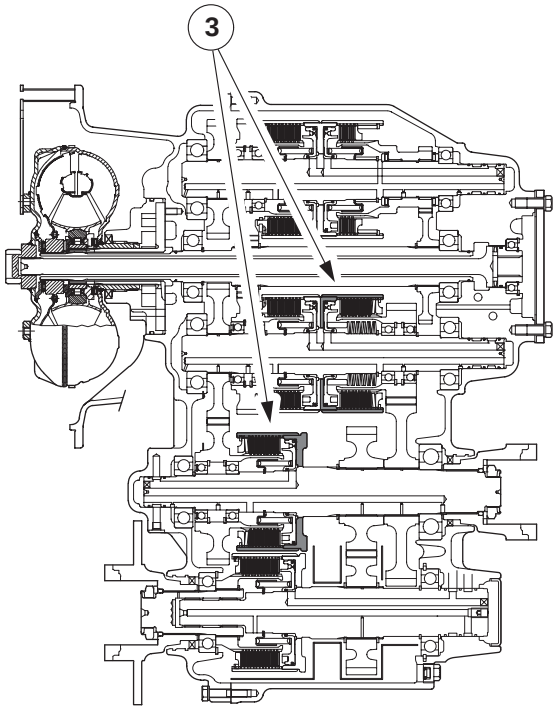
2. Input or Directional Clutches



TV040548

The turbine shaft driven from the turbine transmits power to the forward or reverse clutches.
These clutches consist of a drum with splines and a bore to receive a hydraulic actuated piston.
The piston is oil tight by the use of sealing rings. A steel disc with internal splines is inserted into the drum and rests against the piston. Next, a friction disc with splines at the outer diameter is inserted.
Discs are alternated until the required total is achieved. A backing plate is then inserted and secured with a snap ring. A hub with outer diameter splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.
To engage the clutch, the control valve which is fitted on the side of the transmission will direct oil under pressure through tubes and passages to the selected clutch shafts.
Oil sealings are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.
Pressure of the oil forces the piston and discs against the backing plate. The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows them to drive as one unit.
When the clutch is released, a return spring will push the piston back and oil will drain back via the control valve into the transmission sump.
The powershift transmission has one reverse clutch and two forward clutches (forward Low and forward High).
This, in combination with the two range clutches, results in the transmission having 4 forward speeds and 2 reverse speeds.
The engagement of the directional clutches is modulated; which means that clutch pressure is built up gradually. This will enable the unit to make forward, reverse shifts while the vehicle is still moving and will allow smooth engagement of drive. The modulation is controlled electronically in the control valve.

3. The Range Clutches

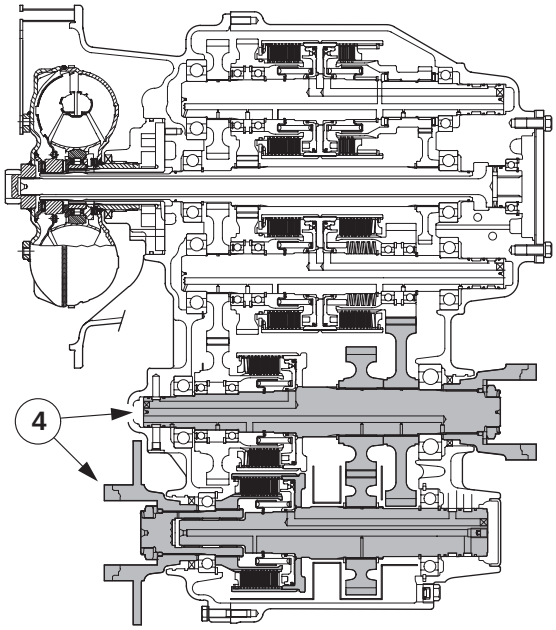


TV040549

Once a directional clutch is engaged power is transmitted to the range clutches (1st or 2nd).
Operation and actuation of the range clutches is similar to the directional clutches.
The engagement of the range clutches is also modulated to enable a smooth engagement.

The modulation for these clutches is achieved by means of a restrictor valve fitted in the control valve which is controlled electronically and which limits oil flow to the clutch during shifts. In the clutch itself the plate before the end plates is dished to build up the clamping force of the clutch gradually.

4. The Output Section

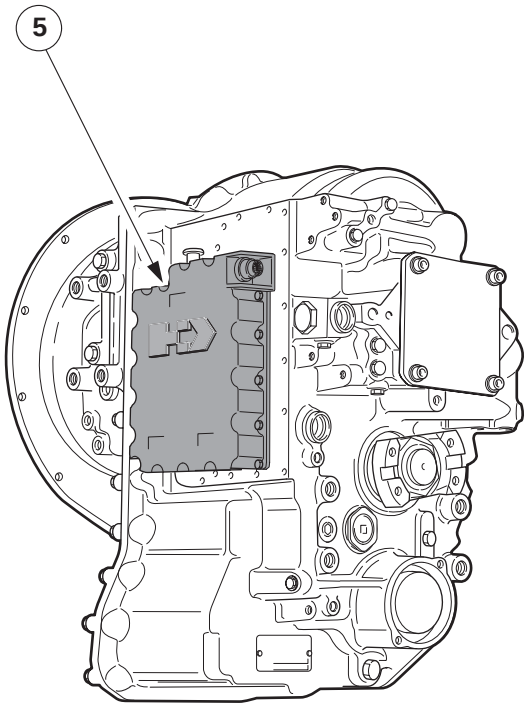


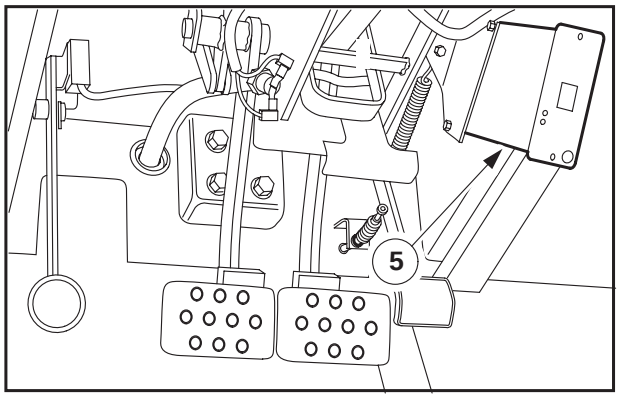
TV040550

With a range clutch engaged power is finally transmitted to the output shafts.
The powershift transmission can have an upper output or lower output at the rear side of the unit, and a lower output at the front side. Output rotation of the rear upper output is opposite the engine rotation when the forward clutch is engaged, while output rotation of the lower rear output and the front output is the same as the engine rotation with the forward clutch engaged.

The lower front output has an axle disconnect clutch to enable four-wheel drive.
The clutch is similar to the other clutches except that it has no modulation. The disconnect clutch is controlled electronically. The clutch is engaged with an electrical signal.

5. The Transmission Controls





TV040551

Operation of the valve is as follows:
(Refer to transmission hydraulic circuit)
The control valve has 6 solenoids, 6 shift spools, a pressure reducer, an electronic controlled modulation valve, an accumulator, a pressure booster and a speed sensor.
Regulated pressure 20 bar (290 PSI) is directed to the shift spools, pressure booster (25) and pressure reducer (13).
In the pressure reducer (13), regulated pressure is reduced to 5.5 bar (80 PSI). This reduced pressure is used as supply for the solenoids (11) and electronic controlled modulation valve (23).
When activated, the electronic controlled modulation valve (23) will give an output pressure curve from 0 to 5,5 bar (0 to 80 PSI).
This pressure curve is multiplied in the pressure booster (25) so that a curve from 0 to 20 bar (0 to 290 PSI) is available for the directional clutches. Between the electronic controlled modulation valve (23) and the pressure booster (25) is an accumulator (26) to dampen any hydraulic vibration.
When forward is selected the electronic controlled modulation valve (23) and the neutral/forward solenoid (14) are activated.
The pilot pressure of the neutral/forward solenoid will move the shift spool so that the forward clutch (34) or (36) can be fed with modulated pressure.
If the High/Low solenoid (16) is not activated, the forward high clutch (36) is engaged. If it is activated, the Forward Low clutch (34) is engaged.
When reverse is selected the electronic controlled modulation valve (23) and the neutral/reverse solenoid (15) are activated, the pilot pressure of the neutral/reverse solenoid will move the shift spool so that the reverse clutch (32) can be fed with modulated pressure.
The shift spools from forward and reverse are located against each other with a return spring in between; this is to ensure that only one direction can be selected.
Range is selected as follows:
If the range 2nd/1st solenoid (17) is not activated, regulated pressure is fed through the modulation shift spool and through the 2nd/1st shift spool to the 2nd clutch (38).
If the range 2nd/1st solenoid (17) is activated, the pilot pressure will move the shift spool so that 1st clutch (40) is engaged.
The range clutches also have modulation which operates as follows:
When the range is changed, oil will flow through the modulation shift spool to the chosen range clutch momentary until the friction discs are closed against the dished plate. At that moment the range modulation solenoid (18) is activated.
The pilot pressure will move the modulation shift spool so that the oil supply is fed through a restrictor which is in by-pass of the valve.
The controlled volume of oil is used to push in the dished outer plate gradually until the clutch is fully closed.
This will give a smooth build up of torque. At that moment the range modulation solenoid (18) is released, so that the modulation shift spool returns to its rest position and allows full oil flow to the clutch.

The control valve also controls the front lower output disconnect (four-wheel drive) clutch (42). If the disconnect solenoid (19) is activated, the pilot pressure of the disconnect solenoid (19) will move the shift spool so that the disconnect (four-wheel drive) clutch (42) can be fed with full pressure

The control valve also has a speed sensor. This sensor will pick up upper output gear speed. This information is used in the electronic gear selector to determine shift logic. Since the sensor picks up upper output gear speed, the signal will be in direct relation to the turbine speed if any directional clutch is engaged.

Control Valve Solenoid Activation

Transmission Gear	Activated Solenoids						Engaged Clutches
	Direction Solenoids		Range Solenoids			Disconnect (Four-Wheel Drive)	
	N/F	N/R	2/1	High/Low	Range Modulation		
F1	■		■	■			Forward Low, 1st
F2	■			■			Forward Low, 2nd
F3	■		■				Forward High, 1st
F4	■						Forward High, 2nd
N1			■	■			1st
N2				■			2nd
R1		■	■	■			Reverse, 1st
R2		■		■			Reverse, 2nd
Four-Wheel Drive							Disconnect (Four-Wheel Drive)
	■ = Active Solenoid						

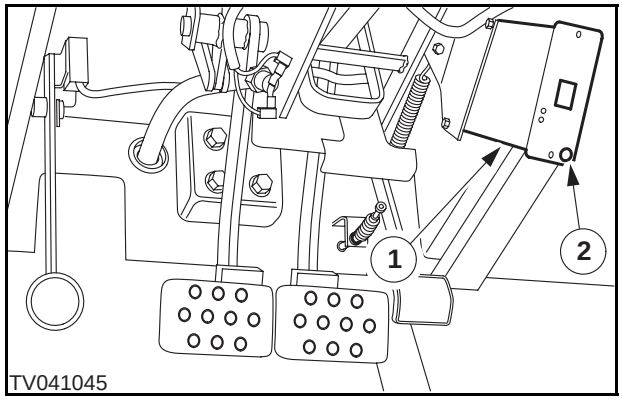
Note:

- The High/Low solenoid is activated when in reverse in preparation for a direction change to forward.

  Range modulation solenoid is activated for 0.5 seconds every time the 1st / 2nd solenoid is energized.

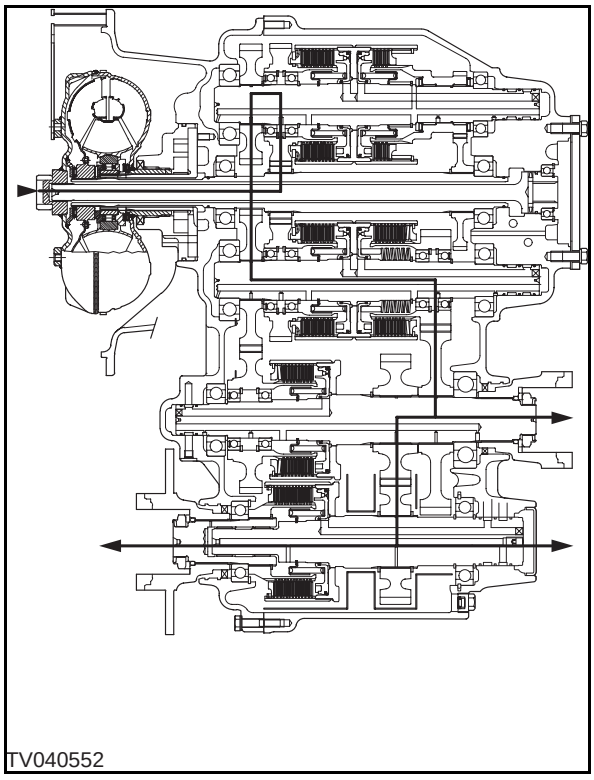
  When four-wheel drive is selected the disconnect (four-wheel drive) clutch is pressurised.

The transmission is controlled by an electronic gear selector (EGS or TCT16). This unit has a microprocessor which receives certain inputs (gear selector position, speed sensor etc.) which are processed and will give output signals to the control valve.
Three types of transmission controller (1) are available. These can be identified by the colour of the decal (2).

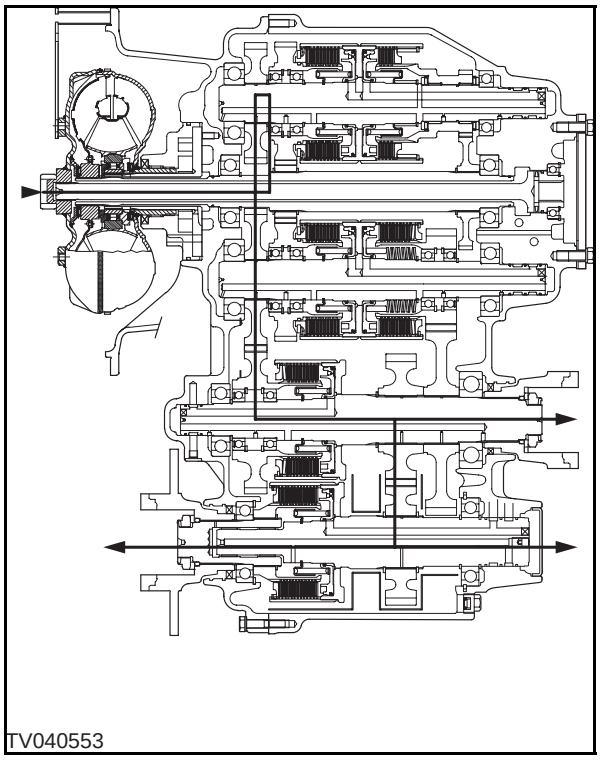


Coloured Decal	Number of Forward Speeds	Transmission Type
Red	4	Automatic
Blue	4	Manual
Green	3	Manual

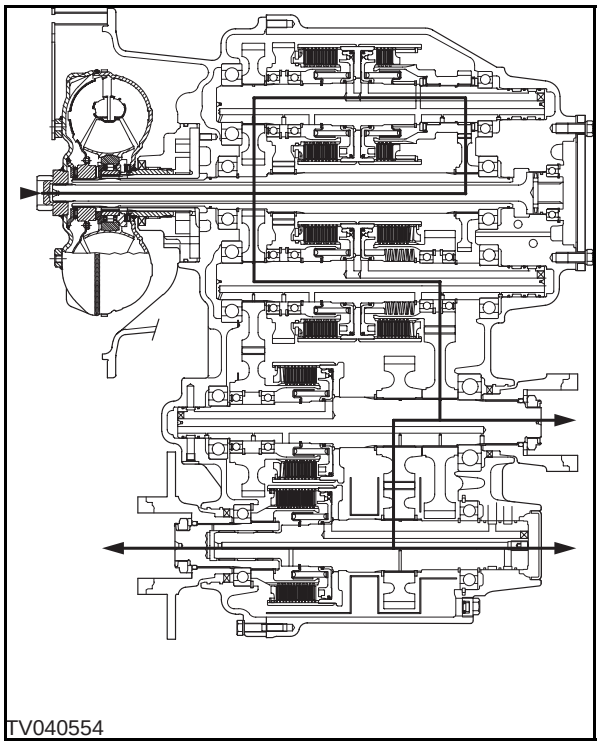
Power Flows
Forward 1st Gear — Forward Low and 1st clutch engaged.



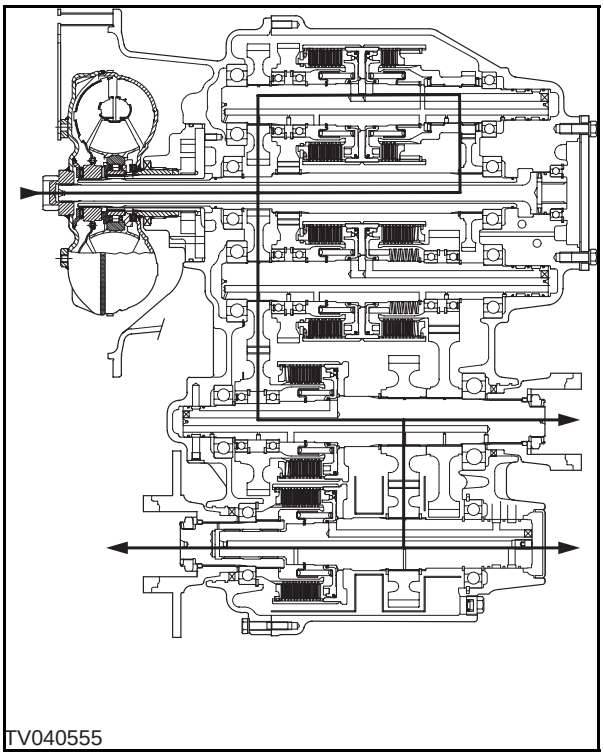
Forward 2nd Gear — Forward Low and 2nd clutch engaged.


TV040553

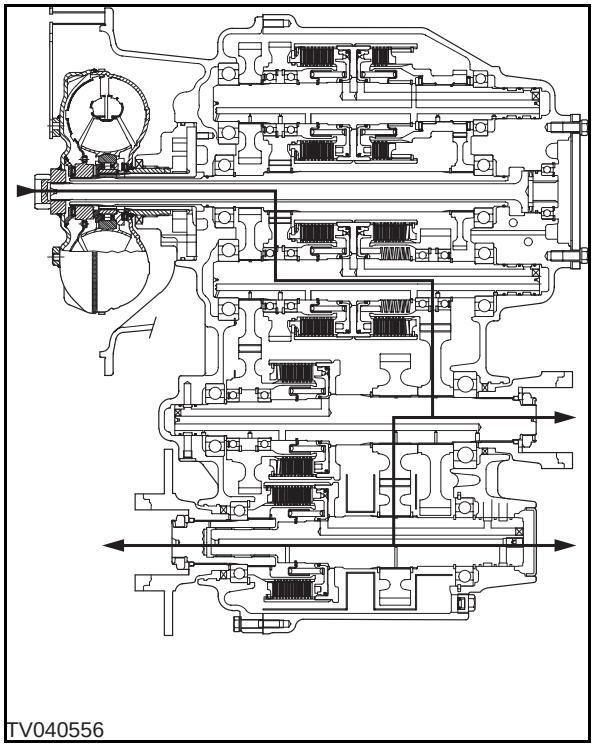
Forward 3rd Gear — Forward High and 1st clutch engaged.


TV040554

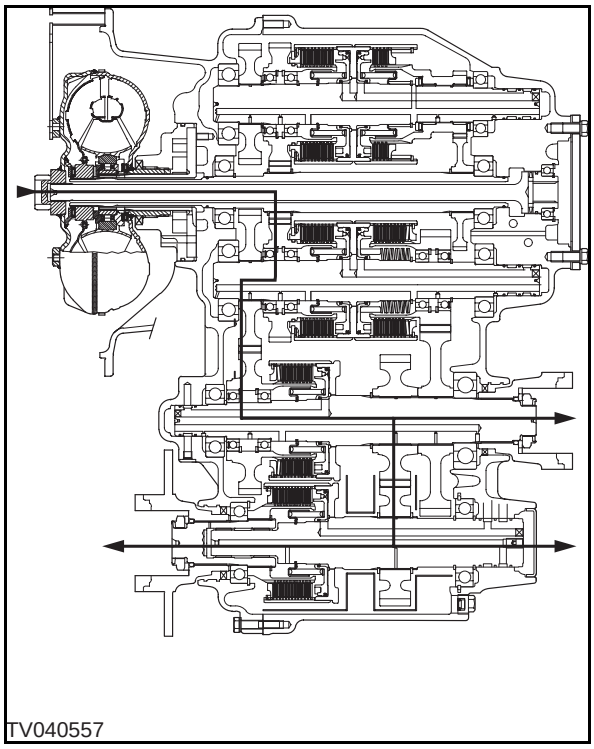
Forward 4th Gear — Forward High and 2nd clutch engaged.


TV040555

Reverse 1st Gear — Reverse and 1st clutch engaged.


TV040556

Reverse 2nd Gear — Reverse and 2nd clutch engaged.


TV040557

DIAGNOSING AND TESTING — POWERSHIFT TRANSMISSION

BHN1301TA

The following information is presented as an aid to isolate and determine the specific problem area in a transmission that is not functioning correctly.
When diagnosing a transmission problem, it should be kept in mind that the transmission is only the central unit of a group of related powertrain components. Proper operation of the transmission depends on the condition and correct functioning of the other components of the group. Therefore, to properly diagnose a suspected problem in the transmission, it is necessary to consider the transmission fluid, charging pump, torque converter, transmission assembly, oil cooler, filter, connection lines, and controls, including the engine as a complete system.
By analysing the description and operation together with the information in this and the pressure testing section, it should be possible to identify and correct any malfunction which may occur in the system.

Diagnosing Procedures

In addition to the mechanical and electrical components, all of which must be in the proper condition and functioning correctly, the correct functioning of the hydraulic circuit is most important. Transmission fluid is the “life blood” of the transmission. It must be supplied in an adequate quantity and delivered to the system at the correct pressures to ensure converter operation, to engage and hold the clutches from slipping, and to cool and lubricate the working components.
Faults fall into three general categories: mechanical, hydraulic and electrical.

Stall Test

Use a stall test to identify whether the transmission, torque converter, or the engine is the malfunctioning component when a complaint of poor performance is made.

Transmission Pressure Checks

Transmission problems can be isolated by the use of pressure tests. When the stall test indicates slipping clutches, then measure clutch pack pressure to determine if the slippage is due to low pressure or clutch plate friction material failure.
In addition, converter charging pressure and transmission lubrication pressure may also be measured.

Mechanical And Electrical Checks

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- Check the parking brake for correct adjustment.
- Ensure all lever linkages are properly connected and adjusted in each segment and at all connecting points.
- The controls are actuated electrically. Check the wiring and electrical components.
- Ensure that all components of the cooling system are in good condition and operating correctly.
- The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.
- The engine must be operating correctly. Ensure that it is correctly tuned and adjusted to the correct idle and maximum no-load governed speed specifications.

Hydraulic Check

Note:

- The transmission fluid must be at the operating temperatures of 82° to 93°C (180° to 200° F) to achieve correct fluid level and pressure readings.

⚠ Caution:

- **Do not attempt to make these checks with cold oil.**

Also, before checking the transmission clutches, torque converter, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:
Check the oil level in the transmission. The transmission fluid must be at the correct (full level). All clutches and the converter and its fluid circuit lines must be fully charged (filled) at all times.
To raise the oil temperature to this specification it is necessary to either operate (work) the vehicle or run the engine with torque converter at “stall”. (Refer to torque converter stall procedure).

Torque Converter Stall Procedure

⚠ Caution:
- **If the operating pressures at idle are too low, do not carry out this test.**

⚠ Caution:
- **Do not operate the torque converter at stall condition longer than 30 seconds at one time, shift to neutral for 15 seconds and repeat the procedure until desired temperature is reached. Excessive temperature 120°C (250°F) maximum will cause damage to transmission clutches, fluid, torque converter, and oil seals.**

⚠ Caution:
- **If the engine RPM recorded by the tachometer exceeds the maximum specified RPM, reduce the engine RPM to idle immediately. Clutch slippage is indicated.**

Permitted Torque Converter Stall Speeds

	Models			
	820	**860 SX**	**860 Elite**	**970**
Maximum no-load engine RPM	2325 — 2375	2325 — 2375	2325 — 2375	2325 — 2375
Stall speed RPM	2125 — 2175	1975 — 2225	1975 — 2225	1975 — 2225

Note:
- Transmission fluid level and engine coolant level must be correct. Both fluids must be at normal operating temperature

Note:
- The transmission fluid must be at the operating temperature of 82° to 93°C (180° to 200° F) to achieve the correct readings.

Note:
- Check the engine is capable of obtaining the specified maximum no-load engine RPM before stall testing.

⚠ Caution:
- **Be careful that the vehicle does not move unexpectedly when operating the engine and torque converter at stall RPM.**

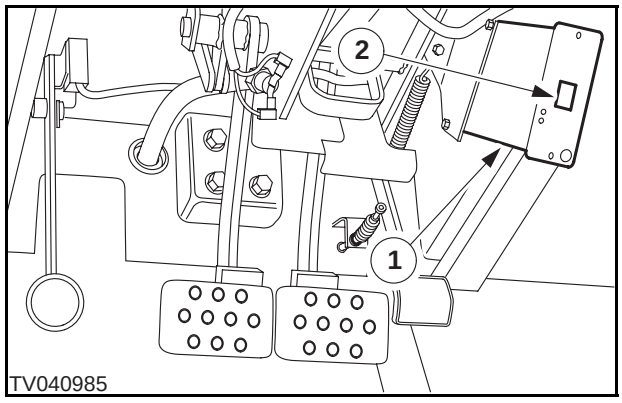
1. Put the vehicle against a solid barrier, such as a wall, apply the parking brake, service brakes and block the wheels.
2. Start the engine.
3. Put the directional control lever in FORWARD (or REVERSE, as applicable).
4. Select the highest gear and increase the engine speed to the maximum RPM until the tachometer reading stabilizes.
5. Read of the stall speed RPM on the tachometer.

Problem	Possible Cause	Action
Stall speed too high	• Low oil level	• CHECK the oil level (should always be checked prior to stall testing).
	• Low clutch pressure(s).	• CHECK clutch pressure(s).
	• Slipping clutch(es).	• CHECK clutch(es).
Stall speed too low	• Engine maximum no-load RPM speed too low.	• CHECK engine controls and performance.
	• Internal damage within the torque converter.	• REPAIR/REPLACE the torque converter.

Problem	Possible Cause	Action
Low clutch pressure	• Low oil level.	• FILL to proper level.
	• Clutch pressure regulating valve stuck open.	• CLEAN valve spool and housing.
	• Faulty charging pump.	• REPLACE charging pump.
	• Broken or worn clutch shaft or piston sealing rings.	• REPLACE sealing rings.
Low charging pump output	• Low oil level.	• FILL to correct oil level.
	• Suction screen blocked.	• CLEAN suction screen and charging pump.
	• Defective charging pump.	• REPLACE charging pump.
Overheating	• Dirty oil cooler.	• CLEAN oil cooler.
	• Restriction in cooler lines.	• CHANGE cooler lines.
	• Low oil level.	• FILL to correct oil level.
	• Worn oil sealing rings.	• REMOVE, DISASSEMBLE and REBUILD torque converter assembly.
	• Worn charging pump.	• REPLACE.
Noisy torque converter	• Worn charging pump.	• REPLACE.
	• Worn or damaged bearings.	• A complete DISASSEMBLY will be necessary to determine which bearing is faulty.
Lack of power	• Low engine RPM at torque converter stall.	• TURN engine check governor.
	• See “Overheating” and make same checks.	• MAKE corrections as explained in “Overheating”.

Fault Codes

The Powershift transmission controller (1) has an inbuilt diagnostic facility. This facility utilises the digital display (2) at the front of the controller to indicate, in coded format, malfunctions in the transmission electrical and electronic circuitry.

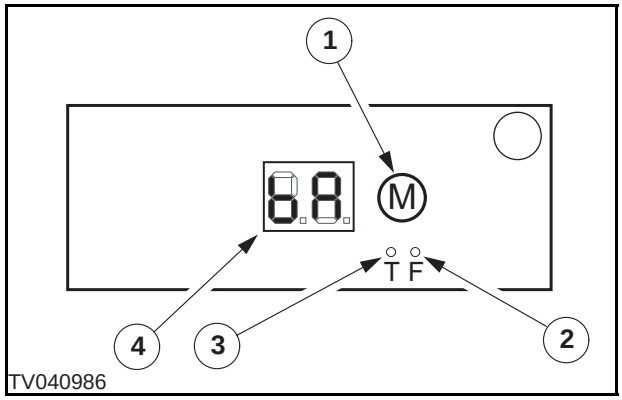


If the controller recognises a fault, the yellow **"T"** Light Emitting Diode (LED) (3) will start to flash.
If the controller is in the reset condition, the red **"F"** LED (2) will be illuminated.
To display the fault code, depress and hold the mode button **"M"** (1) for 2 seconds. The fault code will be displayed in the digital display (4). The digital display will alternate between a first set of digits that represent the fault area and a second set of digits that represents the fault type.
If several faults occur at the same time, the controller will only display the most severe fault code on the digital display.

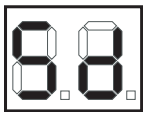
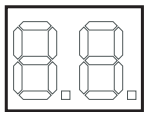
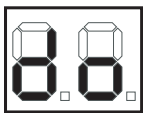
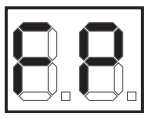
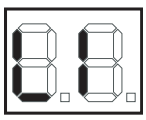
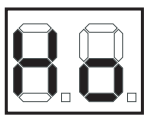
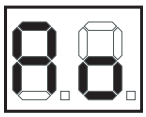
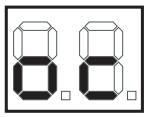
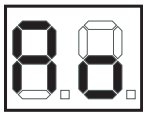
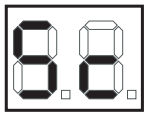
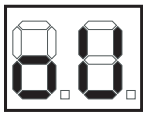
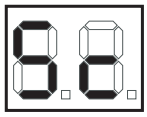
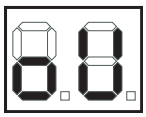
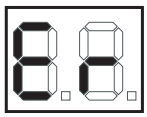
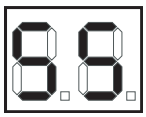
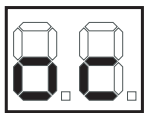
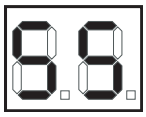
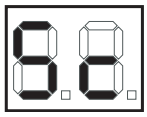
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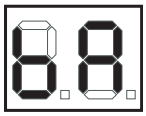
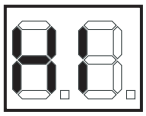
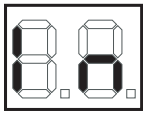
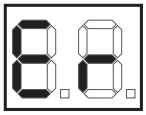
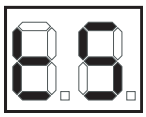
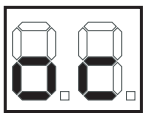
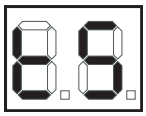
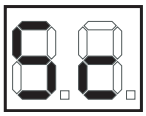
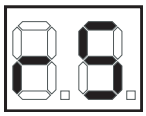
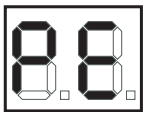
- Releasing the mode button **"M"** will clear the memory.

If an intermittent fault occurs, the controller will store the last fault code in memory. To view the stored fault code, depress and hold the mode button **"M"** (1) for 2 seconds. Releasing the mode button **"M"** will clear the fault code from the memory. If the mode button **"M"** is depressed again, the digital display will alternate between **— —** and **— —** to indicate the memory has been cleared.



Fault Code List

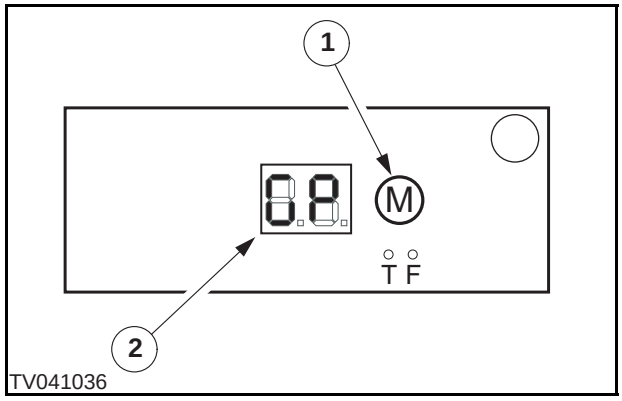
Fault Area	Fault Type	Fault	Description
		Direction outputs — shutdown (latched)	In severe dangerous conditions, all outputs will be shutdown. Turn the starting key to the OFF position to reset the controller and leave the shutdown mode.
		Direction outputs — forced to a positive voltage or open circuit	One of the direction outputs (Forward solenoid, C214, Pin 6 or Reverse solenoid, C214, Pin 7) is forced to a positive voltage or has an open circuit.
		Limp home mode	An internal fault with the EEPROM parameters is detected at power up. The transmission can be operated in F1, F2, R1 and R2. There are no downshift and direction change protections and no modulation for speed changes.
		Direction modulator output — open circuit or short to ground.	Direction modulation solenoid output (C214, Pin 3) is shorted to ground or has an open circuit.
		Direction modulator output — short circuit	Direction modulation solenoid output (C214, Pin 3) is shorted to a positive voltage.
		Digital output — short circuit	One of the digital outputs (1/2 solenoid, C214, Pin 4 or Forward Low/High solenoid, C214, Pin 5 or Axle Disconnect solenoid, C214, pin 9) is shorted to ground.
		Digital output — other fault	One of the digital outputs (1/2 solenoid, C214, Pin 4 or Forward Low/High solenoid, C214, Pin 5 or Axle Disconnect solenoid, C214, pin 9) is shorted to a positive voltage or has an open circuit.
		Speed sensor failure — open circuit	The speed sensor (C214, Pin 21) has an open circuit.
		Speed sensor failure — short circuit	The speed sensor (C214, Pin 11 or 21) is shorted to ground.

Fault Area	Fault Type	Fault	Description
		Battery — voltage high	If the battery voltage is greater than 16.5 Volts, there will be no speed readings. Speed changes above 2nd gear are not possible. If the battery voltage is greater than 24 Volts, the direction and range modulator outputs (C214, Pins 3 and 13) will not function correctly. A 24 Volt jump-start (less than 5 minutes) is allowed.
		Forward/Reverse input error	The direction lever Forward request input (C214, Pin 12) and Reverse request input (C214, Pin 19) are activated at the same time.
		Temperature sensor failure — open circuit	The temperature sensor (C214, Pin 18) has an open circuit. This fault will also occur if the temperature is greater than 150 degrees Celsius. Temperature sensor resistance — –50 ºC = 1.030 K Ohms and 150 ºC = 4.280 K Ohms.
		Temperature sensor failure — short circuit	The temperature sensor (C214, Pin 18 or 11) is shorted to ground. The fault will also occur if the temperature is less than –50 degrees Celsius.
		Redundant shutdown path error (latched)	The controller uses a relay to cut off the power to the output circuits in case of severe danger. The relay is checked at power up and if a problem is detected, this error will be displayed. Turn the starting key to the OFF position to reset the controller and leave the shutdown mode. This fault is also displayed if at power up an external power source is connected to an output circuit.

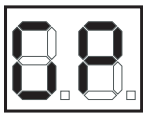
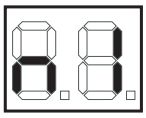
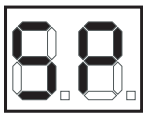
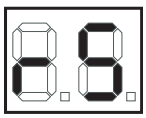
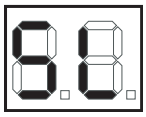
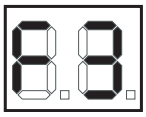
General Information Display Modes

The general information display modes are to provide information on speed, shift lever position and gear position.

After turning the key start switch ON, the controller defaults to the gear position display. Depress the mode button **"M"** (1) to navigate through the available information display modes in order. When the mode button **"M"** is released, the digital display (2) will show the values for the selected menu.



General Information Display Modes Available

Mode	Value	Description
		**Gear Position** This mode displays the engaged direction and range. If either or both differ from the shift lever, the corresponding decimal point will flash. The example shows Neutral 1st.
		**Speed (km/h)** This mode displays the vehicle speed in km/h. For speeds below 10 km/h, the speed is displayed in 0.1 km/h increments. The example shows 4.2 km/h.
		**Speed (mph)** This mode displays the vehicle speed in mph. For speeds below 10 mph, the speed is displayed in 0.1 mph increments. The example shows 4.2 mph.
		**Shift Lever Position** This mode displays the current shift lever position. Only the positions actually available on the transmission are displayed. If different from the transmission, the corresponding decimal point will flash. The example shows Forward 3rd.

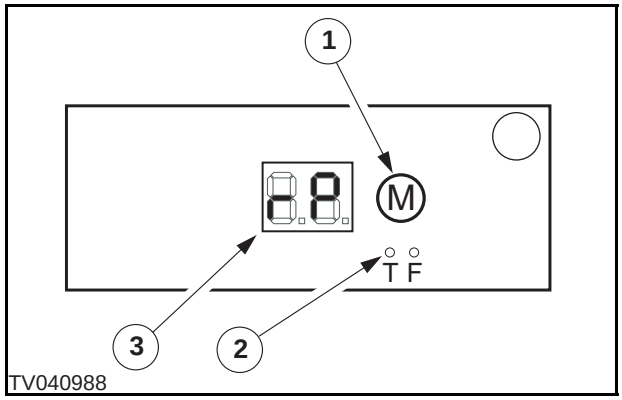
On-Board Diagnostic Modes

The on-board diagnostic modes are part of the transmission controller, providing diagnostic support through the resources available on the system.

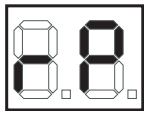
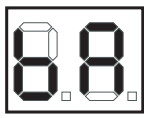
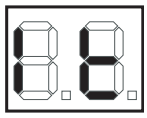
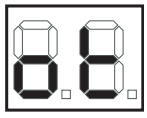
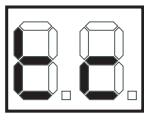
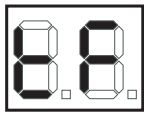
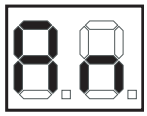
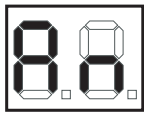
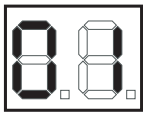
To access the diagnostic modes, depress and hold the mode button **"M"** (1) while turning the key start switch ON.

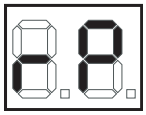
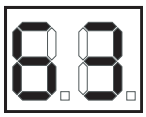
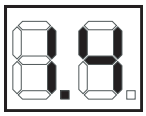
At key ON the digital display (3) will show the first menu on the list and the yellow **"T"** LED (2) will be illuminated to indicate the diagnostic menu has been activated.

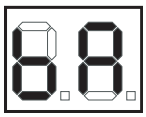
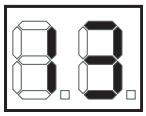
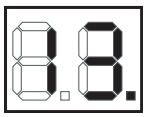
Depress the mode button **"M"** (1) to navigate through the available diagnostic modes in order. When the mode button **"M"** is released, the digital display (3) will show the values for the selected menu.

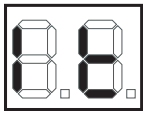
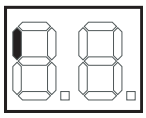
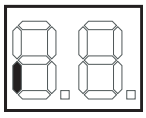
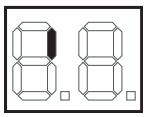
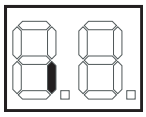
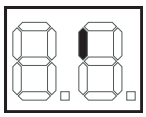
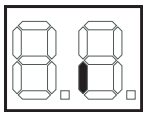
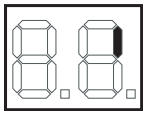
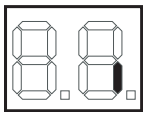


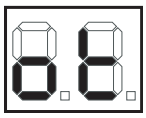
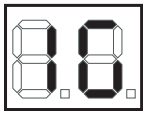
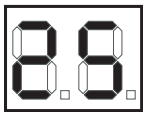
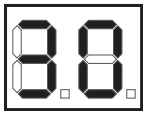
On-Board Diagnostic Modes Available

Diagnostic Screen	Mode (Digital Display)		Description
1			Turbine speed (“rP” rotations per minute).
2			Supply voltage (“bA” battery voltage).
3			Input test (“It” input test).
4			Output test (“ot” output test).
5			Temperature displayed in Celsius (“tc” temperature Celsius).
6			Temperature displayed in Fahrenheit (“tF” temperature Fahrenheit).
7			Direction modulator — Direction modulation solenoid (“An” analogue output 00).
8			Range modulator — Range modulation solenoid valve (“An” analogue output 01).

Diagnostic Screen 1 — Turbine Speed	
	This mode displays the turbine speed. After releasing the mode button, the digital display shows the turbine speed in Revolutions Per Minute (RPM).
	From 0 to 999 RPM the digital display shows the value x10. The value in the example is 630 RPM.
	From 1000 RPM, the digital display shows the value x1000. The value in the example is 1400 RPM.

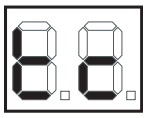
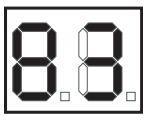
Diagnostic Screen 2 — Supply Voltage	
	This mode displays the supply voltage from the battery into the controller. After releasing the mode button, the digital display shows the supply voltage in Volts.
	Voltage range: 13.0 to 13.4 Volts.
	Values with a fractional part of 0.5 Volts or higher have the right decimal point on. Voltage range 13.5 to 13.9 Volts.

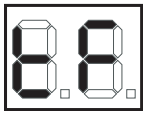
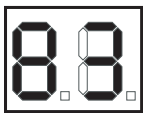
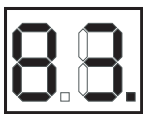
Diagnostic Screen 3 — Input Test	
	**Note:** • The vehicle can be driven in this mode. This mode is used to verify operation of the direction change lever (Forward / Reverse) and other inputs. After releasing the mode button, the digital display shows the inputs that are active.
	ON if an input at C214, Pin 12 (Forward) is detected.
	ON if an input at C214, Pin 19 (Reverse) is detected.
	ON if an input at C214, Pin 14 (Shift lever Forward Low/High selection) is detected.
	ON if an input at C214, Pin 15 (Shift lever 2/1 selection) is detected.
	ON if an input at C214, Pin 16 (Four-Wheel Drive request) is detected.
	ON if an input at C214, Pin 17 (De-clutch request) is detected.
	ON if an input at C214, Pin 26 (Kickdown request) is detected.
	ON if an input at C214, Pin 27 (Not Used) is detected.

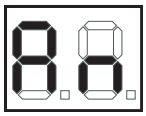
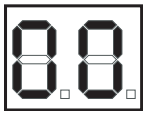
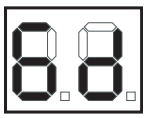
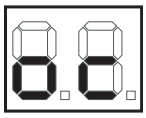
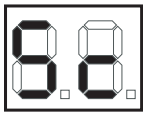
Diagnostic Screen 4 — Output Test	
	**Note:** • This mode can only be selected when stationary. When depressing the mode button while driving or if a speed sensor fault is present, this mode will be skipped. After operating in this mode, the transmission is locked in neutral until the shift lever is cycled through the neutral position. This mode is used to supply information on the status of the outputs. The possible states are **G** (Good) **S** (Short circuit to ground) and **O** (Open circuit or a short circuit to battery voltage). The controller tests each output sequentially, the left side of the digital display shows a number representing the output being tested, the right side shows the status of the tested output. After releasing the mode button, the digital display shows the status of the outputs.
	Example 1 Output 1 is Good.
	Example 2 Output 2 has a short circuit to ground.
	Example 3 Output 3 has an open circuit or has a short circuit to battery voltage.

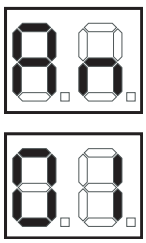
Note:
- Each output corresponds to a specific pin on the transmission controller connector 214.

Output (First Number Displayed on the digital display)	Function	Connector 214 Pin Number
1	Forward solenoid	6
2	Reverse solenoid	7
3	1/2 selection solenoid	4
4	Forward Low/High selection solenoid	5
5	Four-Wheel Drive/Rear Wheel Drive solenoid	9
8	Direction and range modulation solenoid valve supplys	22

Diagnostic Screen 5 — Temperature Displayed in Celsius	
	This mode is used to diagnose if there is a fault with the temperature sensor. After releasing the mode button, the digital display shows the transmission temperature in ºC.
	Temperature of 83 ºC
	Temperature of 99 ºC or higher have both decimal points flashing. Temperature of 99 ºC
	Temperature of 0ºC or less have both decimal points flashing. Temperature of 0 ºC

Diagnostic Screen 6 — Temperature Displayed in Fahrenheit	
	This mode is used to diagnose if there is a fault with the temperature sensor. After releasing the mode button, the digital display shows the transmission temperature in ºF.
	Temperature of 83 ºF (28 ºC)
	If the right decimal point is on, the temperature must be increased by 100 ºF 183 ºF (84 ºC)
	If the left decimal point is on, the temperature must be increased by 200 ºF 283 ºF (140 ºC)
	Temperature of 299 ºF or higher have both decimal points flashing. 299 ºF (148 ºC)
	Temperature of 0 ºF or less have both decimal points flashing. 0 ºF

Diagnostic Screen 7 — Direction modulation solenoid valve (Analogue Output 00)	
 	This mode is used to supply information on the status of the direction modulator solenoid valve (C214, Pin 3). The possible states are **Gd** (Good) **oc** (open circuit or a short circuit to ground) and **Sc** (Short circuit to a positive voltage). After releasing the mode button, the digital display shows the status of the analogue output.
	Output is good.
	Output has an open circuit or a short circuit to ground.
	Output has a short circuit to a positive voltage.

Diagnostic Screen 8 — Range modulation solenoid valve (Analogue Output 01)	
	This mode is used to supply information on the status of the range modulator solenoid valve (C214, Pin 13). The possible states are **Gd** (Good) **oc** (open circuit or a short circuit to ground) and **Sc** (Short circuit to a positive voltage). After releasing the mode button, the digital display shows the status of the analogue output.
	Output is good.
	Output has an open circuit or a short circuit to ground.
	Output has a short circuit to a positive voltage.

Component Testing

- Solenoid (forward reverse, high/low, 2nd/1st, modulation, disconnect).
  coil resistance: 28 Ohms (± 2 Ohms) at 20°C (68°F).
- Electronic controlled modulation valve:
  coil resistance: 3.55 Ohms (± 0.25 Ohm) at 20°C (68°F).
- Speed sensor:
  — frequency: 0 — 25000 Hz.
  — sensing distance: 0 — 2.5 mm.
  — Wire identification:
  Speed Signal = Red
  Temperature Signal = Green
  Sensor Ground = Blue

Temperature sensor (in speed sensor) resistance versus temperature

Temperature °C	Resistance Ω	Temperature °C	Resistance Ω
— 55	980	50	2417
— 50	1030	60	2597
— 40	1135	70	2785
— 30	1247	80	2980
— 20	1367	90	3182
— 10	1496	100	3392
0	1630	110	3607
10	1772	120	3817
20	1922	125	3915
25	2000	130	4008
30	2080	140	4166
40	2245	150	4280

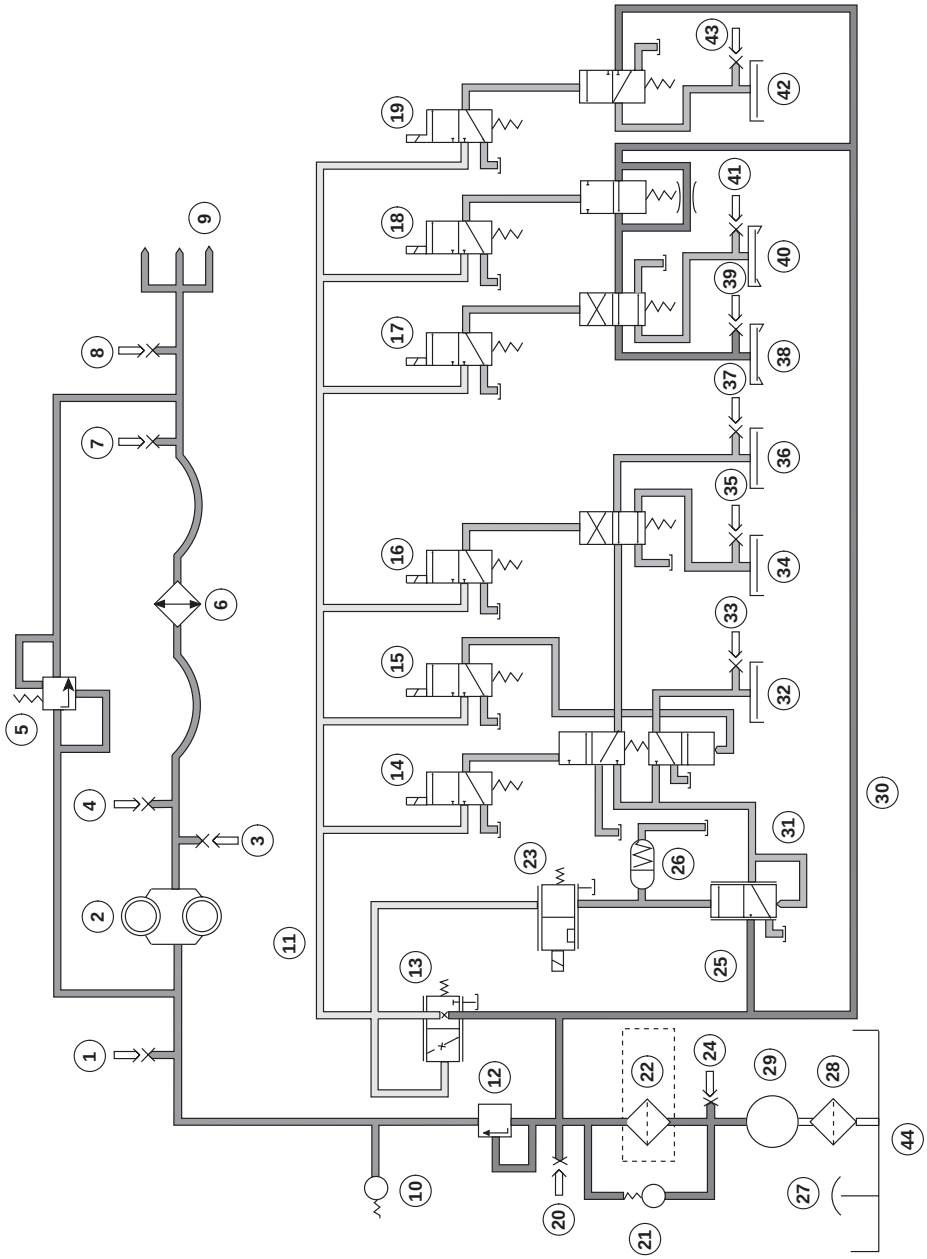
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DIAGNOSING AND TESTING — POWERSHIFT TRANSMISSION PRESSURE TESTING

BHN1301TB

Transmission Hydraulic Circuit

Neutral and 2nd Clutch Engaged



TV040542

1	Pressure Test Port — Torque Converter In
2	Torque Converter
3	Temperature Test Port — Torque Converter Out To Oil Cooler
4	Pressure Test Port — Torque Converter Out To Oil Cooler
5	Torque Converter By-Pass Valve — Pressure Difference 4 Bar (58 PSI)
6	Transmission Oil Cooler
7	Temperature Test Port — Oil Cooler Out To Lubrication
8	Pressure Test Port — From Oil Cooler (Lubrication Pressure)

9	Transmission Lubrication
10	Safety Valve — 10 Bar (145 PSI) Cracking Pressure
11	Solenoid Pressure — 5 Bar (73 PSI)
12	Pressure Regulating Valve — 20 Bar (290 PSI)
13	Pressure Reducer to 5.5 Bar (80 PSI)
14	Neutral/Forward Solenoid
15	Neutral/Reverse Solenoid
16	High/Low Solenoid
17	2nd/1st Solenoid
18	Range Modulation Solenoid

19	Axle Disconnect (Four-Wheel Drive) Solenoid
20	Pressure Test Port — Regulated Pressure
21	Oil Filter By-Pass Valve — Pressure Difference 4.3 Bar (62 PSI)
22	Oil Filter
23	Electronic Controlled Modulation Valve — (5.5 to 0 Bar (80 to 0 PSI)
24	Pressure Test Port — Pressure Before the Oil Filter
25	Pressure Booster — 0–5.5 to 0–20 Bar (0–80 to 0–290 PSI)
26	Accumulator
27	Air Breather
28	Suction Oil Strainer
29	Hydraulic Charge Pump
30	Clutch Pressure — 20 Bar (290 PSI)
31	Modulated Pressure — 0 to 20 Bar (290 PSI)
32	Reverse Clutch
33	Pressure Test Port — Reverse Clutch
34	Forward Low Clutch
35	Pressure Test Port — Forward Low Clutch
36	Forward High Clutch
37	Pressure Test Port — Forward High Clutch
38	2nd Clutch
39	Pressure Test Port — 2nd Clutch
40	1st Clutch
41	Pressure Test Port — 1st Clutch
42	Axle Disconnect (Four-Wheel Drive) Clutch
43	Pressure Test Port — Axle Disconnect (Four-Wheel Drive) Clutch
44	Transmission Sump

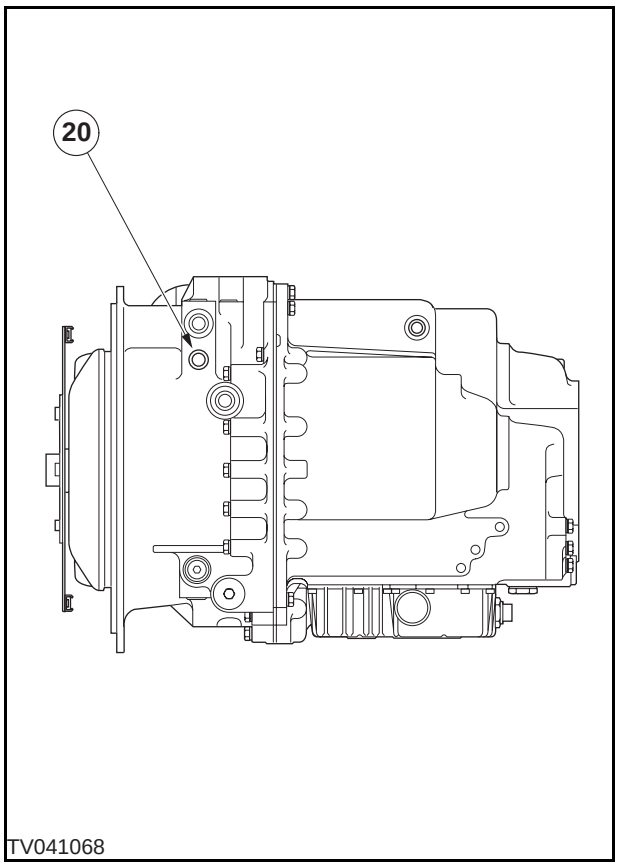
⚠ Warning:
- **Do not work on or around hydraulic systems without wearing safety glasses. Failure to follow this instruction, may result in personal injury.**

Note:
- All pressures and flows to be measured with the transmission oil temperature between 82°C and 93°C (180–200°F).

Note:
- All temperature and pressure test ports have M10 x 1 THD O-ring port ISO 6149–1.

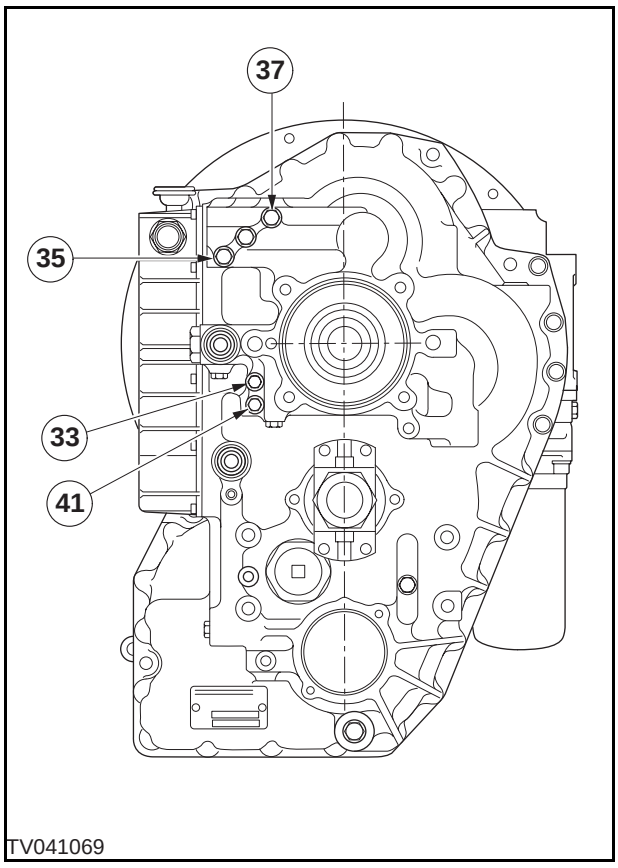
1. **Temperature test port (3) — Torque converter out to oil cooler** Transmission Bottom View
   - Normal operating temperature should be 70 – 120°C (158 – 248°F). Maximum allowed temperature 120°C (248°F).

2. **Pressure test port (20) — Transmission regulated pressure** Transmission Top View
   - Select Neutral 2nd
   - Pressure should be 16.5 bar (239 PSI) at 600 Engine RPM
   - Pressure should be 19.6 — 23.1 bar (284 — 335 PSI) at 2200 Engine RPM



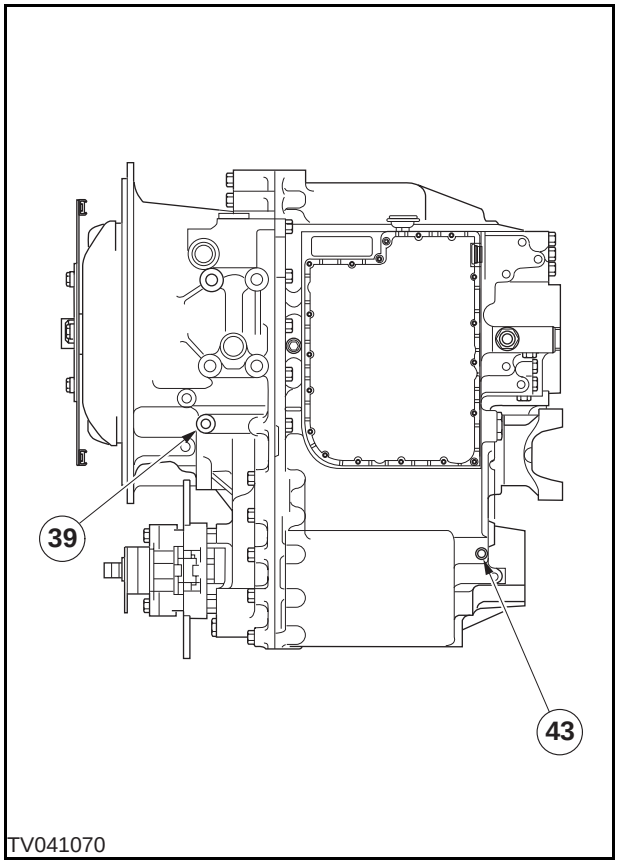
TV041068

3. **Pressure test ports (33), (35), (37) and (41) — Clutch pressures** Transmission Rear View
   - 1st clutch (41) — Clutch engaged when Forward 1st/3rd or Reverse 1st is selected
   - Forward High clutch (37) — Clutch engaged when Forward 3rd or 4th is selected
   - Forward Low clutch (35) — Clutch engaged when Forward 1st or 2nd is selected
   - Reverse clutch (33) — Clutch engaged when Reverse 1st or 2nd is selected
   - Pressure should be 18.1 — 21.5 bar (263 — 312 PSI) with clutch engaged at 2200 Engine RPM
   - Pressure should be 0 — 0.2 bar (0 — 3 PSI) with clutch disengaged at 2200 Engine RPM

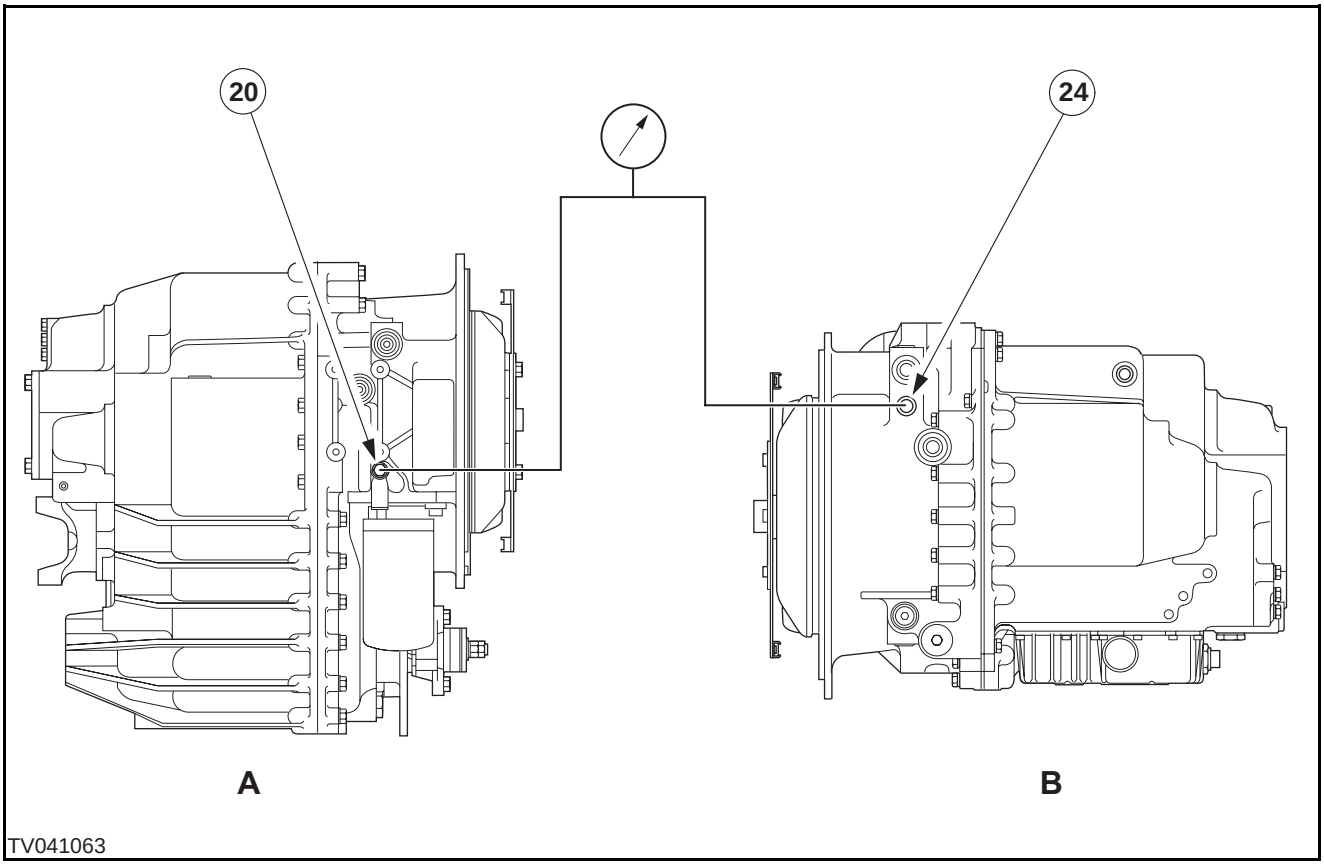


TV041069

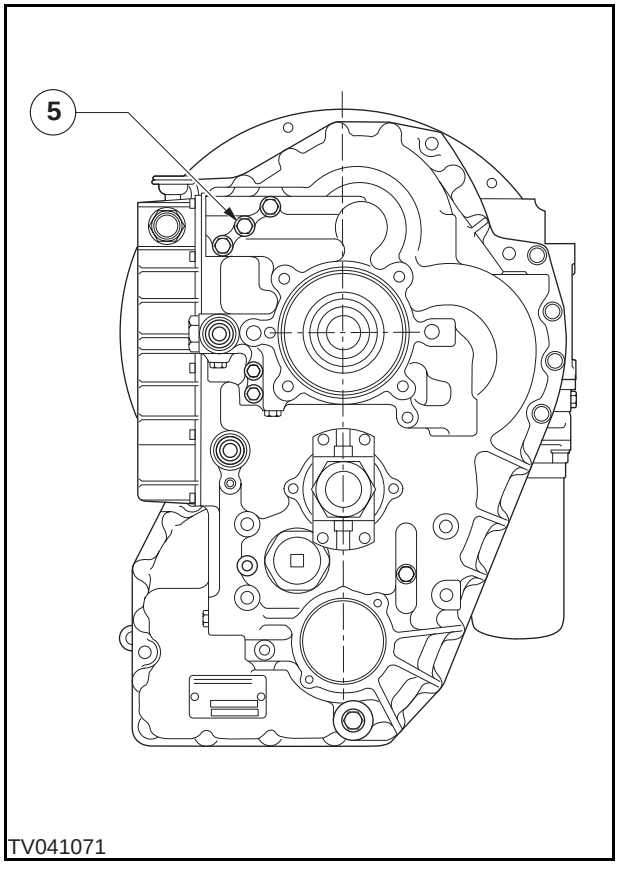
4. **Pressure test ports (39) and (43) — Clutch pressures** Transmission Left Side View
   - 2nd clutch (39) — Clutch engaged when Forward 2nd/4th or Reverse 2nd is selected
   - Disconnect clutch (four-wheel drive) (43) — Clutch engaged when four-wheel drive is selected
   - Pressure should be 18.1 — 21.5 bar (263 — 312 PSI) with clutch engaged at 2200 Engine RPM
   - Pressure should be 0 — 0.2 bar (0 — 3 PSI) with clutch disengaged at 2200 Engine RPM



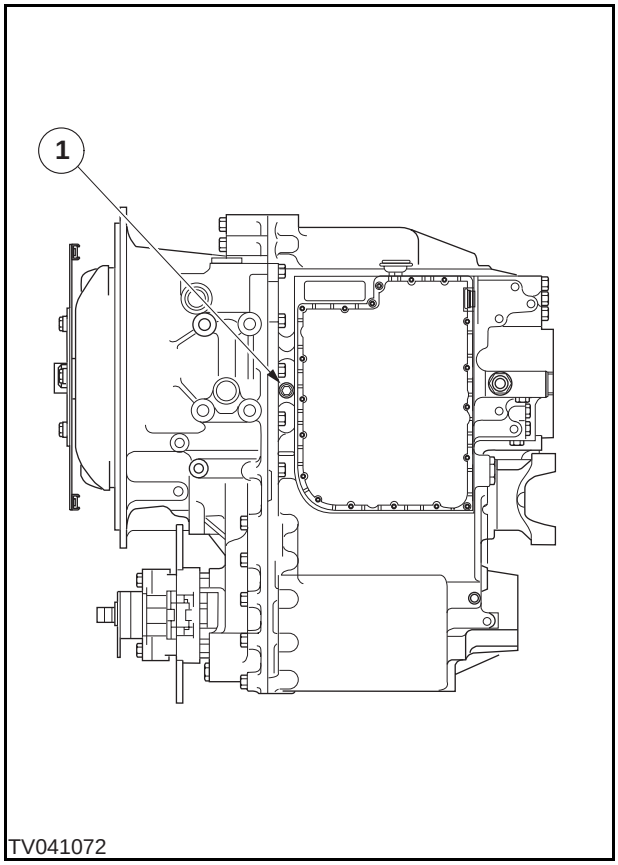
5. **Pressure test ports (20) and (24) — Oil filter by-pass valve** A — Transmission Right Side View, B — Transmission Top View
   - Pressure should not exceed 4.1 – 5 bar (59 – 73 PSI)



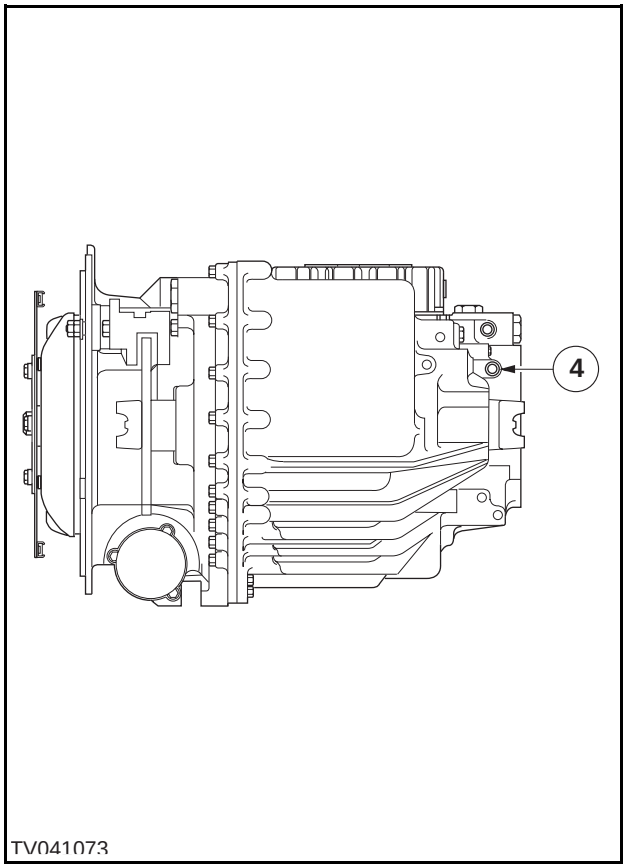
6. **Pressure test port (5) — Lubrication oil** Transmission Rear View
   - Pressure should be 0.3 — 0.5 bar at 47 l/min (12.4 GPM) pump flow (+/- 1800 Engine RPM)



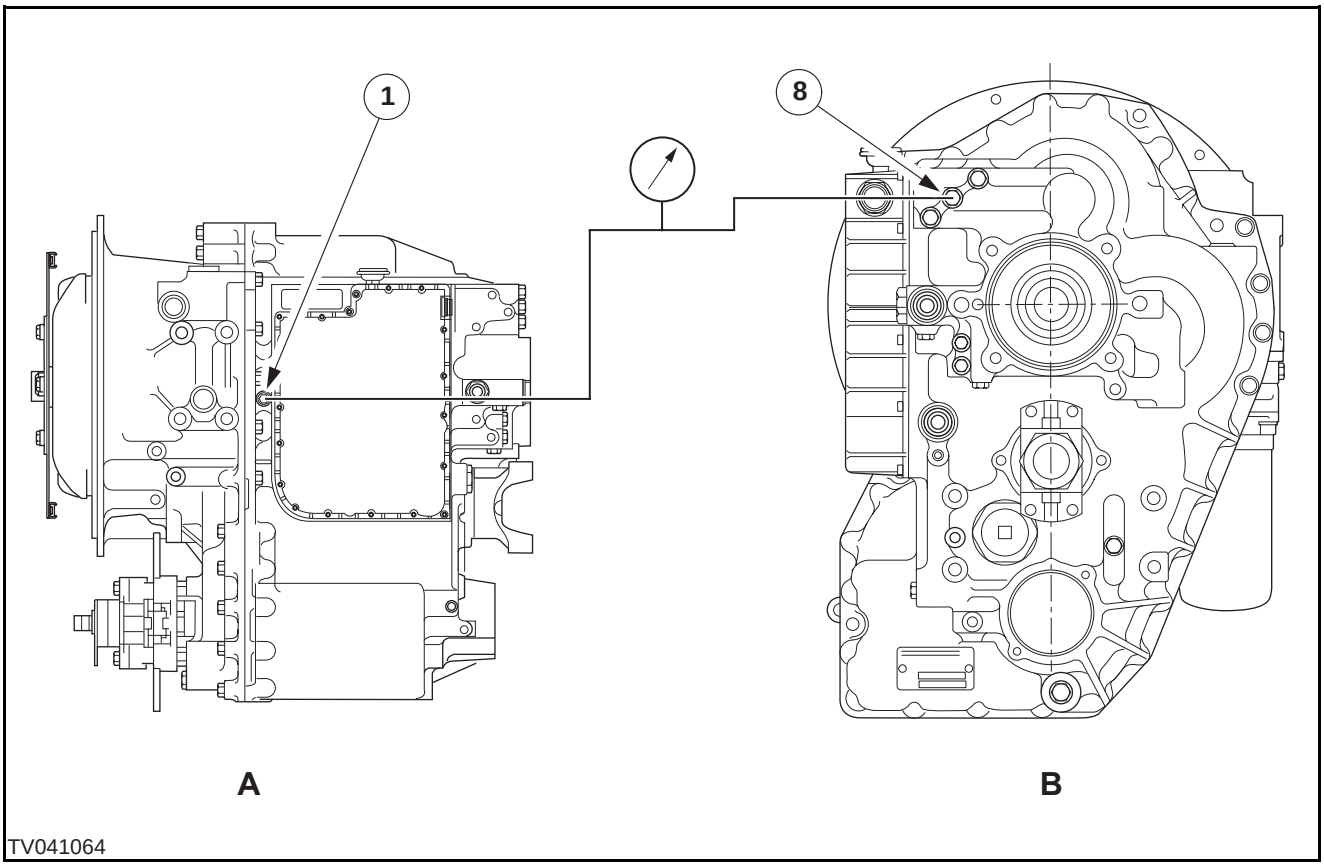
7. **Pressure test port (1) — Safety valve**
   Transmission Left Side View
   - Pressure should not exceed 9.5 — 10.5 bar (138 — 152 PSI)



8. **Pressure test port (4) — Pressure to oil cooler (torque converter out)** Transmission Bottom View
   - Pressure should be a minimum of 2 bar (29 PSI) at 2000 Engine RPM
   - Pressure should be a maximum of 5 bar (73 PSI) at 2375 Engine RPM



9. **Pressure test ports (1) and (8) — Torque converter by-pass valve** A — Transmission Left Side View, B — Transmission Rear View
   - Pressure should not exceed 5 – 7 bar (73 – 102 PSI)



TV041064

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REMOVAL AND INSTALLATION — POWERSHIFT TRANSMISSION

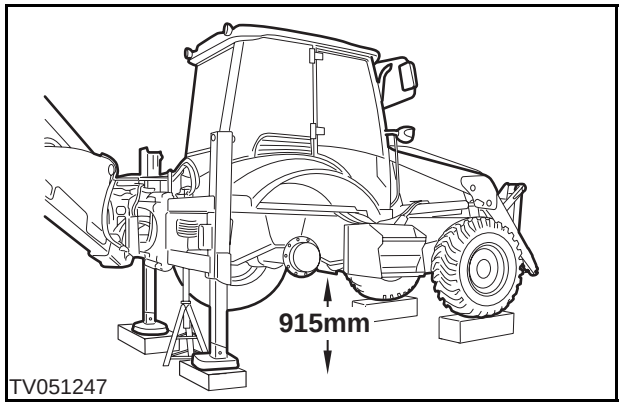
BHN1301RA

Operation: **Removing and Installing the Powershift Transmission**	*Job Code:* **13 24 13 xx**		
Suitable lifting equipment, Suitable transmission jack	Standard tools		

Removal

1. Position 150mm blocks under each stabiliser and fully lower. Raise the front of the machine to the same level.
2. Remove the right-hand rear wheel. For additional information, refer to Section M12-01 REAR WHEEL, PAGE M12–01–5 .
3. Support the machine.

   Note:
   - Ensure there is at least 915mm clearance between the ground and the chassis .

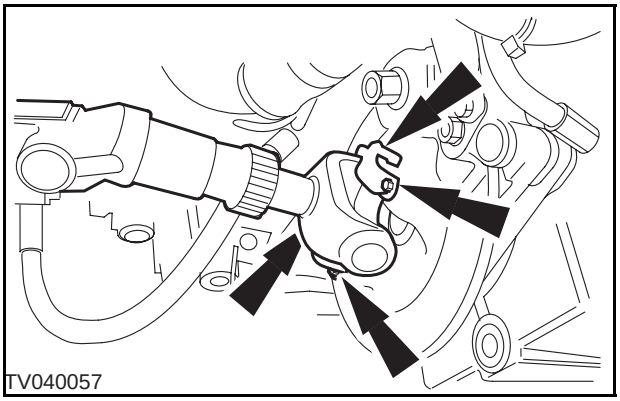


4. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
5. Drain the transmission fluid into a suitable container.
6. Install the transmission drain plug and a new O-ring.
7. Tighten to 44Nm (32 lb.ft).
8. Remove the parking brake caliper. For additional information, refer to Section N13-03 PARKING BRAKE CALIPER, PAGE N13–03–13 .

⚠ Caution:
- **Secure the universal joint bearing cups to prevent contamination or damage.**

Note:
- Remove and discard the retaining bolts.

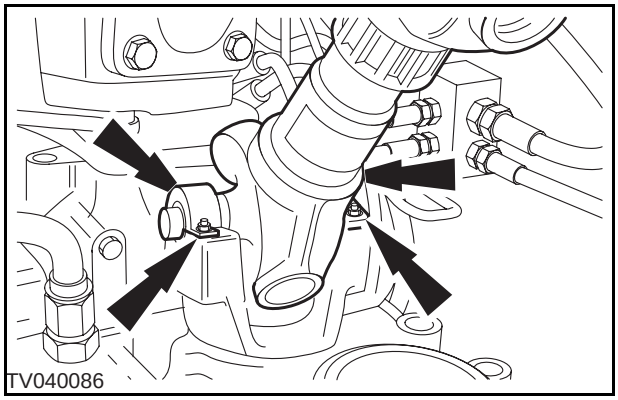
9. Detach the rear propeller shaft from the rear differential and secure it to one side.


TV040057

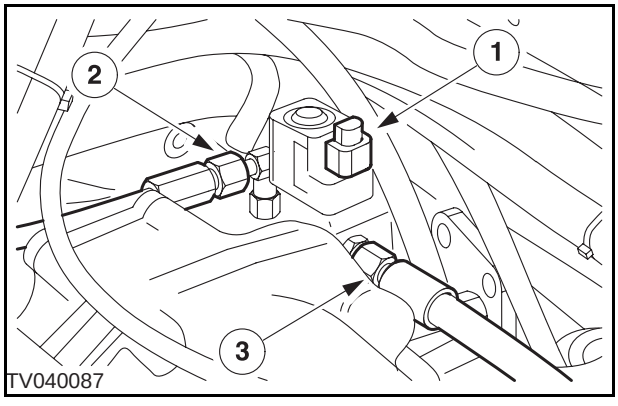
⚠ Caution:
- **Secure the universal joint bearing cups to prevent contamination or damage.**

Note:
- Remove and discard the retaining bolts.

10. Remove the rear propeller shaft from the transmission.

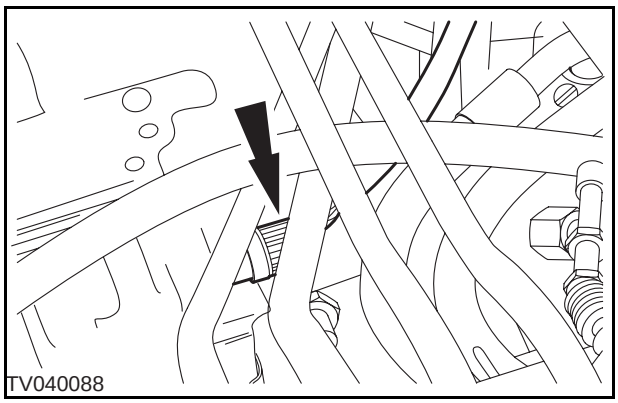

TV040086

11. Remove the cabin heater air ducting. For additional information, refer to Section H08-01 CABIN HEATER AIR DUCTING, PAGE H08–01–13 .
12. Disconnect the differential lock solenoid electrical connector (1), supply hose (2) and steering supply hose (3).

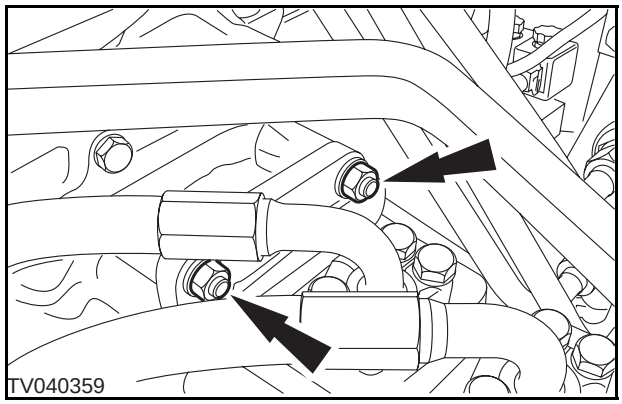


TV040087

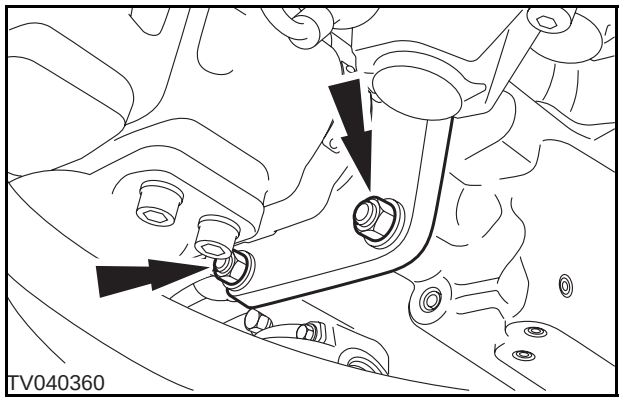
13. Disconnect the transmission harness electrical connector.



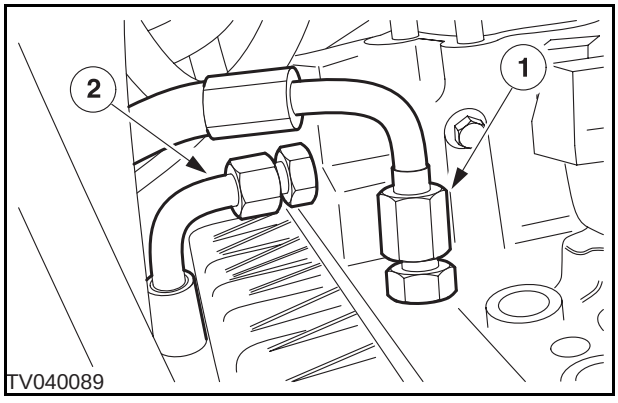
14. Remove the hydraulic oil pump upper retaining bolts.



15. Remove the hydraulic oil pump lower retaining bolts and secure the hydraulic pump to one side.



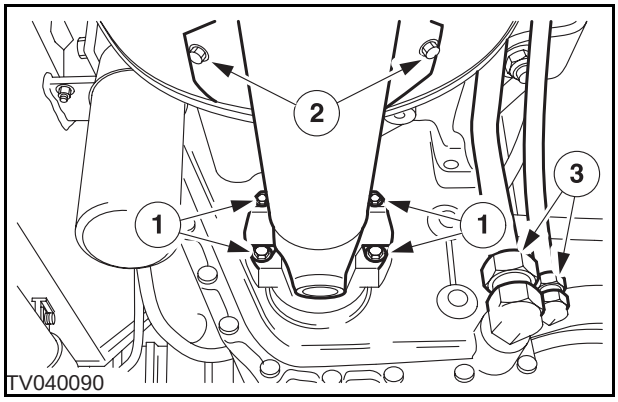
16. Disconnect the transmission oil cooler inlet pipe (1) and the transmission oil cooler outlet pipe (2).



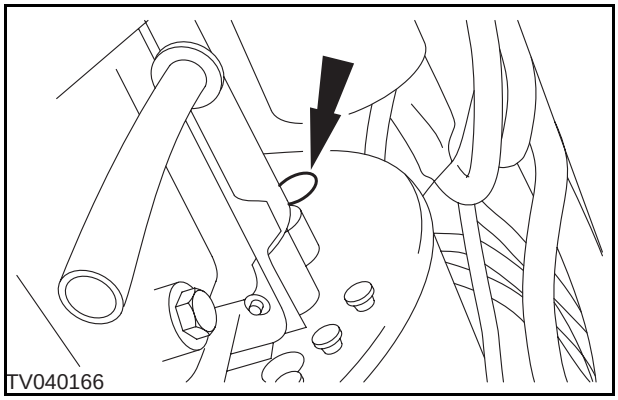
⚠ Caution:
- **Secure the universal joint bearing cups to prevent contamination or damage.**

Note:
- Discard the propeller shaft retaining bolts.

17. Remove the front propeller shaft retaining bolts (1) and detach the front propeller shaft. Remove the bell housing cover (2). Disconnect the transmission filler tube and steering return pipe (3).



18. Using the access hole, remove the torque converter retaining bolts.



⚠ Warning:
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

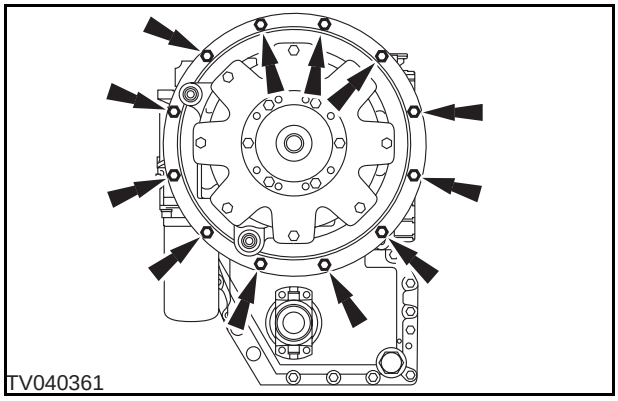
19. Using suitable lifting equipment, support the engine.
20. Reposition the transmission oil cooler pipes and wiring harness to one side, to gain access to the upper transmission retaining bolts.

⚠ Warning:
- **Secure the transmission to the transmission jack. Failure to follow this instruction may result in personal injury.**

21. Using a suitable transmission jack, support the transmission.

⚠ **Caution:**
- **Ensure the torque converter is removed with the transmission.**

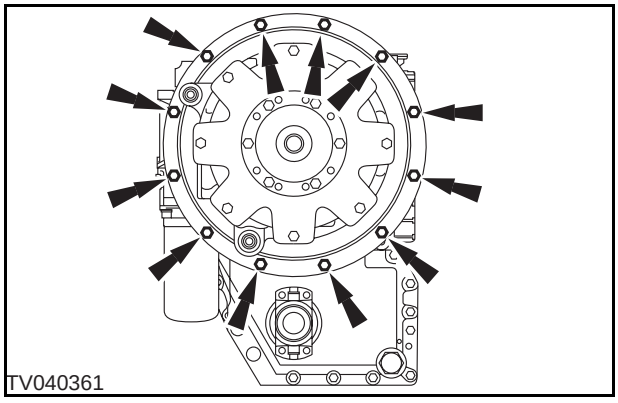
22. Remove the transmission retaining bolts and remove the transmission.


TV040361

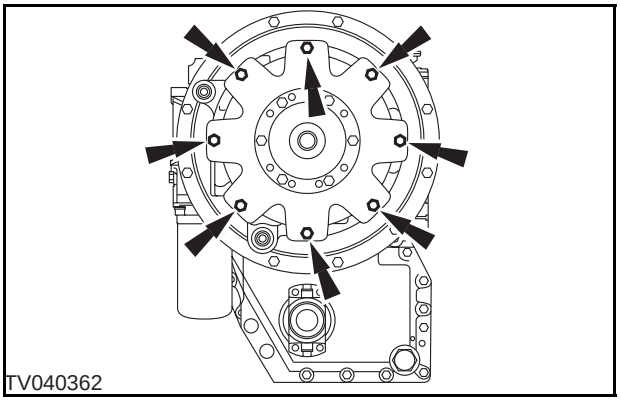
23. Remove the transmission from the right-hand side of the machine.

Installation

1. To install, reverse the removal procedure.
2. Tighten to 71 Nm (52 lb.ft).

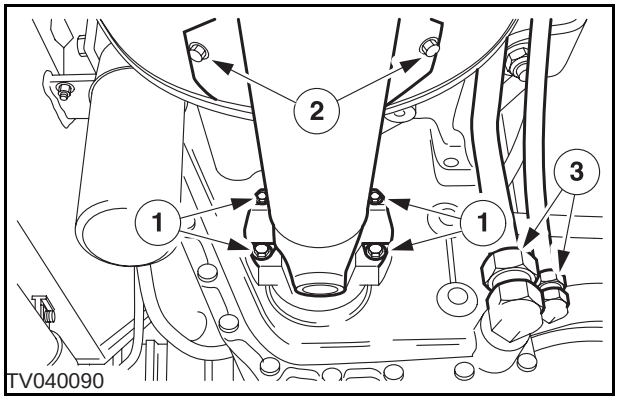

TV040361

3. Tighten to 41 Nm (30 lb.ft).

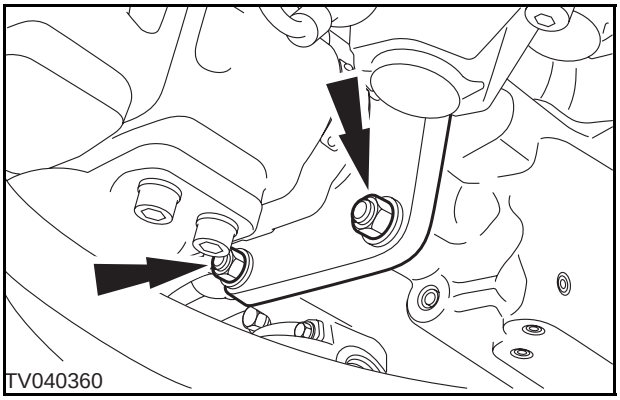

TV040362

Note:
- Install new propeller shaft retaining bolts.

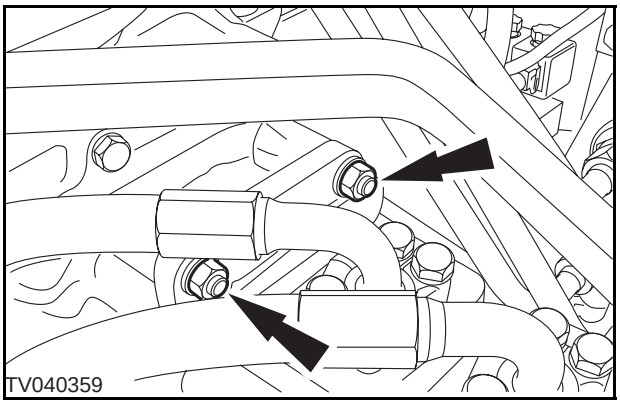
4. Tighten 1 to 47 Nm (35 lb.ft).



5. Tighten to 98Nm (72 lb.ft).

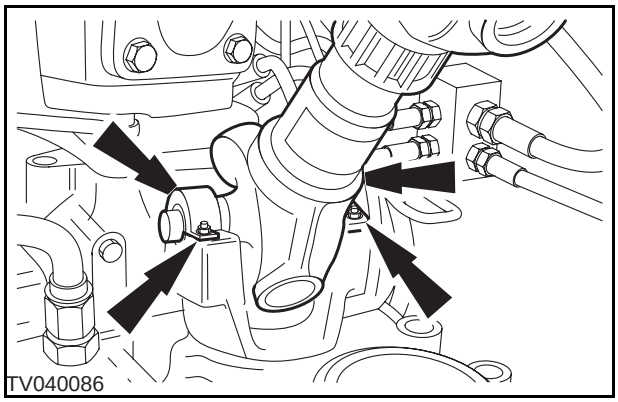


6. Tighten to 98Nm. (72 lb.ft).



Note:
- Install new retaining bolts.

7. Tighten to 47 Nm (35 lb.ft).



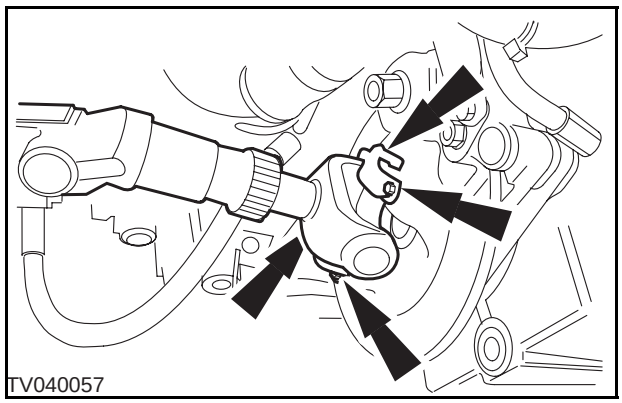
⚠ **Caution:**

- **Make sure the propeller shaft universal joints are in line. Failure to follow this instruction may result in damage to the machine.**

Note:

- Install new retaining bolts.

8. Tighten to 47Nm (35 lb.ft).


TV040057

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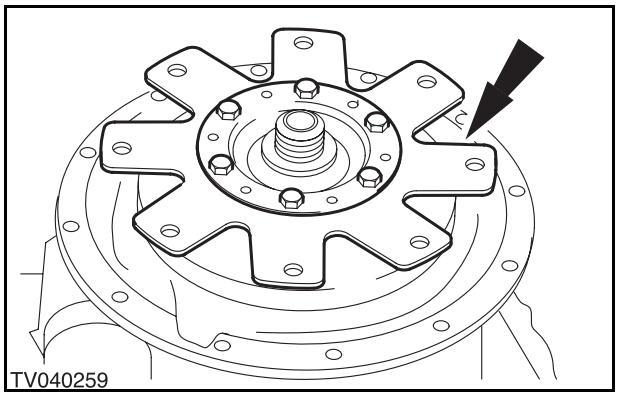
DISASSEMBLY AND ASSEMBLY — POWERSHIFT TRANSMISSION

BHN1301DA

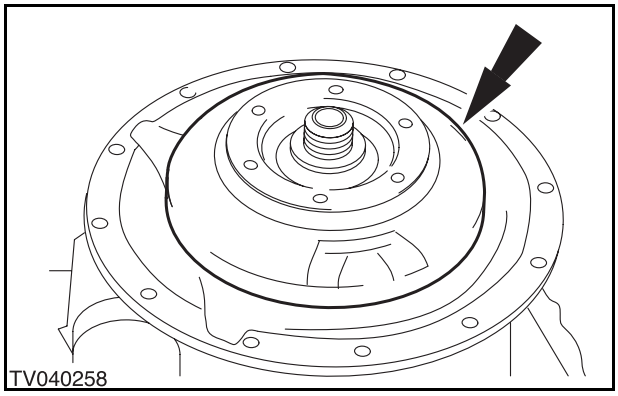
Operation: **Disassembly and Assembly of the Powershift Transmission**	*Job Code:* **13 24 17 xx**		
Suitable lifting equipment	Standard tools, Locally fabricated transmission housing lifting tool, Suitable puller, Bearing heater		

Disassembly

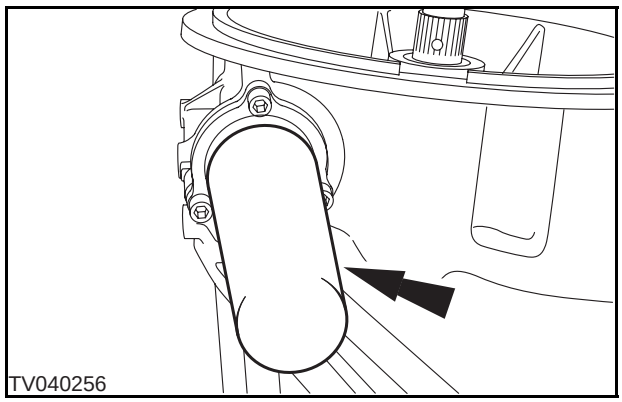
1. Remove the drive plates and backing ring.


TV040259

2. Remove the torque converter.

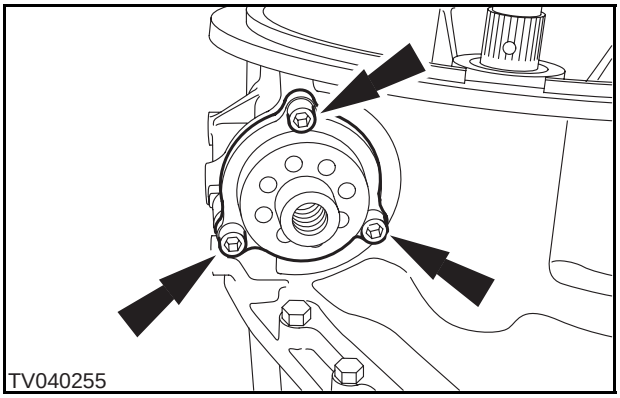

TV040258

3. Remove and discard the transmission oil filter.

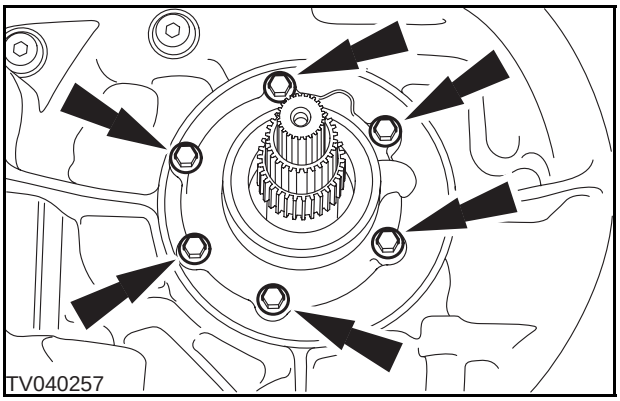

TV040256

4. Remove the transmission oil filter adapter.

Note:
- Remove and discard the O-ring seal.

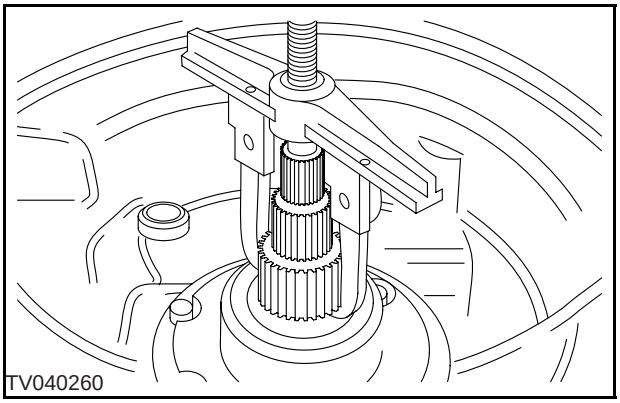

TV040255

5. Remove the charging pump retaining bolts.


TV040257

6. Using a suitable puller, remove the charging pump.
7. Remove and discard the oil seal.

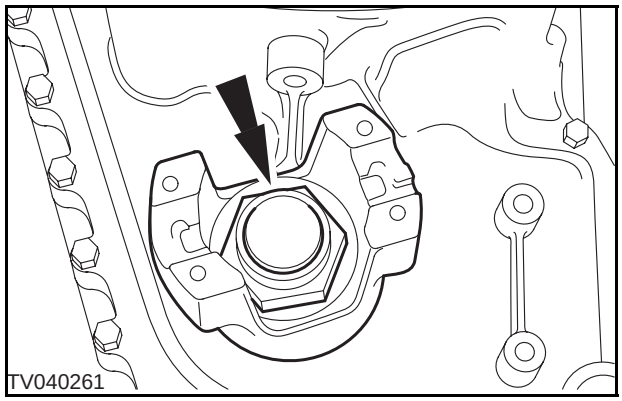
Note:
- Remove and discard the O-ring seal.


TV040260

8. Remove the four-wheel drive flange retaining nut.

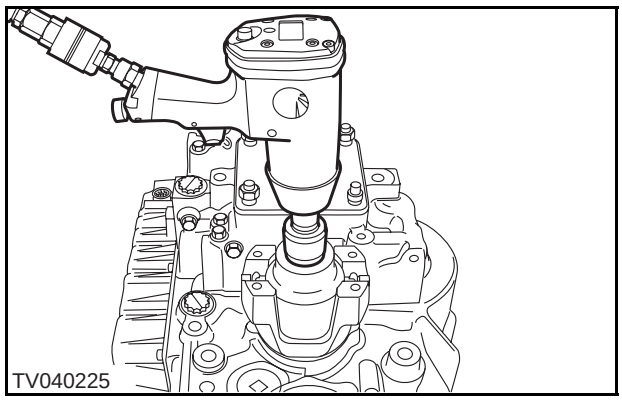
9. Recover the washer, O-ring seal and remove the four-wheel drive flange.

   Note:
   - Discard the O-ring seal.

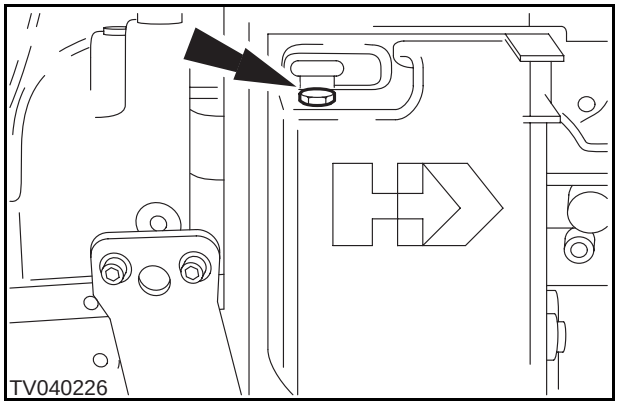

TV040261

10. Remove the output flange retaining nut.
11. Recover the washer, O-ring seal and remove the output flange.

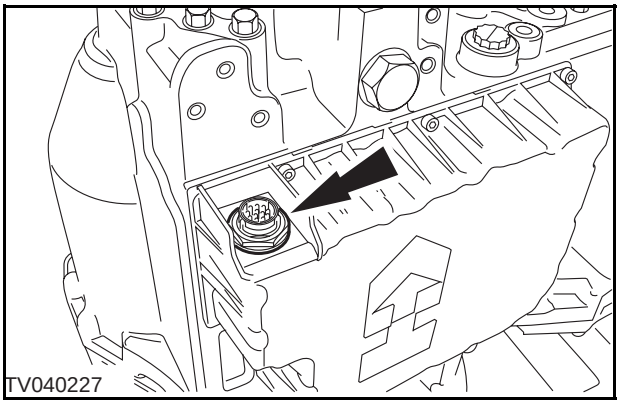
    Note:
    - Discard the O-ring seal.


TV040225

12. Remove the breather.

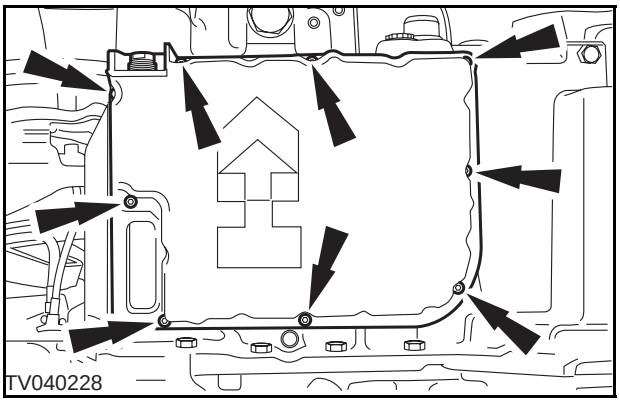

TV040226

13. Remove the wiring harness electrical connector mounting nut.



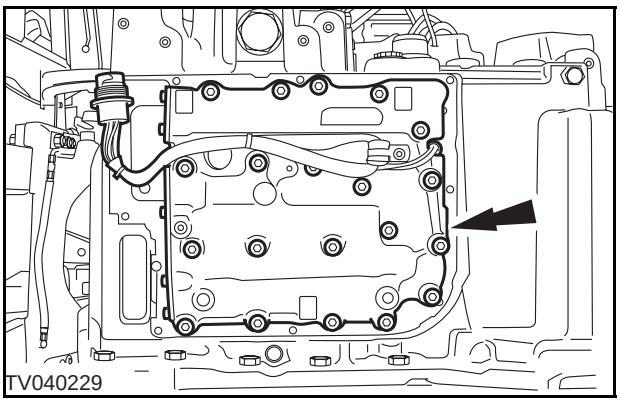
14. Remove the control valve protection cover.

Note:
- Remove and discard the gasket.

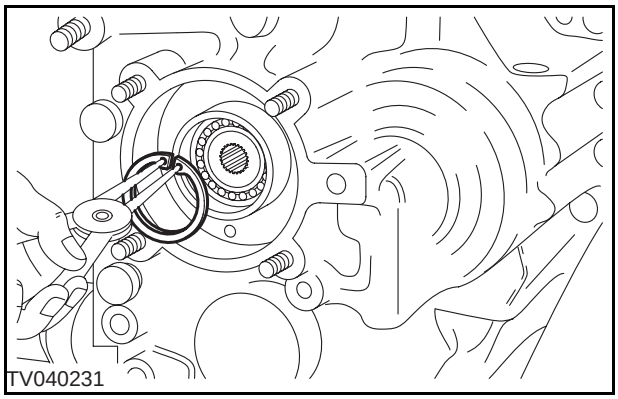


15. Remove the transmission control valve

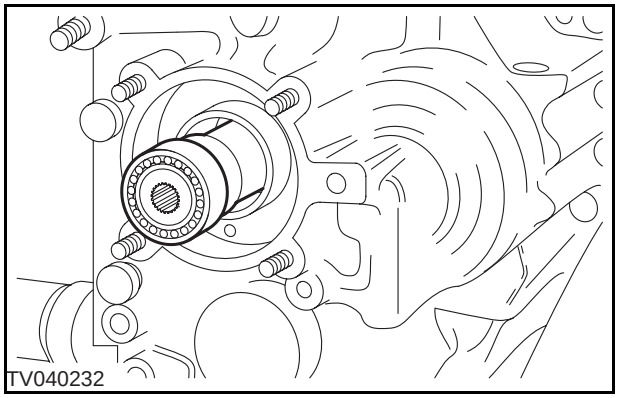
Note:
- Recover the bypass valve spool and spring.



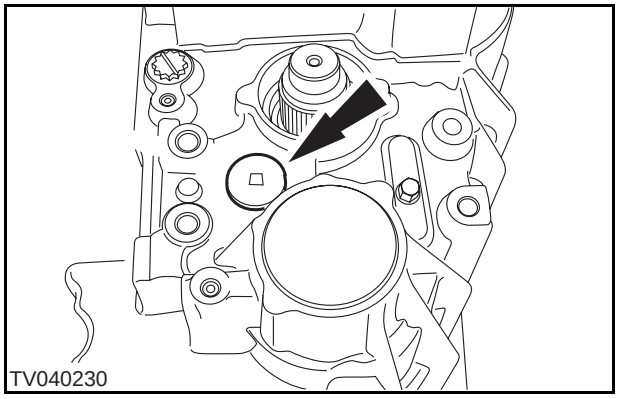
16. Using suitable circlip pliers, remove the charging pump drive shaft bearing retaining circlip.


TV040231

17. Using a suitable soft faced hammer, knock the shaft through the torque converter housing.
18. Remove the charging pump drive shaft assembly.

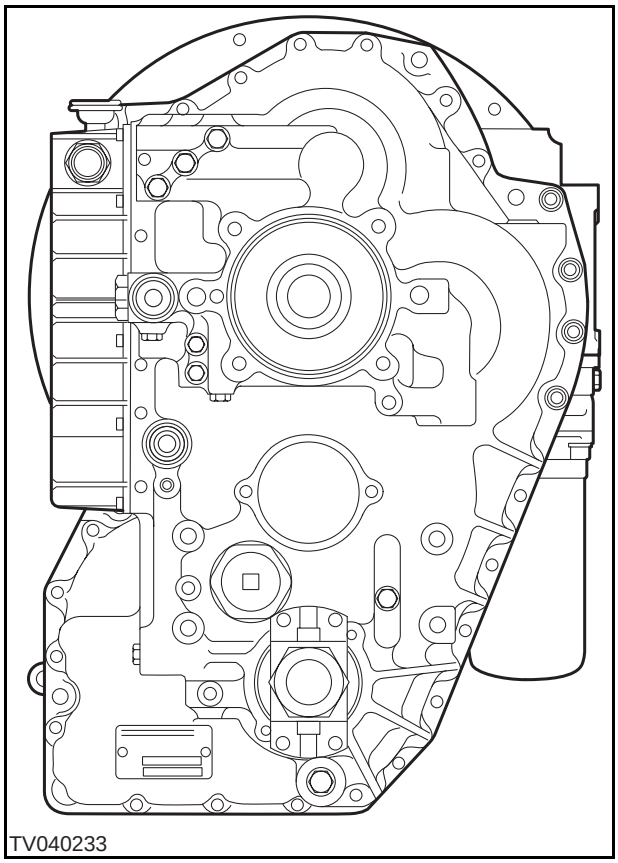

TV040232

19. Remove the transmission housing plug.


TV040230

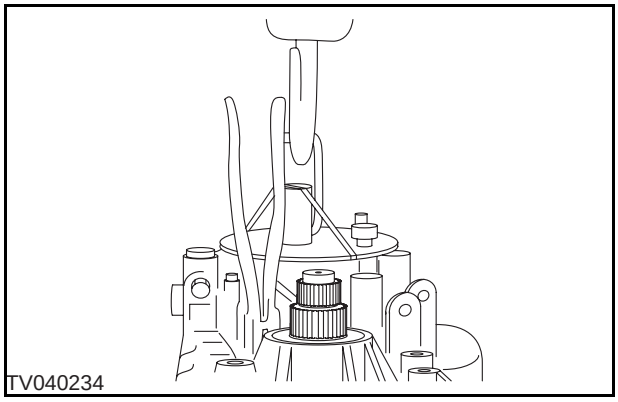
Note:
- Make a note of the position of the bolts prior to removal, to aid installation.

20. Remove the converter housing to transmission housing retaining bolts.


TV040233

21. Install the locally fabricated transmission housing lifting tool. For additional information refer to SPECIFICATIONS, PAGE N13–01–157 in this section.
22. Using internal snap ring pliers, expand the output shaft rear bearing retaining snap ring.
23. Holding the snap ring open, tap on output shaft and transmission housing to separate the two parts of the housing.

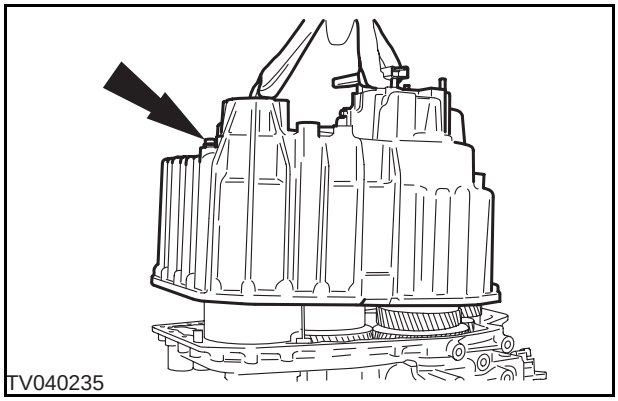
Note:
- Remove the bearing spacer.


TV040234

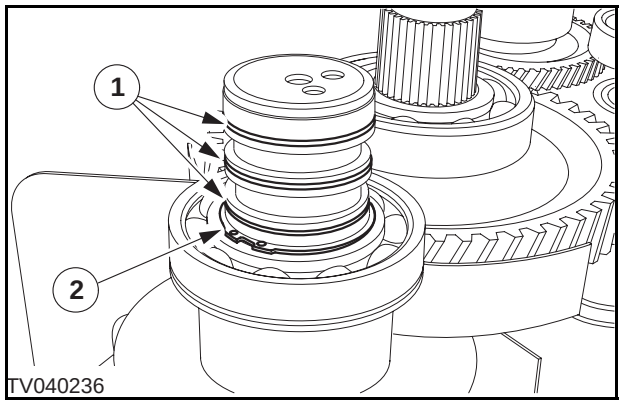
⚠ **Caution:**
- **Make sure all clutchpacks and shafts remain in the torque converter housing.**

24. Using suitable lifting equipment, remove the transmission housing from the torque converter housing.

Note:
- Remove and discard the gasket.

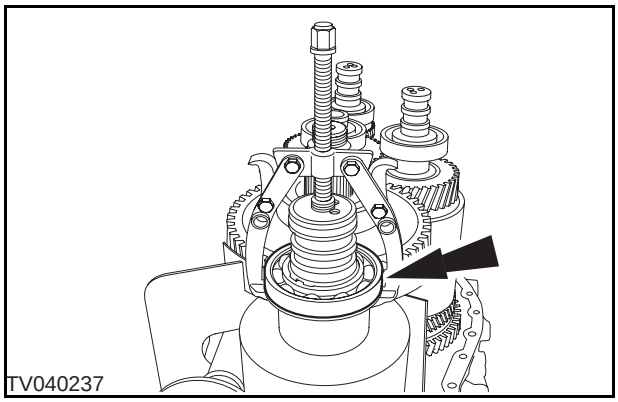

TV040235

25. Remove and discard the output shaft sealing rings (1).
26. Using suitable circlip pliers, remove the output shaft bearing circlip (2).

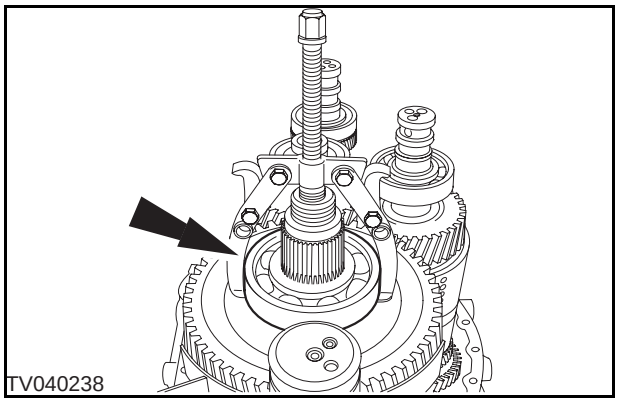


TV040236

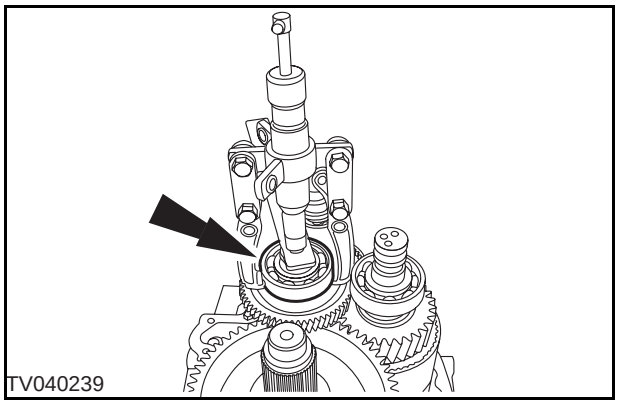
27. Using suitable circlip pliers, remove the output shaft bearing retaining ring.
28. Using a suitable puller, remove the output shaft bearing.


TV040237

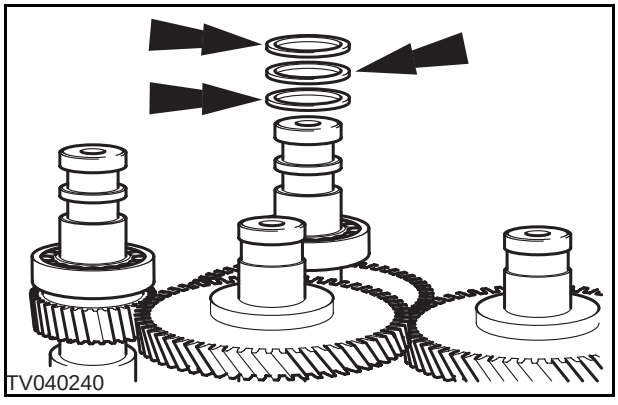
29. Using a suitable puller, remove the 2nd shaft bearing.



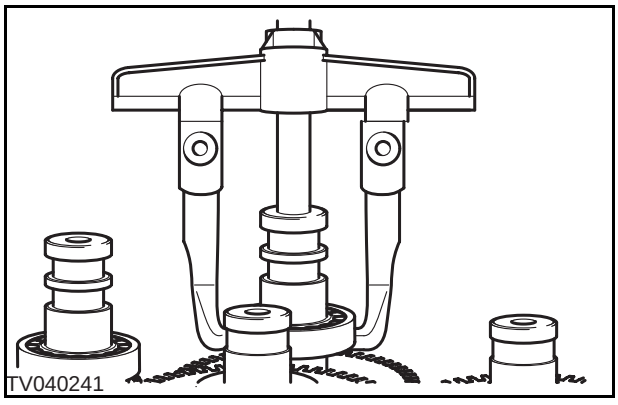
30. Using a suitable puller, remove the input shaft bearing.



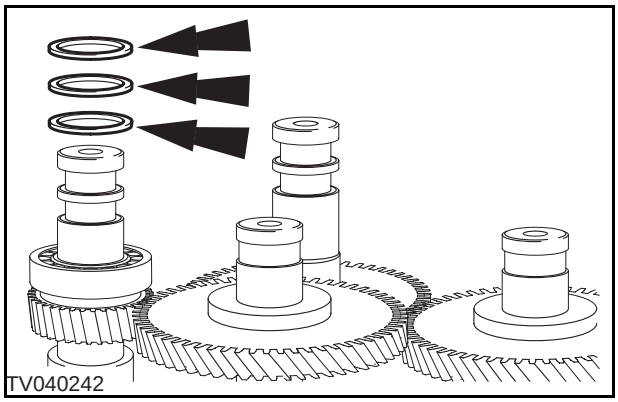
31. Remove and discard the reverse/1st shaft sealing rings.



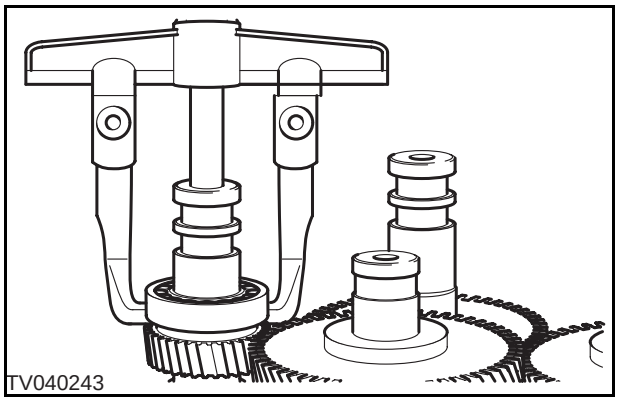
32. Using a suitable puller, remove the reverse/1st shaft bearing.



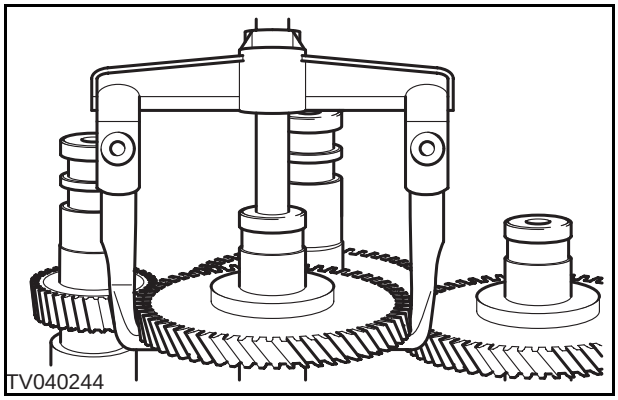
33. Remove and discard the forward low/high shaft sealing rings.



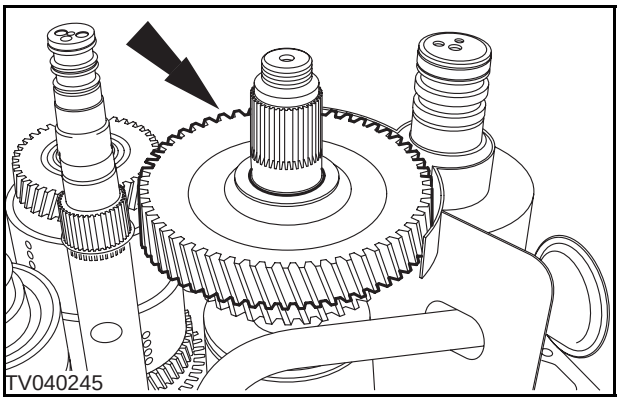
34. Using a suitable puller, remove the forward low/high shaft bearing.



35. Using a suitable puller, remove the forward high gear from the input shaft.

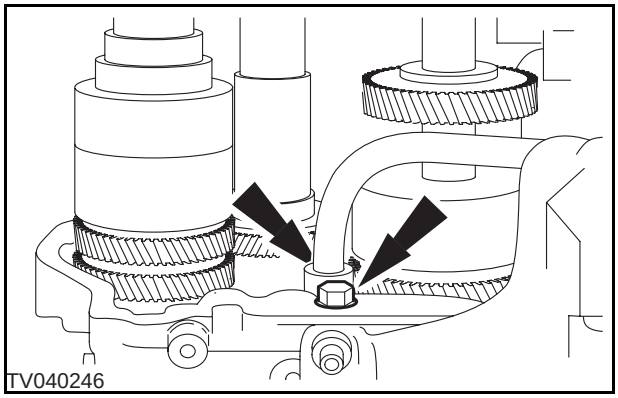


36. Remove the upper output gear from the 2nd shaft.

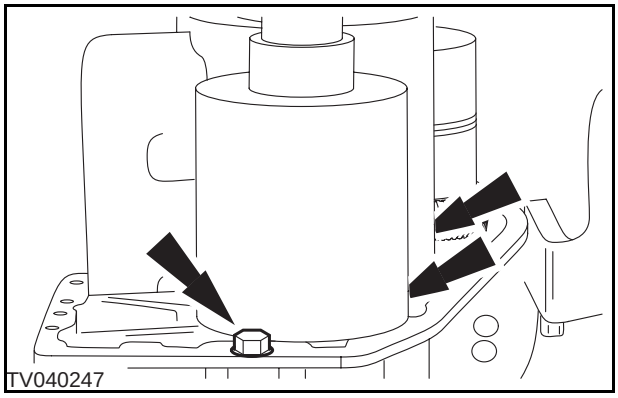


37. Remove the suction tube.

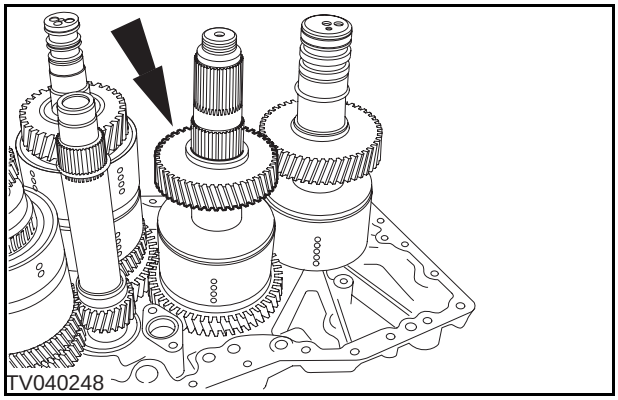
Note:
- Remove and discard the O-ring seal.


TV040246

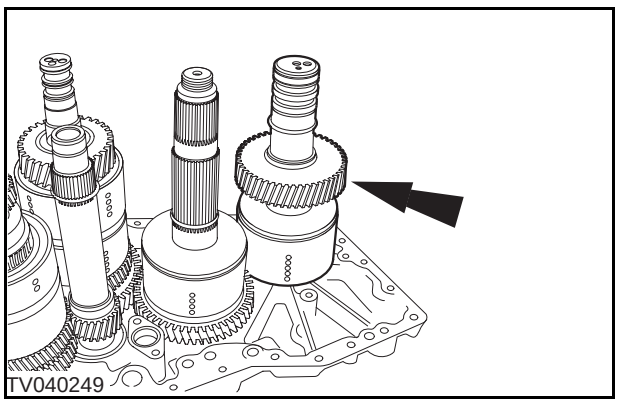
38. Remove the oil baffle.


TV040247

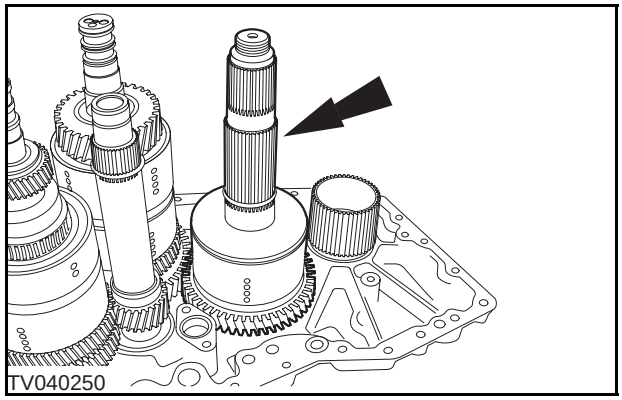
39. Remove the gear from the 2nd shaft.


TV040248

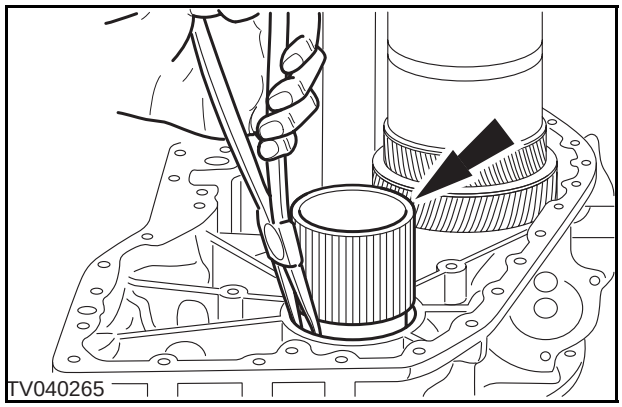
40. Remove the output shaft.


TV040249

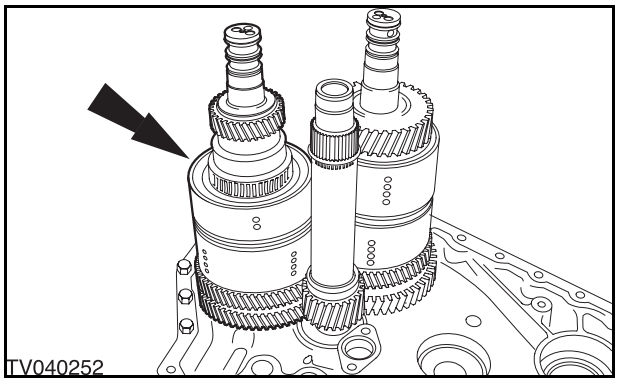
41. Remove the 2nd shaft.


TV040250

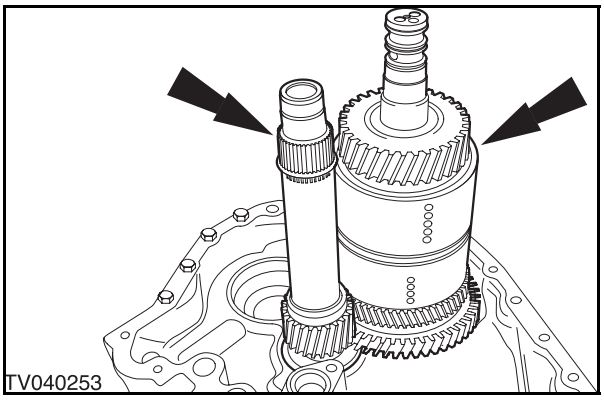
42. Using suitable circlip pliers, expand the circlip and remove the disconnect shaft assembly.


TV040265

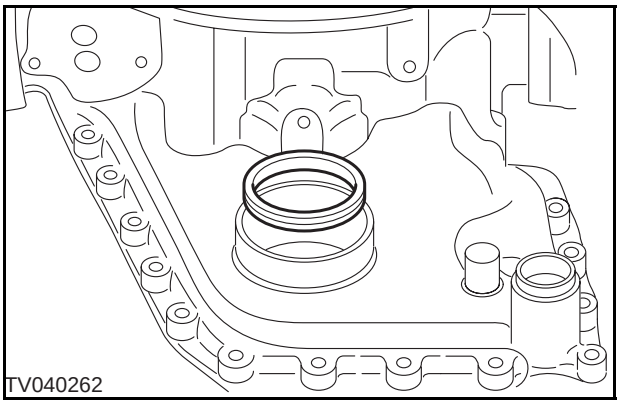
43. Remove the forward high/low shaft assembly.


TV040252

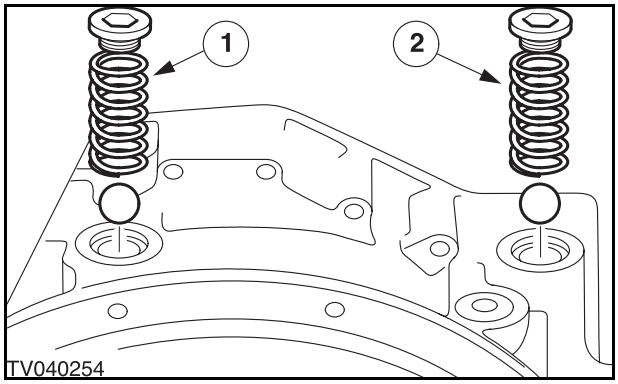
44. Remove the input shaft and reverse/1st shaft together.


TV040253

45. Remove and discard the output shaft oil seal

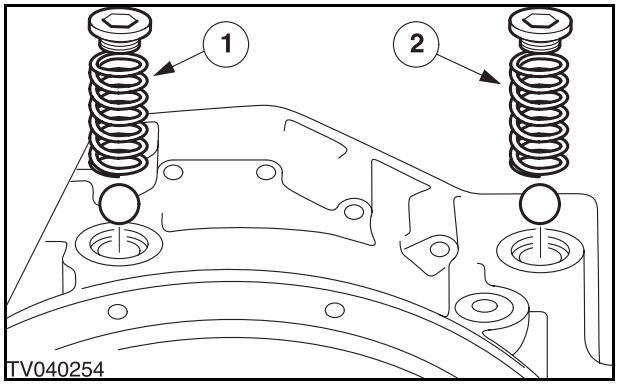


46. Remove the bypass plug, spring and ball (1).
47. Remove the safety valve plug, spring and ball (2).



Assembly

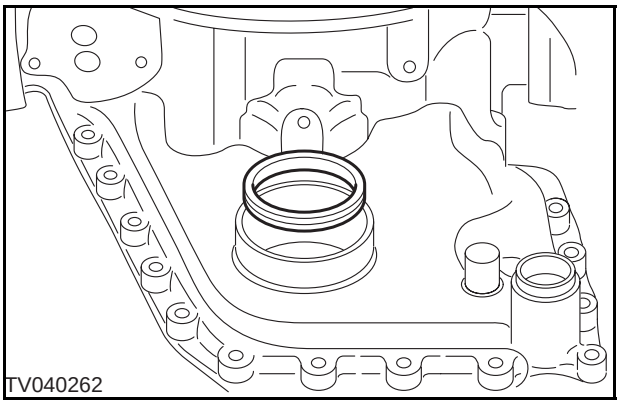
1. Install the safety valve ball, spring and plug (2).
2. Install the bypass plug, spring and ball (1).



Note:

- Lubricate the oil seal with a light grease.

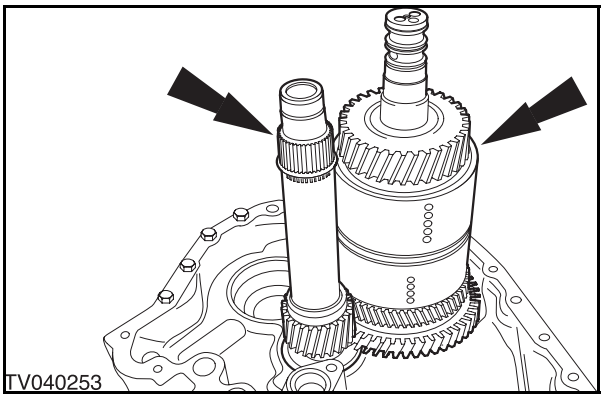
3. Install a new output shaft oil seal



⚠ **Caution:**

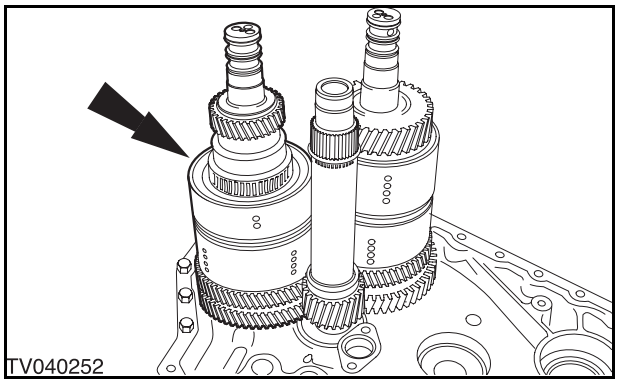
- **Take care not to damage the sealing rings.**

4. Install the input shaft and the reverse/1st shaft together.



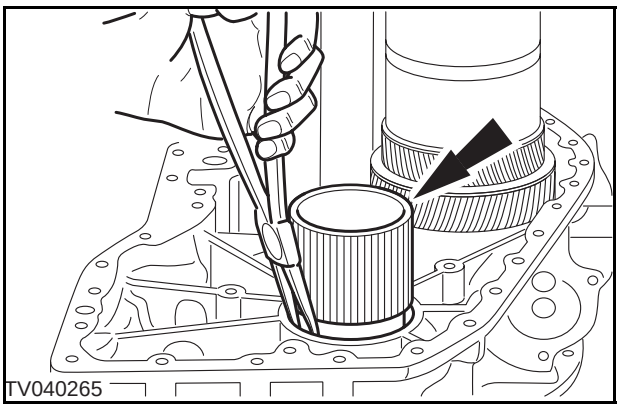
⚠ **Caution:**
- **Take care not to damage the sealing rings.**

5. Install the forward low/high shaft.


TV040252

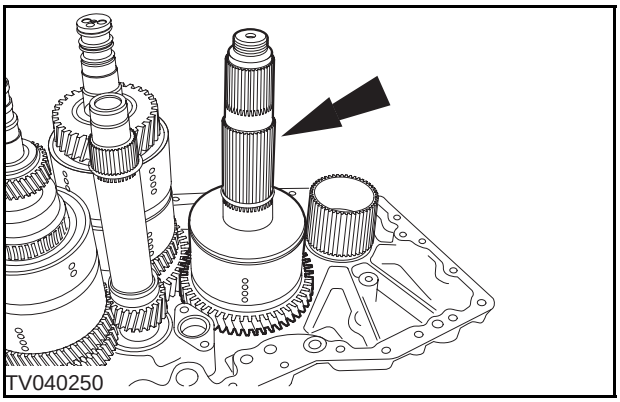
6. Using suitable circlip pliers, expand the circlip and install the disconnect shaft into the housing.

Note:
- Make sure the circlip is correctly located into the groove.


TV040265

⚠ **Caution:**
- **Take care not to damage the sealing rings.**

7. Install the 2nd shaft assembly.

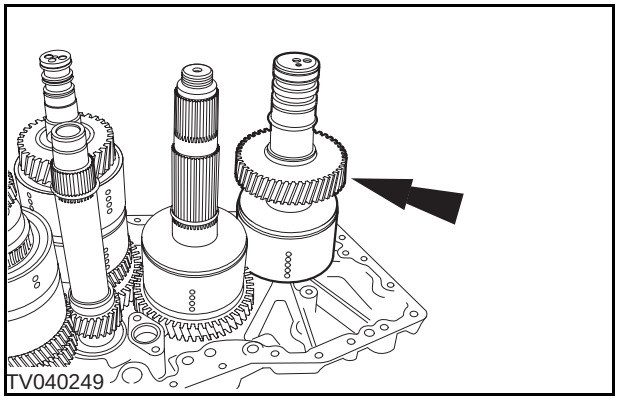

TV040250

⚠ Caution:
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

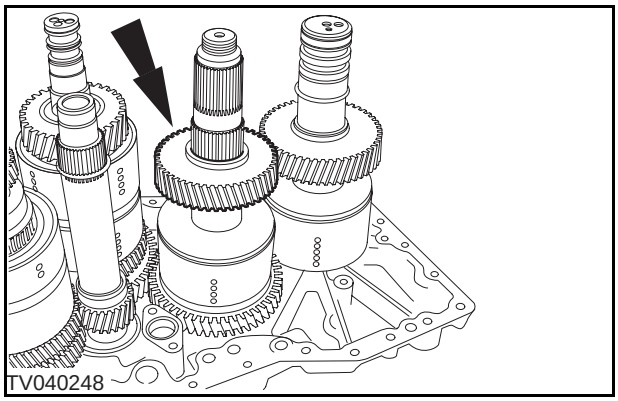
⚠ Caution:
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

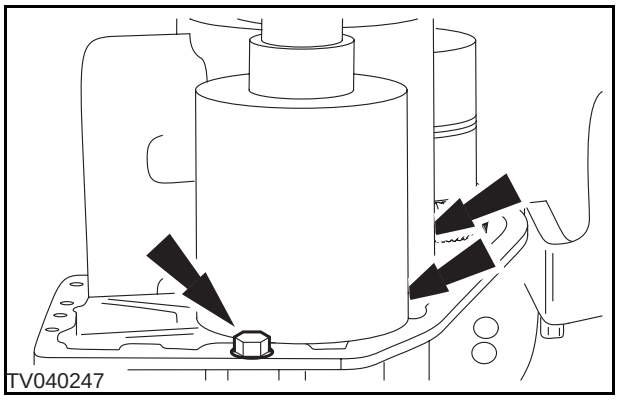
8. Install the output shaft assembly.


TV040249

9. Install the lower output gear to the 2nd shaft.


TV040248

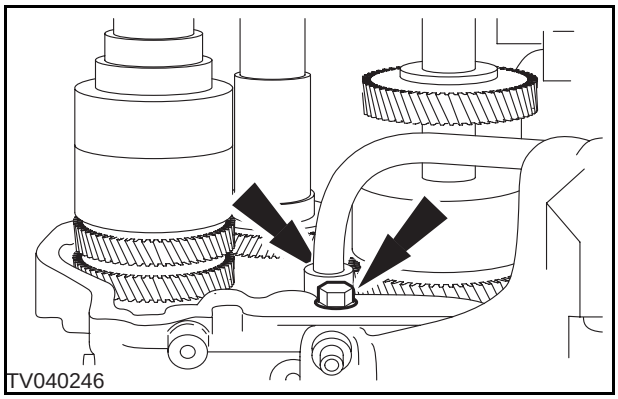
10. Install the oil baffle.
11. Apply Loctite 243 to the threads of the retaining bolts.


TV040247

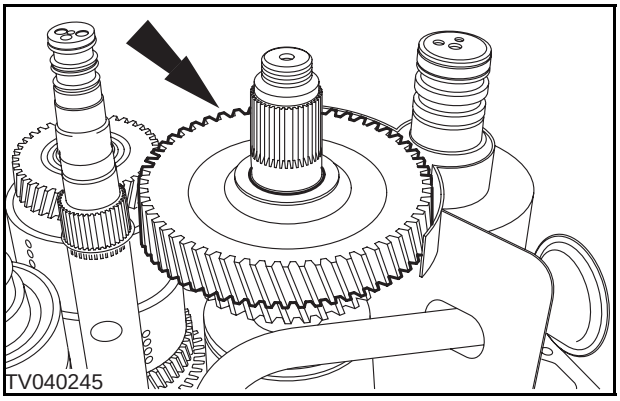
Note:
- Install a new O-ring seal.

12. Install the suction tube.

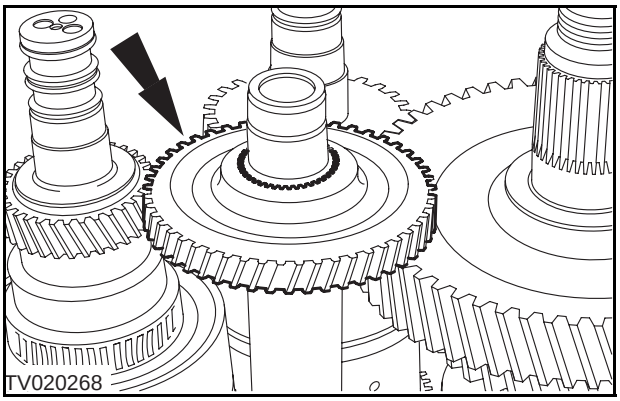
13. Apply Loctite 243 to the threads of the retaining bolts.



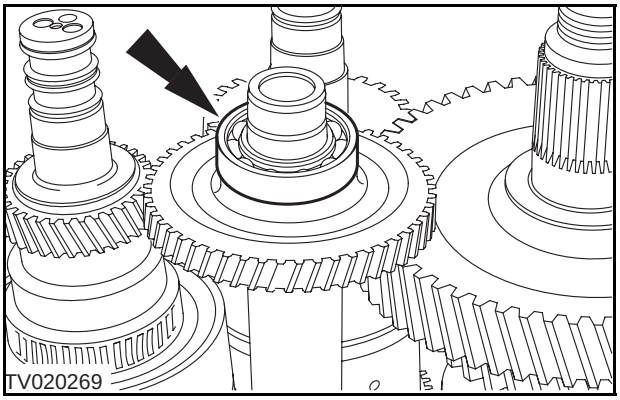
14. Install the upper output gear to the 2nd shaft.



15. Using a suitable bearing heater, heat the forward high gear to 150°C (302°F).
16. Install the forward high gear.

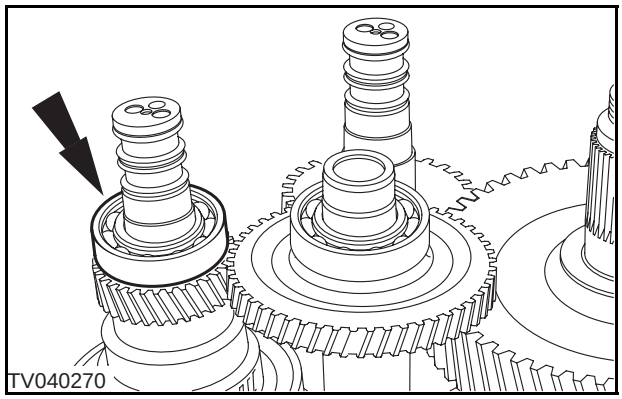


17. Using a suitable bearing heater, heat the input shaft bearing to 120°C (248°F).
18. Install the input shaft bearing.

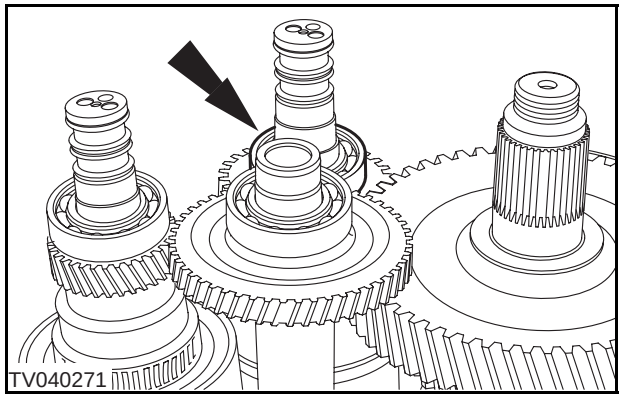


19. Using a suitable bearing heater, heat the reverse/1st shaft bearing to 120°C (248°F).

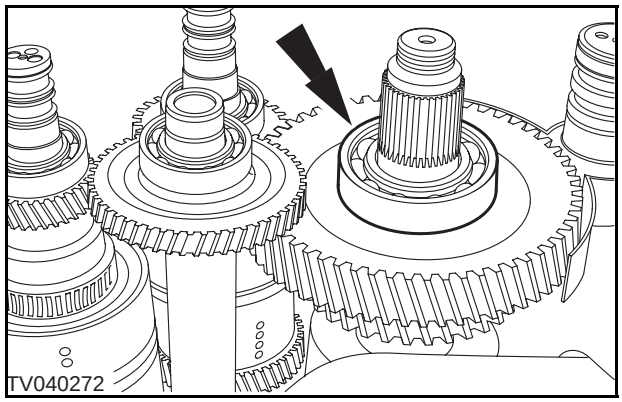
20. Install the reverse/1st shaft bearing.



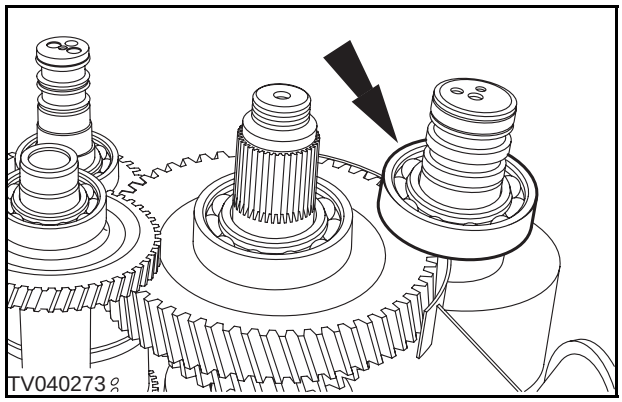
21. Using a suitable bearing heater, heat the reverse/high shaft bearing to 120°C (248°F).
22. Install the reverse/high shaft bearing.



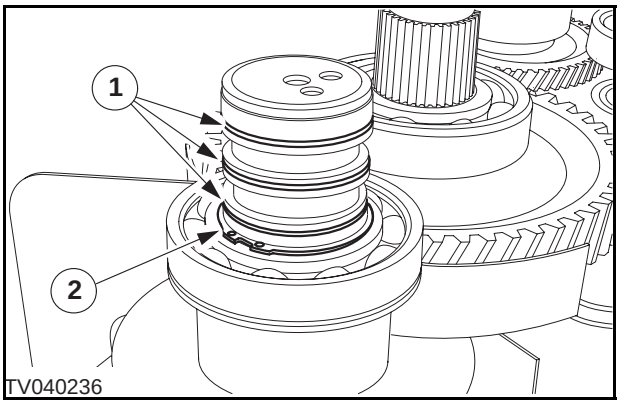
23. Using a suitable bearing heater, heat the upper output shaft bearing to 120°C (248°F).
24. Install the upper output shaft bearing.



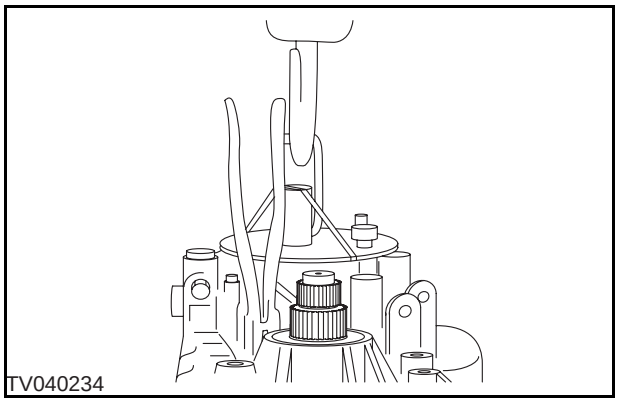
25. Using a suitable bearing heater, heat the lower output shaft bearing to 120°C (248°F).
26. Install the lower output shaft bearing with the groove facing down.



27. Install the output shaft bearing retaining circlip (2).
28. Install the output shaft sealing rings (1).



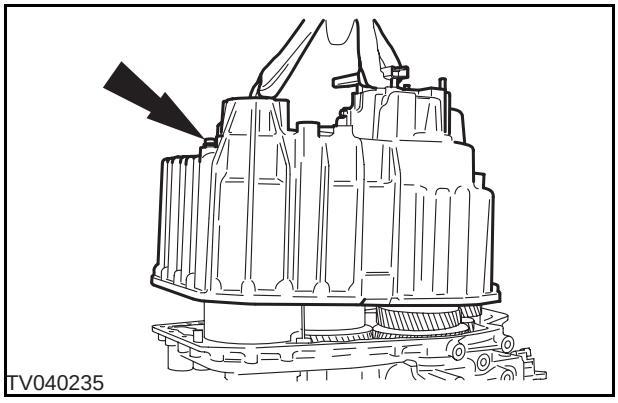
29. Install a new gasket and clutch pressure O-ring seals into the O-ring grooves.
30. Tap the dowel pins in transmission case and torque converter housing.
31. Using internal snap ring pliers, expand the output shaft bearing retaining snap ring.



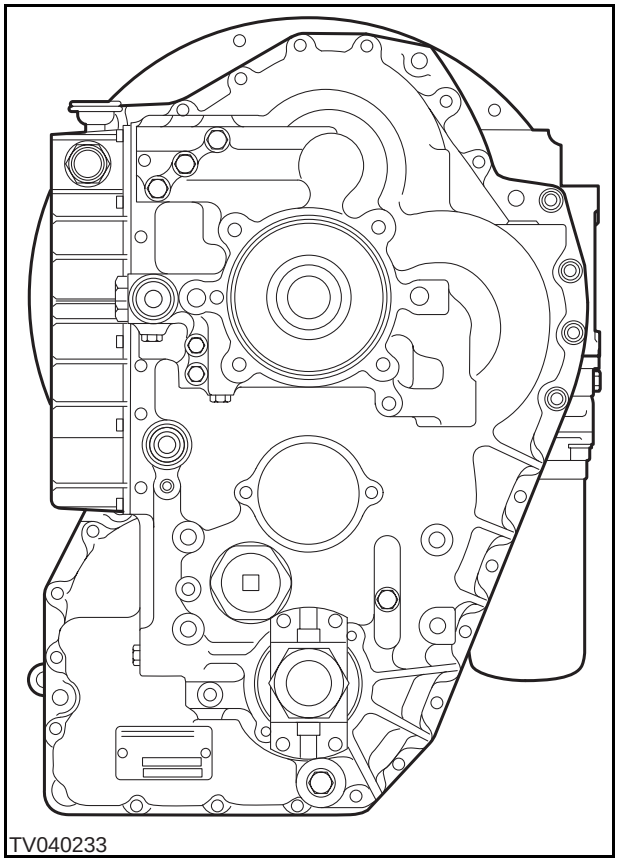
32. Using the locally fabricated transmission housing lifting tool and suitable lifting equipment. Install the transmission housing on to the torque converter housing.

Note:
- Make sure the snap ring is fully in located in the groove.

Note:
- Install the bearing spacer.

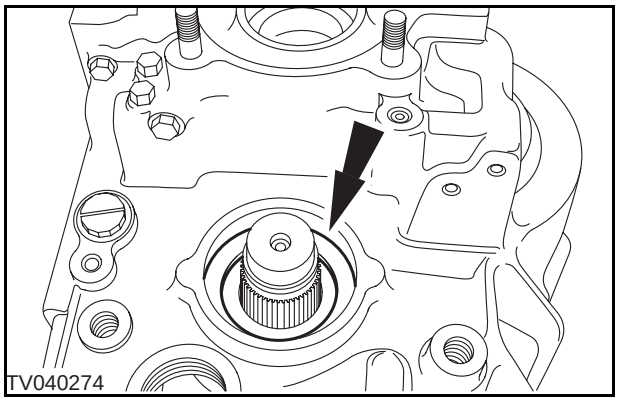


33. Tighten the torque converter housing to transmission housing retaining bolts to 45Nm (33 lb.ft).

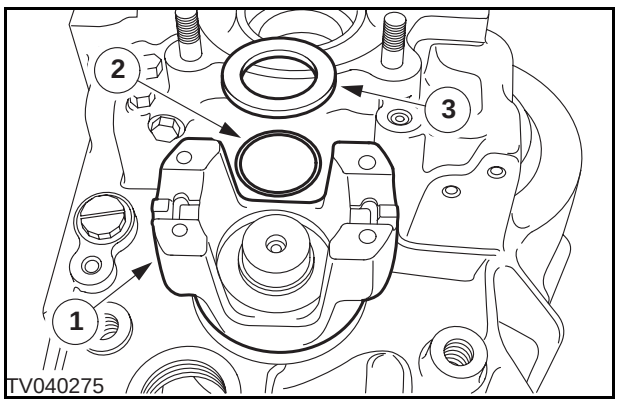

TV040233

Note:
- Lubricate the oil seal with a light grease.

34. Install the lower output shaft oil seal.

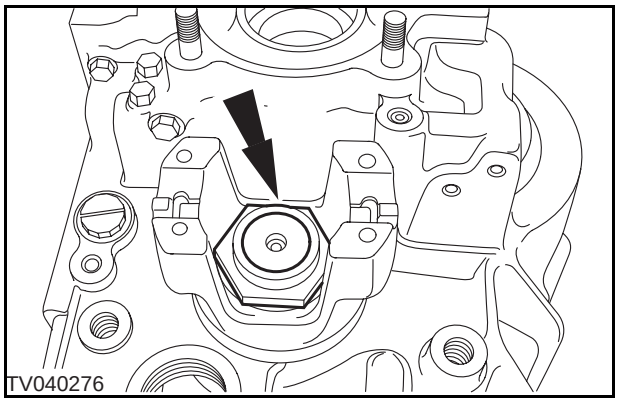

TV040274

35. Install the upper output bore plug.
36. Install the output flange (1) O-ring seal (2) and washers (3).



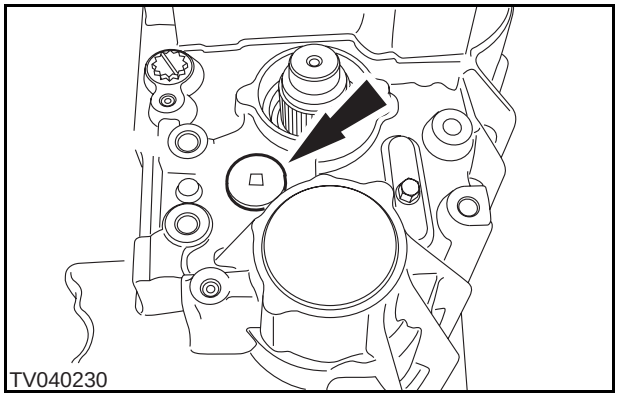
TV040275

37. Install a new output flange retaining nut.
38. Tighten to 380Nm.

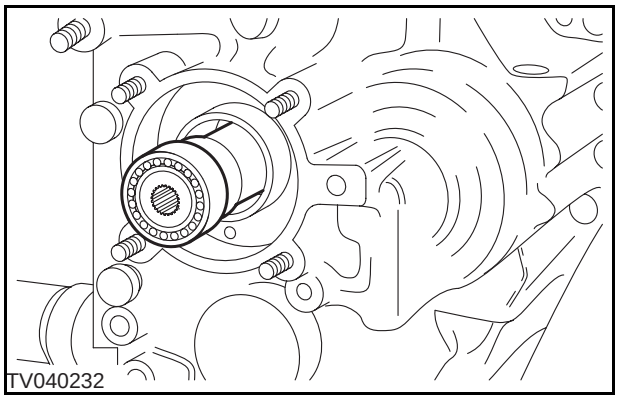

TV040276

Note:
- Install a new O-ring seal.

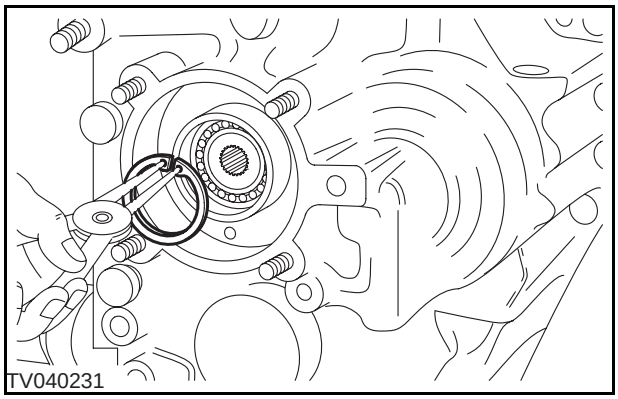
39. Install the transmission housing plug.
40. Tighten to 17Nm (13 lb.ft)


TV040230

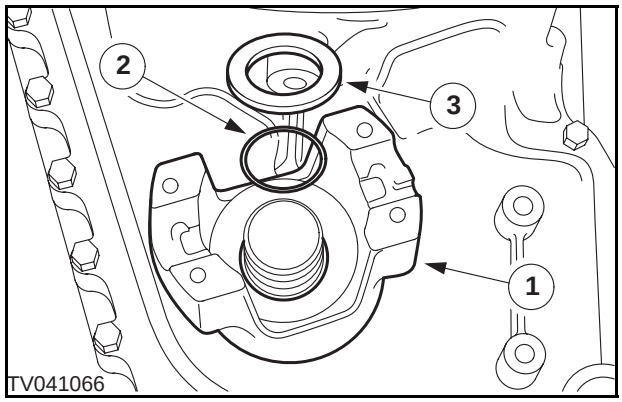
41. Install the charging pump drive shaft assembly into the housing.


TV040232

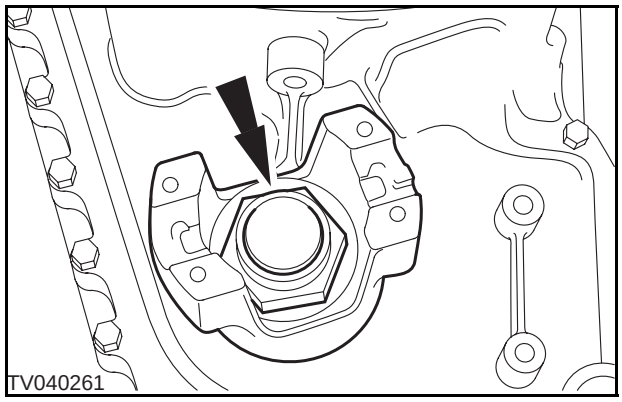
42. Using suitable circlip pliers, install the charging pump drive shaft rear bearing circlip.


TV040231

43. Install the four-wheel drive flange (1), O-ring seal (2) and washer (3).

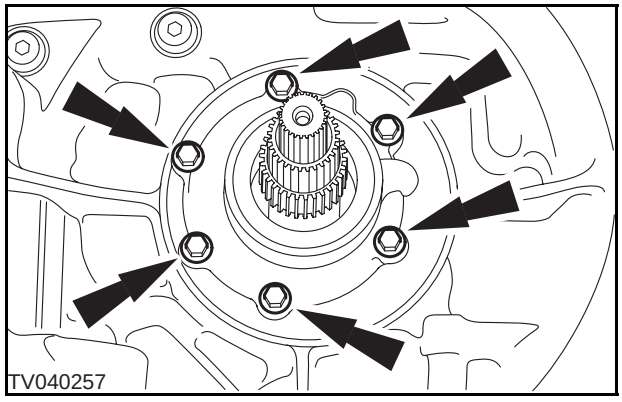


44. Install a new four-wheel drive flange retaining nut.
45. Tighten to 380Nm (280 lb.ft).

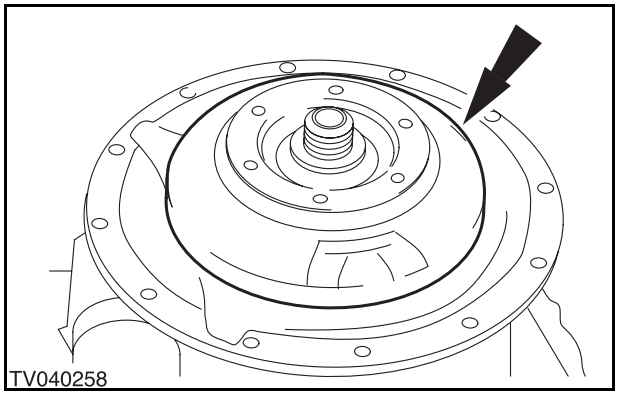


Note:
- Install a new O-ring seal and doughty washers.

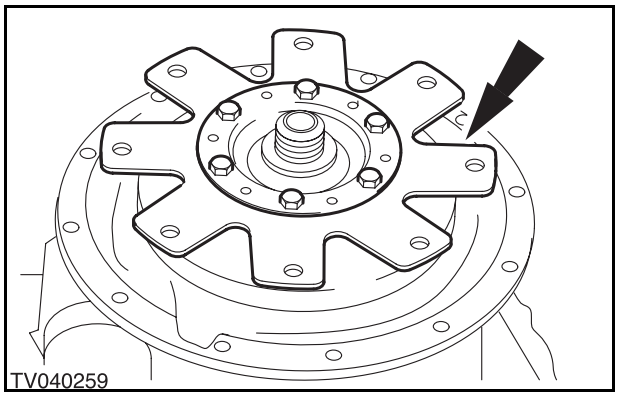
46. Install the charging pump into the converter housing.
47. Tighten to 23Nm (17 lb.ft).



48. Install the torque converter.

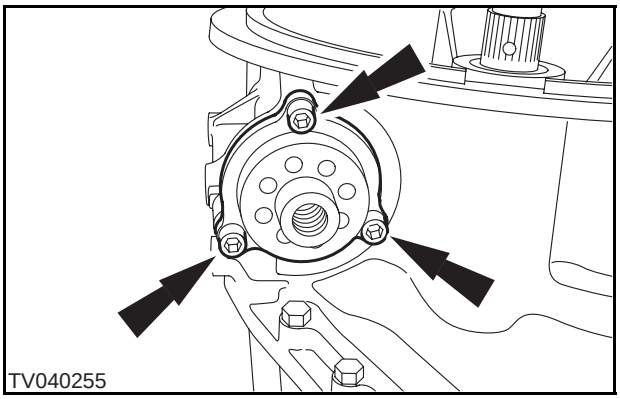


49. Install the drive plates and backing ring.
50. Tighten to 37Nm (27 lb.ft).

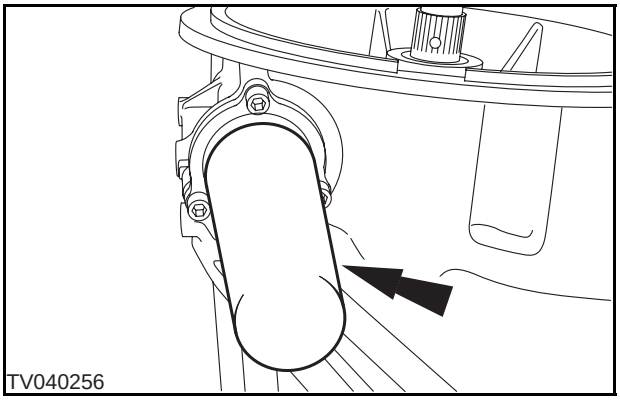


Note:
- Install a new 0–ring seal.

51. Install the transmission oil filter adaptor.
52. Tighten to 23Nm (17 lb.ft).



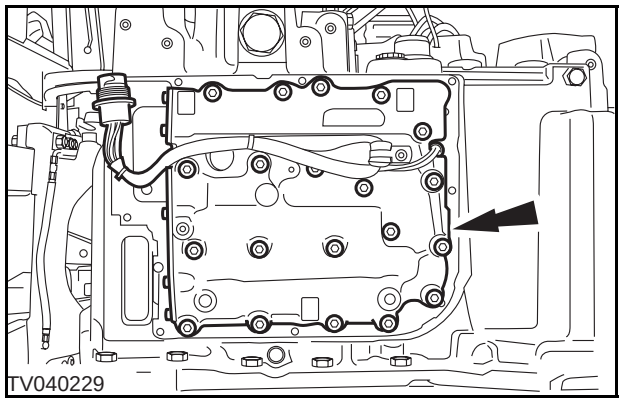
53. Install a new transmission oil filter.
54. Tighten to 34Nm (25 lb.ft).



Note:
- Install the bypass valve spool into the solenoid housing and the spring into the transmission case.

55. Install the transmission control valve.

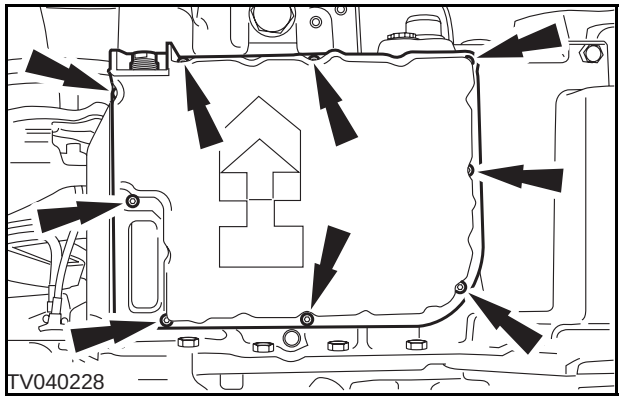
56. Tighten to 22Nm (16 lb.ft).


TV040229

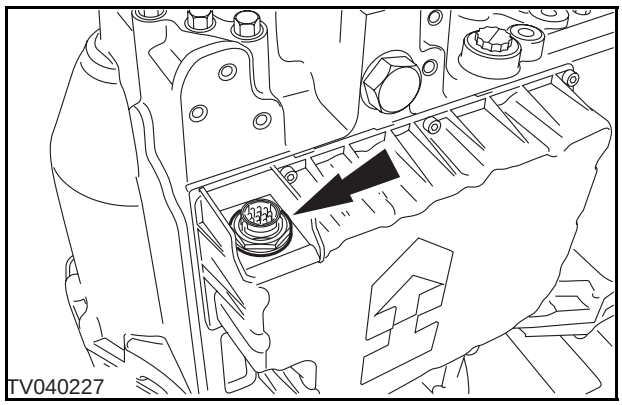
Note:
- Position the wiring harness electrical connector in the transmission control valve protection cover.

Note:
- Install a new gasket.

57. Install the control valve protection cover.
58. Tighten to 6Nm (4 lb.ft).

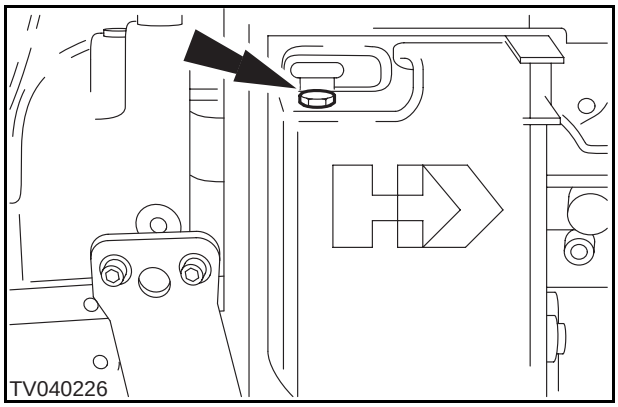

TV040228

59. Install the wiring harness electrical connector mounting nut.
60. Tighten to 7Nm (5 lb.ft).


TV040227

61. Install the breather.

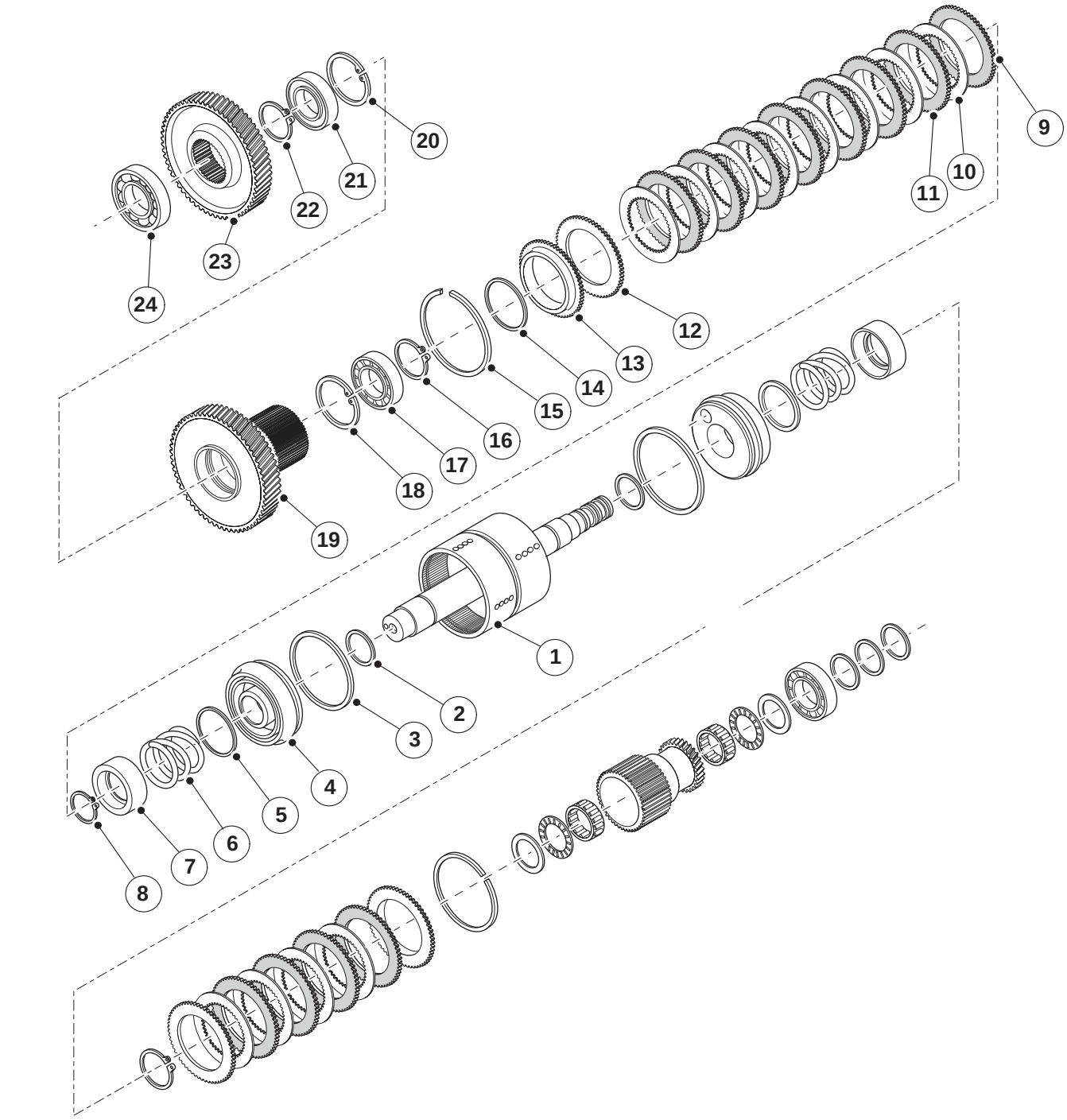
62. Tighten to 38Nm (28 lb.ft).



DISASSEMBLY AND ASSEMBLY — FORWARD LOW CLUTCH

BHN1301DC

Operation: **Disassembly and Assembly of the Forward Low Clutch**	*Job Code:* **13 42 17 xx**		
None	Standard tools, Clutch piston spring compressor		

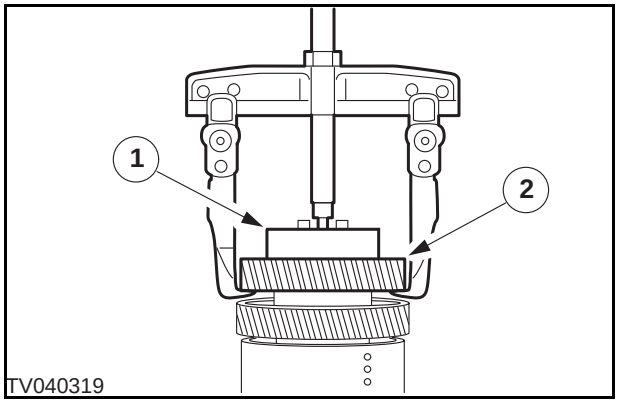


TV040571

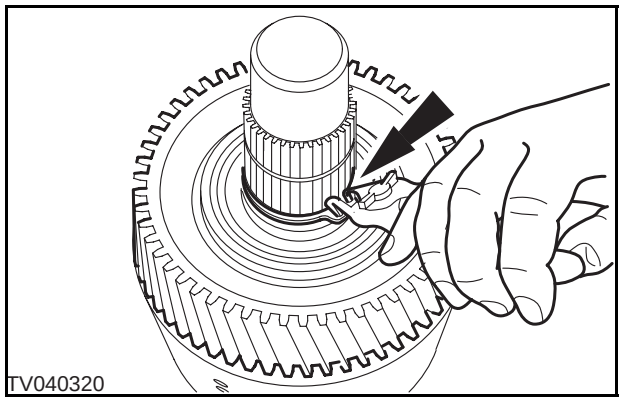
1	Low/High Clutch Shaft
2	Clutch Piston Inner Seal
3	Clutch Piston Outer Seal
4	Clutch Piston
5	Piston Wear Washer
6	Piston Return Spring
7	Spring Retainer
8	Circlip
9	Clutch Outer Half Friction Disc
10	Clutch Inner Friction Disc (x8)
11	Clutch Outer Steel Disc (x7)
12	Clutch Outer Half Friction Disc
13	Backing Plate
14	Backing Plate Seal
15	Backing Plate Retaining Snap Ring
16	Circlip
17	Clutch Gear Bearing
18	Circlip
19	Low Clutch Gear
20	Circlip
21	Clutch Gear Bearing
22	Circlip
23	Reverse Driven Gear
24	Low/High Clutch Shaft Bearing

Disassembly

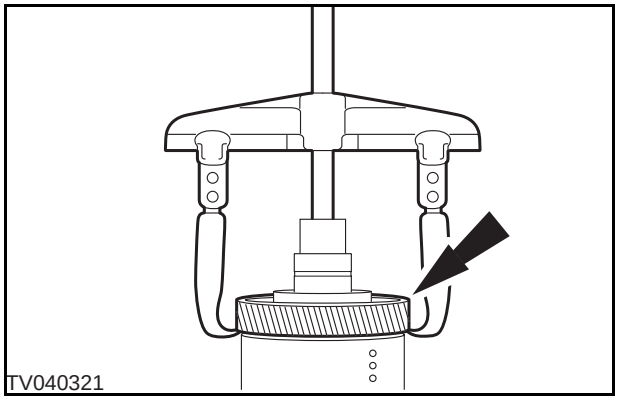
1. Using a suitable puller, remove the low/high clutch shaft bearing (1) and reverse driven gear (2).



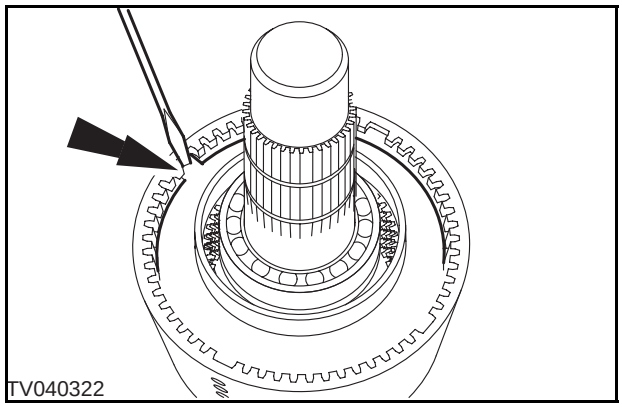
2. Using suitable circlip pliers, remove the clutch gear circlip.



3. Using a suitable puller, remove the clutch gear and clutch gear outer bearing.

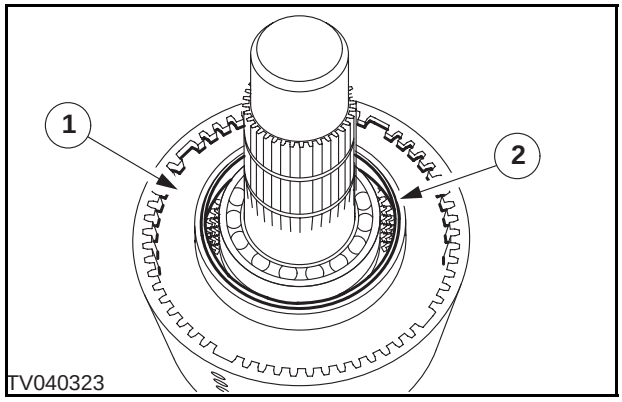


4. Remove the backing plate retaining snap ring.

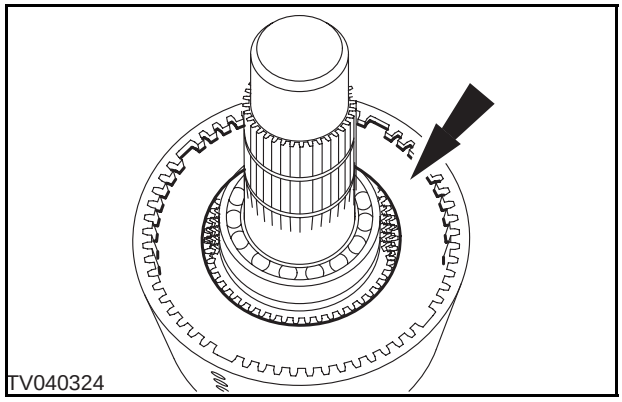


5. Remove the clutch disc backing plate (1).

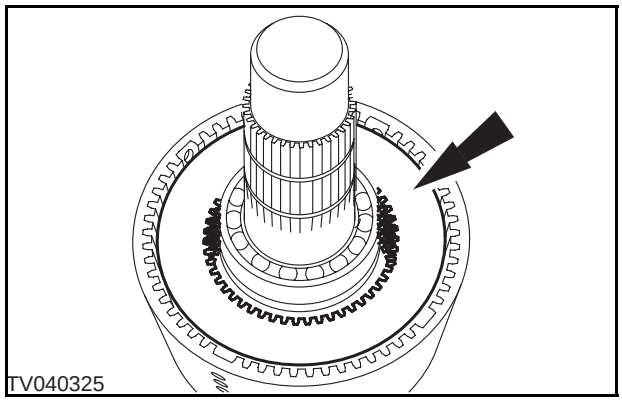
Note:
- Remove and discard the sealing ring (2).



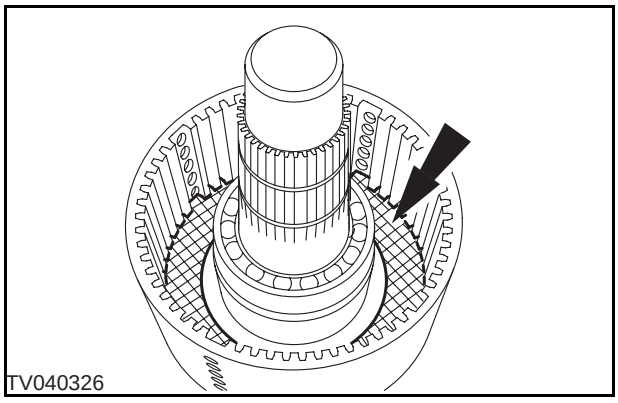
6. Remove the outer half friction disc.



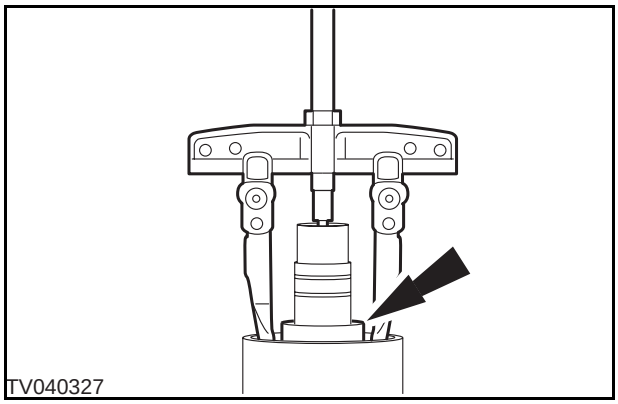
7. Remove the eight clutch inner steel discs and seven clutch outer friction discs.



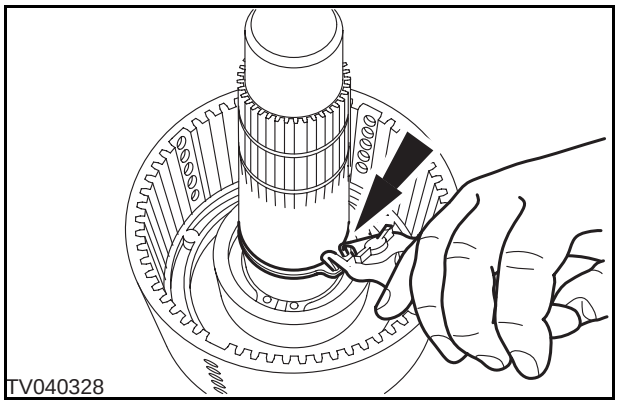
8. Remove the outer half friction disc.



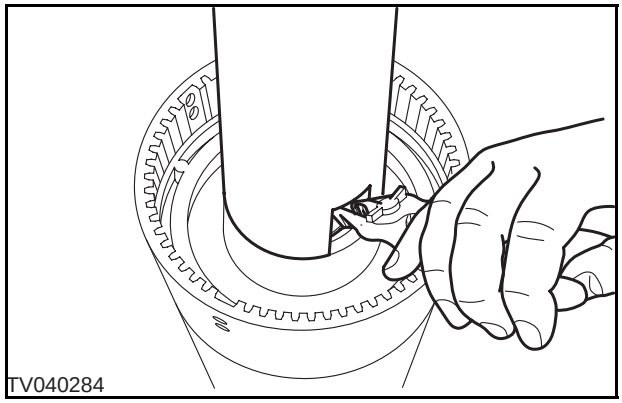
9. Using a suitable puller, remove the clutch gear inner bearing.


TV040327

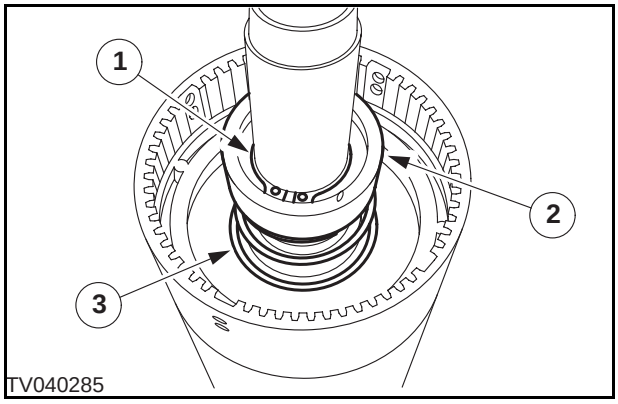
10. Using suitable circlip pliers, remove the clutch gear inner bearing locating circlip.


TV040328

11. Using a suitable hydraulic press, compress the piston return spring.
12. Using suitable circlip pliers, release the piston return spring retaining circlip.

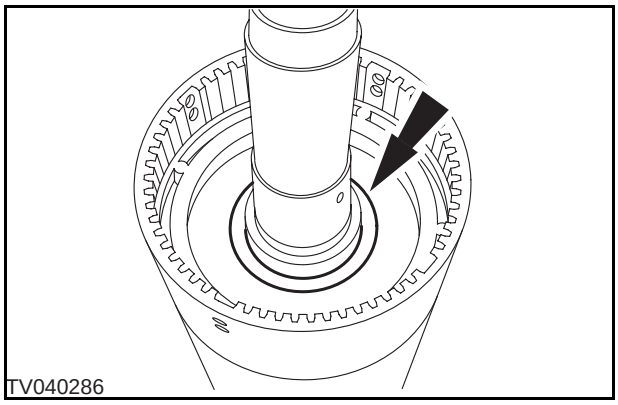

TV040284

13. Remove the circlip (1), spring retainer (2) and piston return spring (3).

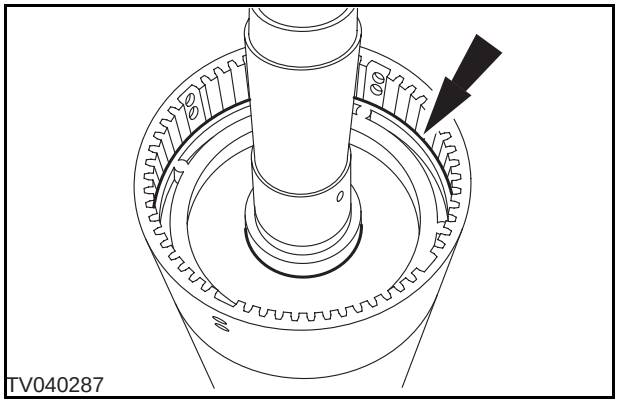


TV040285

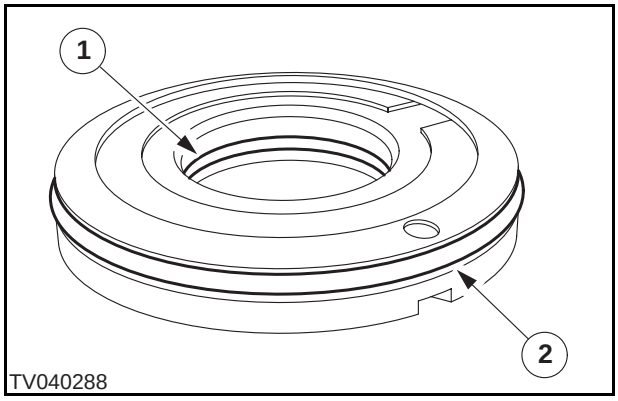
14. Remove the clutch piston wear washer.


TV040286

15. Remove the clutch piston assembly.


TV040287

16. Remove and discard the clutch piston inner seal (1) and outer seal (2).



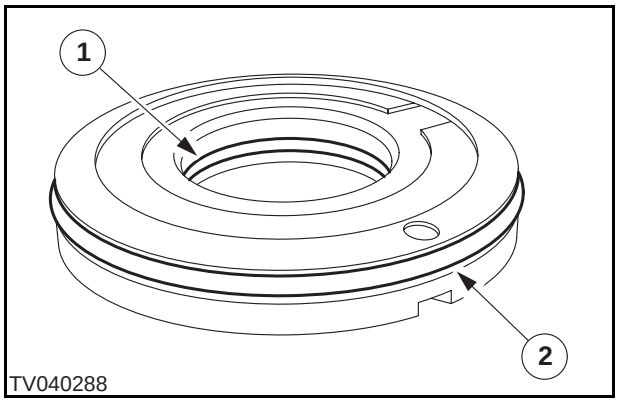
TV040288

Assembly

Note:
- Install new sealing rings.

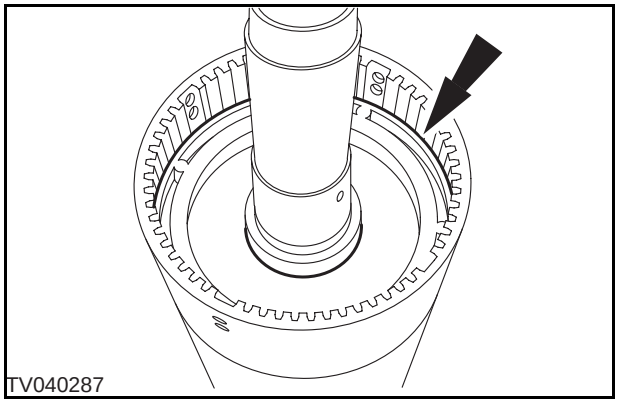
1. Install clutch piston inner seal (1) and outer seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

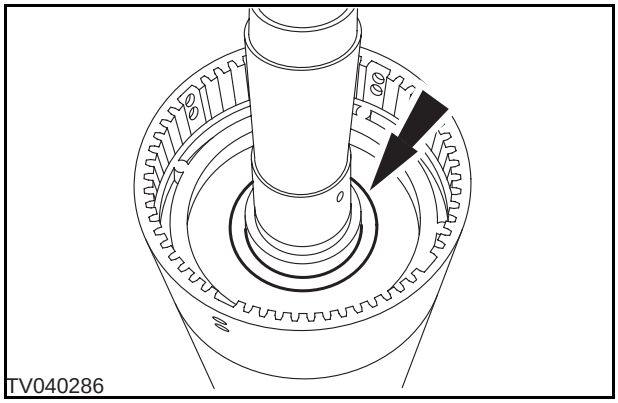


⚠ Caution:
- **Take care not to damage the sealing rings.**

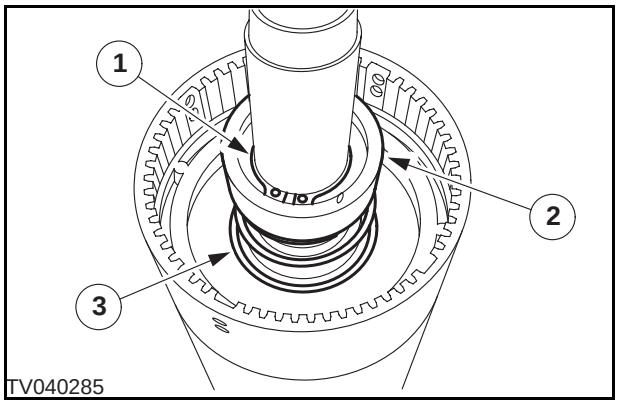
2. Install the clutch piston into the clutch drum.



3. Install the clutch piston wear washer.

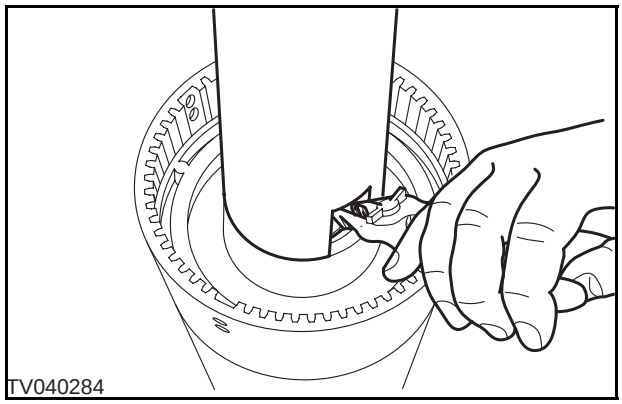


4. Install the piston return spring (3), spring retainer (2) and the circlip (1).

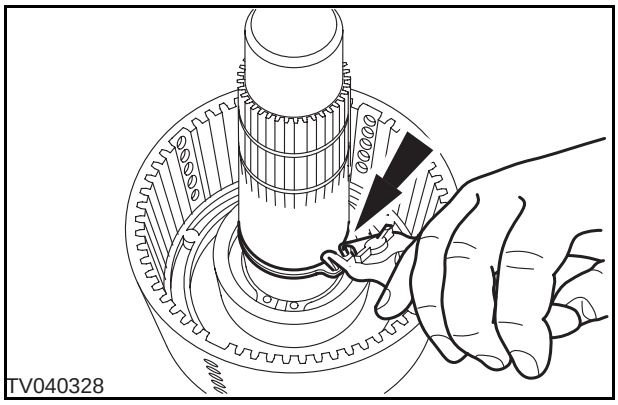


5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable circlip pliers, install the circlip.

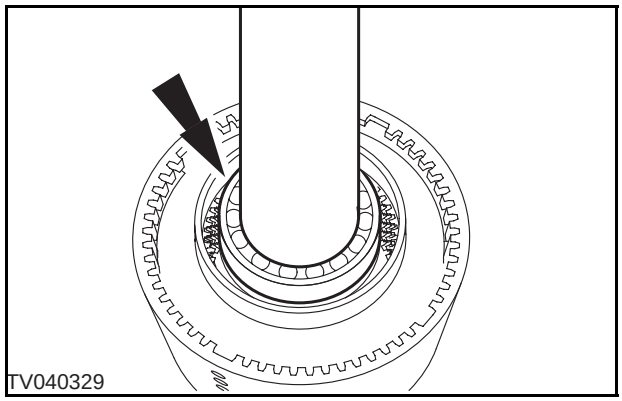
Note:
- Make sure the circlip is correctly located in the groove.



7. Using suitable circlip pliers, install the clutch gear inner bearing locating circlip.



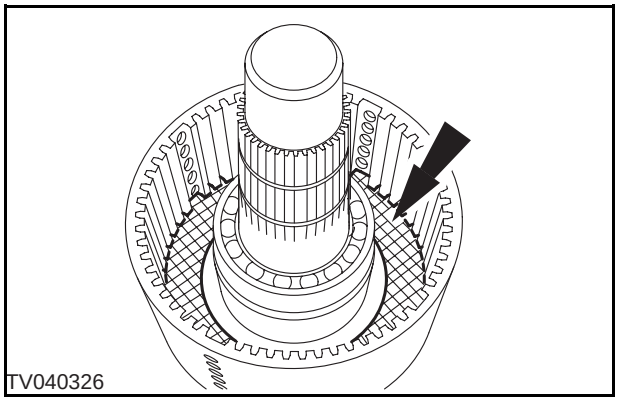
8. Using a suitable hydraulic press, install the clutch gear inner bearing.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Install the outer half friction disc with the friction side of the disc away from the piston.

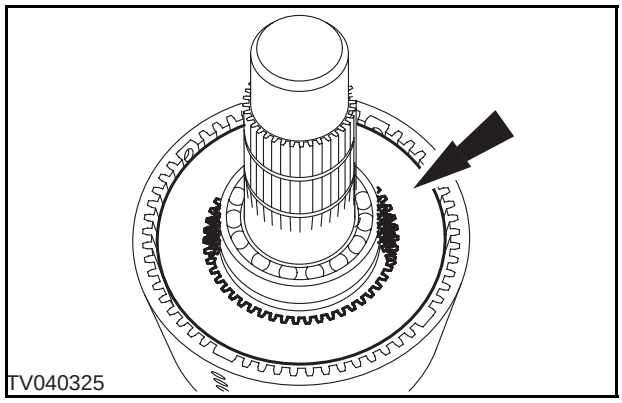
9. Install the outer half friction disc.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed. The first and last discs are steel.

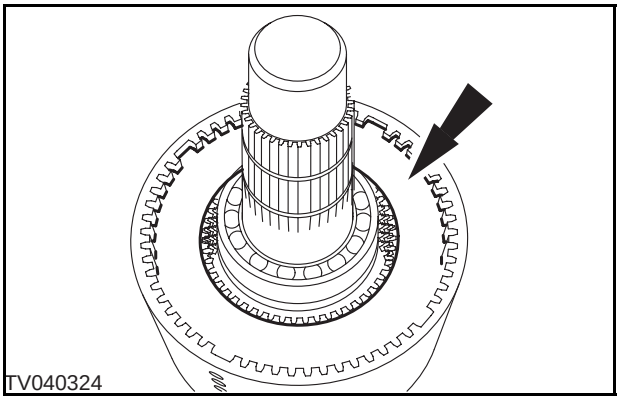
10. Install the eight clutch inner steel discs and seven clutch outer friction discs.



Note:
- Soak new friction discs in transmission oil before assembly.

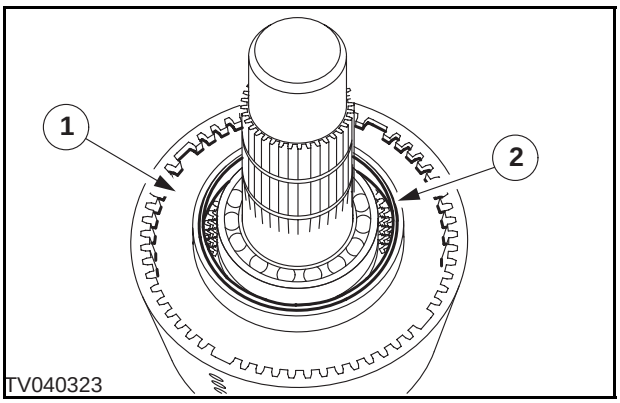
Note:
- Install the outer half friction disc with the friction side of the disc towards the piston.

11. Install the outer half friction disc.

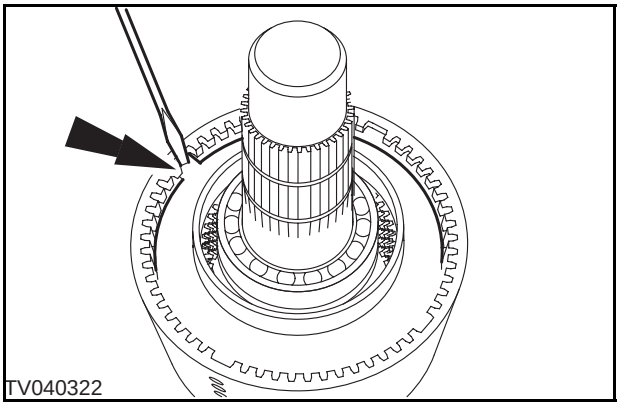


Note:
- Install a new sealing ring (2).

12. Install the clutch disc backing plate (1).



13. Install the backing plate retaining snap ring.



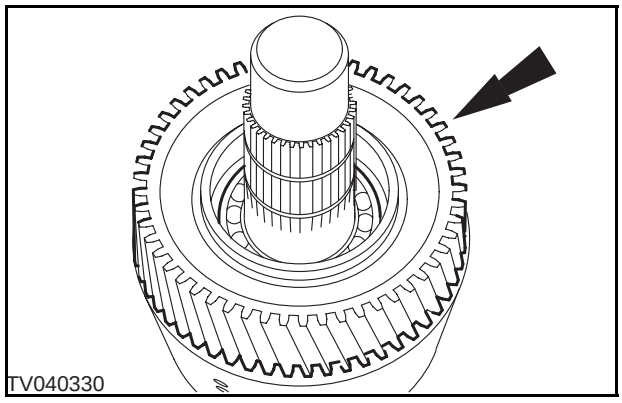
⚠ **Caution:**
- **Take care not to damage the sealing ring.**

⚠ **Caution:**
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

⚠ **Caution:**
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

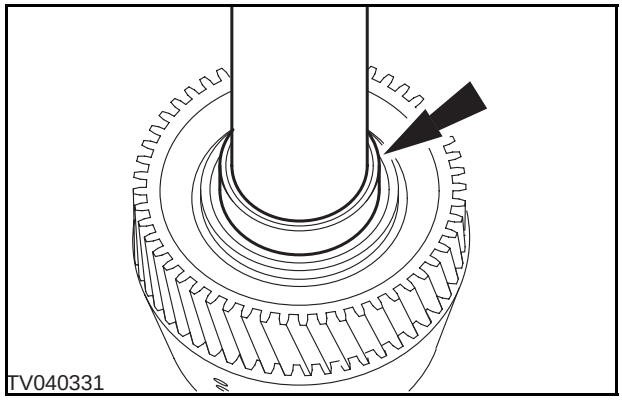
Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

14. Install the low clutch gear assembly.

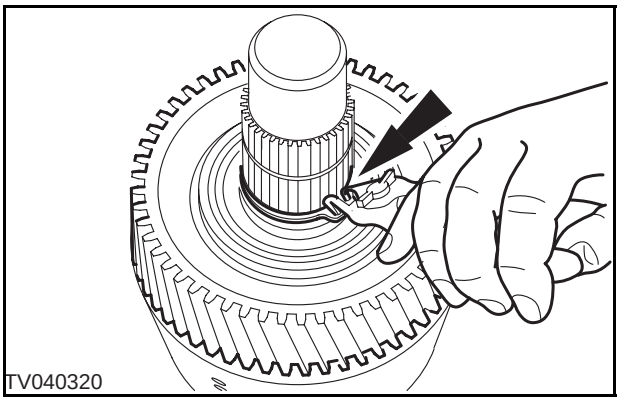

TV040330

Note:
- Make sure that the bearing shield is on the outside.

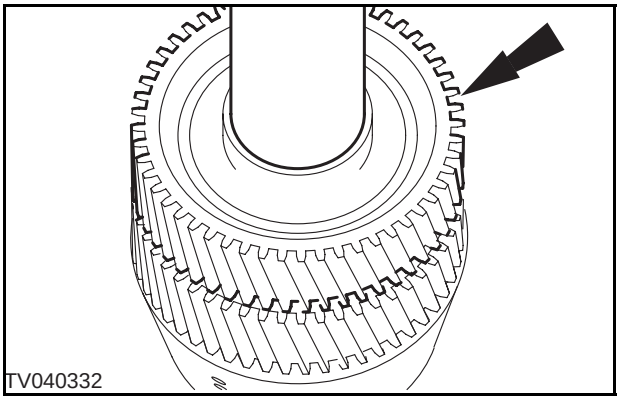
15. Using a suitable hydraulic press, install the clutch gear outer bearing.


TV040331

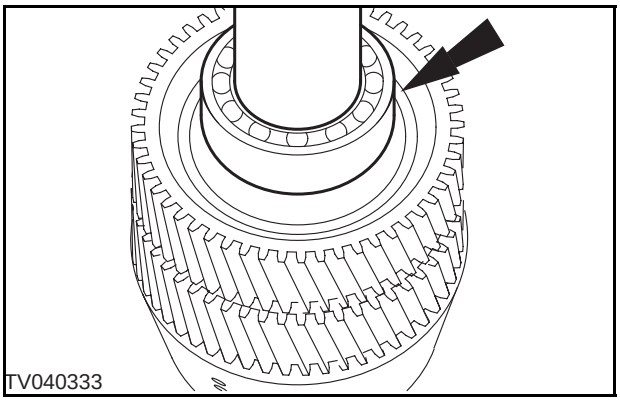
16. Using suitable circlip pliers, install the outer bearing circlip.



17. Using a suitable hydraulic press, install the reverse driven gear.



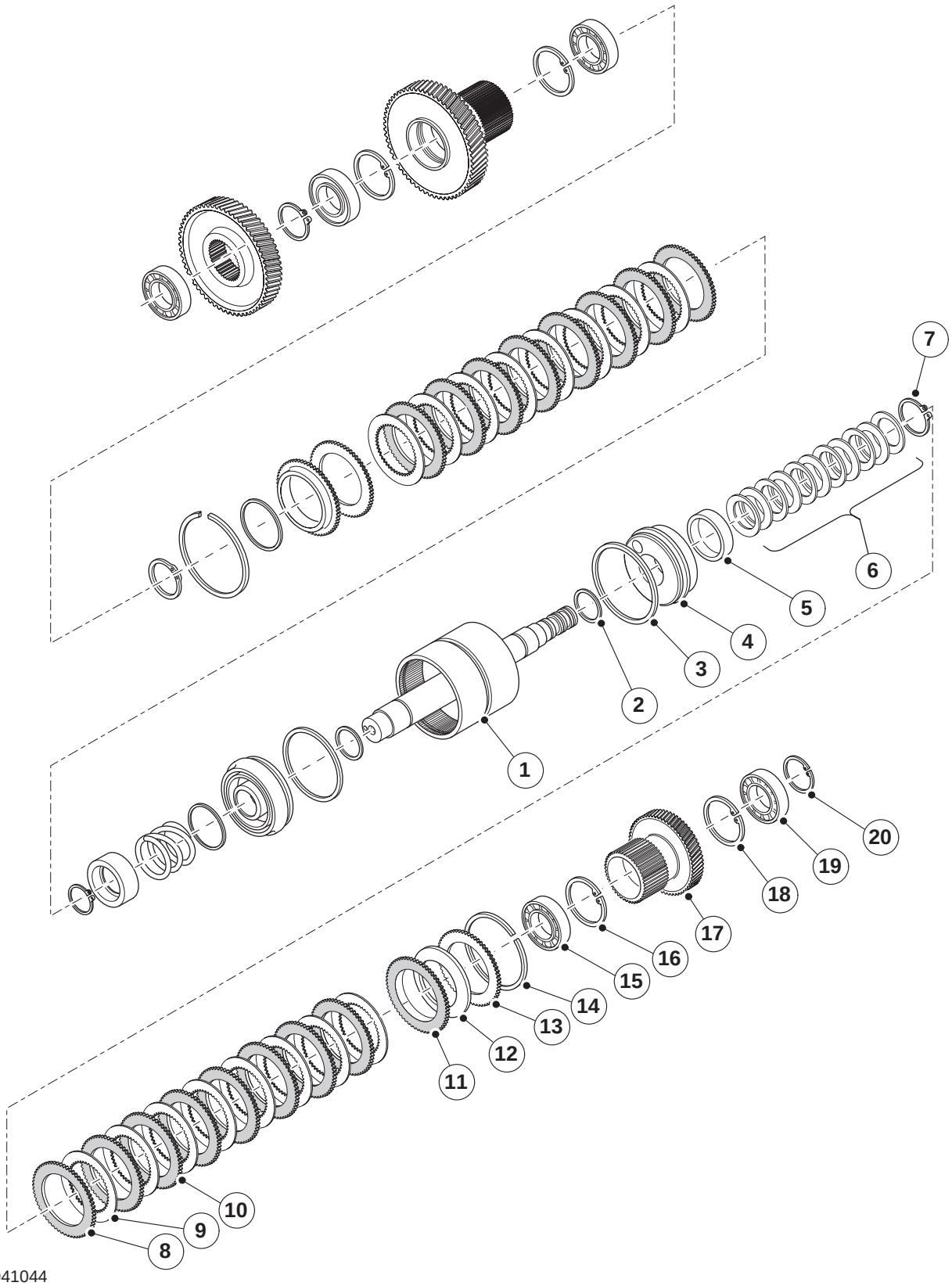
18. Using a suitable hydraulic press, install the clutch shaft bearing.



DISASSEMBLY AND ASSEMBLY — 1ST CLUTCH

BHN1301DD

Operation: **Disassembly and Assembly of the 1st Clutch**	*Job Code:* **13 43 17 xx**		
None	Standard tools		

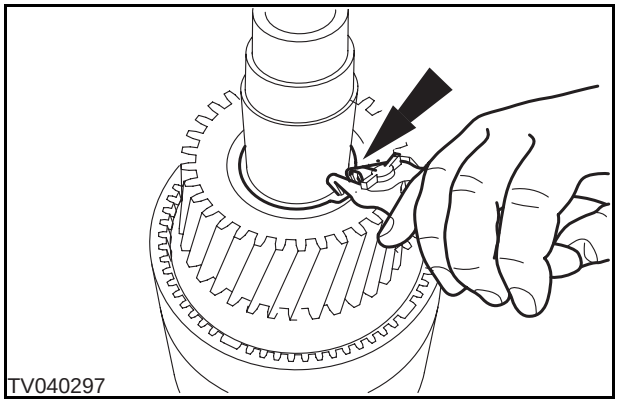


TV041044

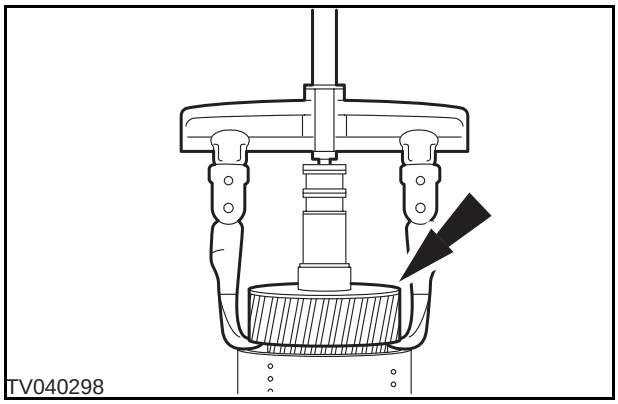
1	Reverse/1st Clutch Shaft
2	Clutch Piston Inner Seal
3	Clutch Piston Outer Seal
4	Clutch Piston
5	Clutch Piston Wear Spacer
6	Belleville Washers (x11)
7	Circlip
8	Clutch Outer Half Friction Disc
9	Clutch Inner Steel Disc (x8)
10	Clutch Outer Friction Disc (x7)
11	Clutch Outer Half Friction Disc
12	Modulation Spring
13	Backing Plate
14	Backing Plate Retaining Snap Ring
15	Clutch Gear Bearing
16	Circlip
17	1st Clutch Gear
18	Circlip
19	Clutch Gear Bearing
20	Snap Ring

Disassembly

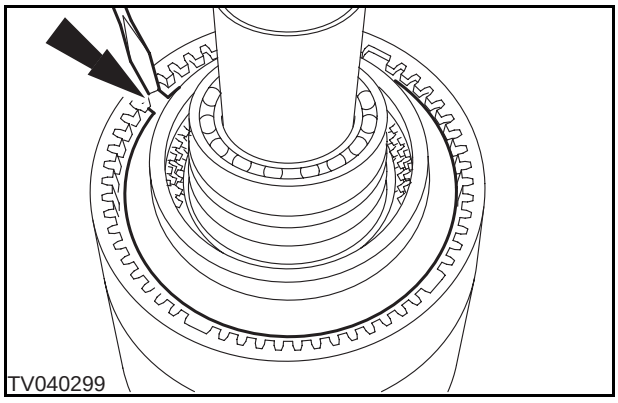
1. Using suitable circlip pliers, remove the 1st clutch gear bearing circlip.



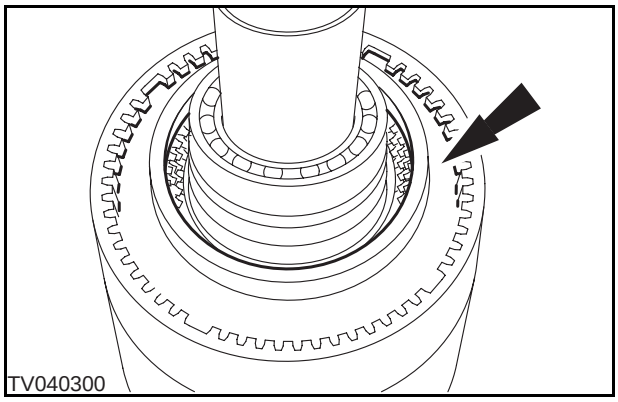
2. Using a suitable puller, remove the 1st clutch gear and clutch gear bearing.



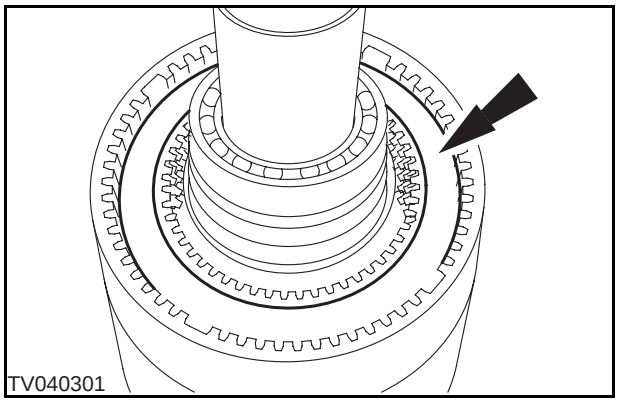
3. Remove the backing plate retaining snap ring.



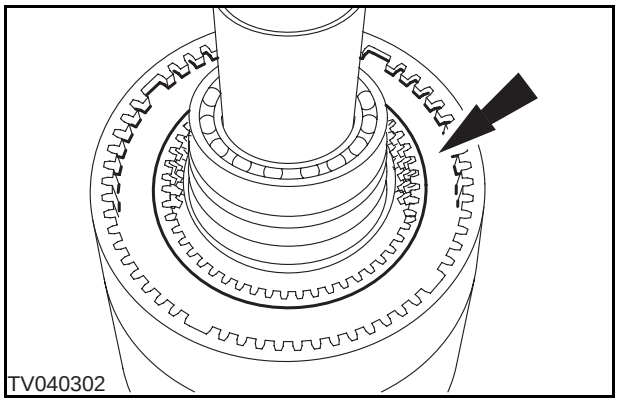
4. Remove the backing plate.



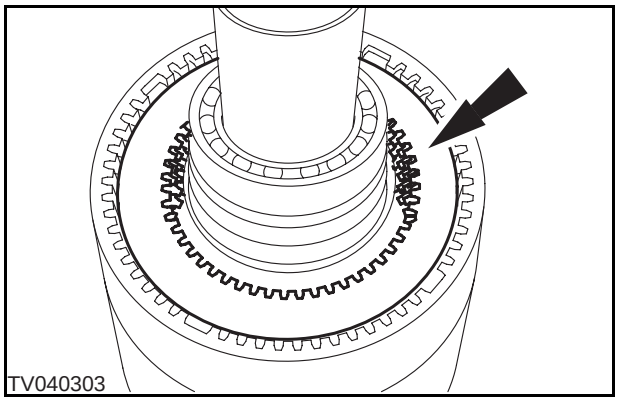
5. Remove the modulation spring.


TV040301

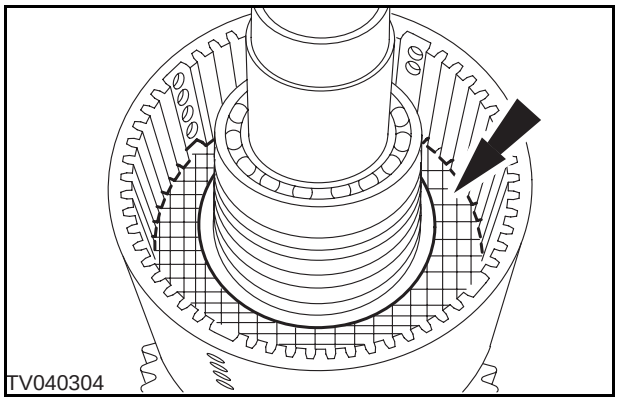
6. Remove the outer half friction disc.


TV040302

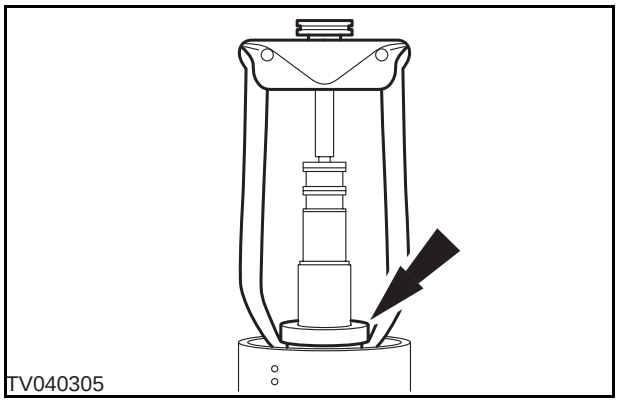
7. Remove the eight inner steel discs and seven outer friction discs.


TV040303

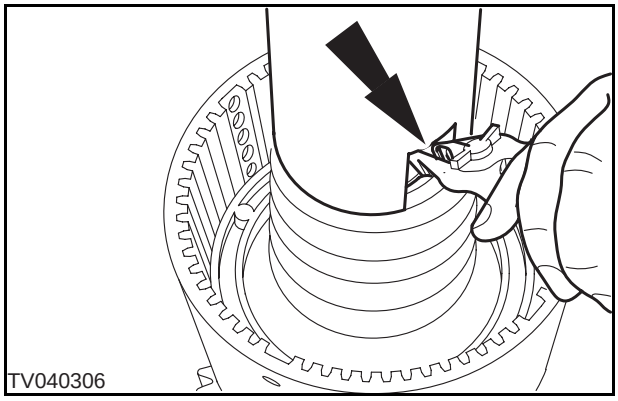
8. Remove the outer half friction disc.


TV040304

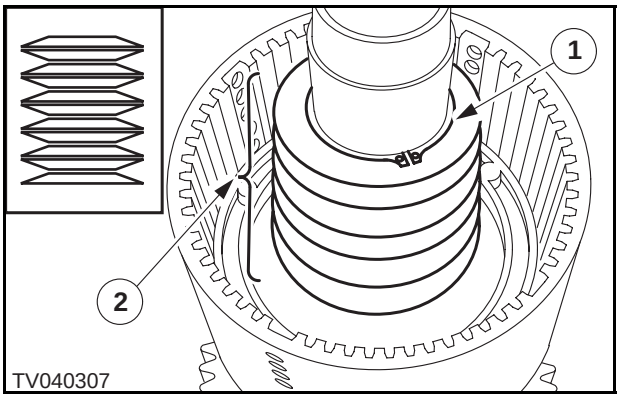
9. Using a suitable puller, remove the 1st clutch gear inner bearing.



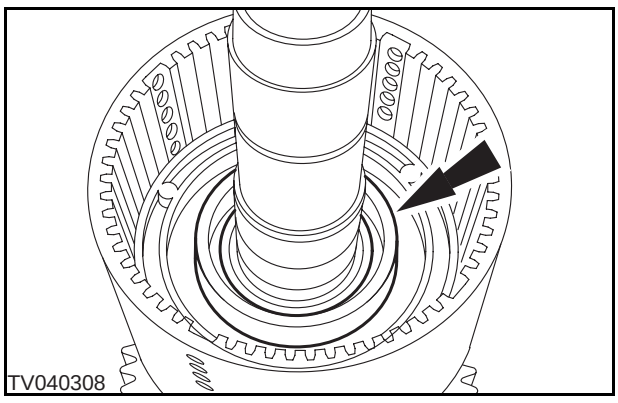
10. Using a suitable hydraulic press, compress the clutch piston belleville washers.
11. Using suitable circlip pliers, release the circlip.



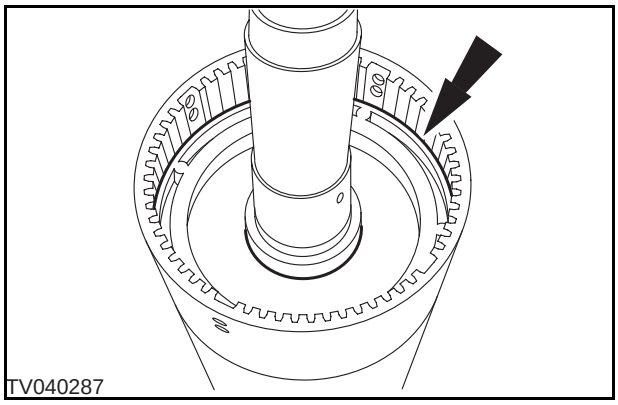
12. Remove the circlip (1).
13. Remove the eleven belleville washers (2).



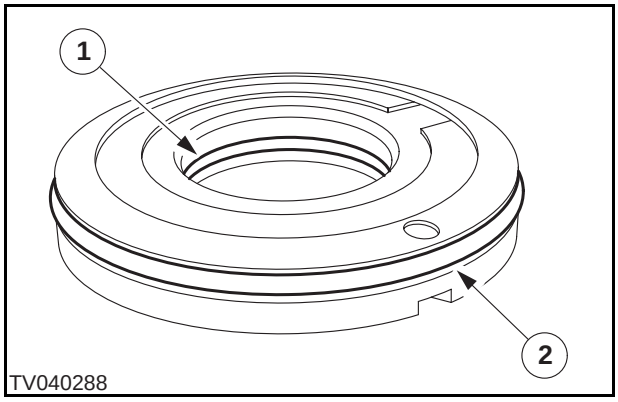
14. Remove the clutch piston wear spacer.



15. Remove the clutch piston assembly.


TV040287

16. Remove and discard the clutch piston inner seal (1) and outer seal (2).



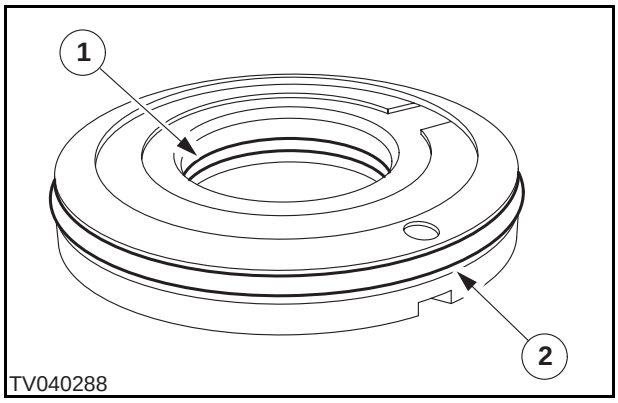
TV040288

Assembly

Note:
- Install new sealing rings.

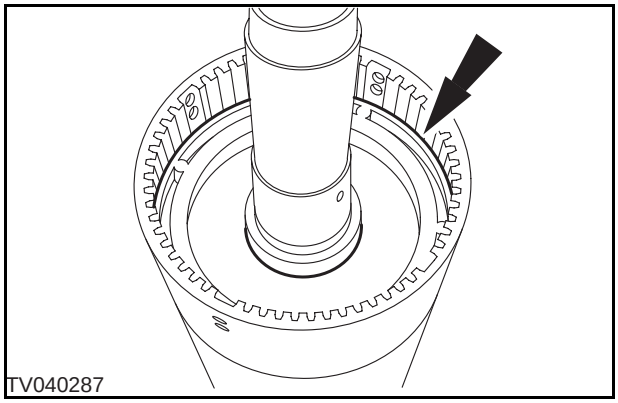
1. Install clutch piston inner seal (1) and outer seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

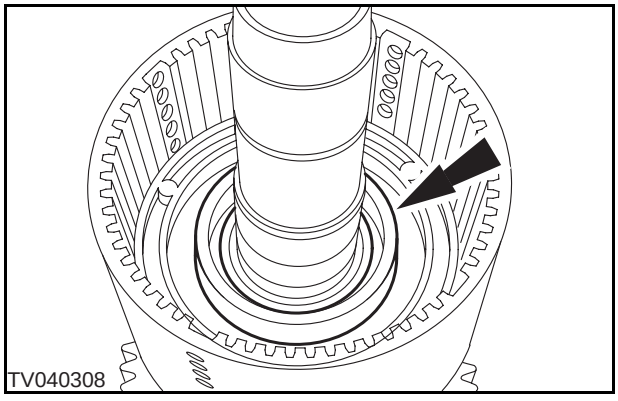


⚠ Caution:
- **Take care not to damage the sealing rings.**

2. Install the clutch piston into the clutch drum.



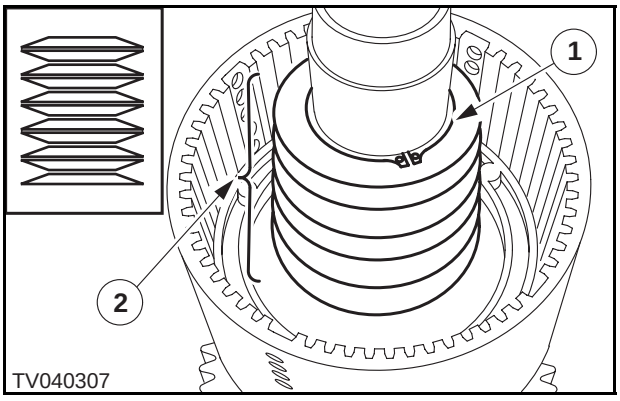
3. Install the clutch piston wear spacer.



4. Install the eleven clutch piston belleville washers (2).

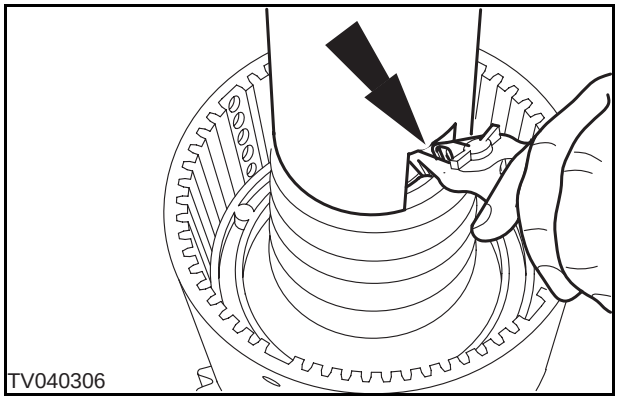
   Note:
   - Install the first belleville washer with the large diameter of bevel towards the wear spacer. Alternate the ten remaining belleville washers.

5. Install the circlip (1) on to the reverse/1st clutch shaft.

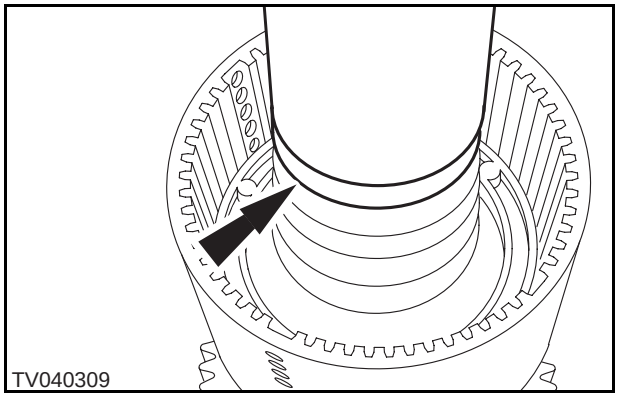


6. Using a suitable hydraulic press, compress the clutch piston belleville washers.
7. Using suitable circlip pliers, install the circlip.

   Note:
   - Make sure the circlip is correctly located in the groove.



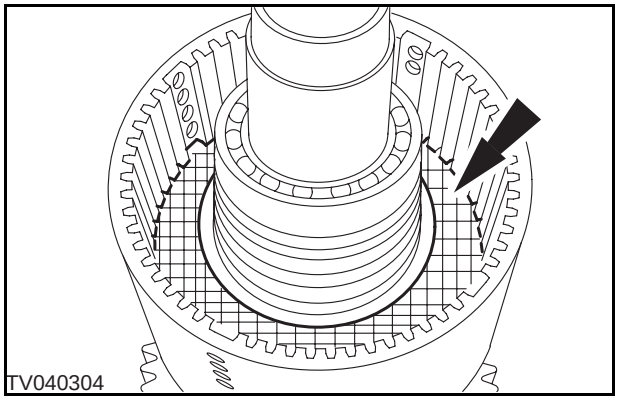
8. Using a suitable hydraulic press, install the 1st clutch gear inner bearing.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Install the outer half friction disc with the friction side of the disc away from the piston.

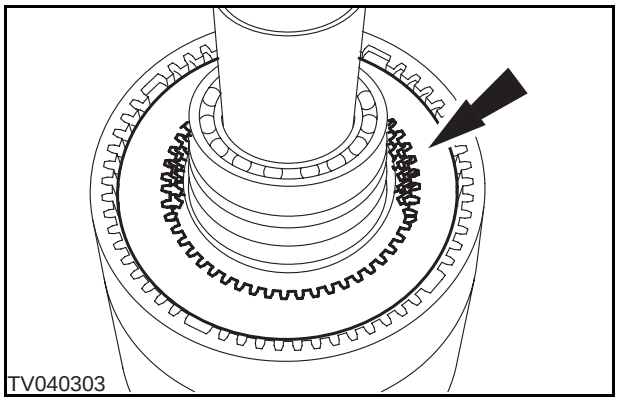
9. Install the outer half friction disc.


TV040304

Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed. The first and last discs are steel.

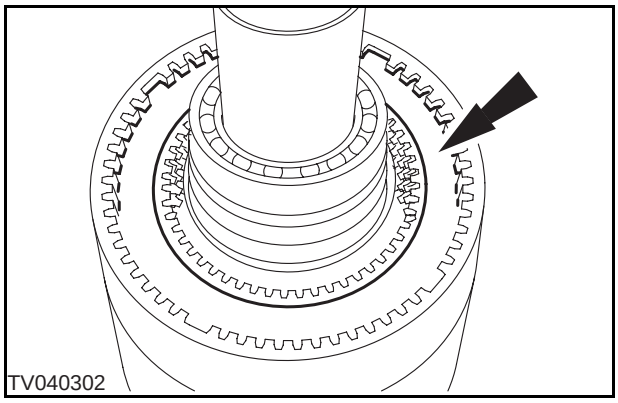
10. Install the eight clutch inner steel discs and seven clutch outer friction discs.


TV040303

Note:
- Soak new friction discs in transmission oil before assembly.

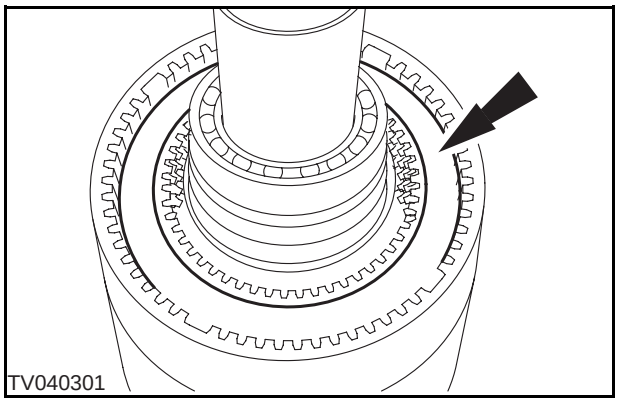
Note:
- Install the outer half friction disc with the friction side of the disc towards the piston.

11. Install the outer half friction disc.

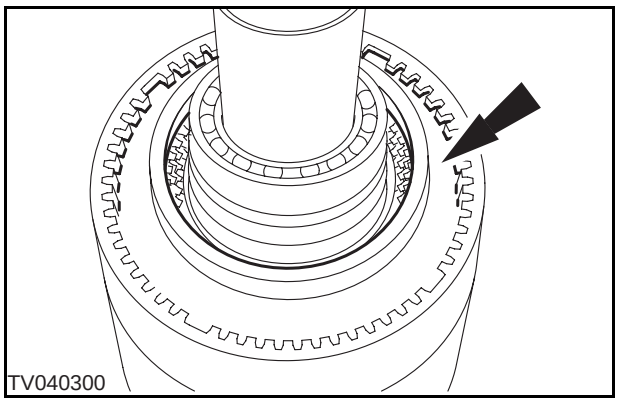

TV040302

Note:
- Install the modulation spring with the large diameter of the bevel away from the piston.

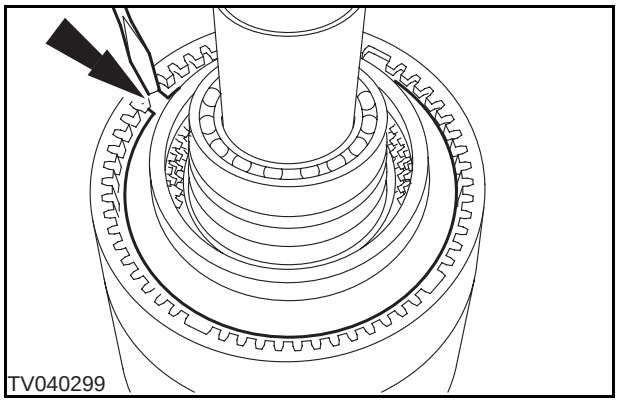
12. Install the modulation spring.


TV040301

13. Install the backing plate.


TV040300

14. Install the backing plate retaining snap ring.

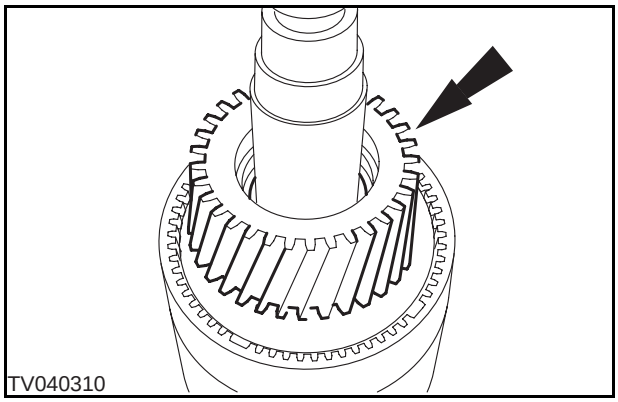


⚠ Caution:
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

⚠ Caution:
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

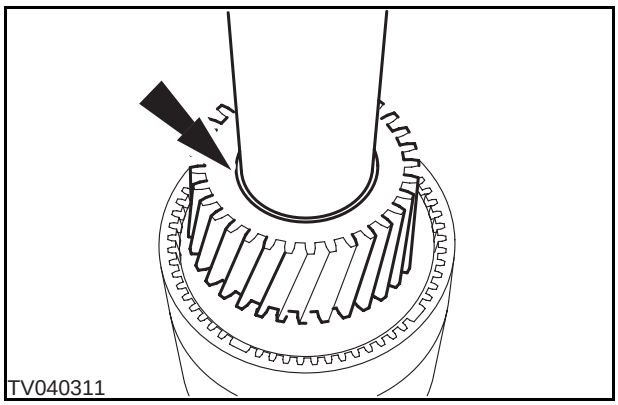
Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

15. Install the 1st clutch gear assembly.

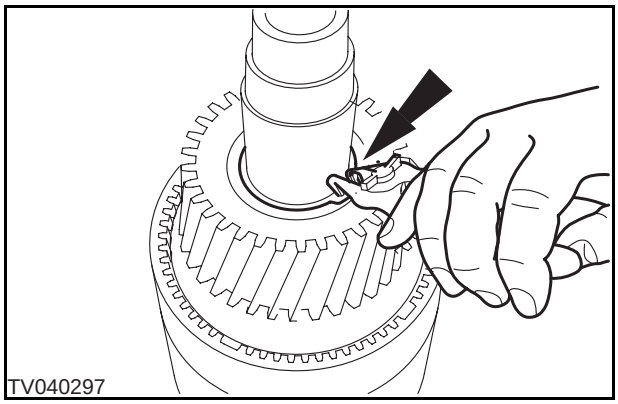


Note:
- Make sure that the bearing shield is on the outside.

16. Using a suitable hydraulic press, install the clutch gear outer bearing.



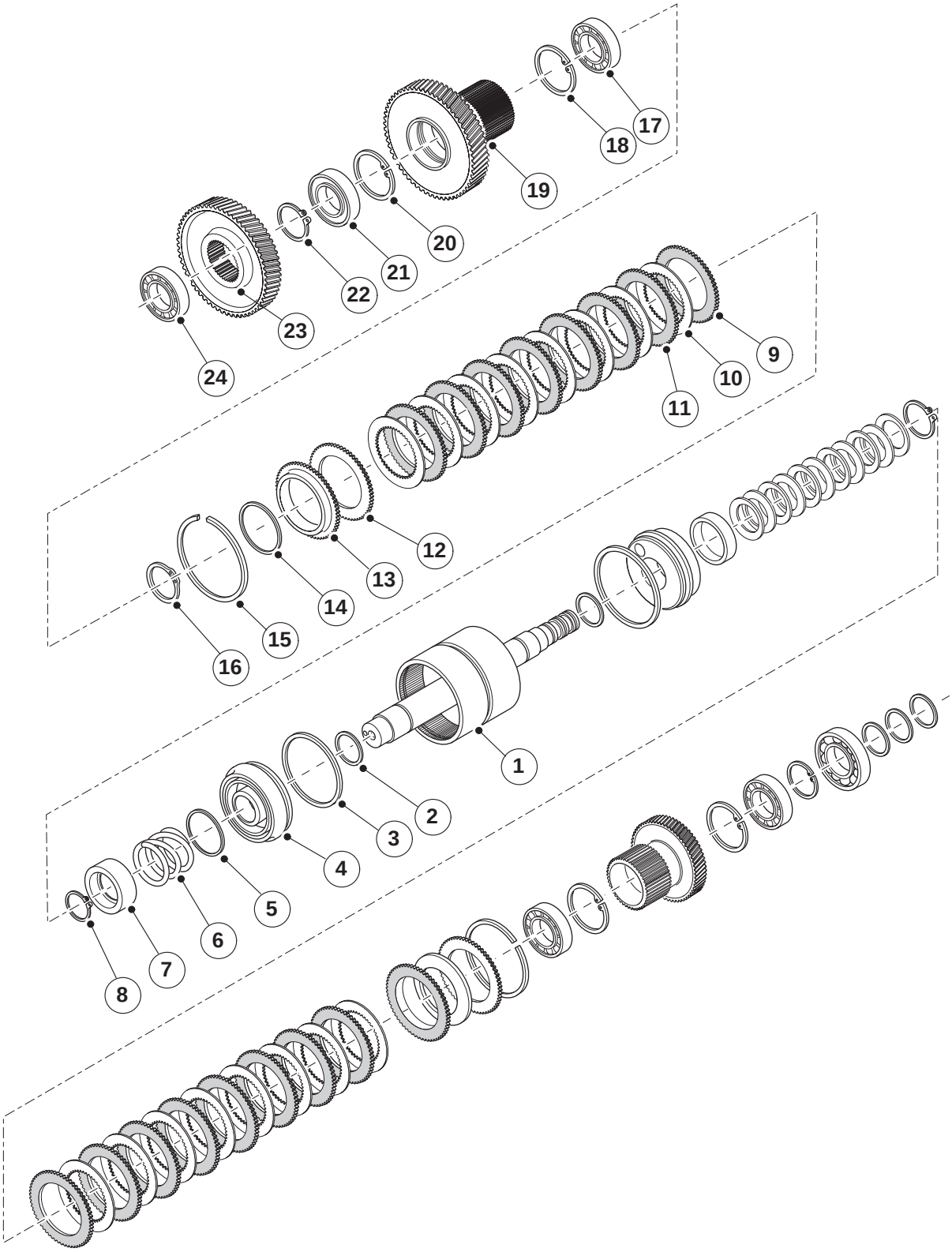
17. Using suitable circlip pliers, install the outer bearing retaining circlip.



DISASSEMBLY AND ASSEMBLY — REVERSE CLUTCH

BHN1301DE

Operation: **Disassembly and Assembly of the Reverse Clutch**	*Job Code:* **13 45 17 xx**		
None	Standard tools, Bearing heater		

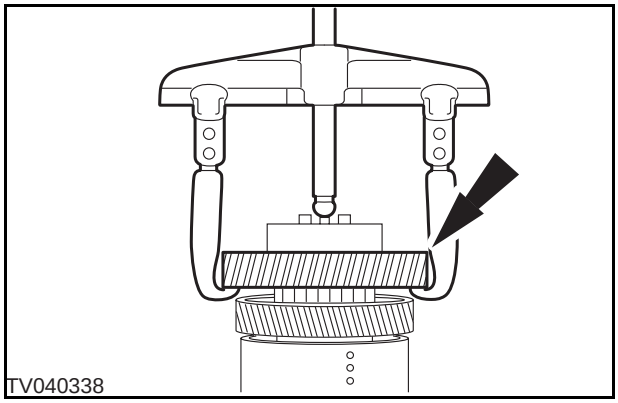


TV040572

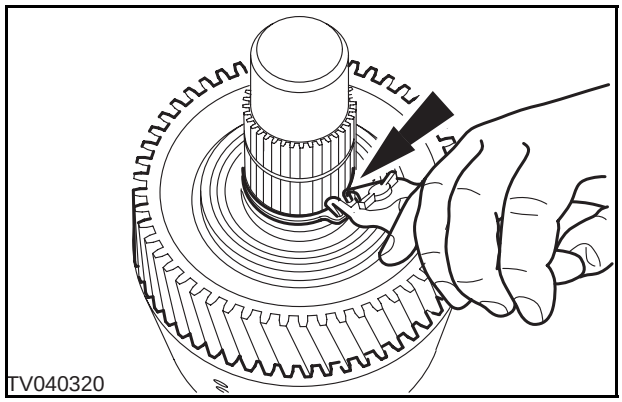
1	Reverse/1st Clutch Shaft
2	Clutch Piston Inner Seal
3	Clutch Piston Outer Seal
4	Clutch Piston
5	Clutch Piston Wear Washer
6	Piston Return Spring
7	Spring Retainer
8	Circlip
9	Clutch Outer Half Friction Disc
10	Clutch Inner Steel Disc (x8)
11	Clutch Outer Friction Disc (x7)
12	Clutch Outer Half Friction Disc
13	Backing Plate
14	Backing Plate Seal
15	Backing Plate Retaining Snap Ring
16	Circlip
17	Clutch Gear Bearing
18	Circlip
19	Reverse Clutch Gear
20	Circlip
21	Clutch Gear Bearing
22	Circlip
23	Reverse Driven Gear
24	Reverse/1st Shaft Bearing

Disassembly

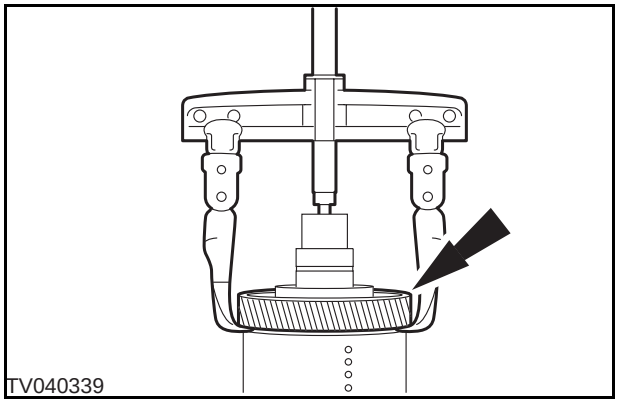
1. Using a suitable puller, remove the reverse driven gear and reverse/1st shaft bearing.



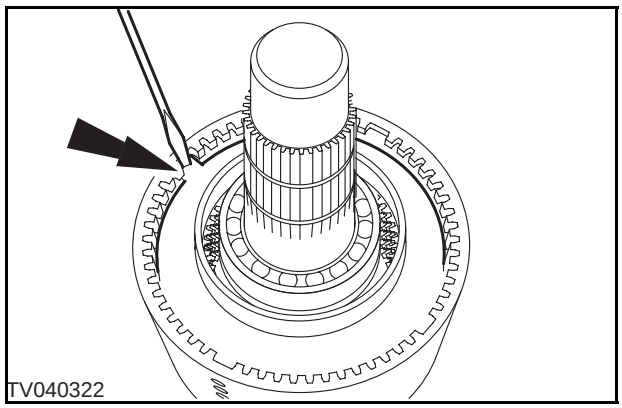
2. Using suitable circlip pliers, remove the clutch gear bearing circlip.



3. Using a suitable puller, remove the reverse clutch gear and clutch gear outer bearing.

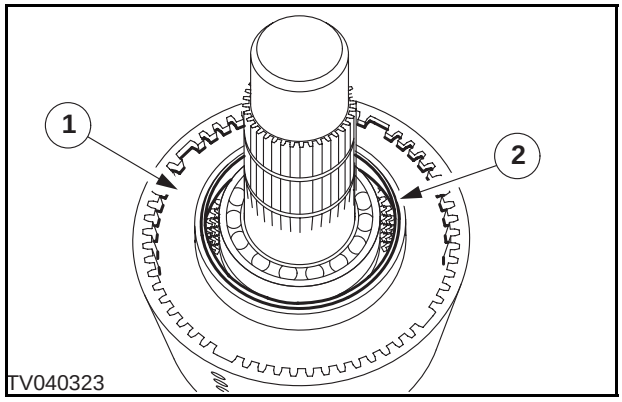


4. Remove the backing plate retaining snap ring.

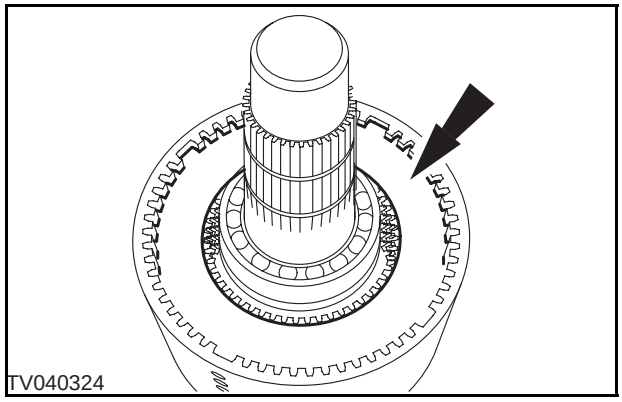


5. Remove the clutch disc backing plate (1).

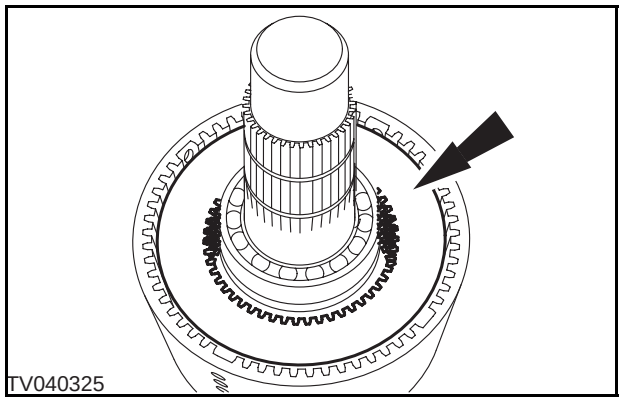
   Note:
   - Remove and discard the sealing ring (2).



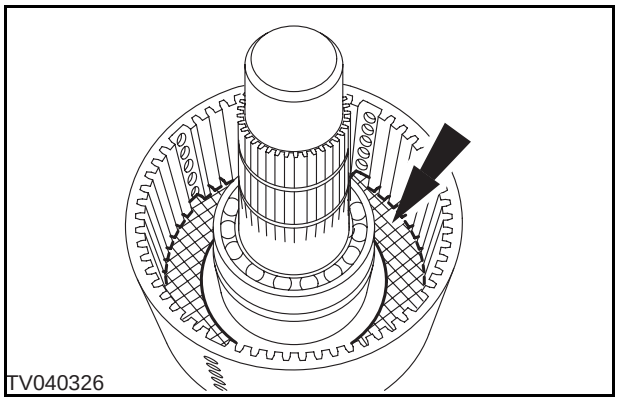
6. Remove the outer half friction disc.



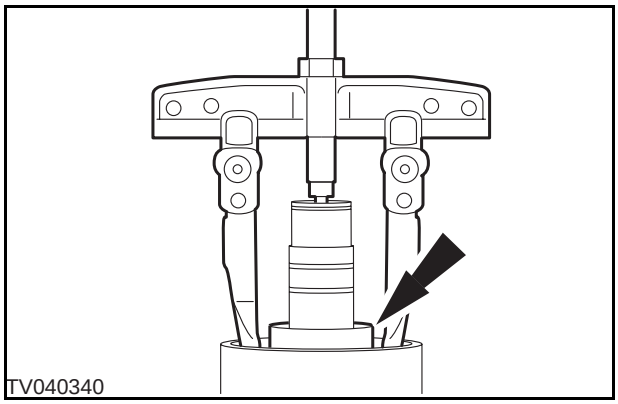
7. Remove the eight clutch inner steel discs and seven clutch outer friction discs.



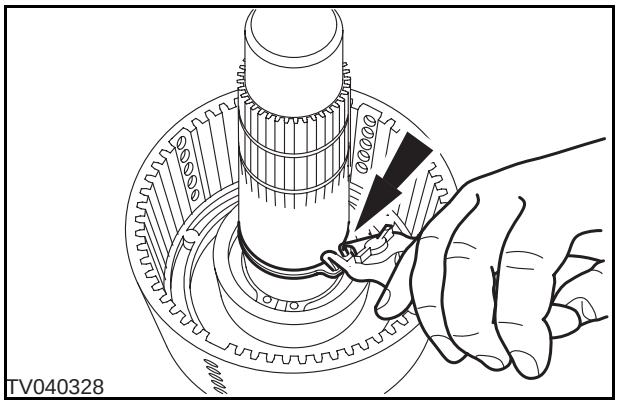
8. Remove the outer half friction disc.



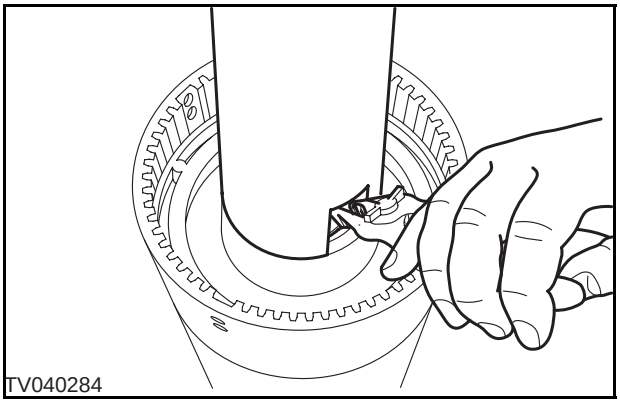
9. Using a suitable puller, remove the clutch gear inner bearing.



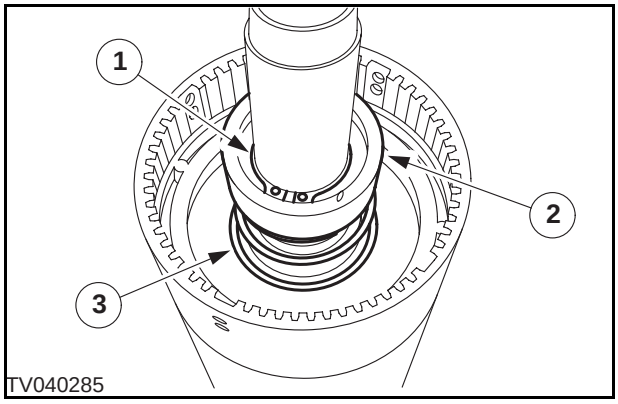
10. Using suitable circlip pliers, remove the clutch gear inner bearing locating circlip.



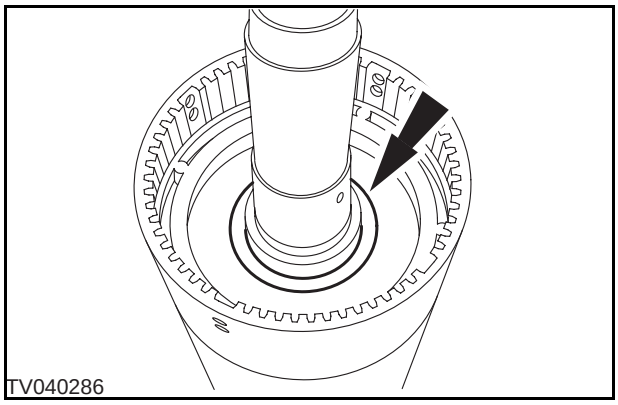
11. Using a suitable hydraulic press, compress the piston return spring.
12. Using suitable circlip pliers, release the piston return spring retaining circlip.



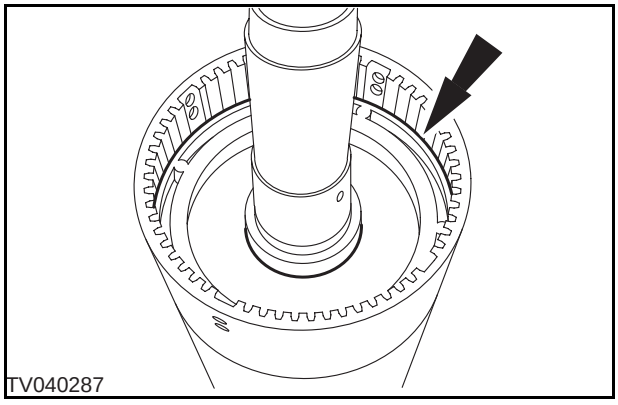
13. Remove the circlip (1), spring retainer (2) and piston return spring (3).



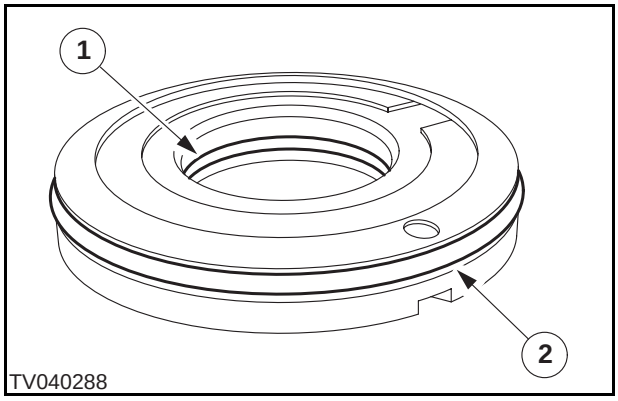
14. Remove the clutch piston wear washer.



15. Remove the clutch piston assembly.



16. Remove and discard the clutch piston inner seal (1) and outer seal (2).

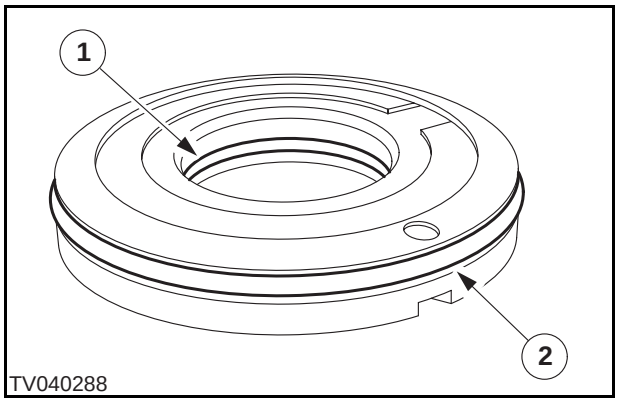


Assembly

Note:
- Install new sealing rings.

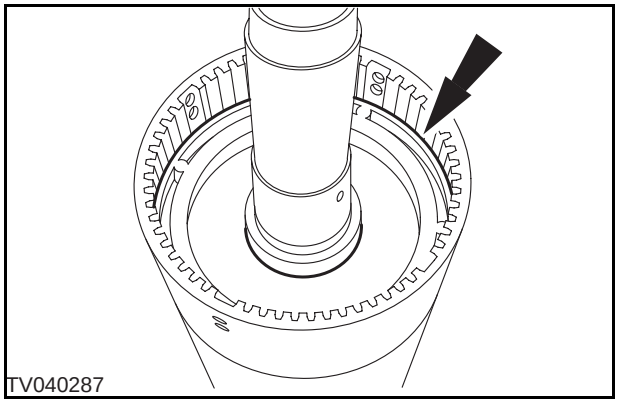
1. Install clutch piston inner seal (1) and outer seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

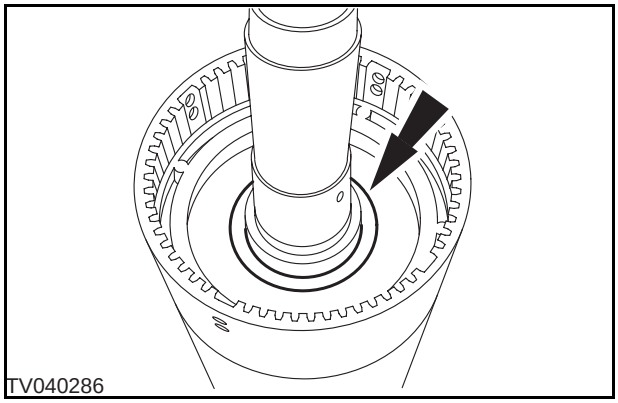


⚠ Caution:
- **Take care not to damage the sealing rings.**

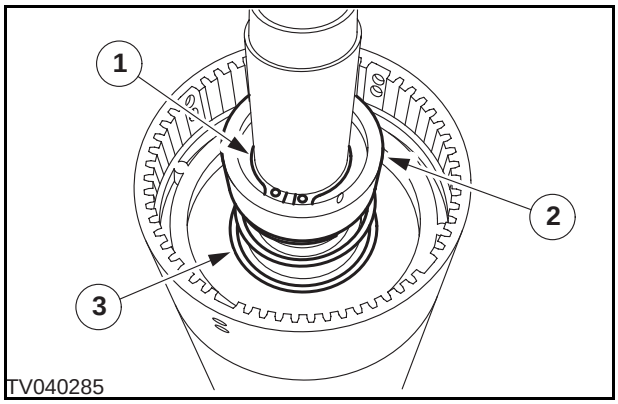
2. Install the clutch piston into the clutch drum.



3. Install the clutch piston wear washer.

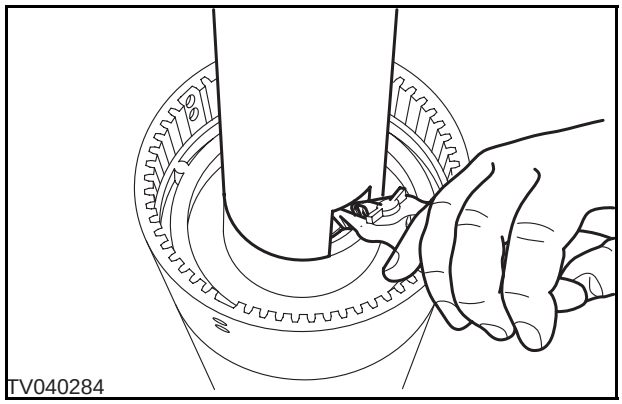


4. Install the piston return spring (3), spring retainer (2) and the circlip (1).

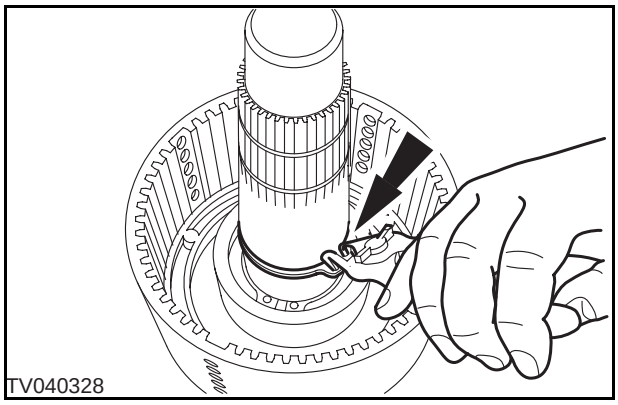


5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable circlip pliers, install the circlip.

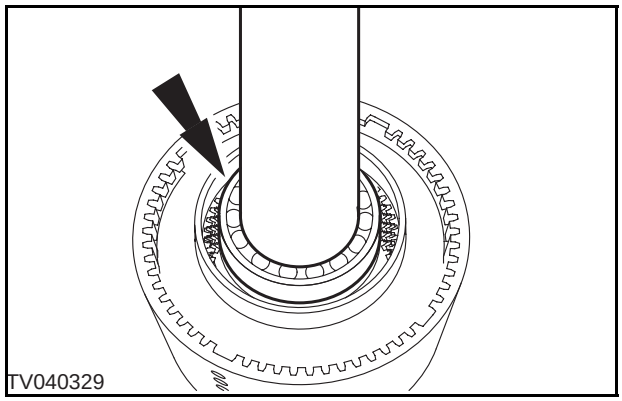
Note:
- Make sure the circlip is correctly positioned in the groove.



7. Using suitable circlip pliers, install the clutch gear inner bearing locating circlip.



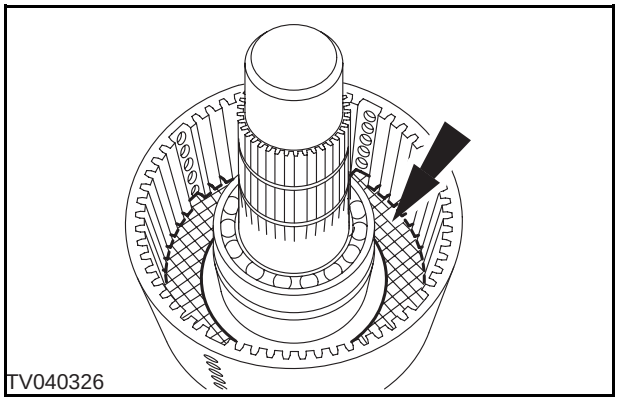
8. Using a suitable hydraulic press, install the clutch gear inner bearing.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Install the outer half friction disc with the friction side of the disc away from the piston.

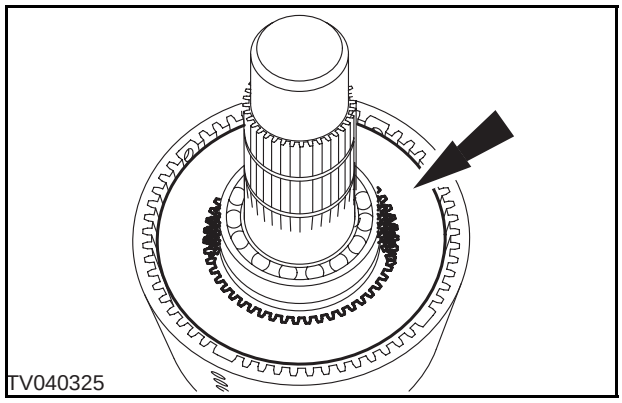
9. Install the outer half friction disc.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed. The first and last discs are steel.

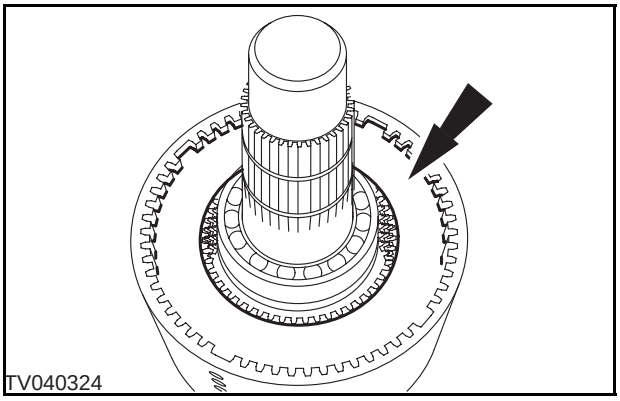
10. Install the eight clutch inner steel discs and seven clutch outer friction discs.



Note:
- Soak new friction discs in transmission oil before assembly.

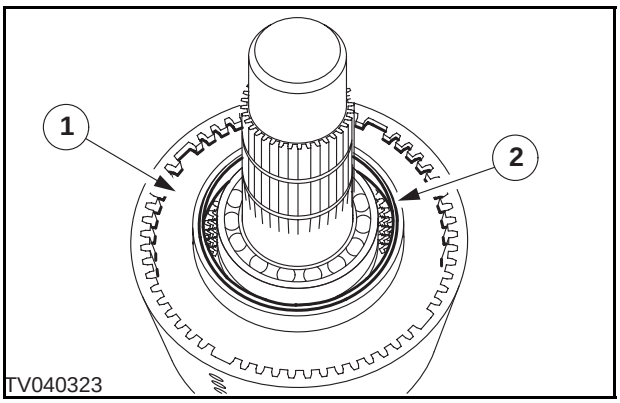
Note:
- Install the outer half friction disc with the friction side of the disc towards the piston.

11. Install the outer half friction disc.

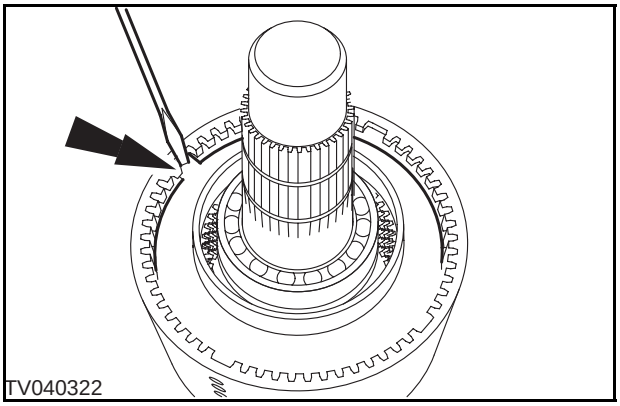


Note:
- Install a new sealing ring (2).

12. Install the clutch disc backing plate (1).



13. Install the backing plate retaining snap ring.



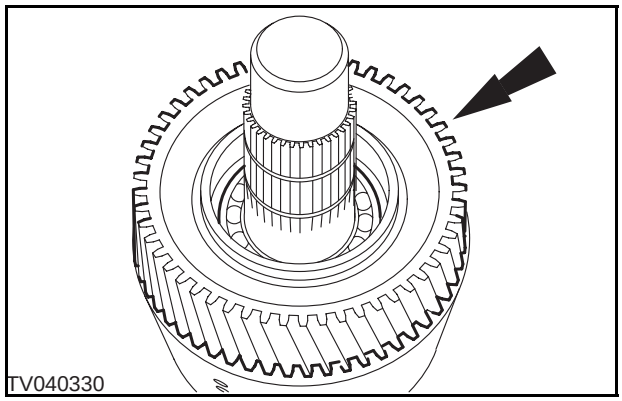
⚠ **Caution:**
- **Take care not to damage the sealing ring.**

⚠ **Caution:**
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

⚠ **Caution:**
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

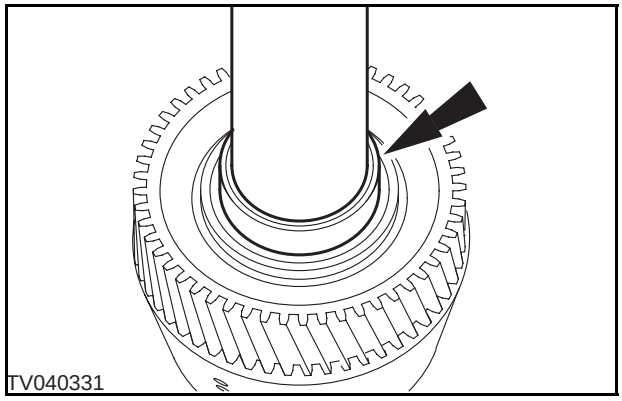
Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

14. Install the reverse clutch gear assembly.

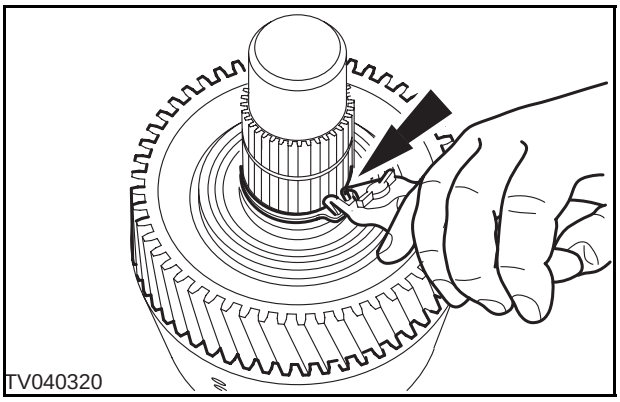

TV040330

Note:
- Make sure that the bearing shield is on the outside.

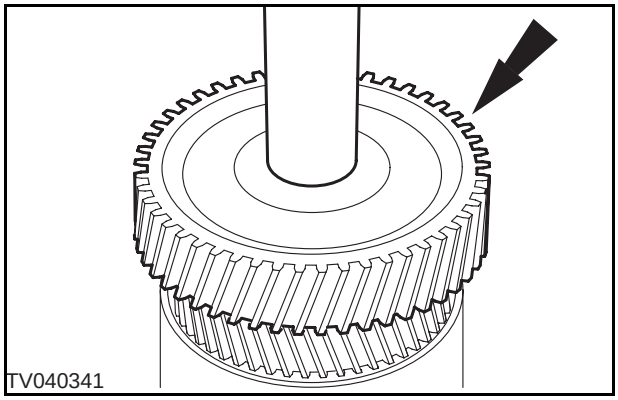
15. Using a suitable hydraulic press, install the clutch gear outer bearing.


TV040331

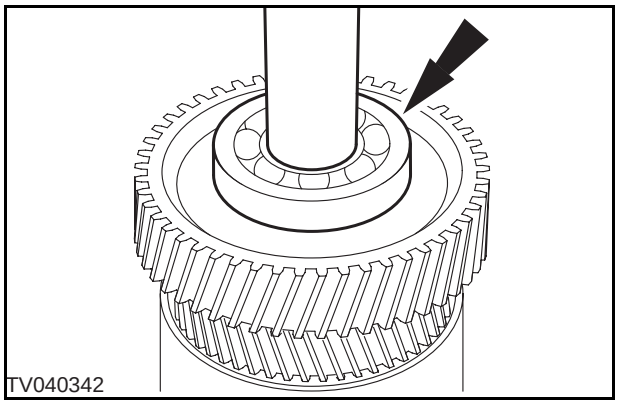
16. Using suitable circlip pliers, install the outer bearing circlip.



17. Using a suitable hydraulic press, install the reverse driven gear.



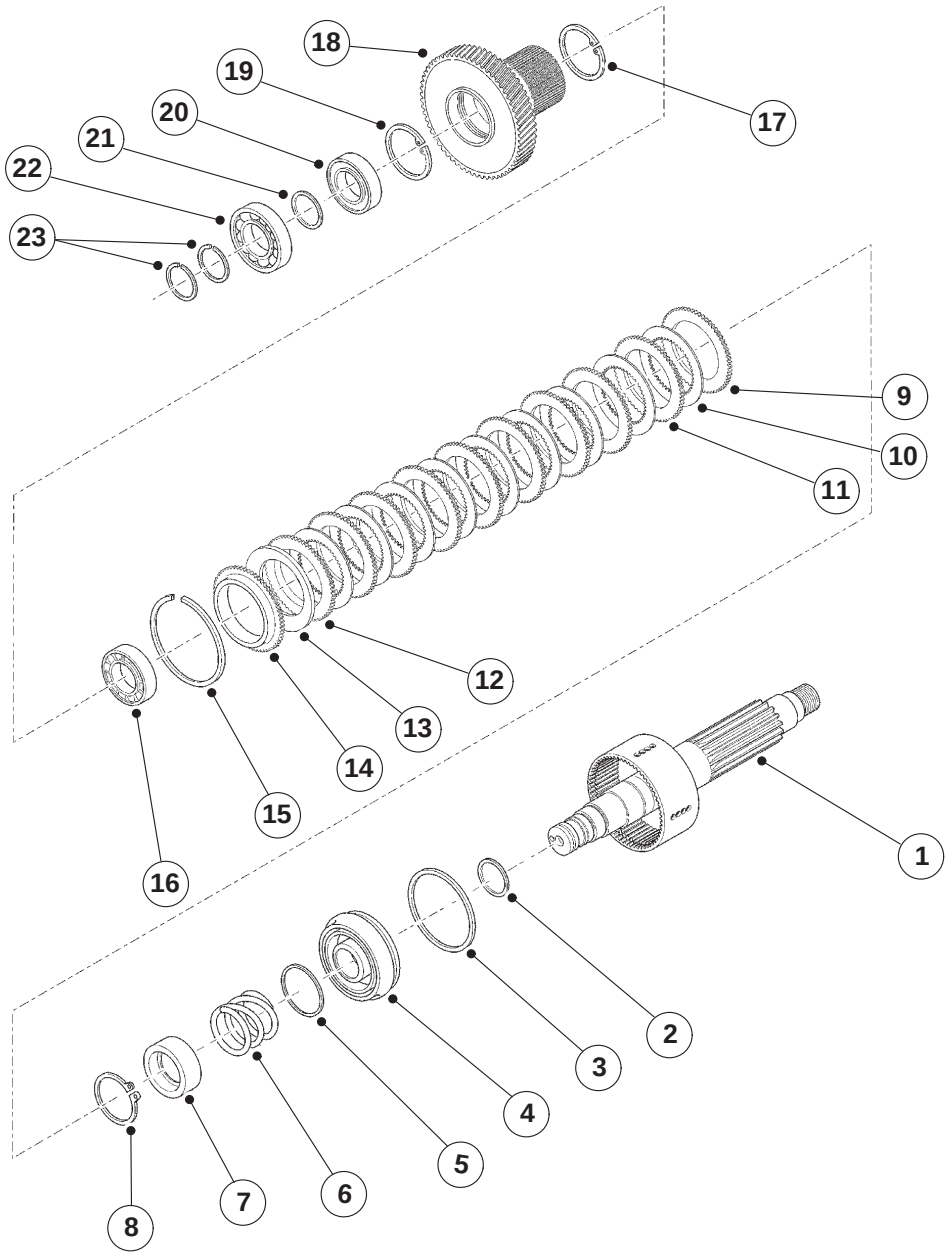
18. Using a suitable hydraulic press, install the clutch shaft bearing.



DISASSEMBLY AND ASSEMBLY — 2ND CLUTCH

BHN1301DF

Operation: **Disassembly and Assembly of the 2nd Clutch**	*Job Code:* **13 44 17 xx**		
None	Standard tools, Suitable puller		

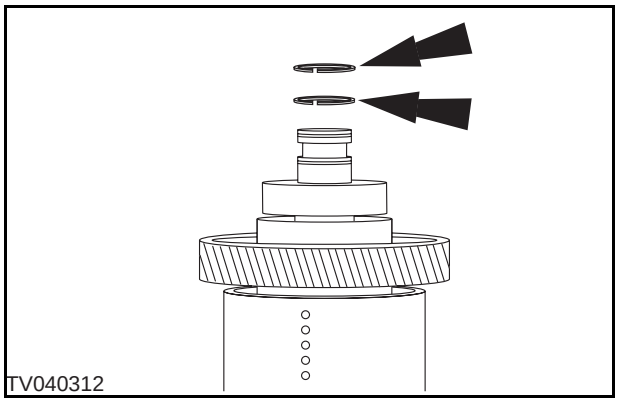


TV040574

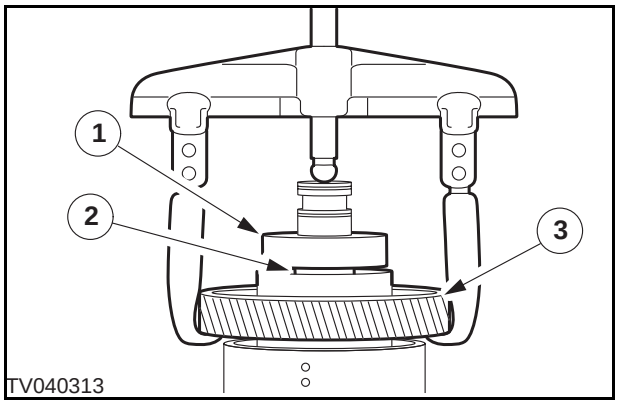
1	2nd Shaft Assembly
2	Clutch Piston Inner Seal
3	Clutch Piston Outer Seal
4	Clutch Piston Assembly
5	Clutch Piston Wear Washer
6	Piston Return Spring
7	Spring Retainer
8	Circlip
9	Clutch Outer Half Friction Disc
10	Clutch Inner Steel Disc (x9)
11	Clutch Outer Friction Disc (x8)
12	Clutch Outer Half Friction Disc
13	Modulation Spring
14	Backing Plate
15	Backing Plate Retaining Snap Ring
16	Clutch Gear Bearing
17	Circlip
18	2nd Clutch Gear
19	Circlip
20	Clutch Gear Bearing
21	Bearing Support Washer
22	2nd Clutch Shaft Bearing
23	Clutch Shaft Sealing Ring (x2)

Disassembly

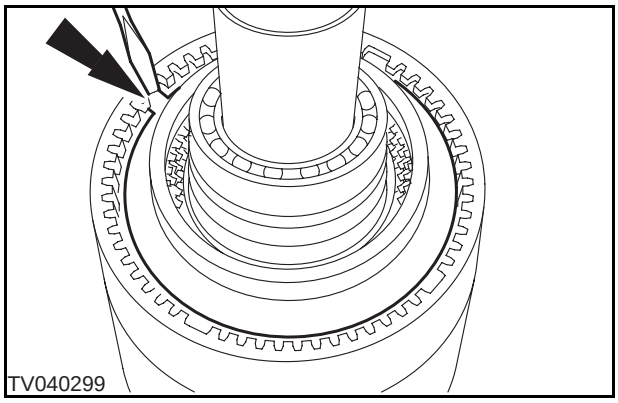
1. Remove and discard the clutch shaft sealing rings.



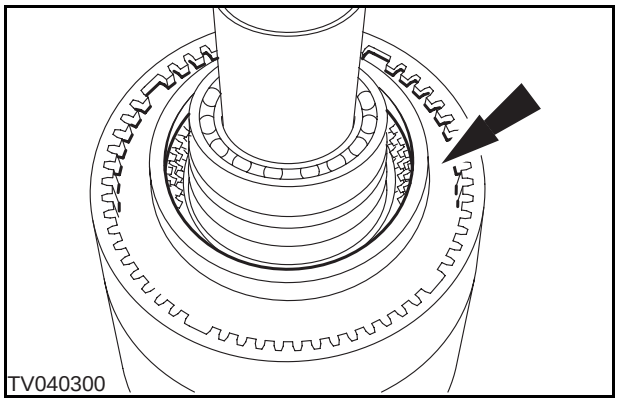
2. Using a suitable bearing puller remove the 2nd clutch shaft bearing (1), the bearing support washer (2) and the 2nd clutch gear (3).
3. Using suiable circlip pliers, remove the bearing locating circlips from the clutch gear.



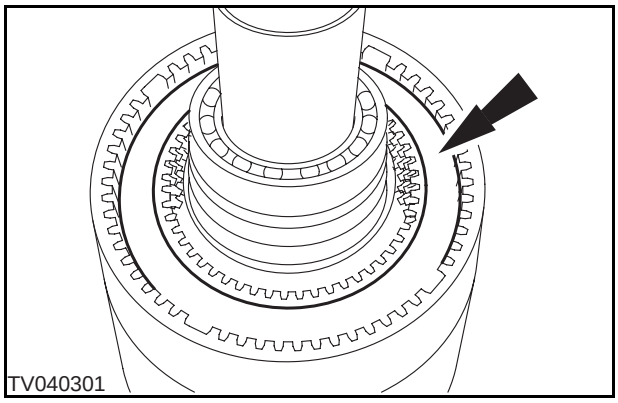
4. Remove the backing plate retaining snap ring.



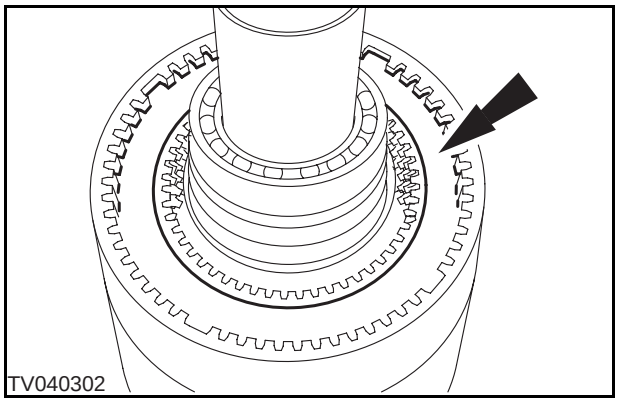
5. Remove the backing plate.



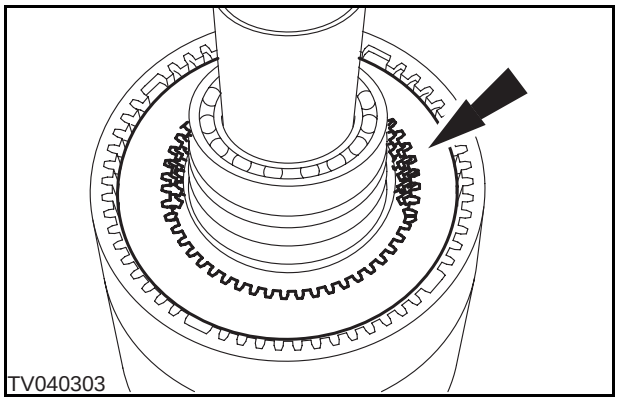
6. Remove the modulation spring.



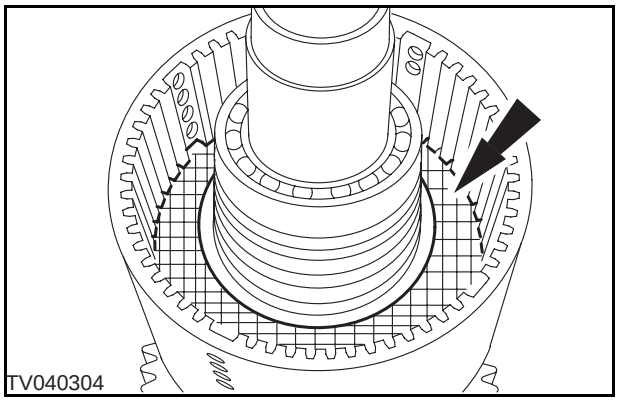
7. Remove the outer half friction disc.



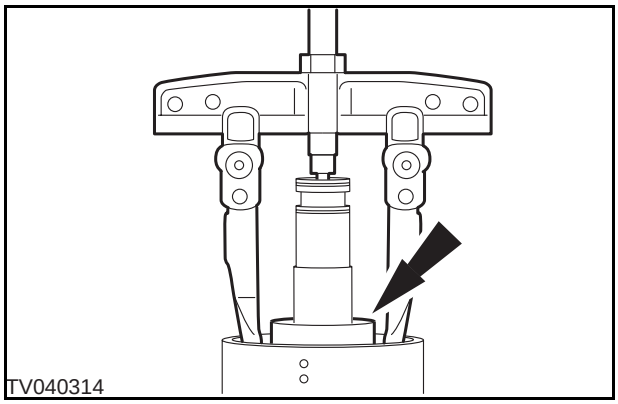
8. Remove the eight inner steel discs and seven outer friction discs.



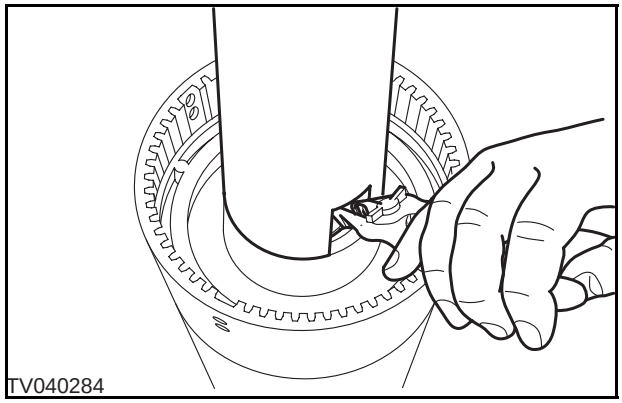
9. Remove the outer half friction disc.



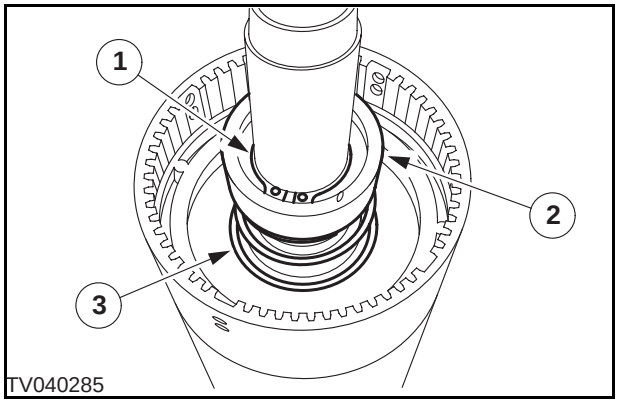
10. Using a suitable bearing puller, remove the clutch gear inner bearing.


TV040314

11. Using a suitable hydraulic press, compress the piston return spring.
12. Using suitable circlip pliers, release the piston return spring retaining circlip.

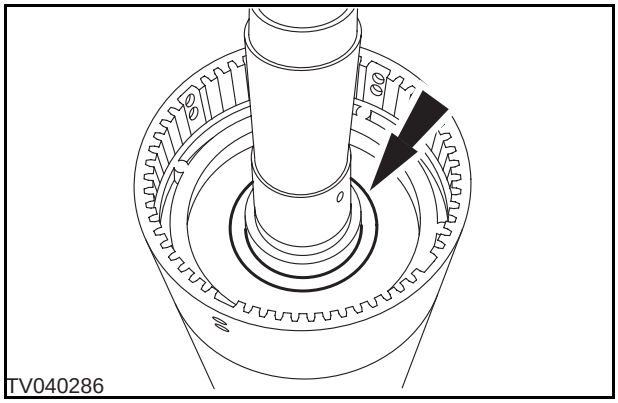

TV040284

13. Remove the circlip (1), spring retainer (2) and piston return spring (3).

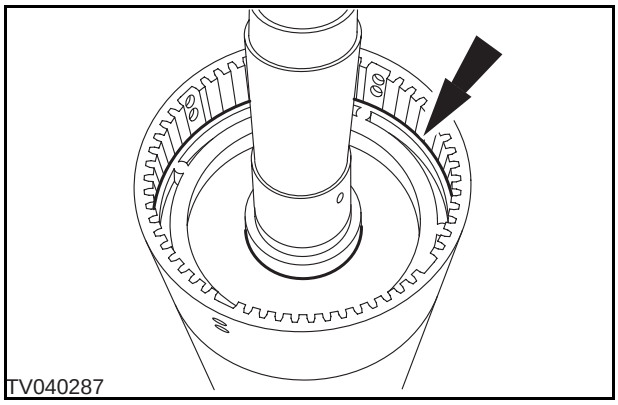


TV040285

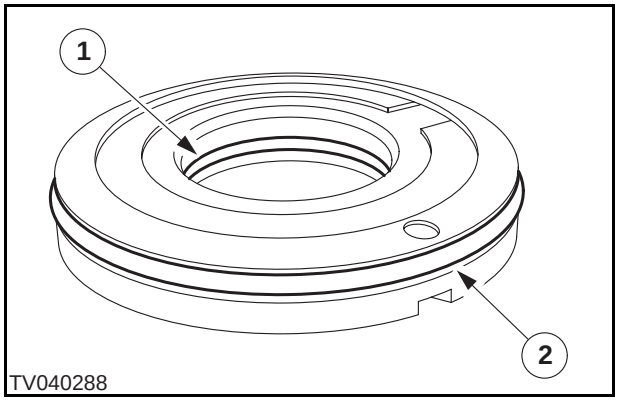
14. Remove the clutch piston wear washer.


TV040286

15. Remove the clutch piston assembly.


TV040287

16. Remove and discard the clutch piston inner seal (1) and outer seal (2).



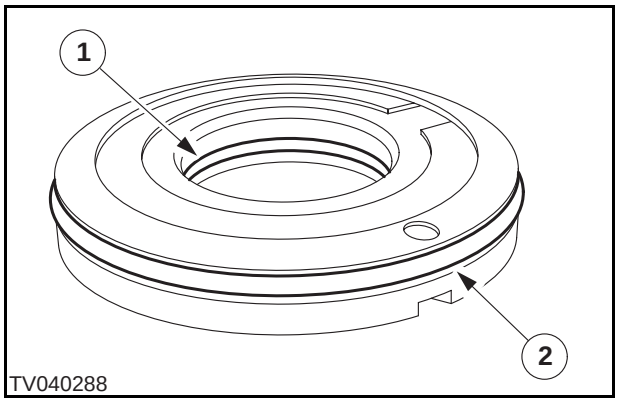
TV040288

Assembly

Note:
- Install new sealing rings.

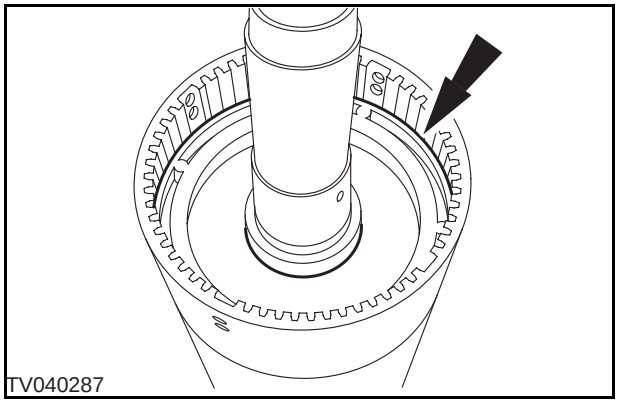
1. Install clutch piston inner seal (1) and outer seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size untill the new seal is flush with the outer diameter of the piston.

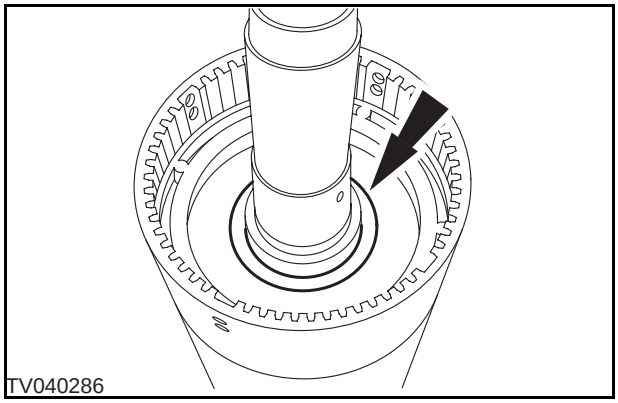


⚠ **Caution:**
- **Take care not to damage the sealing rings.**

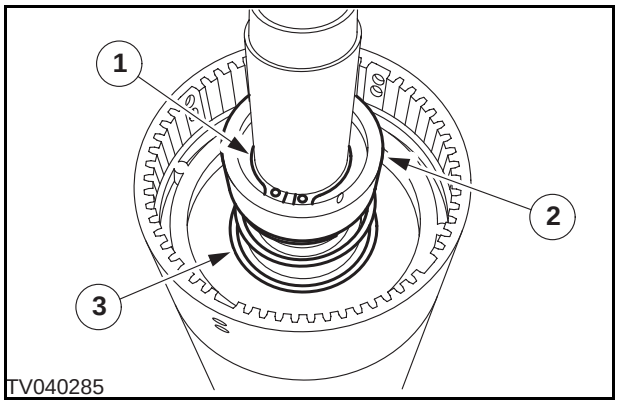
2. Install the clutch piston into the clutch drum.



3. Install the clutch piston wear washer.

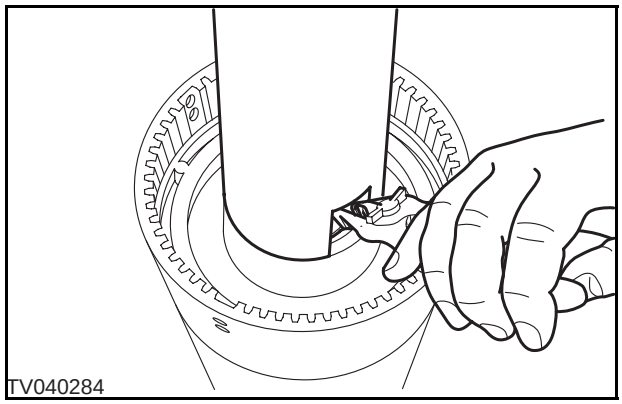


4. Install the piston return spring (3), spring retainer (2) and the circlip (1).

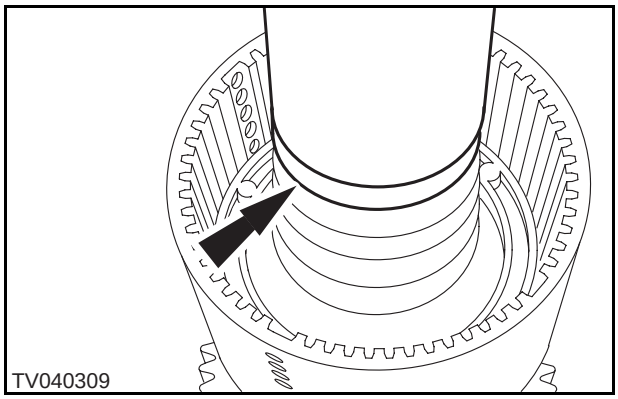


5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable circlip pliers, install the circlip.

Note:
- Make sure the circlip is correctly located in the groove.



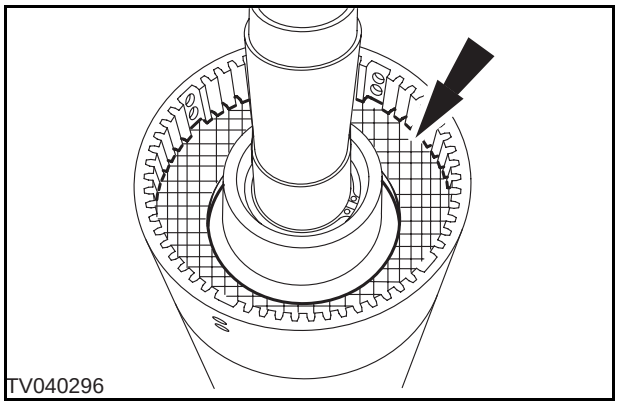
7. Using a suitable hydraulic press, install the clutch gear inner bearing.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Install the half friction disc with the friction side of the disc away from the piston.

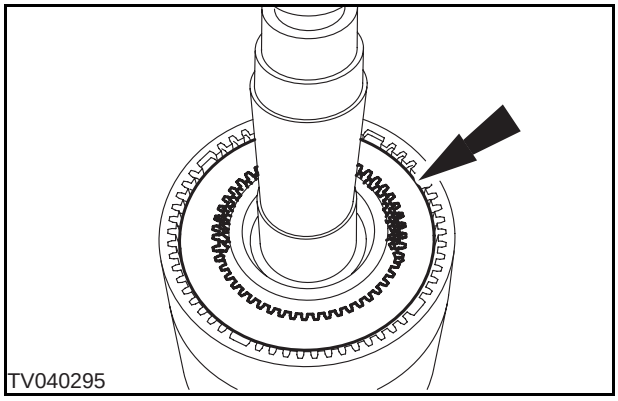
8. Install the outer half friction disc.


TV040296

Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed. The first and last discs are steel.

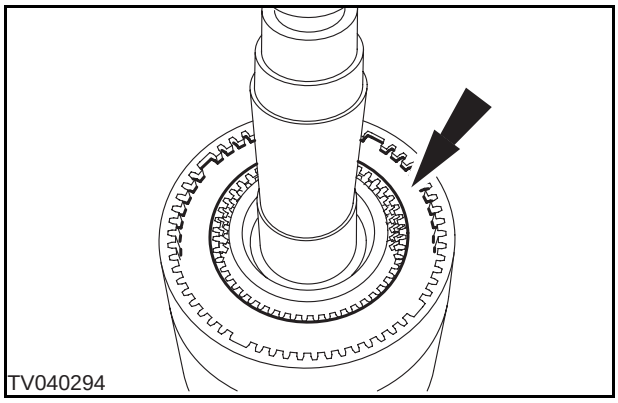
9. Install the eight clutch outer steel discs and seven clutch inner friction discs.


TV040295

Note:
- Soak new friction discs in transmission oil before assembly.

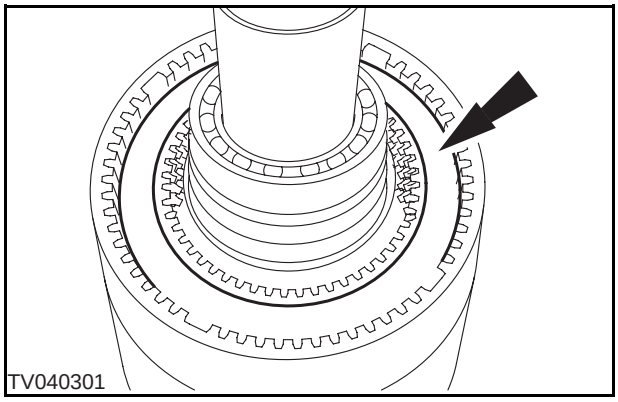
Note:
- Install the outer half friction disc with the friction side of the disc towards the piston.

10. Install the outer half friction disc.

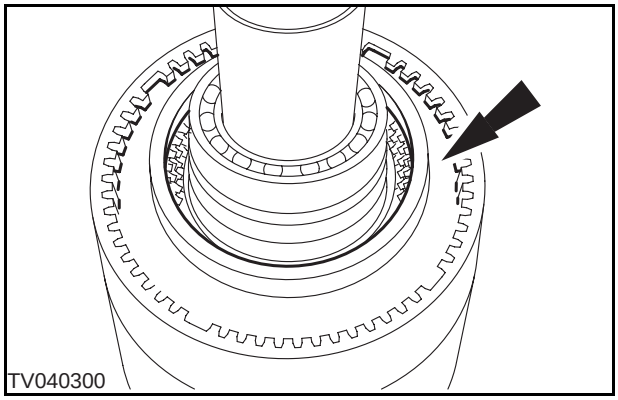

TV040294

Note:
- Install the modulation spring with the large diameter of the bevel away from the piston.

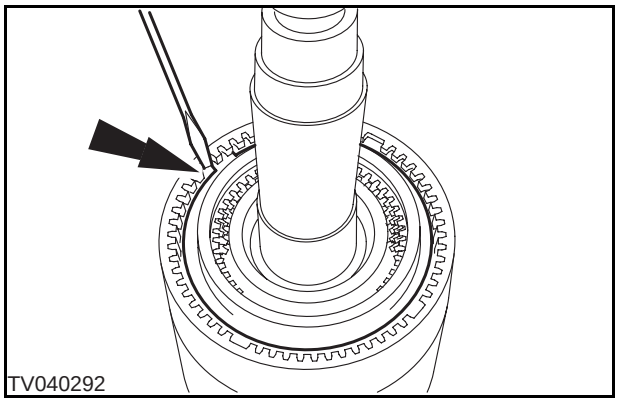
11. Install the modulation spring.


TV040301

12. Install the backing plate.


TV040300

13. Install the backing plate retaining snap ring.


TV040292

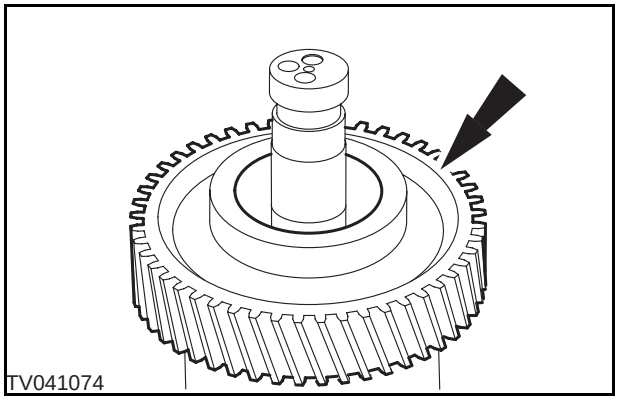
14. Using suiable circlip pliers, install the bearing locating circlips.

⚠ Caution:
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

⚠ Caution:
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

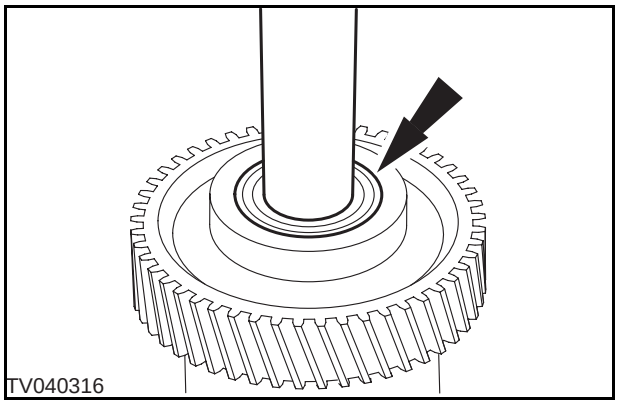
Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

15. Install the 2nd clutch gear assembly.

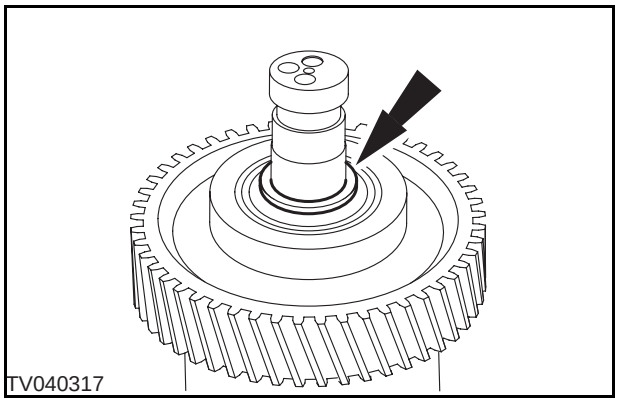

TV041074

Note:
- Make sure the bearing shield is on the outside.

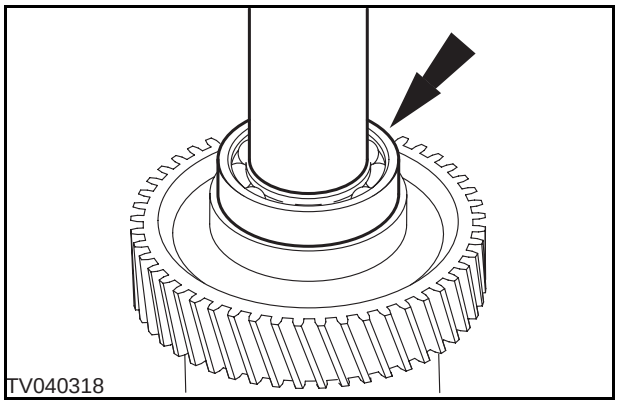
16. Using a suitable hydraulic press, install the outer bearing.


TV040316

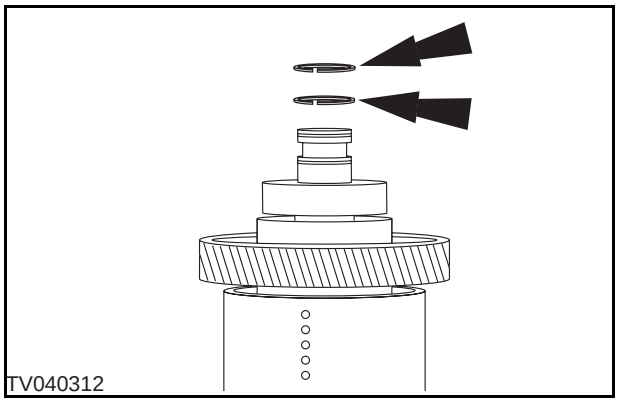
17. Install the bearing spacer.


TV040317

18. Using a suitable hydraulic press, install the 2nd shaft bearing.


TV040318

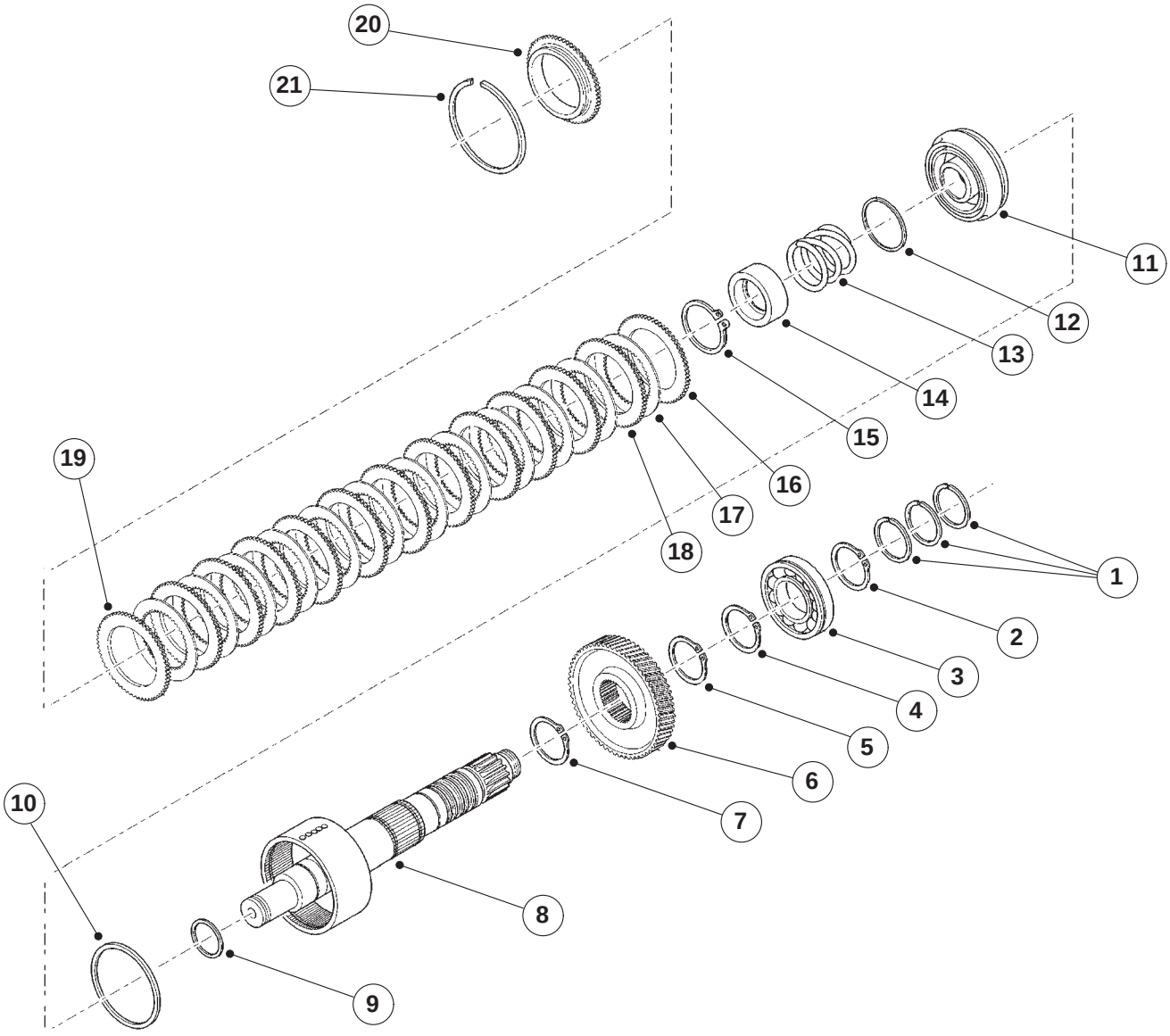
19. Install the 2nd clutch shaft sealing rings.


TV040312

DISASSEMBLY AND ASSEMBLY — OUTPUT SHAFT

BHN1301DG

Operation: **Disassembly and Assembly of the Output Shaft**	*Job Code:* **13 46 17 xx**		
None	Standard tools		

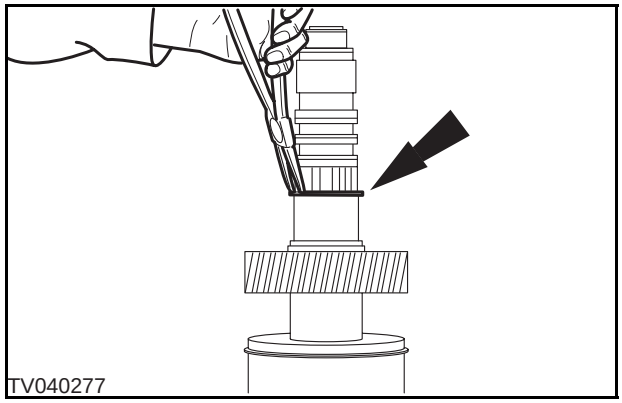


TV040575

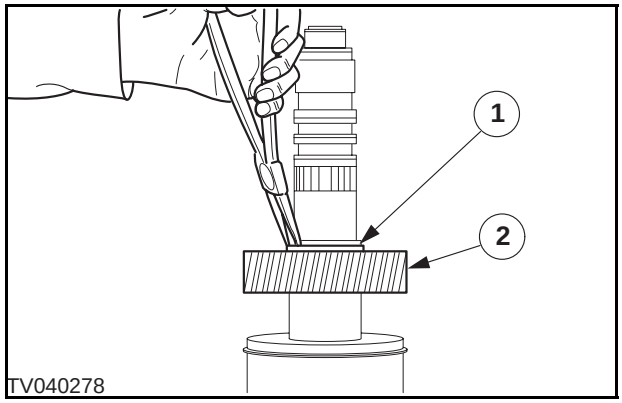
1	Sealing Ring (x3)
2	Circlip
3	Output Shaft Bearing
4	Circlip
5	Circlip
6	Output Gear
7	Circlip
8	Output Shaft
9	Clutch Piston Inner Seal
10	Clutch Piston Outer Seal
11	Clutch Piston
12	Clutch Piston Wear Washer
13	Piston Return Spring
14	Spring Retainer
15	Circlip
16	Clutch Outer Half Friction Disc
17	Clutch Inner Steel Disc (x12)
18	Clutch Outer Friction Disc (x11)
19	Clutch Outer Half Friction Disc
20	Backing Plate
21	Backing Plate Retaining Snap Ring

Disassembly

1. Using suitable circlip pliers, remove the output shaft bearing locating circlip.

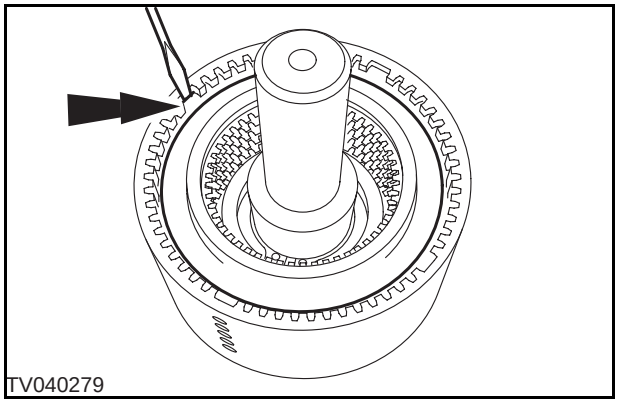


2. Using suitable circlip pliers, remove the output gear circlip (1).
3. Remove the output gear (2).

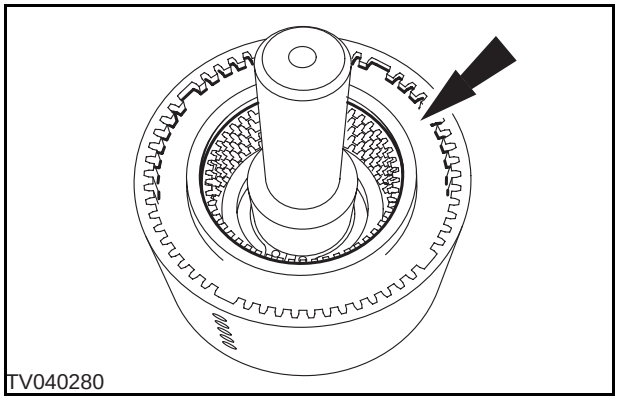


Note:
- Rotate the shaft 180°.

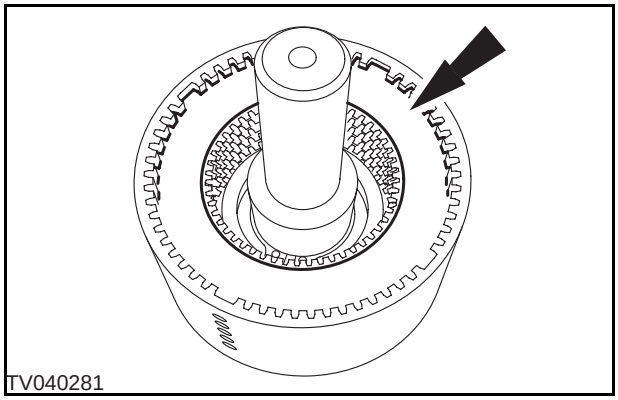
4. Remove the backing plate retaining snap ring.



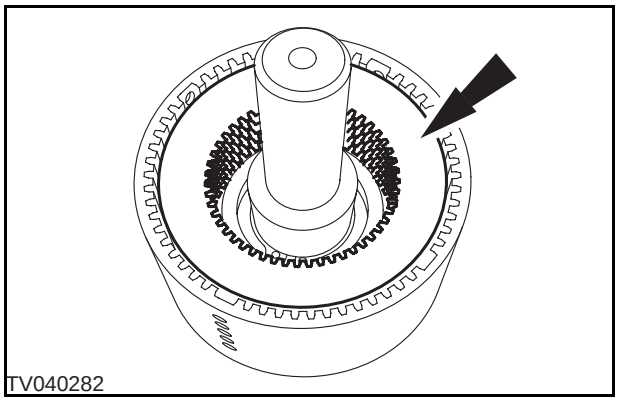
5. Remove the backing plate.



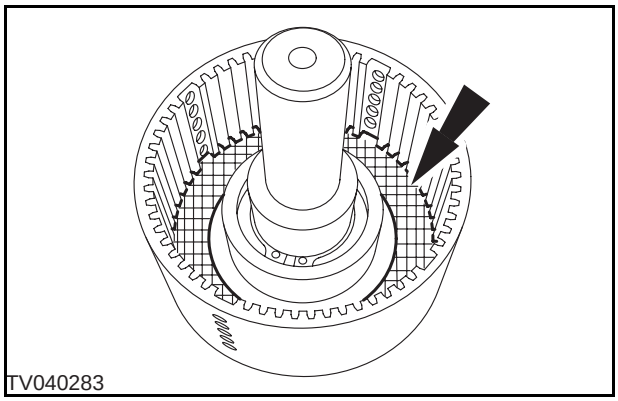
6. Remove the outer half friction disc.


TV040281

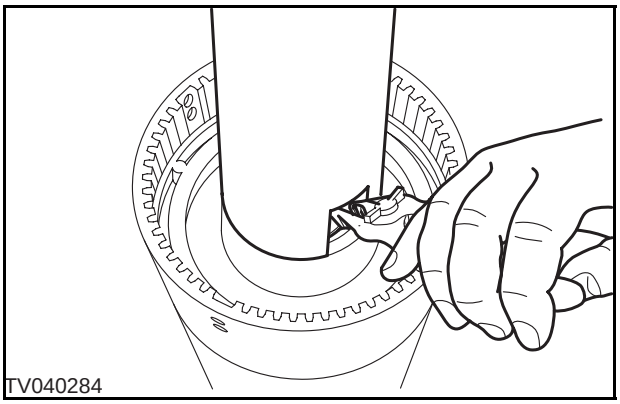
7. Remove the twelve clutch inner steel discs and eleven clutch outer friction discs.


TV040282

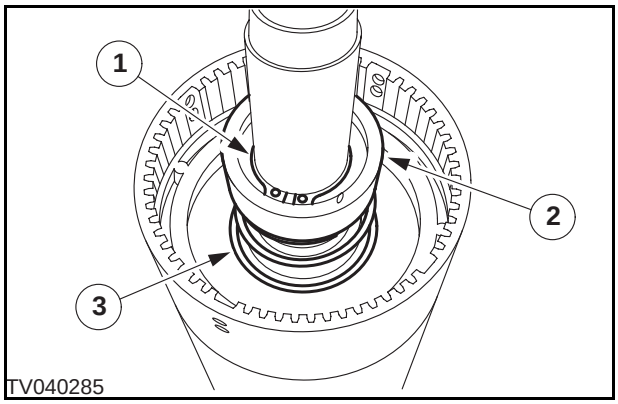
8. Remove the outer half friction disc.


TV040283

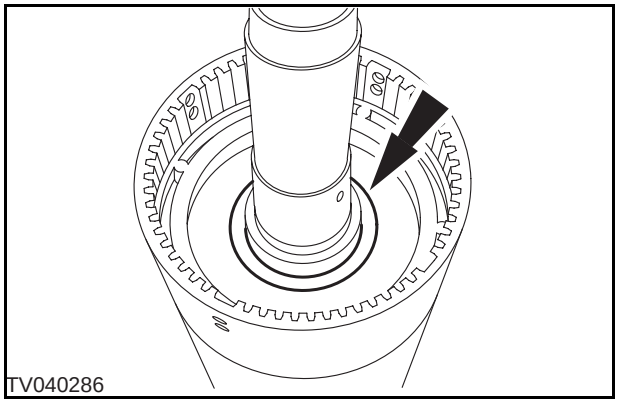
9. Using a suitable hydraulic press, compress the piston return spring.
10. Using suitable circlip pliers, release the piston return spring retaining circlip.


TV040284

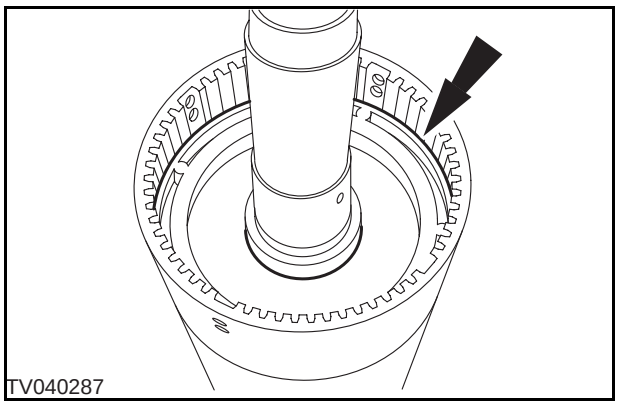
11. Remove the circlip (1), spring retainer (2) and piston return spring (3).



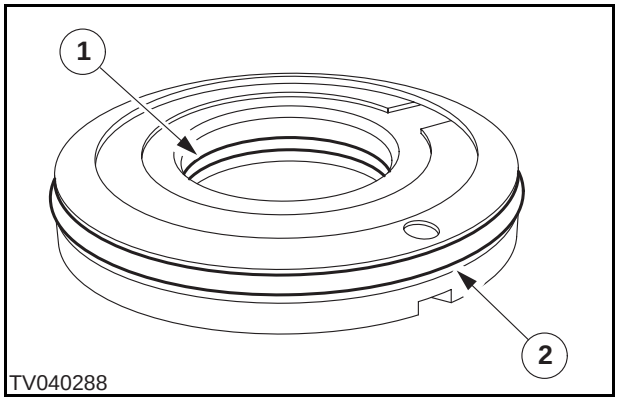
12. Remove the clutch piston wear washer.



13. Remove the clutch piston assembly.



14. Remove and discard the clutch piston inner seal (1) and outer seal (2).

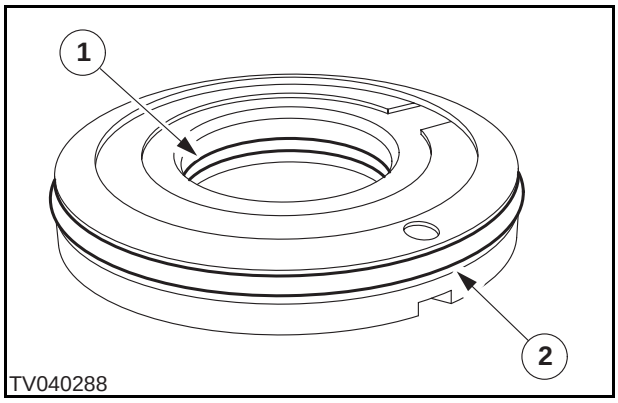


Assembly

Note:
- Install new sealing rings.

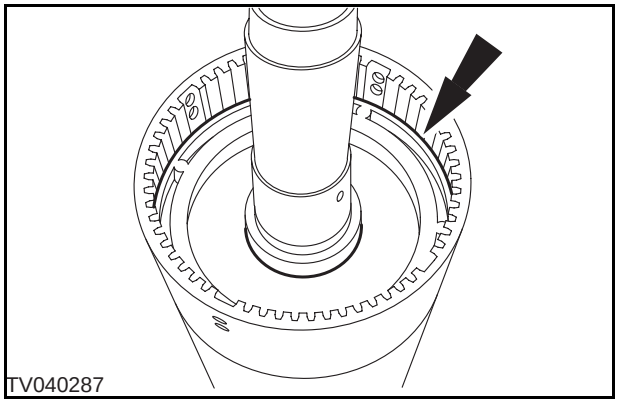
1. Install clutch piston inner seal (1) and outer seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

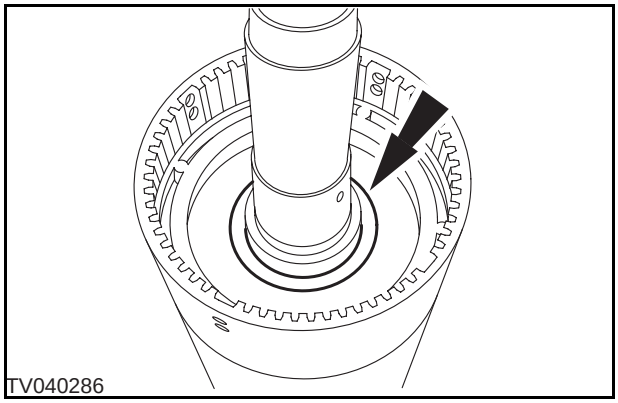


⚠ Caution:
- **Take care not to damage the sealing rings.**

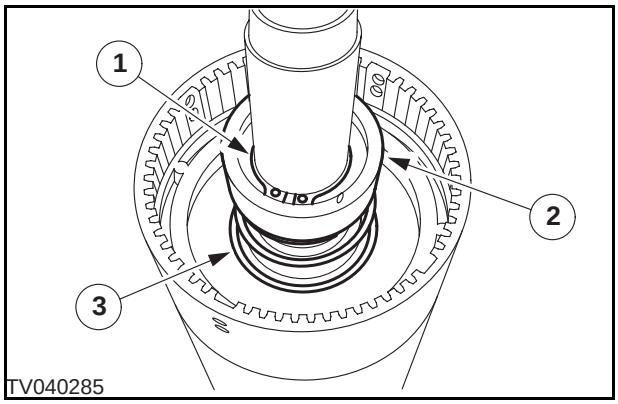
2. Install the clutch piston into the clutch drum.



3. Install the clutch piston wear washer.

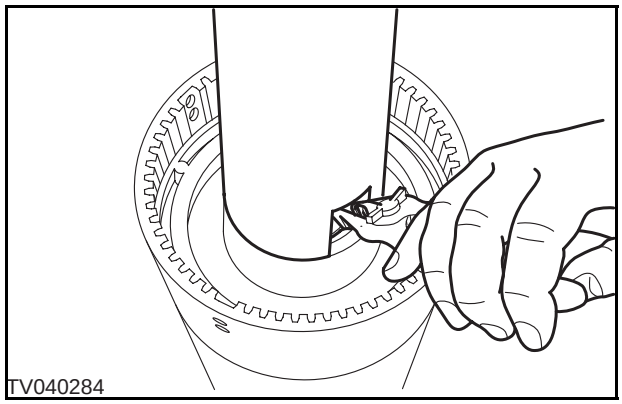


4. Install the piston return spring (3), spring retainer (2) and the circlip (1).



5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable circlip pliers, install the circlip.

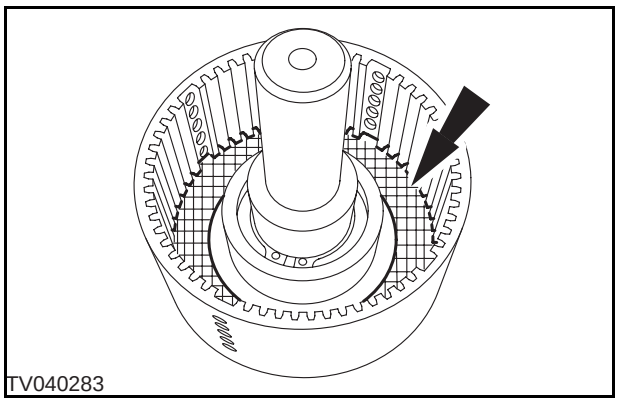
Note:
- Make sure the circlip is correctly located in the groove.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Install the half friction disc with the friction side of the disc away from the piston.

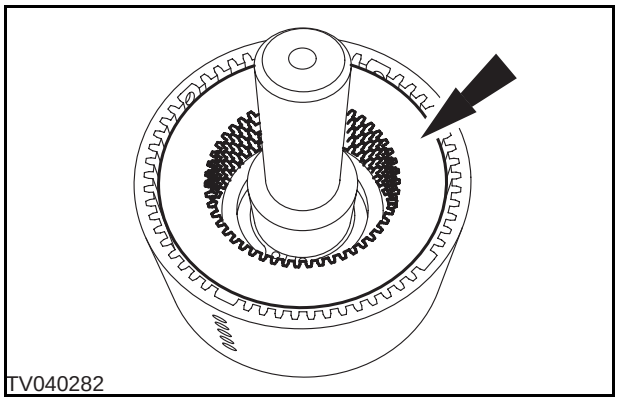
7. Install the outer half friction disc.



Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed. The first and last discs are steel.

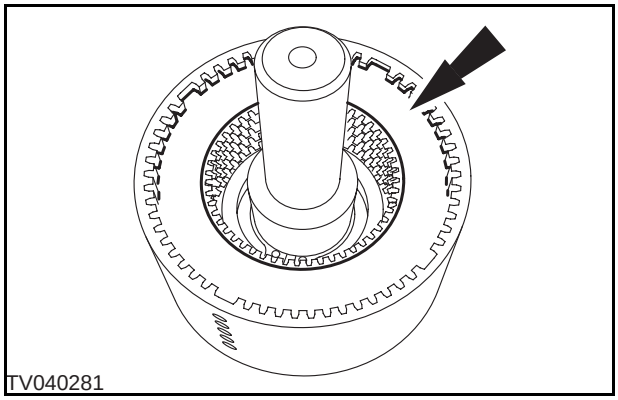
8. Install the twelve clutch outer steel discs and eleven clutch inner friction discs.


TV040282

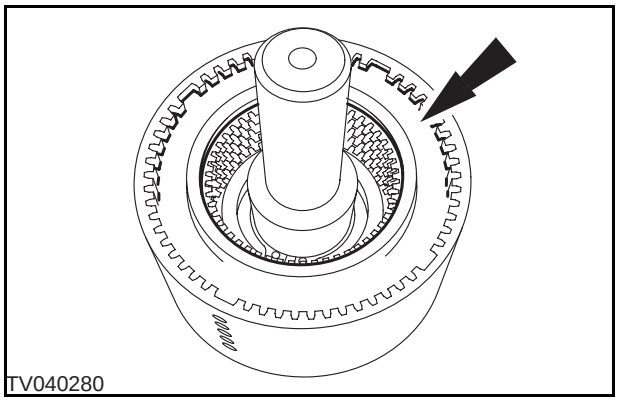
Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Install the outer half friction disc with the friction side of the disc towards the piston.

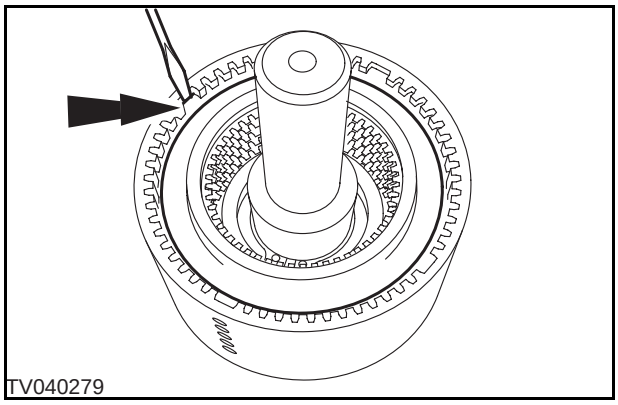
9. Install the outer half friction disc.


TV040281

10. Install the clutch disc backing plate.

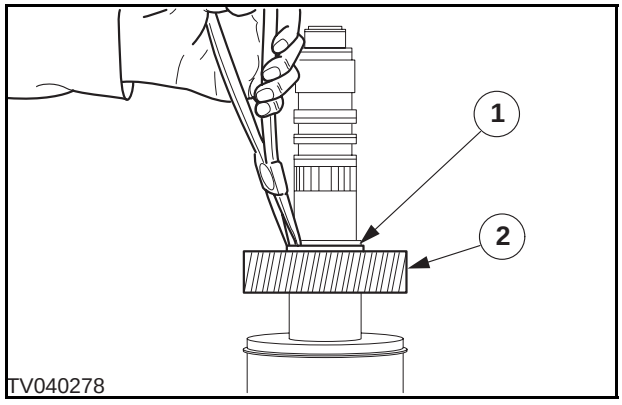

TV040280

11. Install the backing plate retaining snap ring.

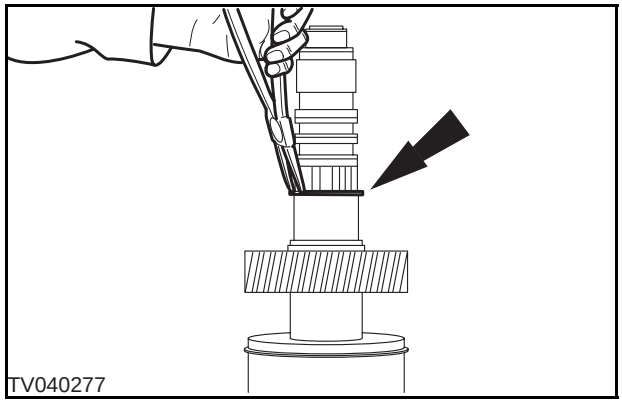


Note:
- Rotate the shaft 180°.

12. Install the output gear (2).
13. Using suitable circlip pliers, install the output gear circlip (1).



14. Using suitable circlip pliers, install the output shaft bearing locating circlip.

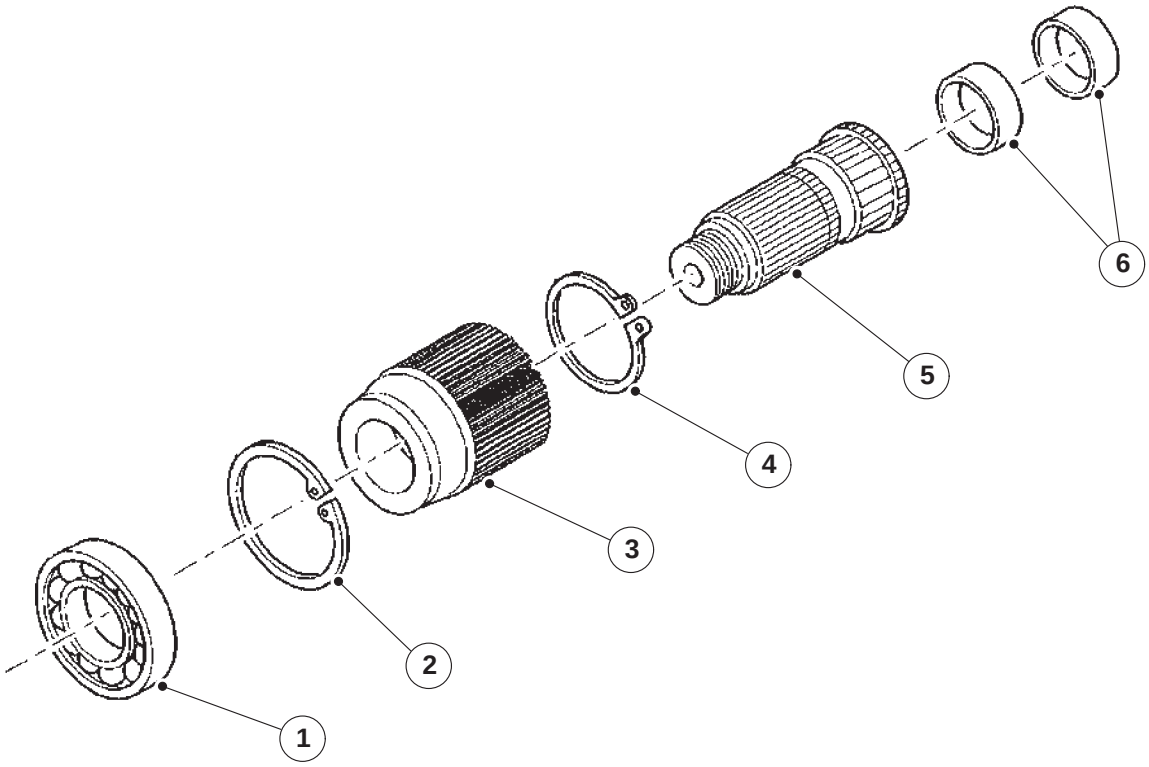


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DISASSEMBLY AND ASSEMBLY — DISCONNECT SHAFT

BHN1301DH

Operation: **Disassembly and Assembly of the Disconnect Shaft**	*Job Code:* **13 47 17 xx**		
None	Standard tools. Suitable puller		

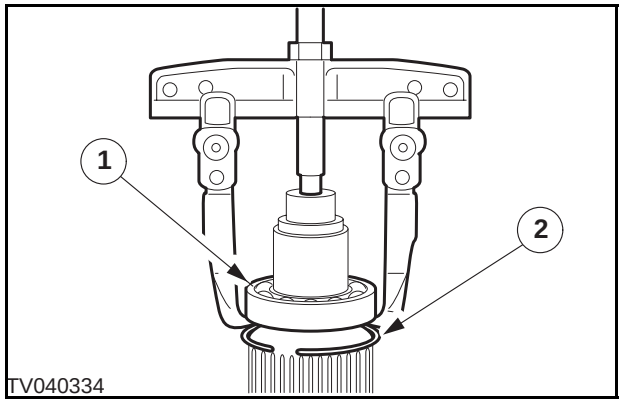


TV041061

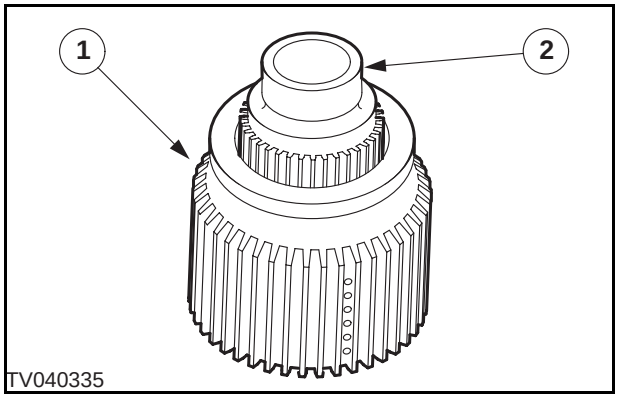
1	Bearing
2	Circlip
3	Clutch Hub
4	Circlip
5	Clutch Disconnect Shaft
6	Bushing (x2)

Disassembly

1. Using a suitable puller, remove the disconnect shaft front bearing (1).
2. Recover the circlip (2).

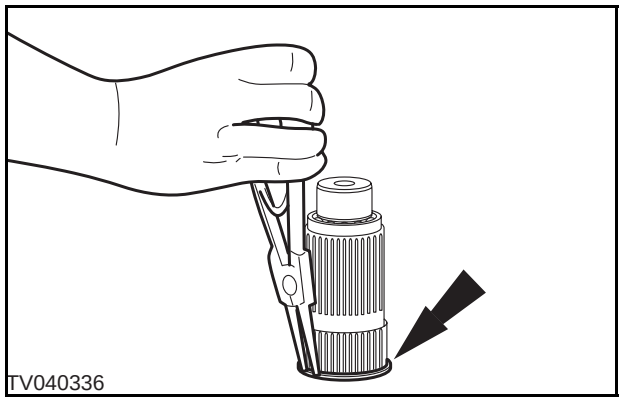


3. Remove the clutch hub (1) from the disconnect shaft (2).



4. Using suitable circlip pliers, remove the clutch hub circlip from the disconnect shaft.

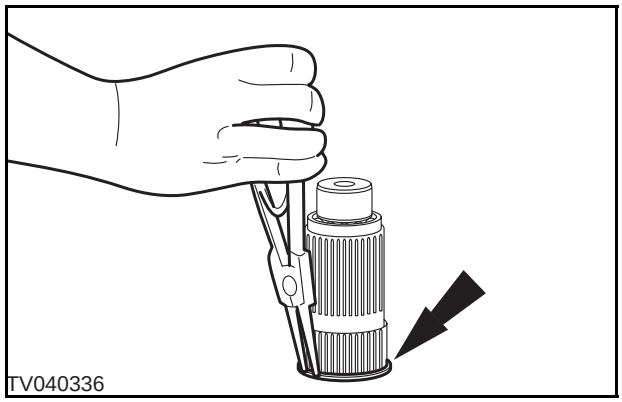
   Note:
   - Remove the bushings if required.



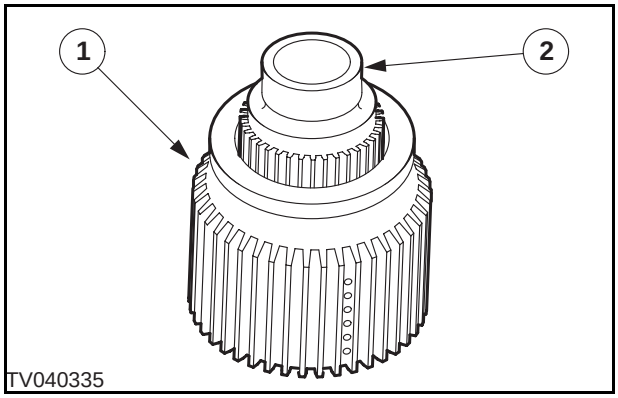
Assembly

Note:
- Install new bushings (if required).

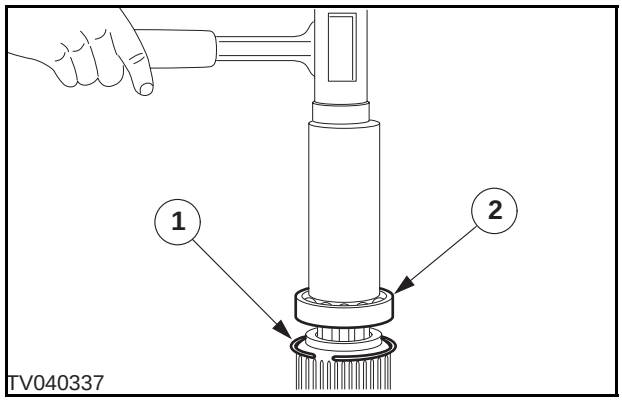
1. Using suitable circlip pliers, install the clutch hub circlip.



2. Install the clutch hub (1) on to the disconnect shaft (2).



3. Install the circlip (1).
4. Install the bearing (2).

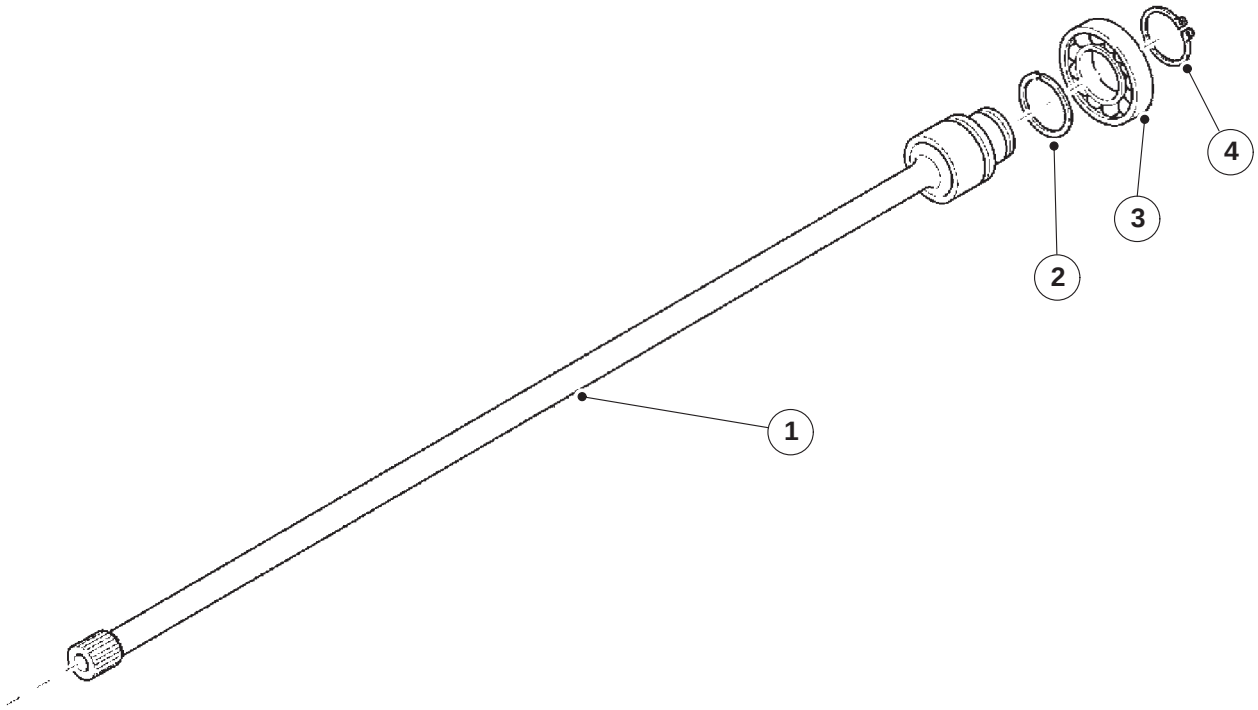


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DISASSEMBLY AND ASSEMBLY — CHARGING PUMP DRIVE SHAFT

BHN1301DJ

Operation: **Disassembly and Assembly of the Charging Pump Drive Shaft**	*Job Code:* **13 38 17 xx**		
None	Standard tools, Suitable puller		

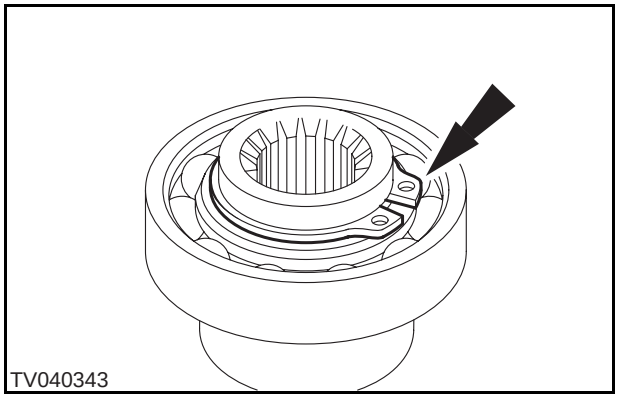


TV040569

1	Charging Pump drive shaft
2	Sealing ring
3	Charging Pump drive shaft bearing
4	Charging Pump drive shaft bearing circlip

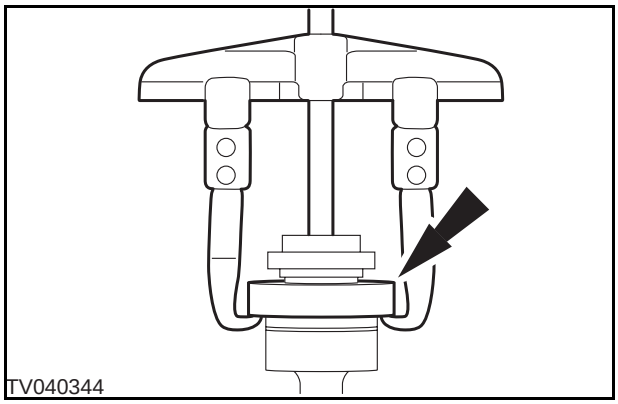
Disassembly

1. Using suitable circlip pliers, remove the charging pump drive shaft bearing circlip.

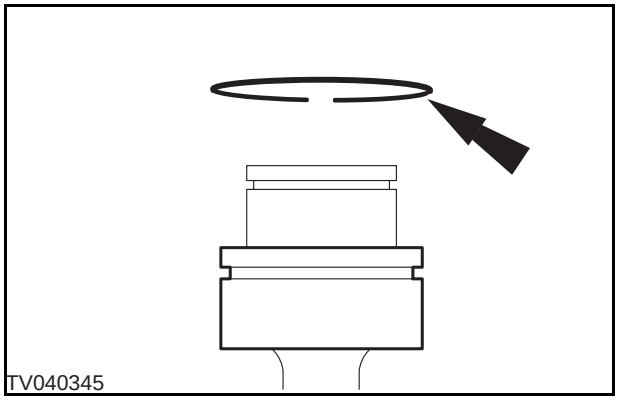


TV040343

2. Using a suitable puller, remove the charging pump drive shaft bearing.

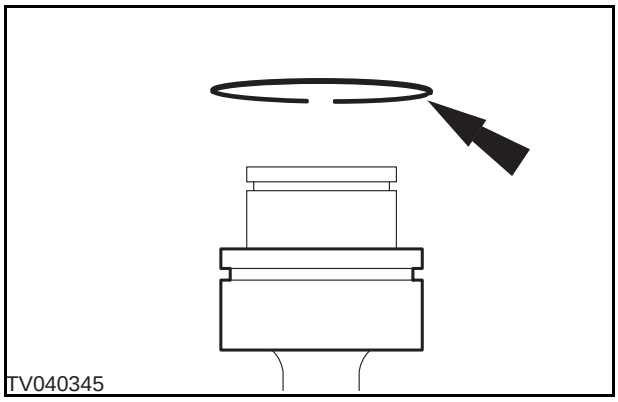

TV040344

3. Remove the sealing ring from the charging pump drive shaft.

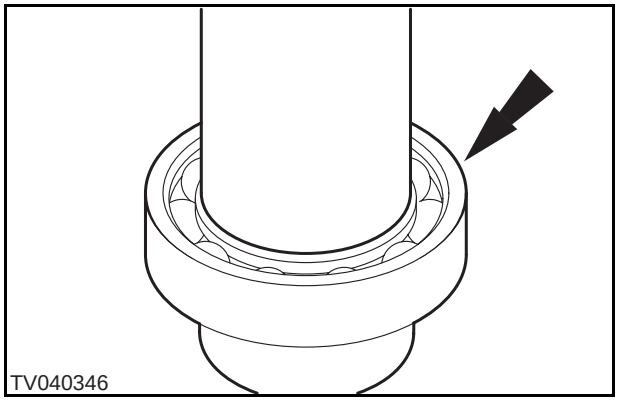

TV040345

Assembly

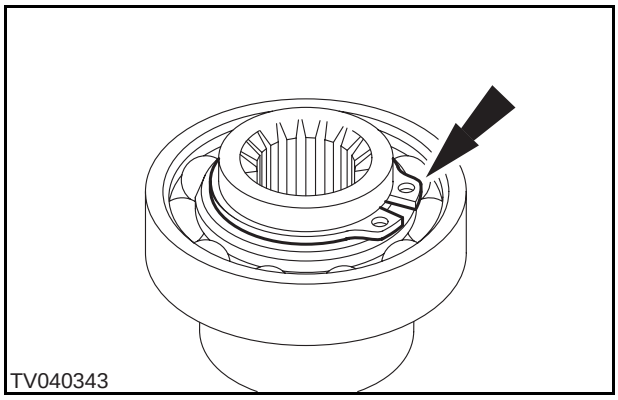
1. Install the sealing ring on the charging pump drive shaft.


TV040345

2. Using a suitable press, install the charging pump drive shaft bearing.


TV040346

3. Using suitable circlip pliers, install the charging pump drive shaft bearing circlip.

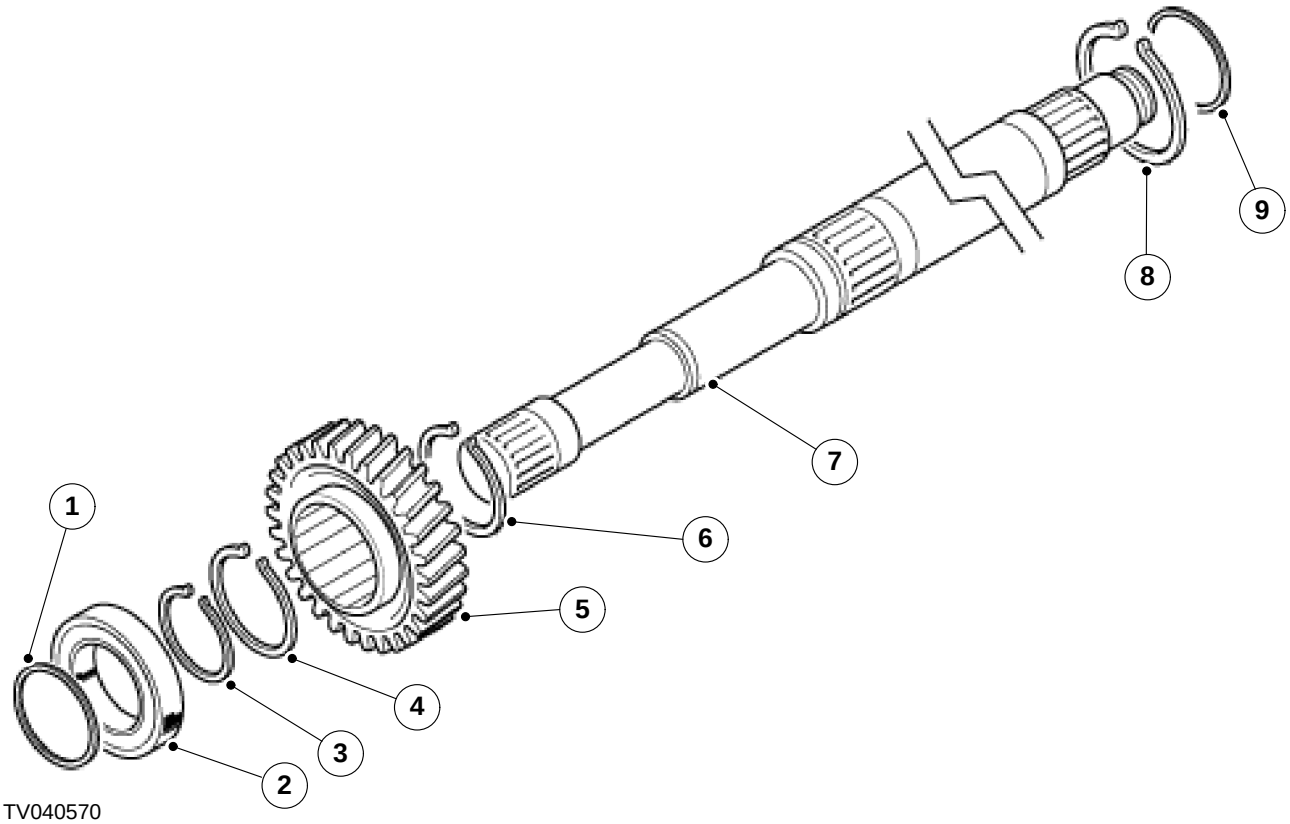

TV040343

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DISASSEMBLY AND ASSEMBLY — INPUT SHAFT

BHN1301DK

Operation: **Disassembly and Assembly of the Input Shaft**	*Job Code:* **13 47 17 xx**		
None	Standard tools, Suitable puller		

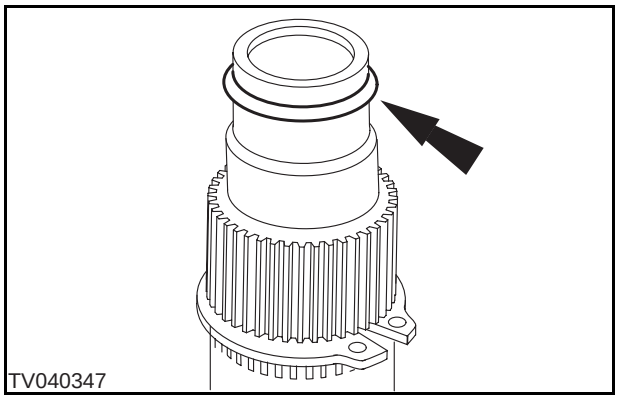


TV040570

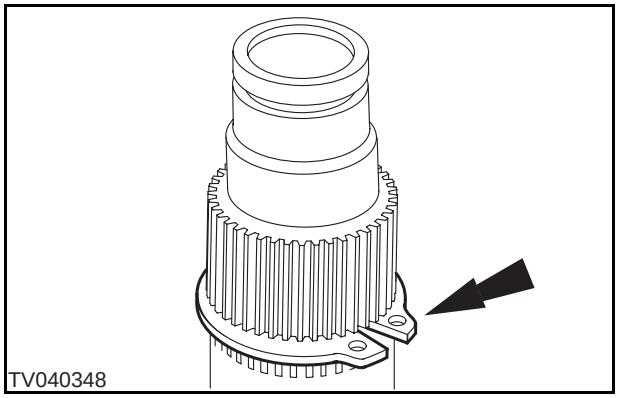
1	Sealing Ring
2	Input Shaft Bearing
3	Circlip
4	Circlip
5	Forward Low Gear
6	Circlip
7	Input Shaft
8	Circlip
9	Sealing Ring

Disassembly

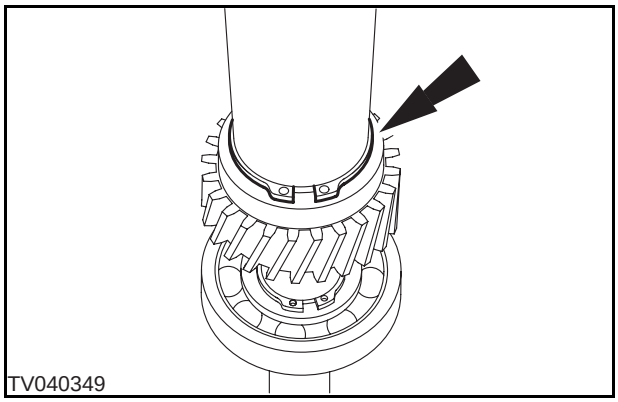
1. Remove the input shaft sealing ring.


TV040347

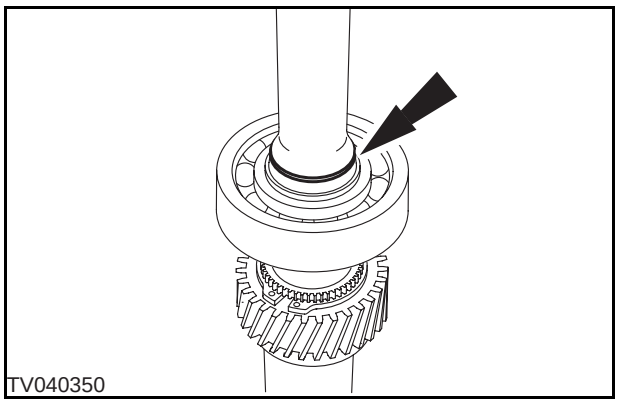
2. Using suitable circlip pliers, remove the forward high gear circlip.


TV040348

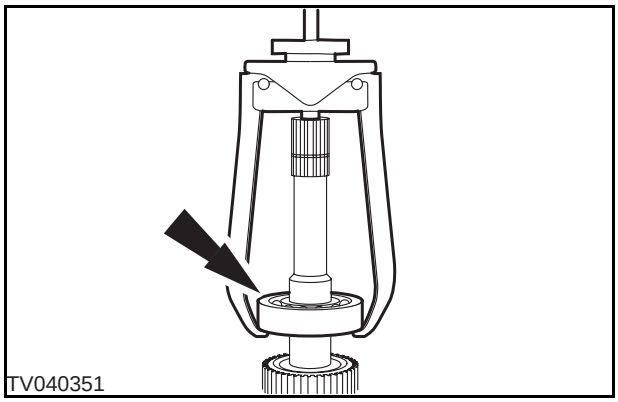
3. Using suitable circlip pliers, remove the forward low gear circlip.


TV040349

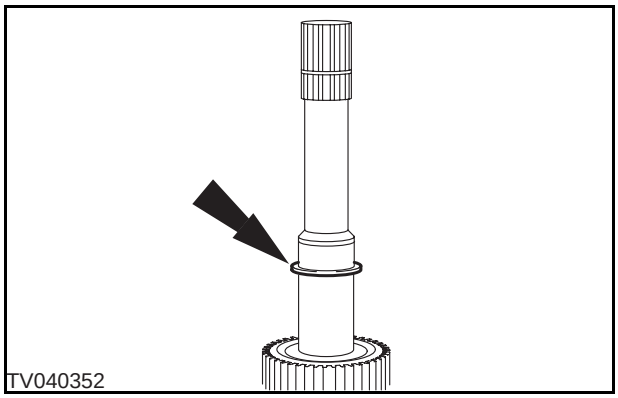
4. Rotate the input shaft 180°.
5. Remove the input shaft sealing ring.


TV040350

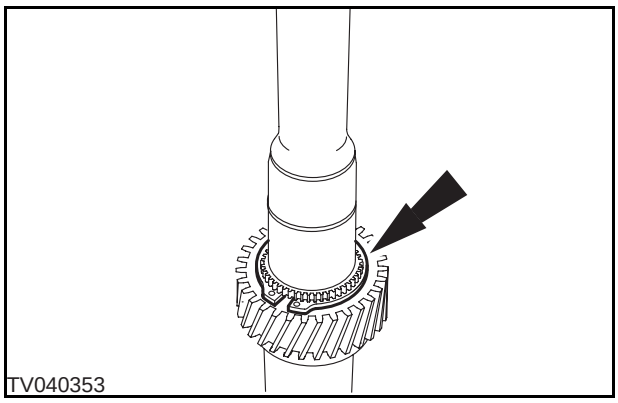
6. Using a suitable puller, remove the input shaft bearing.


TV040351

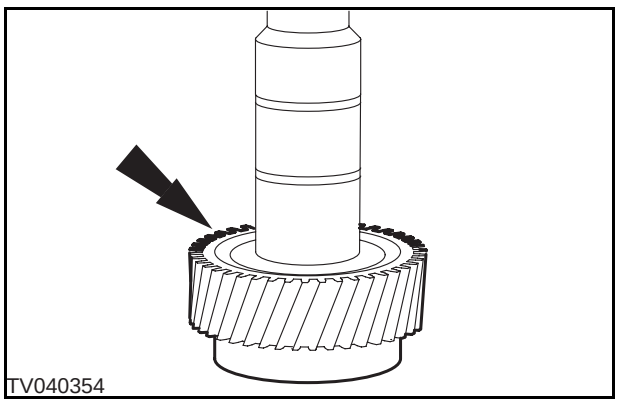
7. Using suitable circlip pliers, remove the input shaft bearing locating circlip.


TV040352

8. Using suitable circlip pliers, remove the input shaft forward low gear circlip.

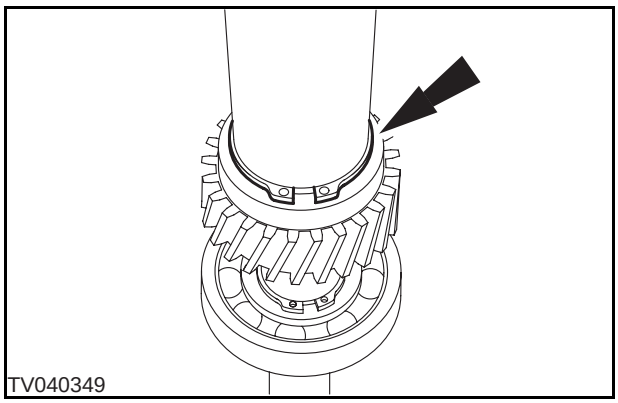

TV040353

9. Using a suitable hydraulic press, remove the forward low gear from the input shaft.

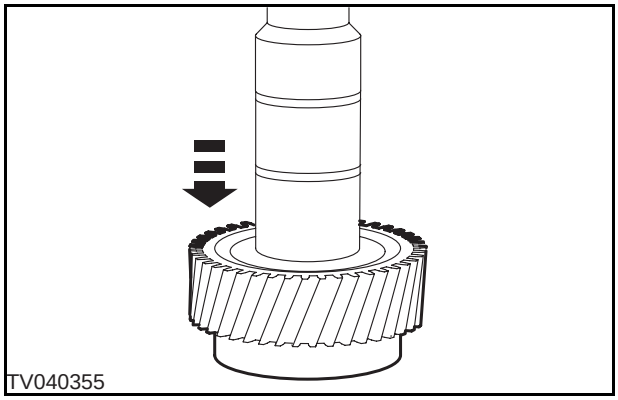

TV040354

Assembly

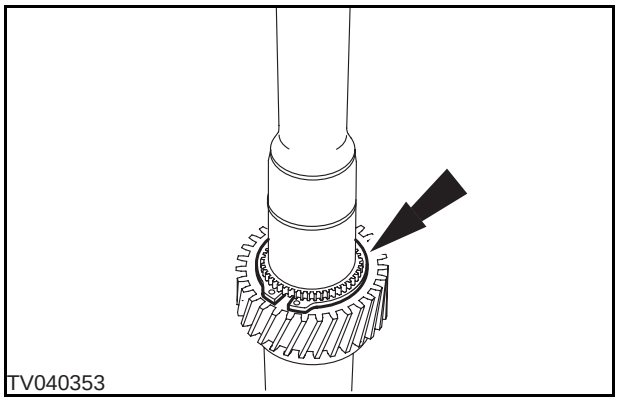
1. Using suitable circlip pliers, install the forward lower gear circlip.



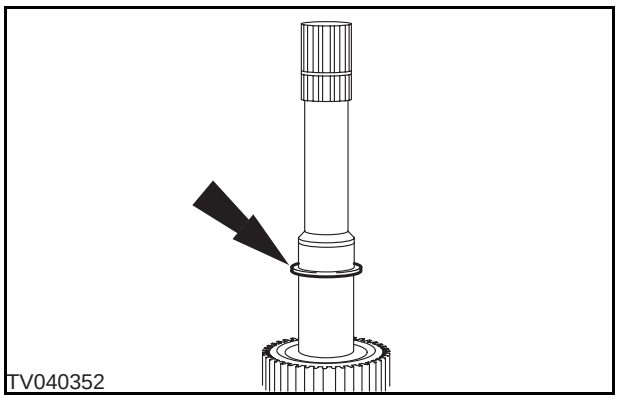
2. Using a suitable bearing heater, heat the forward low gear to 150° C (302° F).
3. Install the forward low gear.



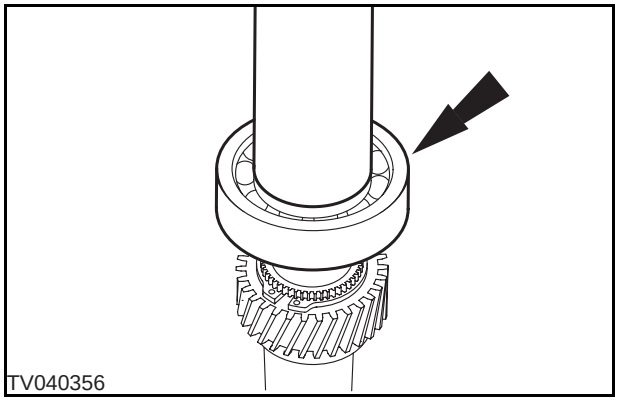
4. Using suitable circlip pliers, install the forward low gear circlip.



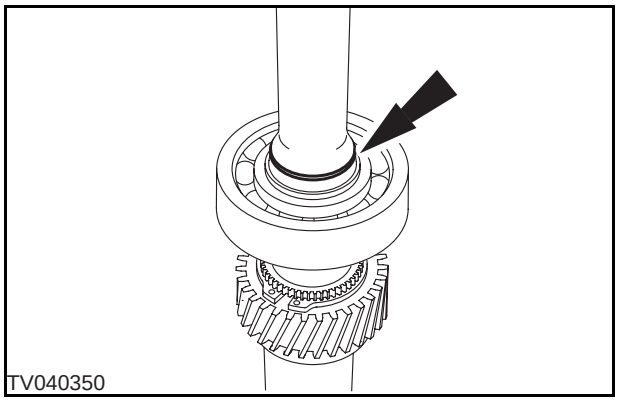
5. Using suitable circlip pliers, install the input shaft bearing locating circlip.



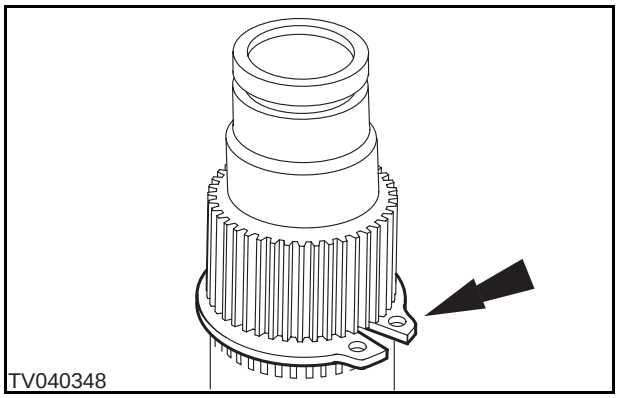
6. Using a suitable bearing heater, heat the input shaft bearing to 150° C (302° F).
7. Install the input shaft bearing.


TV040356

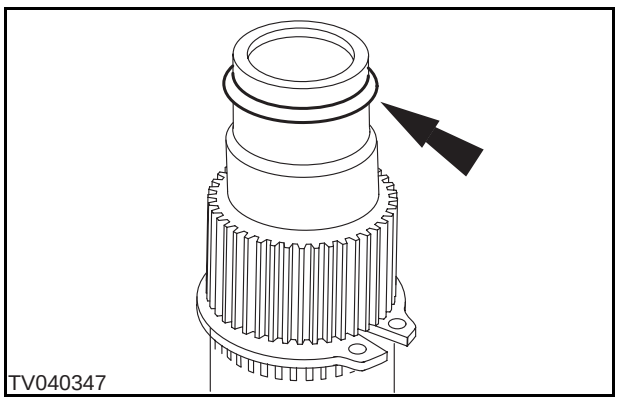
8. Install the input shaft sealing ring.


TV040350

9. Rotate the input shaft 180°.
10. Using suitable circlip pliers, install the input shaft forward high gear circlip.


TV040348

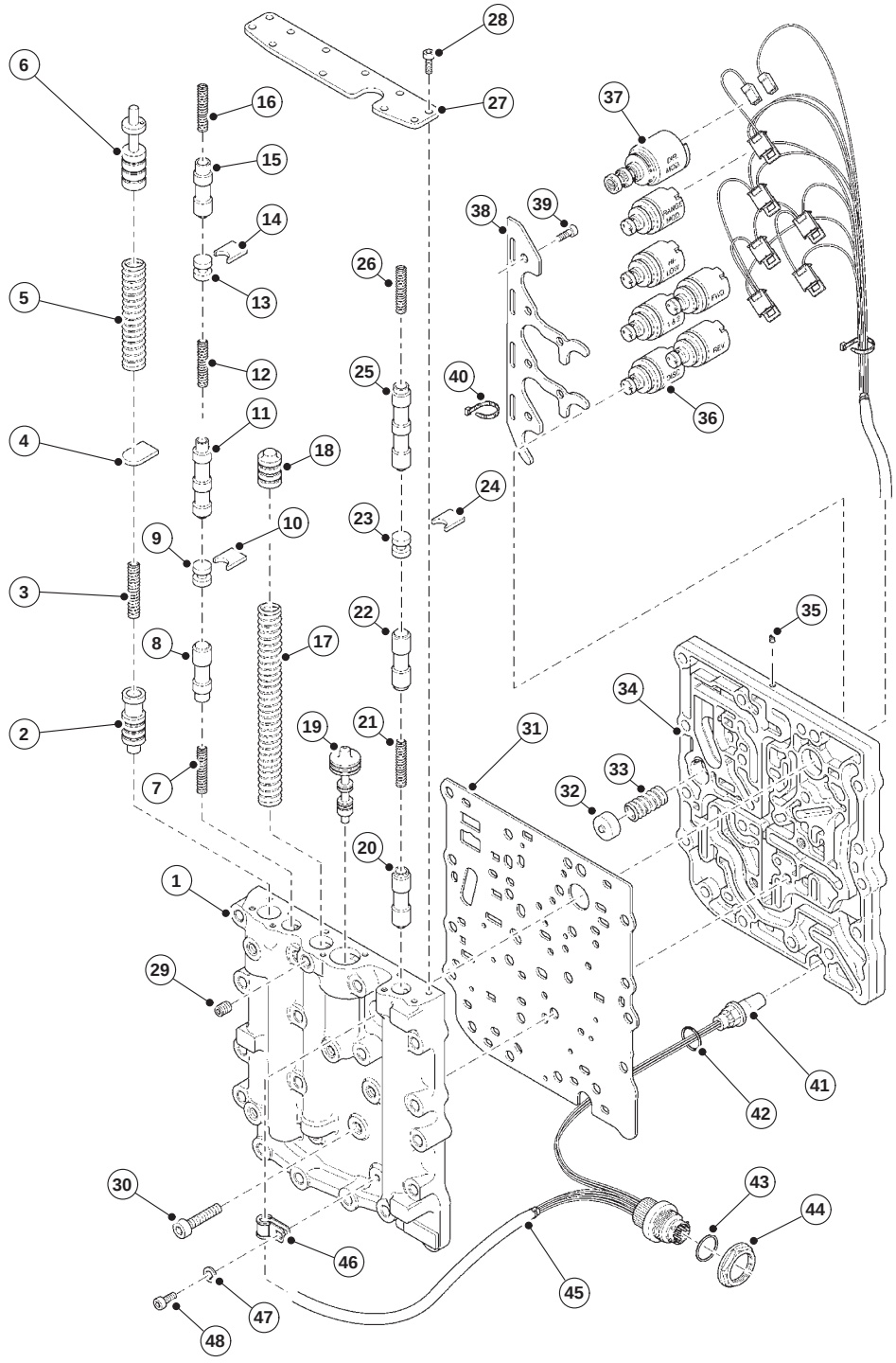
11. Install the input shaft sealing ring.


TV040347

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DISASSEMBLY AND ASSEMBLY — TRANSMISSION CONTROL VALVE

BHN1301DL



TV040578

1	Valve Body
2	Pressure Reducer Spool
3	Pressure Reducer Spring
4	Separator Plate
5	Pressure Regulator Spring
6	Pressure Regulator Spool
7	Pilot Spool Spring

8	Disconnect Spool
9	Spool
10	Separator Plate
11	1st/2nd Spool
12	Pilot Spool Spring
13	Stop Spool
14	Separator Plate

15	Range Modulation Spool
16	Pilot Spool Spring
17	Accumulator Spring
18	Accumulator Spool
19	Booster Spool
20	Reverse Spool
21	Pilot Spool Spring
22	Forward Spool
23	Stop Spool
24	Separator Plate
25	Forward Low/Forward High Spool
26	Pilot Spool Spring
27	Spool Cover
28	Spool Cover Retaining Bolt
29	Check Port Plug
30	Retaining Bolt
31	Spacer Plate
32	Bypass Valve Spool
33	Bypass Valve Spring
34	Solenoid Plate
35	Plug
36	Solenoid
37	Electronic Controlled Modulation Valve
38	Solenoid Retaining Clamp
39	Solenoid Retaining Clamp Retaining Bolt
40	Wiring Strap
41	Speed Sensor
42	O-ring
43	O-ring
44	Retaining Nut
45	Wiring Harness
46	Wiring Harness Clamp
47	Lock Washer
48	Clamp Screw

GENERAL PROCEDURE — CLEANING AND INSPECTION AFTER TRANSMISSION REPAIR

BHN1301GB

After the repaired transmission has been installed in the machine, the oil cooler, and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgement must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain the entire system thoroughly.
2. Disconnect and clean all hydraulic lines. Where feasible, hydraulic lines should be removed from the machine for cleaning.
3. Replace oil filter elements cleaning out filter cases thoroughly.
4. The oil cooler must be thoroughly cleaned. The cooler should be “back flushed” with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, the cooler assembly should be removed from the machine for cleaning, using oil, compressed air, and steam cleaner for that purpose. DO NOT use flushing compounds for cleaning purposes.
5. Reassemble all components and use only the specified type of oil.
   Fill the transmission through the filler opening until fluid comes up to the oil level check port.
   Run the engine for 2 minutes at low RPM to prime the torque converter and hydraulic lines.
   Check the transmission oil with the engine running at idle RPM and add oil as necessary.
   Check the transmission oil level when the transmission is at the operating temperature 82 — 93°C (180 — 200°F).
6. Check all drain plugs, lines, connections, etc. for leaks and tighten where necessary.

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GENERAL PROCEDURE — POWERSHIFT TRANSMISSION CLUTCH CALIBRATION

BHN1301GA

The powershift controller can be used to determine the optimal clutch fill parameters. The calibration process creates the ideal start situation for clutch engagement. The clutch fill times can be calibrated in two ways.

- Using the Microsoft Windows based T16000 Diagnostic Monitor.
- Stand-alone calibration. The transmission controller automatically calibrates the transmission after guiding the user through a set-up procedure.

Note:

- The transmission fluid must be at the normal operating temperature 70 — 120°C (158 — 248°F) to achieve the correct calibration.

⚠ **Caution:**

- **Make sure four-wheel drive is disengaged.**

1. Raise the rear of the machine (wheels off the ground) using the stabiliser legs.
2. Set the engine speed to approximately 1500 RPM.

Note:

- Make sure the transmission output has sufficient resistance to be stalled in neutral, while allowed to spin in either forward or reverse.

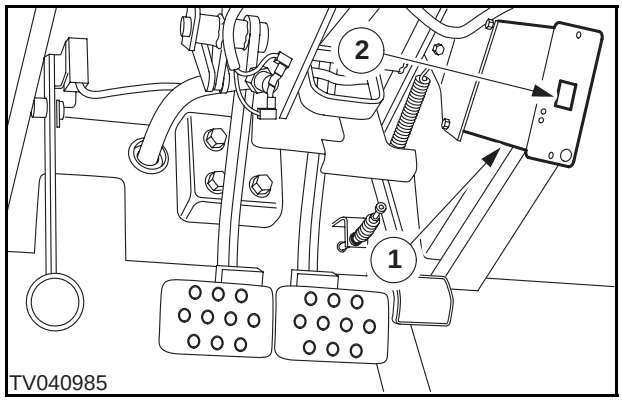
3. Lightly apply the parking brake.

Note:

- During the stand-alone calibration, only the forward and reverse clutches are calibrated.

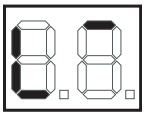
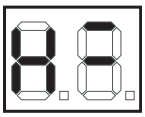
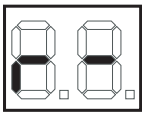
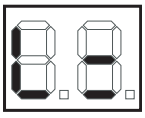
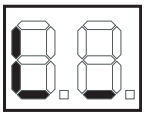
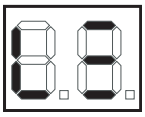
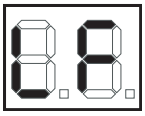
The transmission controller (1) will show the clutch currently being tested and the result of the calibration on the digital display (2).
The left side of the display shows the clutch currently being tested.

- **L** for Forward Low
- **H** for Forward High
- **R** for Reverse



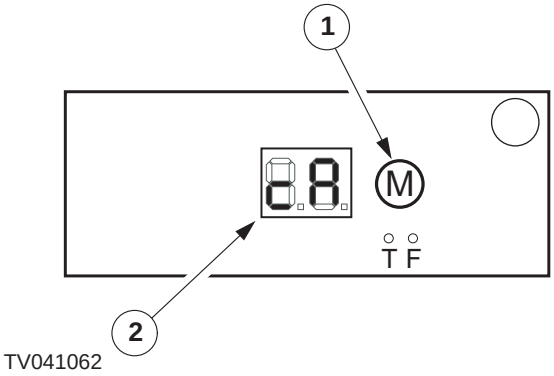
The right side of the display shows the result of the calibration.
If the fill time is too short, only the lowest segment is illuminated. If it is too short, but within twice the tolerance, the middle and lower segments are illuminated.

Display Examples

(Display)	Description
	Fill time for the Forward Low clutch is too high.
	Fill time for the Forward High clutch is too high, but within twice the tolerance.
	Fill time for the reverse clutch was successful and within tolerance. The middle segment is illuminated for 1 second, indicating the successful calibration.
	Fill time for the Forward Low clutch is too short, but within twice the tolerance.
	Fill time for the Forward Low clutch is too short.
	Fill time for the Forward Low clutch failed. Three segments of the LCD will be illuminated for 0.5 seconds indicating a problem. The transmissions output was prevented from rotating. This can be caused by braking too hard during the calibration process or a fill time that is excessively high. If the fill time is too high, the calibration system will attempt to reduce the fill time by adapting the fill parameters.
	The Forward Low clutch calibration phase failed. If the calibration for a specific clutch failed, the original fill time values will be used. This failure can be caused by braking too hard during the calibration process .

Stand-Alone Calibration

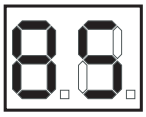
To start the calibration, depress and hold the mode button **"M"** (1) for 10 seconds (this can be done during or after the key start switch is turned ON). The digital display (2) will show **"cA"** to indicate the controller has entered the calibration menu.



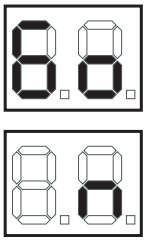
TV041062

If the transmission temperature is outside the range for calibration, the temperature will be displayed. The example below shows 85 ºC

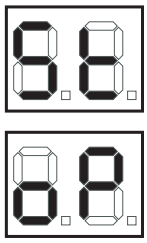
Temperatures less than 0 ºC are shown as **"0.0."** and temperatures greater than 99 ºC are shown as **"9.9."** .



When the transmission temperature is within the range for calibration, the transmission controller digital display will alternate between **Go** and **n(GO to Neutral)** to indicate Neutral has to be selected.



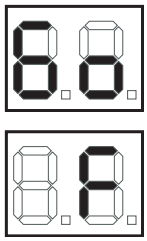
When neutral has been selected, the transmission controller digital display will alternate between **"St"** and **"oP"(STOP)** to indicate the parking brake or service brake needs to be lightly applied.



Note:

- Make sure the transmission output has sufficient resistance to be stalled in neutral, while allowed to spin in either forward or reverse.

When the initial conditions have been carried out, i.e. temperature within range, output speed is zero and the shift lever is in neutral, the transmission controller digital display will alternate between **"Go"** and **"F"(Go to Forward)** to indicate Forward has to be selected.



Note:

- To exit the calibration process at any time, move the shift lever to the opposite direction. All original calibration values will be restored.

When forward is selected, the transmission calibration starts and completes automatically.

Note:

- Make sure the transmission controllers power supply is not interrupted during, and 3 seconds after the calibration process has completed. If the power supply is interrupted, re-calibrate the transmission again.

The transmission calibration values are automatically stored in permanent memory after the calibration process has completed.

If the calibration of a clutch fails, the controller will default to the factory presets for the clutch.

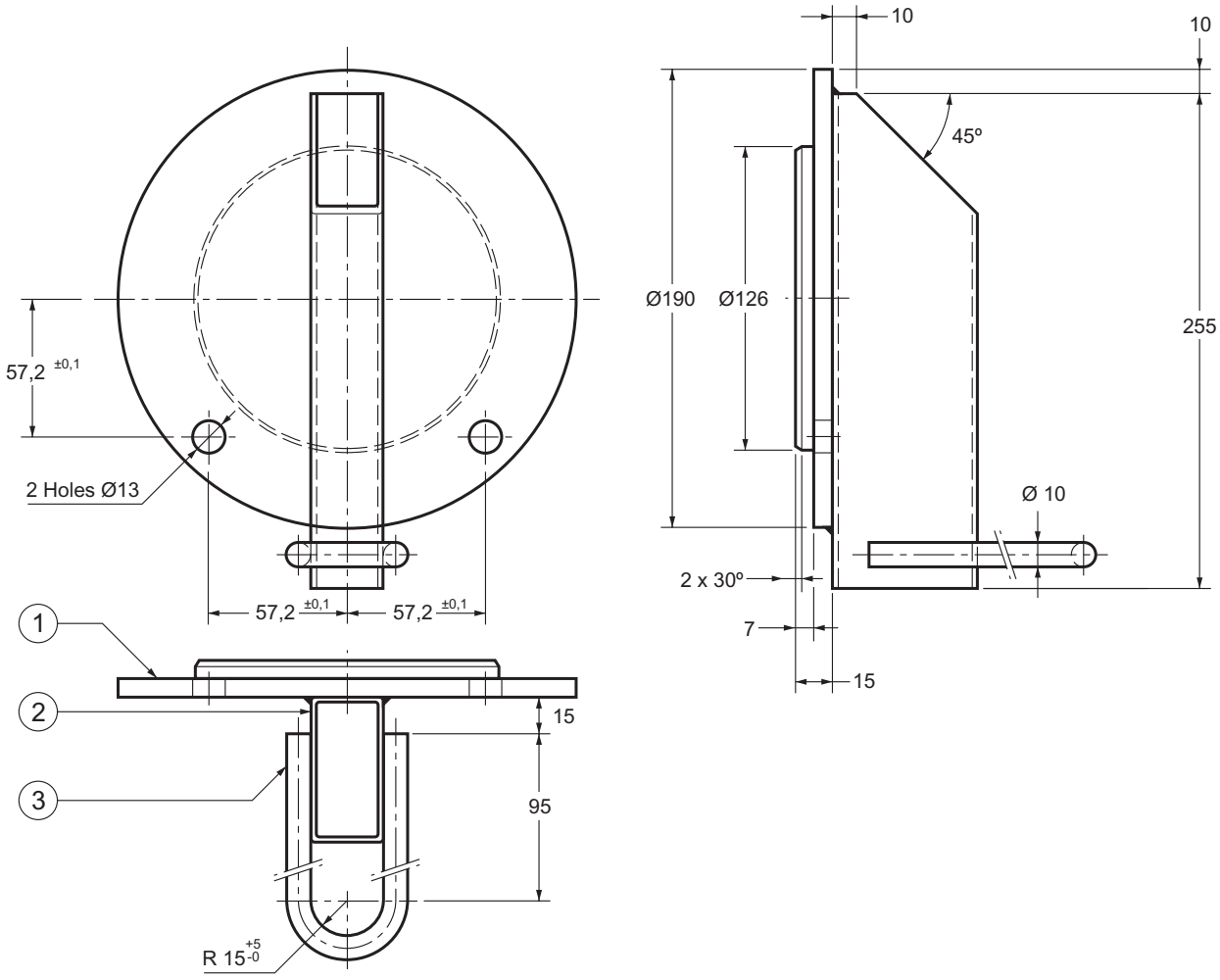
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SPECIFICATIONS — POWERSHIFT TRANSMISSION

BHN1301SA

Special Tools

Transmission Housing Lifting Tool (P.N: TG 1500-676)



TV041080

1	Mounting Plate
2	Box Section
3	Lifting Eye

Note:

- Material: ST37

General Information

Transmission	Power Shift
Make	Dana
Model	121-4FT 16000-22
Fermec P/N	6108875M91
Torque Converter Stall Ratio	2.60:1
Pump Pressure	20.5 – 23.5bar
Clutch Pressure	20.5 – 23.0bar
Torque Converter Working Pressure	4.9 – 5.0bar
Torque Converter Safety Valve Pressure	9.0bar
Solenoid Pressure	9.5bar
860 Transmission Control Unit	4503428
970 Transmission Control Unit	4503427
Lubrication Pressure	0.4 – 0.5bar

Capacity

System	Temperatures	Viscocity	Specification	Capacity	Notes
Powershift Transmission	ALL	10W	ATF	23 (Total System)	Check oil level with engine running at idle. Approved oils: ATF Elfmatic G3 Esso D (21611)

Temperature Specifications

- Normal operating temperature 70 — 120°C (158 — 248°F).
- Maximum allowed transmission temperature 120°C (248°F).

Torque Values

Note:

- All threads must be lubricated before assembly.

Description	Nm	Lb.ft
Transmission Bell Housing	71	52
Torque Converter	41	30
Propeller Shaft	47	35
Hydraulic Pump	98	72
Transmission/Converter Housing	45	33
Output Flange	380	280
Transmission Housing Plug	17	13
Four-wheel Drive Flange	380	280
Charging Pump	23	17
Torque Converter Drive Plates	37	27
Transmission Oil Filter Adapter	23	17
Transmission Oil Filter	34	25
Transmission Control Valve	22	16
Transmission Control Valve Cover	6	4
Wiring Harness Connector Mounting Nut	7	5
Transmission Air Breather	38	28

Torque Chart (Bolts)

Note:
- (Based in VDI 2230, μ = 0,14 and CCI standard)

Metric			**Inch**		
Class 8,8	Torque		Grade 5	Torque	
	Nm	lbft		Nm	lbft
M5 x 0,8 M8 x 1,25 M10 x 1,5	5 — 6 20 — 25 40 — 50	3,7 — 4,4 14,7 — 18,4 29,5 — 36,8	0,5000	87 — 95	64,1 — 70,0

Torque Chart (O-Ring Port Plugs)

Metric			**Inch**		
Size	Torque		Size	Torque	
	Nm	lbft		Nm	lbft
M10 x 1 M22 x 1,5 M33 x 2	8 — 10 48 — 60 112 — 140	5,9 — 7,4 35,4 — 44,2 82,5 — 103,2	1,3125 — UN	112 — 140	82,5 — 103,2

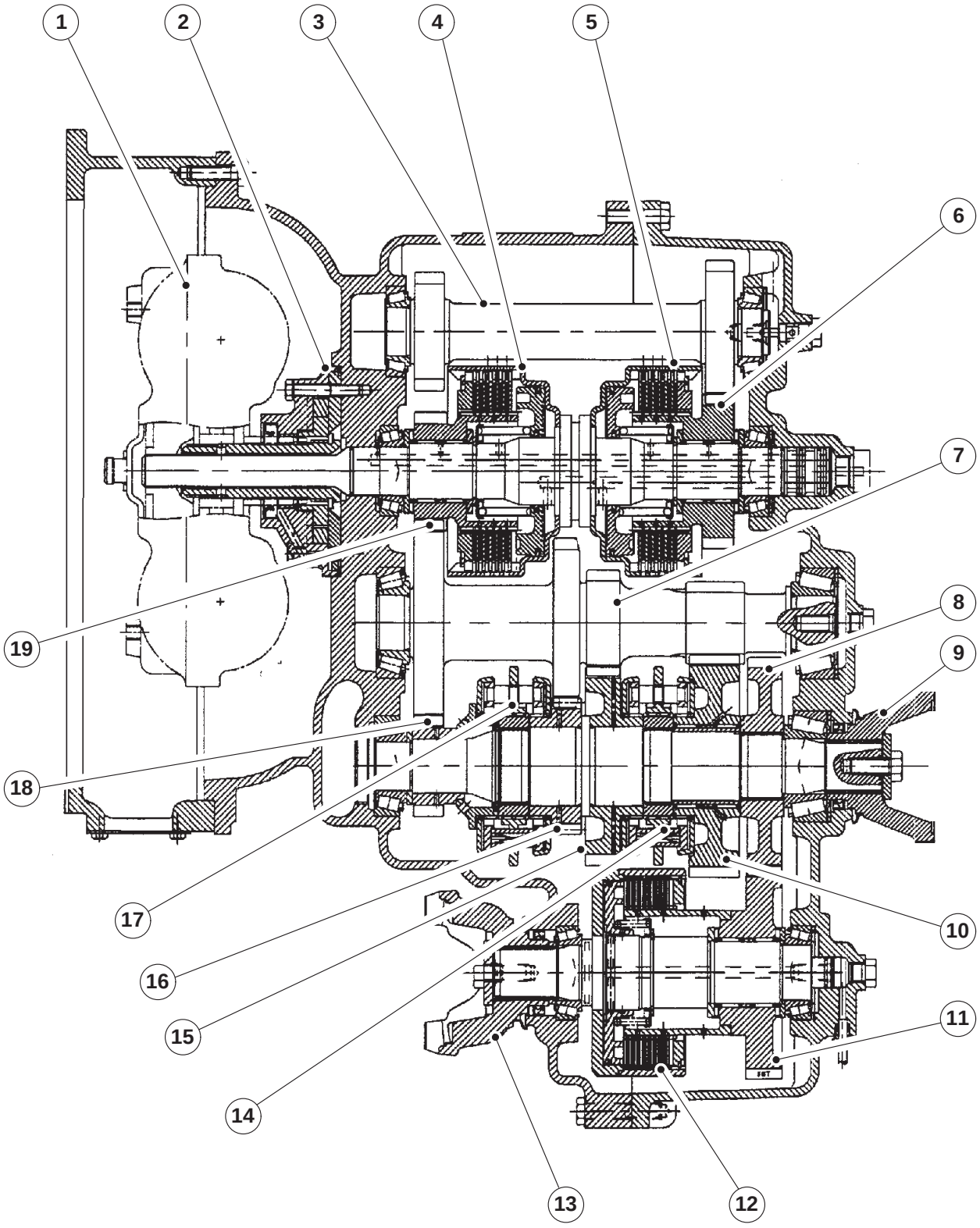
Torque Chart (Pipe Plugs)

Metric			**Inch**		
Size	Torque		Size	Torque	
	Nm	lbft		Nm	lbft
M22 x 1,5 UNI 7707	48 — 60	35,4 — 44,2	0,1250 — 27 NPTF	9 — 13	6,6 — 9,6

DESCRIPTION AND OPERATION — SYNCHROSHUTTLE TRANSMISSION — TURNER

BHN1302OA

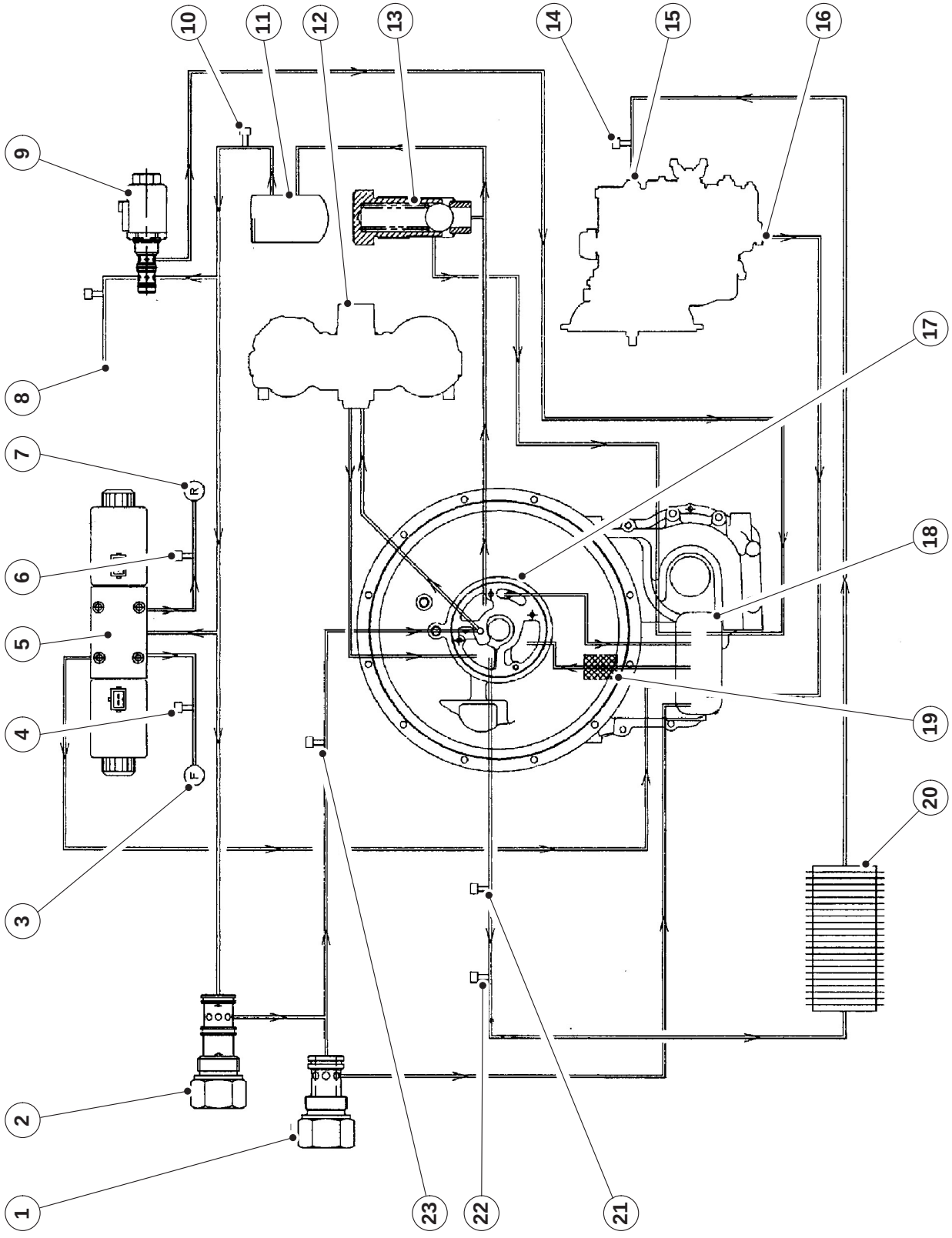
Schematic View Synchroshuttle Transmission



TV040913

1	Torque Converter
2	Transmission Oil Pump
3	Reverse Idler Shaft
4	Forward Clutch
5	Reverse Clutch
6	Reverse Primary Gear
7	Countershaft
8	Four-wheel Drive Gear Drive
9	Output Shaft Flange
10	1st Gear
11	Four-wheel Drive Gear Driven
12	Four-wheel Drive Hydraulic Multiplate Clutch
13	Four-wheel Drive Output Shaft Flange
14	1st / 2nd Synchroniser
15	2nd Gear
16	3rd Gear
17	3rd / 4th Synchroniser
18	4th Gear
19	Forward Primary Gear

Transmission Hydraulic Circuit



TV040912

1	Torque Converter Relief Valve
2	Pressure Regulator Valve
3	Forward Clutch
4	Forward Clutch Oil Pressure Test Port
5	Forward / Reverse Control Valve
6	Reverse Clutch Oil Pressure Test Port
7	Reverse Clutch
8	Four-wheel Drive Clutch
9	Four-wheel Drive Solenoid Valve
10	Transmission Oil Pump Pressure Test Port
11	Transmission Full Flow Oil Filter
12	Torque Converter
13	Cold Start Relief Valve
14	Lubrication Oil Pressure Test Port
15	Oil Cooler Inlet
16	Oil Cooler Outlet
17	Transmission Oil Pump
18	Sump
19	Suction Strainer
20	Oil Cooler
21	Transmission Temperature Sender
22	Lubrication Oil Pressure Test Port
23	Torque Converter Oil Pressure Test Port

The Clutch Circuit

Oil from the transmission sump (18) is drawn up through the suction strainer (19) by the transmission oil pump (17).

It is forced, under pressure from the transmission oil pump (17), through the transmission full flow oil filter (11) into the clutch circuit. To protect the transmission full flow oil filter (11) during cold start the cold start relief valve (13), dumps oil back to the sump (18) should it exceed 26 bar pressure.

From the transmission full flow oil filter (11) the oil flows through the pressure regulator valve (2). This maintains the clutch system pressure at 14 bar. From this valve, oil also enters the torque converter circuit.

The solenoid actuated forward / reverse control valve (5), when operated, sends oil from the clutch circuit to the forward or reverse clutch piston which then applies the appropriate clutch. When in neutral the valve closes and oil from the clutch pistons is returned to the sump (18).

On four-wheel drive models an additional solenoid valve (9), when engaged, sends oil from the clutch circuit to the four-wheel drive clutch piston which then applies the clutch. When disengaged the valve (9) closes and oil from the clutch piston is returned to the sump (18).

The Torque Converter Circuit

Oil enters the torque converter circuit from the pressure regulator valve (2).

It flows through passages in the transmission oil pump housing (17) and into the torque converter (12).

Pressure is controlled by the torque converter relief valve (1) which prevents the pressure within the torque converter from exceeding the design limits. Any excess is returned to the sump (18).

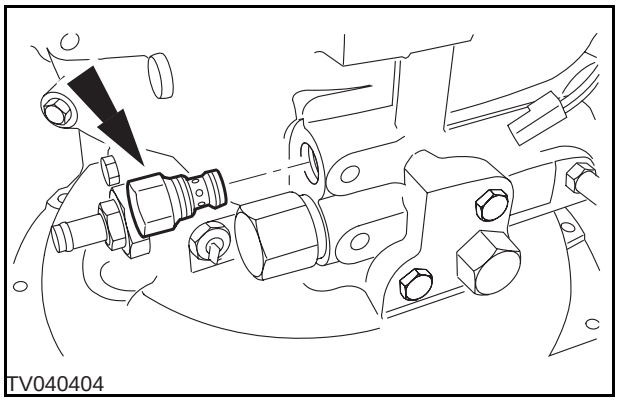
The Cooling and Lubrication Circuit

Hot oil flows from the torque converter (12) via the inside of the transmission oil pump (17) stator tube, through the centre of the transmission oil pump (17) , and out of the transmission via connecting hoses (15) and (16).

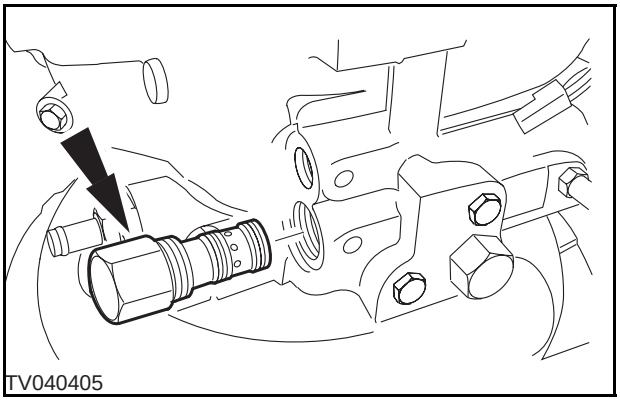
It is then passed through an external oil cooler (20) before being returned to the transmission where it is used to cool the clutches and lubricate the input shaft bearings before being returned to the sump (18).

Component Location

Torque Converter Relief Valve (1) — 10.5 bar

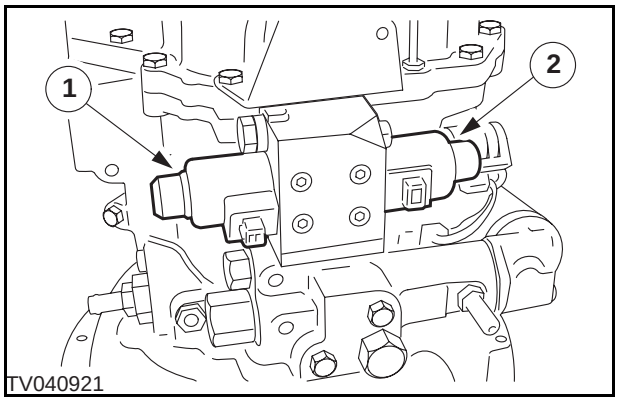


Pressure Regulator Valve (2) — 14 bar

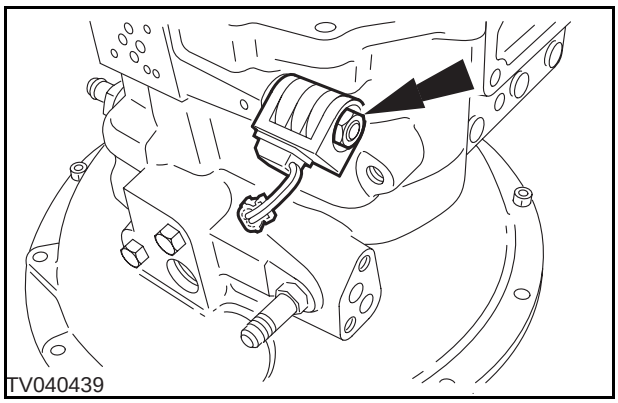


Forward / Reverse Control Valve (5)

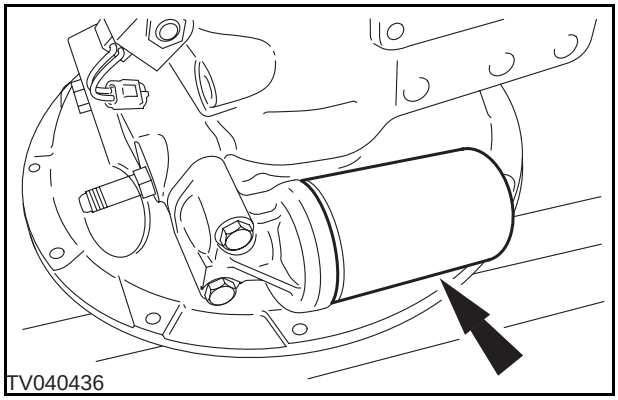
1 – Reverse solenoid
2 – Forward solenoid



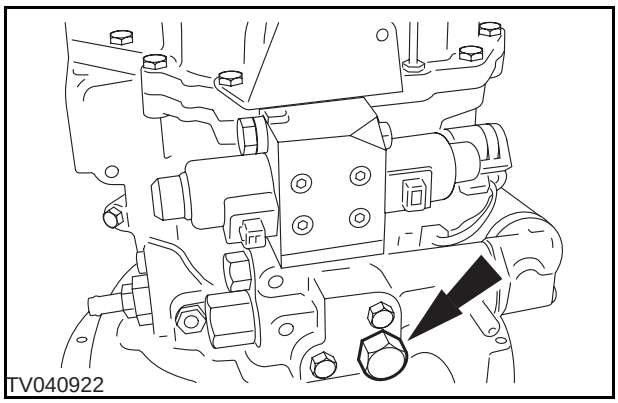
Four-wheel Drive Solenoid Valve (9)



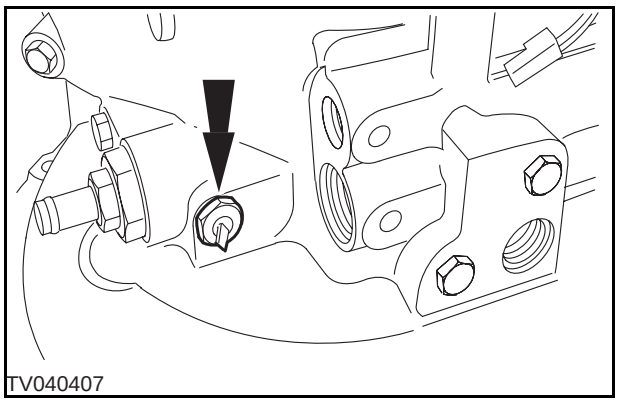
Transmission Full Flow Oil Filter (11)


TV040436

Cold Start Valve (13) — 26 bar


TV040922

Transmission Temperature Sender (21)


TV040407

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DIAGNOSING AND TESTING — SYNCHROSHUTTLE TRANSMISSION

BHN1302TA

If a malfunction of the transmission is indicated a systematic pressure checking procedure should be followed. These checks should be carried out while the transmission is still in the vehicle so that true operating conditions are created. Pressure checks are essential since a failure in the transmission hydraulic system may not be easily traceable when the transmission is stripped down on a bench.

All pressure checks should be carried out with the transmission gear lever in the neutral position, the oil temperature at 80 to 85 degrees celcius. and the engine speed maintained at 2000 to 2500 RPM. As a safety precaution the vehicles parking brake should be applied.

All pressure test ports have a 9/16 ins. UNF thread. A pressure gauge is required that will measure up to 20 bar (290 lb / in2.).

For test port locations refer to PRESSURE TEST PORTS in this section.

Fault Diagnosis Hydraulic System

Problem	Possible Cause
Transmission fails to drive in either direction	• Low or no transmission oil pump pressure.
	• Low or no oil in the transmission.
	• Mechanical failure in the transmission.
	• Worn or broken input shaft sealing rings.
	• Pressure regulator valve faulty.
	• Direction control valve not operating.
	• Blockage in oil ports restricting flow.
Transmission drives in one direction only	• Low oil pressure on one clutch pack due to leaks.
	• Clutch piston seals worn or damaged.
	• Clutch pack excessively worn.
	• Direction valve or coil faulty.
	• Mechanical failure in the transmission.
	• Blockage in oil ports restricting flow.
	• Worn or damaged input shaft sealing ring.
Delay in taking up drive	• Low torque converter pressure.
	• Low or no oil in the transmission.
	• Low clutch pressure.
	• Faulty modulation in direction control valve.
	• Blockage in direction valve.
	• Blockage in oil ports restricting flow.
No drive from Four-wheel drive	• Four-wheel drive solenoid valve or coil not operating.
	• Mechanical failure in the transmission.
	• Low four-wheel drive clutch pack pressure.
	• Four-wheel drive clutch pack worn.
Transmission overheating	• Oil level too high or low.
	• Restriction in the oil cooler flow.
	• Low oil pressure.
	• Clutch packs slipping due to oil low pressure or wear.
	• Mechanical failure in the transmission.
	• Excessive stall operation.

Problem	Possible Cause
Difficult gear selection	• Forward or reverse clutch pack pressurised when not selected.
	• Direction valve faulty.
	• Input shaft sealing rings leaking.
	• Mechanical failure in the transmission.
	• Forward and reverse clutch pack not releasing due to mechanical failure.
Vehicle moves with direction valve in neutral position	• See “Difficult gear selection”.
High stall speed	• Low or no oil in the transmission.
	• Air in oil.
	• Clutch plates slipping due to low oil pressure or wear.
	• Torque converter faulty.
	• Torque converter relief valve faulty.
	• Incorrect torque converter fitted.
Low stall speed	• Poor engine performance.
	• Torque converter defective.
	• Incorrect torque converter fitted.
Low transmission oil pump pressure	• Worn or broken transmission oil pump.
	• Leaking transmission oil pump sealing ring.
	• Blocked oil strainer or filter.
	• Blockage in oil ports between transmission sump and oil pump.
	• Pressure regulator valve stuck open.
	• Cold start valve stuck open.
High pump pressure	• Pressure regulator valve faulty.
	• Very low transmission oil temperature.
Low forward or reverse clutch pack pressure	• Faulty direction control valve.
	• Piston seal or O-ring leaking.
	• Input shaft sealing ring leaking.
High forward / reverse clutch pack pressure	• Pressure regulator valve faulty.
Torque converter pressure low	• Torque converter relief valve faulty.
	• Leak in torque converter, oil cooler or connecting hoses.
	• Very high transmission oil temperature.
Torque converter pressure high	• Converter relief valve faulty.
	• Blockage or restriction in oil cooler.
	• Very low transmission oil temperature.

Problem	Possible Cause
Low four-wheel drive clutch pack pressure	• Four-wheel drive piston seals leaking.
	• Four-wheel drive shaft sealing ring leaking.
	• Leak from four-wheel drive clutch supply pipe.
	• Faulty Four-wheel drive solenoid.
	• Blockage or restriction in four-wheel drive clutch supply pipe.
High four-wheel drive clutch pack pressure	• Pressure regulator valve faulty.
Low lubrication pressure	• Blockage or restriction in oil cooler.
	• Input shaft front sealing ring leaking.
	• Very high transmission oil temperature.

Fault Diagnosis Mechanical System

Problem	Possible Cause
Noise	• Vehicle driveline problem:- Axles, prop shaft, engine, engine mounts.
	• Mis-alignment of transmission / engine.
	• Bearings worn or damaged.
	• Gear teeth damaged or broken.
	• Excessive end float of shafts or gears.
	• Clutch plate failure forward, reverse or four-wheel drive.
	• Incorrect grade of oil in the transmission.
	• Low or no oil in the transmission.
	• Gear or thrust washer beginning to seize.
Difficult gear selection	• Shift rods worn or bent.
	• Shift forks worn, loose or twisted.
	• Synchroniser assemblies worn or damaged.
	• Clutch pack not releasing due to mechanical fault.
	• Clutch pack not releasing due to hydraulic fault.
	• Gear shift stub lever worn or damaged.
	• Incorrect grade of oil in the transmission.
	• Low or no oil in the transmission.
Jumping out of gear	• Detent springs worn or broken.
	• Synchroniser or gear dog teeth worn or damaged.
	• Synchroniser assembies worn or damaged.
	• Shift forks worn, loose or twisted.
	• Restriction or wear in gear linkage or stub lever assembly not allowing gears to be fully selected.
	• Excess end float on output shaft assembly or gears.

DIAGNOSING AND TESTING — SYNCHROSHIFT TRANSMISSION PRESSURE TESTING

BHN1302TB

Note:

- Forward, reverse and four-wheel drive clutch pack pressures should not be more than 1 bar lower than the transmission oil pump pressure.

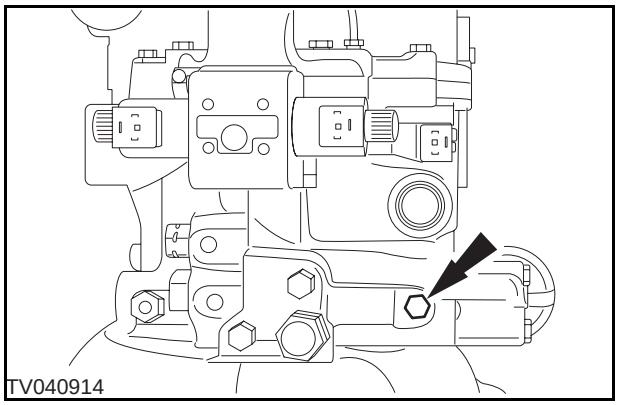
  Note:

  - The transmission oil, should be at an approximate temperature of 80 Degrees Celsius during pressure tests.

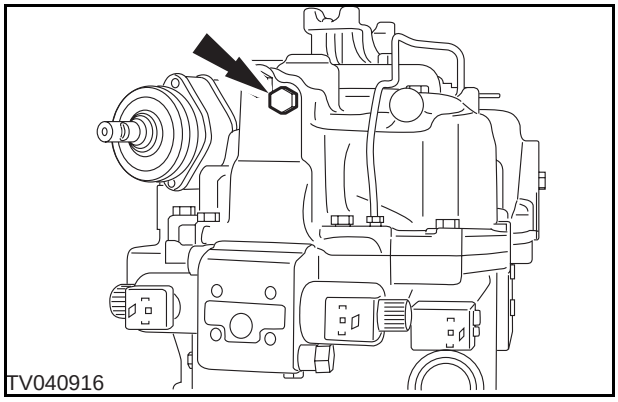
  Note:

  - All test ports have a 9/16” UNF thread.

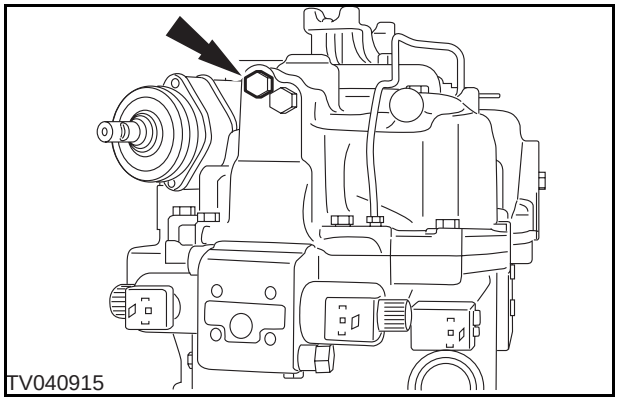
1. **Transmission oil pump** — Pressure should be 13.5 to 15.5 bar at maximum engine speed. (2350 RPM).


TV040914

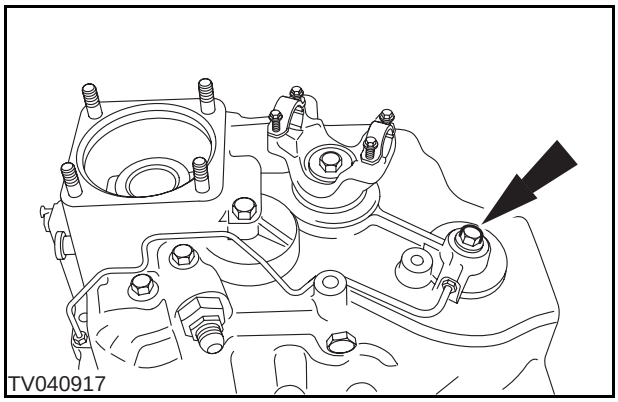
2. **Reverse clutch** — Pressure should be 12.5 to 15.5 bar at maximum engine speed. (2350 RPM).


TV040916

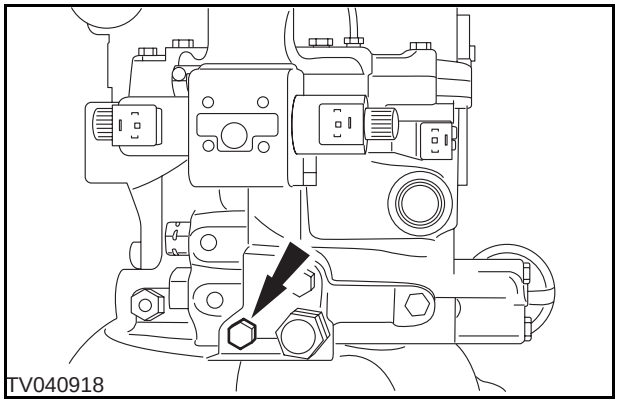
3. **Forward clutch** — Pressure should be 12.5 to 15.5 bar at maximum engine speed. (2350 RPM).


TV040915

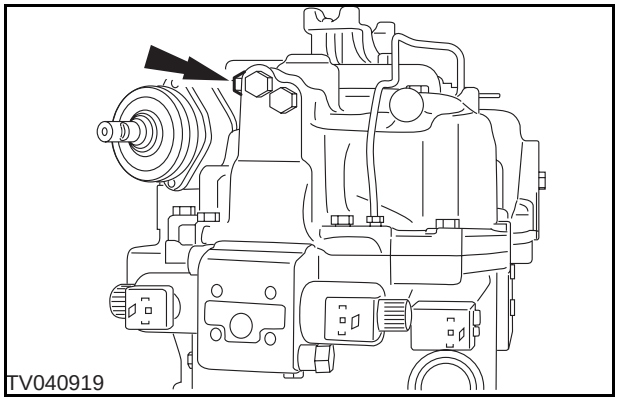
4. **Four-wheel drive** — Pressure should be 12.5 to 15.5 bar at maximum engine speed. (2350 RPM).


TV040917

5. **Torque Converter relief valve** — Pressure should not exceed 10.5 bar at maximum engine speed. (2350 RPM).


TV040918

6. **Lubrication oil** — Pressure should be 0.5 to 2.5 bar at maximum engine speed. (2350 RPM).


TV040919

REMOVAL AND INSTALLATION — SYNCHROSHIFT TRANSMISSION

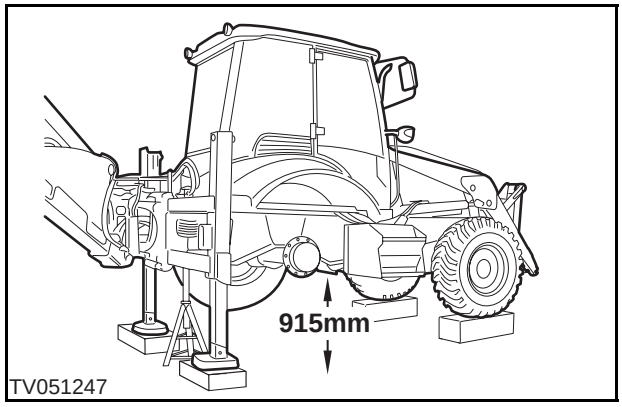
BHN1302RA

Operation: **Removing and Installing the Synchroshift Transmission**	*Job Code:* **13 26 13 xx**		
Suitable lifting equipment, Suitable transmission jack	Standard tools		

Removal

1. Position 150mm blocks under each stabilizer and fully lower.
2. Remove the right-hand rear wheel. For additional information, refer to Section M12-01 REAR WHEEL, PAGE M12–01–5 .
3. Support the machine as shown using suitable supports.

   Note:
   - Ensure there is at least 915mm clearance between the ground and the lower chassis.

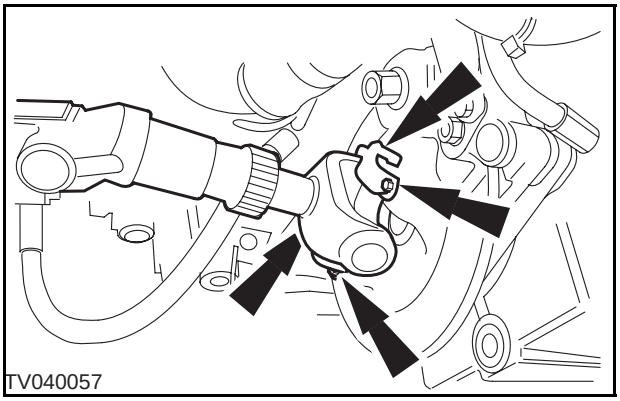


4. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
5. Drain the transmission fluid into a suitable container.
6. Install the transmission drain plug and a new O-ring.
7. Tighten to 44Nm.
8. Remove the parking brake caliper. For additional information, refer to Section N13-03 PARKING BRAKE CALIPER, PAGE N13–03–13 .

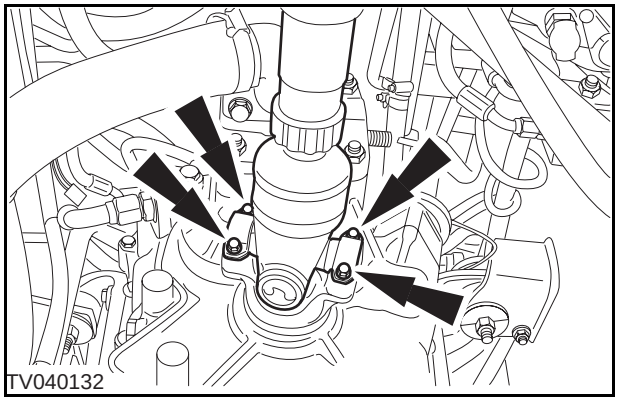
⚠ **Caution:**
- **Secure the universal joint bearing cups to prevent contamination or damage.**

Note:
- Remove and discard the retaining bolts.

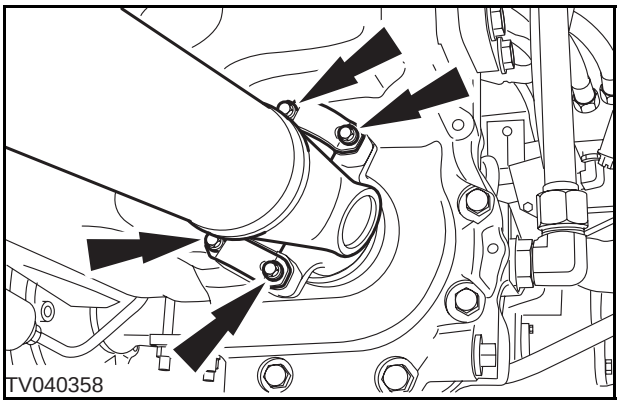
9. Detach the rear propeller shaft from the rear differential and secure it to one side.


TV040057

10. Remove the rear propeller shaft from the transmission.

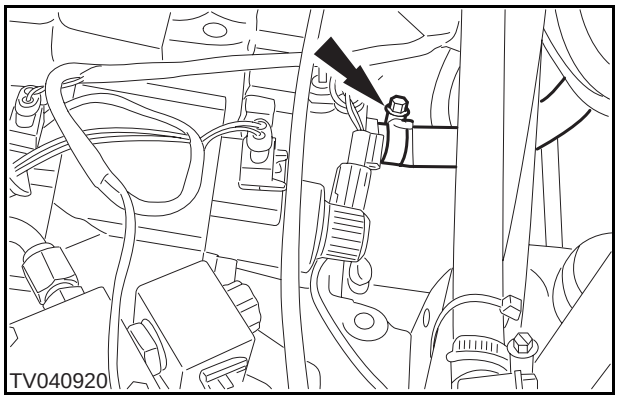

TV040132

11. Detach the front propeller shaft from the transmission and secure it to one side.


TV040358

12. Remove the cabin heater air ducting. For additional information, refer to Section H08-01 CABIN HEATER AIR DUCTING, PAGE H08–01–13 .

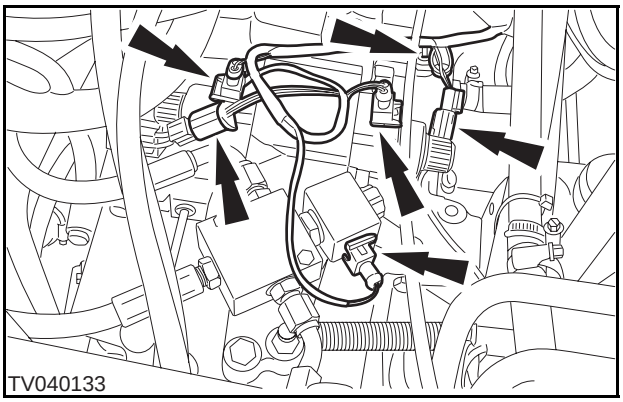
13. Disconnect the transmission oil cooler pipe.



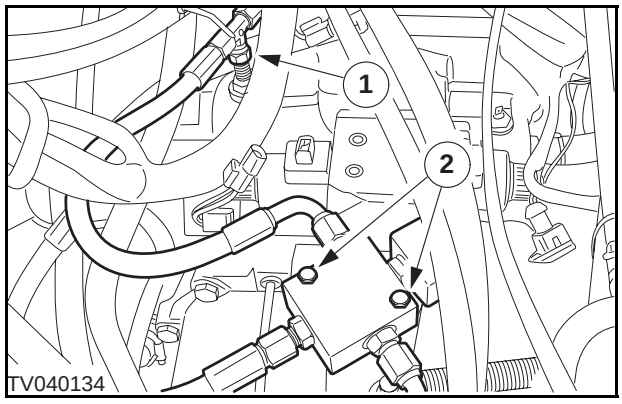
Note:

- Make a note of the position of the transmission wiring harness electrical connectors to aid installation.

14. Disconnect the transmission wiring harness electrical connectors and position it to one side.

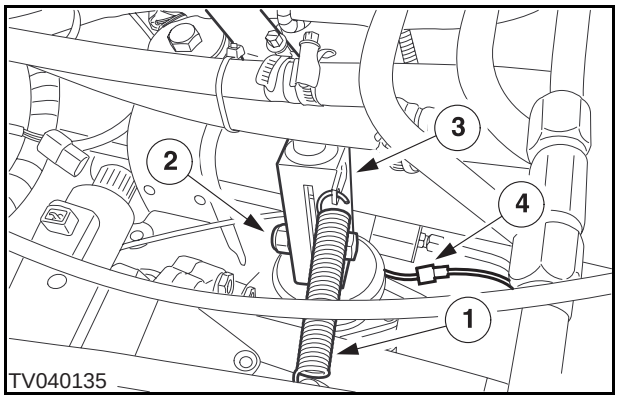


15. Disconnect the differential lock/steering supply hose (1).
16. Detach the differential lock control valve (2) and position it to one side.

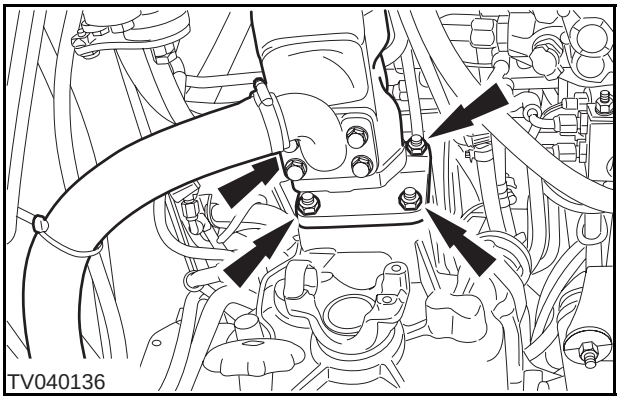


17. Remove the gearshift selector lever return spring (1), retaining bolt (2) and the gearshift selector lever (3).

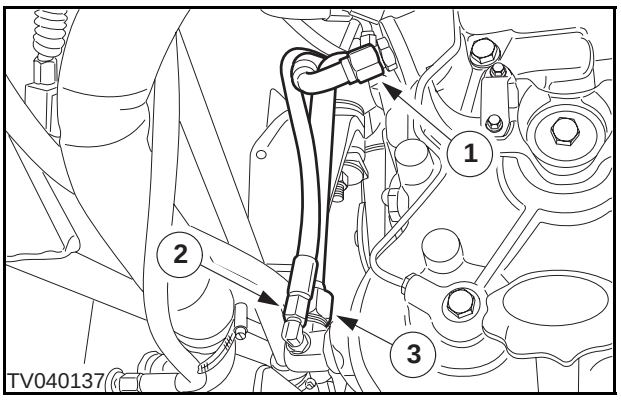
18. Disconnect the gearshift selector lever electrical connector (4).



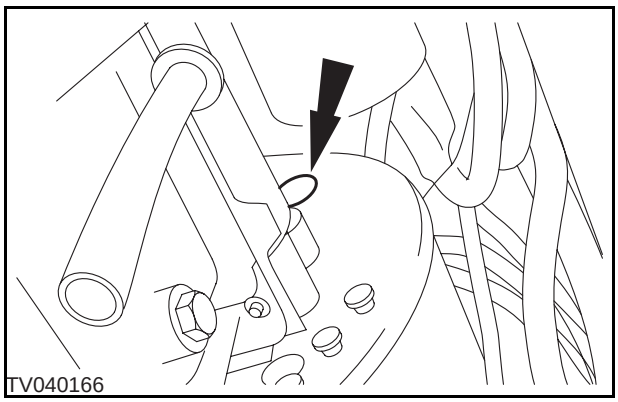
19. Detach the hydraulic oil pump and secure to it one side.



20. Disconnect the transmission oil cooler inlet pipe (1), steering return hose (2) and transmission oil filler tube (3).

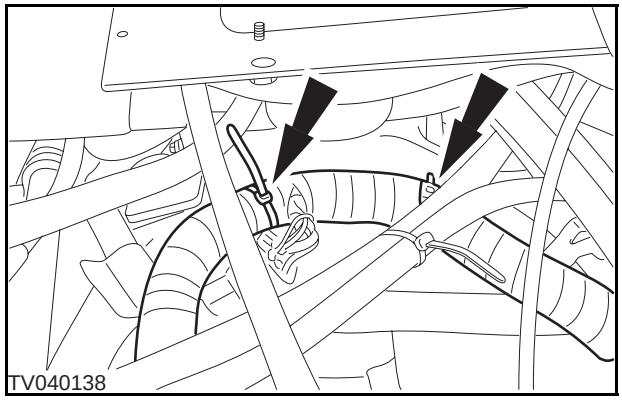


21. Using the access hole remove the torque converter retaining bolts.



⚠ Warning:
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

22. Using suitable lifting equipment, support the engine.
23. Cut the cable ties and position the wiring harness to one side.

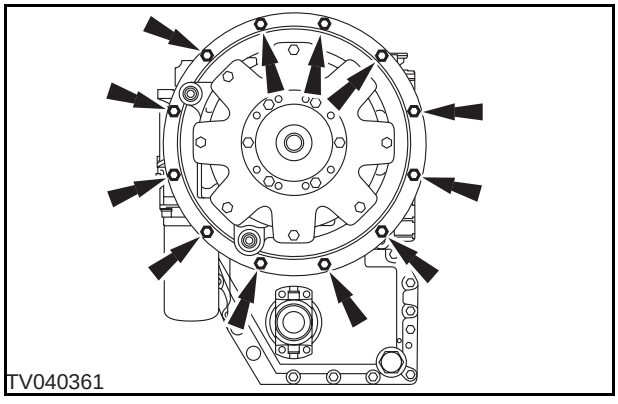

TV040138

⚠ Warning:
- **Secure the transmission to the transmission jack. Failure to follow this instruction may result in personal injury.**

24. Using a suitable transmission jack, support the transmission.

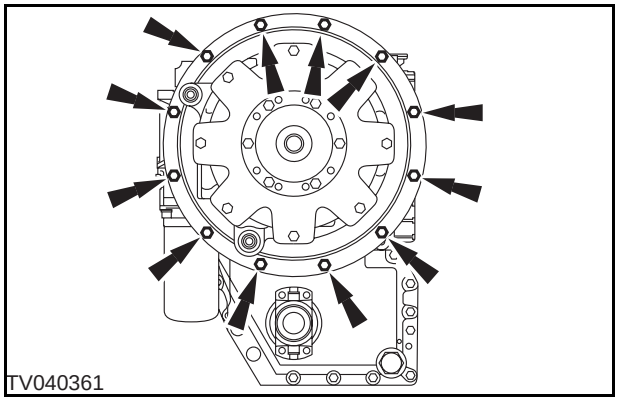
⚠ Caution:
- **Ensure the torque converter is removed with the transmission.**

25. Remove the transmission retaining bolts and remove the transmission.

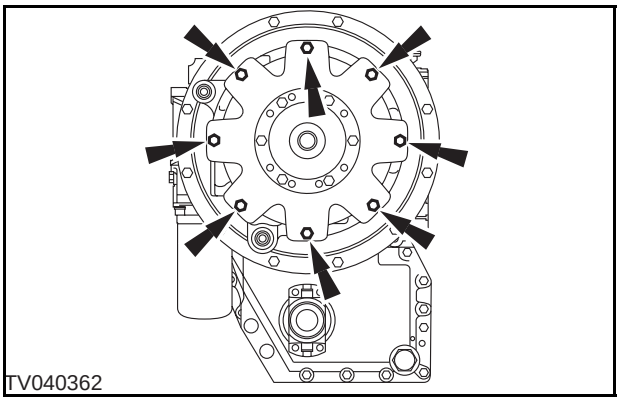

TV040361

Installation

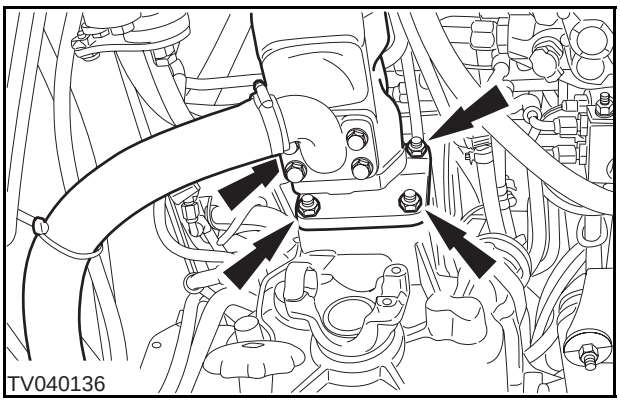
1. To install, reverse the removal procedure.
2. Tighten to 71Nm (52 lb.ft).



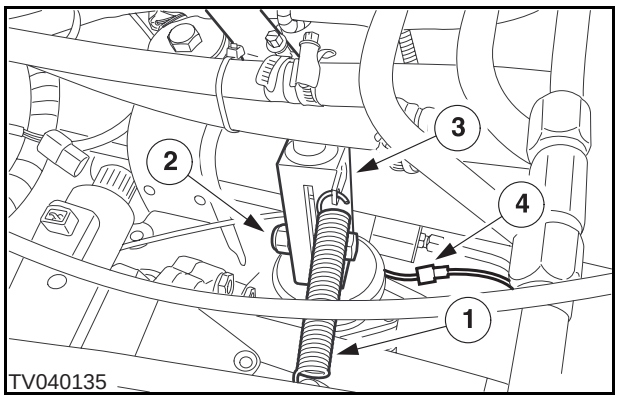
3. Tighten to 41Nm (30 lb.ft).



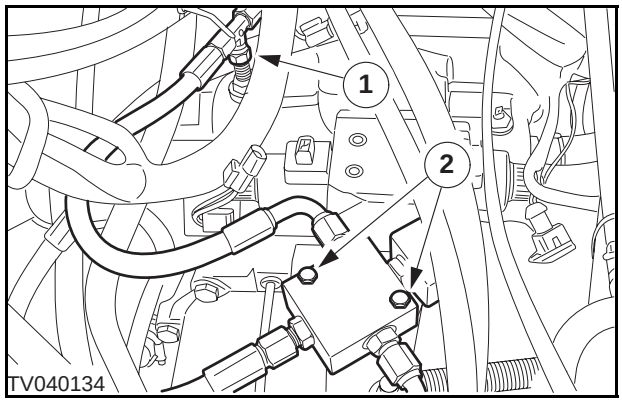
4. Tighten to 98Nm (72 lb.ft).



5. Tighten (2) to 58Nm (42 lb.ft).

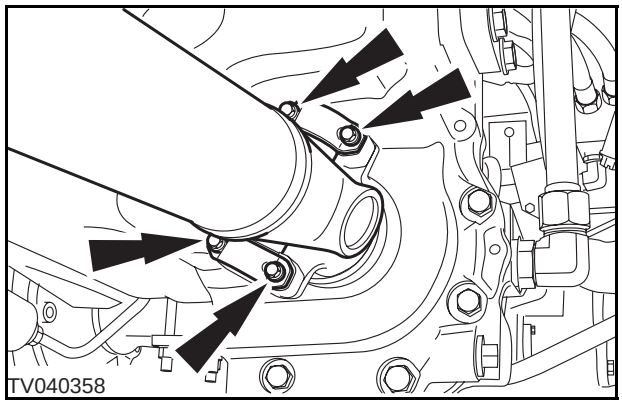


6. Tighten (2) to 12Nm (9 lb.ft).



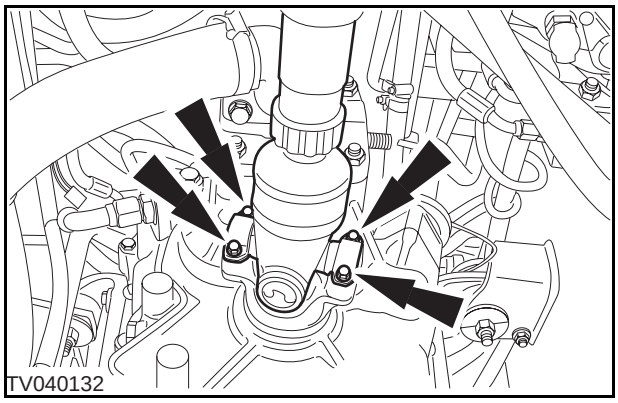
Note:
- Install new retaining bolts.

7. Tighten to 47Nm (35 lb.ft).



Note:
- Install new retaining bolts.

8. Tighten to 47Nm (35 lb.ft).



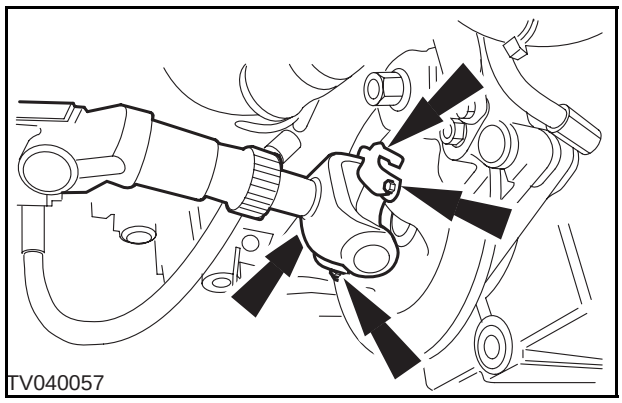
⚠ **Caution:**

- **Make sure the propeller shaft universal joints are in line. Failure to follow this instruction may result in damage to the machine.**

Note:

- Install new retaining bolts.

9. Tighten to 47Nm (35 lb.ft).


TV040057

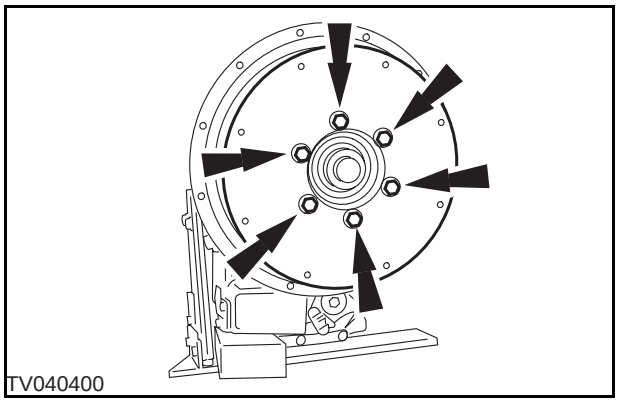
DISASSEMBLY AND ASSEMBLY — SYNCROSHIFT TRANSMISSION

BHN1302DA

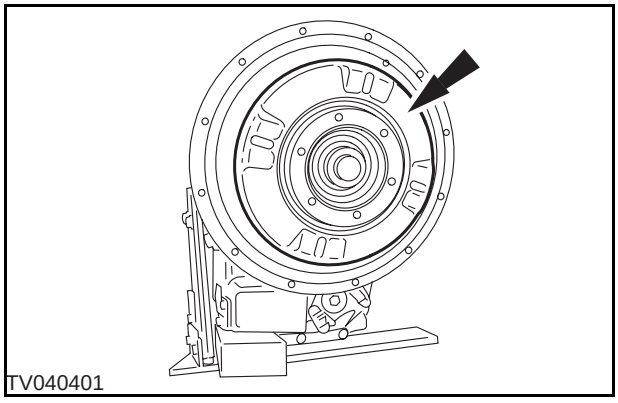
Operation: **Disassembly and Assembly of the Syncroshift Transmission**	*Job Code:* **13 26 17 xx**		
Suitable lifting equipment	Standard tools, FER.011 (KM3524), Dial test indicator (D.T.I) gauge		

Disassembly

1. Remove the torque converter adapter plate.


TV040400

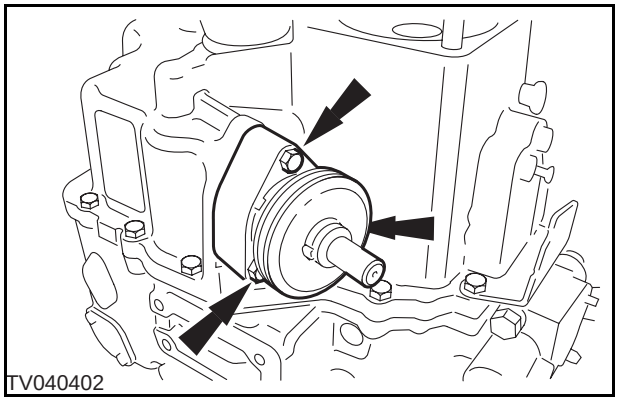
2. Remove the torque converter.


TV040401

3. Rotate the transmission 90 degrees and place on a suitable bench.

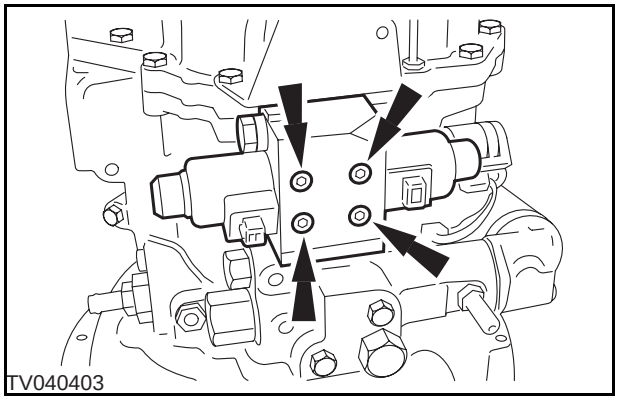
   Note:
   - For convenience the bench top should have a hole in it to accommodate the input shaft and pump.

4. Remove the gear shift lever assembly.

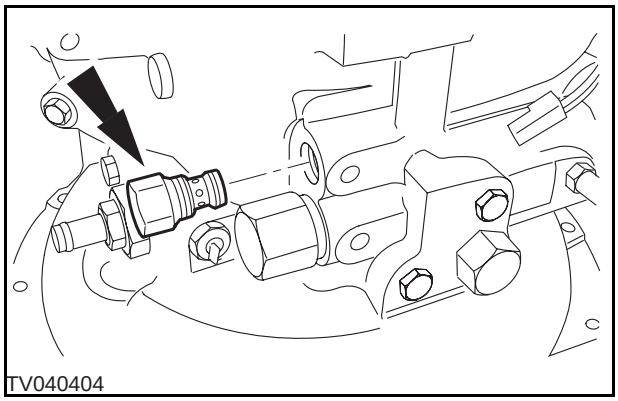

TV040402

5. Remove the protective plastic caps.

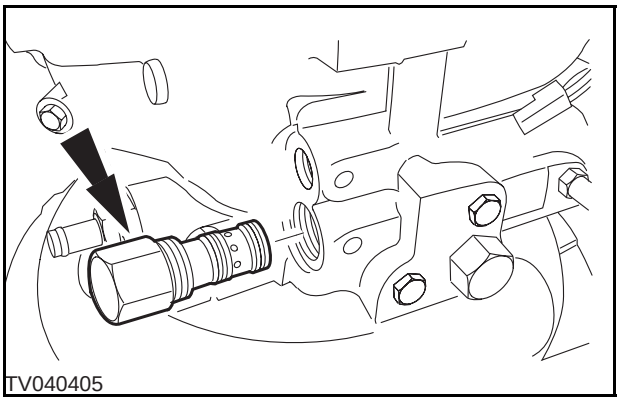
6. Remove the direction control valve.


TV040403

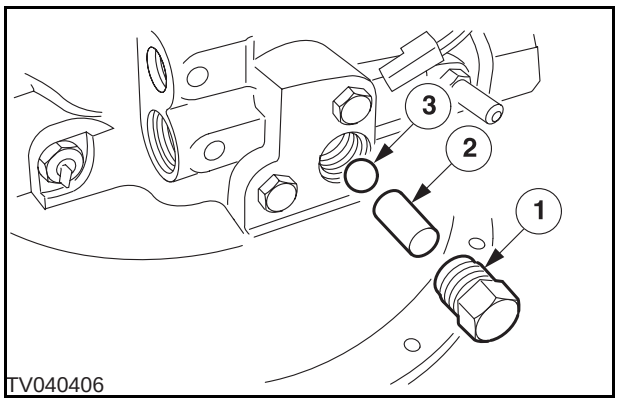
7. Remove the torque converter relief valve.


TV040404

8. Remove the pressure regulator valve.

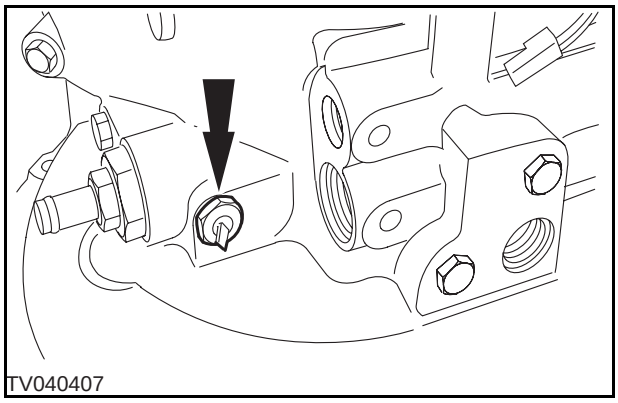

TV040405

9. Remove the cold start plug (1), plunger (2) and ball (3).



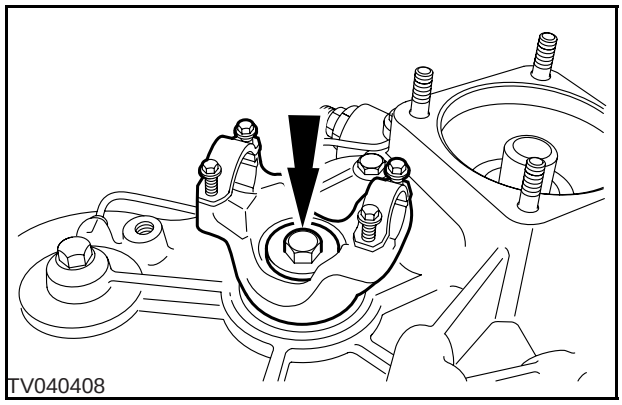
TV040406

10. Remove the temperature sender.


TV040407

11. Remove the output shaft flange.

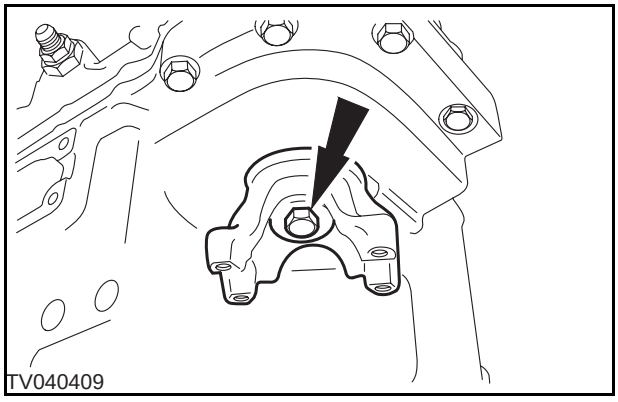
Note:
- Remove and discard the O-ring oil seal.


TV040408

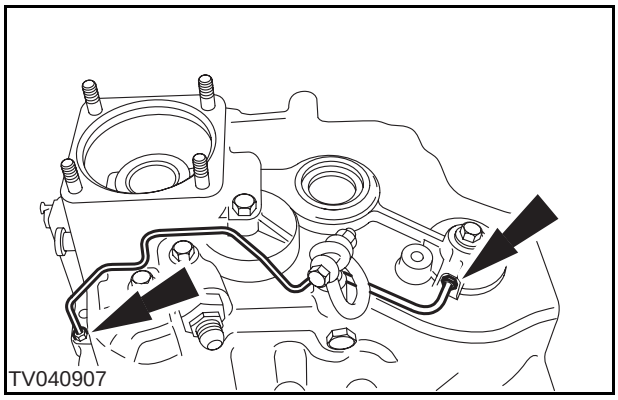
12. Remove the four-wheel drive output shaft flange. (If equipped).

Note:
- Remove and discard the O-ring oil seal.

13. Recover the spacer.


TV040409

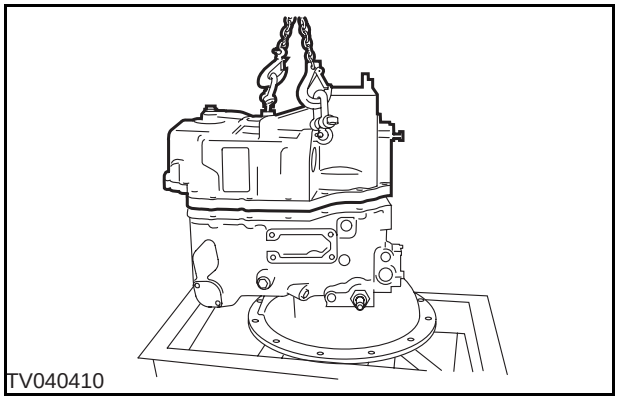
14. Remove the four-wheel drive clutch supply pipe (If equipped).


TV040907

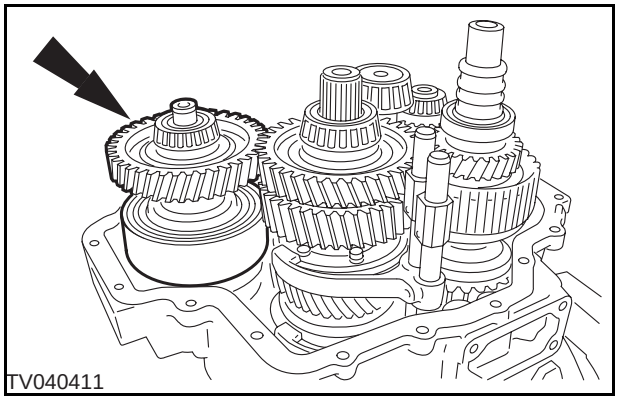
Note:
- Lever slots are provided to assist removal.

Note:
- The bearing cones and shims may fall from the rear case during removal.

15. Remove 18 retaining bolts.
16. Using suitable lifting equipment remove the rear transmission case.

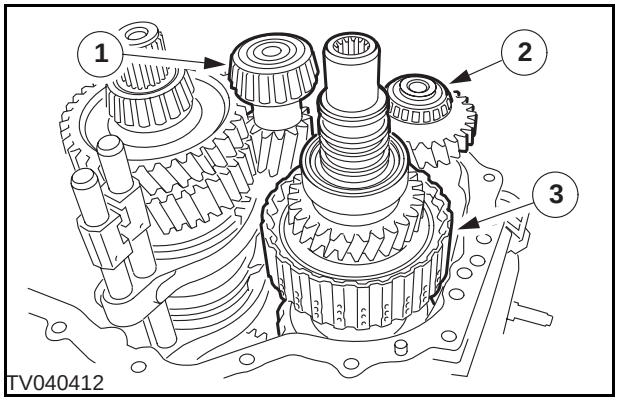

TV040410

17. Remove the four-wheel drive shaft assembly. (If equipped).

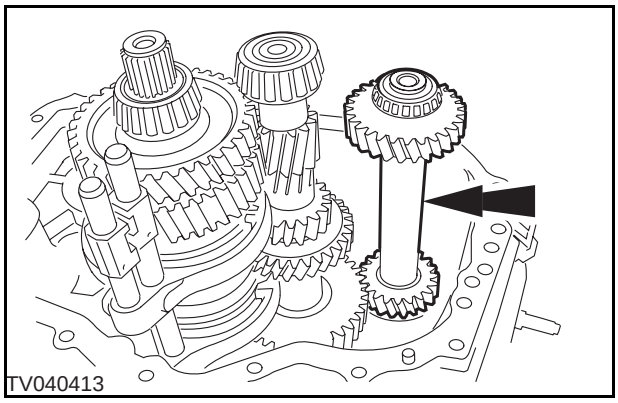

TV040411

Note:
- To aid removal, tilt the countershaft (1) and reverse idler shaft (2).

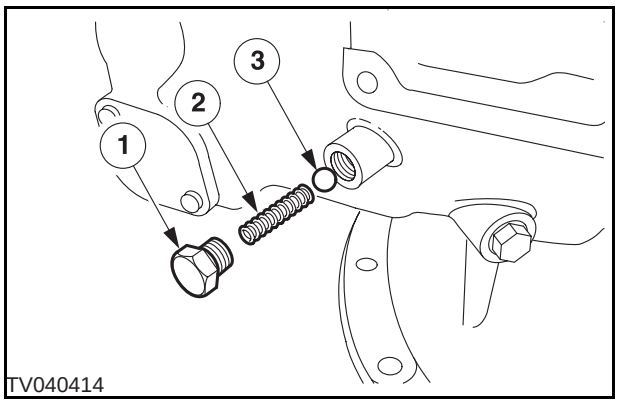
18. Remove the input shaft assembly (3).



19. Remove the reverse idler shaft assembly.

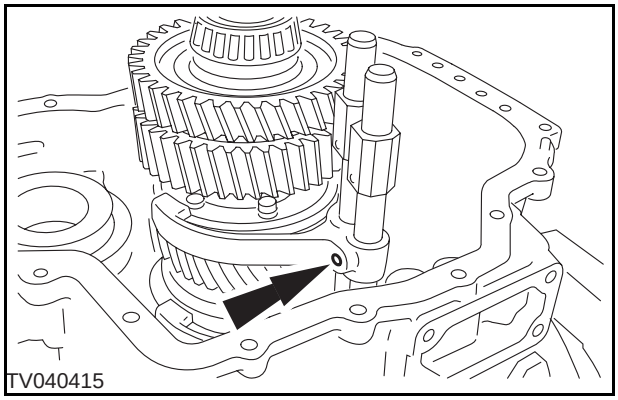


20. Remove the outer detent plug (1), spring (2) and ball (3).



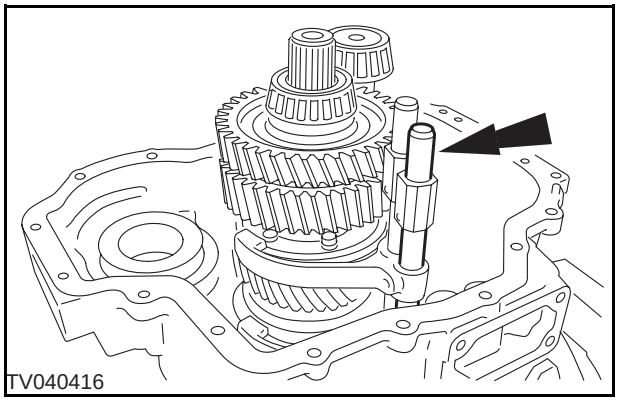
Note:
- Ensure both synchronisers are in the neutral position.

21. Remove the 1st / 2nd shift fork grub screw.


TV040415

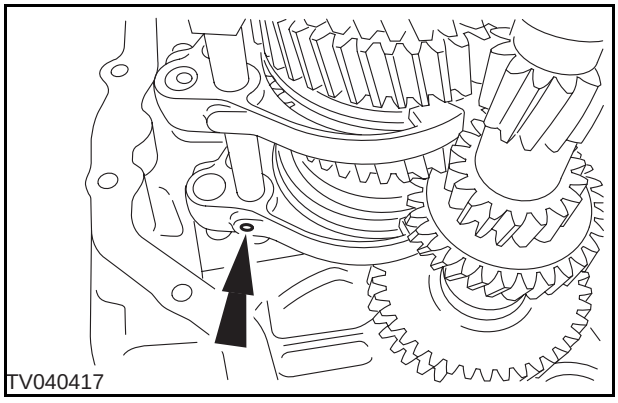
22. Remove the 1st / 2nd shift rod from the housing.

Note:
- Recover the interlock ball from the detent bore.

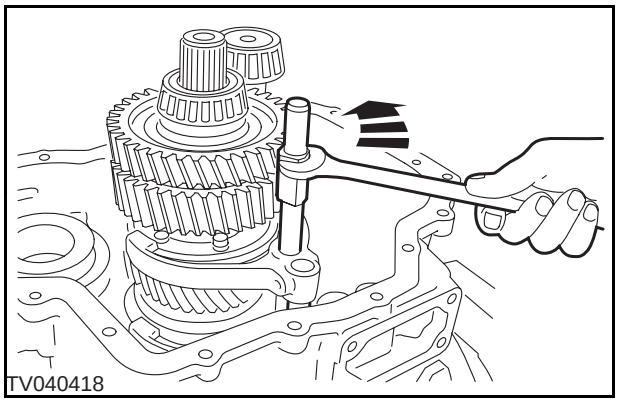

TV040416

⚠ **Warning:**
- **Before attempting to remove the 3rd / 4th shift rail, replace the detent plug as the ball and spring may shoot out. Failure to follow this instruction may result in personal injury.**

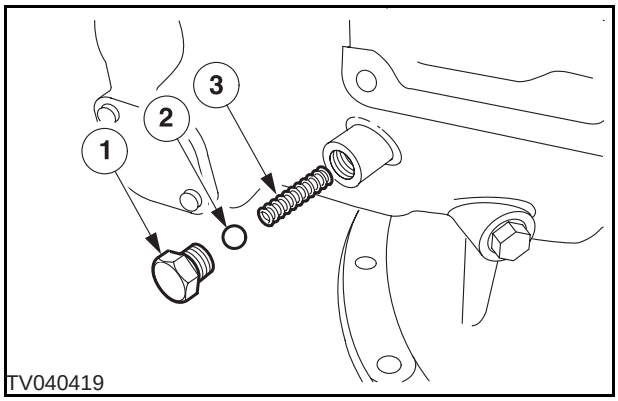
23. Remove the 3rd / 4th shift fork grub screw.


TV040417

24. Turn the 3rd / 4th shift rod through 90 degrees and withdraw from the housing.

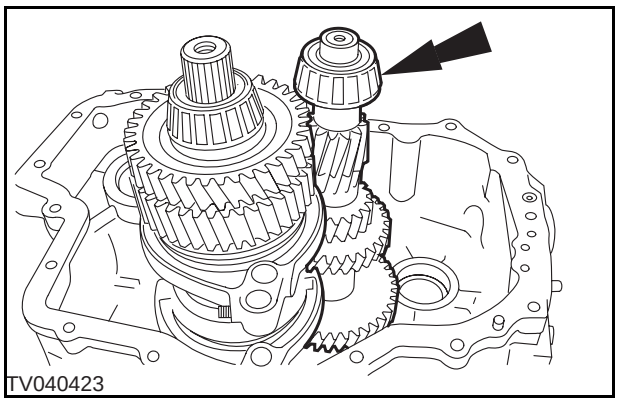

TV040418

25. Remove the detent plug (1), inner detent ball (2) and spring (3).

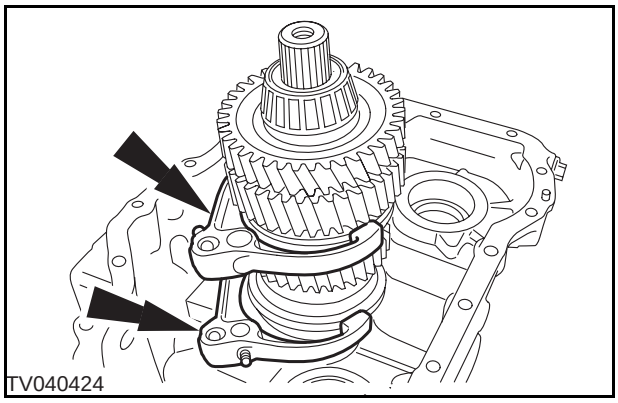


TV040419

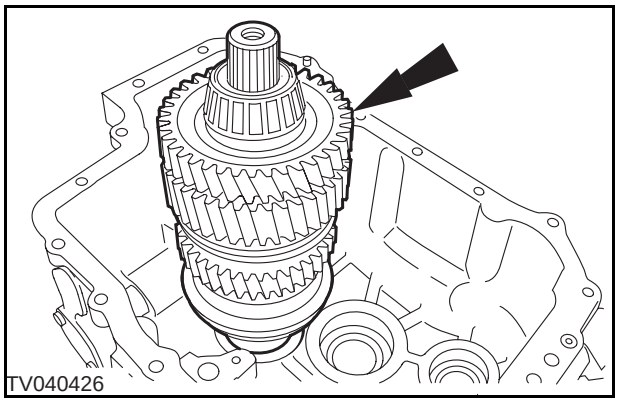
26. Remove the counter shaft assembly.


TV040423

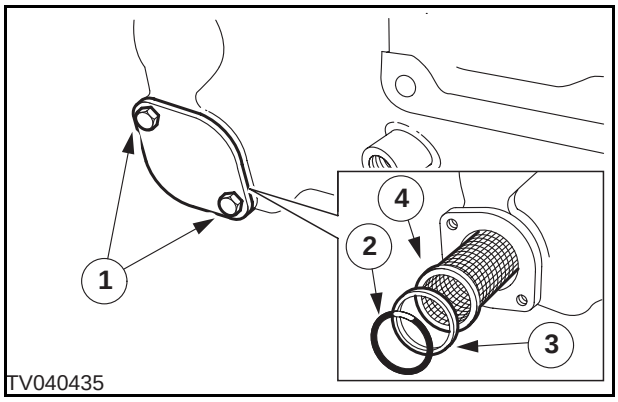
27. Remove the 1st / 2nd and 3rd / 4th shift forks.


TV040424

28. Remove the output shaft assembly.

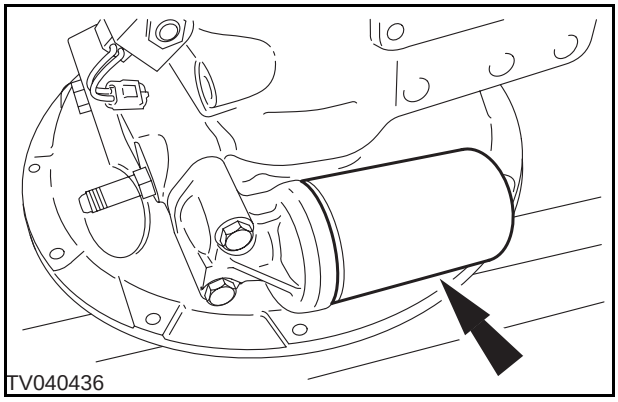

TV040426

29. Remove the transmission oil strainer cover (1), O-ring (2), spacer (3) and transmission oil strainer (4).



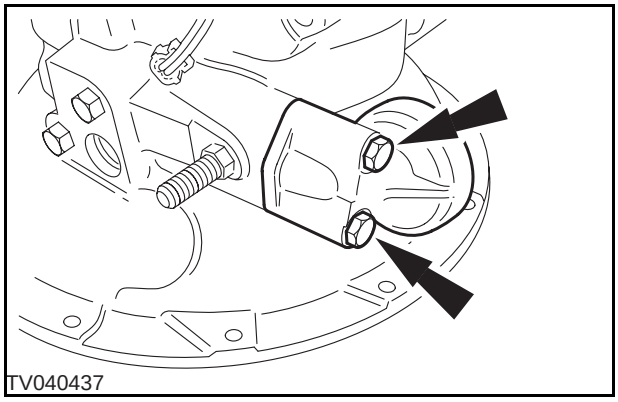
TV040435

30. Remove and discard the oil filter.

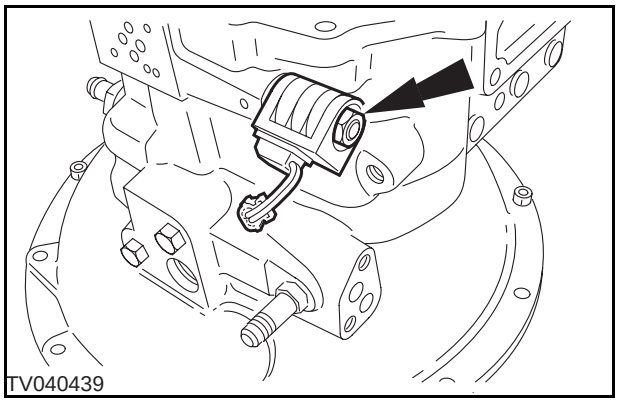

TV040436

31. Remove the oil filter housing.

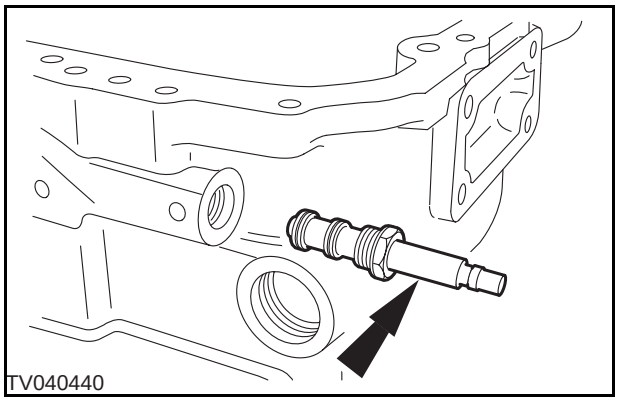
Note:
- Remove and discard the gasket.


TV040437

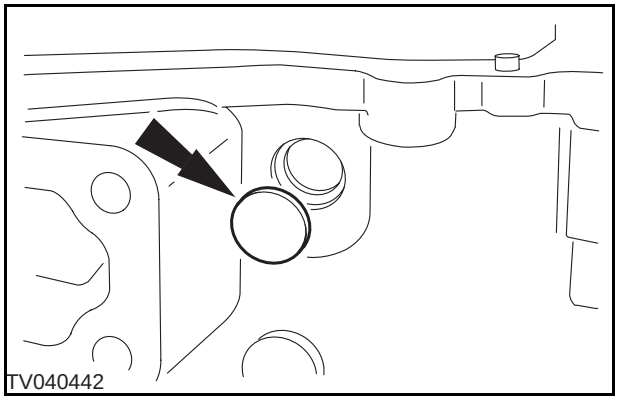
32. Remove the four-wheel drive solenoid coil. (If equipped).


TV040439

33. Remove the four-wheel drive solenoid spool. (If equipped).


TV040440

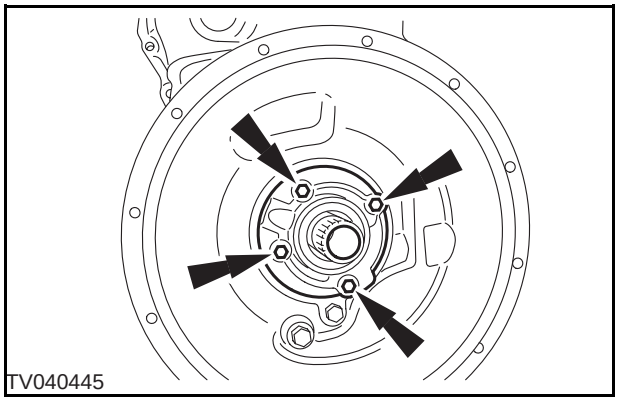
34. Remove and discard the expansion plug from the shimming access hole.


TV040442

35. Rotate the case 90 degrees. Remove the transmission oil pump assembly.

Note:

- Remove and discard the sealing ring and cooper washers.


TV040445

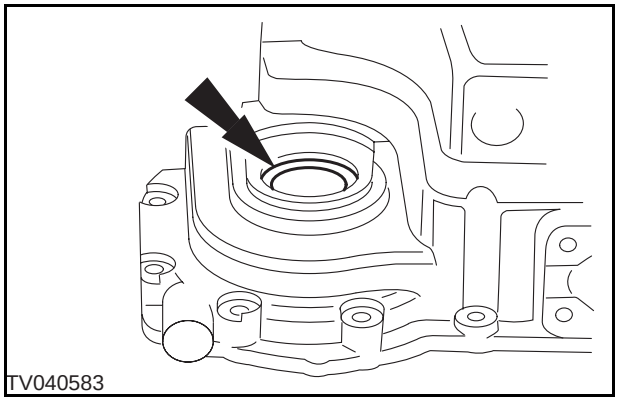
Assembly

Note:
- All shafts and bearings should be lubricated with transmission fluid prior to assembly.

Note:
- To prevent possible contamination of hydraulic parts, lint or cotton rags should not be used.

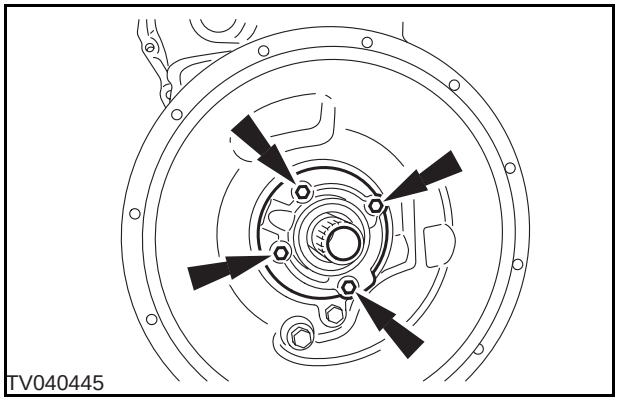
Note:
- Lubricate the oil seal with a light grease.

1. Position the front case as shown and using a suitably sized tube, fit a new four-wheel drive output shaft oil seal to a depth of 6mm below the housing face. (If equipped).


TV040583

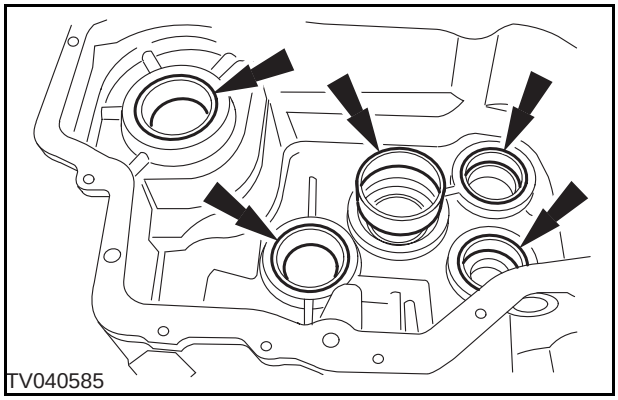
Note:
- Install new copper washers and sealing ring.

2. Install the transmission oil pump assembly and sealing ring.
3. Tighten to 18Nm.
4. Check for free rotation of the transmission oil pump rotor.

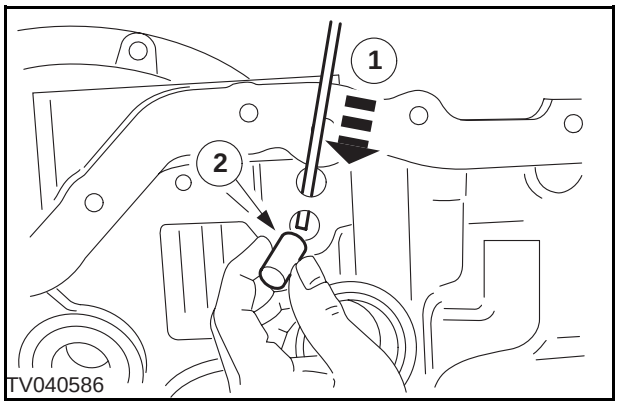

TV040445

Note:
- Use a light grease to hold the bearing cups into the case.

5. Install the bearing cups (if previously removed).

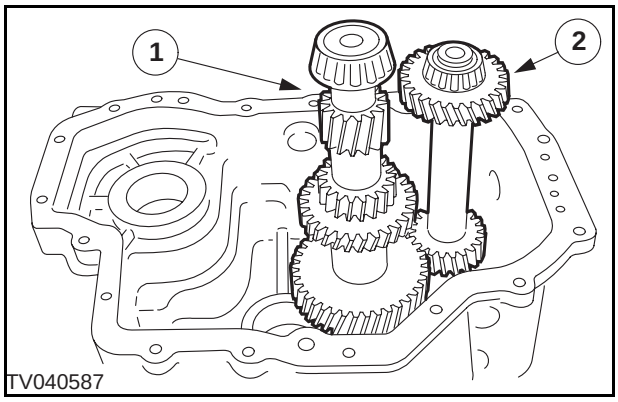

TV040585

6. Using a suitable tool, push the inner detent spring and ball into the case (1) and secure in place with a dummy plug (2).



TV040586

7. Install the countershaft (1) and reverse idler shaft (2) assemblies.



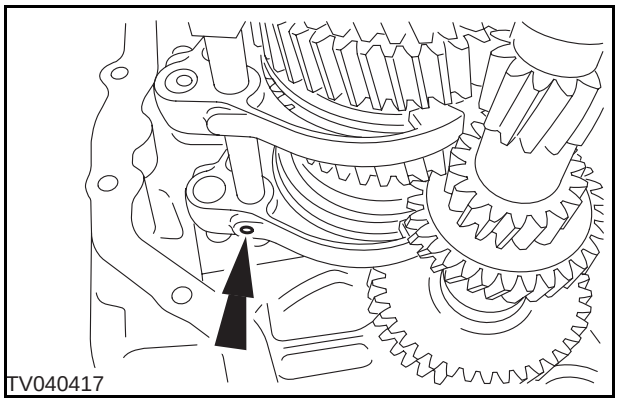
TV040587

8. Slide the 1st / 2nd fork onto the 3rd / 4th rail. Install the 3rd / 4th shift fork.
9. Tighten to 21 Nm.

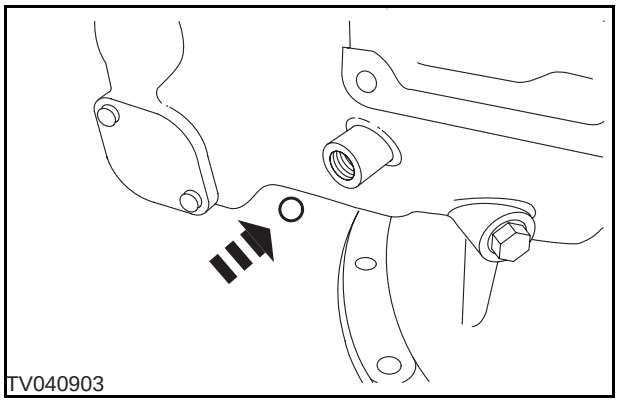
10. Hold the forks and rail in place on the output shaft then install the complete assembly into the case.

Note:
- The shift rail should displace the dummy plug as it enters the bore.

⚠ **Caution:**
- **Check that the inner detent spring and ball have not become displaced and remove the loose dummy plug from the case sump.**

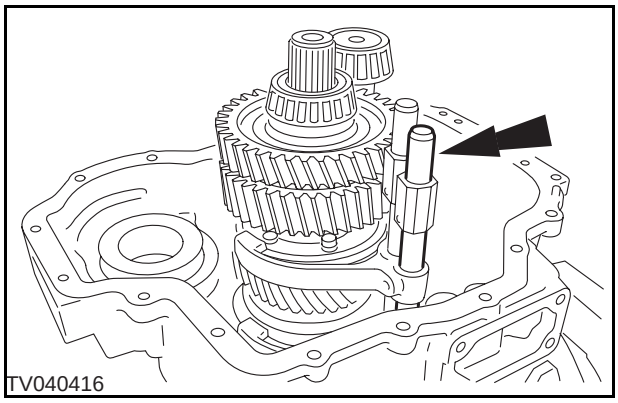

TV040417

11. Install the interlock ball into the detent bore.


TV040903

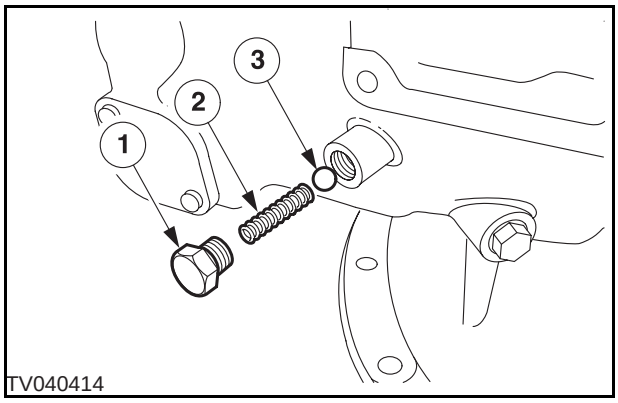
12. Install the 1st / 2nd shift rod.
13. Tighten the 1st / 2nd shift fork retaining screw to 21Nm.

Note:
- Check that the interlock ball is correctly positioned in between the two rails.


TV040416

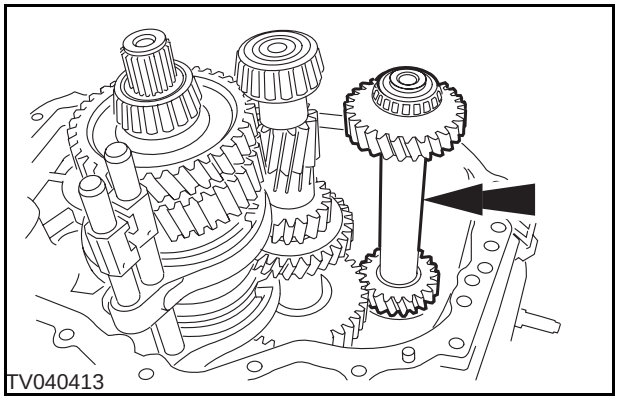
14. Install the outer detent ball (3), spring (2) and plug (1).

15. Tighten to 47Nm (35 lb.ft).



Note:
- Lubricate the oil seal with a light grease.

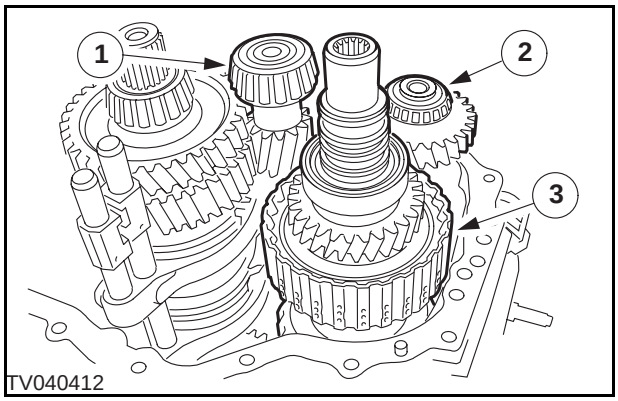
16. Install the four-wheel drive shaft assembly. (If equipped).



Note:
- Lubricate the oil seal with a light grease.

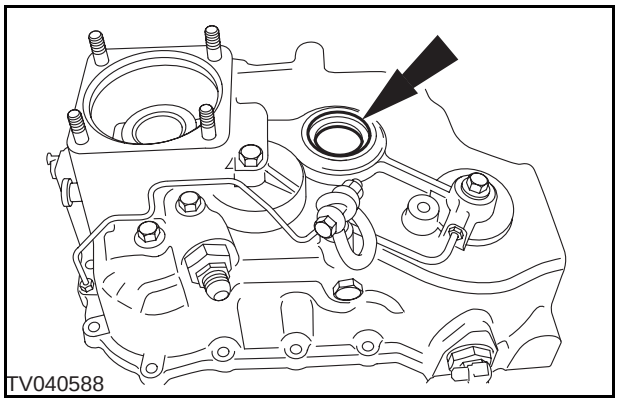
Note:
- To aid installation, tilt the countershaft (1) and reverse idler shaft (2).

17. Install the input shaft assembly (3).



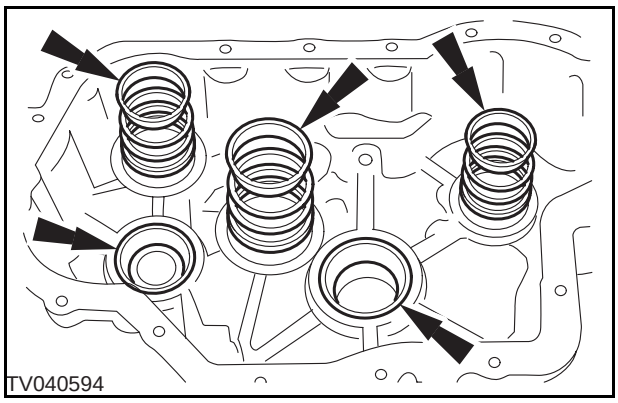
Note:
- Lubricate the oil seal with a light grease.

18. Position the rear case as shown and using a suitably sized tube, fit a new output shaft oil seal to a depth of 6mm below the housing face.


TV040588

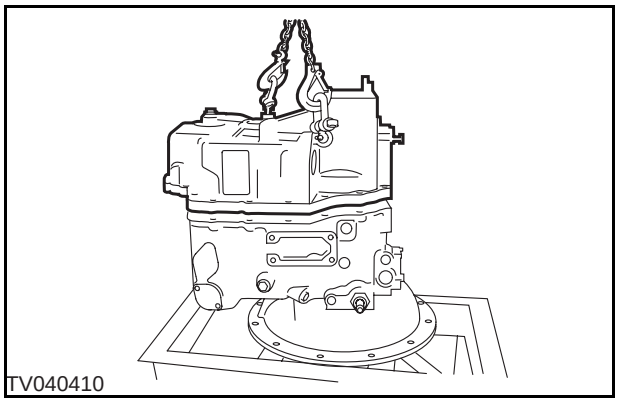
Note:
- Use a light grease to hold the bearing cups into the case.

19. Rotate the case 180 degrees and replace the shim packs and bearing cups. The 2mm thick spacer shim should be fitted into the case first, then fit the remaining shims followed by the bearing cup.


TV040594

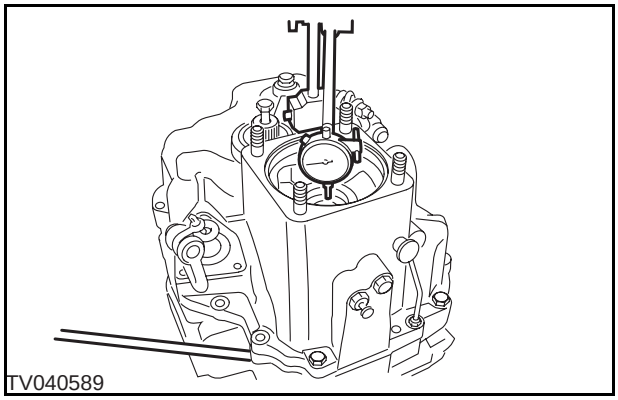
⚠ **Caution:**
- **When fitting the rear case be careful to avoid damaging the input shaft sealing rings.**

20. Install the rear case, (without sealant at this stage), and secure with at least 6 equally spaced bolts.
21. Tighten to 55Nm.

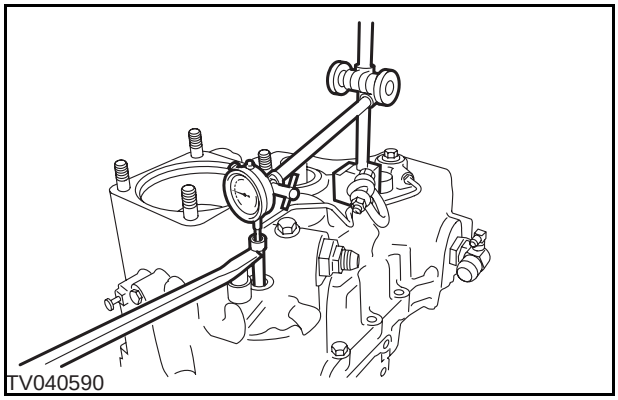

TV040410

Note:
- All shaft assemblies should be rotated several times to seat the bearings prior to measuring the end float.

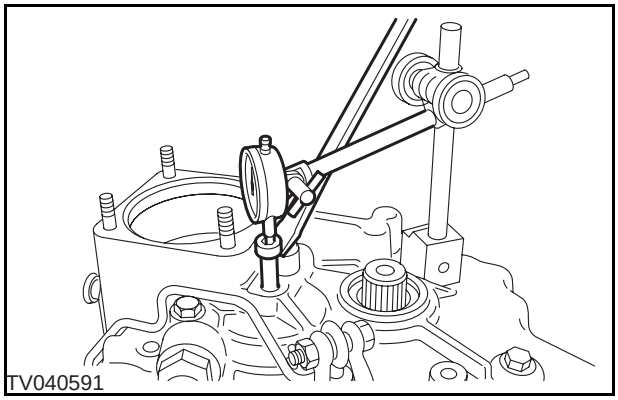
22. Position a Dial Test Indicator (D.T.I) Gauge on the end of the input shaft as shown, and using a suitable pry bar through the side access hole, measure and note the shaft end float.


TV040589

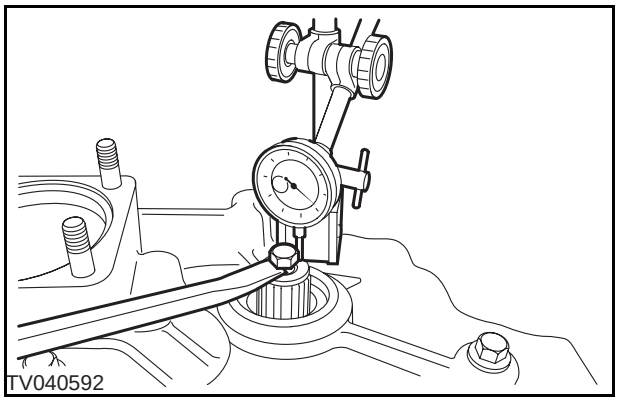
23. Install special tool FER.011 (KM3524) (12mm thread), to the end of the reverse idler shaft. Position a D.T.I. gauge as shown, and using a pry bar lift the shaft, then measure and note the end float.


TV040590

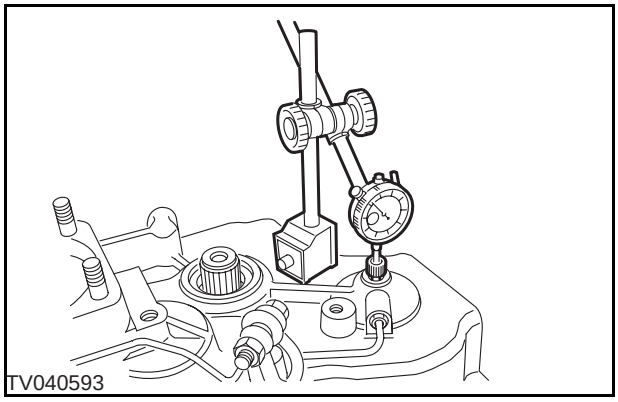
24. Install special tool FER.011 (KM3524) (12mm thread), to the end of the countershaft. Position a D.T.I. gauge as shown, and using a pry bar lift the shaft, then measure and note the end float.


TV040591

25. Install special tool FER.011 (KM3524) (12mm thread), to the end of the output shaft. Position a D.T.I. gauge as shown, and using a pry bar lift the shaft, then measure and note the end float.


TV040592

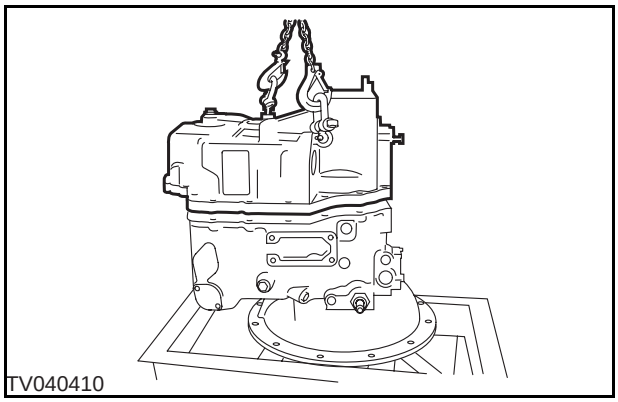
26. Install special tool FER.011 (KM3524) (12mm thread), to the end of the four-wheel drive shaft. (If equipped). Position a D.T.I. gauge as shown, and using a pry bar lift the shaft, then measure and note the end float.


TV040593

27. Remove the rear case and add or remove shims as necessary to give 0.0254 to 0.0762 (0.001” to 0.003”) end float on all shafts.
28. Repeat steps 18 to 26 until all shaft end floats are correct.
29. Replace the O-rings in the front case.

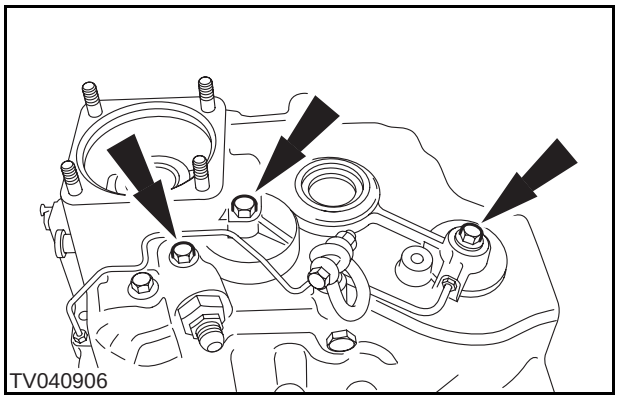
    Note:
    - The input shaft and four-wheel drive shaft sealing rings should now be fitted.

30. Using an approved liquid gasket (Loctite 5203), install the rear case taking care not to damage the input shaft or four-wheel drive shaft sealing rings.
31. Tighten the 18 bolts to 55Nm.

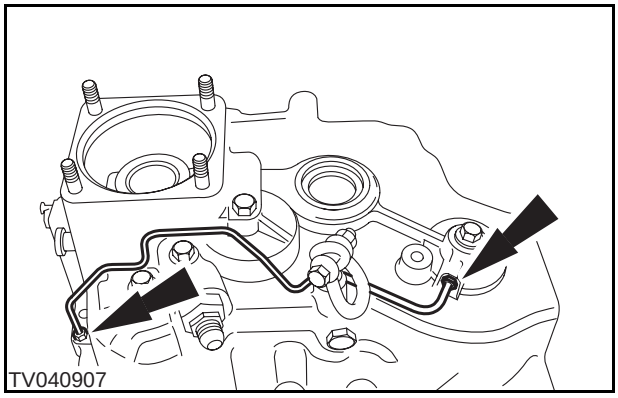

TV040410

32. Replace the shaft end plug and O-ring assemblies.

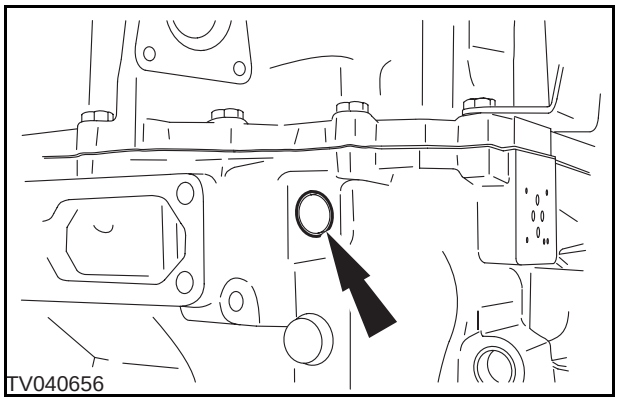
33. Tighten to 47Nm (35 lb.ft).



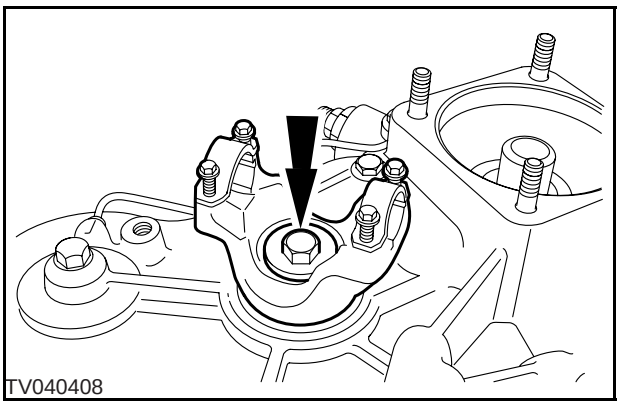
34. Install the four-wheel drive clutch supply pipe (If equipped).
35. Apply sealant (Loctite 542) to threads. Tighten to 5Nm.



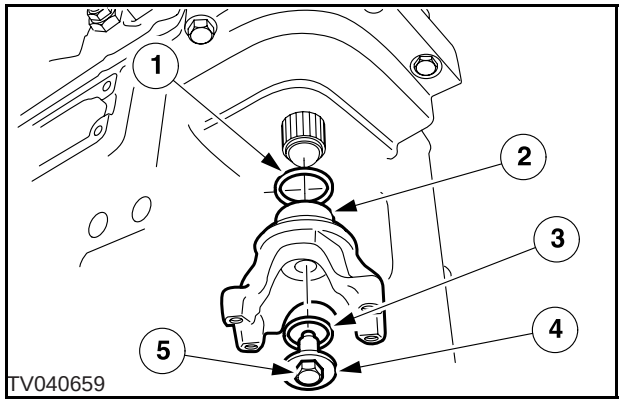
36. Using an approved sealant (Loctite 649), fit a new expansion plug to the shimming access hole.



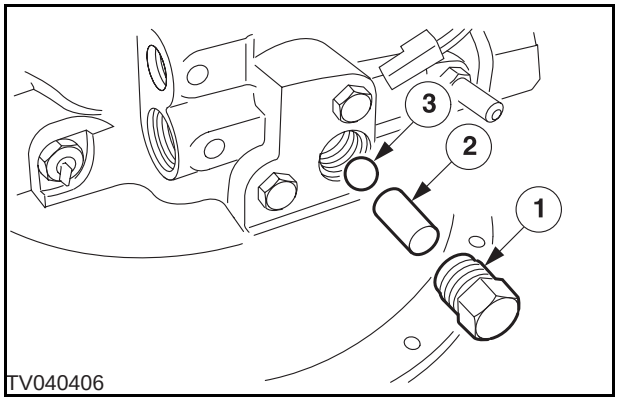
37. Install the output shaft flange, O-ring, washer and bolt.
38. Tighten to 78Nm (56 lb.ft).



39. Install the spacer (1), four-wheel drive output shaft flange (2), O-ring (3), washer (4) and bolt (5).
40. Tighten to 78Nm (56 lb.ft).

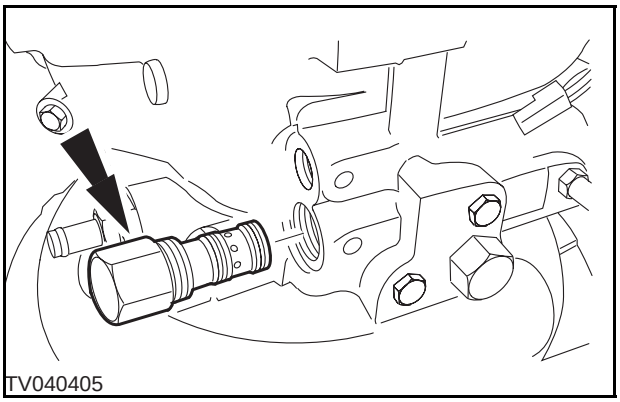


41. Install the cold start ball (3), plunger (2) and plug (1).
42. Tighten to 53Nm.



Note:
- Lubricate the oil seals with transmission fluid.

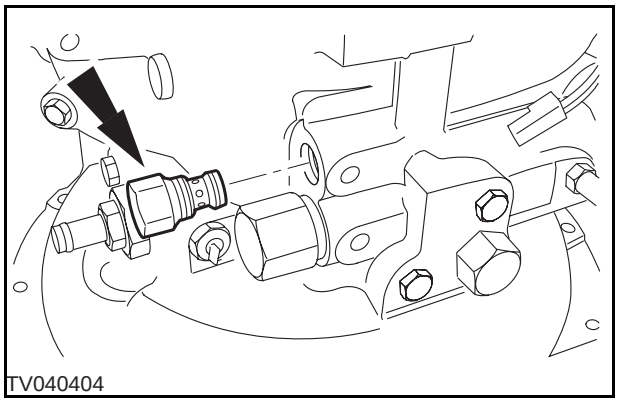
43. Install the pressure regulator valve.
44. Tighten to 53Nm (39 lb.ft).



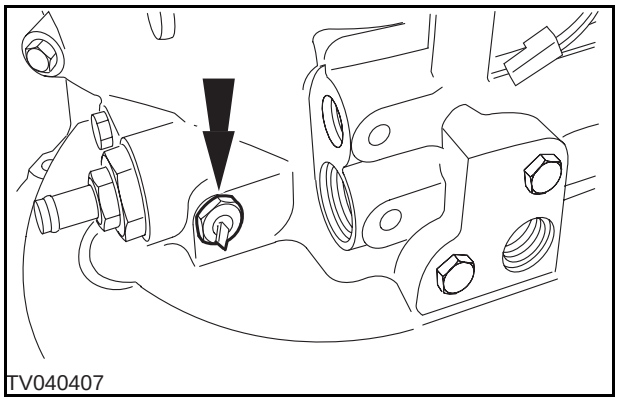
Note:
- Lubricate the oil seals with transmission fluid.

45. Install the torque converter regulator valve.

46. Tighten to 27Nm (20 lb.ft).


TV040404

47. Install the temperature sender.
48. Tighten to 24Nm (18 lb.ft).

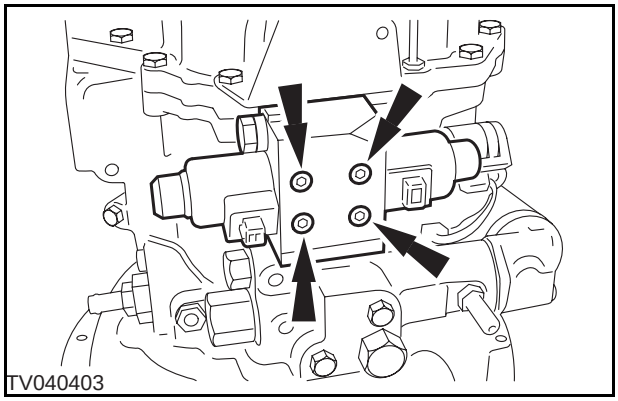

TV040407

Note:
- Install new O-ring oil seals.

49. Install the transmission control valve.

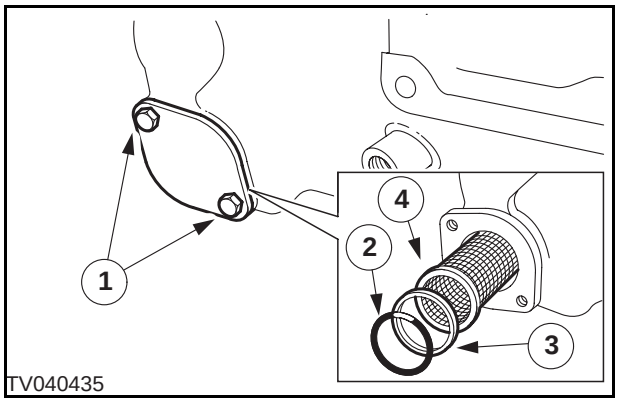
Note:
- The valve can only be fitted one way round as it is located by a small dowel pin.

50. Tighten to 7Nm (5 lb.ft).
51. Install new protective plastic caps.

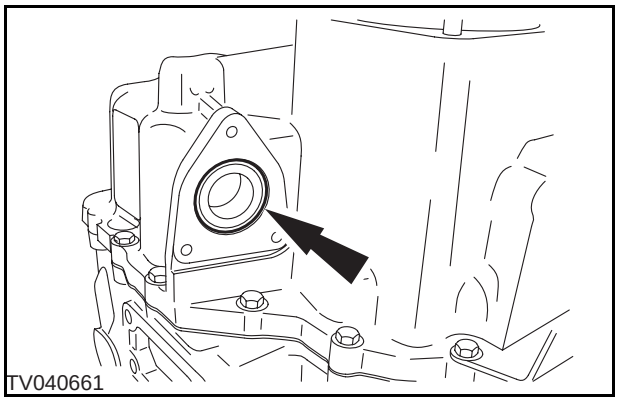

TV040403

52. Install the transmission oil strainer (1), spacer (2), O-ring (3) and transmission oil strainer cover (4).

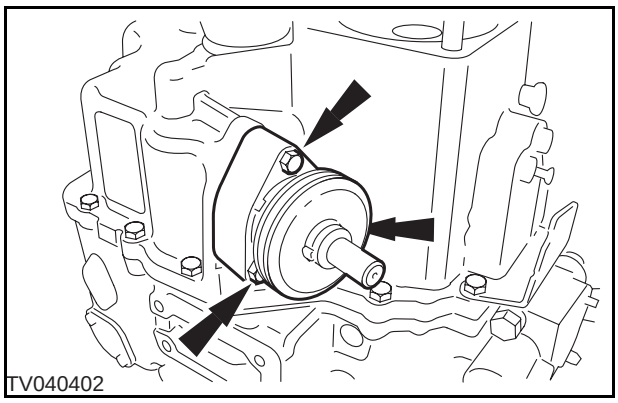
53. Tighten (1) to 25Nm (18 lb.ft).



54. Apply a bead of an approved sealant (Loctite 5900), to the gear case as shown.

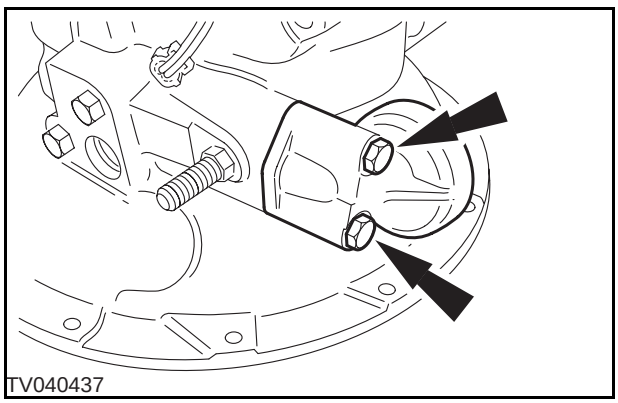


55. Install the gear lever assembly.
56. Tighten to 20Nm (15 lb.ft).



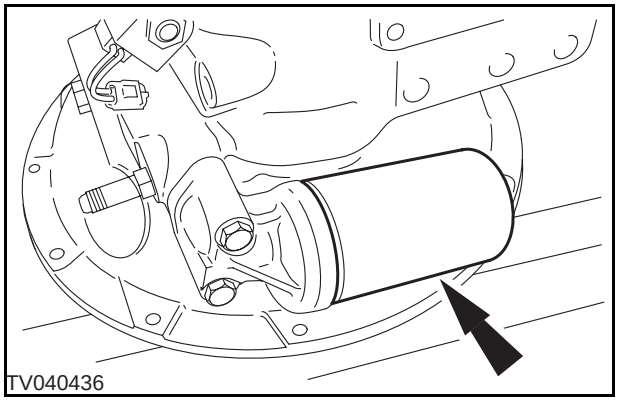
Note:
- Do not use sealant on this gasket it is graphite coated.

57. Install the filter housing and gasket.
58. Tighten to 55Nm (41 lb.ft).



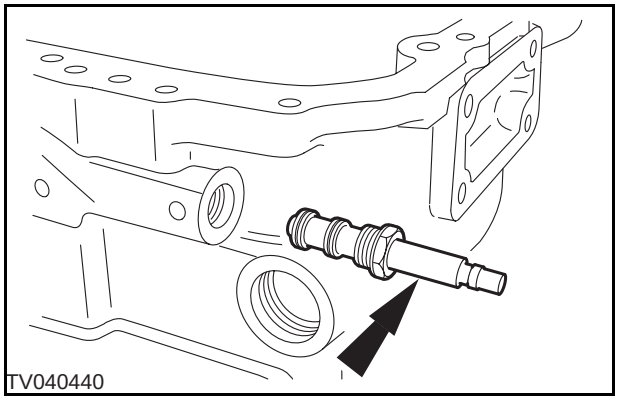
Note:
- Lubricate the oil seal with a light grease.

59. Install a new oil filter.
60. Tighten to 9Nm (7 lb.ft).

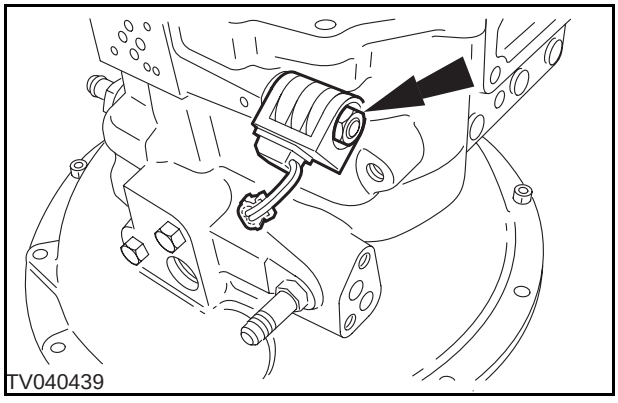

TV040436

Note:
- Lubricate the oil seals with a light grease.

61. Install the four-wheel drive solenoid spool. (If equipped).
62. Tighten to 25Nm (18 lb.ft).

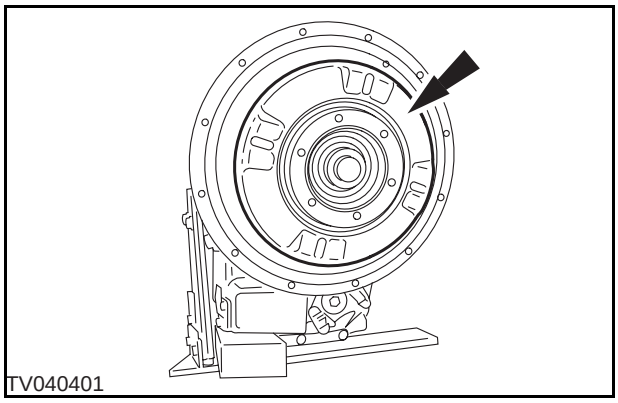

TV040440

63. Install the four-wheel drive solenoid coil and nut. (If equipped).
64. Tighten to 6Nm (4 lb.ft).

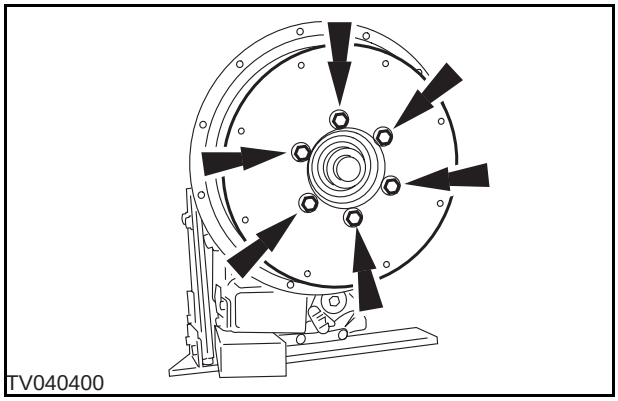

TV040439

65. Install the pump drive shaft.
66. Rotate the transmission 90 degrees.

67. Install the torque converter.


TV040401

68. Install the torque converter adaptor plate.
69. Tighten to 37Nm (27 lb.ft).

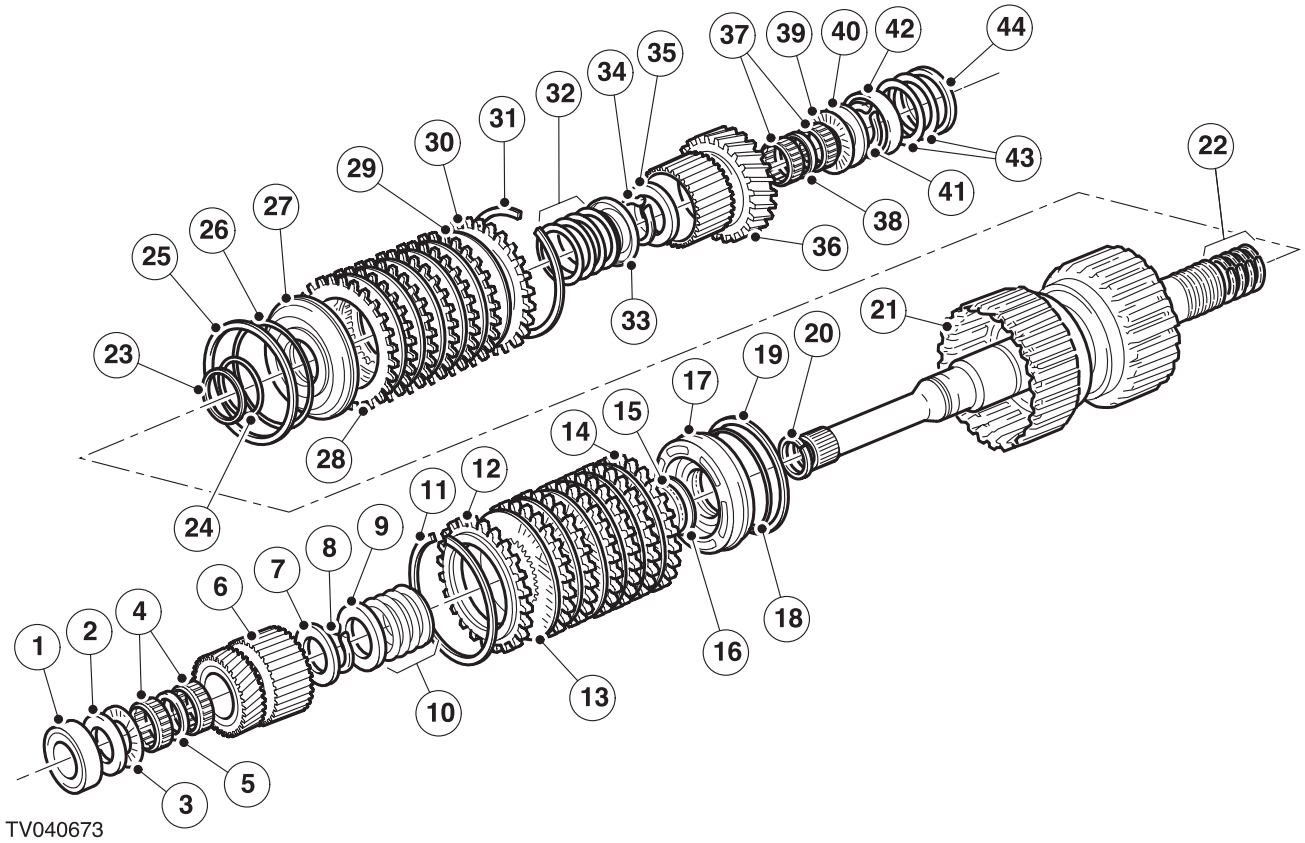

TV040400

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DISASSEMBLY AND ASSEMBLY — INPUT SHAFT

BHN1302DB

Operation: **Disassembly and Assembly of the Input Shaft**	*Job Code:* **13 48 17 xx**		
None	Standard tools, FER.001 (KM3003), (KM3519), FER.009 (KM3523), FER.004 (KM3516).		



TV040673

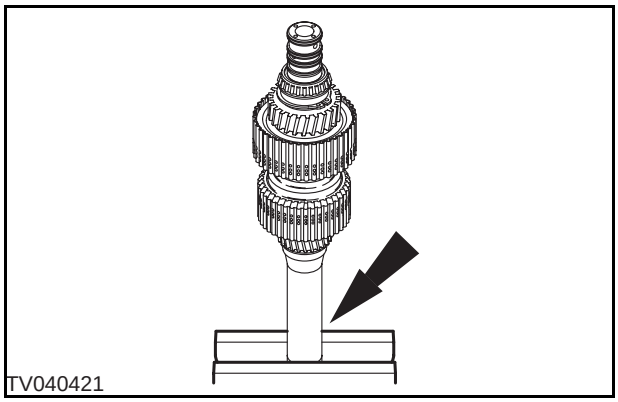
1	Bearing
2	Support Washer
3	Thrust Bearing
4	Needle Roller Bearings
5	Needle Roller Bearings Spacer
6	Forward Primary Gear
7	Thrust Washer
8	Circlip
9	Spring Retainer
10	Piston Return Spring
11	Clutch Pack Retaining Ring
12	Clutch Pack Retaining Plate
13	Clutch Plate — Friction
14	Clutch Plate — Steel
15	Piston Sealing Ring
16	O-ring
17	Clutch Piston
18	O-ring
19	Piston Sealing Ring
20	Sealing Ring
21	Input Shaft Assembly Co-axial
22	Sealing Rings

23	Piston Sealing Rings
24	O-ring
25	Piston Sealing Ring
26	O-ring
27	Clutch Piston
28	Clutch Plate — Steel
29	Clutch Plate — Friction
30	Clutch Pack Retaining Plate
31	Clutch Pack Retaining Ring
32	Piston Return Spring
33	Spring Retainer
34	Circlip
35	Thrust Washer
36	Reverse Primary Gear
37	Needle Roller Bearing
38	Needle Roller Bearing Spacer
39	Thrust Bearing
40	Thrust Washer
41	Circlip
42	Bearing
43	Shims
44	Bearing Spacer

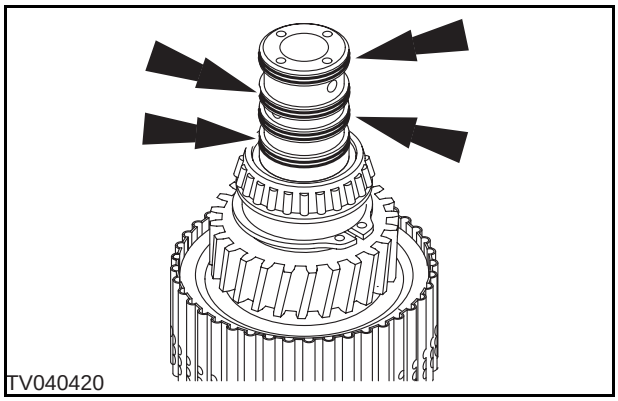
Note: This page intentionally left blank.

Disassembly (Reverse Clutch)

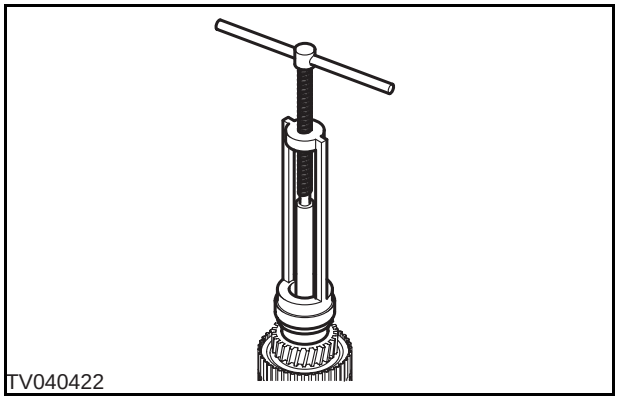
1. Position the shaft assembly in a soft jawed vice.



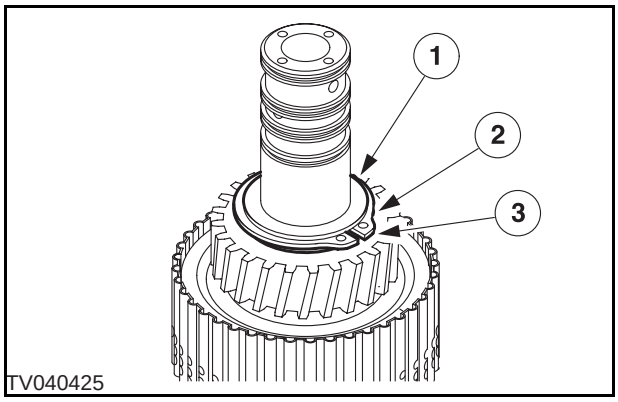
2. Remove and discard the sealing rings.



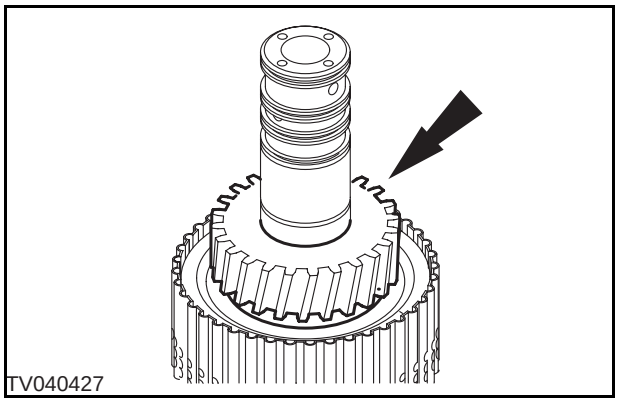
3. Using the appropriate bearing puller **FER.001 (KM3003)** with the removable collet **KM3519** , remove the rear bearing.



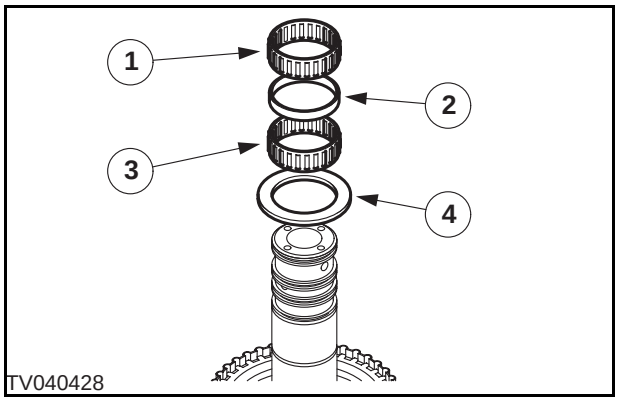
4. Remove the circlip (1), thrust washer (2) and needle roller bearing (3).



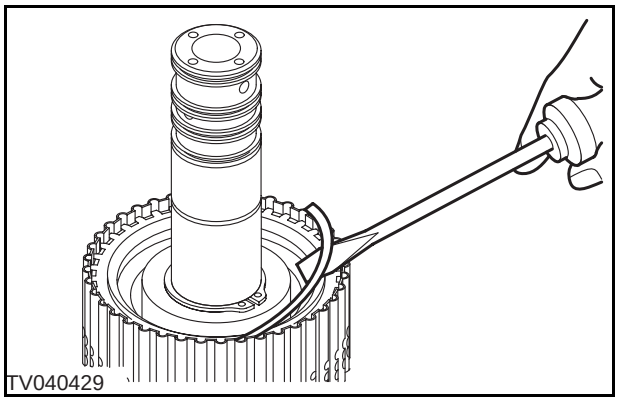
5. Remove the reverse primary gear.



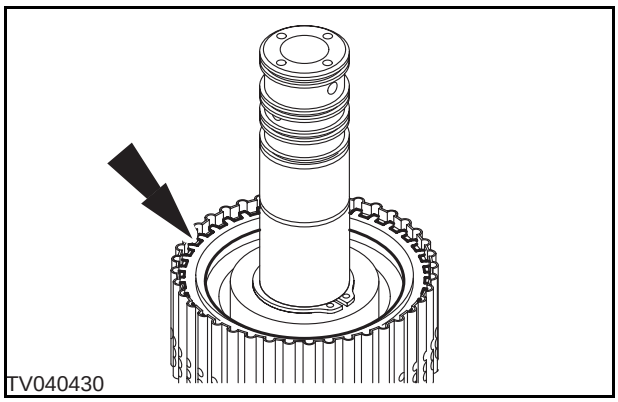
6. Remove the needle roller bearing (1), spacer (2), needle roller bearing (3) and thrust washer (4).



7. Remove the clutch pack retaining ring.

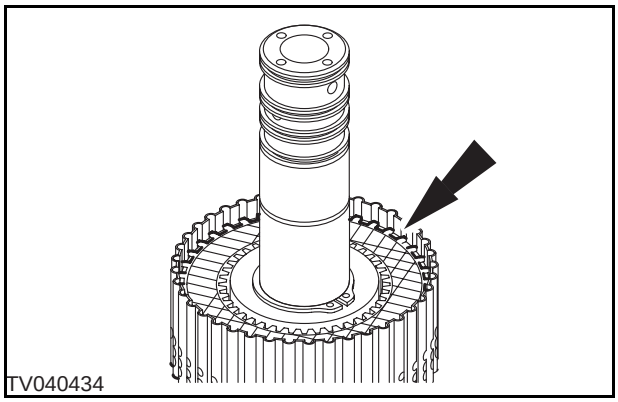


8. Remove the clutch pack retaining plate.

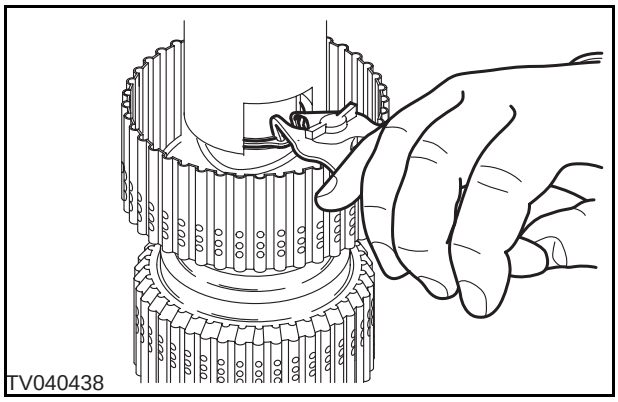


9. Remove the clutch pack.

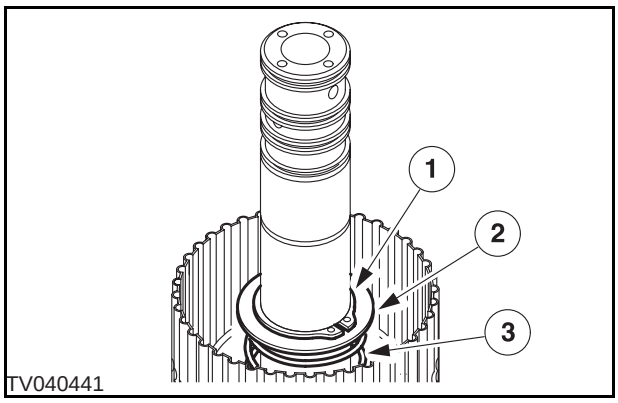
Note:
- Six plain clutch plates (externally splined) and six friction clutch plates (internally splined).


TV040434

10. Using the appropriate tool **FER.009 (KM3523)** , compress the piston spring and release the circlip.


TV040438

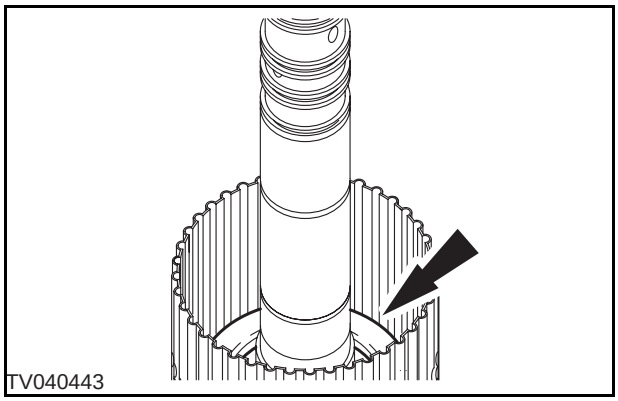
11. Remove the circlip (1), retainer (2) and spring (3).



TV040441

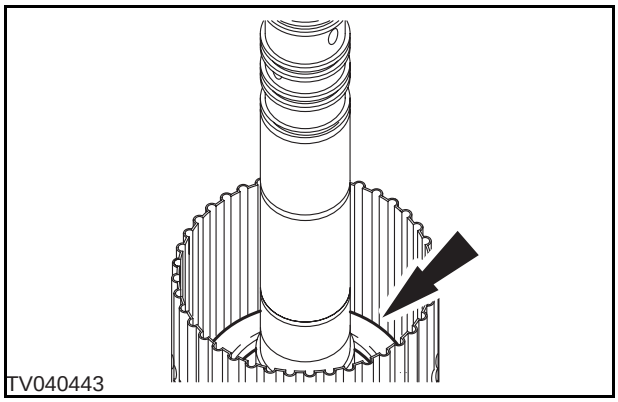
12. Remove the clutch piston.

13. Remove and discard the piston sealing rings and O-rings.

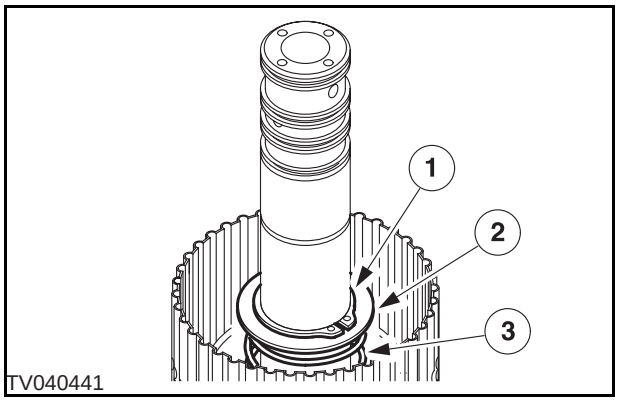

TV040443

Assembly (Reverse Clutch)

1. Renew the piston sealing rings and O-rings. To assist assembly bend the inner sealing ring into a heart shape.
2. Using transmission fluid to lubricate the seals, push the clutch piston into the clutch housing.

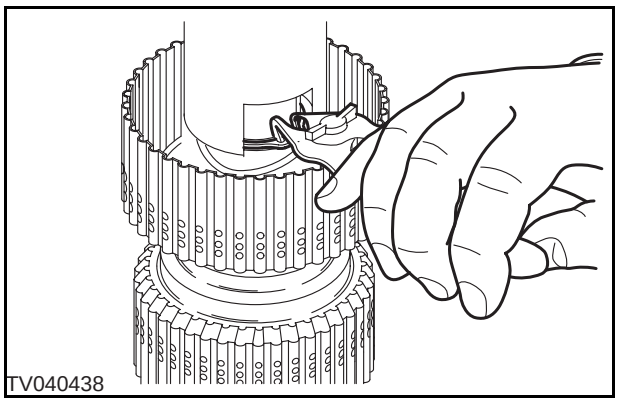

TV040443

3. Install the spring (3), retainer (2) and circlip (1).

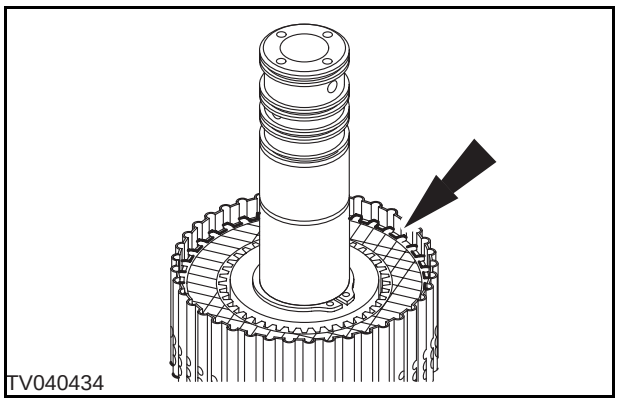


TV040441

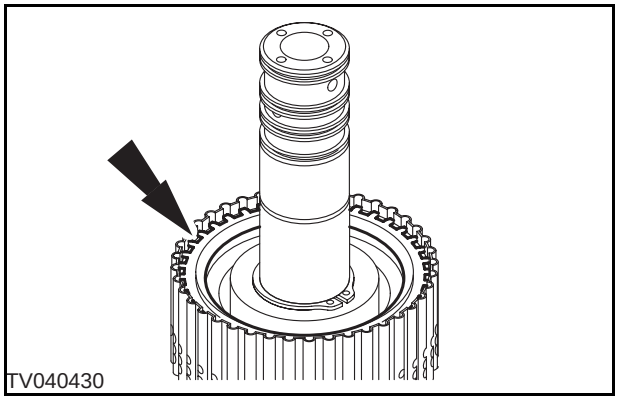
4. Using the appropriate tool **FER.009 (KM3523)** , compress the spring and locate the circlip into its groove.


TV040438

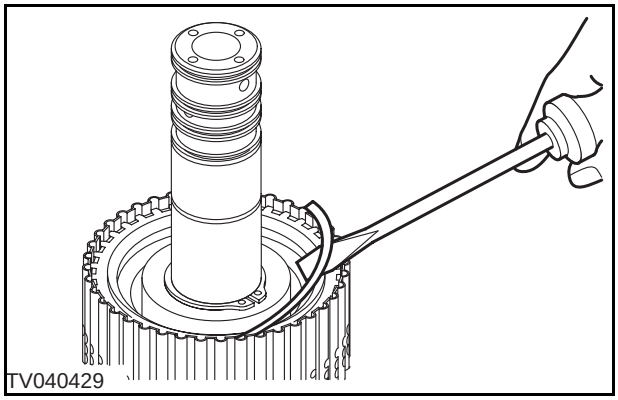
5. Install six plain clutch plates (externally splined) and six friction clutch plates (internally splined) alternately.



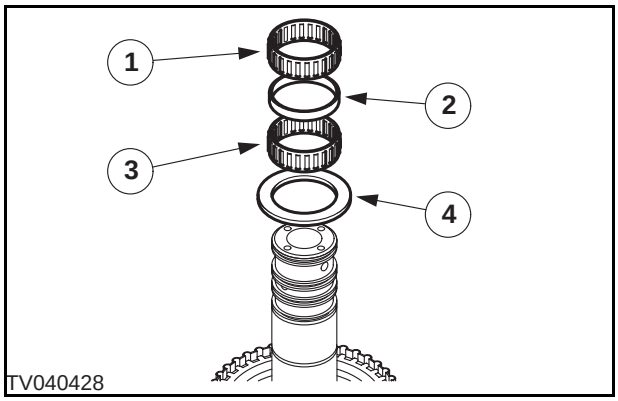
6. Install the clutch pack retaining plate.



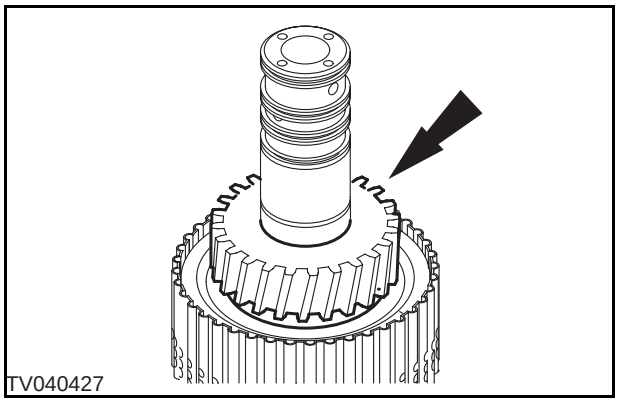
7. Install the clutch pack retaining ring.



8. Install the thrust washer (4), needle roller bearing (3), spacer (2) and needle roller bearing (1).

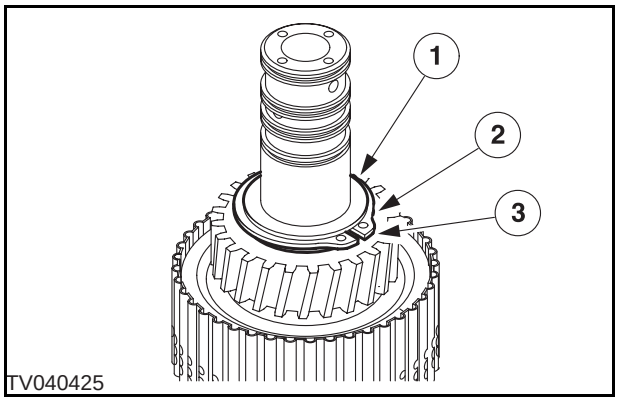


9. Install the reverse primary gear.

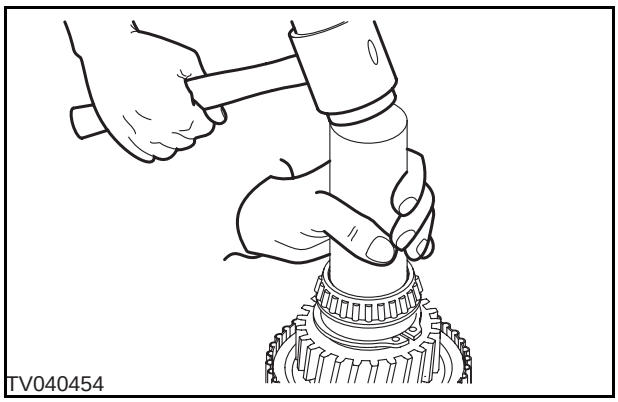


10. Install the needle roller bearing (3), thrust washer (2) and circlip (1).

Note:
- The needle roller bearing should be fitted with the closed side of its cage against the gear.



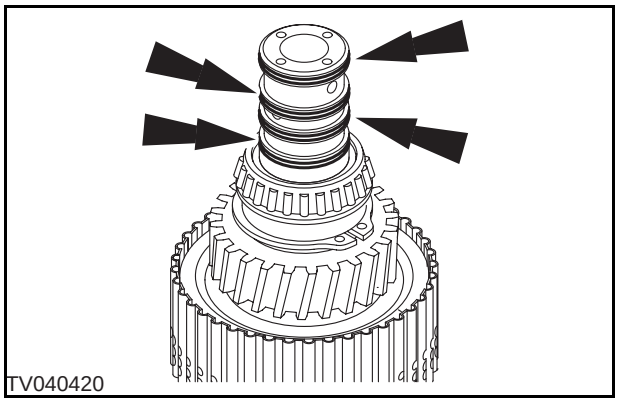
11. Using an appropriately sized tube, install the rear bearing.



Note:
- To avoid damage, the sealing rings should be left off until all shimming operations have been completed.

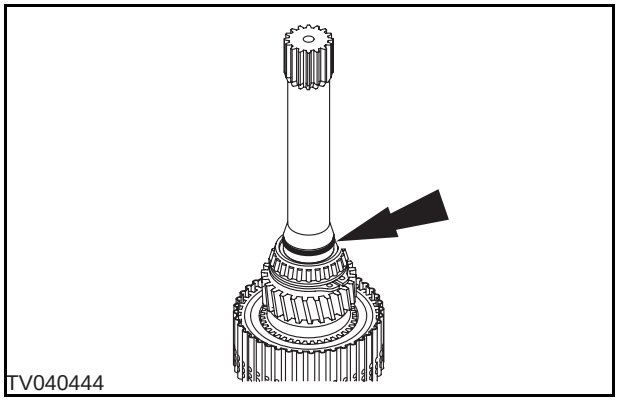
12. Install new sealing rings.

13. There is a pump drive shaft bush fitted in the end of the shaft which may be replaced if worn.

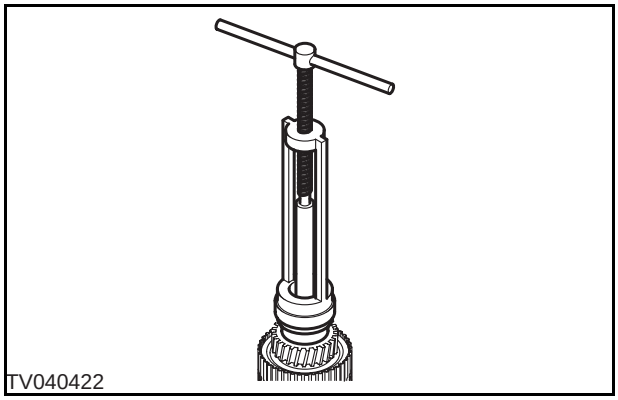

TV040420

Disassembly (Forward Clutch)

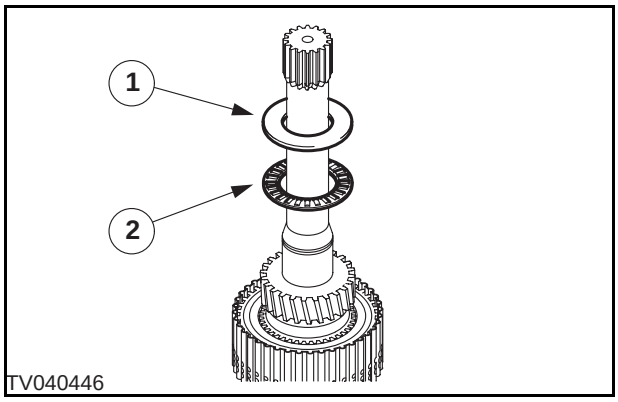
1. Turn the shaft over and secure in a soft jawec vice.
2. Remove and discard the sealing ring.



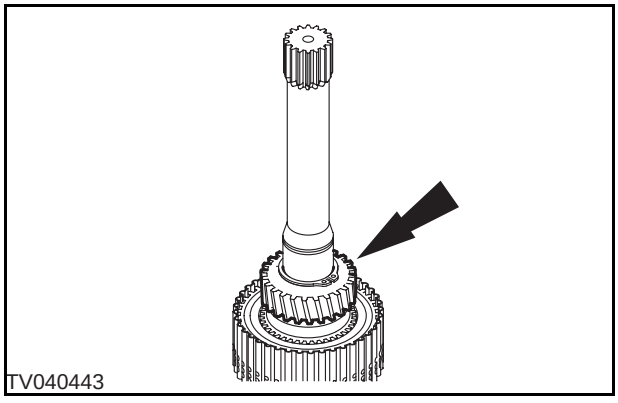
3. Using the appropriate bearing puller **FER.001 (KM3003)** with the removable collet **FER.004 (KM3516)** , remove the front bearing.



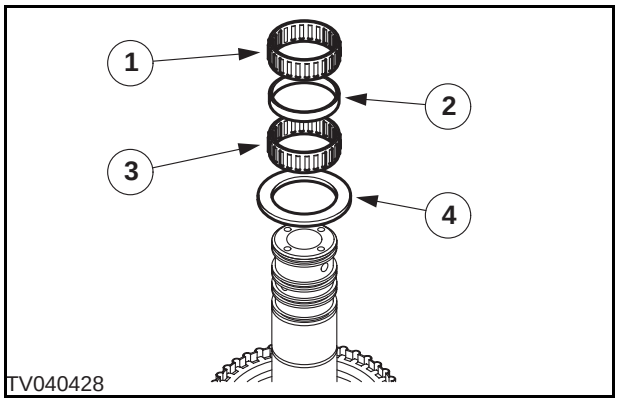
4. Remove the thrust washer (1) needle roller bearing (2).



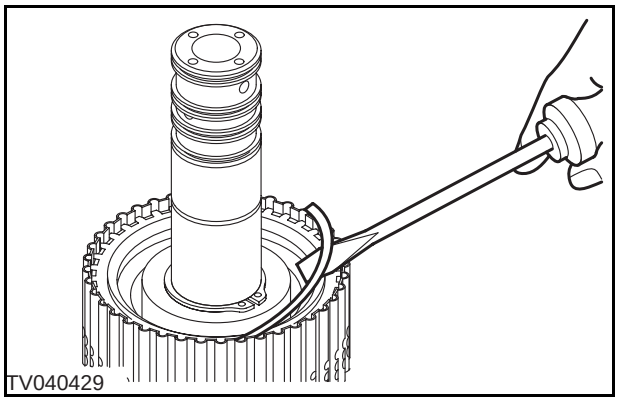
5. Remove the forward primary gear.



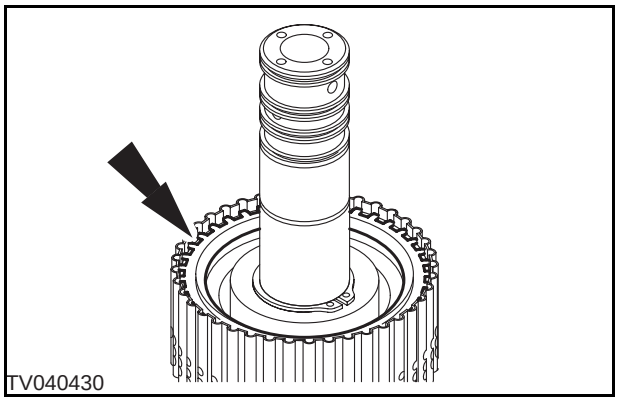
6. Remove needle roller bearing (1), spacer (2), needle roller bearing (3) and the thrust washer (4).



7. Remove the clutch pack retaining ring.



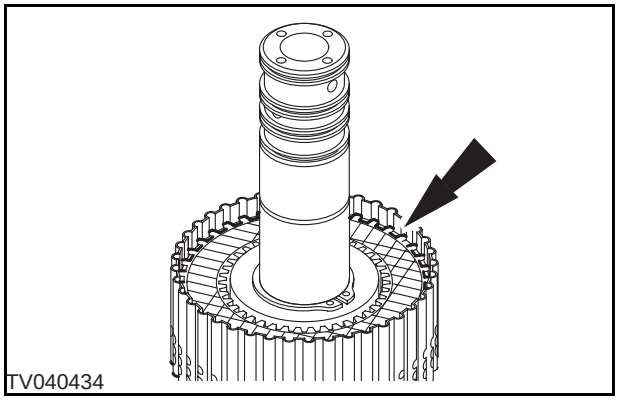
8. Remove the clutch pack retaining plate.



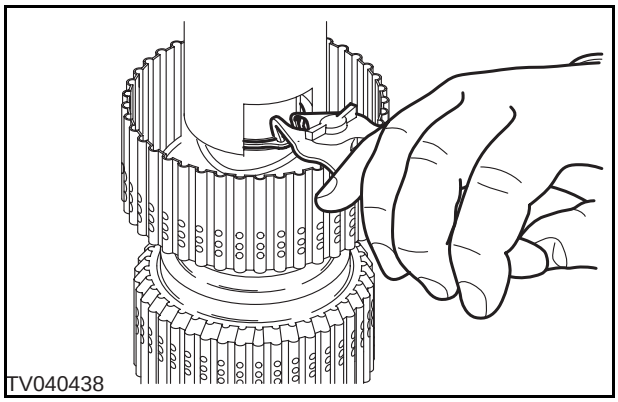
9. Remove the clutch pack.

Note:

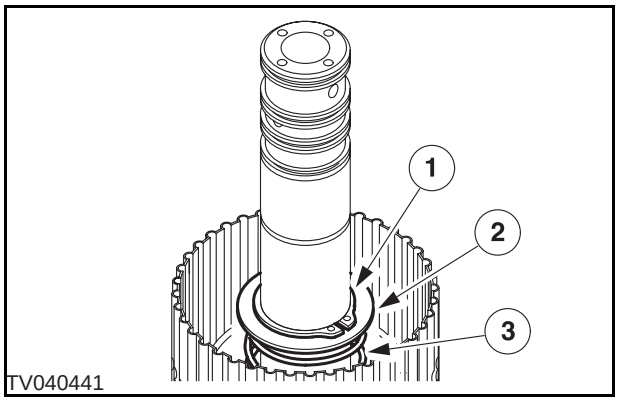
- Six plain clutch plates (externally splined) and six friction clutch plates (internally splined).



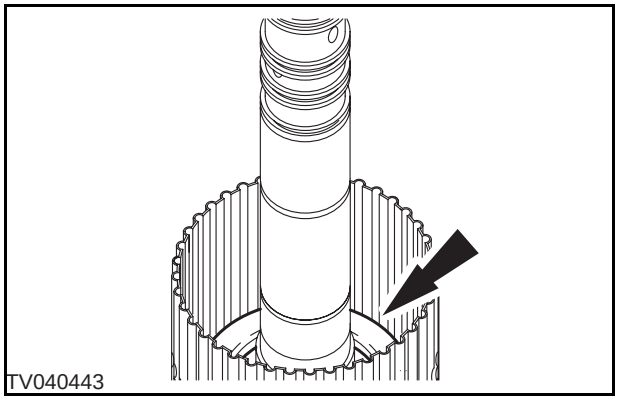
10. Using the appropriate tool **FER.009 (KM3523)** , compress the piston spring and release the circlip.



11. Remove the circlip (1), retainer (2) and spring (3).

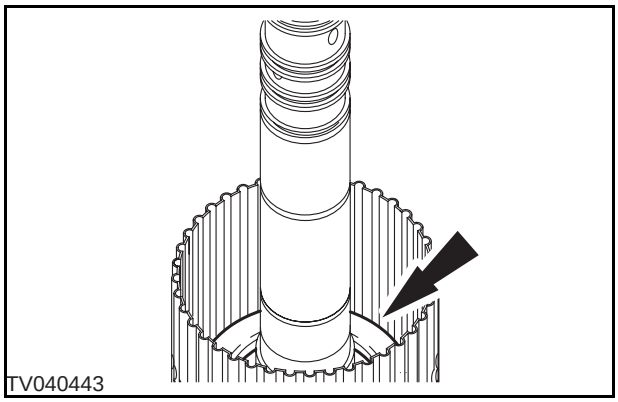


12. Remove the clutch piston.
13. Remove and discard the piston sealing rings and O-rings.

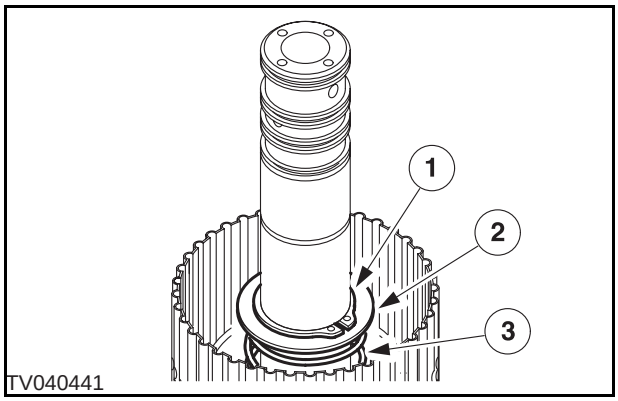


Assembly (Forward Clutch)

1. Renew the piston sealing rings and O-rings. To assist assembly bend the inner sealing ring into a heart shape.
2. Using transmission fluid to lubricate the seals, push the piston into the clutch housing.

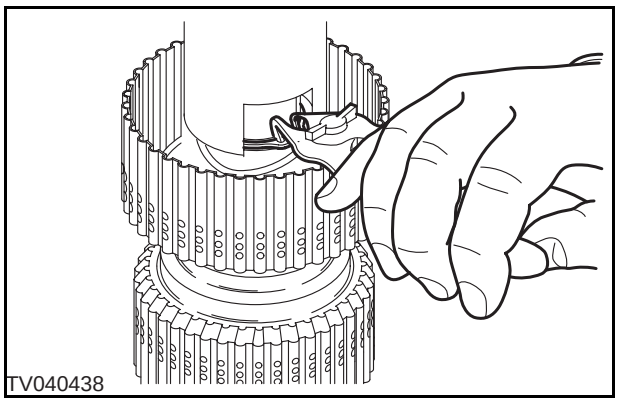

TV040443

3. Install the spring (3), retainer (2) and circlip (1).

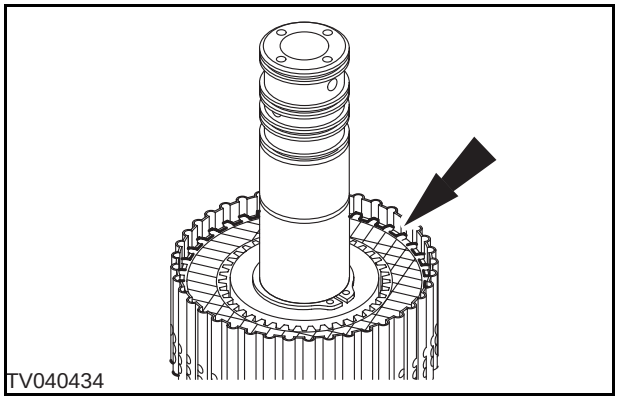


TV040441

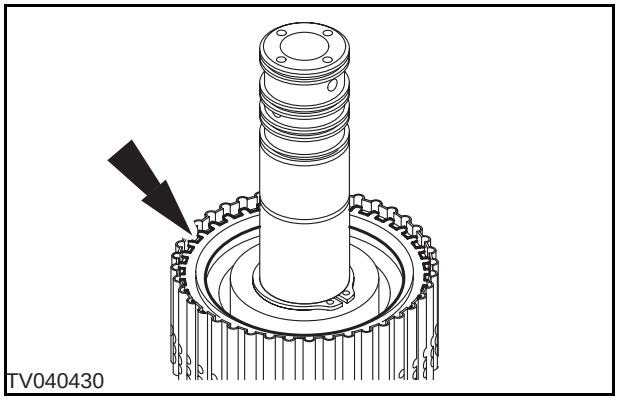
4. Using the appropriate tool **FER.009 (KM3523)** , compress the spring and locate the circlip into its groove.


TV040438

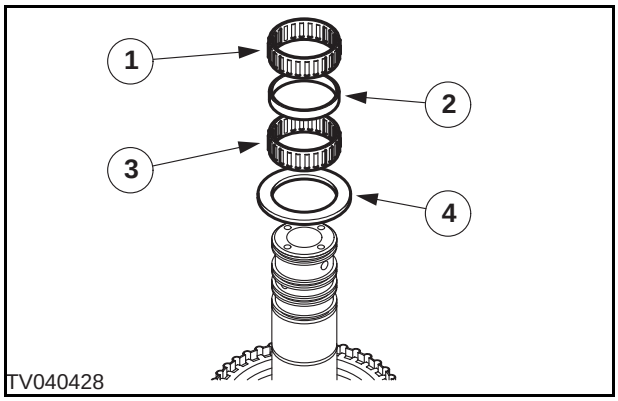
5. Install six plain clutch plates (externally splined) and six friction clutch plates (internally splined) alternately.


TV040434

6. Install the clutch pack retaining plate.

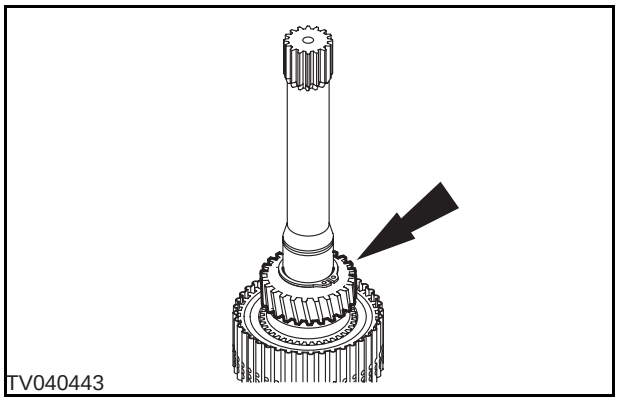

TV040430

7. Install the thrust washer (4), needle roller bearing (3), spacer (2) and needle roller bearing (1).

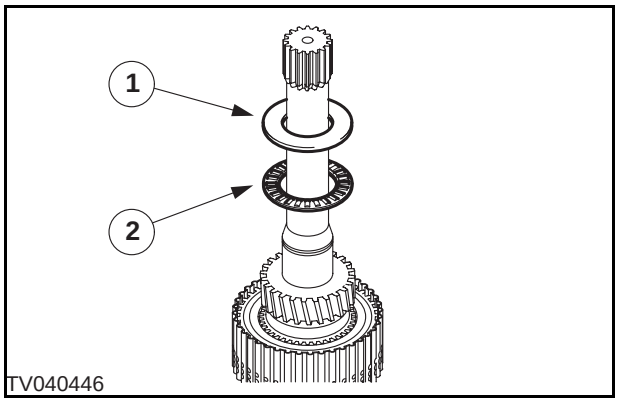


TV040428

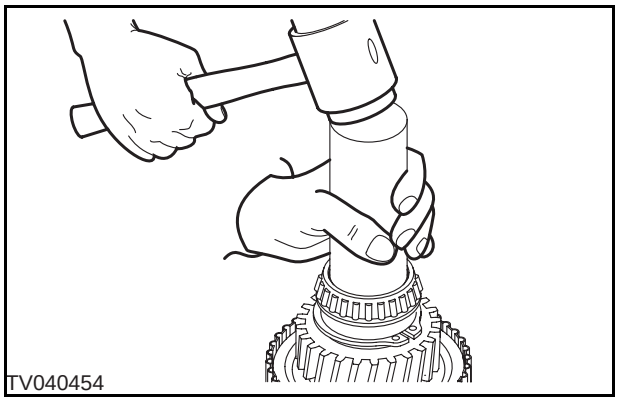
8. Install the forward primary gear.


TV040443

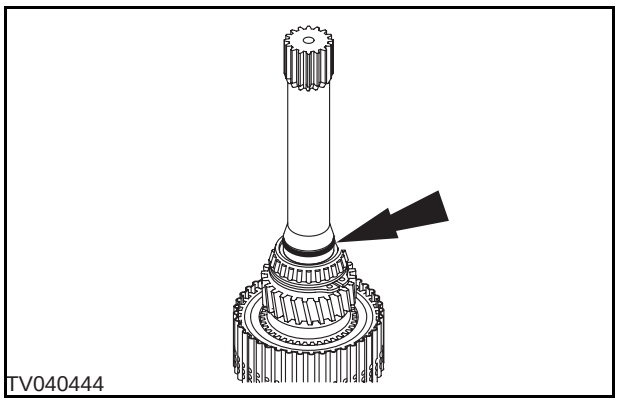
9. Install the needle roller bearing (2) and thrust washer (1).



10. Using an appropriately sized tube, Install the bearing as shown.



11. Install a new sealing ring

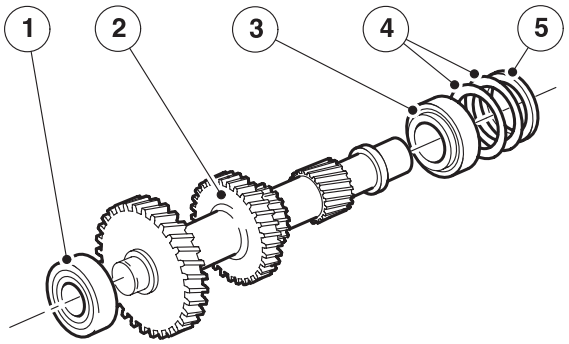


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DISASSEMBLY AND ASSEMBLY — COUNTERSHAFT

BHN1302DC

Operation: **Disassembly and Assembly of the Countershaft**	*Job Code:* **13 49 17 xx**		
None	Standard tools, FER.001 (KM3003), FER.006 (KM3518)		



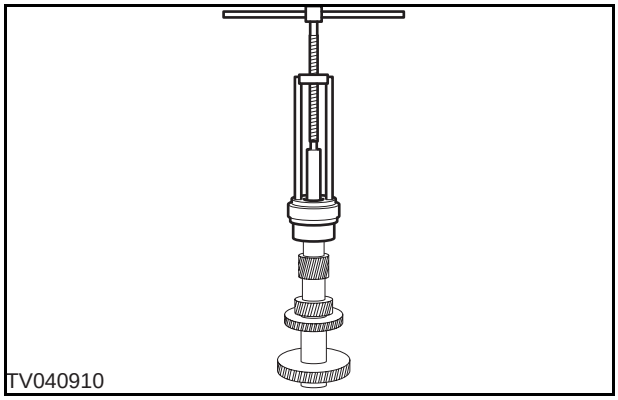
TV040677

1	Bearing
2	Countershaft
3	Bearing
4	Shims
5	Bearing Spacer

Disassembly

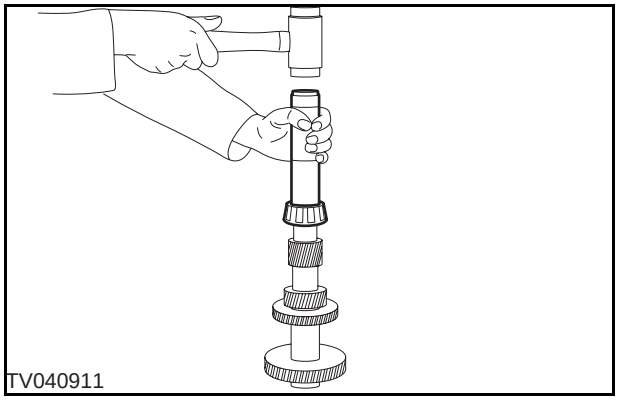
1. Position the shaft assembly in a suitable soft jawed vice.

2. Using the appropriate bearing puller **FER.001 (KM3003)** and removable collets **FER.007 (KM3522)** and **FER.006 (KM3518)** , remove the front and rear bearings.


TV040910

Assembly

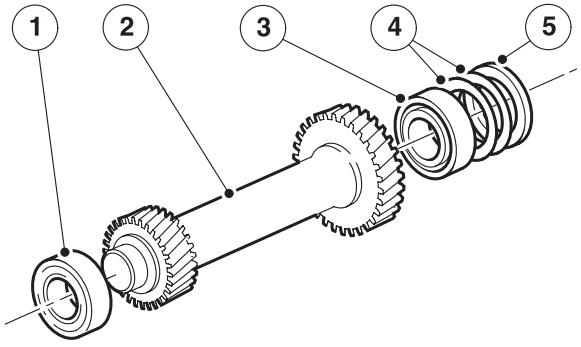
1. Using an appropriately sized tube, install the front and rear bearings.


TV040911

DISASSEMBLY AND ASSEMBLY — REVERSE IDLER SHAFT

BHN1302DD

Operation: **Disassembly and Assembly of the Reverse Idler Shaft**	*Job Code:* **13 50 17 xx**		
None	Standard tools, FER.001 (KM3003), FER.002 (KM3509)		

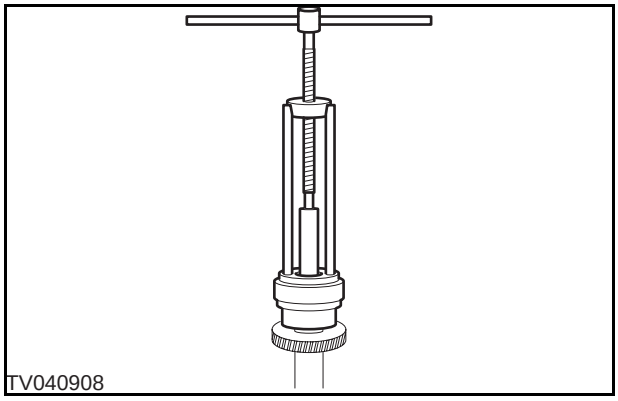


TV040674

1	Bearing
2	Reverse Idler Shaft
3	Bearing
4	Shims
5	Bearing Spacer

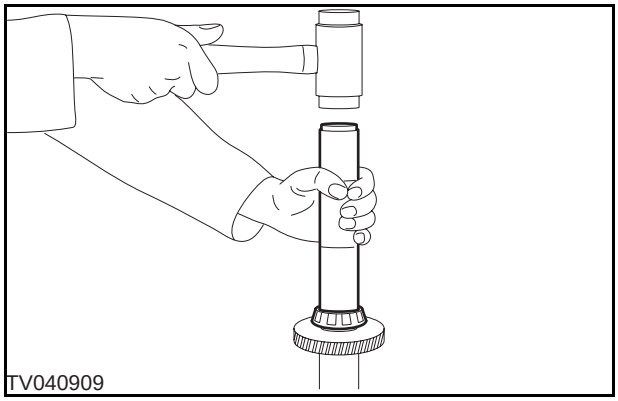
Disassembly

1. Position the shaft assembly in a suitable soft jawed vice.
2. Using the appropriate bearing puller **FER.001 (KM3003)** and removable collet **FER.002 (KM3509)** , remove the front and rear bearings.


TV040908

Assembly

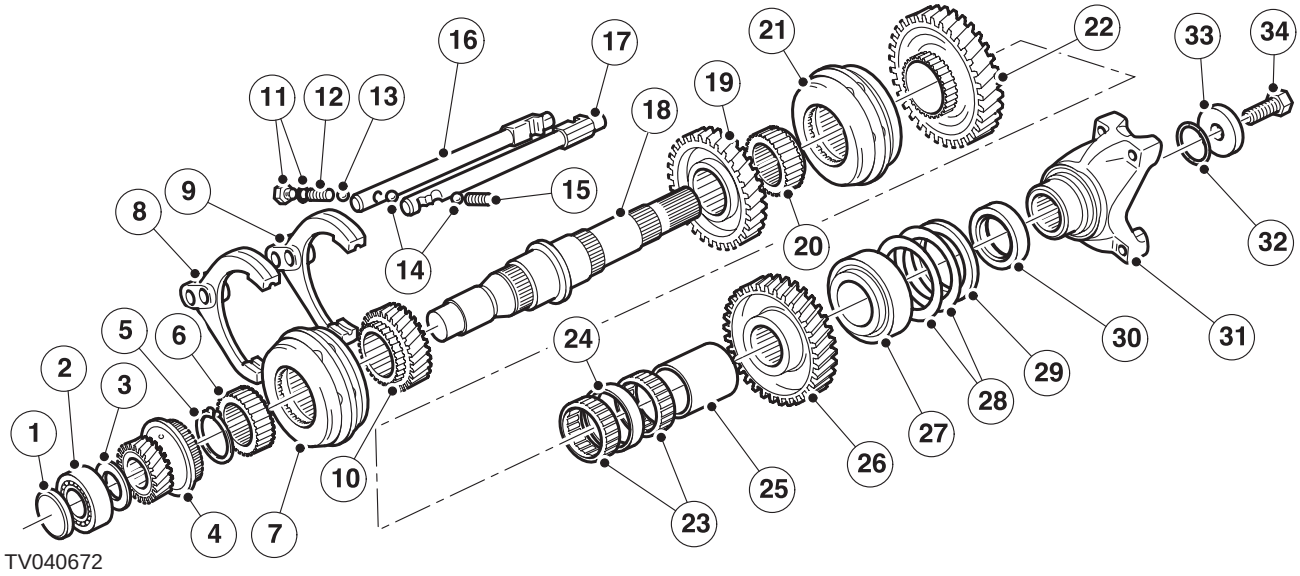
1. Using an appropriately sized tube, install the front and rear bearings.


TV040909

DISASSEMBLY AND ASSEMBLY — OUTPUT SHAFT

BHN1302DE

Operation: **Disassembly and Assembly of the Output Shaft**	*Job Code:* **13 46 17 xx**		
None	Standard tools, FER.001 (KM3003), FER.005 (KM3517), FER.006 (KM3518),		

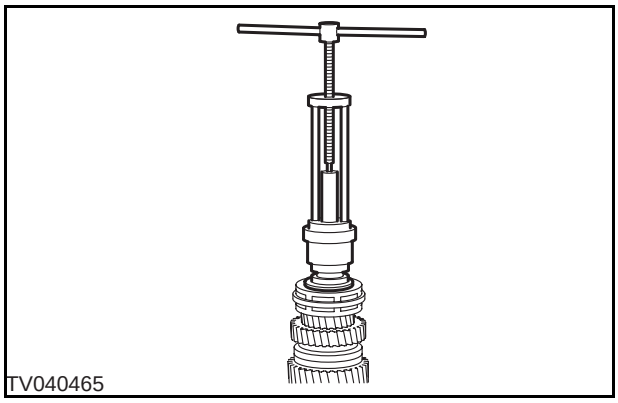


TV040672

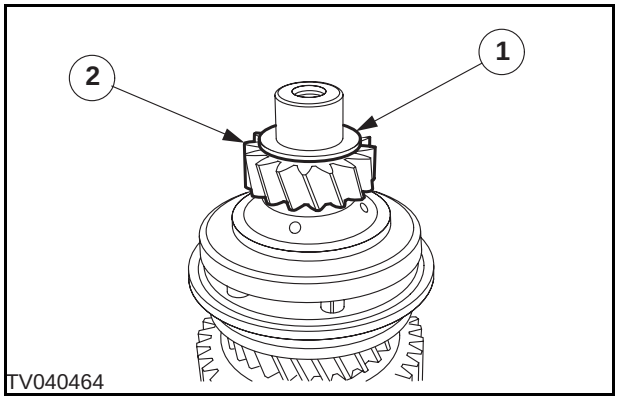
1	Sealing cap
2	Bearing
3	Thrust Washer
4	4th Gear
5	Circlip
6	Synchroniser Hub
7	3rd / 4th Synchroniser Assembly
8	3rd / 4th Shift Fork
9	1st / 2nd Shift Fork
10	3rd gear
11	Plug Assembly
12	Detent Spring
13	Detent Ball
14	Detent Balls
15	Detent Spring
16	1st / 2nd Shift Rod
17	3rd / 4th Shift Rod
18	Output Shaft
19	2nd Gear
20	Synchroniser Hub
21	1st / 2nd Synchroniser Assembly
22	1st Gear
23	1st Gear Output Shaft Needle Roller Bearings
24	Bearing Spacer
25	Bearing Sleeve
26	Four-Wheel Drive Gear
27	Bearing
28	Shims
29	Bearing Spacer
30	Oil Seal
31	Output Shaft Flange
32	O-ring Seal
33	Washer
34	Retaining Bolt

Disassembly

1. Position the shaft assembly in a soft jawed vice.
2. Using the appropriate bearing puller **FER.001 (KM3003)** and removable collet **FER.005 (KM3517)** , remove the front bearing.

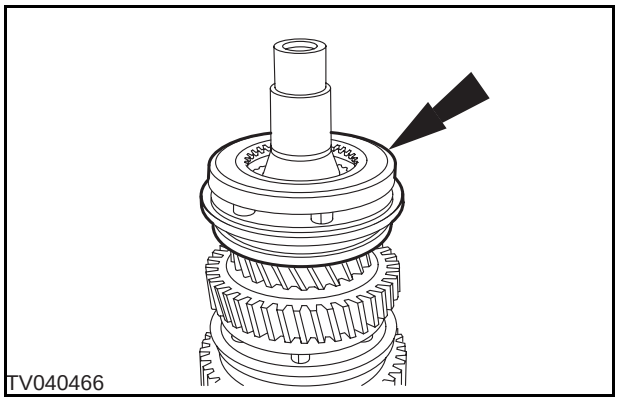

TV040465

3. Remove the thrust washer (1) and the 4th gear (2).

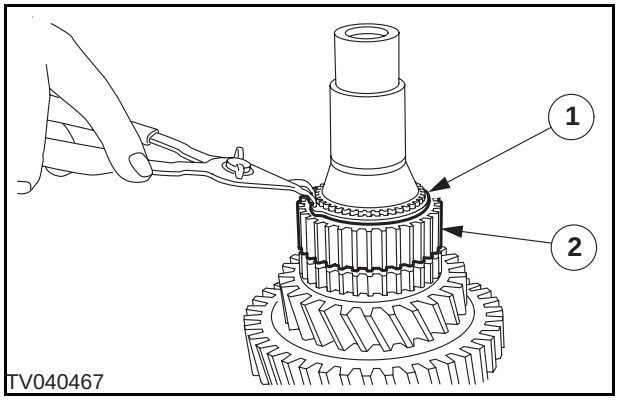


TV040464

4. Remove the 3rd / 4th synchroniser assembly.

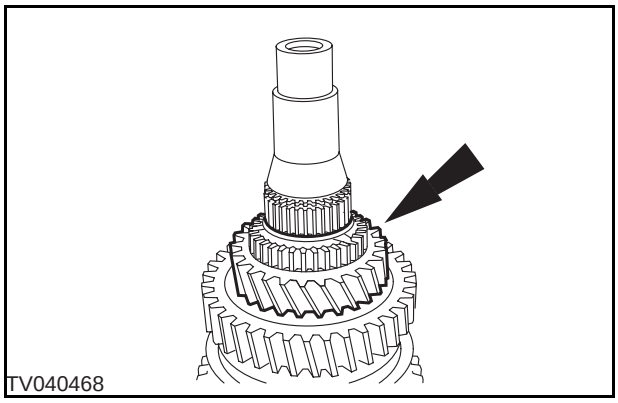

TV040466

5. Using suitable circlip pliers, remove the circlip (1) and the synchroniser hub (2).

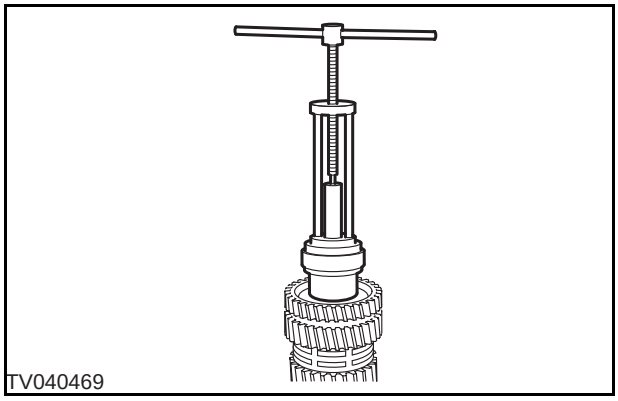


TV040467

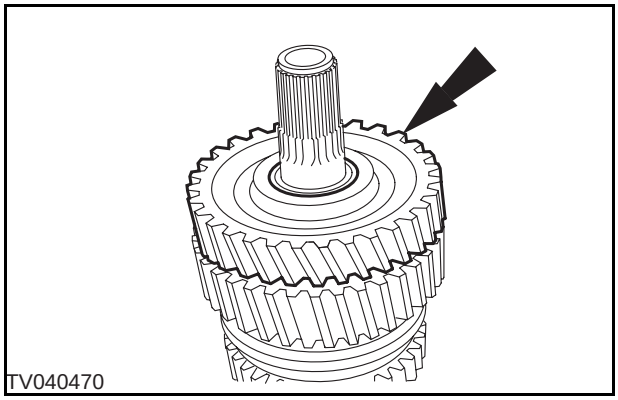
6. Remove the 3rd gear.


TV040468

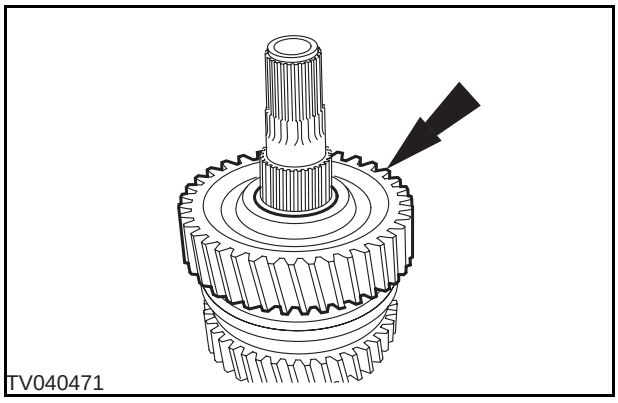
7. Rotate the shaft 180 degrees.
8. Using the appropriate bearing puller **FER.001 (KM3003)** with the removable collet **FER.006 (KM3518)** , remove the front bearing.


TV040469

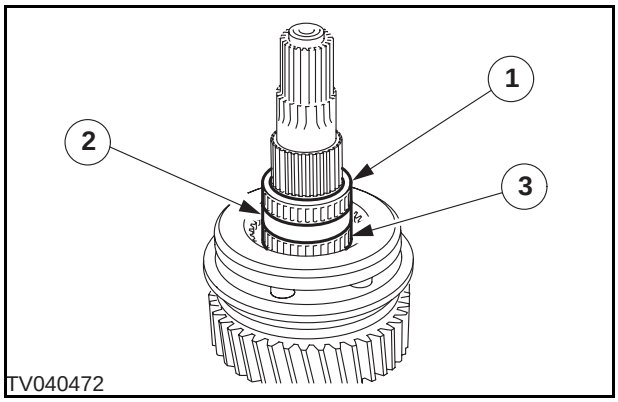
9. Remove the four-wheel drive gear. (If equipped).


TV040470

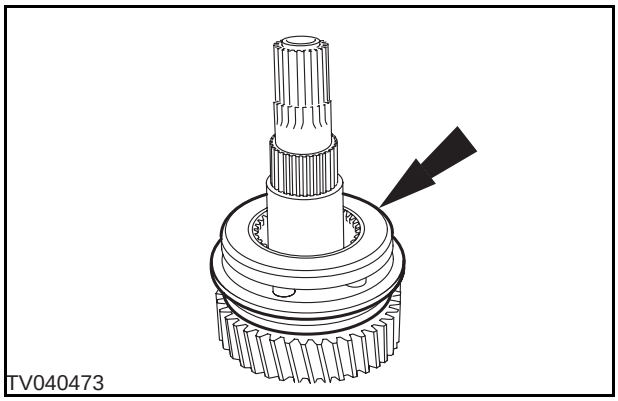
10. Remove the 1st gear.


TV040471

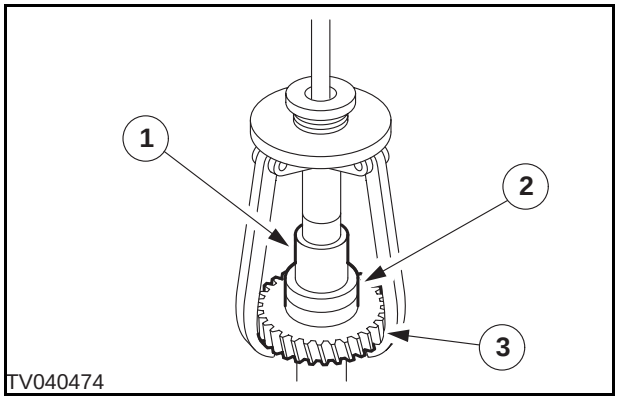
11. Remove the 1st gear needle roller bearing (1), spacer (2) and needle roller bearing (3).



12. Remove the 1st / 2nd synchroniser assembly.

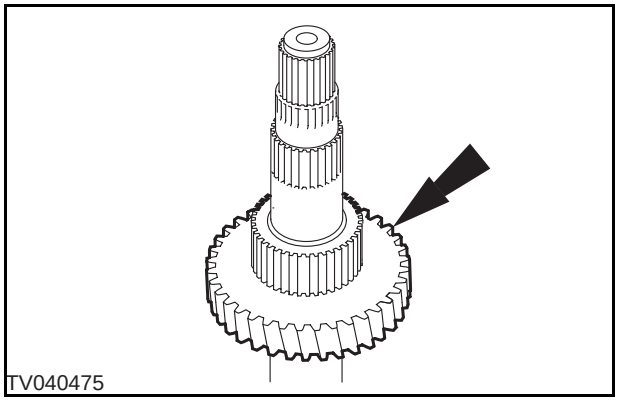


13. Using a suitable bearing puller or hydraulic press, remove the 1st gear bearing sleeve (1), synchroniser hub (2) and 2nd gear (3).

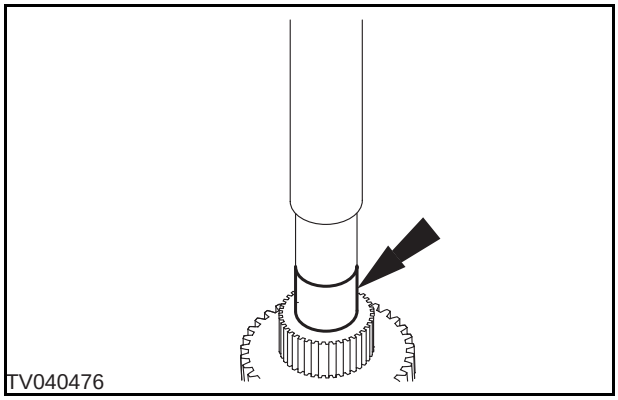


Assembly

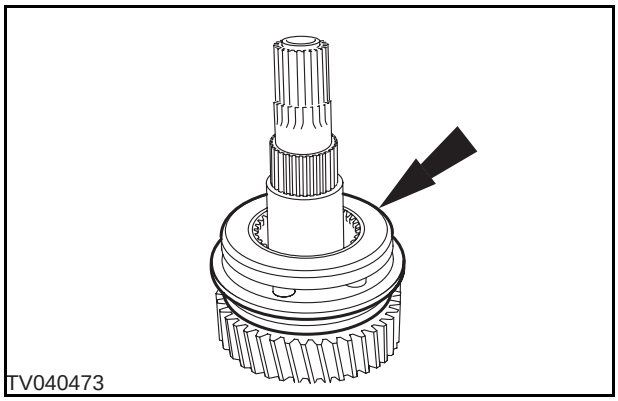
1. Install the 2nd gear (1) and the synchroniser hub (2).


TV040475

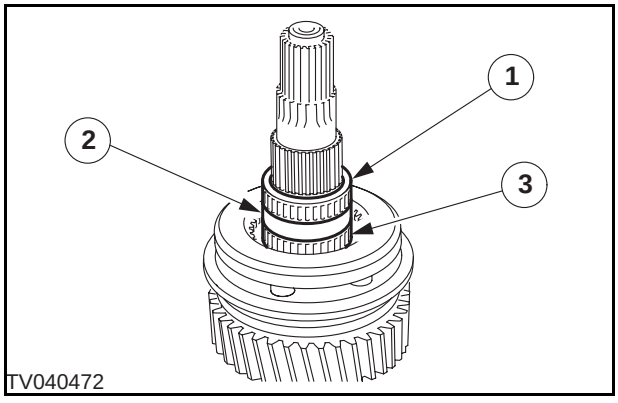
2. Using a suitable hydraulic press and an appropriately sized tube, install the 1st gear bearing sleeve.


TV040476

3. Install the 1st / 2nd synchroniser assembly.

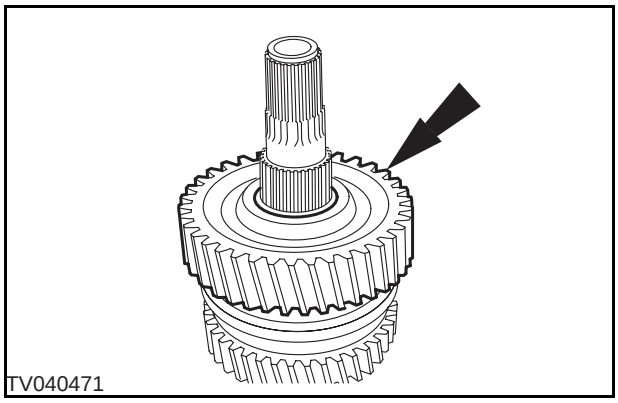

TV040473

4. Install the 1st gear needle roller bearing (3), spacer (2) and the 1st gear needle roller bearing (1).



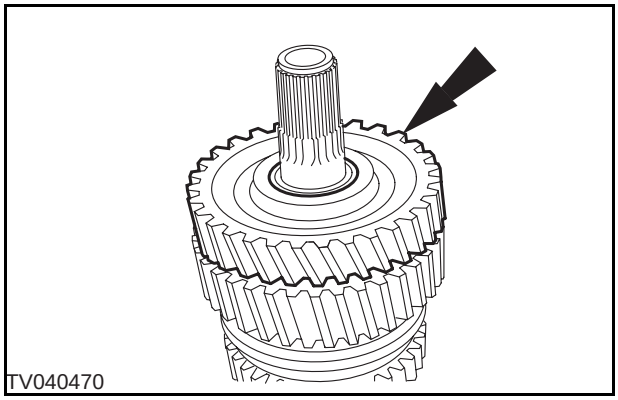
TV040472

5. Install the 1st gear.

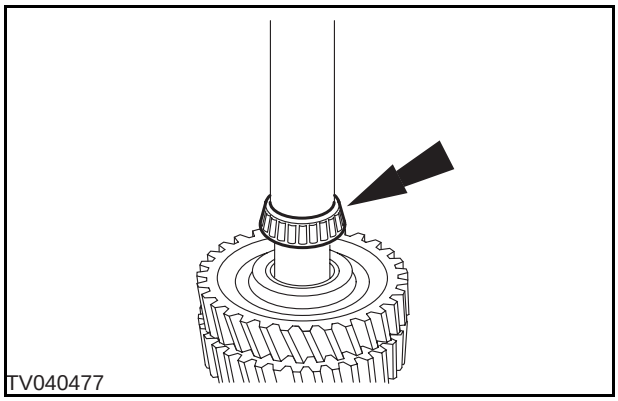

TV040471

Note:
- The gear should be fitted with the fluted boss against the 1st gear.

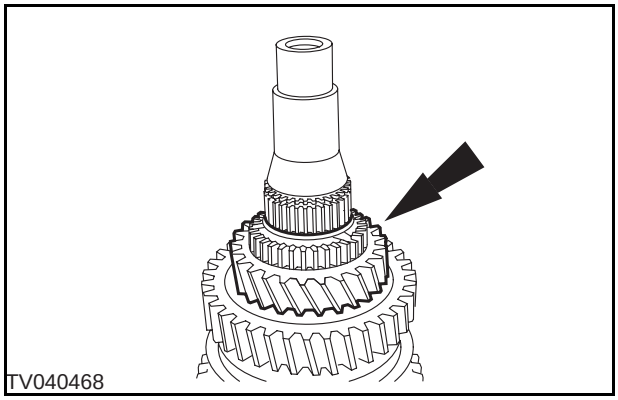
6. Using Loctite 649 spline lock or equivalent, install the four-wheel drive gear (If equipped).


TV040470

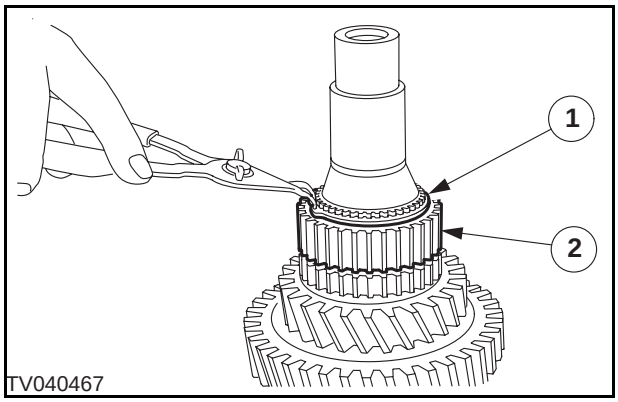
7. Using a suitable hydraulic press and an appropriately sized tube, install the rear bearing.


TV040477

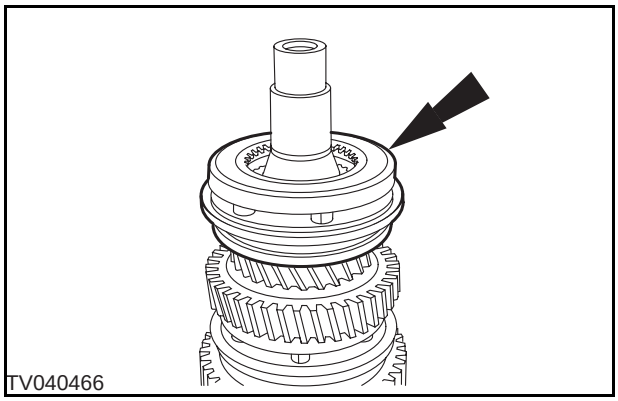
8. Rotate the shaft 180 degrees.
9. Install the 3rd gear.


TV040468

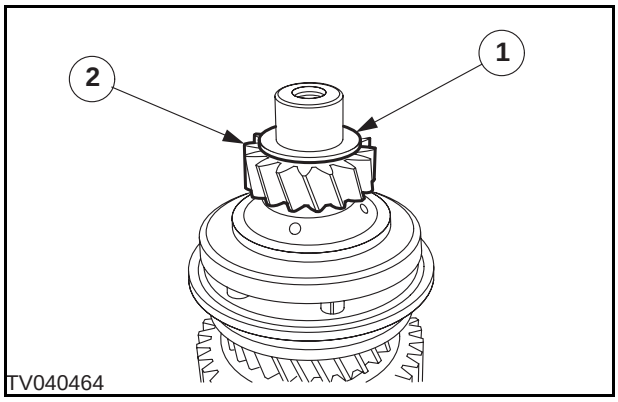
10. Install the synchroniser hub (2) and using suitable circlip pliers install the circlip (1).



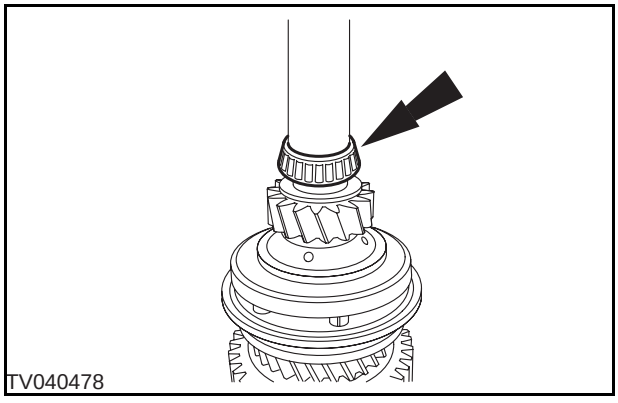
11. Install the 3rd / 4th synchroniser assembly.



12. Install the 4th gear (2) and the thrust washer (1).



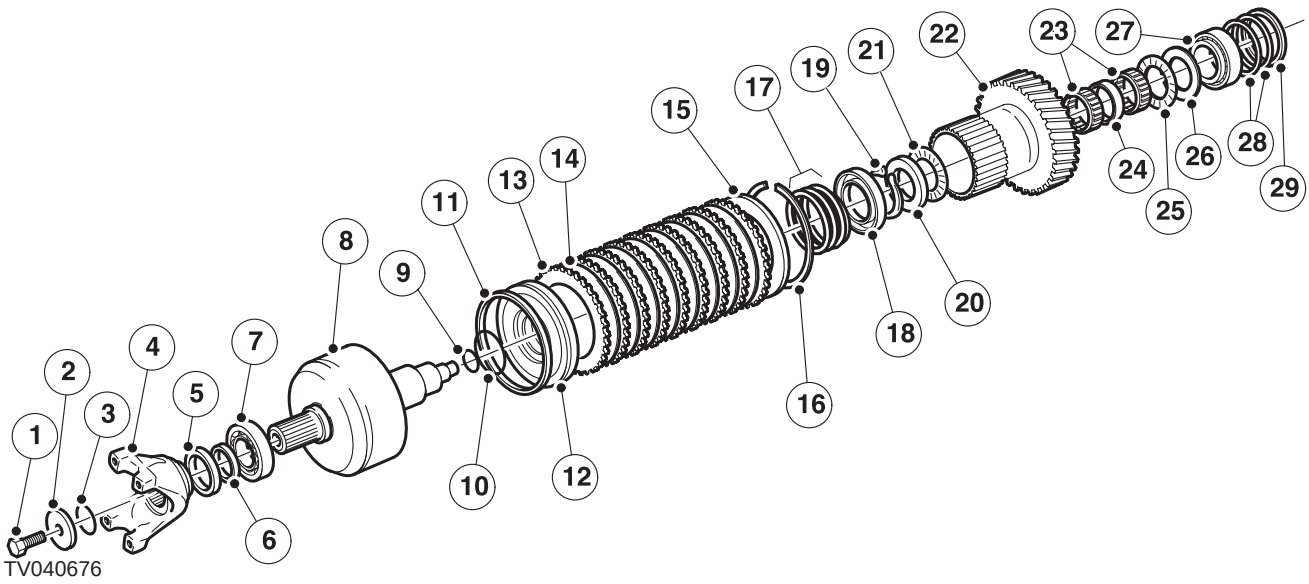
13. Using a suitable hydraulic press and an appropriately sized tube, install the front bearing.



DISASSEMBLY AND ASSEMBLY — HYDRAULIC MULTIPLATE CLUTCH FOUR-WHEEL DRIVE SHAFT

BHN1302DF

Operation: **Disassembly and Assembly of the Hydraulic Multiplate Clutch Four-Wheel Drive Shaft**	*Job Code:* **13 30 17 xx**		
None	Standard tools, FER.001 (KM3003), FER.004 (KM3516), KM3521, FER.003 (KM3510)		

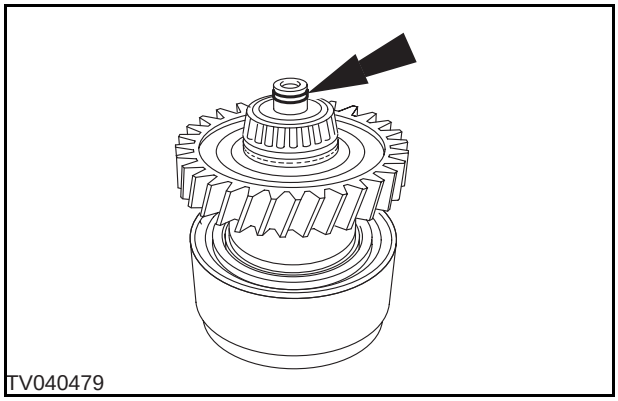


TV040676

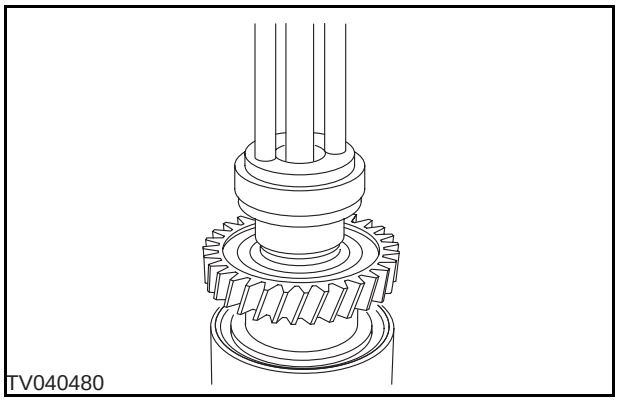
1	Output Shaft Flange Retaining Bolt
2	Output Shaft Flange Washer
3	O-ring
4	Output Shaft Flange
5	Oil Seal
6	Output Shaft Flange Spacer
7	Bearing
8	Four-wheel Drive Clutch Housing
9	Shaft Sealing Ring
10	Piston Inner Oil Seal
11	Piston Outer Oil Seal
12	Piston
13	Clutch Plate — Steel
14	Clutch Plate — Friction
15	End Plate
16	Clutch Pack Retaining Ring
17	Spring
18	Spring Retainer
19	Circlip
20	Thrust Washer
21	Thrust Bearing
22	Four-wheel Drive Gear Assembly
23	Needle Roller Bearing
24	Spacer
25	Needle Roller Bearings
26	Thrust Bearing
27	Bearing
28	Shims
29	Spacer

Disassembly

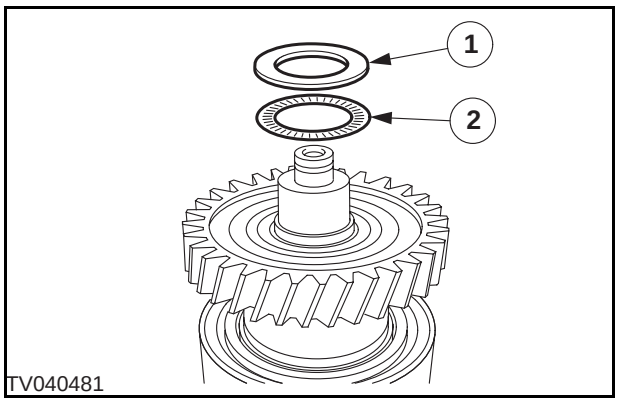
1. Position the shaft assembly in a suitable soft jawed vice.
2. Remove the rear sealing ring.


TV040479

3. Using the appropriate bearing puller **FER.001 (KM3003)** and removable collet **FER.004 (KM3516)** , remove the rear bearing.

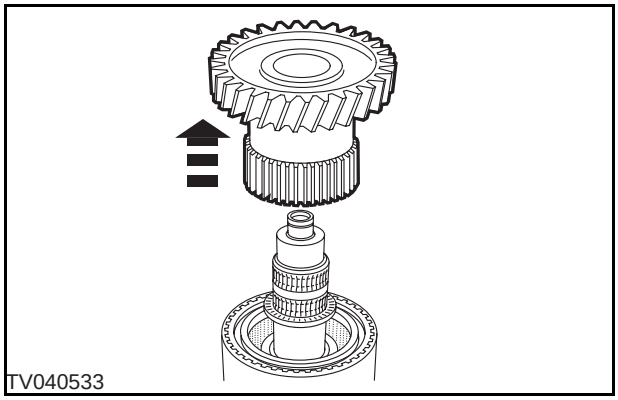

TV040480

4. Remove the thrust washer (1) and the needle roller bearing (2).

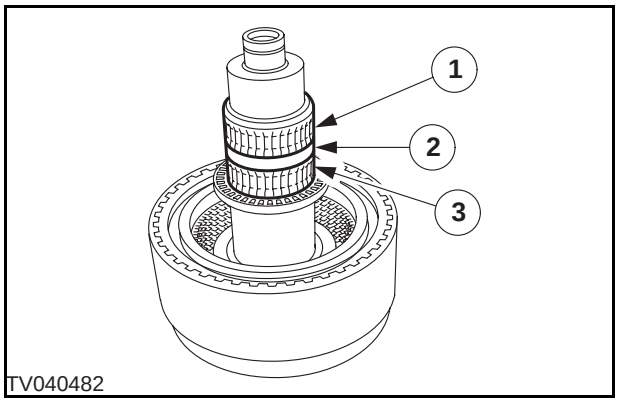


TV040481

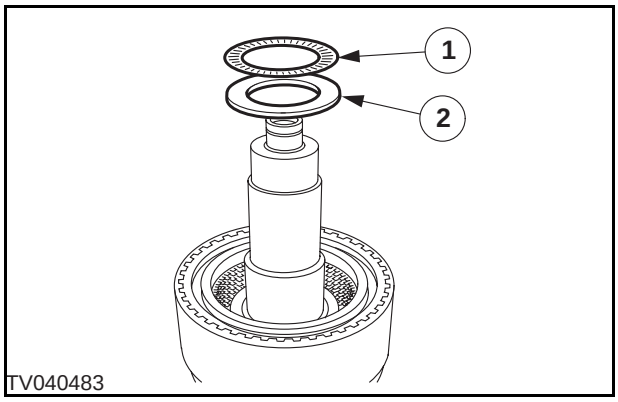
5. Remove the four-wheel drive gear assembly.


TV040533

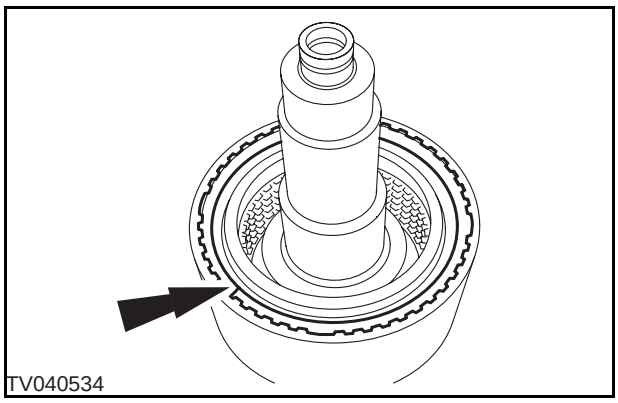
6. Remove the needle roller bearing (1), spacer (2) and needle roller bearing (3).



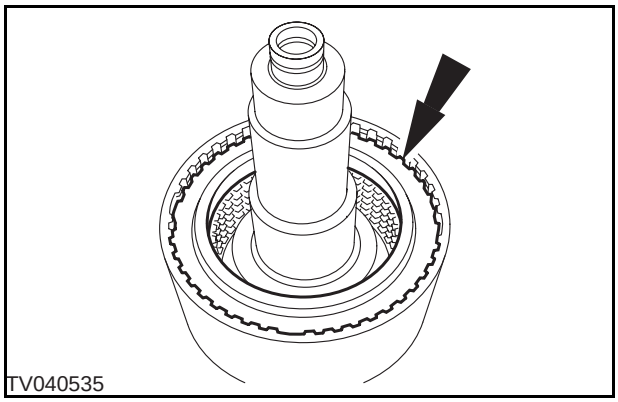
7. Remove the thrust bearing (1) and the thrust washer (2).



8. Remove the clutch pack retaining ring.

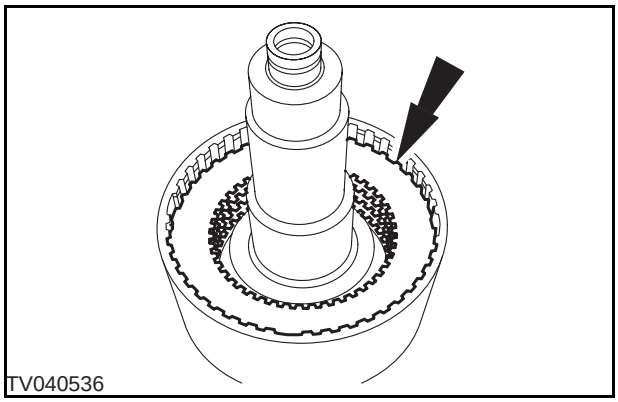


9. Remove the clutch pack end plate.

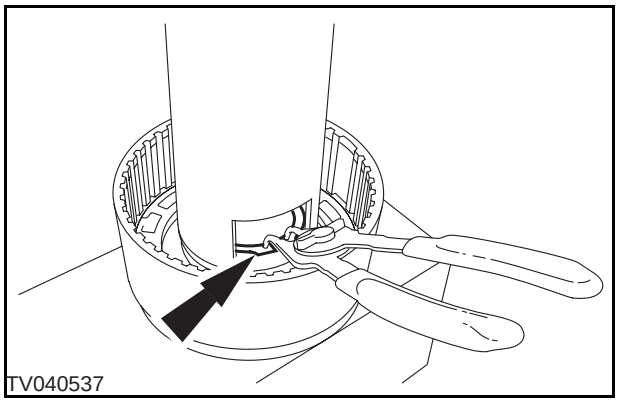


10. Remove the clutch pack.

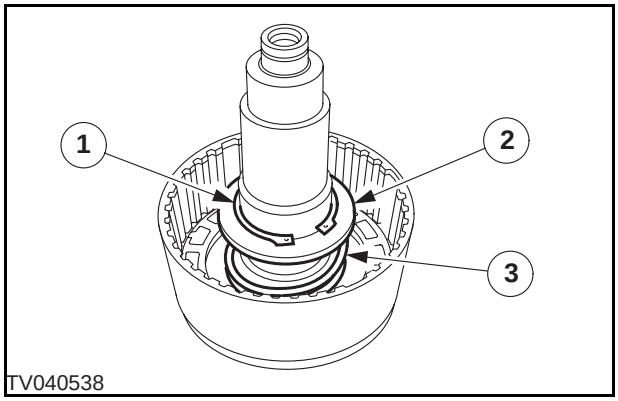
Note:
- Eight plain clutch plates (externally splined) and eight friction clutch plates (internally splined).


TV040536

11. Using the appropriate tool **KM3521** and a suitable hydraulic press, compress the piston return spring and release the circlip.

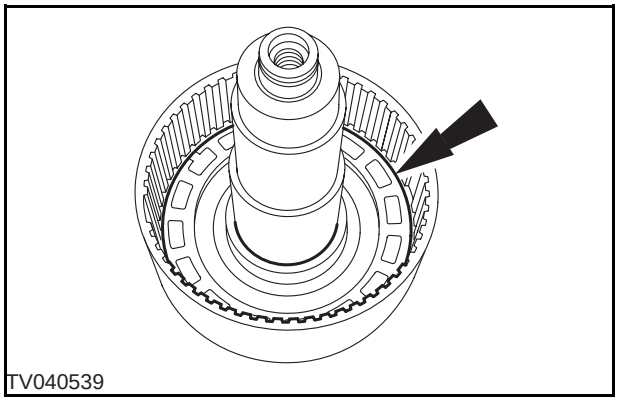

TV040537

12. Remove the circlip (1), spring retainer (2) and the spring (3).

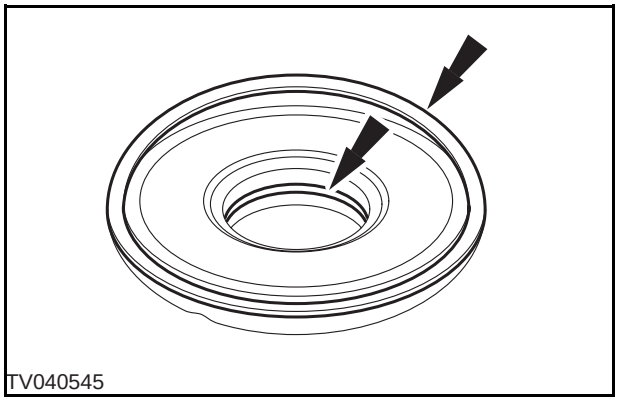


TV040538

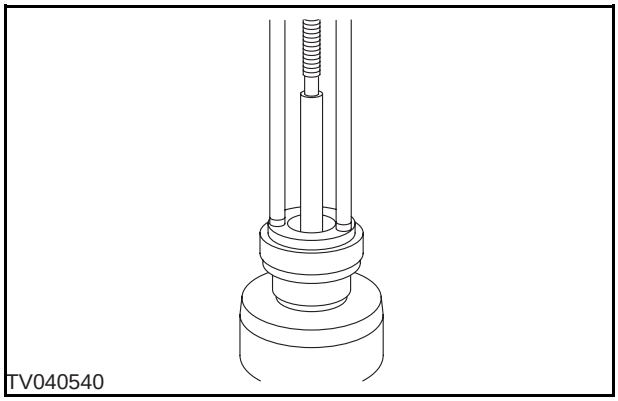
13. Remove the clutch piston inner and outer oil seals.


TV040539

14. Remove and discard the piston sealing rings.

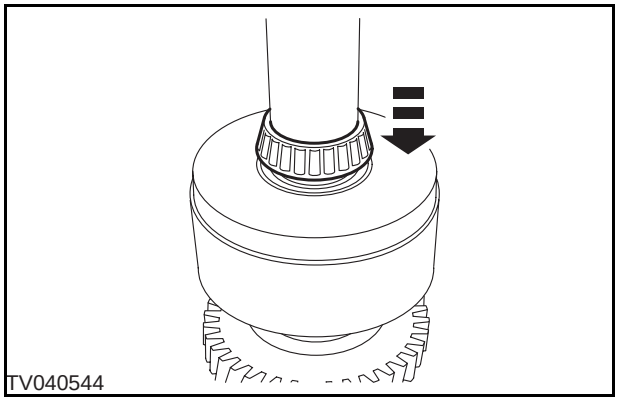

TV040545

15. Using the appropriate bearing puller **FER.001 (KM3003)** and removable collet **FER.004 (KM3516)** , remove the front bearing.


TV040540

Assembly

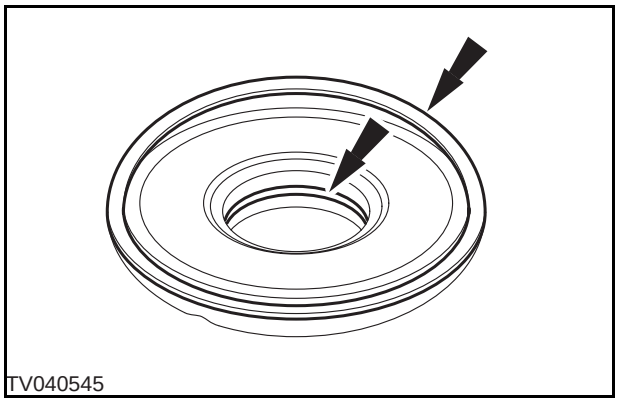
1. Using a suitable hydraulic press and an appropriately sized tube, install the front bearing.


TV040544

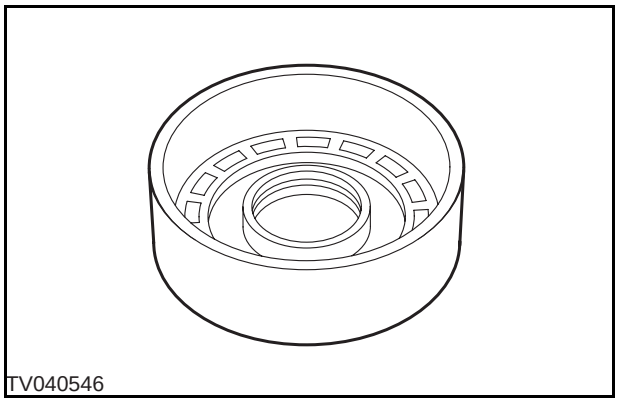
2. Install new piston sealing rings.

   Note:
   - To assist assembly, the piston inner and outer oil seals may be warmed in lukewarm water prior to assembly.

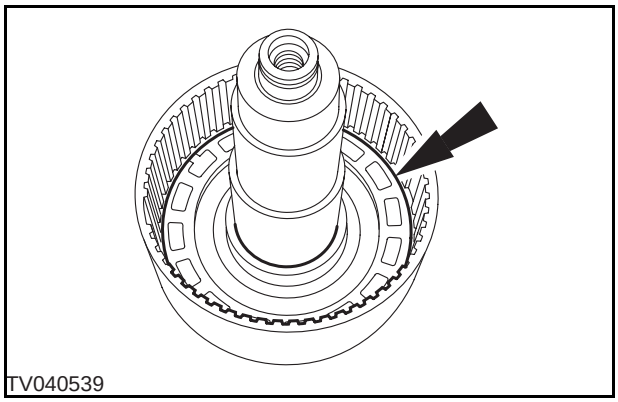
   Note:
   - The outer oil seal must be fitted with the open edge facing away from the clutch pack.


TV040545

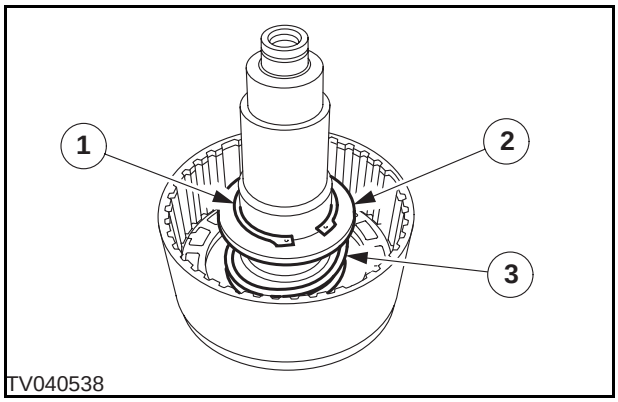
3. Using the appropriate tool **FER.003 (KM3510)** , compress the piston outer oil seal. The piston should be left in the tool for a minimum of 30 minutes prior to installing the piston into the clutch housing.


TV040546

4. Install the clutch piston.

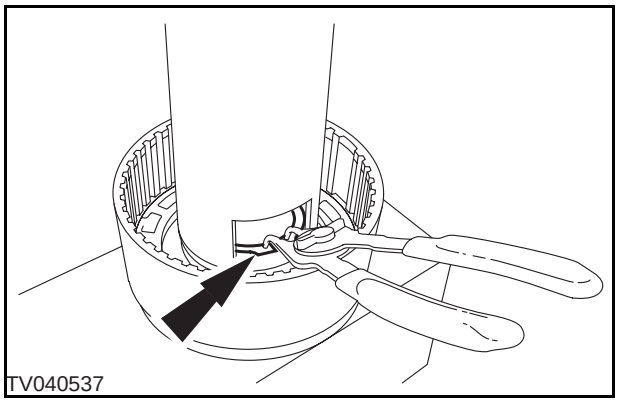

TV040539

5. Install the spring (3), retainer (2) and the circlip (1).



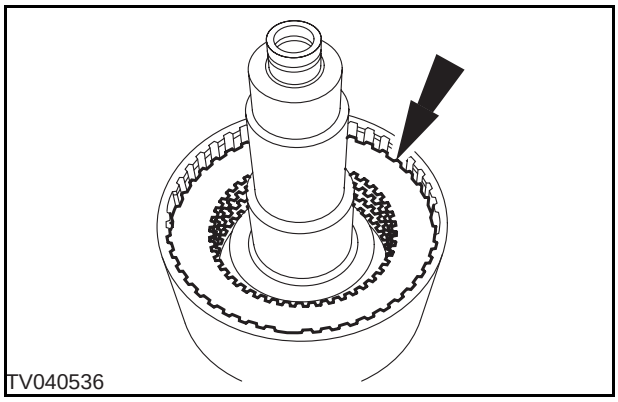
TV040538

6. Using the appropriate tool **KM3521** , and a suitable hydraulic press, compress the piston return spring and locate the circlip into its groove.

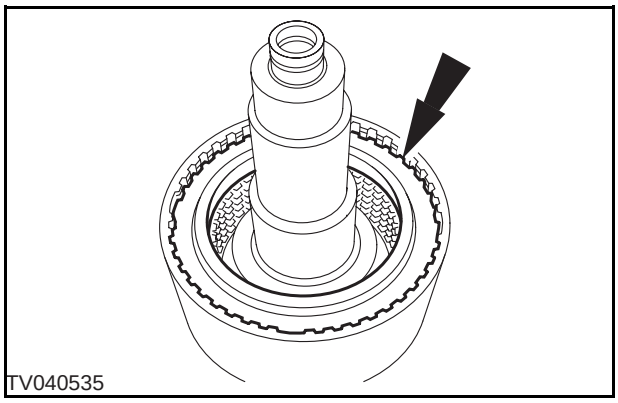

TV040537

Note:
- Soak new friction discs in transmission oil before assembly.

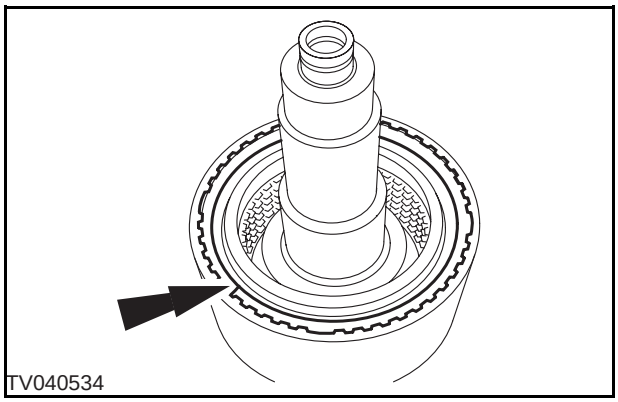
7. Install eight plain clutch plates (externally splined) and eight friction clutch plates (internally splined) alternately.


TV040536

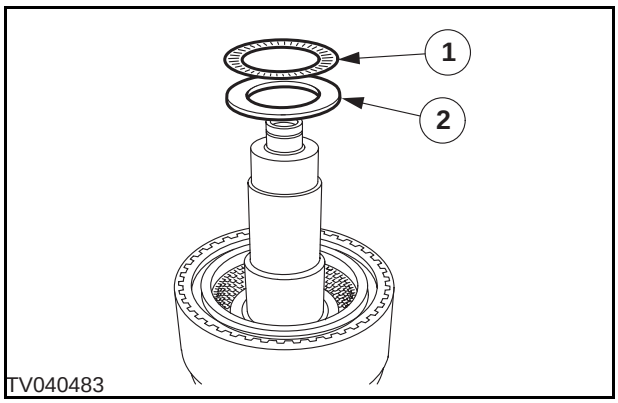
8. Install the clutch pack end plate.


TV040535

9. Install the clutch pack retaining ring.

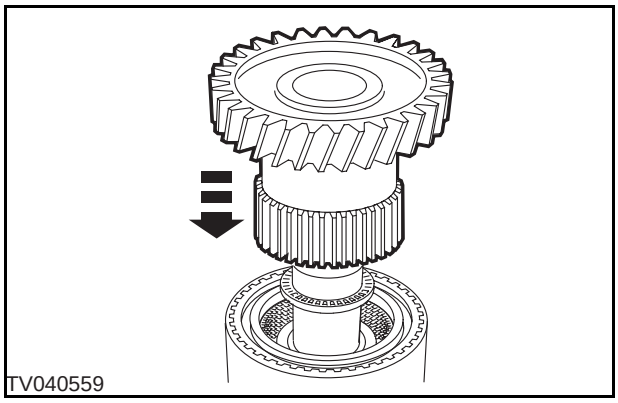

TV040534

10. Install the thrust washer (2) and the needle bearing (1).

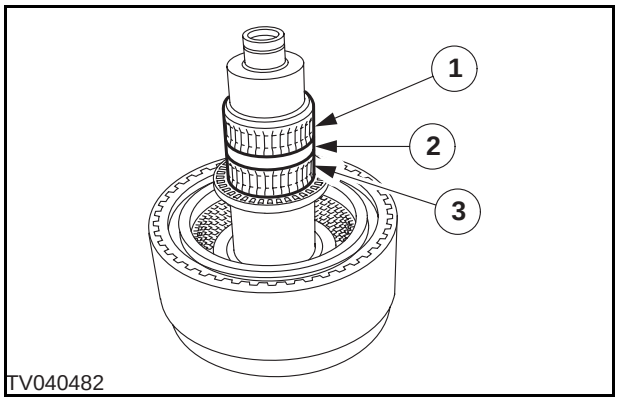


TV040483

11. Install the four-wheel drive gear.

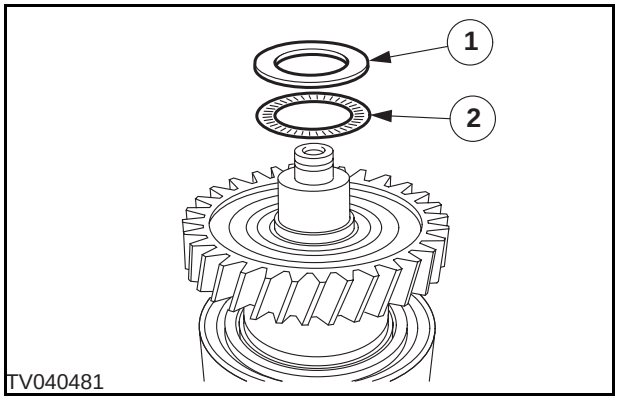

TV040559

12. Install the needle roller bearing (3), spacer (2) and the needle roller bearing (3).



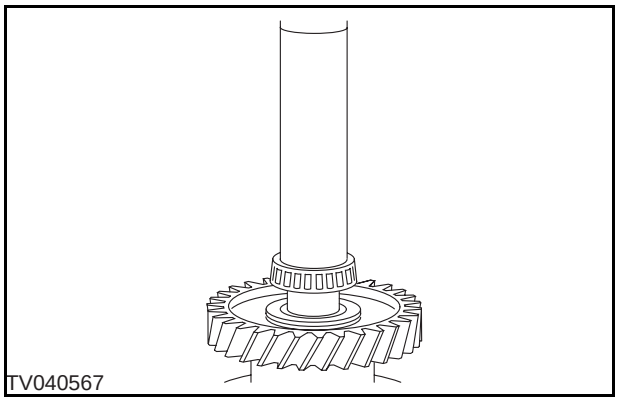
TV040482

13. Install the thrust bearing (2) and the thrust washer (1).



TV040481

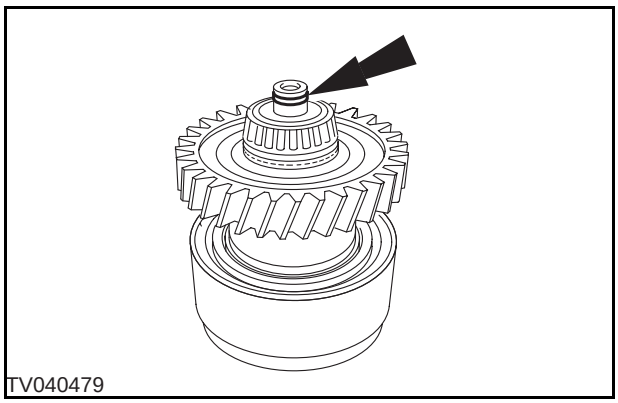
14. Using a suitable hydraulic press and an appropriately sized tube, install the rear bearing.


TV040567

Note:

- To avoid damage, the sealing ring should be left off until all shimming operations have been completed.

15. Install a new sealing ring and lubricate with a light grease.


TV040479

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DISASSEMBLY AND ASSEMBLY — DIRECTION CONTROL VALVE

BHN1302DH

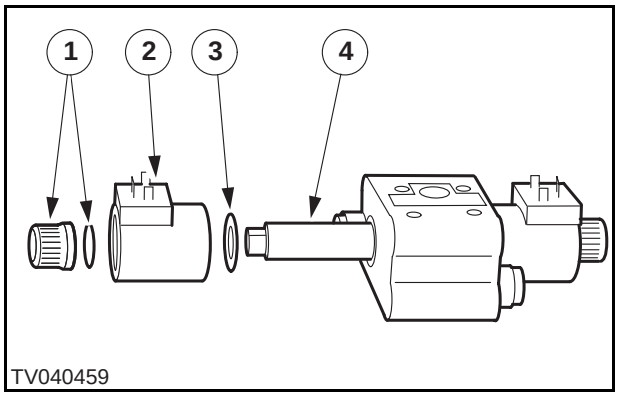
Operation: **Disassembly and Assembly of the Direction Control Valve**	*Job Code:* **13 51 17 xx**		
None	Standard tools		

Disassembly

Note:
- Disassembly of the control valve is not generally recommended as, with the exception of the solenoids, individual parts are non serviceable. It may however be dismantled for cleaning and examination.

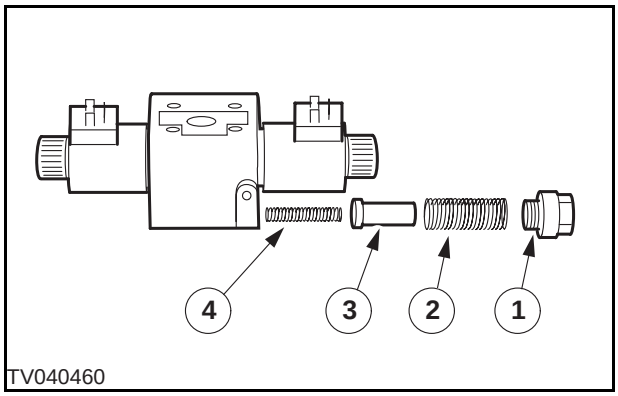
1. Remove the direction control solenoid coil retaining nut (1), the solenoid coil (2), washer (3) and the direction control valve (4).

Note:
- Remove and discard the O-ring oil seal.



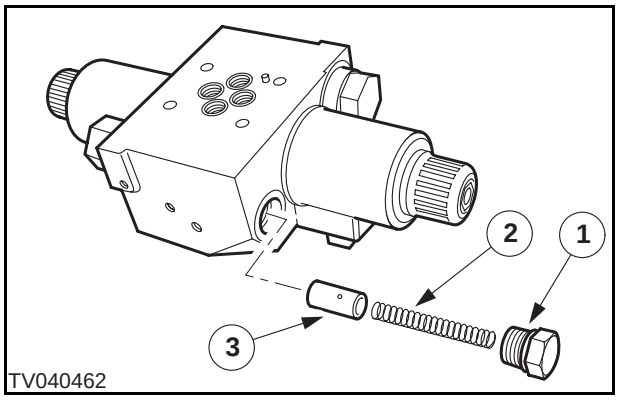
TV040459

2. Remove the modulation valve cap (1), the spring (2), the modulation valve (3) and the spring (4).



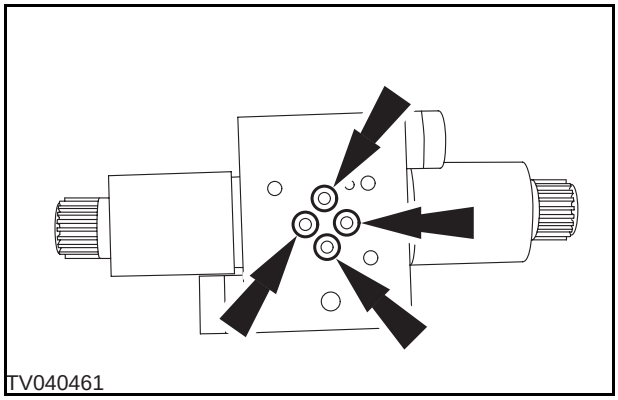
TV040460

3. Remove the valve cap (1), the spring (2) and the valve (3).



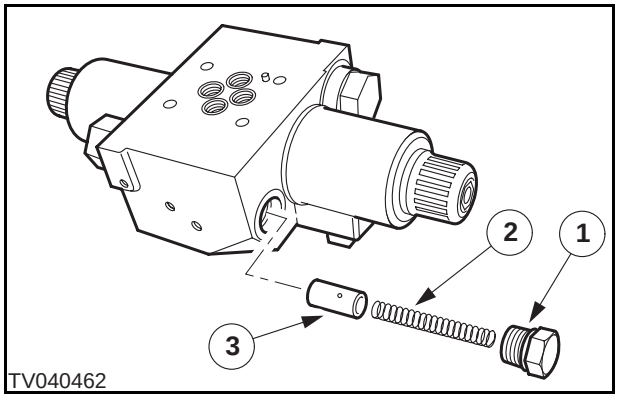
TV040462

4. Remove and discard the O-ring oil seals.

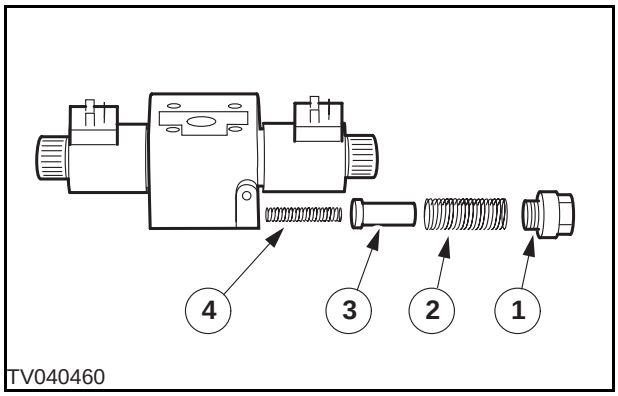

TV040461

Assembly

1. Install the valve (3) the spring (2), and the valve cap (1).

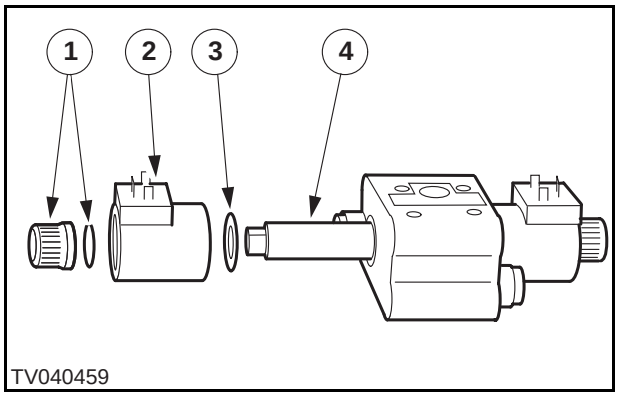


2. Install the spring (4), the modulation valve (3), the spring (2) and the modulation valve cap (1).

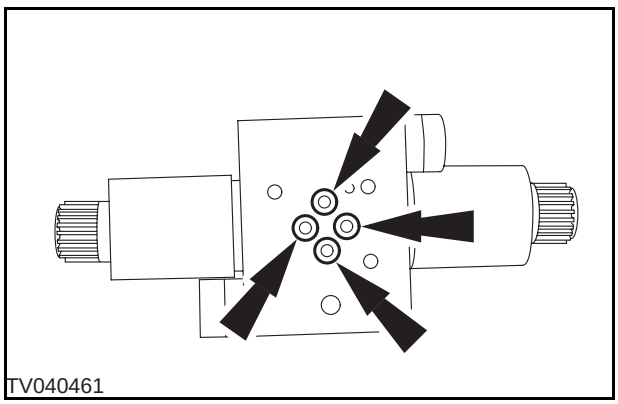


Note:
- Install a new O-ring oil seal.

3. Install the direction control valve (4), the washer (3), the solenoid coil (2) and the solenoid coil retaining nut (1).



4. Install new O-ring oil seals.

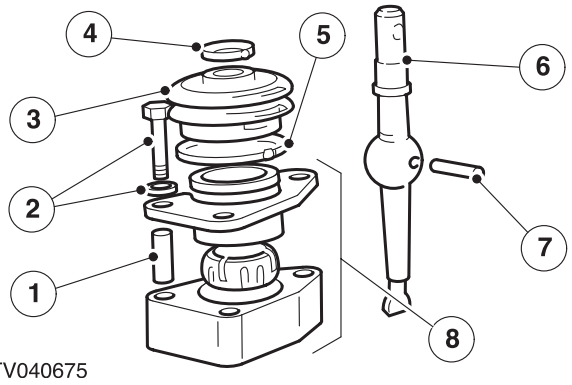


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DISASSEMBLY AND ASSEMBLY — GEAR LEVER HOUSING

BHN1302DJ

Operation: **Disassembly and Assembly of the Gear Lever Housing**	*Job Code:* **13 32 17 xx**		
None	Standard tools		



TV040675

1	Spacer
2	Bolt and Washer
3	Rubber Boot
4	Clip
5	Clip
6	Gear Stub Lever
7	Pin
8	Gear Lever Seating

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SPECIFICATIONS — SYNCHROSHIFT TRANSMISSION

BHN1302SA

General Information

Transmission	SynchroShift
Make	Turner
Model	COM-T4-2032
Fermec P/N	6108873M91
Torque Converter Stall Ratio	3.01:1
Pump Pressure	13.5 – 15.5bar
Clutch Pressure	12.5 – 15.5bar
Torque Converter Safety Valve Pressure	6.5 – 7.5bar
Lubrication Pressure	0.5 — 2.5bar

Recommended Lubricants

10W or 10W 30 Grade mineral oils or automatic transmission fluids which meet at least one of the following specifications are allowable for use in ambient temperatures of between -20 and 40 Degrees Celsius
A.P.I. GL4, Allison C3, MIL-L-2105B, or Caterpillar TO2.
The following lubricants meet these requirements:

Note:

- This list has been compiled for guidance only . Turner Powertrain or the appropriate oil company should be consulted on any specific application.

Oil Company	A.T.F.	Mineral Oil
Mobil	—	Delvac 1310 or Mobilube HD 80
Shell	Donax TM or TA	Donax TC 10W
B.P.	Autran MBX	Vanellus C3 10W
Esso	Torque Fluid 56	Unifarm
Castrol	—	Castrol RX 10 or Multiplant
Texaco	Texamatic C3, 9230 or 9226	—
Total	Total Fluid ATX	—
Elf	Elfmatic G3 or Elfmatic H	—
Fina	Finamatic HD	Kappa TD 10W

Capacity

System	Temperatures	Viscocity	Specification	Capacity	Notes
Synchroshift Transmission	ALL	10W	ATF	22 ltrs(Total System)	Check oil level with engine running at idle. Clean suction strainer at oil change.

Recommended Tube Sizes for Replacing Bearings

Bearing	Tube Bore	Tube O/D
Countershaft, Four-wheel drive shaft, Output shaft rear and Co-axial input shaft front bearing.	41mm	47mm
Reverse idler, Output shaft front and Input shaft bearing.	36mm	41mm
Output shaft 1st gear bearing sleeve and Co-axial input shaft rear bearing.	50.5mm	58mm

The dummy plug for installing inner detent spring and ball can be made using a piece of bar 18mm diameter x 25mm long.

Special Tools

Terex Tool No.	Churchill Tool No.	Description
FER.001	KM 3003	Bearing extractor, use with bearing removal collets.
FER.002	KM 3509	Input / reverse idler shaft bearing removal collet. Bearing Ref. 48548 Pt.No.9713
FER.003	KM 3510	Piston seal sizing ring. (Hydraulic multi plate four-wheel drive only)
FER.004	KM 3516	Four—wheel drive shaft front \ rear and co-axial input shaft front bearing removal collet. Bearing Ref. 32008 Pt.No.68609
FER.005	KM 3517	Output shaft front bearing removal collet. Bearing Ref. 32207 Pt.No.68116
FER.006	KM 3518	Countershaft and output shaft rear bearing removal collet. Bearing Ref. 33208 Pt.No.68608
—	KM 3519	Co-Axial input shaft rear bearing removal collet. Bearing Ref. 32010 Pt. No.68772
FER.008	KM 3520	Input shaft spring compressor
—	KM 3521	Four-wheel drive shaft spring compressor. (Hydraulic multi plate four-wheel drive only)
FER.007	KM 3522	Countershaft front bearing removal collet. Bearing Ref. 32208 Pt.No.65381
FER.009	KM 3523	Input shaft spring compressor
FER.011	KM 3524	Shimming Adapter

Shaft End Floats

All shaft end floats should be 0.025 to 0.075 mm. (0.001 to 0.003 ins.)

Gear End Floats

Gear	End Float
Input shaft forward and reverse primary gears	0.061 to 0.41 mm (0.0024” to 0.016”)
Output Shaft 4th Gear	0.20 to 0.56 mm (0.008” to 0.022”)
Output Shaft 3rd Gear	0.38 to 0.84 mm (0.015” to 0.033”)
Output Shaft 2nd Gear	0.36 to 0.56 mm (0.014” to 0.022”)
Output Shaft 1st Gear	0.33 to 0.51 mm (0.013” to 0.020”)
Four-Wheel Drive Output gear	0.051 mm. to 0.28 mm (0.002” to 0.011”)

Torque Values

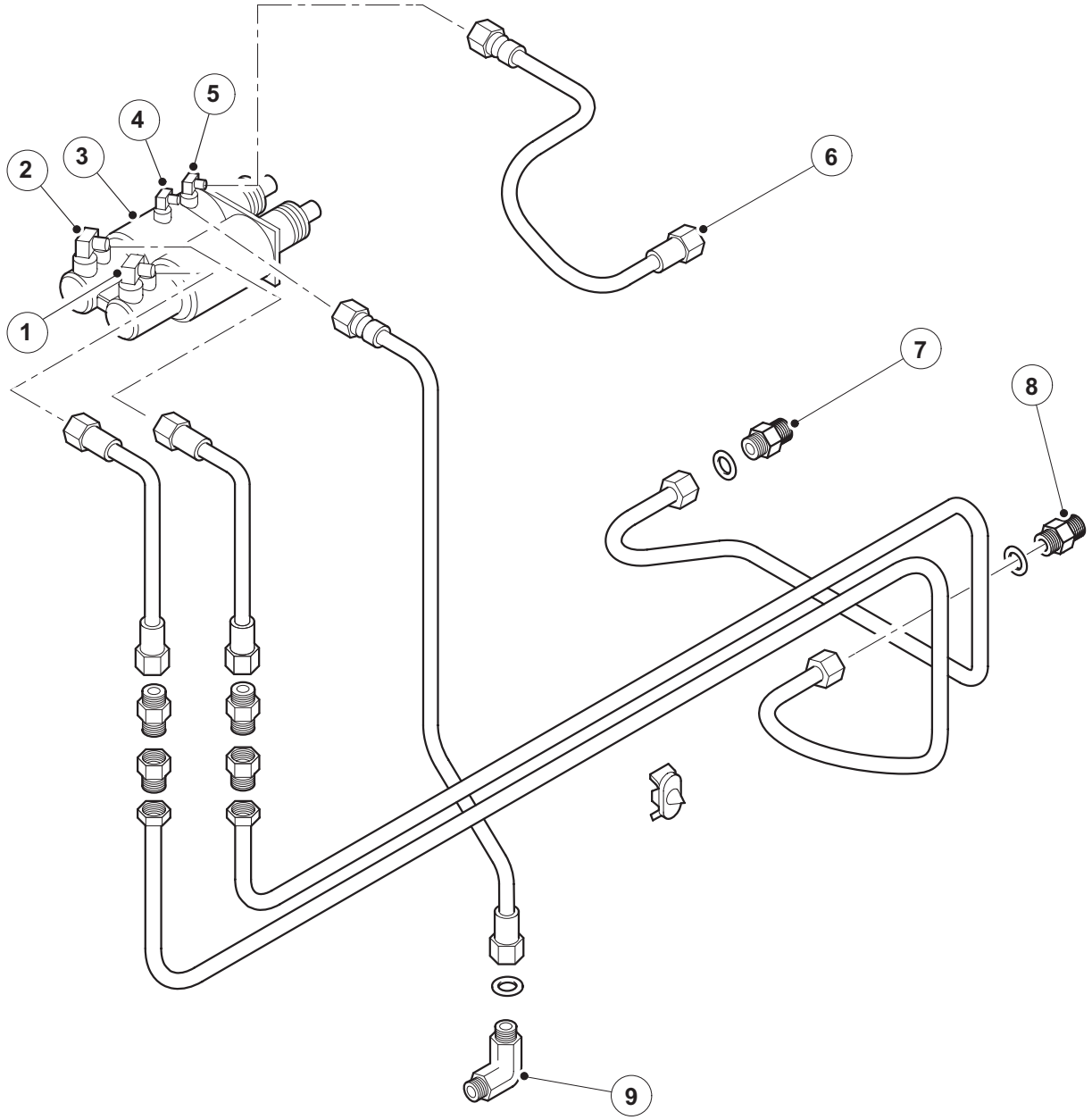
Description	Nm	Lb.ft
Transmission to engine	71	52
Torque converter	41	30
Hydraulic oil pump	98	72
Gear selector lever	58	43
Differential lock control valve	12	9
Front prop shaft	47	35
Rear prop shaft	47	35
Transmission oil pump	18 — 31	13 — 23
Shift rod detent plug	47	35
Transmission housing	45 — 64	33 — 47
Transmission drain plug	44	32
Pressure test ports	47	35
Four-wheel drive clutch supply pipe	5	4
Output shaft flange	78	58
Four-wheel drive output shaft flange	78	58
Cold start plug	53	39
Pressure regulator valve	53	39
Torque converter regulator valve	27	20
Temperature sender	24	18
Transmission control valve	7	5
Transmission oil strainer cover	25	18
Gear lever housing assembly	20	15
Filter housing	55	41
Oil filter	9	7
Four-wheel drive solenoid spool	25	18
Four-wheel drive solenoid coil	6	4
Torque converter adaptor plate	37	27

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DESCRIPTION AND OPERATION — HYDRAULIC BRAKING SYSTEM

BHN1303OA

Braking System Overview



TV040957

1	Rear Left Brake Outlet
2	Rear Right Brake Outlet
3	Brake Booster
4	Transmission Oil Reservoir Return
5	Transmission Oil Inlet
6	Brake Booster Supply Hose
7	Right Rear Brake Supply Hose
8	Left Rear Brake Supply Hose
9	Transmission Reservoir Return Hose

The braking system consists of two brake pedals that are independently linked to the brake booster (3). The brake booster contains two pistons that can operate independently to enable left wheel braking, right wheel braking or all wheel braking. The brake pedals can be linked together with the use of a latching plate.

The brake booster uses the same oil as the transmission. The oil is supplied under pressure from the transmission through hose (6) and into the brake booster transmission oil inlet (5), this pressurized oil increases the braking force exerted by the brake booster. The brake booster is also linked directly to the oil reservoir located in the transmission through hose (9) using the brake booster transmission oil reservoir return (4).

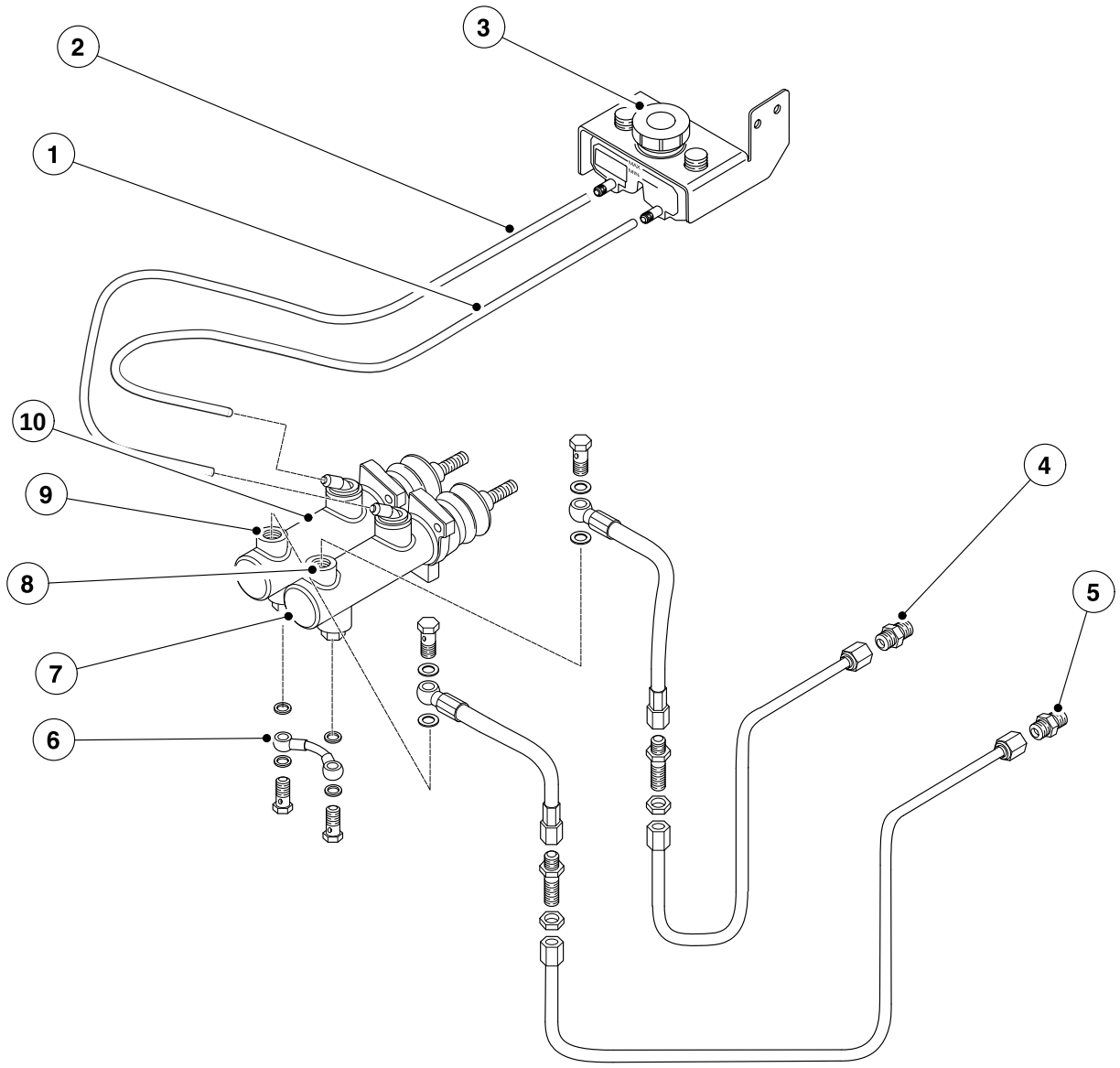
The pressurized oil is then supplied to the rear left or rear right brake discs (which are housed in the rear axle) through the brake booster outlets (1) and (2) to the rear axle brake connections. For additional information on the brake components contained in the rear axle, refer to Section N13-04 TWO–WHEEL STEER REAR AXLE or Section N13-05 FOUR-WHEEL STEER AXLE.

On machines with four-wheel drive, four-wheel braking is available. With this system no braking components are located in the front axle, instead the braking is achieved using the transmission by engaging four-wheel drive.

DESCRIPTION AND OPERATION — HYDRAULIC BRAKING SYSTEM SAFIM

BHN1303OB

Braking System Overview



TV074020

1	Left Brake Fluid Reservoir Hose
2	Right Brake Fluid Reservoir Hose
3	Brake Fluid Reservoir
4	Right Brake Supply Union
5	Left Brake Supply Union
6	Brake Balance Pipe
7	Left Brake Master Cylinder
8	Left Brake Master Cylinder Outlet
9	Right Brake Master Cylinder Outlet
10	Right Brake Master Cylinder

The braking system consists of two brake pedals that are independently linked to there own master cylinders. These brake master cylinders contain pistons that operate independently to enable left

wheel braking, right wheel braking or all wheel braking on 4WD models. The brake pedals can be linked together with the use of a latching plate.

The braking system uses its own oil contained in a separate reservoir. This oil is supplied from the reservoir to the master cylinders.

The oil is then supplied to the rear left or rear right brake discs (which are housed in the rear axle) through the master cylinder outlets to the rear axle brake connections. For additional information on the brake components contained in the rear axle, refer to Section N13-04 TWO–WHEEL STEER REAR AXLE or Section N13-05 FOUR-WHEEL STEER AXLE.

On machines with four-wheel drive, four-wheel braking is available. With this system no braking components are located in the front axle, instead the braking is achieved using the transmission by engaging four-wheel drive.

REMOVAL AND INSTALLATION — MASTER CYLINDER (POWER BRAKES)

BHN1303RA

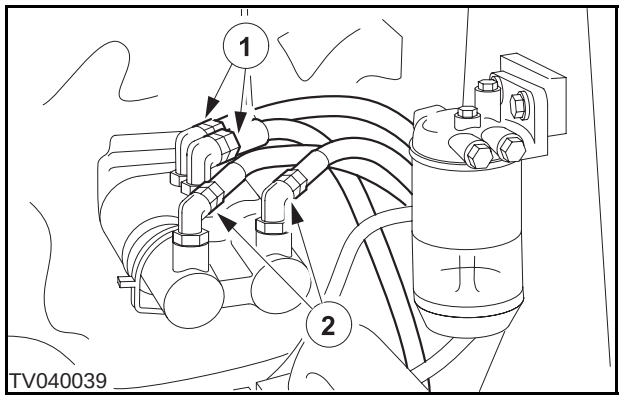
Operation: **Removing and Installing the Master Cylinder (Power Brakes)**	*Job Code:* **13 06 13 xx**		
None	Standard tools		

Removal

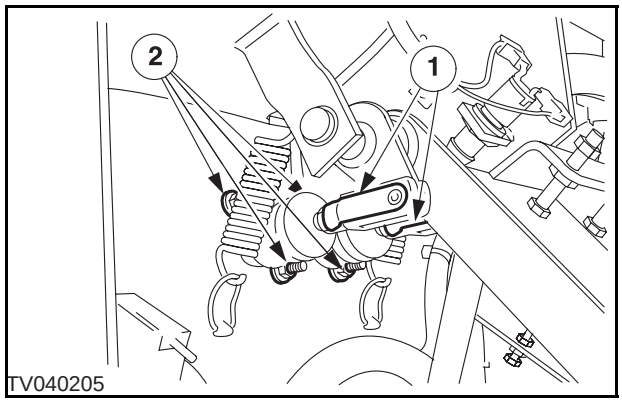
Note:
- Make a note of the position of the hydraulic hoses prior to disconnection to aid installation.

Note:
- Install blanking plugs to avoid contamination.

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the air cleaner. For additional information, refer to Section P14-01 AIR CLEANER, PAGE P14–01–33 .
3. Disconnect the master cylinder supply and return hoses from the master cylinder (1).
4. Disconnect the left-hand and right-hand brake supply hose from the master cylinder (2).



5. Disconnect the clevis from the brake pedals (1).
6. Remove the brake master cylinder (2).



Installation

Note:
- Make sure there is 1.5mm of clearance between the Push rods and the Master cylinder.

1. To install, reverse the removal procedure.

2. Bleed the braking system. For additional information, refer to BRAKE BLEEDING (POWER BRAKES), PAGE N13–03–19 in this section.
3. Check and adjust the transmission oil level as required.

REMOVAL AND INSTALLATION — MASTER CYLINDER (SAFIM BRAKES)

BHN1303RF

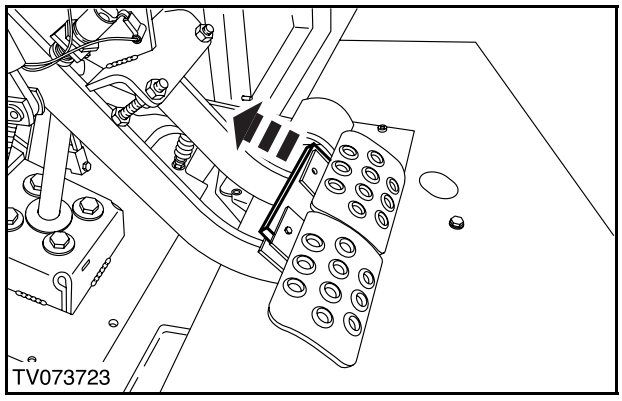
Operation: **Removing and Installing the Master Cylinders (Safim Brakes)**	*Job Code:* **xx xx x xxx**		
None	Standard tools		

Removal

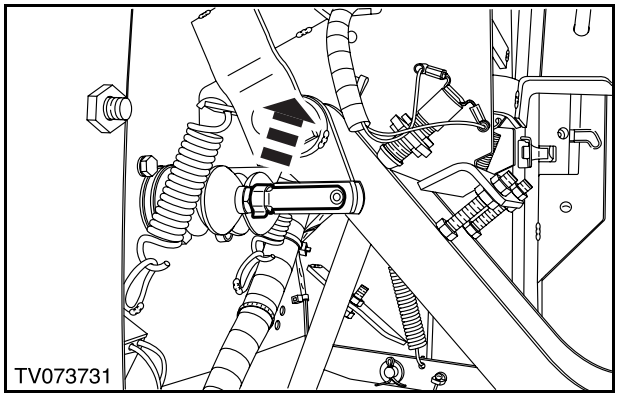
1. Park the machine on firm, level ground.

   ⚠ **Warning:**
   - **Place suitable wheel chocks against the wheels to prevent vehicle movement. Failure to follow this instruction may result in personal injury.**

2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the brake fluid reservoir. For additional information, refer to Brake Fluid Reservoir, PAGE N13–03–11 in this section.
4. Remove the heater air ducting. For additional information, refer to Section 08-01 HEATER AIR DUCTING, PAGE H08–01–13 .
5. Unlatch the brake pedals.


TV073723

6. Remove the clevis pin from the left hand brake pedal.

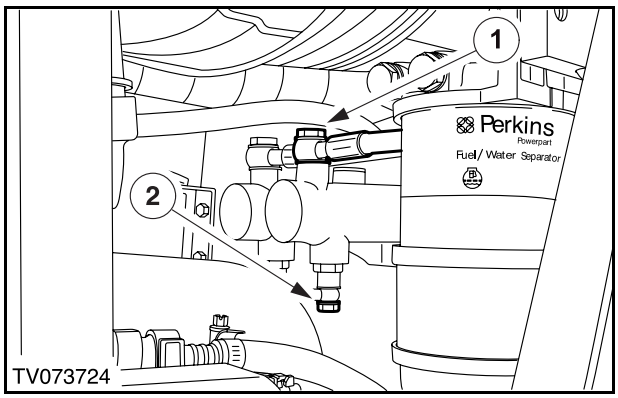

TV073731

⚠ **Caution:**
- **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

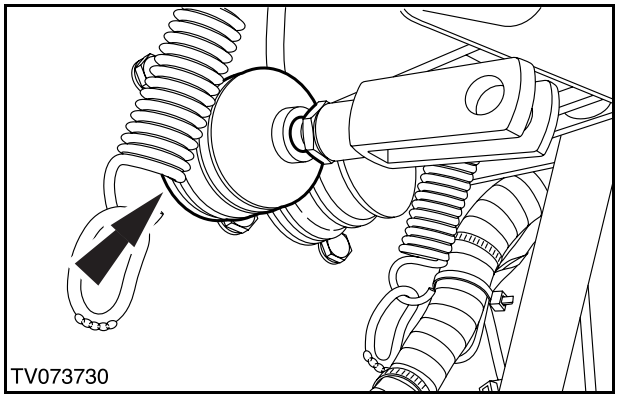
Note:
- Make a note of the position of the hoses prior to disconnection to aid installation.

Note:
- Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

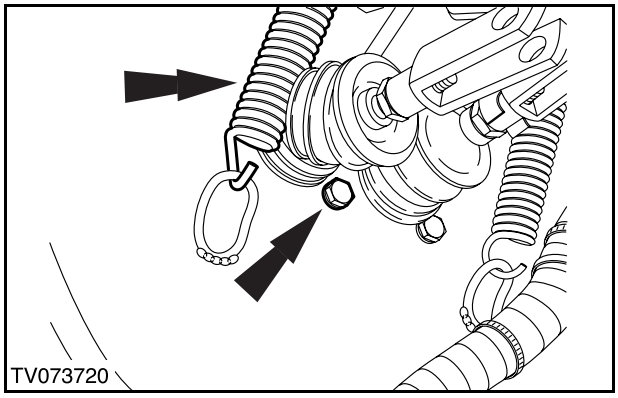
7. Disconnect the left rear brake hose (1) and the brake balance pipe (2).



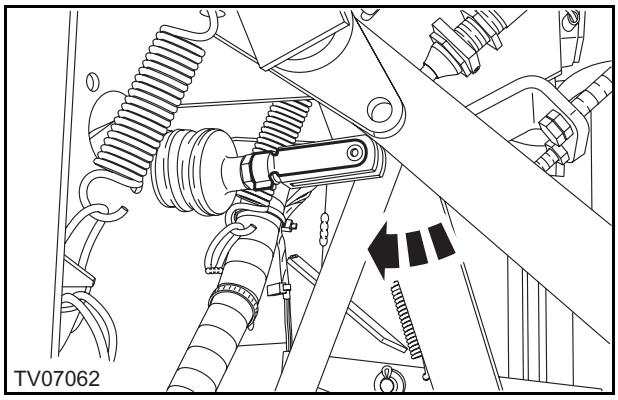
8. Detach and reposition the rubber gaiter.



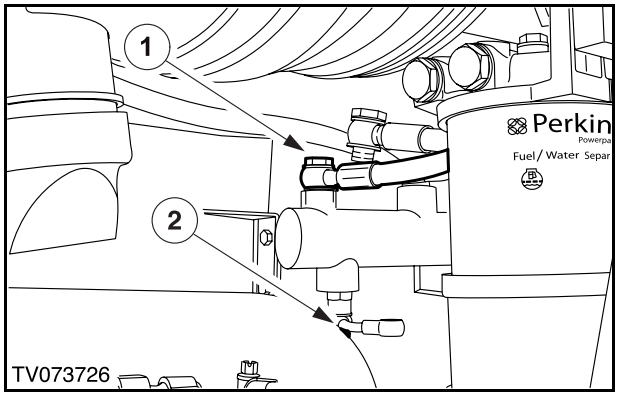
9. Remove the left master cylinder.



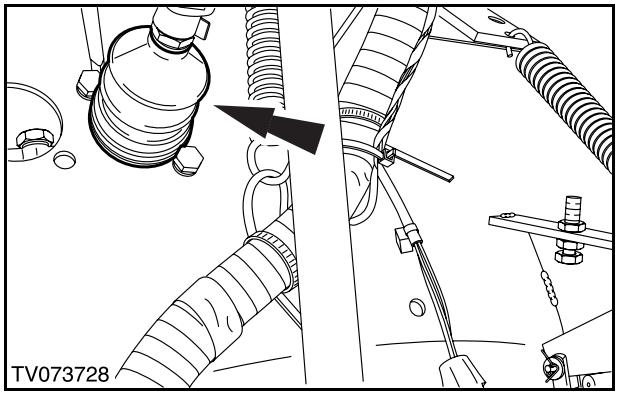
10. Detach the right hand clevis pin.
11. Press the left hand pedal and hold down.



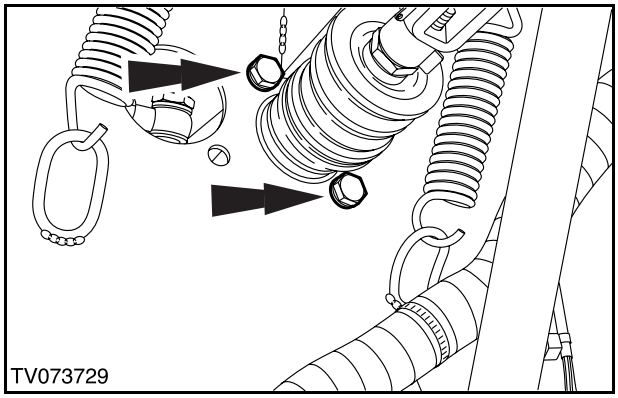
12. Remove the clevis pin.
13. Disconnect the right rear brake hose (1) and remove the brake balance pipe (2).



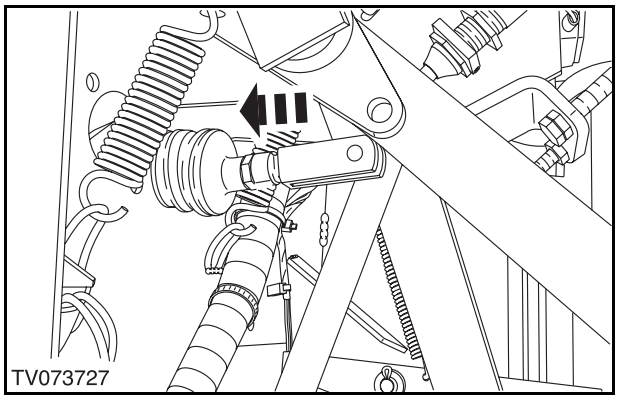
14. Detach and reposition the rubber gaiter.



15. Remove the right master cylinder retaining bolts.



16. Remove the right master cylinder.



17. Remove the brake fluid reservoir hoses.

Installation

Note:

- If a new master cylinder is to be used the bellows must installed from the old master cylinder.

1. To install, reverse the removal procedure.
2. Bleed the braking system. For additional information, refer to BRAKE BLEEDING Safim Brakes in this section.

REMOVAL AND INSTALLATION — BRAKE FLUID RESERVOIR (SAFIM BRAKES)

BHN1303RG

Operation: **Removing and Installing the Brake Fluid Reservoir (Safim Brakes)**	*Job Code:* **xx xx xx xx**		
None	Standard tools		

Removal

1. Park the machine on firm, level ground.

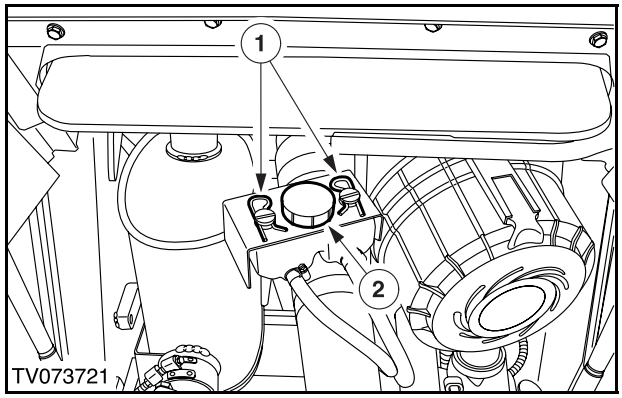
⚠ Warning:
- **Place suitable wheel chocks against the wheels to prevent vehicle movement. Failure to follow this instruction may result in personal injury.**

Note:
- Make a note of the position of the hoses prior to disconnection to aid installation.

⚠ Caution:
- **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

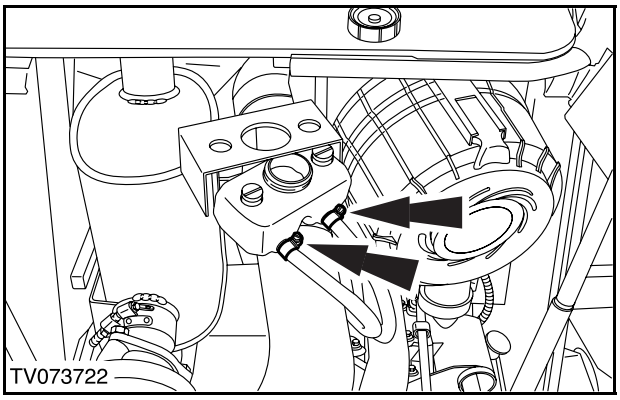
Note:
- Install blanking plugs to avoid contamination.

2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the retaining -clips (1) support the brake fluid reservoir and remove the filler cap (2).



4. Collect the brake fluid in a suitable container and dispose of the fluid in an appropriate manner.

5. Disconnect the hoses.



6. Remove the brake fluid reservoir.

Installation

1. To install, reverse the removal procedure.
2. Bleed the braking system. For additional information, refer to BRAKE BLEEDING Safim Brakes, PAGE N13–03–19 in this section.

REMOVAL AND INSTALLATION — PARKING BRAKE CALIPER

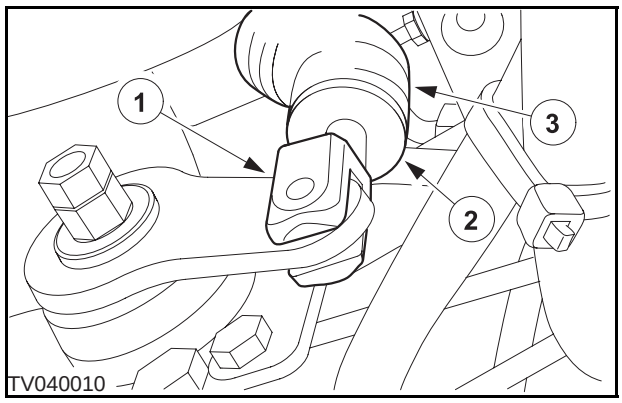
BHN1303RC

Operation: **Removing and Installing the Parking Brake Caliper**	*Job Code:* **13 07 13 xx**		
Suitable wheel chocks	Standard tools		

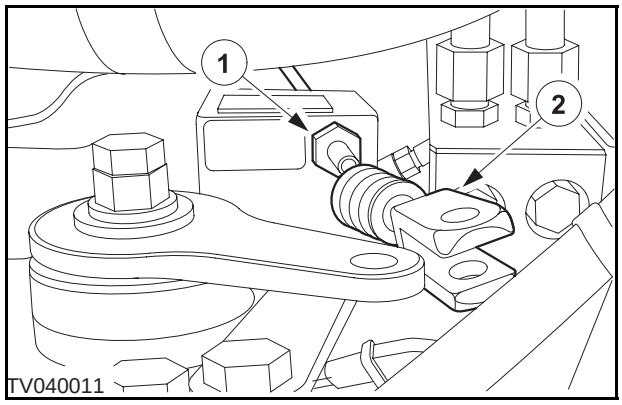
Removal

⚠ Warning:
- **Place suitable wheel chocks against the wheels to prevent vehicle movement. Failure to follow this instruction may result in personal injury.**

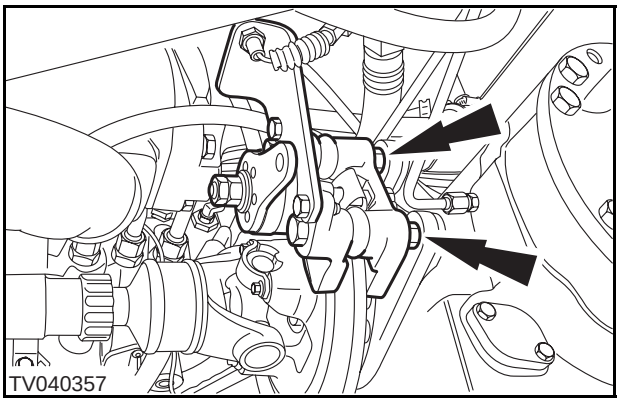
1. Isolate the battery ground cable. For additional information, refer to section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Remove the parking brake cable retaining clip (1).
3. Remove the parking brake return spring retainer (2).
4. Remove the parking brake return spring (3).



5. Remove the parking brake cable adjustment nut (1).
6. Detach the parking brake cable (2).



7. Remove the parking brake caliper.



Installation

1. To install, reverse the removal procedure.
2. Adjust the parking brake. For additional information, refer to the Operator's Manual.

REMOVAL AND INSTALLATION — PARKING BRAKE DISC

BHN1303RD

Operation: **Removing and Installing the Parking Brake Disc**	*Job Code:* **13 08 13 xx**		
None	Standard tools, Suitable wheel chocks, Suitable container		

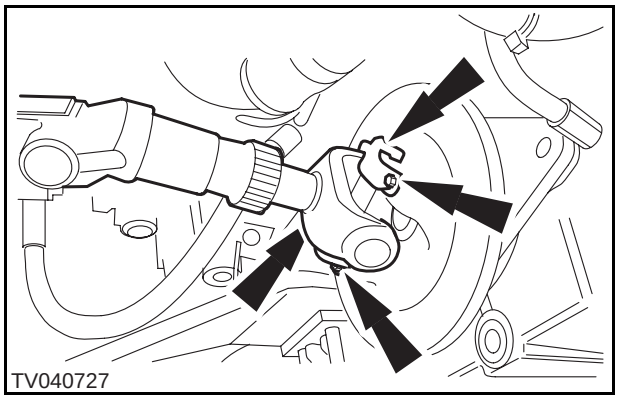
Removal

1. Remove the parking brake caliper. Refer to PARKING BRAKE CALIPER, PAGE N13–03–15 in this section.
2. Drain the rear axle oil into a suitable container.

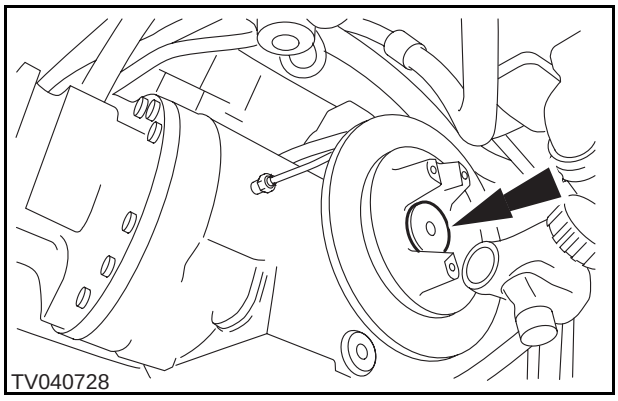
   ⚠ Caution:
   - **Secure the universal joint bearing cups to prevent contamination or damage.**

   Note:
   - Remove and discard the retaining bolts.

3. Disconnect the propeller shaft from the parking brake disc and secure it to one side.


TV040727

4. Remove the circlip and remove the parking brake disc.


TV040728

Installation

1. To install, reverse the removal procedure.

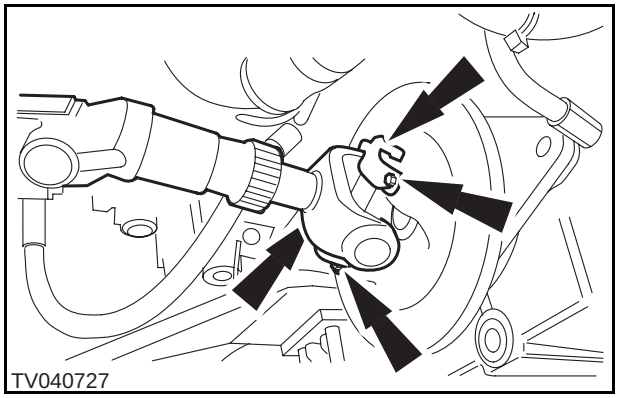
⚠ **Caution:**

- **Make sure the propeller shaft universal joints are in line. Failure to follow this instruction may result in damage to the machine.**

Note:

- Install new retaining bolts.

2. Tighten to 47Nm (35 lb.ft).



REMOVAL AND INSTALLATION — DIFFERENTIAL LOCK SOLENOID VALVE

BHN1303RE

Operation: **Removing and Installing the Differential Lock Solenoid Valve**	*Job Code:* **13 02 13 xx**		
None	Standard tools		

Removal

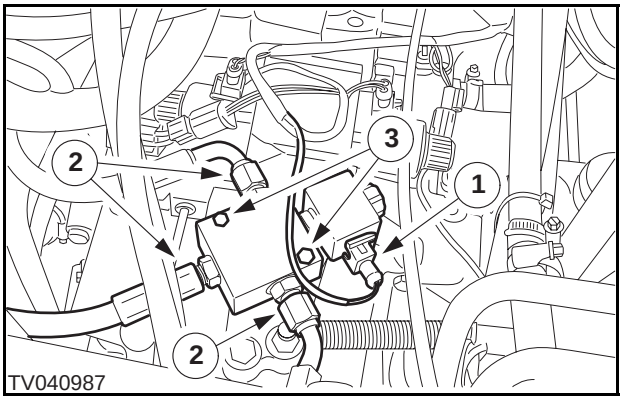
1. Remove the cabin heater air ducting. For additional information, refer to Section H08-01 CABIN HEATER AIR DUCTING, PAGE H08–01–13 .
2. Disconnect the differential lock solenoid valve electrical connector (1).

   Note:
   - Make a note of the position of the hydraulic hoses prior to disconnection, to aid installation.

3. Disconnect the hydraulic hoses (2) from the differential lock solenoid valve.

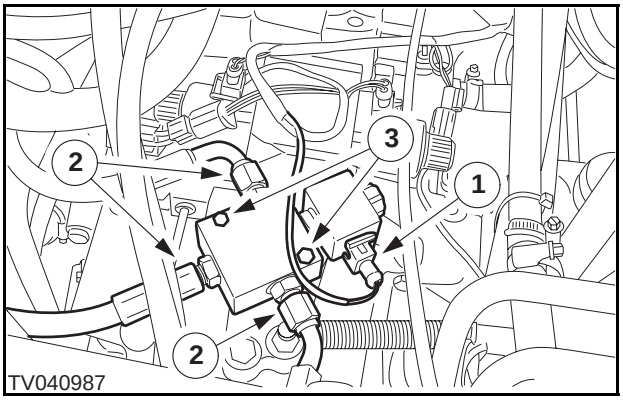
   Note:
   - Install blanking plugs to avoid contamination.

4. Remove the differential lock solenoid valve (3).



Installation

1. To install, reverse the removal procedure.
2. Tighten (3) to 12Nm.
3. Check and adjust the transmission oil level as required.



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GENERAL PROCEDURE — BRAKE BLEEDING POWER BRAKES

BHN1303GA

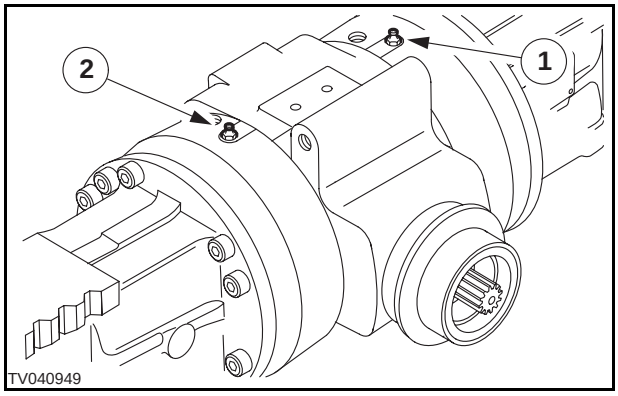
Operation: **Brake Bleeding**	*Job Code:* **13 04 09 xx**		
None	Standard tools, Suitable clear tubing, Suitable container		

Bleeding

⚠ Warning:

- **This procedure will require being under the machine while the engine is running and the brake pedals are being depressed. Apply the parking brake, chock the wheels and make sure the machine remains in neutral during this procedure. Failure to follow these instructions may result in personal injury.**

1. Start the engine and run at idle speed.
2. Connect a suitable piece of clear tubing to the left hand brake bleed nipple (1) on the rear axle and place the other end into a suitable container.
3. Connect a suitable piece of clear tubing to the right hand brake bleed nipple (2) on the rear axle and place the other end into a suitable container.



4. Remove the cab front mat to allow full brake pedal(s) travel.

   Note:
   - Make sure the brake pedals are latched together.

5. Press both brake pedals 10 times to purge the brake booster.
6. Unlatch the brake pedals.
7. Open the right hand bleed nipple (2) and press the right hand brake pedal until fluid is flowing from the bleed nipple.
8. Close the right hand bleed nipple (2).
9. Press the right hand brake pedal 10 times to build up a hard pedal and hold the pedal down on the final press.

Note:

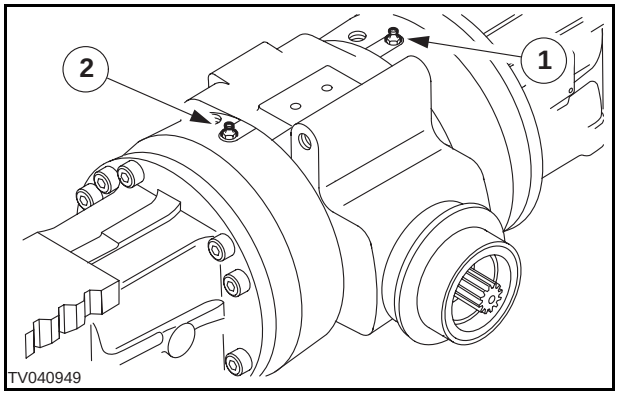
- As the bleed nipple is opened the pedal will go to the floor. Do not apply excessive pressure to the pedal because the tubing may detach from the bleed nipple.

10. Open the right hand bleed nipple (2) to free the trapped air and with the pedal now on the floor, close the right hand bleed nipple (2).
11. Repeat steps 9 and 10 a further 5 times.
12. Repeat steps 7 to 11 to bleed the left hand brake.
13. Latch the brake pedals together.
14. Press both brake pedals 10 times to build up a hard pedal and hold the pedal down on the final press.

Note:

- As the bleed nipples are opened the pedal will go to the floor. Do not apply excessive pressure to the pedals because the tubings may detach from the bleed nipples.

15. Open both bleed nipples (1) and (2) to free the trapped air and with both pedals now on the floor, close the bleed nipples.
16. Repeat steps 14 and 15 a further 5 times.
17. Press the pedals and check the pedals do not travel beyond the position of the differential lock pedal.



GENERAL PROCEDURE — BRAKE BLEEDING SAFIM BRAKES

BHN1301GB

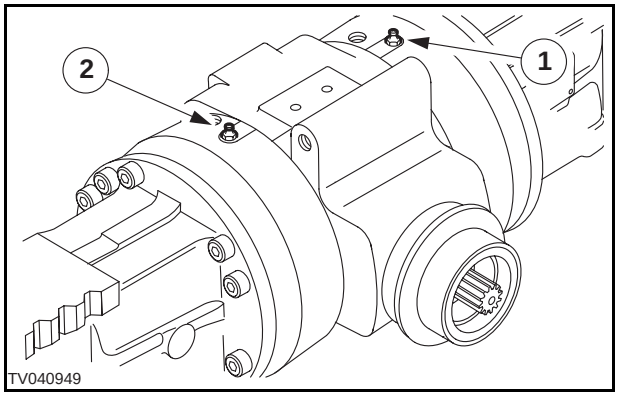
Bleeding

⚠ **Warning:**
- **Place suitable wheel chocks against the wheels to prevent vehicle movement. Failure to follow this instruction may result in personal injury.**

⚠ **Warning:**
- **Under NO circumstances allow conventional BRAKE FLUID to be added to the system, and never purge the system and refill with brake fluid. Otherwise damage will occur to all the rubber sealing components within the brake system. Use mineral based hydraulic oil only.**

Note:
- Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

1. Park the machine on firm, level ground.
2. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION .
3. Unlatch the brake pedals.
4. Connect a suitable length of tubing to the bleed nipple (1) and place the other end in a suitable container

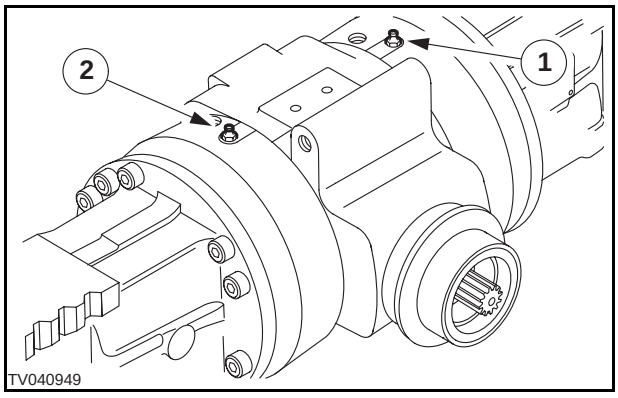


5. Remove the cab front mat to allow full brake pedal(s) travel
6. Open the bleed nipple (1).
7. Depress the left brake pedal and hold down

Note:
- Maintain the fluid level in the reservoir.

8. Tighten the bleed nipple.
9. Release the pedal , repeat steps 6 to 8 until all of the trapped air is released.

10. Then repeat the process for the right brake using bleed nipple (2).



11. After the brakes have been bleed relatch the brake pedals together.

SPECIFICATIONS — POWER BRAKES

BHN1303SA

General Information

Brakes	Oil Immersed Disk Type in the Rear Axle
Booster	Transmission Pressure Activated
Boost ratio	2.60:1
Master Cylinders Diameter	31.75mm (1 1/4”)
Master cylinder seals	Specific for Mineral Oil
Brake Disks	
Friction Discs (820–860)	2 Each Side
Friction Disks (970)	3 Each Side
Brake Piston Seals	Specific for Mineral Oil

Torque Values

Description	Nm	Lb.ft
Propeller Shaft Universal Joints	47	35
Master Cylinder Retaining Bolts	28	21
Parking Brake Caliper Retaining Bolt	150	111
Parking Brake Caliper Bracket Retaining Bolt	45	33
Parking Brake Caliper Flange	80	59

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SPECIFICATIONS — BRAKES - SAFIM

BHN1303SB

General Information

Brake fluid Safim brake system only

Type of oil to be used : Mobil LHM (mineral brake fluid)

Brakes	Oil Immersed Disk Type in the Rear Axle
Master Cylinders Diameter	31.75mm (1 1/4”)
Master cylinder seals	Specific for Mineral Brake Fluid
Brake Disks	
Friction Discs (820–860)	2 Each Side
Friction Disks (970)	3 Each Side
Brake Piston Seals	Specific for Mineral Brake Fluid

Service specifications

Fluid level check	Every 10 hours or every day
Fluid change	Every 500 hours
Type of oil	Mobil LHM (mineral brake fluid)
Oil capacity	225cc

Torque Values

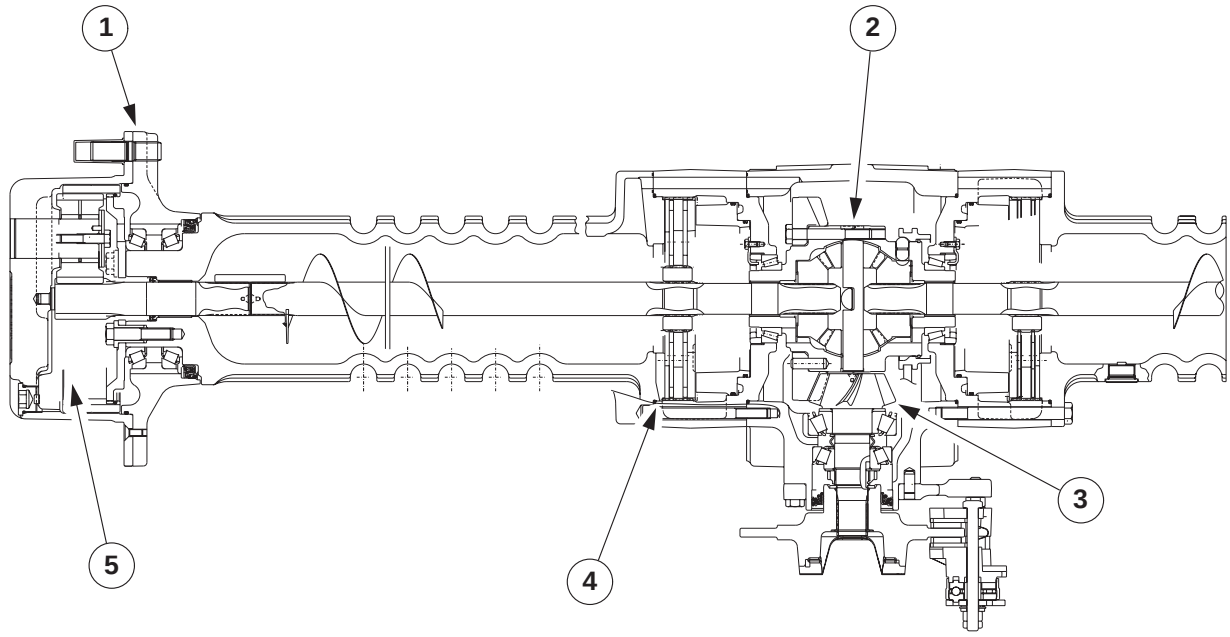
Description	Nm	Lb.ft
Propeller Shaft Universal Joints	47	35
Master Cylinder Retaining Bolts	28	21
Parking Brake Caliper Retaining Bolt	150	111
Parking Brake Caliper Bracket Retaining Bolt	45	33
Parking Brake Caliper Flange	80	59

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DESCRIPTION AND OPERATION — TWO-WHEEL STEER REAR AXLE

BHN1304OA

General Description



TV040948

1	Wheel Hub Group
2	Differential Group
3	Pinion Group
4	Half Shaft and Brake Group
5	Epicyclic Reduction Gear Group

The axle described in this manual, consists of a beam casing, housing the differential in the centre and a wheel hub unit at each end. The differential - mechanical lock, hydraulically controlled - is supported by two bearings mounted on a suitable structure allowing the bevel gear set to be adjusted.

The ring bevel gear is adjusted using two ring nuts located opposite each other. The position of the bevel pinion, supported by two bearings, is adjusted by installing adjusting shims. The wheel hubs containing the epicyclic reduction gears are supported by two tapered roller bearings.

The axle also has a braking system fitted with a hydraulic drive for service braking and mechanical control for the parking brake.

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DIAGNOSING AND TESTING — TWO-WHEEL STEER REAR AXLE

BHN1304TA

Problem	Possible Cause	Action
Ring gear tooth broken at the outer side	• Excessive gear load compared to the one foreseen.	• REPLACE crown wheel and pinion gear set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Incorrect gear adjustment (excessive backlash).	• REPLACE crown wheel and pinion gear set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Pinion nut loosened.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
Ring gear tooth broken side	• Load bump.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Incorrect gear adjustment (insufficient backlash).	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Pinion nut loosened.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
Pinion or ring gear teeth worn	• Insufficient lubrication.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.

Problem	Possible Cause	Action
Pinion or ring gear teeth worn (continued)	• Contaminated oil.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.
	• Incorrect lubrication or depleted additives.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.
	• Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.
Overheated ring and pinion teeth. Check if gear teeth have faded.	• Prolonged functioning at high temperatures.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
	• Incorrect lubrication.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
	• Low oil level.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
	• Contaminated oil.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
Axle beam body bent	• Vehicle overloaded.	• REPLACE axle beam body.
	• Vehicle accident.	• REPLACE axle beam body.
	• Load bump.	• REPLACE axle beam body.

Problem	Possible Cause	Action
Pinion teeth pitting	• Excessive wear.	• REPLACE crown wheel and pinion set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE crown wheel and pinion set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Worn out or pitted bearings	• Insufficient lubrication.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive wear.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive wear.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Pinion nut loosened.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Oil leakage from gaskets and seals	• Prolonged functioning at high temperature of the oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Oil gasket assembled incorrectly.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Seal lip damaged.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.

Problem	Possible Cause	Action
Excessive wearing out of input flange spline	• Heavy use.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE crown wheel and pinion set if required.
	• Pinion nut loosened.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE crown wheel and pinion set if required.
	• Pinion axle backlash.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE crown wheel and pinion set if required.
Fatigue failure of pinion teeth. Check if the fracture line is well defined (wave lines, beach lines)	• Heavy use.	• REPLACE crown wheel and pinion set.
	• Continuous overload.	• REPLACE crown wheel and pinion set.
Pinion and ring teeth breakage	• Crash load of differential components.	• CHECK and/or REPLACE other differeential components.
Side gear spline worn out. Replace all scratched washers (Excessive backlash)	• Excessive wear.	• REPLACE differential gear group. • REPLACE halfshaft if required.
Thrust washer surface worn out or scratched	• Insufficient lubrication.	• USE correct lubrication and FILL to right level. • REPLACE at recommended intervals. • REPLACE all scratched washers and those with 0,1 mm thickness lower than the new ones.
	• Incorrect lubrication.	• USE correct lubrication and FILL to right level. • REPLACE at recommended intervals. • REPLACE all scratched washers and those with 0,1 mm thickness lower than the new ones.
	• Contaminated oil.	• USE correct lubrication and FILL to right level. • REPLACE at recommended intervals. • REPLACE all scratched washers and those with 0,1 mm thickness lower than the new ones.

Problem	Possible Cause	Action
Inner diameter of tapered roller bearing worn out	• Excessive wear.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
	• Excessive pinion axial backlash.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
Bent or broken halfshaft	• Vehicle intensively operated or overloaded.	• REPLACE half shaft.
Halfshaft broken at wheel side	• Wheel support loosened.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.
	• Beam body bent.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.

Axle Problem and Diagnosis

Problem	Possible Cause	Action
Noise while driving	• Excessive backlash between pinion and ring gear.	• ADJUST.
	• Worn out pinion and gear ring.	• REPLACE.
	• Worn out pinion bearings.	• REPLACE.
	• Pinion bearings loosened.	• ADJUST.
	• Excessive axial pinion backlash.	• ADJUST.
	• Worn out differential bearings.	• REPLACE.
	• Differential bearings loosened.	• ADJUST.
	• Ring gear out of roundness.	• REPLACE.
	• Low Lubricant level.	• OIL level.
	• Poor or wrong lubricant.	• REPLACE.
	• Bent halfshaft.	• REPLACE.
Noise whilst driving in neutral	• Noise coming from axle is usually heard when vehicle moves in neutral gear but are not loud.	• REPLACE or ADJUST (see above).
	• Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed.	• REPLACE.
	• Pinion or input flange worn out.	• ADJUST.
Intermittent noise	• Ring gear damaged.	• REPLACE crown wheel and pinion set.
	• Differential box bolts loosened.	• TIGHTEN to torque.
Constant noise	• Ring gear teeth or pinion damaged.	• REPLACE crown wheel and pinion set.
	• Worn out bearings.	• REPLACE.
	• Pinion spline worn out.	• REPLACE.
	• Bent halfshaft.	• REPLACE.
Noise while steering	• Worn out differential gears.	• REPLACE.
	• Worn out differential box or spider.	• REPLACE.
	• Differential thrust washers worn out.	• REPLACE.
	• Halfshaft spline worn out.	• REPLACE.

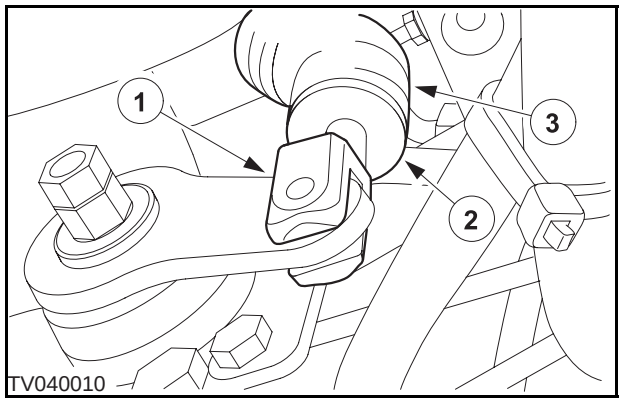
REMOVAL AND INSTALLATION — TWO WHEEL STEER REAR AXLE

BHN1304RA

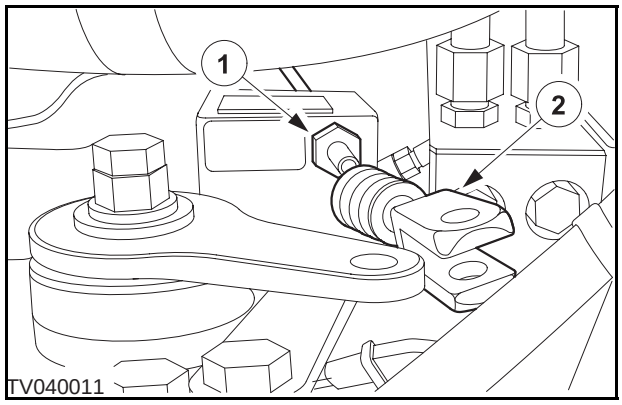
Operation: **Removing and Installing the Rear Axle**	*Job Code:* **13 52 13 xx**		
Suitable transmission jack	Standard tools		

Removal

1. Remove the rear wheels. For additional information, refer to Section M12-01 REAR WHEEL .
2. Isolate the battery ground cable. For additional information, refer to section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the parking brake cable retaining clip (1).
4. Remove the parking brake cable return spring retainer (2).
5. Remove the parking brake cable return spring (3).



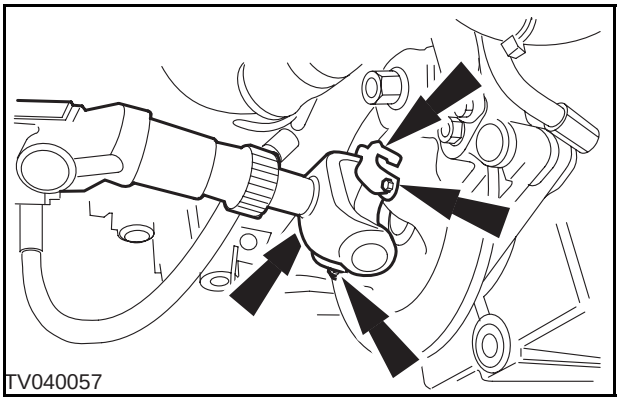
6. Remove the parking brake cable adjustment nut (1).
7. Detach the parking brake cable from the parking brake calliper (2).



⚠ **Caution:**
- **Secure the universal joint bearing cups to prevent contamination or damage.**

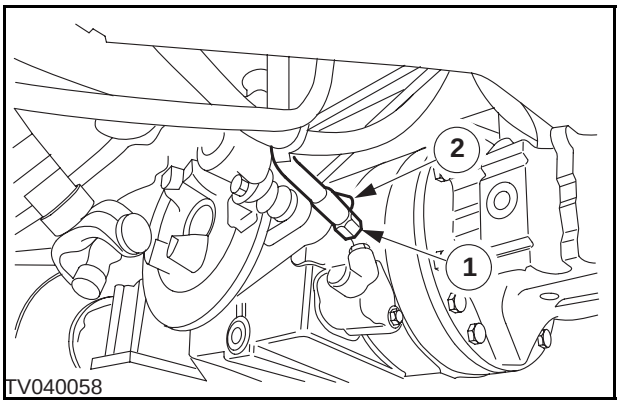
Note:
- Remove and discard the retaining bolts.

8. Detach the rear propeller shaft from the rear differential and secure it to one side.


TV040057

Note:
- Install blanking plugs to avoid contamination.

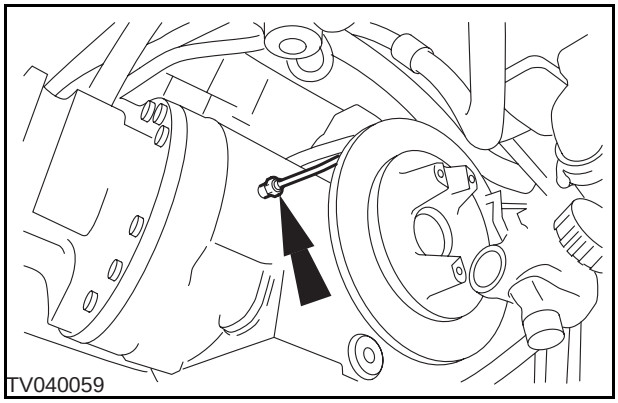
9. Disconnect the rear axle differential lock oil supply pipe (1).
10. Disconnect the rear axle left-hand inboard brake pipe (2).



TV040058

Note:
- Install blanking plugs to avoid contamination.

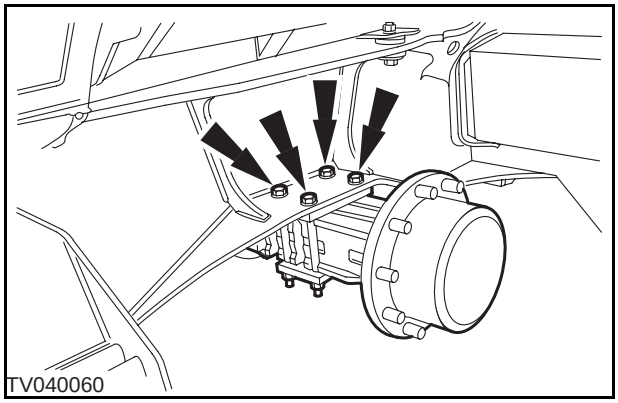
11. Disconnect the rear axle right-hand inboard brake pipe.


TV040059

⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

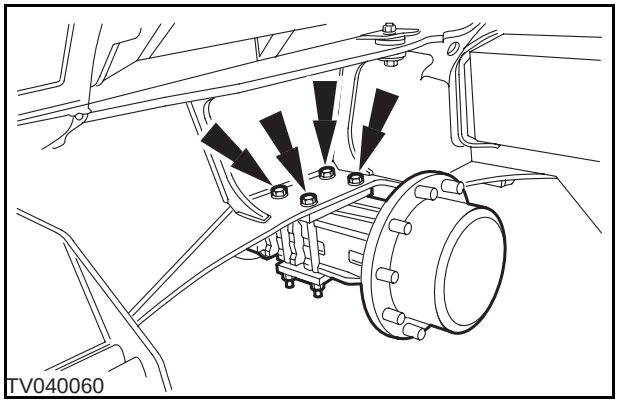
⚠ **Warning:**
- **Secure the rear axle to the transmission jack. Failure to follow this instruction may result in personal injury.**

12. Using a suitable transmission jack, support the rear axle.
13. Remove the rear axle retaining bolts and remove the rear axle (left-hand side shown, right-hand side similar



Installation

1. To install, reverse the removal procedure.
2. Tighten to 475Nm (35 lb.ft).



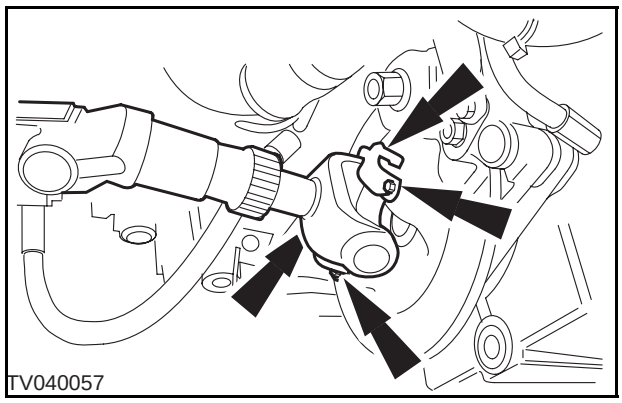
⚠ **Caution:**

- **Make sure the propeller shaft universal joints are in line. Failure to follow this instruction may result in damage to the machine.**

Note:

- Install new retaining bolts.

3. Tighten to 47Nm (35 lb.ft).

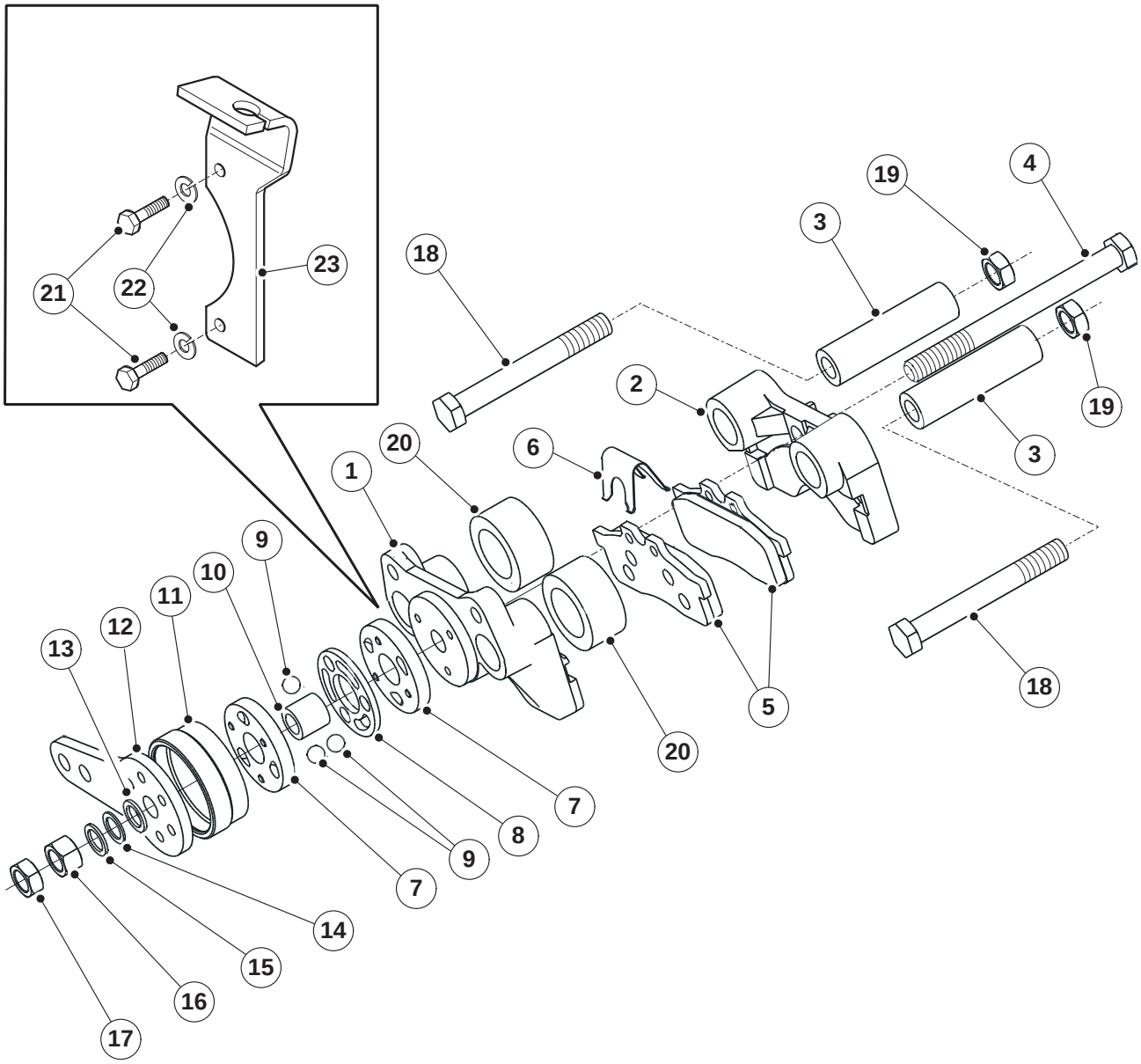

TV040057

4. Bleed the brakes. For additional information, refer to Section N13-01 BRAKE BLEEDING, PAGE N13–01–153 .
5. Adjust the parking brake. For additional information, refer to the Operator's Manual.

DISASSEMBLY AND ASSEMBLY — BRAKE CALIPER

BHN1304DA

Operation: **Disassembly and Assembly of the Brake Caliper**	*Job Code:* **13 12 17 xx**		
None	Standard tools		



TV040817

1	Front Torque Plate
2	Rear Torque Plate
3	Spacer
4	Adjustment Bolt
5	Brake Friction Pads
6	Spring Clip
7	Outer Cam
8	Inner Cam
9	Ball
10	Seal
11	Boot
12	Lever
13	Thrust Washer
14	Stainless Steel Washer
15	Hardened Washer
16	Adjustment Nut
17	Locking Nut
18	Mounting Bolt
19	Locking Nut
20	Sleeve Seal
21	Bolt
22	Lock Washer
23	Cable Retaining Bracket

DISASSEMBLY AND ASSEMBLY — EPICYCLIC REDUCTION GEAR GROUP

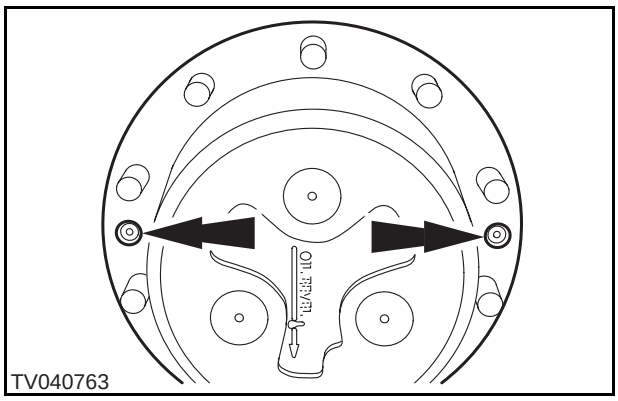
BHN1304DB

Operation: **Disassembly and Assembly of the Epicyclic Reduction Gear Group**	*Job Code:* **13 16 17 xx**		
None	Standard tools		

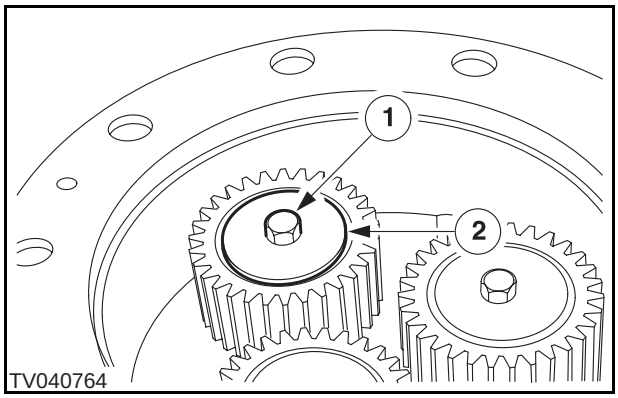
Disassembly

1. Remove the wheel. For additional information, refer to M12-01 REAR WHEEL, PAGE M12–01–5 .
2. Drain the hub oil. For additional information, refer to L11-02 DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67
3. Remove the epicyclic reduction gear carrier.

   Note:
   - Remove and discard the O-ring oil seal.

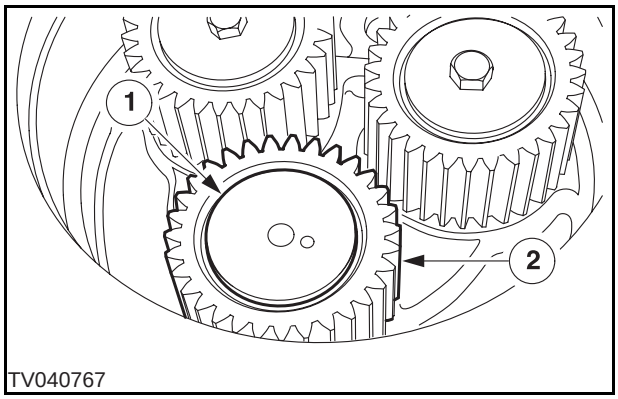


4. Remove the epicyclic gear retaining bolt (1) and washer (2).



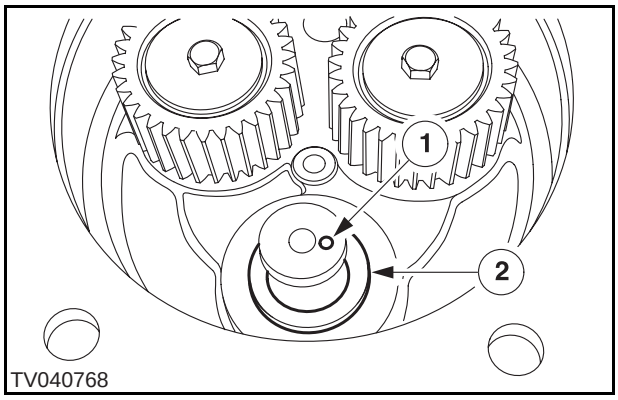
5. Remove the locating washer (1) and the epicyclic gear (2).

   Note:
   - Recover the needle roller bearings and the needle roller bearings spacer.



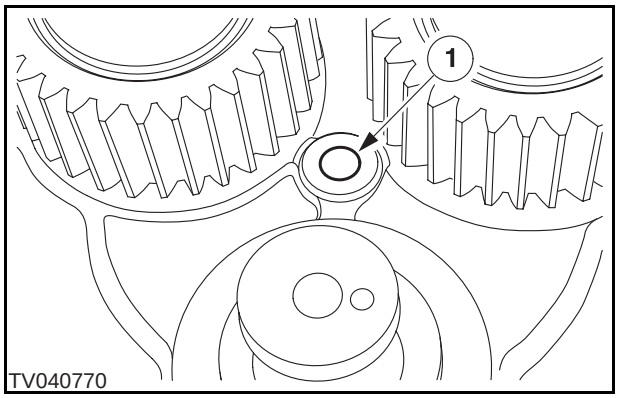
TV040767

6. Remove the locating pin (1) and the wear washer (2).
7. Repeat steps 5, 6 and 7 to remove the remaining epicyclic gears.
8. Inspect the pinion pins, if they are in poor condition a new epicyclic reduction gear carrier assembly should be installed.



TV040768

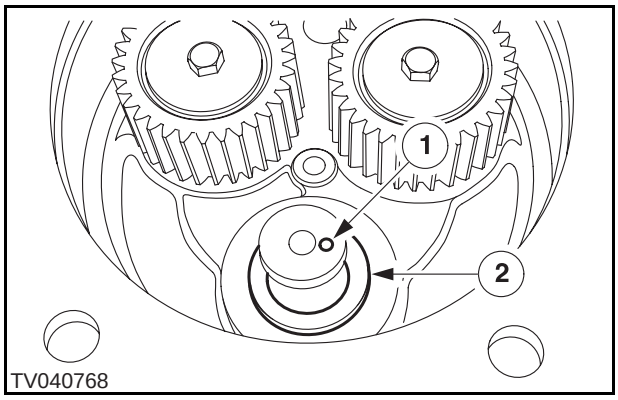
9. If the half-shaft stop (1) is worn, a new epicyclic reduction gear carrier assembly should be installed.



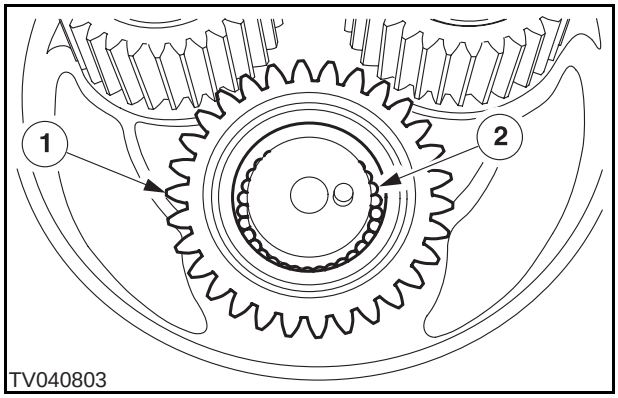
TV040770

Assembly

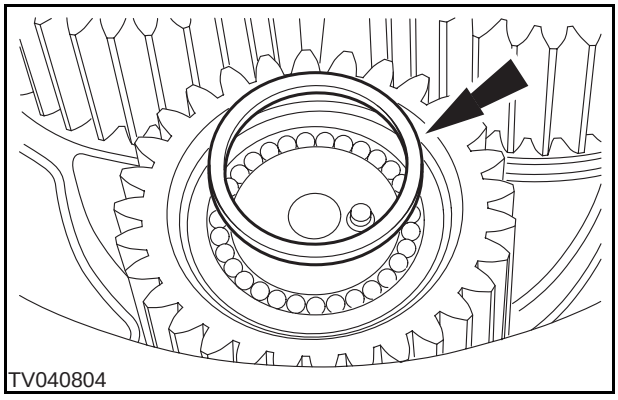
1. Install the wear washer (2) and the locating pin (1).



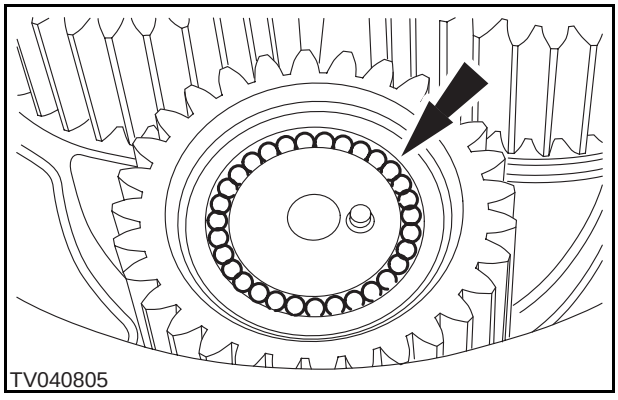
2. Install the epicyclic gear (1) and the first set of needle roller bearings (2).



3. Install the needle roller bearings spacer.

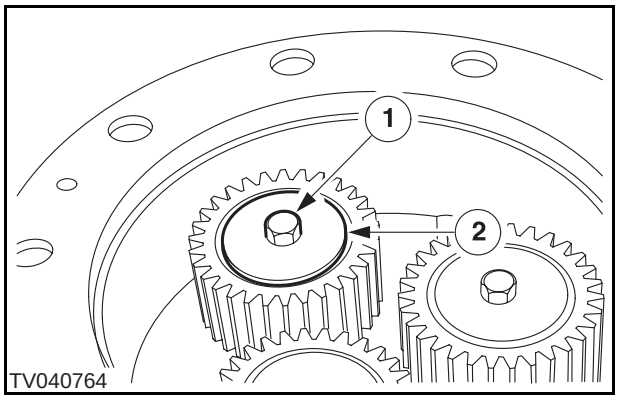


4. Install the second set of needle roller bearings.
5. Repeat steps 1 to 4 to install the remaining epicyclic gears.



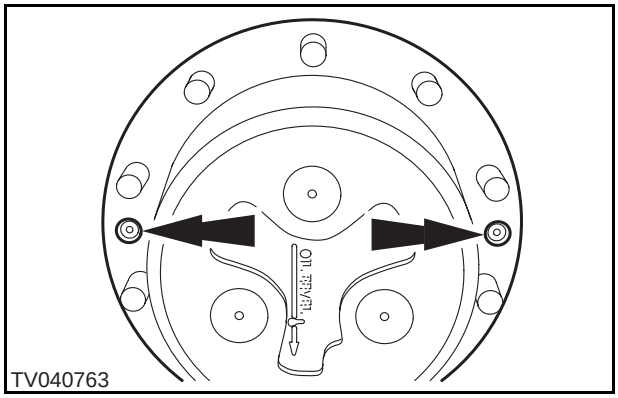
6. Install the washer (2) and epicyclic gear retaining bolt (1).

7. Tighten (1) to 79Nm (58 lb.ft).



Note:
- Install a new O-ring oil seal.

8. Install the epicyclic reduction gear carrier.
9. Tighten to 25Nm (18 LB.FT).
10. Fill the hub with oil. For additional information, refer toL11-02 DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67
11. Install the rear wheel. For additional information, refer toM12-01 REAR WHEEL, PAGE M12–01–5



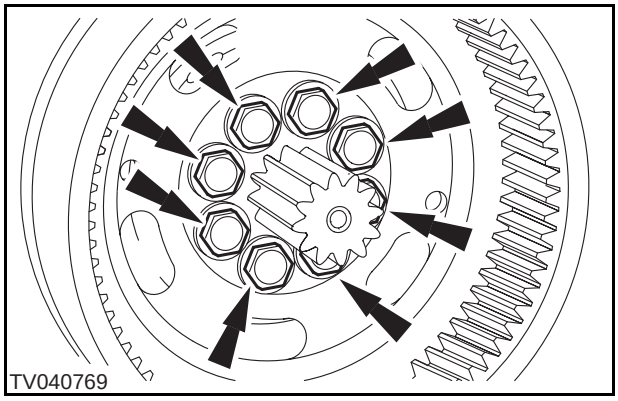
DISASSEMBLY AND ASSEMBLY — WHEEL HUB GROUP

BHN1304DC

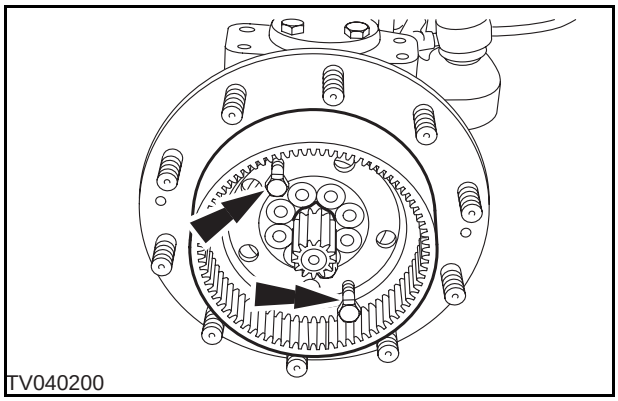
Operation: **Disassembly and Assembly of the Wheel Hub Group**	*Job Code:* **13 18 17 xx**		
None	Standard tools, CA715027, CA715026, CA119087		

Disassembly

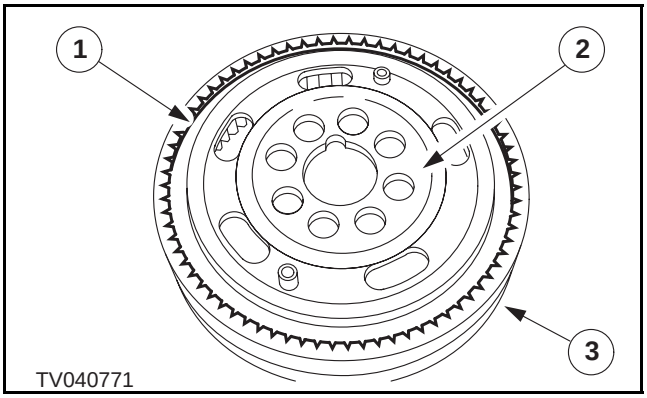
1. Remove the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE N13–04–15 in this section.
2. Remove the wheel hub retaining bolts.


TV040769

3. Using two hub retaining bolts, extract the epicyclic reduction group.


TV040200

4. Remove the snap ring (1) and remove the epicyclic gear hub (2) from the epicyclic ring gear (3).

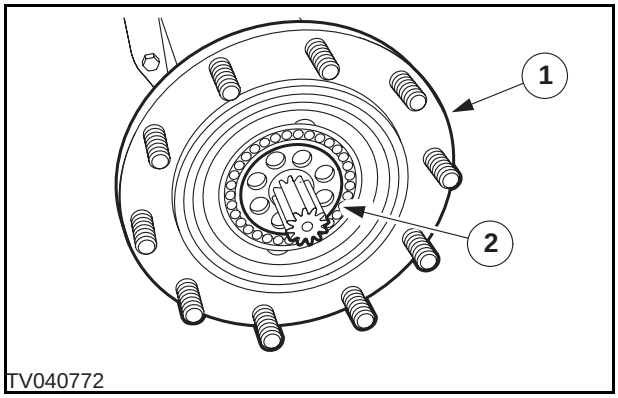


TV040771

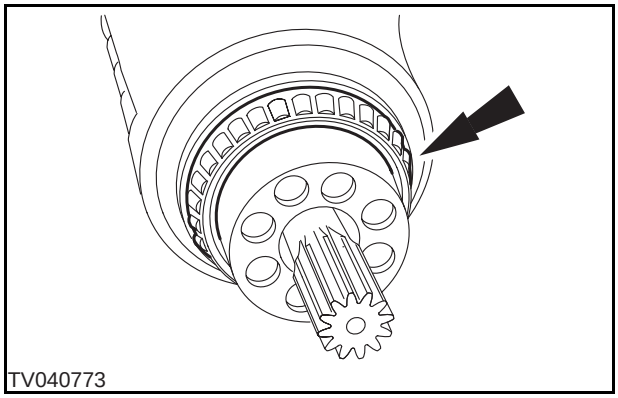
5. Using a suitable soft faced hammer, remove the rear axle hub (1).

   Note:
   - Recover the outer taper roller bearing (2).

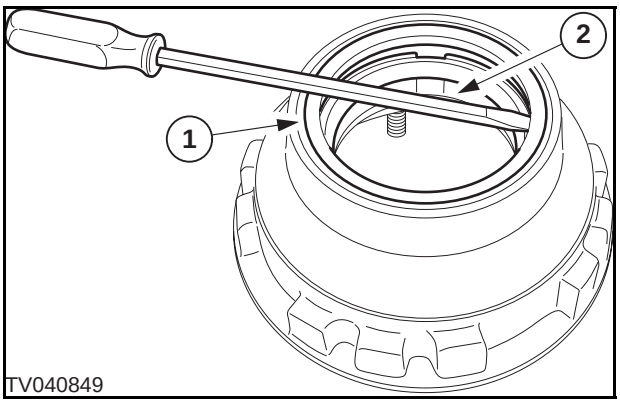
6. Using the special tool **CA715027 — Driver for bush** remove the hub centering bushes.



7. Remove the inner taper roller bearing.

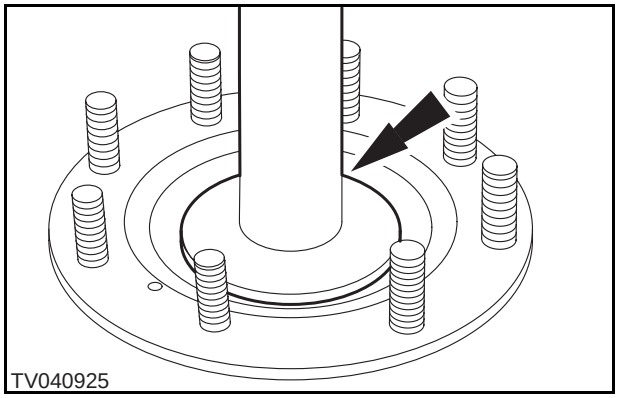


8. Using a suitable lever, remove and discard the hub oil seal (1).
9. Remove the inner and outer taper roller bearing and cones (2).



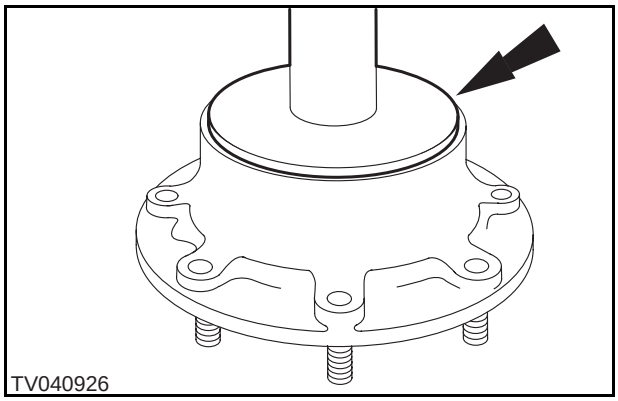
Assembly

1. Using a suitable hydraulic press and the special tool **CA715026 — Driver for bearing race** , install the inner and outer taper roller bearing cones.

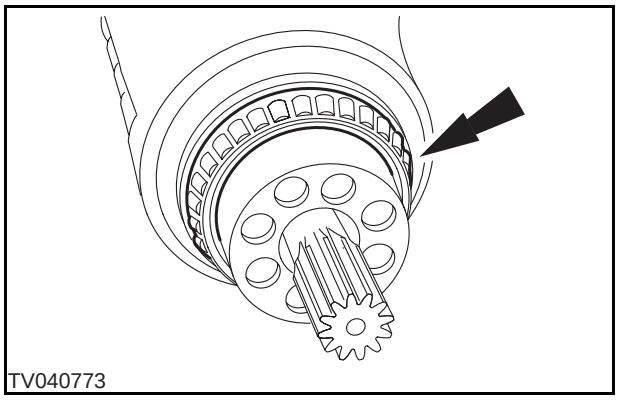

TV040925

Note:
- Lubricate the oil seal with a light grease.

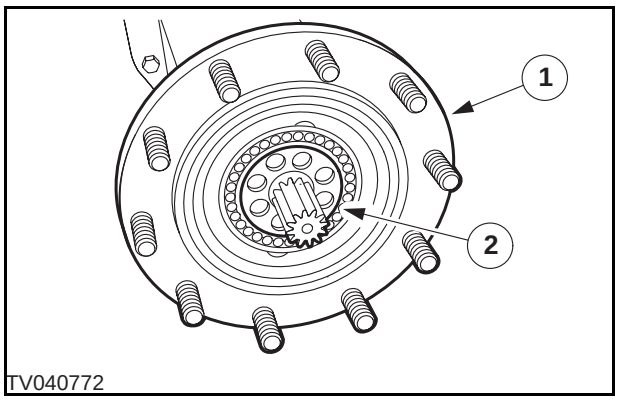
2. Using the special tool **CA119087 — Driver for oil seal** , install a new hub seal.


TV040926

3. Install the inner taper roller bearing.


TV040773

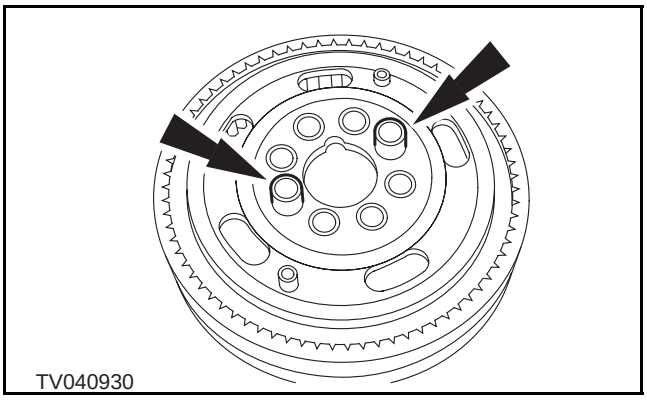
4. Install the rear axle hub (1) .
5. Install the outer taper roller bearing (2).



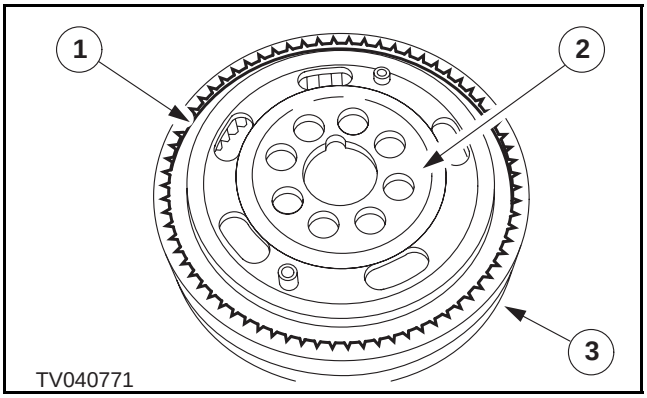
TV040772

Note:
- Install two bushes slightly higher that the hub surface level to be used as dowel pins.

6. Using the special tool **CA715027 — Driver for bush** partially install the hub centering bushes.

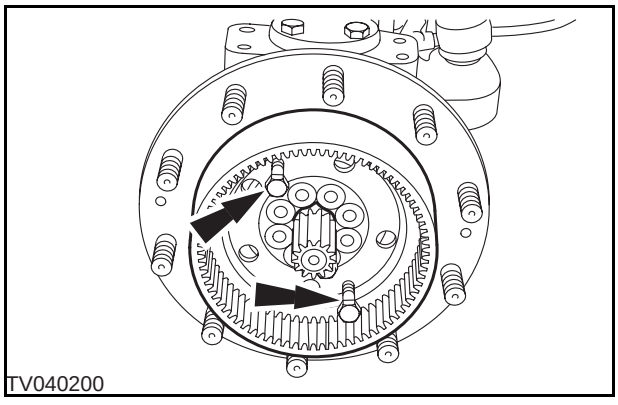

TV040930

7. Install the epicyclic hub (2) to the epicyclic ring gear (3) and install the snap ring (1).

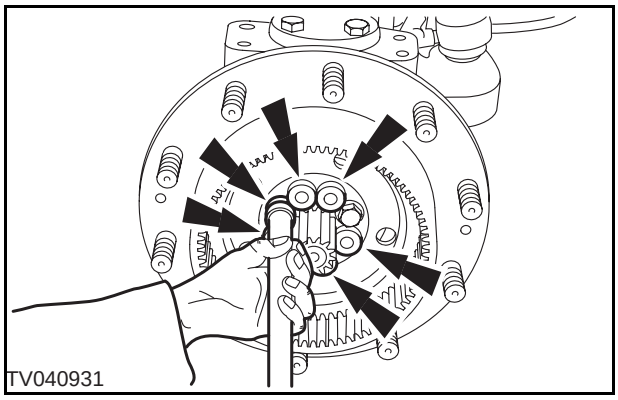


TV040771

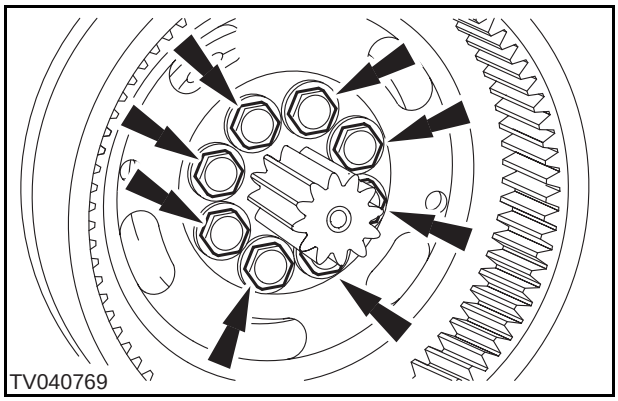
8. Assemble the epicyclic group on the wheel hub using the two protruding centering bushes as dowel pins.


TV040200

9. Using the special tool **CA715027 — Driver for bush** , fully install the remaining centering bushes.



10. Install the wheel hub retaining bolts.
11. Tighten to 230Nm (170 LB.FT).
12. Install the epicyclic reduction gear group. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE N13–04–15 in this section.



Note: This page intentionally left blank.

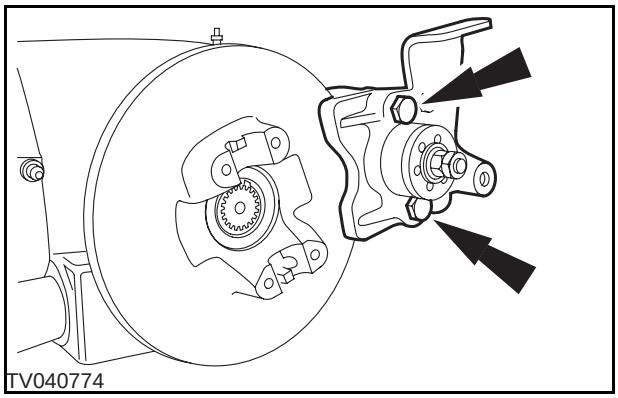
DISASSEMBLY AND ASSEMBLY — HALF SHAFT AND BRAKE GROUP

BHN1304DD

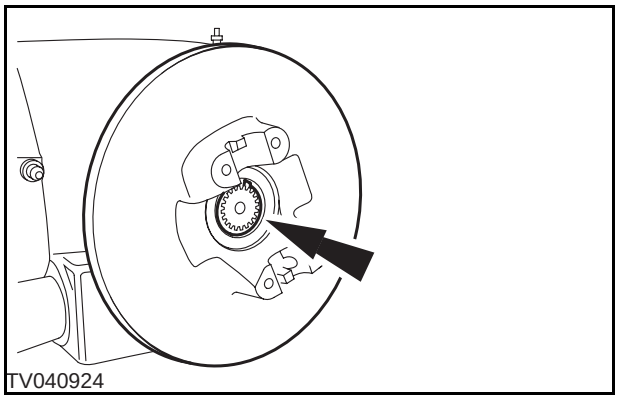
Operation: **Disassembly and Assembly of the Half Shaft and Brake Group**	*Job Code:* **13 18 17 xx**		
Suitable lifting equipment	Standard tools, CA715386, CA715387		

Disassembly

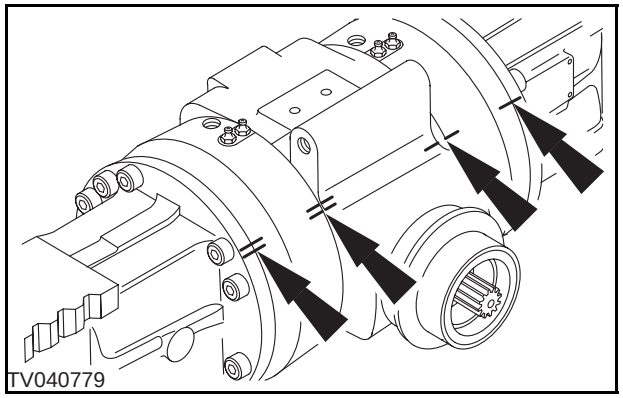
1. Remove the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE N13–04–19 in this section.
2. Drain the axle oil into a suitable container. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL in this section.
3. Remove the parking brake caliper.


TV040774

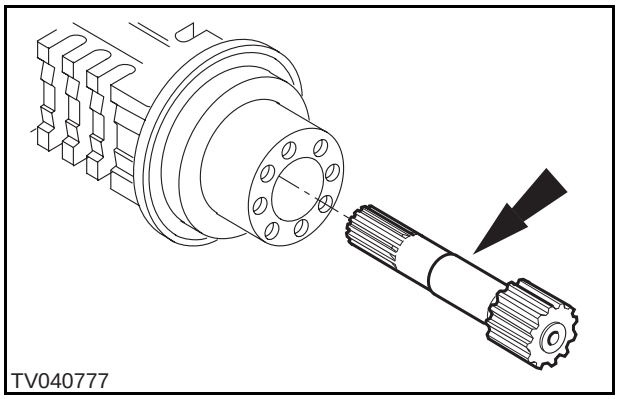
4. Using suitable circlip pliers remove the parking brake disc.


TV040924

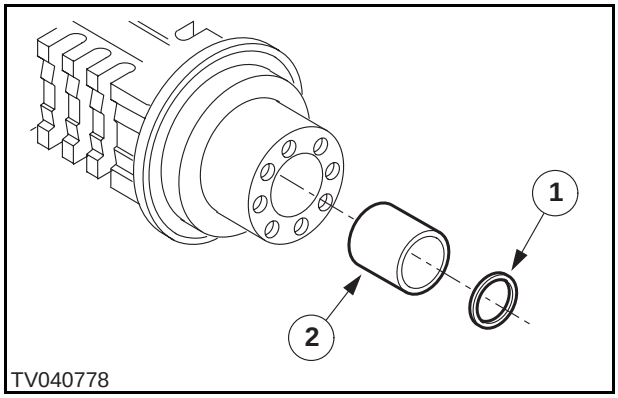
5. Mark the rear axle housing prior to disassembly to aid installation.


TV040779

6. Remove the stub shaft from the half shaft housing.


TV040777

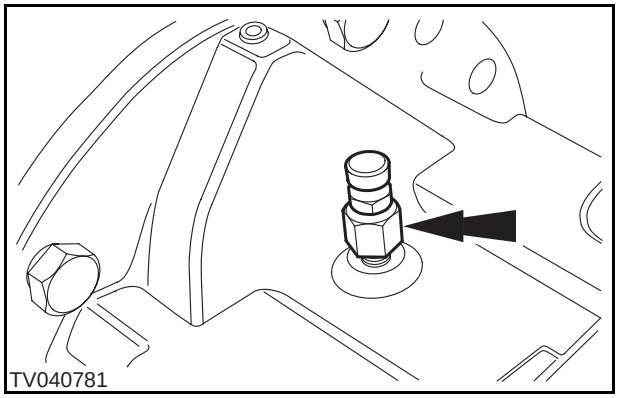
7. Remove and discard the seal (1).
8. Remove and discard the half shaft housing bushing (2).



TV040778

Note:
- Left hand side half shaft only.

9. Remove the axle breather from the half shaft housing.

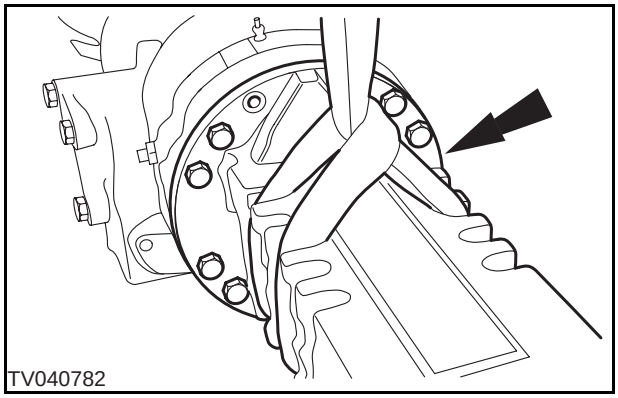

TV040781

⚠ Warning:
- **Support the half shaft housing. Failure to follow this instruction may result in personal injury.**

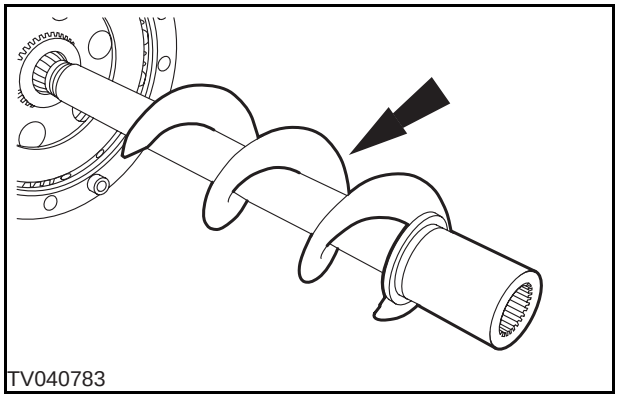
⚠ Caution:
- **Make sure the half shaft remains with the differential housing.**

10. Remove the half shaft housing.

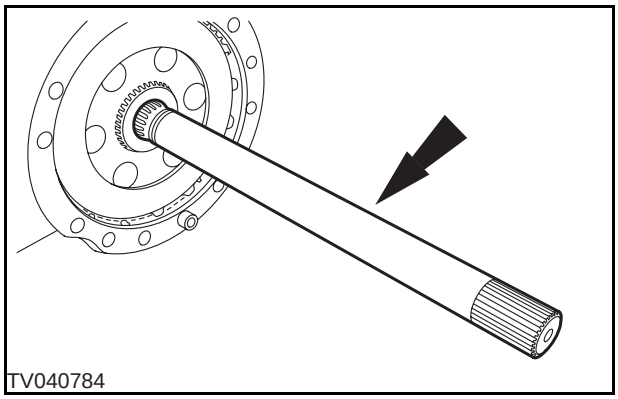
Note:
- Remove and discard the O-ring.


TV040782

11. Remove the half shaft oil thrower from the half shaft.


TV040783

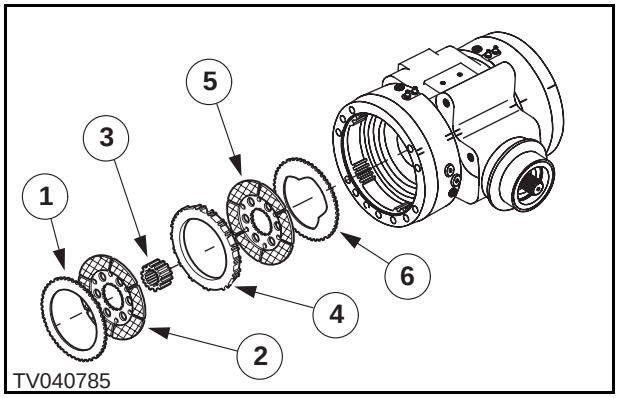
12. Remove the half shaft from the differential housing.


TV040784

Note:
- Check that the friction discs and the fixed discs do not show any sign of burning. If damage is found new components should be installed.

13. Remove the 5 mm fixed steel disc (1).
14. Remove the outer friction disc (2).
15. Remove the brake hub (3).

16. Remove the 11 mm fixed steel disc (4).
17. Remove the inner friction disc (5).
18. Remove the piston pressure disc (6).

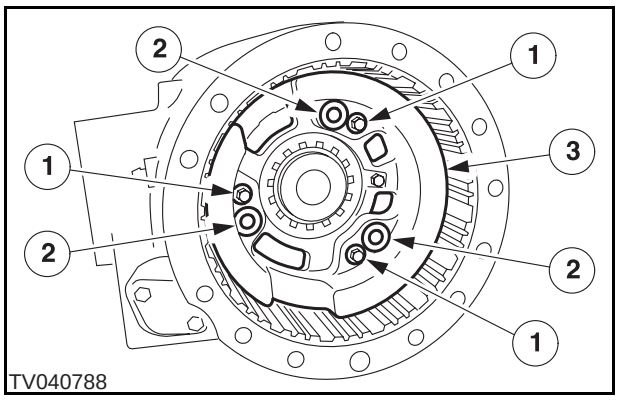


19. Remove the self-adjust retaining bolts (1) and (2).

    Note:
    - Recover the self-adjust components.

20. Remove the brake piston (3).

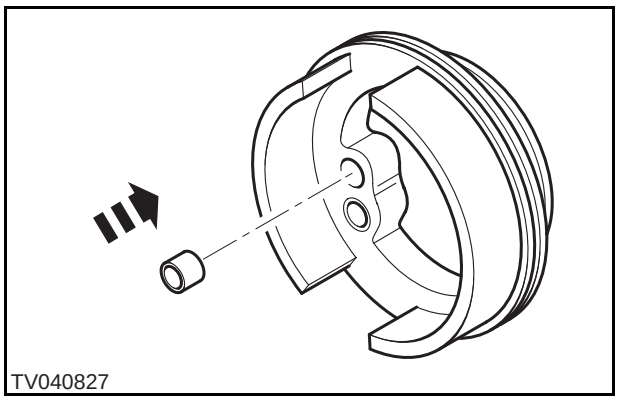
    Note:
    - Remove and discard the brake piston o-ring seals.



21. Repeat steps 6 to 20 to remove the remaining half shaft housing.

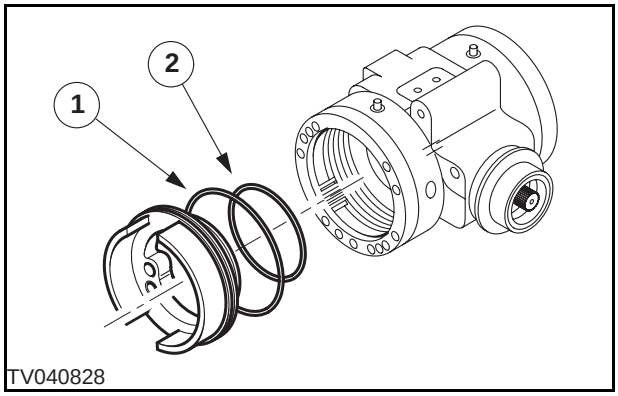
Assembly

1. Install the self-adjust bushings into the brake flange until level with the piston inner surface.


TV040827

Note:
- Lubricate the brake piston oil seals with a light grease.

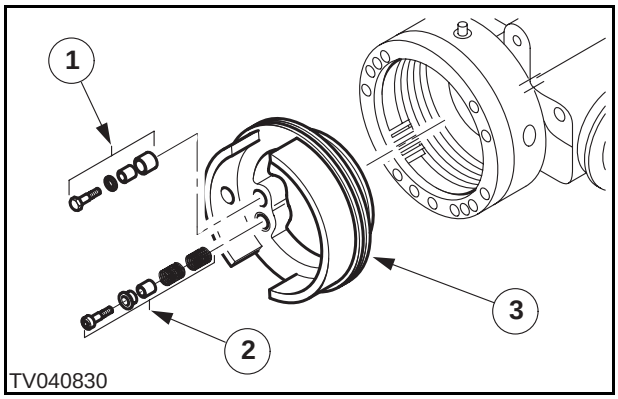
2. Install new outer (1) and inner (2) oil seals to the brake piston.



TV040828

Note:
- Lubricate the brake piston oil seals with a light grease.

3. Install the brake piston (3).
4. Install the brake piston self-adjust retaining bolt assemblies (1) and (2).
5. Tighten to 10Nm (7 LB.FT).



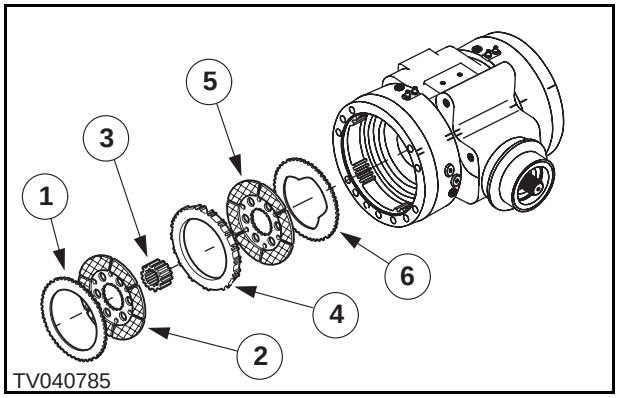
TV040830

Note:
- If new friction discs are installed, they should be soaked in suitable oil before assembling,

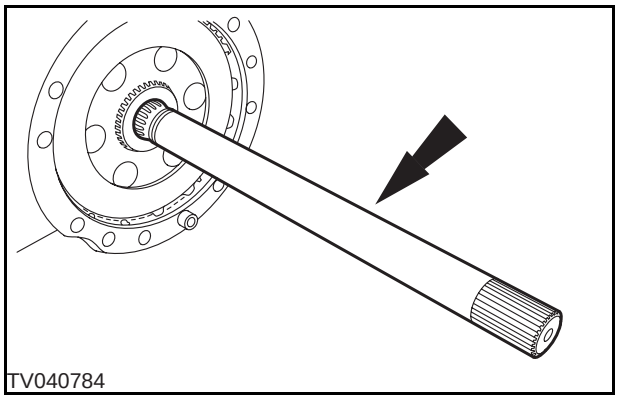
6. Install the piston pressure disc (6).
7. Install the inner friction disc (5).

Note:
- Install the fixed steel disc with the lip towards the piston.

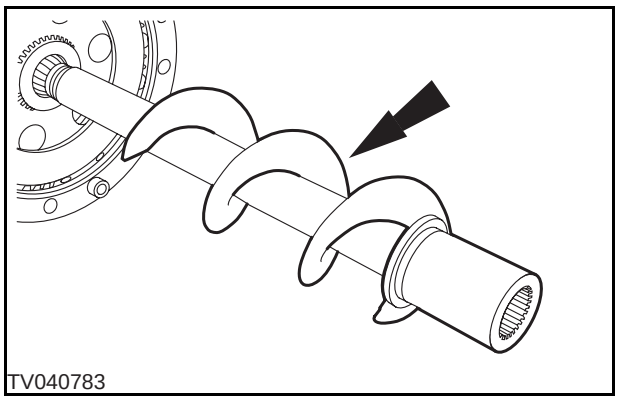
8. Install the 11 mm fixed steel disc (4).
9. Install the brake hub (3).
10. Install the outer friction disc (2).
11. Install the 5 mm fixed steel disc (1).



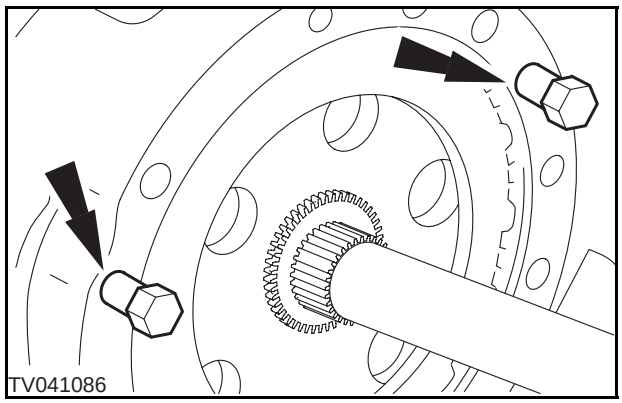
12. Install the half shaft into the differential housing.



13. Install the half shaft oil thrower onto the half shaft.



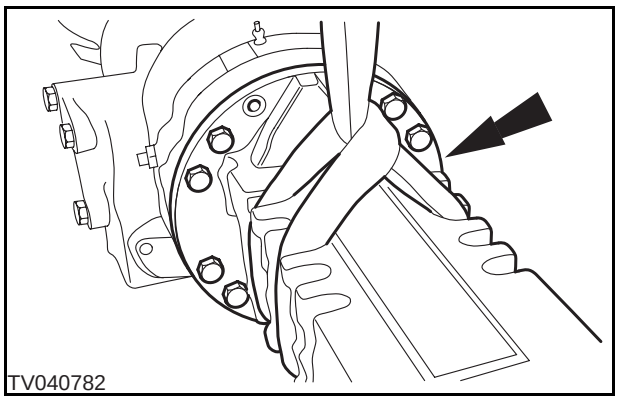
14. Remove the two brake housing retaining bolts.



⚠ **Warning:**
- **Support the half shaft housing. Failure to follow this instruction may result in personal injury.**

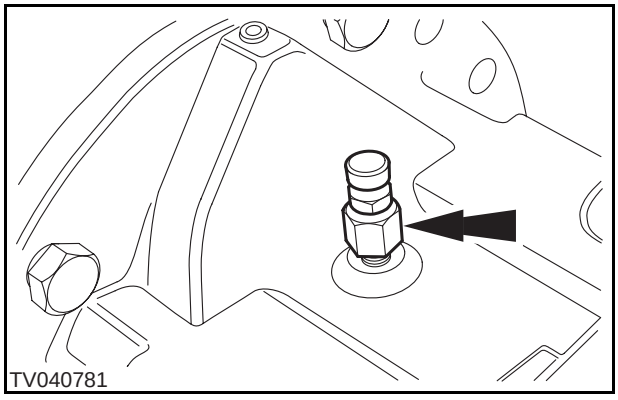
Note:
- Install a new half shaft housing O-ring.

15. Install the half shaft housing.
16. Tighten to 130Nm (98 LB.FT).


TV040782

Note:
- Left-hand side half shaft only.

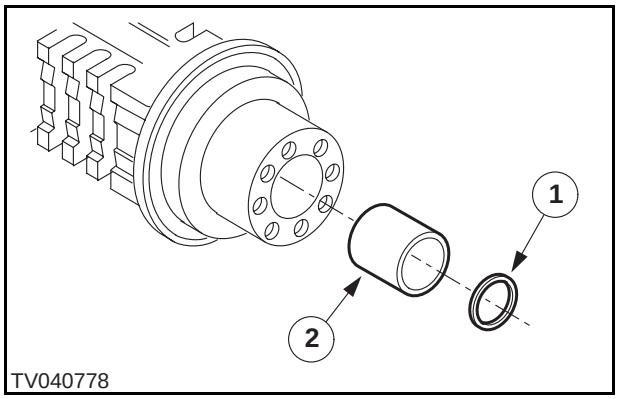
17. Install the axle breather into the half shaft housing.
18. Tighten to 15Nm (11 LB.FT).


TV040781

19. Using the special tool **CA715386 — Driver for bush** , install the half shaft housing bushing (2).

Note:
- Lubricate the oil seal with a light grease.

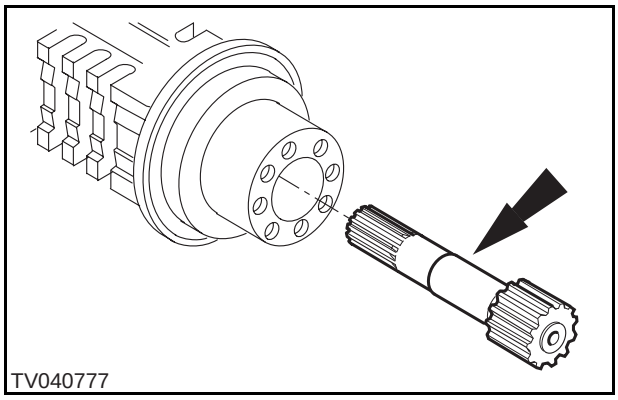
20. Using the special tool **CA715387 — Driver for oil seal** , install the half shaft housing seal (1).



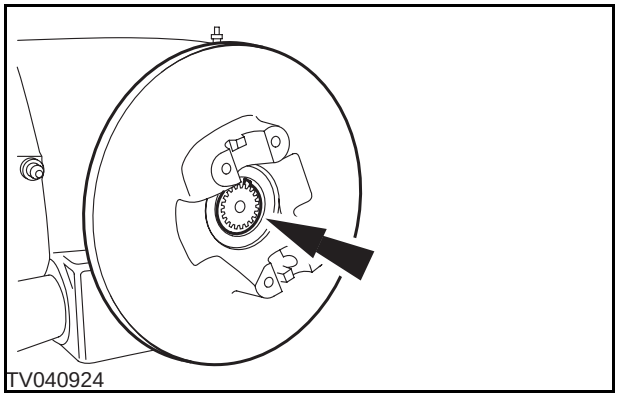
TV040778

21. Install the stub shaft into the half shaft housing.

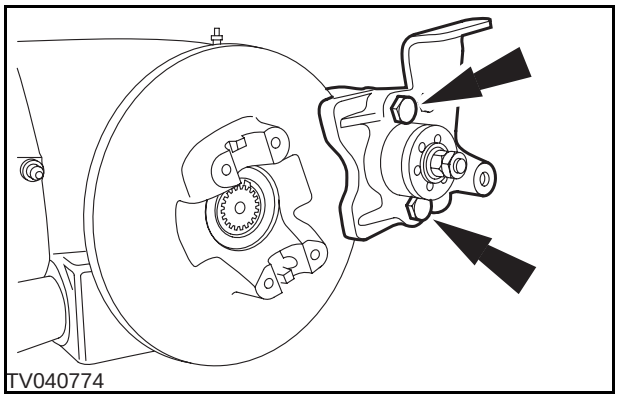
22. Repeat steps 1 to 21 to install the remaining half shaft housing.


TV040777

23. Using suitable circlip pliers Install the parking brake disc.


TV040924

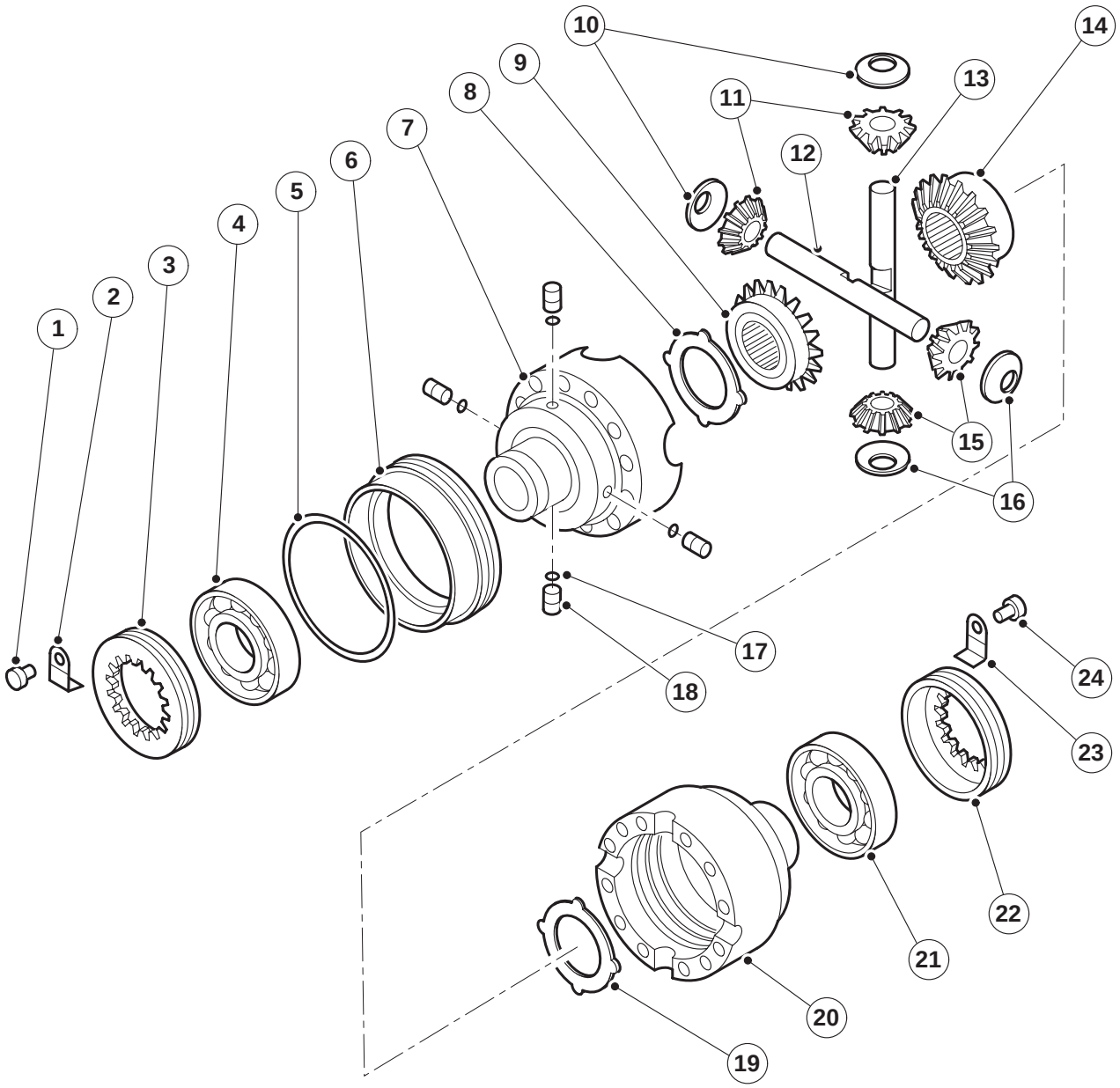
24. Install the parking brake caliper.
25. Tighten to 150Nm (111 LB.FT).
26. Fill the axle with oil. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL in this section.
27. Install the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE N13–04–19 in this section.


TV040774

DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL GROUP

BHN1304DE

Operation: **Disassembly and Assembly of the Differential Group**	*Job Code:* **13 14 17 xx**		
None	Standard tools, CA715133		



TV040929

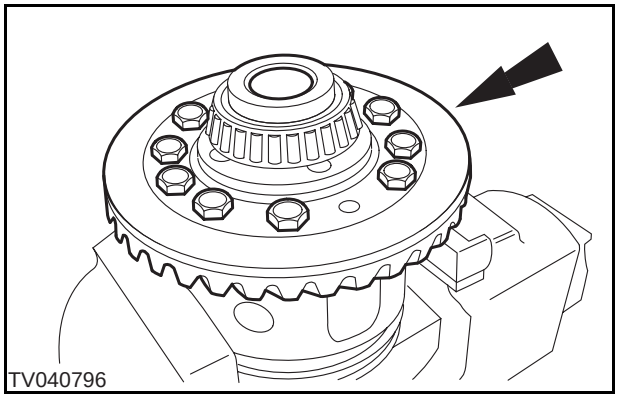
1	Bolt
2	Locking Plate
3	Differential Adjustment Nut
4	Taper Roller Bearing
5	Snap Ring
6	Differential Lock Selector
7	Housing
8	Thrust Plate
9	Sun Gear
10	Thrust Washer
11	Planetary Gear
12	Planetary Shaft
13	Planetary Shaft
14	Sun Gear
15	Planetary Gear
16	Thrust Washer
17	O-ring
18	Differential Locking Pins
19	Thrust Plate
20	Housing
21	Taper Roller Bearing
22	Differential Adjustment Nut
23	Locking Plate
24	Bolt

Disassembly

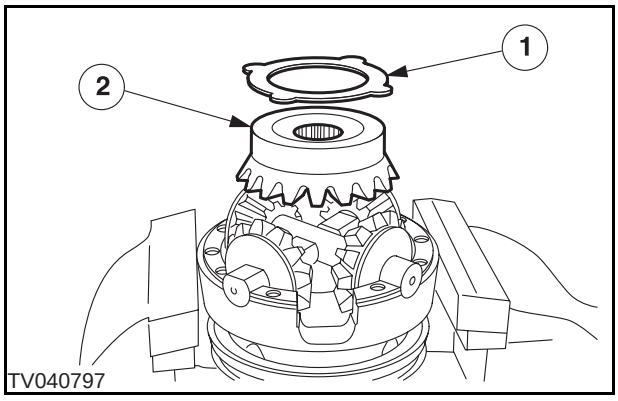
1. Disassemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.
2. Position the differential in a suitable vice.

   Note:
   - Mark the differential carrier prior to disassembly to aid installation.

3. Remove the crown wheel.

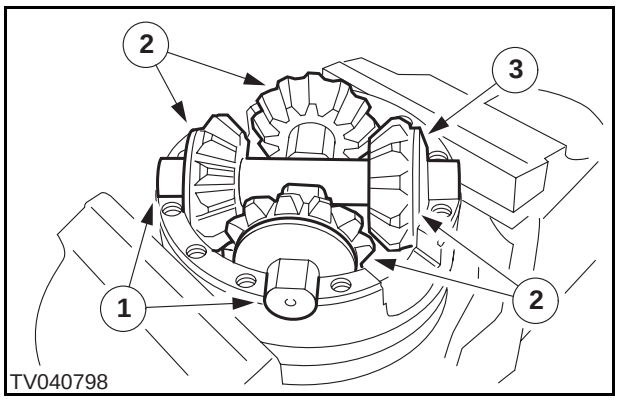


4. Remove the thrust plate (1) and sun gear (2).

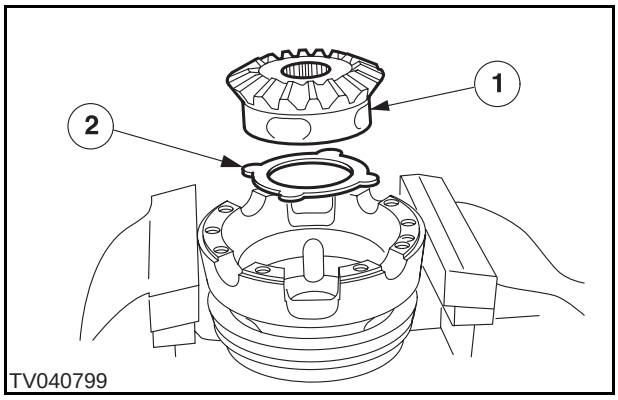


5. Remove the planetary shafts (1) and the planetary gears (2).

Note:
- Recover the thrust washers (3).



6. Remove the sun gear (1) and thrust plate (2).

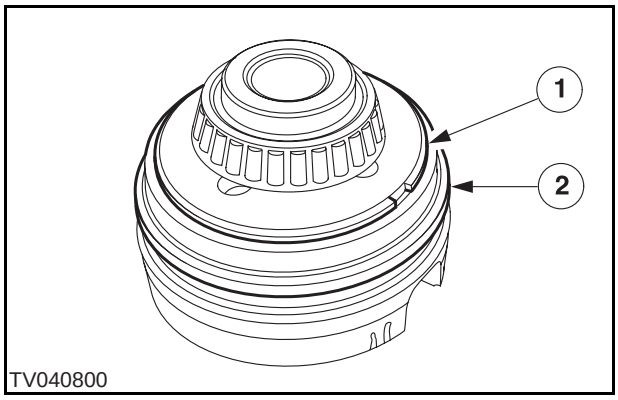


7. Remove the snap ring (1).

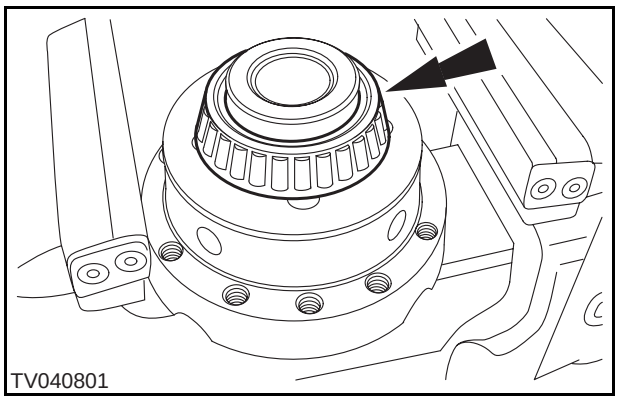
8. Remove the Differential lock selector (2).

Note:
- Recover the differential locking pins.

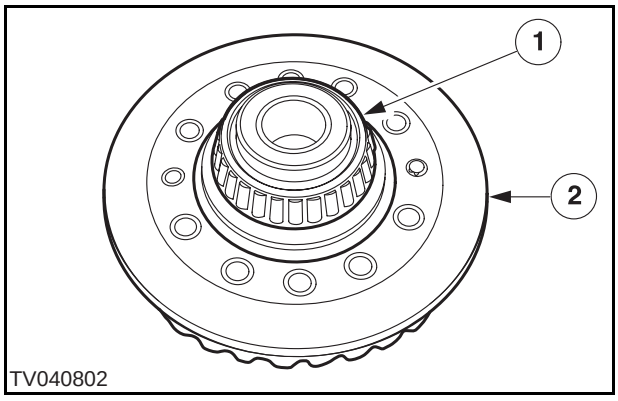
Note:
- Remove and discard the O-rings.



9. Using a suitable puller, remove the right-hand side taper roller bearing.

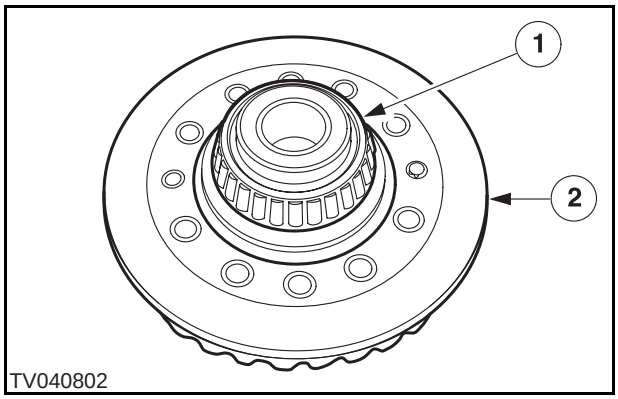


10. Using a suitable puller, remove the left-hand side taper roller bearing (1) and the crown wheel (2).

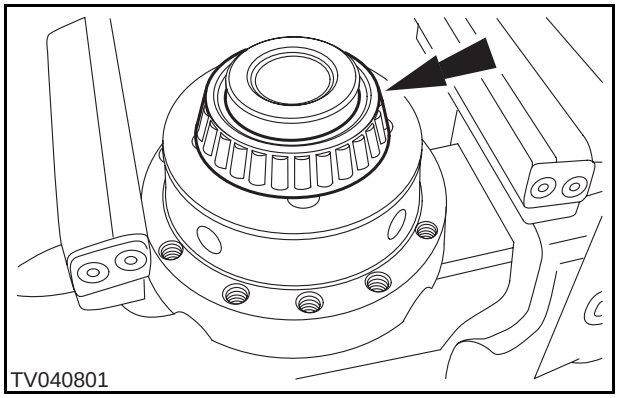


Assembly

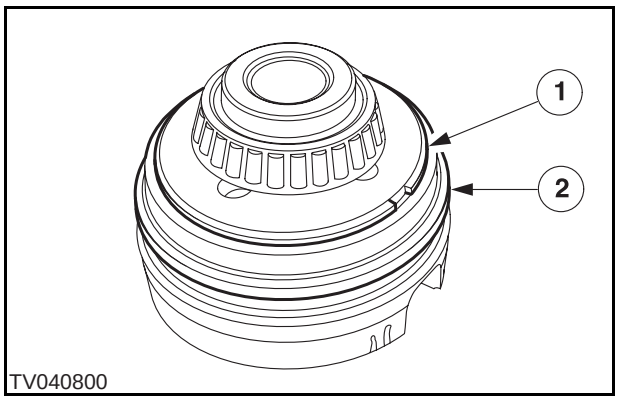
1. Using a suitable hydraulic press and the special tool **CA715133 — Driver for bearing** , install the left-hand side differential taper roller bearing (1) and the crown wheel assembly (2).



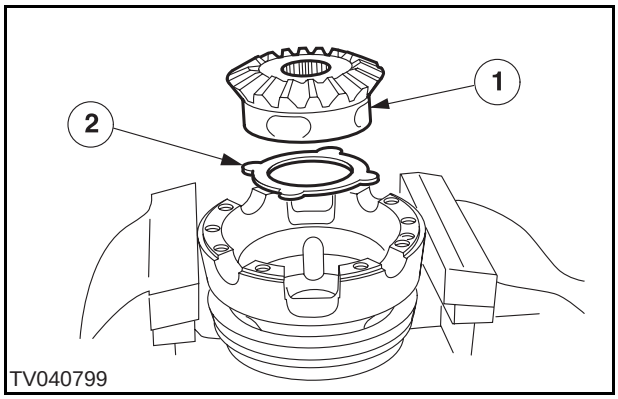
2. Using a suitable hydraulic press and the special tool **CA715133 — Driver for bearing** , install the right hand side differential taper roller bearing.



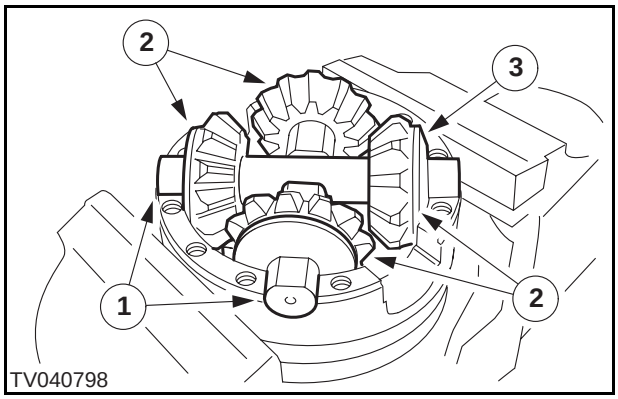
3. Install new O-ring seals and install the differential locking pins.
4. Install the differential lock selector (2).
5. Install the snap ring (1).



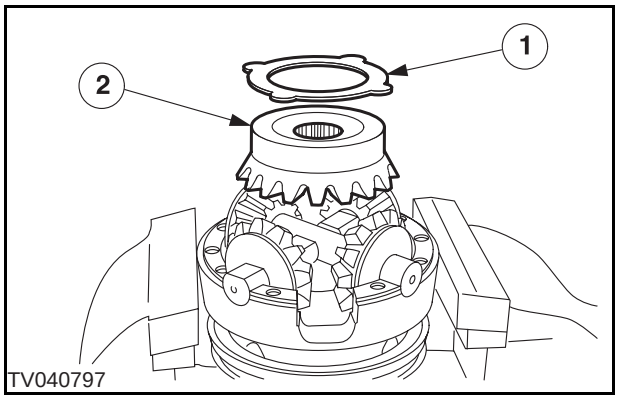
6. Install the thrust washer (2) and the sun gear (1).



7. Install the Planetary shafts (1), planetary gears (2) and the trust washers (3).



8. Install the sun gear (2) and the thrust washer (1).



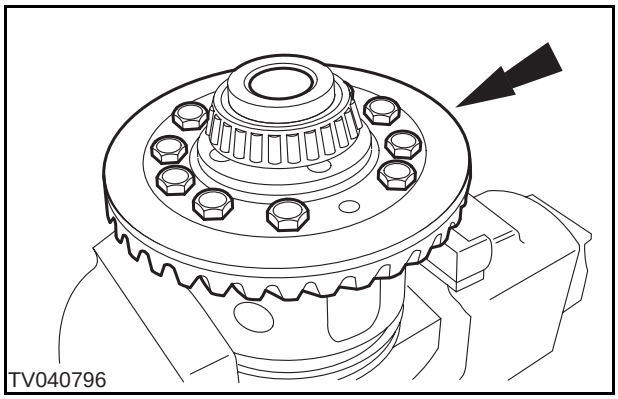
9. Install the crown wheel.

Note:

- Before installing the crown wheel retaining bolts, apply approved sealant (Loctite 270) to the bolt.

10. Tighten to 155Nm (114 LB.FT).

11. Assemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.

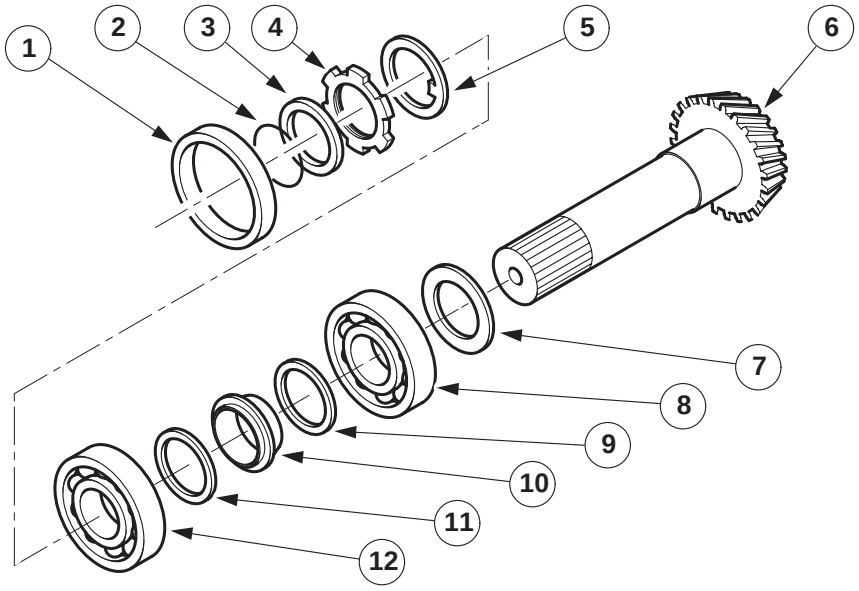

TV040796

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DISASSEMBLY AND ASSEMBLY — PINION GROUP

BHN1304DF

Operation: **Disassembly and Assembly of the Pinion Group**	*Job Code:* **13 20 17 xx**		
None	Standard tools, CA119099, CA715022, CA715380, CA715128, CA715388, CA715004, Suitable measuring device		

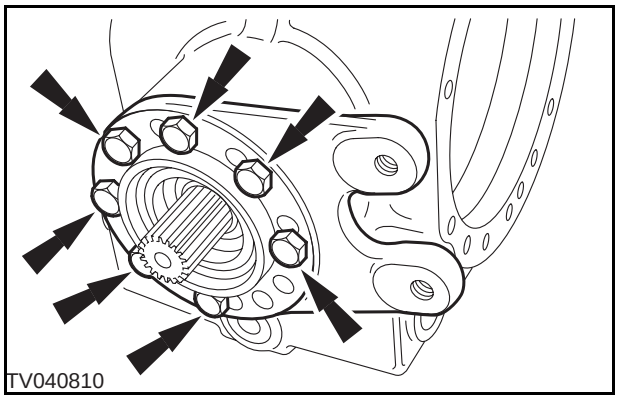


TV040815

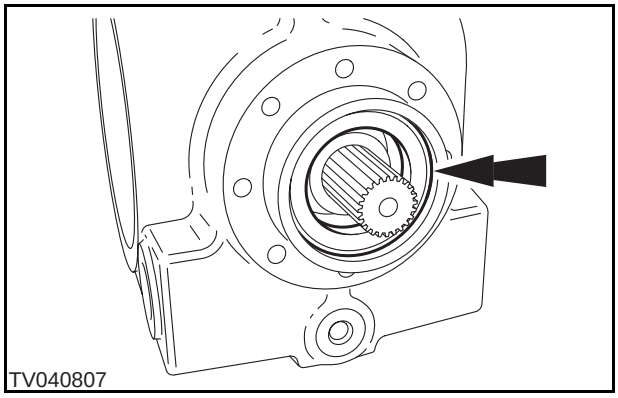
1	Sealing Ring
2	O-ring Seal
3	Spacer
4	Pinion Shaft Retaining Nut
5	Lock Washer
6	Pinion Shaft
7	Shim
8	Taper Roller Bearing
9	Washer
10	Elastic Spacer
11	Washer
12	Taper Roller Bearing

Disassembly

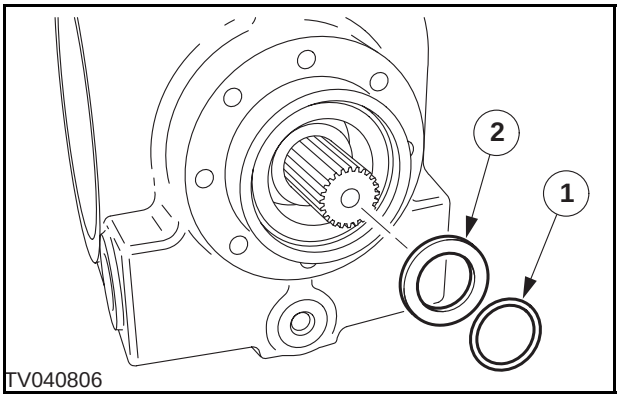
1. Disassemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.
2. Remove the parking brake caliper mounting bracket.


TV040810

3. Remove and discard the pinion sealing ring from the differential housing.


TV040807

4. Remove the O-ring (1) and the spacer (2).

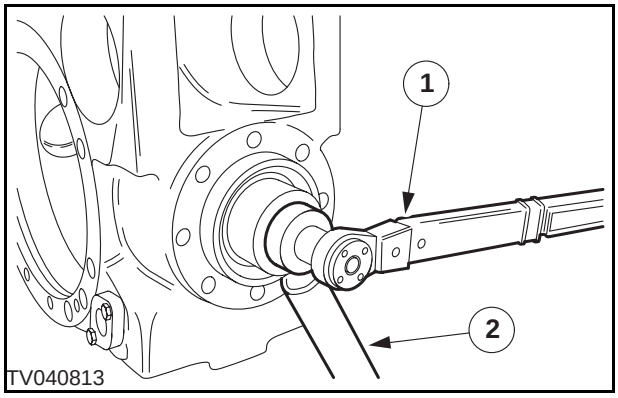


TV040806

⚠ **Caution:**
- **Release the pinion shaft retaining nut locking tabs. Failure to follow this instruction may result in damage to the machine.**

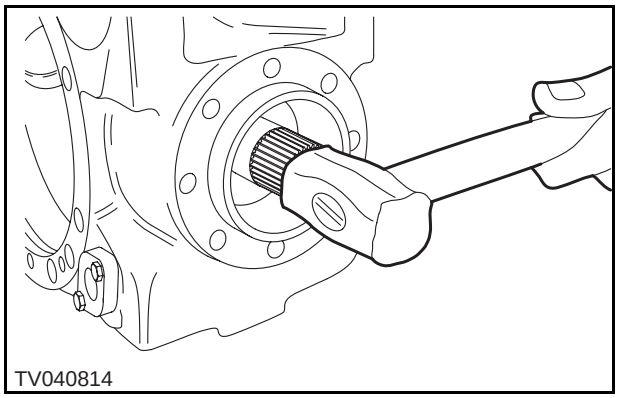
5. Using the special tools **CA119099 — Wrench for lock nut** and **CA715022 — Pinion shaft lock tool** , remove the pinion shaft retaining nut.

   Note:
   - Recover the lock washer.



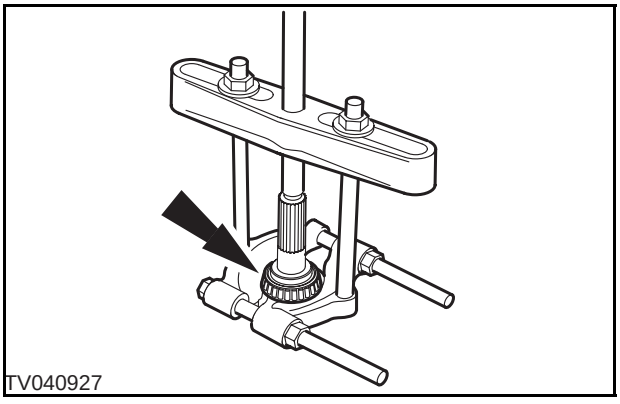
6. Using a suitable soft faced hammer, remove the pinion shaft from the differential housing.

   Note:
   - Recover the outer taper roller bearing, two washers and discard the elastic spacer.

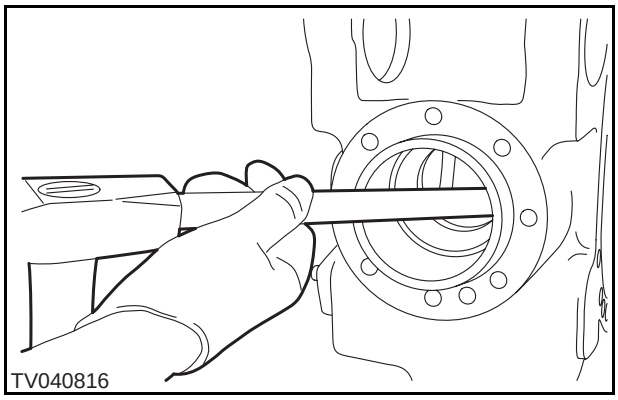


7. Using a suitable puller, remove the taper roller bearing from the pinion shaft.

   Note:
   - Recover the pinion end float adjustment shim.

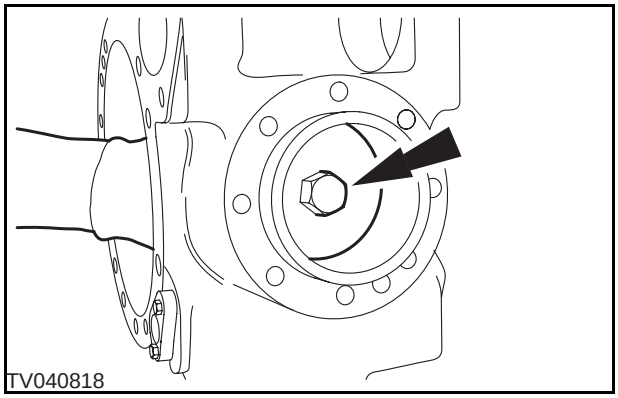


8. Using a suitable drift, remove the pinion shaft taper roller bearing cups from the differential housing.

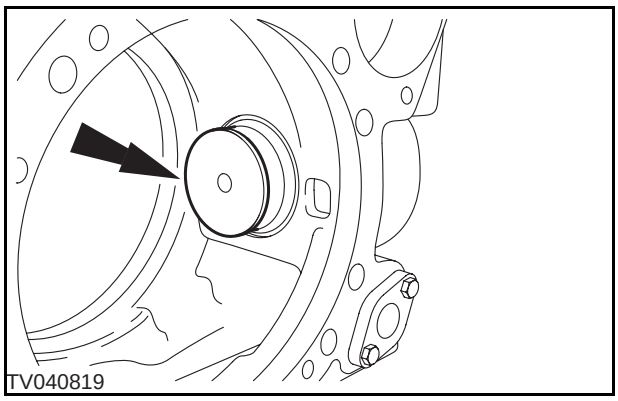


Assembly

1. Using the special tool **CA715380 — Bearing races insertion kit** install the taper roller bearing cups into the differential housing.

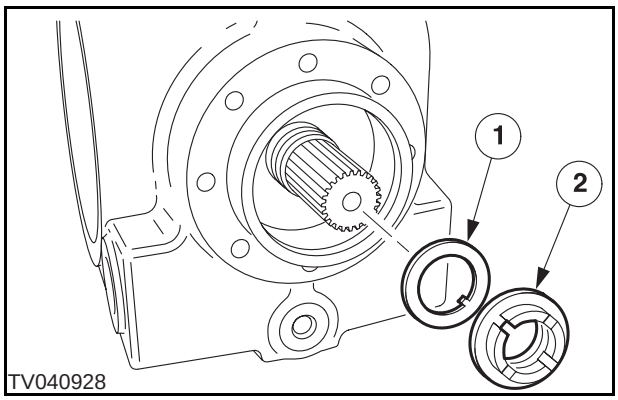

TV040818

2. Install the special tool **CA715128 — False pinion** with the pinion shaft taper roller bearings.


TV040819

⚠ **Caution:**
- **Do not overtighten.**

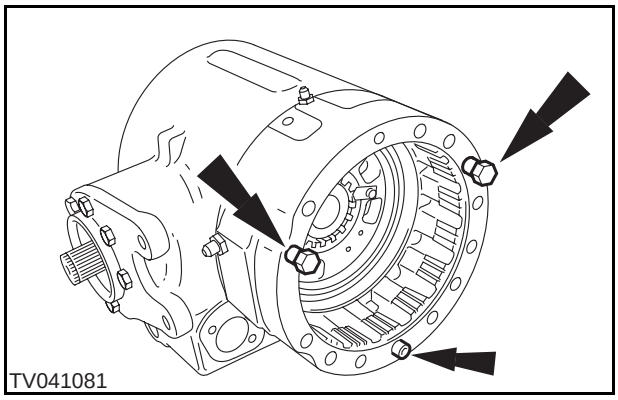
3. Install the lock washer (1) and the pinion shaft retaining nut (2)
4. Tighten until the free play is eliminated.



TV040928

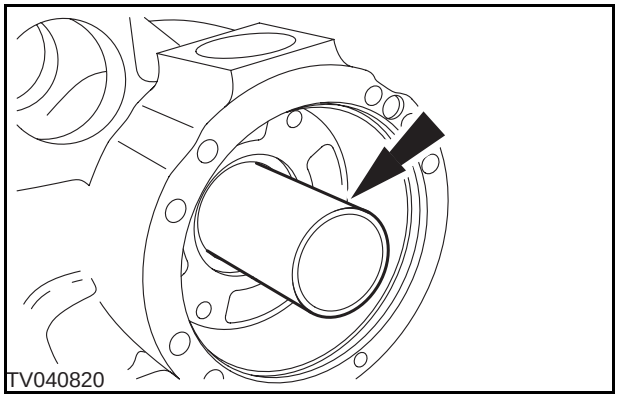
5. Install the brake left-hand side brake housing with three retaining bolts 120° apart.
6. Tighten to 79Nm (58 LB.FT).

7. Repeat steps 5 and 6 for the right-hand side brake housing.

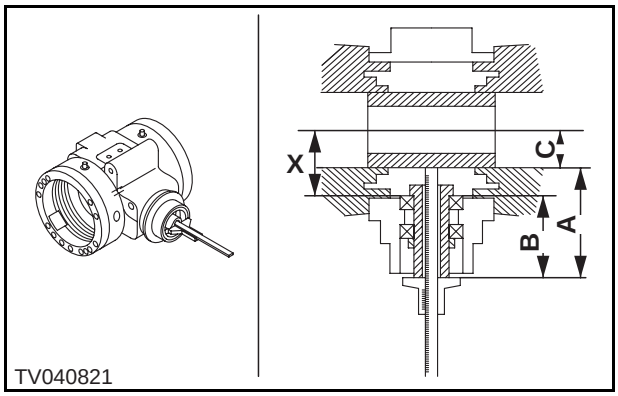

TV041081

Note:
- Ensure the false differential box is inserted in both brake housings.

8. Install the special tool **CA715388 — false differential box** into the differential housing.

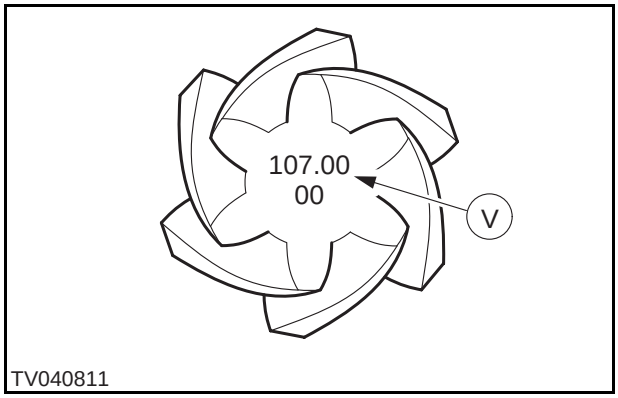

TV040820

9. Using a suitable depth gauge, measure through the false pinion (CA715128) **This measurement is "A"** .
10. Determine the value **"X"** as follows:
    X = (conical distance to be measured)
    A = (measured value)
    B = 100mm
    C = 50mm
    X = (A + C) — B
    Example: **A** = 159.9mm
    therefore: **X** = (159.9 + 50) – 100mm
    X = 109.9mm



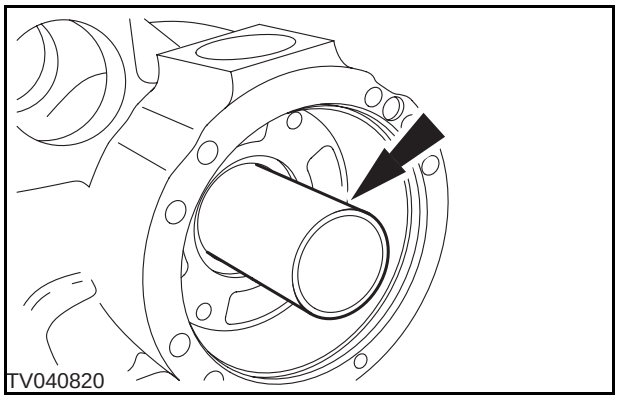
TV040821

11. Determine the pinion shaft position adjustment shim **"S"** as follows:
    subtract the value **"V"** (requested conical distance) from the calculated value **"X"** .
    S = X — V
    Example: Shim thickness **S** = 109.9 – 107.00 = 2.9mm.
    Shim thickness **"S"** = 2.9mm

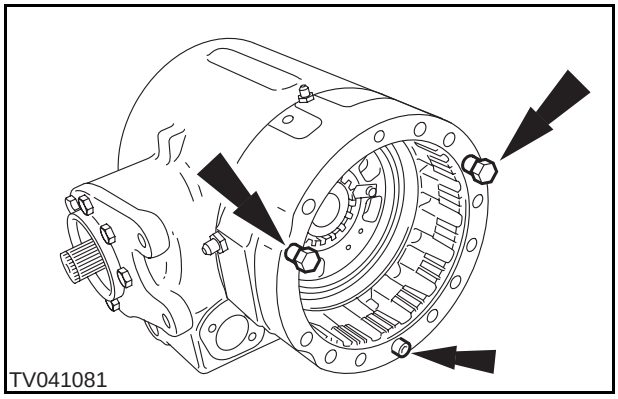


SHIM RANGE										
mm	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4

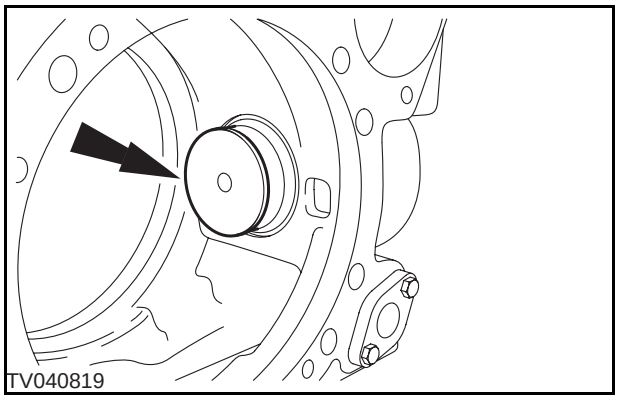
12. Remove the special tool **CA715388 — false differential box** from the differential housing.



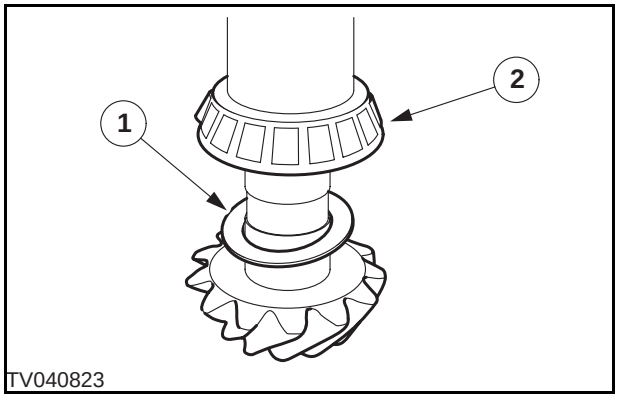
13. Remove the brake housing (both sides).



14. Remove the special tool **CA715128 — False pinion** with the pinion shaft taper roller bearings.


TV040819

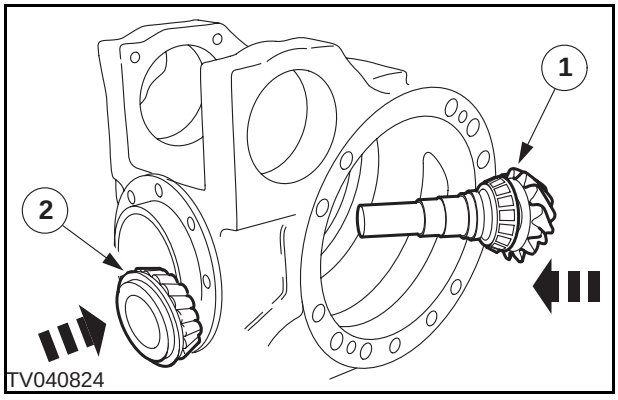
15. Install the pinion shaft adjustment shim (1) with chamfer against the gear.
16. Using a suitable hydraulic press and the special tool **CA715004 — Driver for bearing** install the rear taper roller bearing (2).



TV040823

Note:
- Always use a new elastic spacer.

17. Install the washers and the new elastic spacer onto the pinion shaft.
18. Install the pinion shaft assembly (1) and the front taper roller bearing (2) into the differential housing.

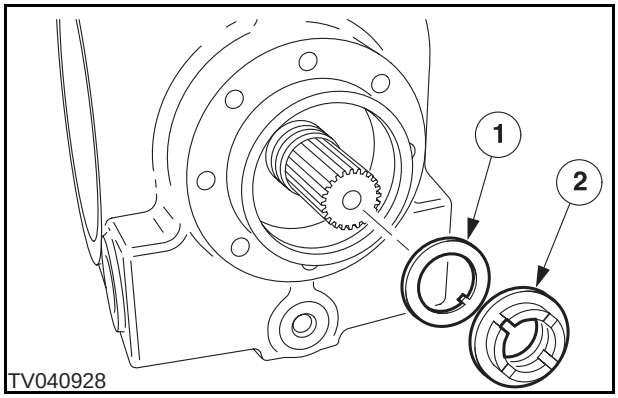


TV040824

19. Install a new lock washer (1).

Note:
- Do not tighten at this stage.

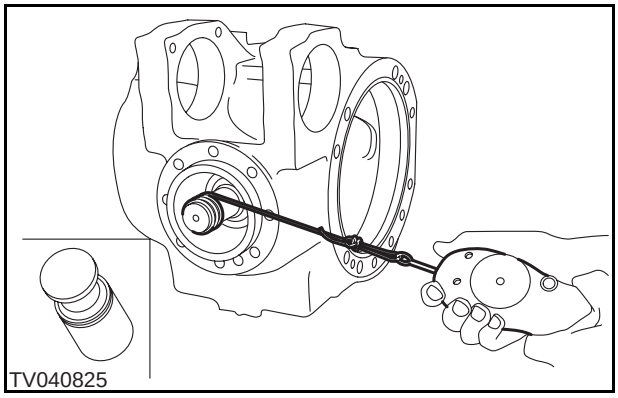
20. Install a new pinion shaft retaining nut (2).



21. Install the special tool **CA715116 — Measurement** onto the pinion shaft.

Note:
- Using a suitable soft faced hammer, settle the pinion shaft bearings.

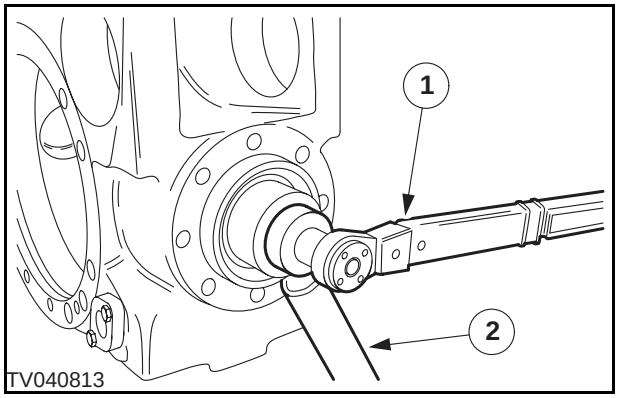
22. Using a suitable measuring device (with the cord wound on the 34.87 mm diameter of the special tool **CA715116 — measurement**), measure the pinion shaft rotational torque.
23. The rotational torque should be within the following range excluding breakaway torque.
9.2 to 13.7 daN



⚠ **Caution:**
- **If the stated rotational torque range is exceeded the elastic spacer must be replaced and the procedure repeated**

24. The adjustment is carried out by increasing the pinion shaft retaining nut torque setting gradually, being careful not to exceed the stated range.
25. Once the correct rotational torque is achieved, secure the pinion shaft retaining nut.

26. Assemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.



DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL HOUSING GROUP

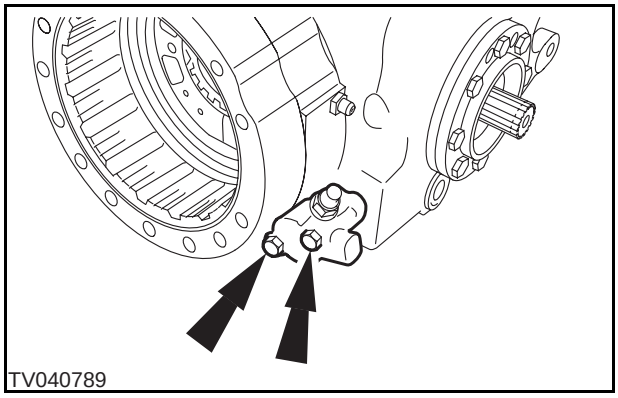
BHN1304DG

Operation: **Disassembly and Assembly of the Differential Housing Group**	*Job Code:* **13 14 13 xx**		Hrs.	Min.
Suitable lifting equipment	Standard tools, CA715265, CA715391, CA119033, CA715056, CA715146, CA715116, CA715156		6	30

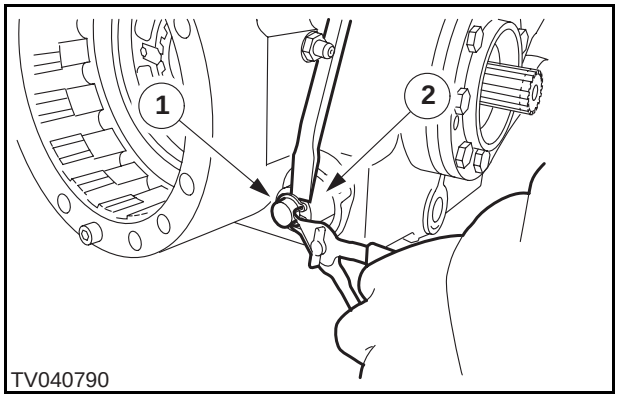
Disassembly

1. Remove the half shaft and brake group. For additional information, refer to HALF SHAFT AND BRAKE GROUP, PAGE N13–04–25 in this section.
2. Remove the differential lock actuator.

Note:
- Remove and discard the O-ring seal.

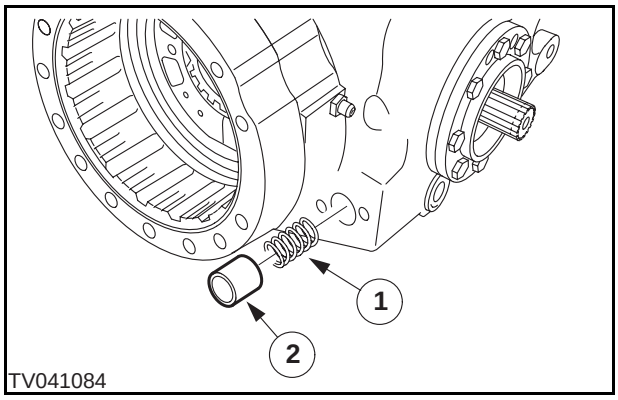

TV040789

3. Using a suitable lever and circlip pliers, remove the differential lock return spring circlip (1).
4. Remove the differential lock bush (2).



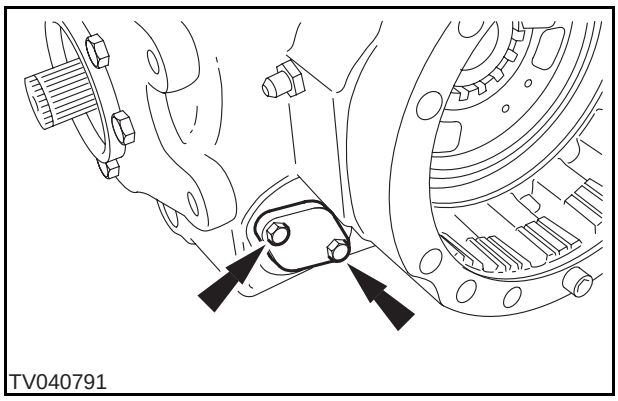
TV040790

5. Remove the bushing (2) and the differential lock return spring (1).

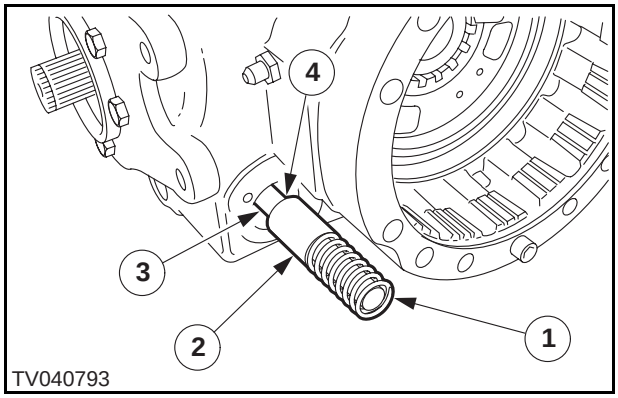


6. Remove the differential lock cover.

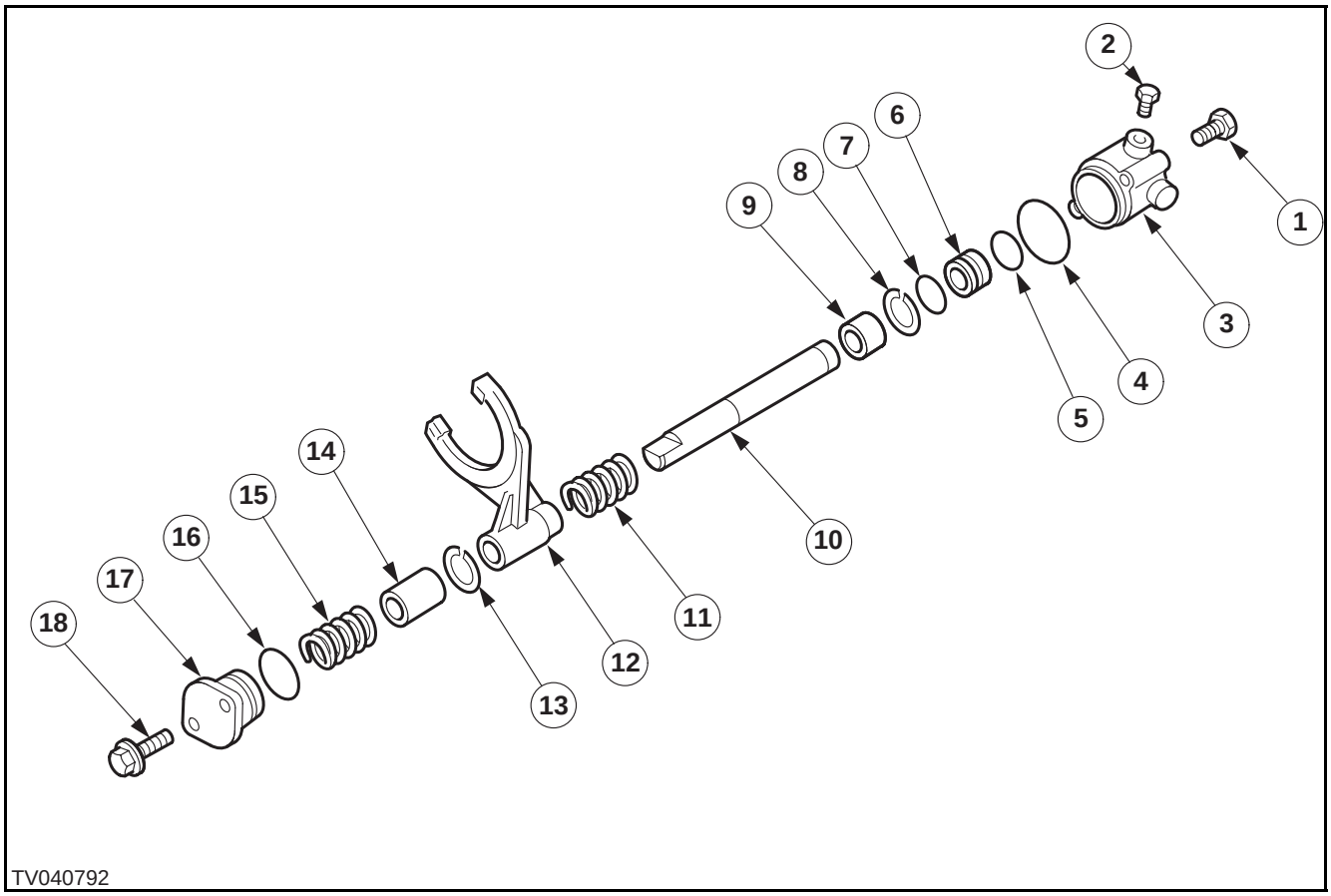
Note:
- Remove and discard the O-ring seal.



7. Remove the differential lock spring (1), spacer (2) shaft (3) and circlip (4).



Exploded View of Differential Lock Control

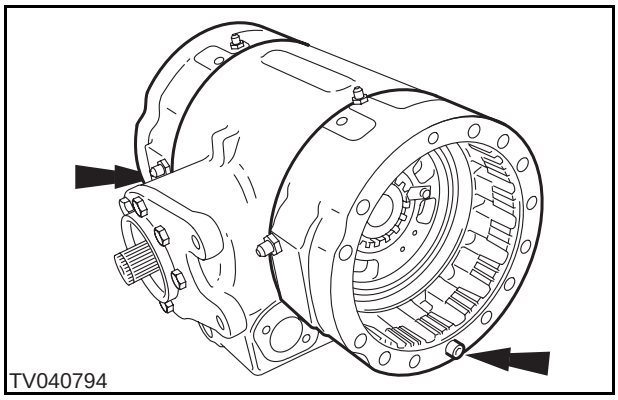


1	Retaining Bolt
2	Plug
3	Piston Housing
4	O-ring
5	Piston Seal
6	Piston
7	Piston Seal
8	Snap Ring
9	Bushing
10	Shaft
11	Spring
12	Fork
13	Snap Ring
14	Spacer
15	Spring
16	O-ring
17	Cover
18	Retaining Bolt

8. Remove the brake housing (both sides).

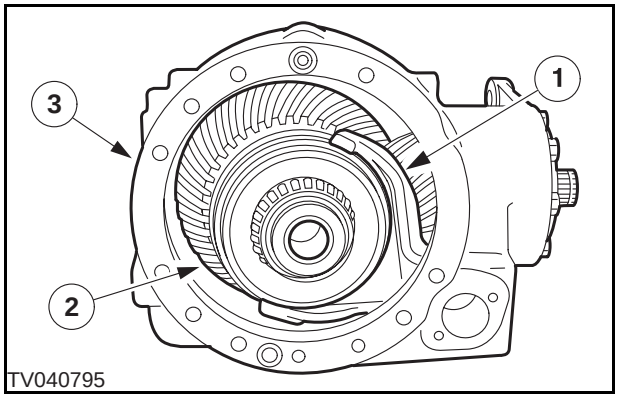
Note:
- Remove and discard the O-ring seals.

9. Remove the differential taper roller bearing cone from the brake housing.


TV040794

10. Re-position the differential lock fork (1).
11. Remove the differential assembly (2).

Note:
- Recover the differential lock fork (1).

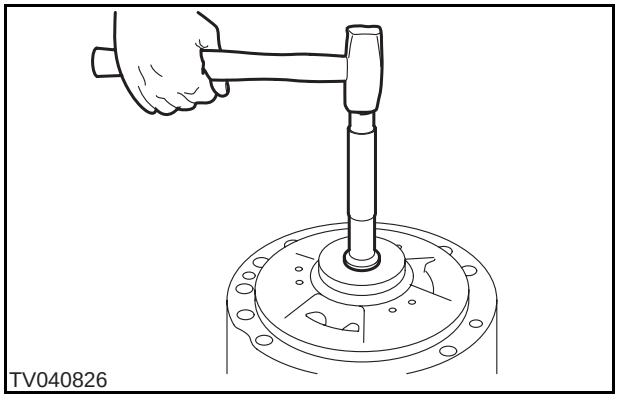


TV040795

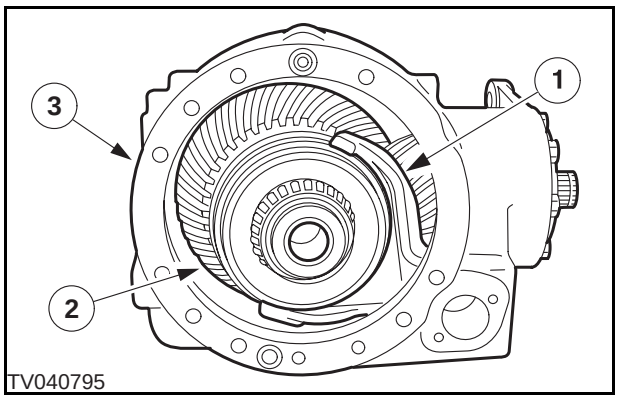
Assembly

Note:
- Position the brake housing on a suitable flat surface.

1. Using the special tool **CA715391 — Driver for bearing race** and **CA119033 — Interchangeable handle** , install the differential taper roller bearing cone.


TV040826

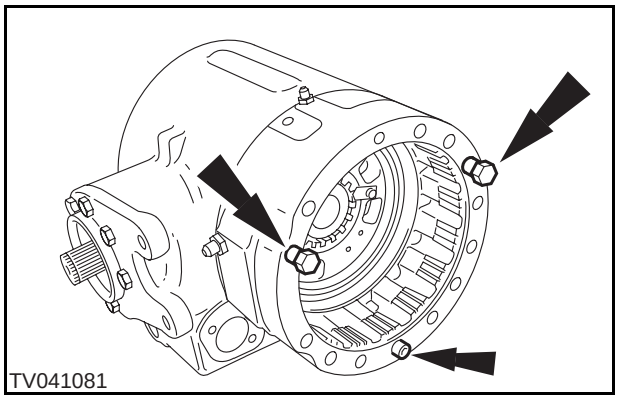
2. Loosely install the differential lock fork in the differential housing.
3. Install the differential (2) into the differential housing (3).
4. Install the differential lock fork (1) into the differential (2).



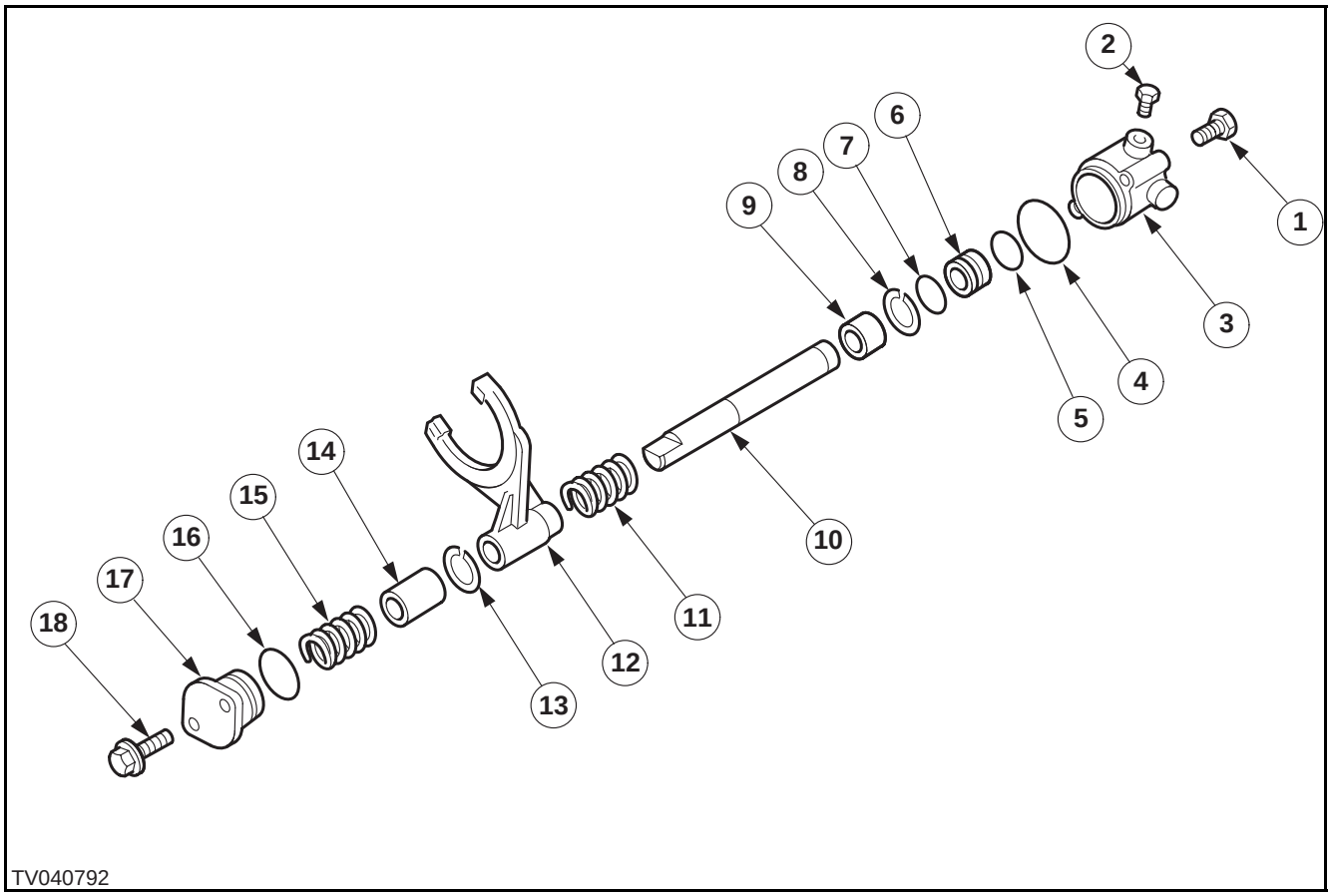
TV040795

5. Install the left hand side brake housing with three retaining bolts 120° apart.
6. Tighten to 79Nm (58 LB.FT).

7. Repeat steps 5 and 6 for the right hand side brake housing.

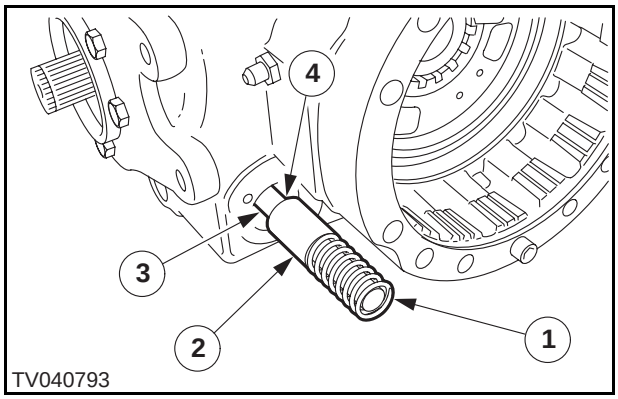

TV041081

Exploded View of Differential Lock Control

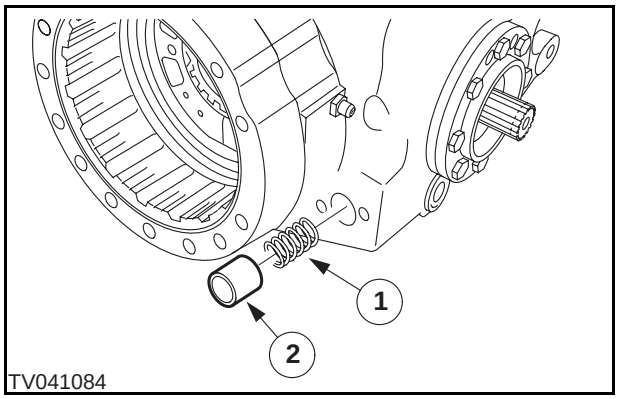


1	Retaining Bolt
2	Plug
3	Piston Housing
4	O-ring
5	Piston Seal
6	Piston
7	Piston Seal
8	Snap Ring
9	Bushing
10	Shaft
11	Spring
12	Fork
13	Snap Ring
14	Spacer
15	Spring
16	O-ring
17	Cover
18	Retaining Bolt

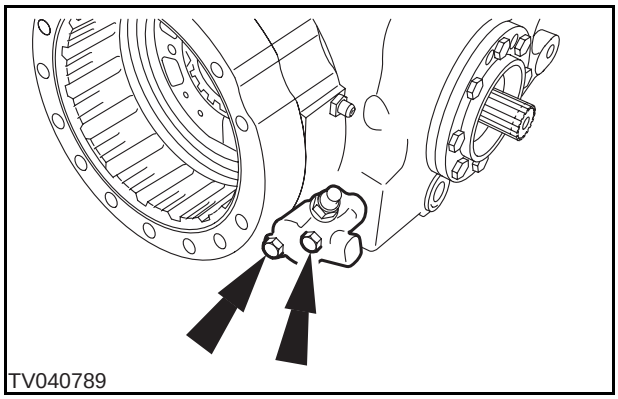
8. Install the circlip (4), shaft (3), spacer (2) and differential lock spring (1).



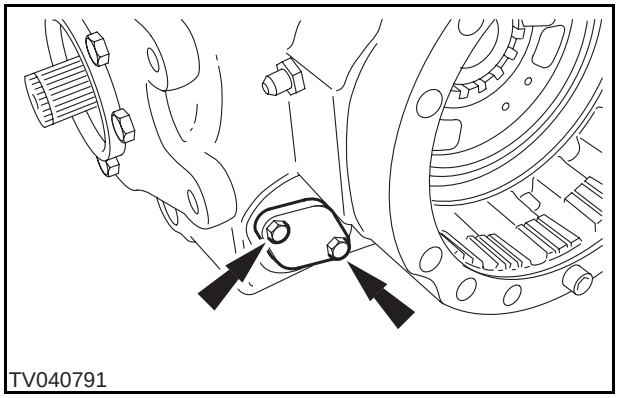
9. Install the differential lock return spring (1) and the bushing (2).



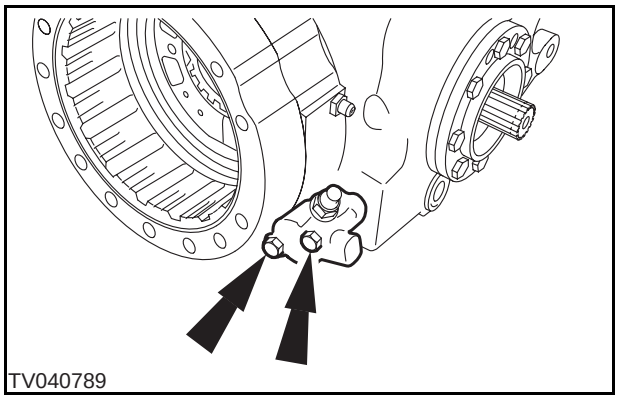
10. Loosely install the differential lock actuator.


TV040789

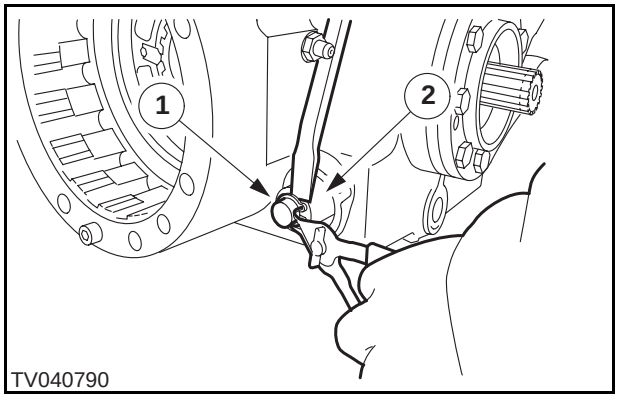
11. Install the differential lock cover.
12. Tighten to 27.6Nm.


TV040791

13. Remove the differential lock actuator.


TV040789

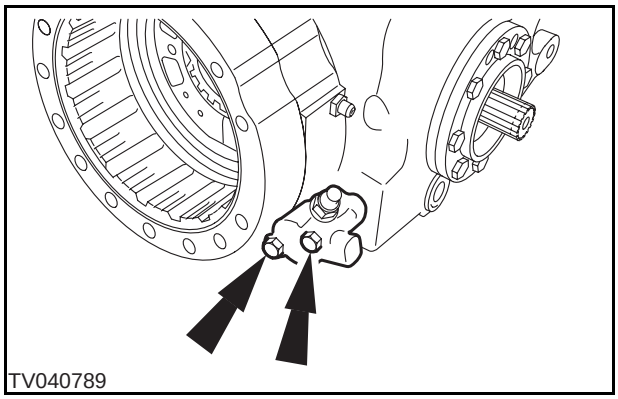
14. Using a suitable lever and circlip pliers, lever back the bushing (2) and install the differential lock return spring circlip (1).



TV040790

15. Install the differential lock actuator.

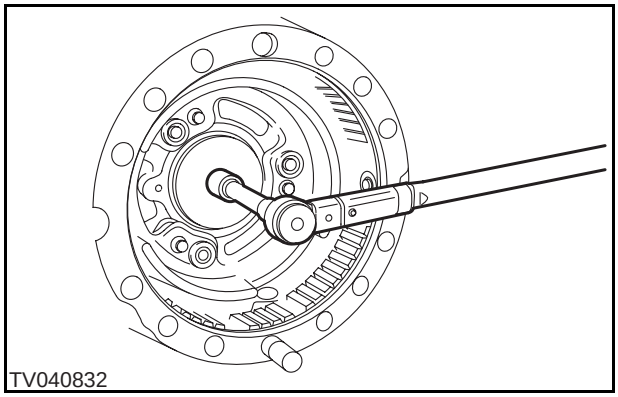
16. Tighten to 27.6Nm.


TV040789

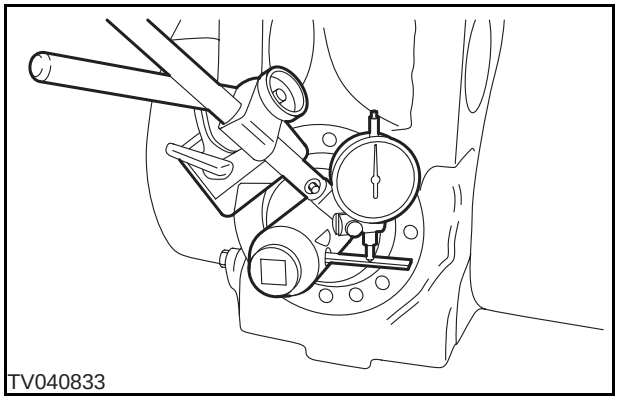
⚠ **Caution:**
- **All adjustments are to be carried out without the pinion shaft oil seal installed.**

Note:
- Only tighten the differential adjustment nut until the bearing free play is removed and nominal pre-load is achieved.

17. Using the special tool **CA715265 — Wrench for differential housing lock nut** , install the differential adjustment nuts.

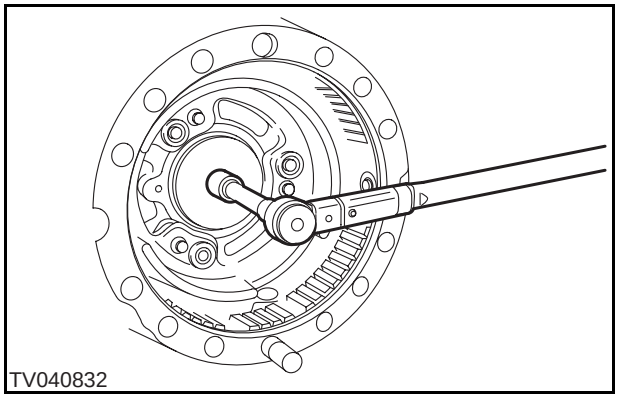

TV040832

18. Using a suitable measuring device and special tool **CA715146 — Kit for backlash measurement** , measure the pinion to crown wheel backlash.
19. The pinion to crown wheel backlash should be within the following range:
0.20mm – 0.30mm

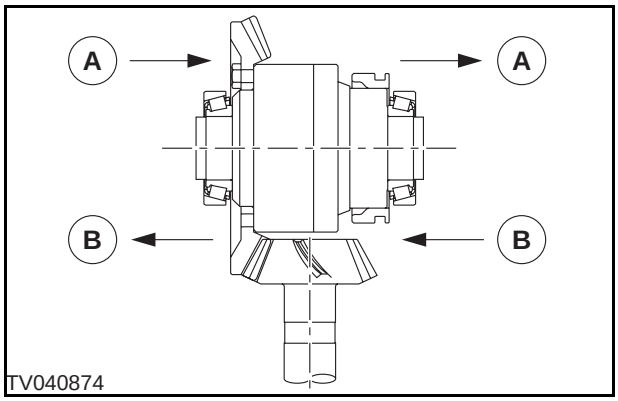

TV040833

Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the nominal bearing pre-load and no free play.

20. Using the special tool **CA715265 — Wrench for differential housing lock nut** , adjust the differential adjustment nuts until the correct pinion to crown wheel backlash is achieved.


TV040832

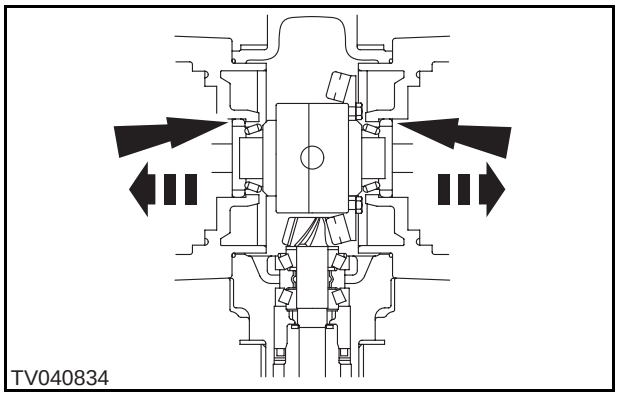
21.
- **Measured backlash is greater than the specified range — (A)** , adjust the differential assembly closer to the pinion shaft by loosening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment nut equal amounts.
- **Measured backlash is less than the specified range — (B)** , adjust the differential assembly away from the pinion shaft by tightening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment nut equal amounts.



TV040874

22. Once the correct pinion to crown wheel backlash is achieved, check that the differential taper roller bearings have no free play and no pre-load is evident.

23. Repeat steps 18 to 22 of the whole sequence of the above mentioned operations, until the indicated conditions are reached.


TV040834

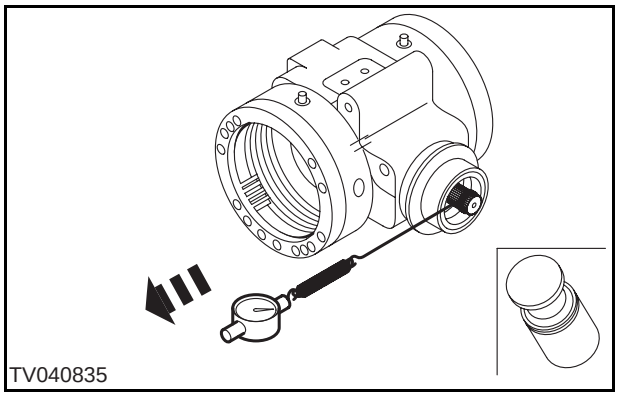
24. Install the special tool **CA715116 — Measurement** onto the pinion shaft.

    ⚠ Caution:
    - **All adjustments are to be carried out without the pinion shaft oil seal installed.**

    Note:
    - Using a suitable soft-faced hammer, settle the differential taper roller bearings.

    Note:
    - Rotate the differential assembly while tightening the adjustment nuts to seat the bearing rollers on their track.

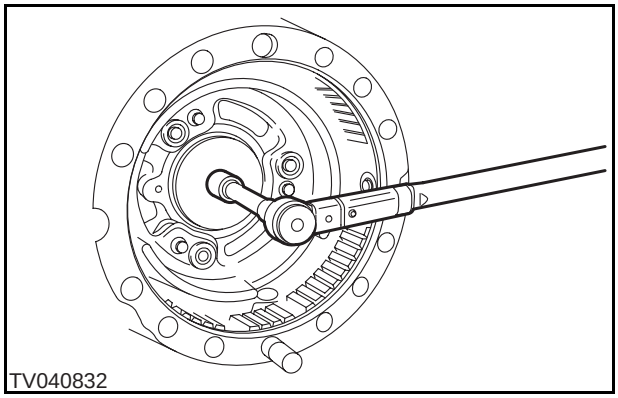
25. Using a suitable measuring device (with the cord wound on the 34.87 mm diameter of the special tool **CA715116 — measurement**), measure the total rotational torque.


TV040835

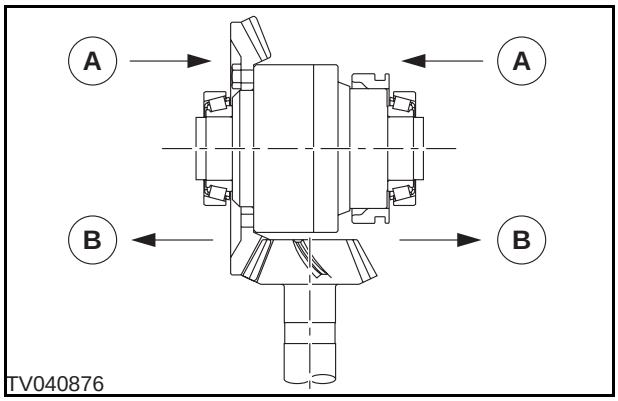
26. The total rotational torque should be within the following range excluding breakaway torque.
    (1.6 + P) to (2.4 + P) daN
    P = Measured pinion shaft rotational torque. For additional information refer to PINION GROUP, PAGE N13–05–49 in this section.

Note:
- Make sure the differential adjustment nuts are adjusted equally to retain the set backlash.

27. Using the special tool **CA715265 — Wrench for differential housing lock nut** , adjust the differential adjustment nuts until the correct differential taper roller bearing pre-load is achieved.


TV040832

28.
- **Total pre-load is less than the specified range — (A)** , increase the differential taper roller bearing pre-load by tightening the left-hand side (crown wheel side) adjustment nut and tightening the right-hand side adjustment equal amounts.
- **Total pre-load is higher than the specified range — (B)** , decrease the differential taper roller bearing pre-load by loosening the left-hand side (crown wheel side) adjustment nut and loosening the right-hand side adjustment equal amounts.

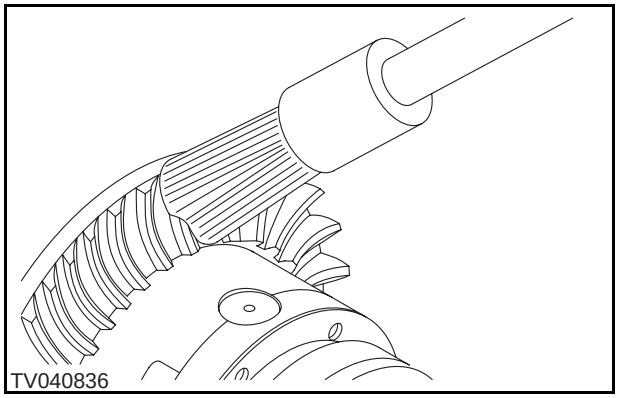


TV040876

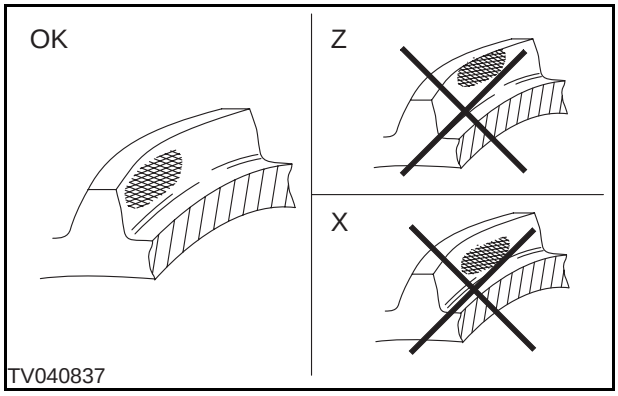
Testing After Adjustment

Note:
- The marking test should always be carried out on both sides of the crown wheel teeth.

29. To test the marks of the crown wheel teeth, paint the ring gear with red lead paint.

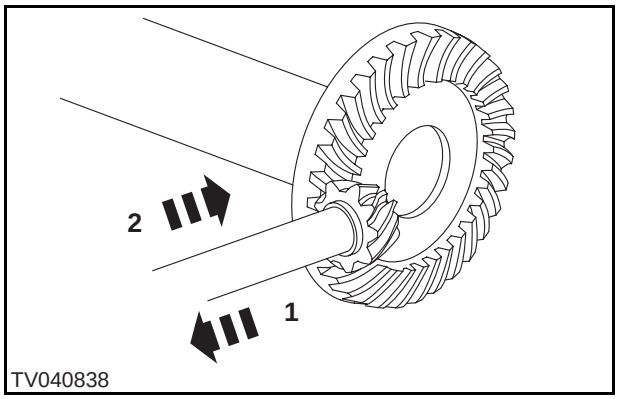

TV040836

30. Check the contact pattern:
    OK = Correct contact — If the crown wheel is well adjusted, the mark on the teeth surfaces will be regular.
    Z = Excessive contact on the tooth tip — Adjust the pinion towards the crown wheel and then adjust the crown wheel away from the pinion in order to adjust the backlash.
    X = Excessive contact at the tooth base — Adjust the pinion away from the crown wheel and then adjust the crown wheel towards the pinion in order to adjust the backlash.

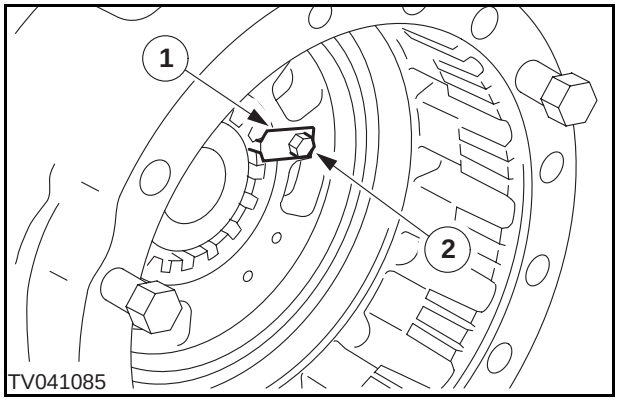


TV040837

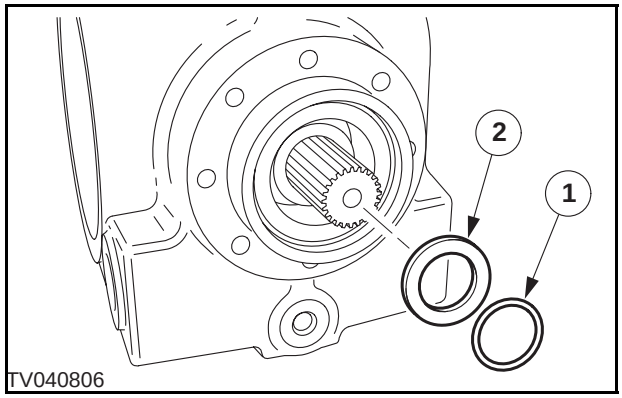
31. **Movements to correct**
    Adjust as required:
    1 = move the pinion for type X contact adjustment.
    2 = move the pinion for type Z contact adjustment.



32. Lock the differential adjustment nuts in position with the locking tabs (1) and secure with the retaining bolts (2).
33. Tighten to 13Nm.

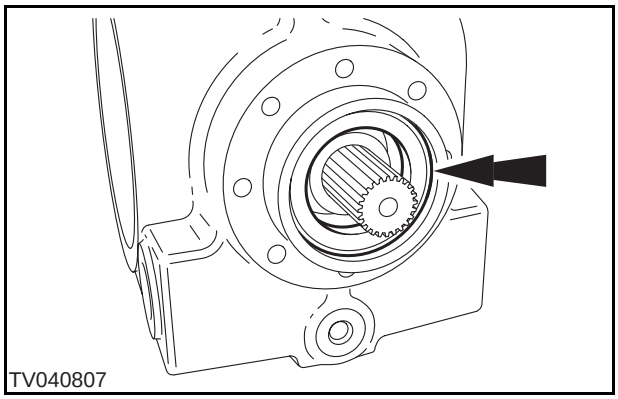


34. Install the spacer (2) and the O-ring (1).

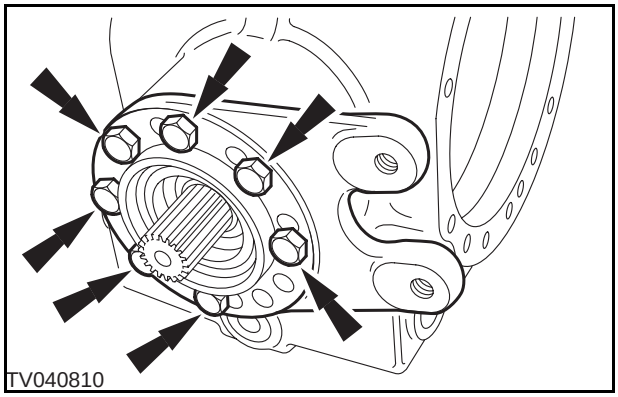


Note:
- Lubricate the oil seal with a light grease.

35. Using the special tool **CA715156 — Driver for oil seal** , install a new pinion shaft oil seal into the differential housing.


TV040807

36. Install the parking brake caliper mounting bracket.
37. Tighten to 80Nm.
38. Install the half shaft and brake group. For additional information, refer to HALF SHAFT AND BRAKE GROUP, PAGE N13–04–25 in this section.

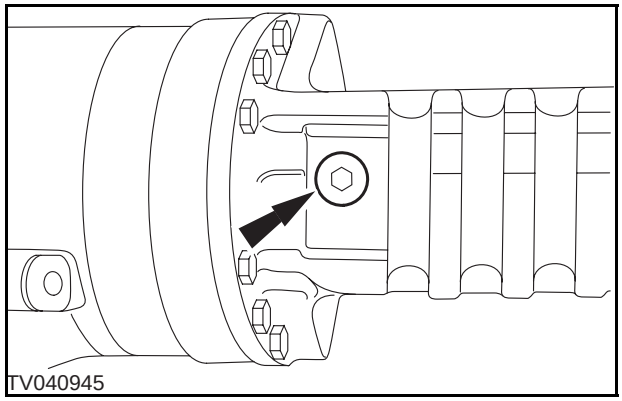

TV040810

GENERAL PROCEDURE — DRAINING AND FILLING THE REAR AXLE HOUSING OIL

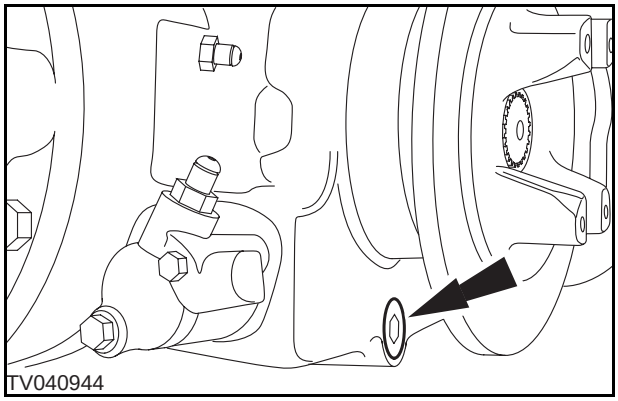
BHL1304GA

Draining

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Loosen the refill plug to release any pressure.

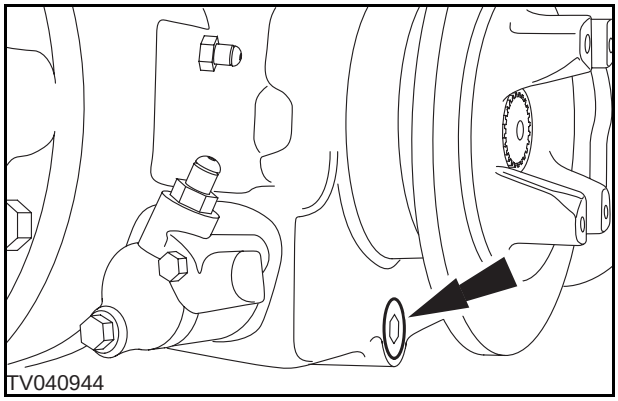

TV040945

3. Remove the drain plug and drain the oil into a suitable container.

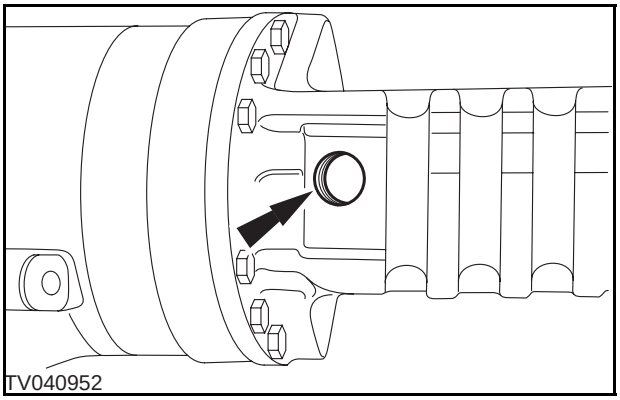

TV040944

Filling

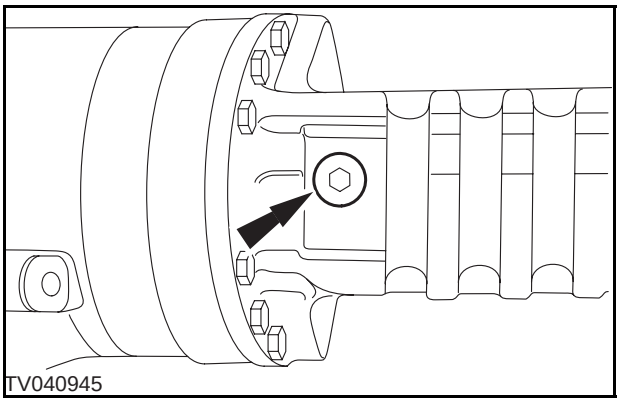
1. Install the drain plug and tighten to 60Nm (44 LB.FT).


TV040944

2. Fill with oil until the refill hole level is reached.


TV040952

3. Install the refill plug and tighten to 60Nm (44 LB.FT).


TV040945

SPECIFICATIONS — TWO-WHEEL STEER REAR AXLE

BHN1304SA

Special Tools

Tool No.	Description
CA119033	Interchangeable Handle
CA119087	Driver for Oil Seal
CA119099	Wrench for Lock Nut
CA715004	Driver for Bearing
CA715022	Pinion Shaft Lock Wrench
CA715026	Driver for Bearing Race
CA715027	Driver for Bush
CA715056	Driver for Oil Seal
CA715116	Extension for Pre-load Measurement
CA715128	False Pinion
CA715133	Driver for Bearing
CA715146	Kit for Backlash Measurement
CA715156	Driver for Oil Seal
CA715265	Wrench for Differential Housing Lock Nut
CA715386	Driver for Bush
CA715387	Driver for Oil Seal
CA715388	False Differential
CA715391	Driver for Bearing Race

General Specifications

Description	Value
Input rotation	Powershift - counter clockwise Synchro shuttle — clockwise
Grease type	POLYMER 400/L DIN = KHER1R ISO-1–XMR-XM2
Differential Backlash	0.20 — 0.30 daN
Pinion Shaft Bearing Pre-load “P”	“P” = 9.2 — 13.7 daN
Total Pinion/Differential Bearing Pre-load	(1.6 + P) — (2.4 + P) daN
Brake Type	Wet Disc
No. of Brake Friction Discs (Each Side)	2
No. of Counter Discs (Each Side)	3
Nominal Brake Friction Disc Thickness	4.83mm
Nominal Counter Disc Thickness	5/10.8/9mm
Max. Brake Friction Disc Wear (Each Side)	0.15mm
Brake Activation Oil	Mineral Oil
Brake Activation Oil Displacement	12 + 12cc
Max. Operating Pressure	43 bar
Flange Type	END YOLK 1410

Capacity

System	Temperatures	Viscocity	Specification	Capacity	Notes
Rear Axle	ALL	80W	API GL4 M1135	14.5 + 1.5 + 1.5	Approved oils: Agip Rotra Multi THT, Esso Torque Fluid 62, Mobil Fluid 422 or 424

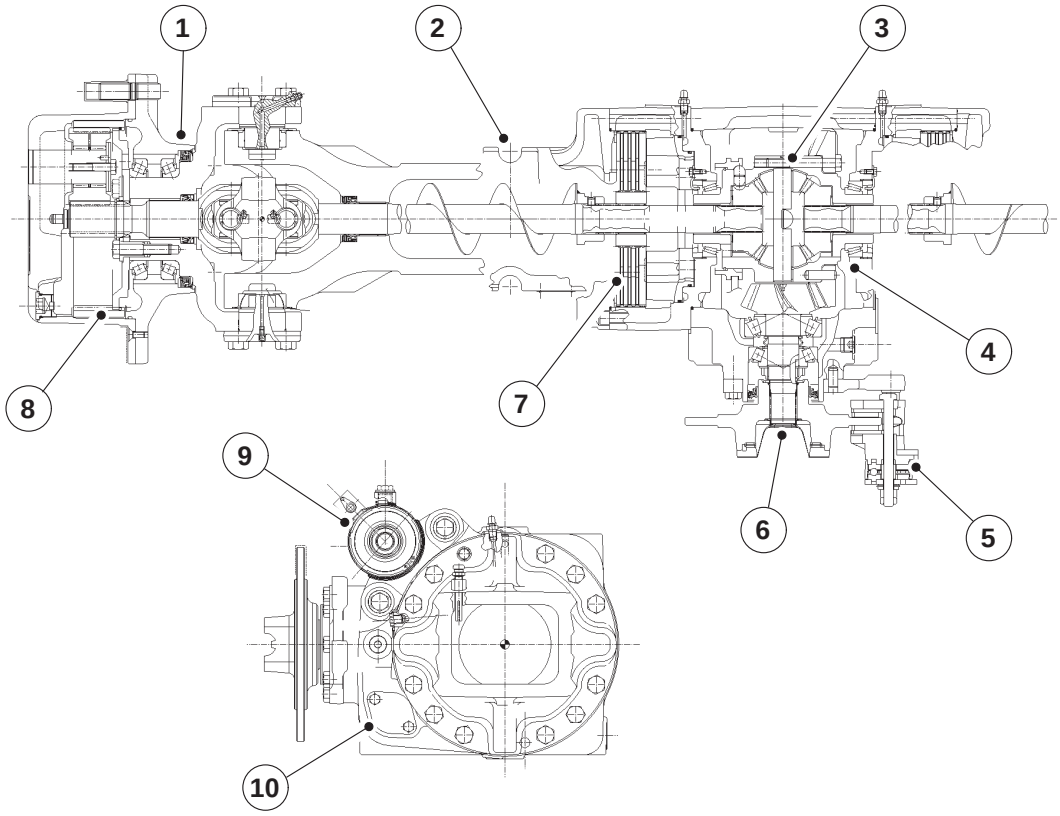
Torque Values

Description	Nm	Lb.ft
Epicyclic Gear	79	58
Wheel Hub	230	170
Hub Drain Plug	60	44
Wheel Studs	70	52
Epicyclic Reduction Hub	25	18
Brake Housing	79	58
Crown Wheel	155	114
Differential Adjustment Nut Locking Tabs	13	10
Half shaft Housing	130	96
Parking Brake Caliper Mounting Bracket	80	59
Parking Brake Caliper	150	111
Parking Brake Caliper Cable Bracket	45	33
Brake Self Adjust Bolts	10	7
Differential Lock Actuator	27.6	20
Differential Lock Cover	27.6	20
Brake Bleed Valve	10	7
Breather Union	15	11
Breather	10	7
Blanking Plug	25	18

DESCRIPTION AND OPERATION — FOUR-WHEEL STEER REAR AXLE

BHN1305OA

General Description



TV041105

1	Wheel Hub Group
2	Axle Beam Trumpet Group
3	Differential Group
4	Differential Support Group
5	Parking Brake Group
6	Pinion Group
7	Brake Group
8	Epicyclic Reduction Gear Group
9	Steering Cylinder Group
10	Differential Locking Group

The axle described in this manual consists of the following groups:

- WHEEL HUB GROUP: wheel support parts containing the epicyclic reduction gears.
- AXLE BEAM TRUMPET GROUP: load-bearing shell structure of the axle.
- DIFFERENTIAL GROUP: differential parts with crown wheel gear.
- DIFFERENTIAL SUPPORT GROUP: differential housing with crown wheel gear adjusting system.
- PARKING BRAKE GROUP: parking brake parts and brake support structure.
- PINION GROUP: pinion with adjusting and support parts.
- BRAKE GROUP: brake parts brake shell structure.
- EPICYCLIC REDUCTION GEAR GROUP: planetary carrier with reduction/transmission parts.
- STEERING CYLINDER GROUP: steering cylinder parts with adjusting system.
- DIFFERENTIAL LOCKING GROUP: control parts of the differential locking.

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DIAGNOSING AND TESTING — FOUR-WHEEL STEER REAR AXLE

BHN1305TA

Problem	Possible Cause	Action
Ring gear tooth broken at the outer side	• Excessive gear load compared to the one foreseen.	• REPLACE crown wheel and pinion gear set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Incorrect gear adjustment (excessive backlash).	• REPLACE crown wheel and pinion gear set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Pinion nut loosened.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
Ring gear tooth broken side	• Load bump.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Incorrect gear adjustment (insufficient backlash).	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
	• Pinion nut loosened.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash.
Pinion or ring gear teeth worn	• Insufficient lubrication.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.

Problem	Possible Cause	Action
Pinion or ring gear teeth worn (continued)	• Contaminated oil.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.
	• Incorrect lubrication or depleted additives.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.
	• Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.	• REPLACE crown wheel and pinion set. • FOLLOW carefully the recommended operations for the adjustment of crown wheel and pinion set backlash. • USE correct lubricants, FILL to the right levels and REPLACE according to the recommended program.
Overheated ring and pinion teeth. Check if gear teeth have faded.	• Prolonged functioning at high temperatures.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
	• Incorrect lubrication.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
	• Low oil level.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
	• Contaminated oil.	• REPLACE crown wheel and pinion set. • USE proper lubrication, FILL to the right level and REPLACE at recommended program.
Axle beam body bent	• Vehicle overloaded.	• REPLACE axle beam body.
	• Vehicle accident.	• REPLACE axle beam body.
	• Load bump.	• REPLACE axle beam body.

Problem	Possible Cause	Action
Pinion teeth pitting	• Excessive wear.	• REPLACE crown wheel and pinion set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE crown wheel and pinion set. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Worn out or pitted bearings	• Insufficient lubrication.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Excessive wear.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
	• Pinion nut loosened.	• REPLACE bearings. • USE correct lubrication, FILL to the right level and REPLACE at recommended intervals.
Oil leakage from gaskets and seals	• Prolonged functioning at high temperature of the oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Oil gasket assembled incorrectly.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Seal lip damaged.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE the gasket or seal and matching surface if damaged. • USE correct lubrication and REPLACE at recommended intervals.

Problem	Possible Cause	Action
Excessive wearing out of input flange spline	• Heavy use.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE crown wheel and pinion set if required.
	• Pinion nut loosened.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE crown wheel and pinion set if required.
	• Pinion axle backlash.	• REPLACE the flange. • CHECK that the pinion spline is not excessively worn out. • REPLACE crown wheel and pinion set if required.
Fatigue failure of pinion teeth. Check if the fracture line is well defined (wave lines, beach lines)	• Heavy use.	• REPLACE crown wheel and pinion set.
	• Continuous overload.	• REPLACE crown wheel and pinion set.
Pinion and ring teeth breakage	• Crash load of differential components.	• CHECK and/or REPLACE other differeential components.
Side gear spline worn out. Replace all scratched washers (Excessive backlash)	• Excessive wear.	• REPLACE differential gear group. • REPLACE halfshaft if required.
Thrust washer surface worn out or scratched	• Insufficient lubrication.	• USE correct lubrication and FILL to right level. • REPLACE at recommended intervals. • REPLACE all scratched washers and those with 0.1 mm thickness lower than the new ones.
	• Incorrect lubrication.	• USE correct lubrication and FILL to right level. • REPLACE at recommended intervals. • REPLACE all scratched washers and those with 0.1 mm thickness lower than the new ones.
	• Contaminated oil.	• USE correct lubrication and FILL to right level. • REPLACE at recommended intervals. • REPLACE all scratched washers and those with 0.1 mm thickness lower than the new ones.

Problem	Possible Cause	Action
Inner diameter of tapered roller bearing worn out	• Excessive wear.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
	• Excessive pinion axial backlash.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
	• Insufficient lubrication.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
	• Contaminated oil.	• REPLACE bearing. • CHECK pinion axial backlash. • USE proper lubrication, FILL to right level and REPLACE at recommended intervals.
Bent or broken halfshaft	• Vehicle intensively operated or overloaded.	• REPLACE half shaft.
Halfshaft broken at wheel side	• Wheel support loosened.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.
	• Beam body bent.	• REPLACE half shaft. • CHECK that wheel support is not worn out or wrongly adjusted.

Axle Problem and Diagnosis

Problem	Possible Cause	Action
Noise while driving	• Excessive backlash between pinion and ring gear.	• ADJUST.
	• Worn out pinion and gear ring.	• REPLACE.
	• Worn out pinion bearings.	• REPLACE.
	• Pinion bearings loosened.	• ADJUST.
	• Excessive axial pinion backlash.	• ADJUST.
	• Worn out differential bearings.	• REPLACE.
	• Differential bearings loosened.	• ADJUST.
	• Ring gear out of roundness.	• REPLACE.
	• Low Lubricant level.	• OIL level.
	• Poor or wrong lubricant.	• REPLACE.
	• Bent halfshaft.	• REPLACE.
Noise whilst driving in neutral	• Noise coming from axle is usually heard when vehicle moves in neutral gear but are not loud.	• REPLACE or ADJUST (see above).
	• Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed.	• REPLACE.
	• Pinion or input flange worn out.	• ADJUST.
Intermittent noise	• Ring gear damaged.	• REPLACE crown wheel and pinion set.
	• Differential box bolts loosened.	• TIGHTEN to torque.
Constant noise	• Ring gear teeth or pinion damaged.	• REPLACE crown wheel and pinion set.
	• Worn out bearings.	• REPLACE.
	• Pinion spline worn out.	• REPLACE.
	• Bent halfshaft.	• REPLACE.
Noise while steering	• Worn out differential gears.	• REPLACE.
	• Worn out differential box or spider.	• REPLACE.
	• Differential thrust washers worn out.	• REPLACE.
	• Halfshaft spline worn out.	• REPLACE.

REMOVAL AND INSTALLATION — FOUR-WHEEL STEER REAR AXLE

BHN1305RA

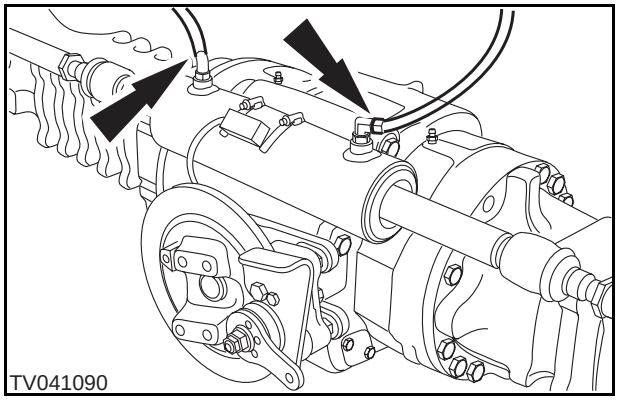
Operation: **Removing and Installing the Rear Axle (Four-Wheel Steer)**	*Job Code:* **13 52 13 xx**		
Suitable transmission jack	Standard tools		

Removal

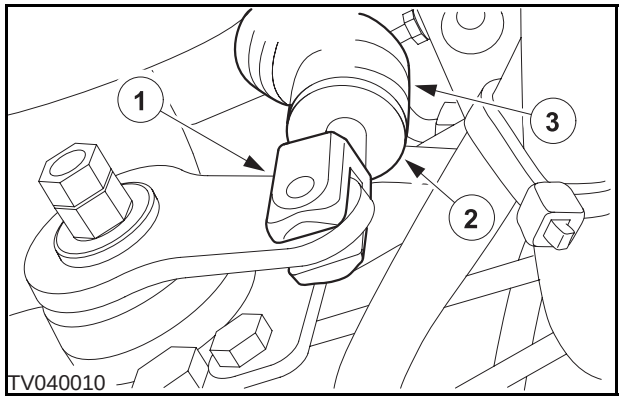
1. Remove the rear wheels. For additional information, refer to Section M12-01 REAR WHEEL .
2. Isolate the battery ground cable. For additional information, refer to section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
3. Remove the four wheel steer change over valve. for additional information, refer to section L11-04 FOUR WHEEL STEER CHANGE OVER VALVE .

   Note:
   - Install blanking plugs to avoid contamination.

4. Disconnect the rear axle steering cylinder supply and return pipes (Rear axle shown removed for clarity).


TV041090

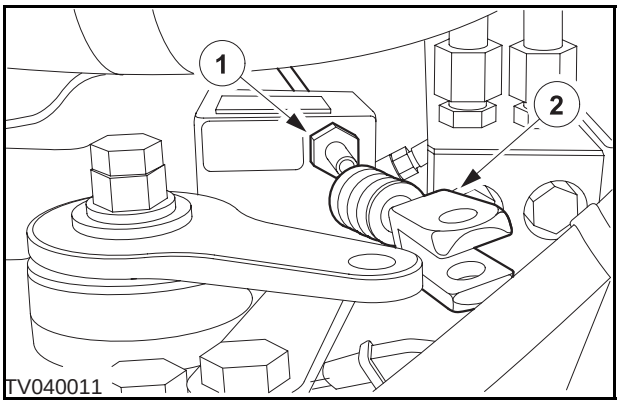
5. Remove the parking brake cable retaining clip (1).
6. Remove the parking brake cable return spring retainer (2).
7. Remove the parking brake cable return spring (3).



TV040010

8. Remove the parking brake cable adjustment nut (1).

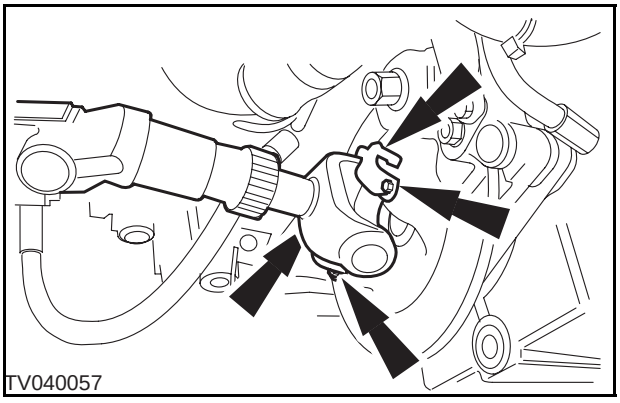
9. Detach the parking brake cable from the parking brake caliper (2).



Note:
- Secure the propshaft to prevent disengagement of the sliding joint.

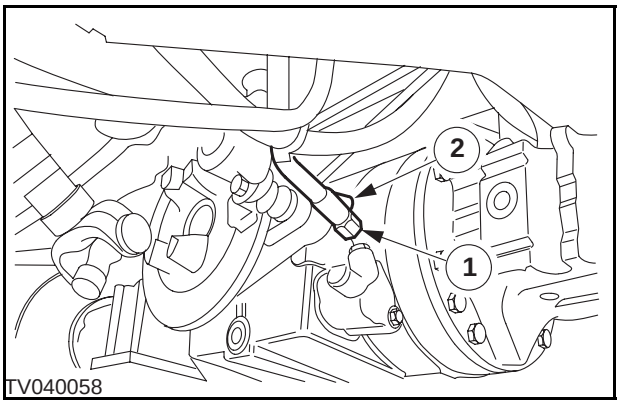
10. Detach the rear propshaft from the rear axle.

Note:
- Discard the retaining bolts.



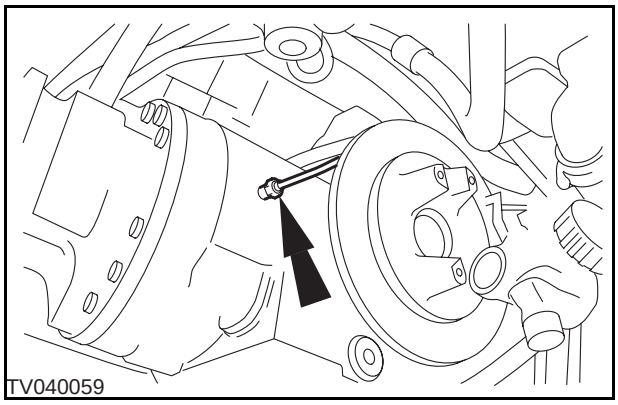
Note:
- Install blanking plugs to avoid contamination.

11. Disconnect the rear axle oil supply pipe (1).
12. Disconnect the rear axle left-hand brake supply pipe (2).



Note:
- Install blanking plugs to avoid contamination.

13. Disconnect the rear axle right-hand brake supply pipe.

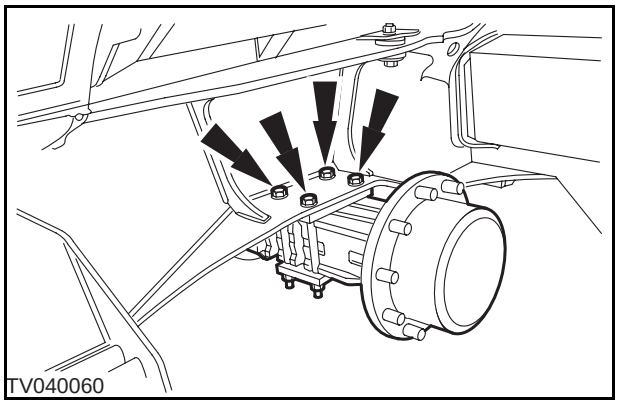

TV040059

⚠ Warning:
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:
- Secure the transmission jack to the rear axle.

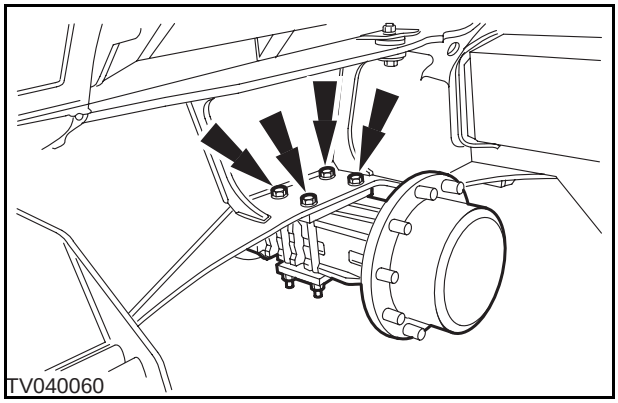
14. Using a suitable transmission jack, support the rear axle.
15. Remove the rear axle retaining bolts and remove the rear axle (left-hand side shown, right-hand side similar

Note:
- Recover the securing plates.


TV040060

Installation

1. To install, reverse the removal procedure. Tighten to 260Nm (192 lb.ft).



2. Bleed the brakes. For additional information, refer to Section N13-01 BRAKE BLEEDING (POWER BRAKES), PAGE N13–01–153 .
3. Check and adjust the hydraulic oil level as required.

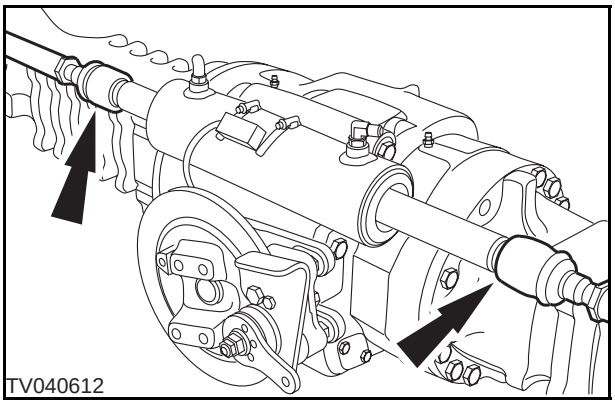
REMOVAL AND INSTALLATION — STEERING CYLINDER (FOUR-WHEEL STEER)

BHN1305RC

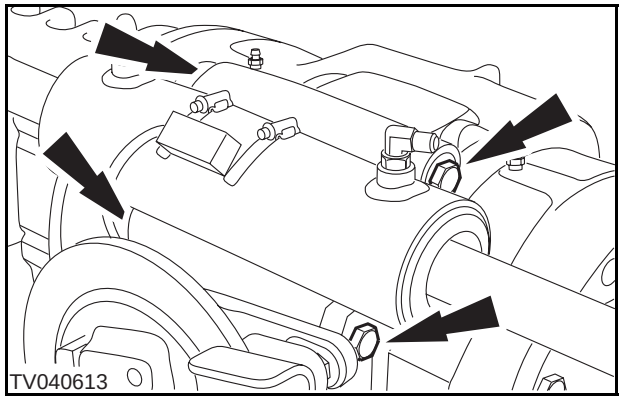
Operation: **Removing and Installing the Steering Cylinder (Four-Wheel Steer)**	*Job Code:* **13 53 13 xx**		
None	Standard tools, Suitable slide hammer		

Removal

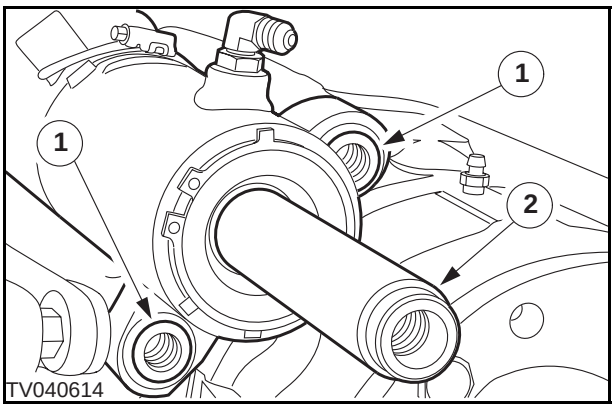
1. Remove the rear axle. For additional information, refer to REAR AXLE, PAGE N13–05–9 in this section.
2. Disconnect the inner tie rods from the rear axle steering ram cylinder.



3. Remove the rear axle steering ram retaining bolts



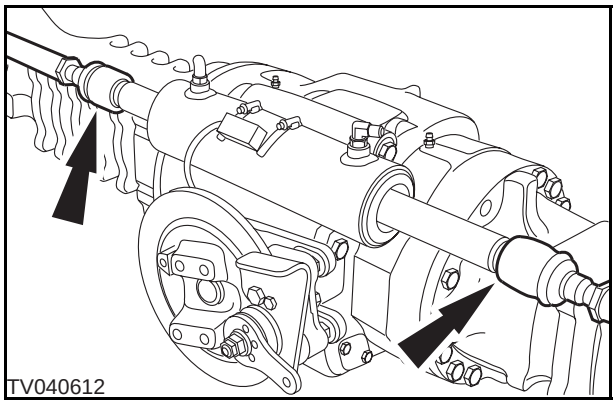
4. Using a suitable slide hammer, remove the rear axle steering ram retaining sleeves (1) and remove the steering ram (2).



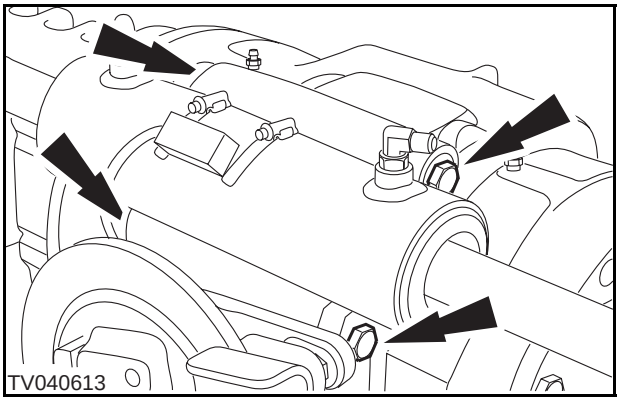
Installation

1. To install, reverse the removal procedure.

2. Tighten to 300Nm (221 lb.ft).



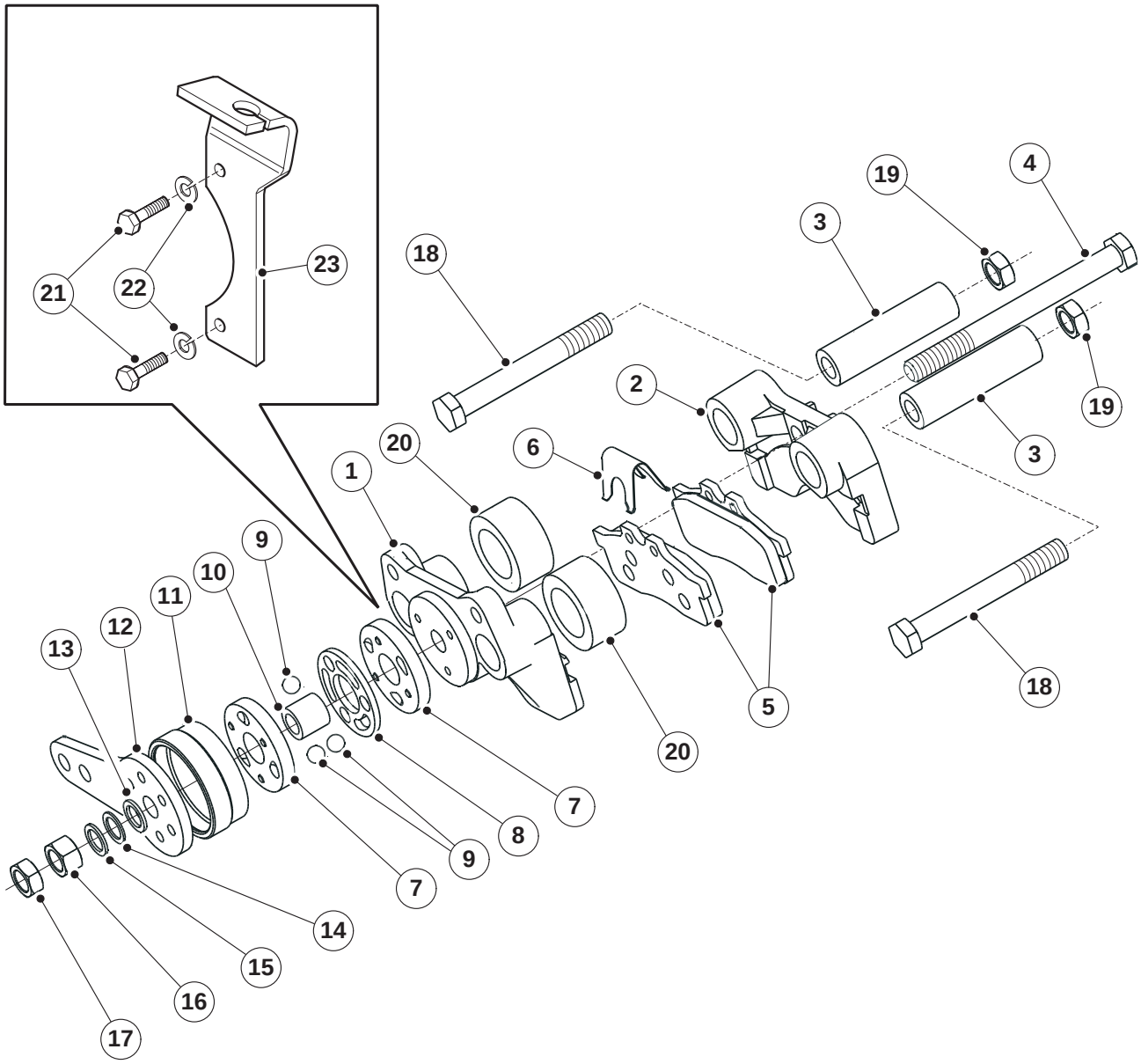
3. Tighten to 660Nm (487 lb.ft).



DISASSEMBLY AND ASSEMBLY — PARKING BRAKE CALIPER (FOUR-WHEEL STEER)

BHN1305DA

Operation: **Disassembly and Assembly of the Parking Brake Caliper (Four-Wheel Steer)**	*Job Code:* **13 07 17 xx**		
None	Standard tools		



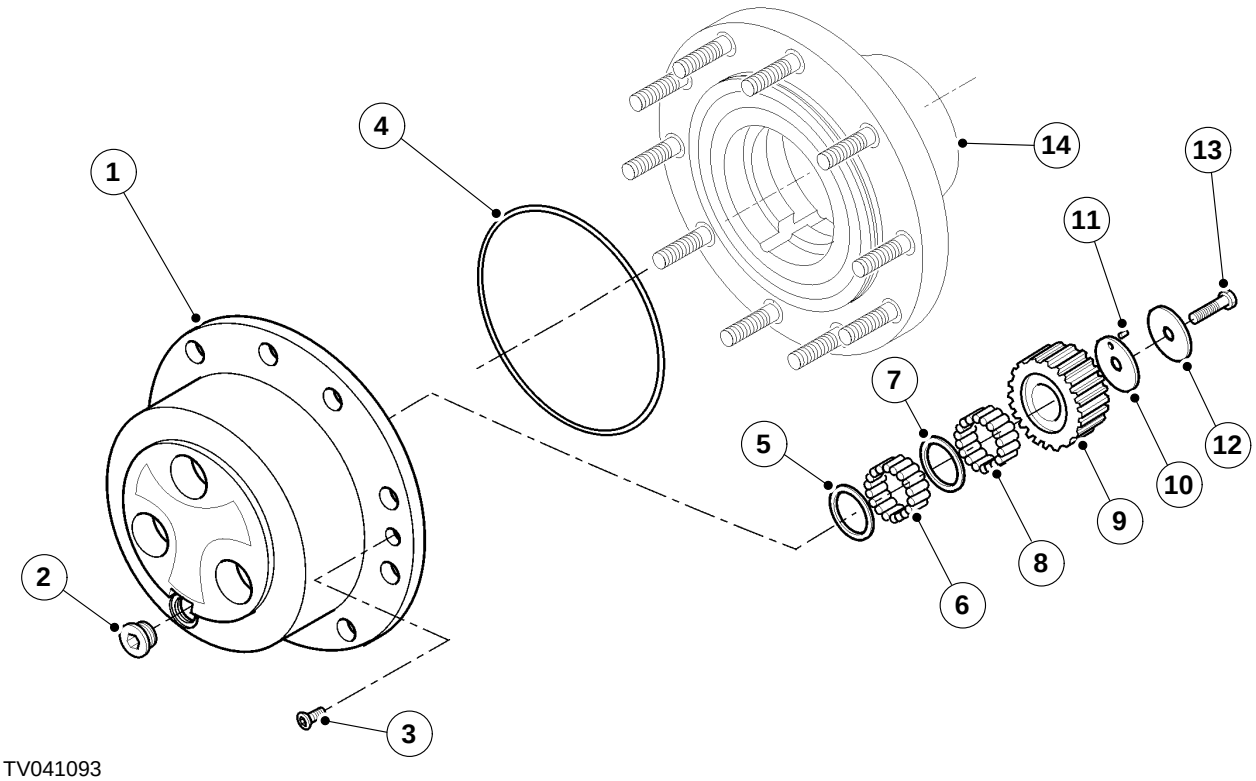
TV040817

1	Front Torque Plate
2	Rear Torque Plate
3	Spacer
4	Adjustment Bolt
5	Brake Friction Pads
6	Spring Clip
7	Outer Cam
8	Inner Cam
9	Ball
10	Seal
11	Boot
12	Lever
13	Thrust Washer
14	Stainless Steel Washer
15	Hardened Washer
16	Adjustment Nut
17	Locking Nut
18	Mounting Bolt
19	Locking Nut
20	Sleeve Seal
21	Bolt
22	Lock Washer
23	Cable Retaining Bracket

DISASSEMBLY AND ASSEMBLY — EPICYCLIC REDUCTION GEAR GROUP (FOUR WHEEL-STEER)

BHN1305DB

Operation: **Disassembly and Assembly of the Epicyclic Reduction Gear Group (Four-Wheel Steer)**	*Job Code:* **13 16 17 xx**		
None	Standard tools Suitable container		



TV041093

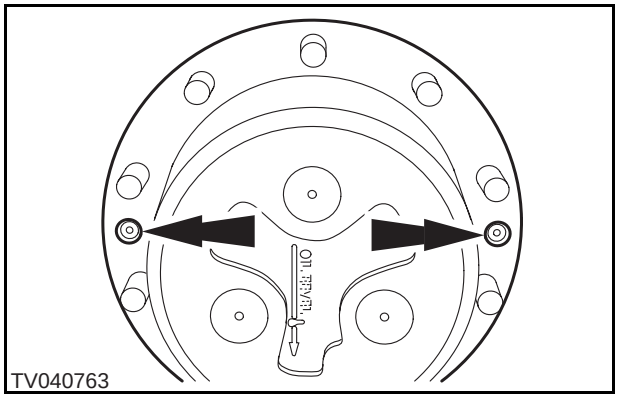
1	Planetary Carrier
2	Drain Plug
3	Retaining Screw
4	O-Ring
5	Thrust Washer
6	Needle Roller Bearings
7	Thrust Washer
8	Needle Roller Bearings
9	Epicyclic Gear
10	Washer
11	Dowel Pin
12	Washer
13	Retaining Bolt

Disassembly

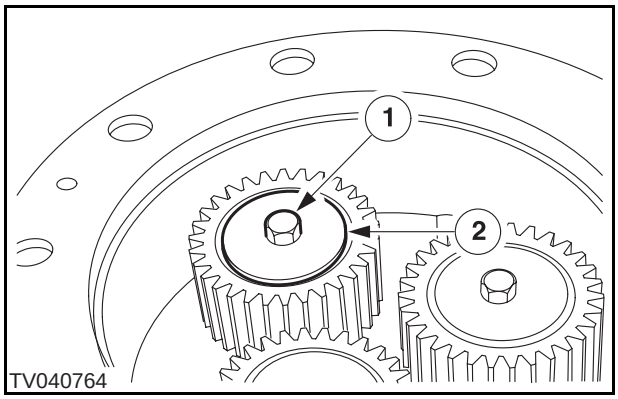
1. Remove the wheel. For additional information, refer to M12-01 REAR WHEEL, PAGE M12–01–5 .

2. Drain the hub oil. For additional information, refer to L11-02 DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67
3. Remove the epicyclic reduction gear carrier.

   Note:
   - Remove and discard the O-ring oil seal.

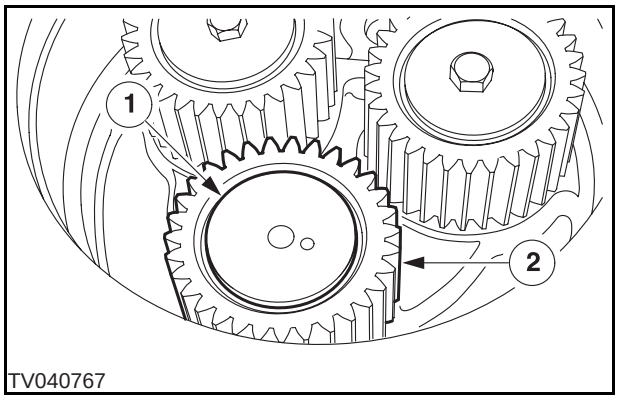


4. Remove the epicyclic gear retaining bolt (1) and washer (2).



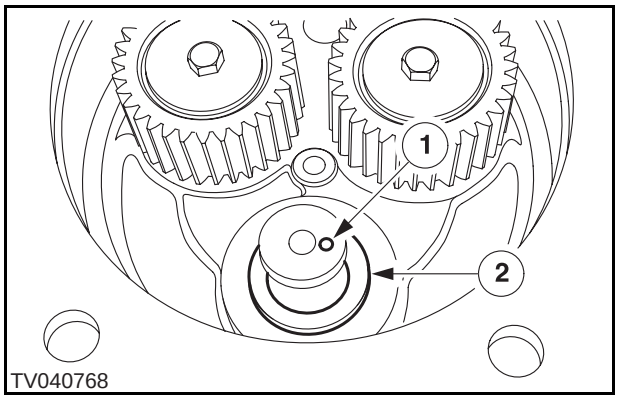
5. Remove the locating washer (1) and the epicyclic gear (2).

   Note:
   - Recover both sets of needle roller bearings and the needle roller bearings spacers.

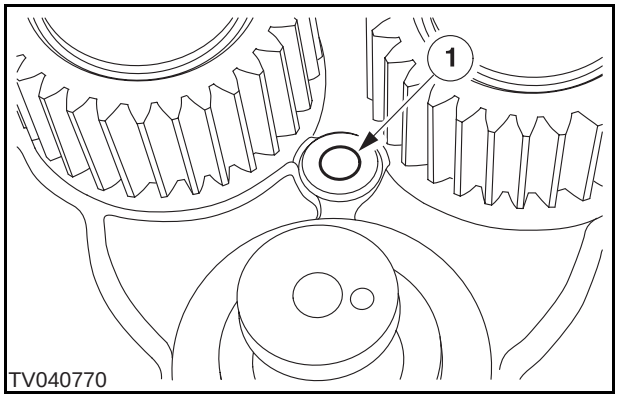


6. Remove the locating pin (1) and the wear washer (2).
7. Repeat steps 5, 6 and 7 to remove the remaining epicyclic gears.

8. Inspect the pinion pins, if they are in poor condition a new epicyclic reduction gear carrier assembly should be installed.

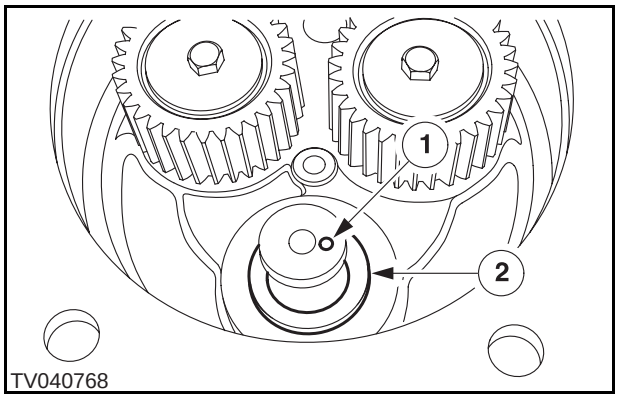


9. If the half-shaft stop (1) is worn, a new epicyclic reduction gear carrier assembly should be installed.

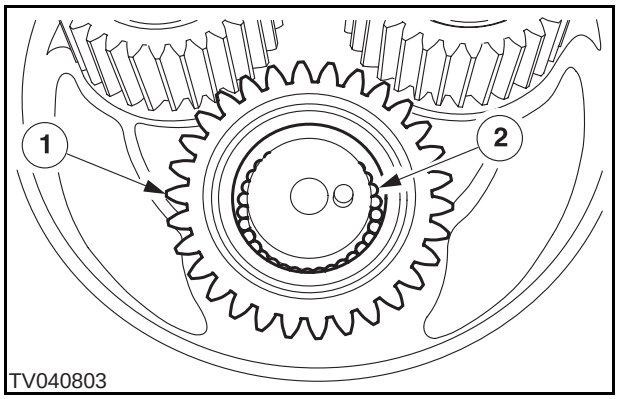


Assembly

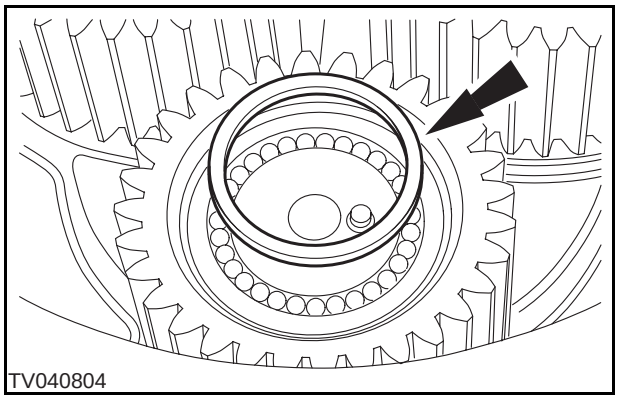
1. Install the wear washer (2) and the locating pin (1).



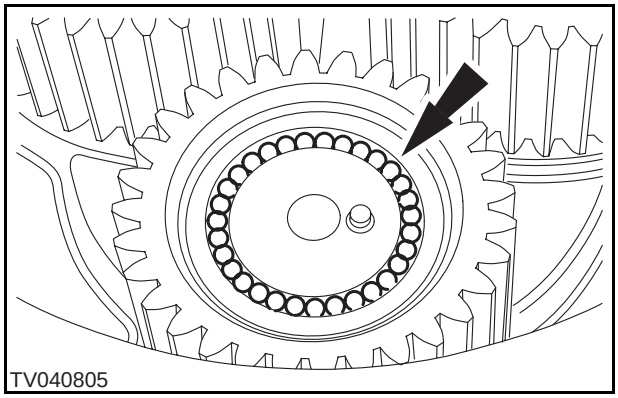
2. Install the epicyclic gear (1) and the first set of needle roller bearings (2).



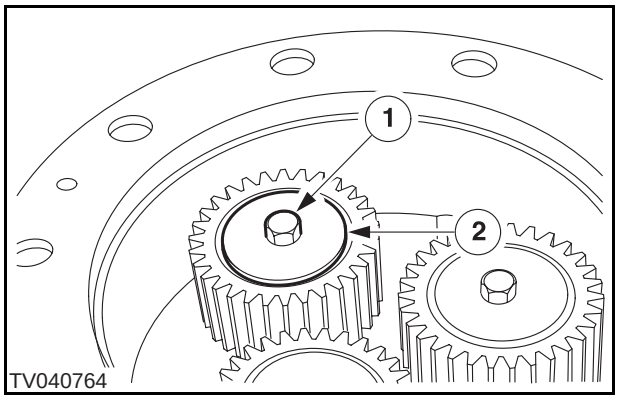
3. Install the needle roller bearings spacer.


TV040804

4. Install the second set of needle roller bearings.
5. Repeat steps 1 to 4 to install the remaining epicyclic gears.


TV040805

6. Install the washer (2) and epicyclic gear retaining bolt (1).
7. Tighten (1) to 79Nm (58 lb.ft).

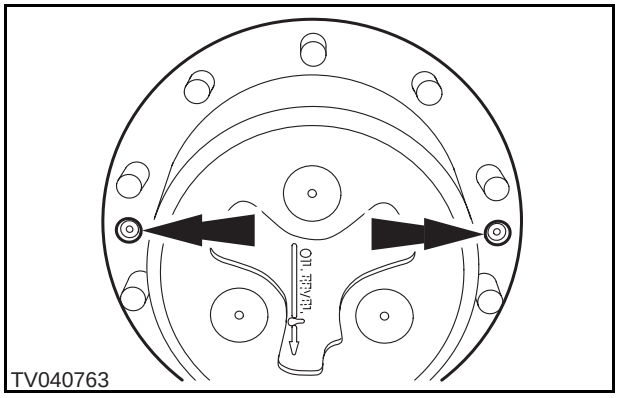


TV040764

Note:
- Install a new O-ring oil seal.

8. Install the epicyclic reduction gear carrier.
9. Tighten to 25Nm (18 lb.ft).
10. Fill the hub with oil. For additional information, refer toL11-02 DRAINING AND FILLING THE HUB OIL, PAGE L11–02–67

11. Install the rear wheel. For additional information, refer toM12-01 REAR WHEEL, PAGE M12–01–5

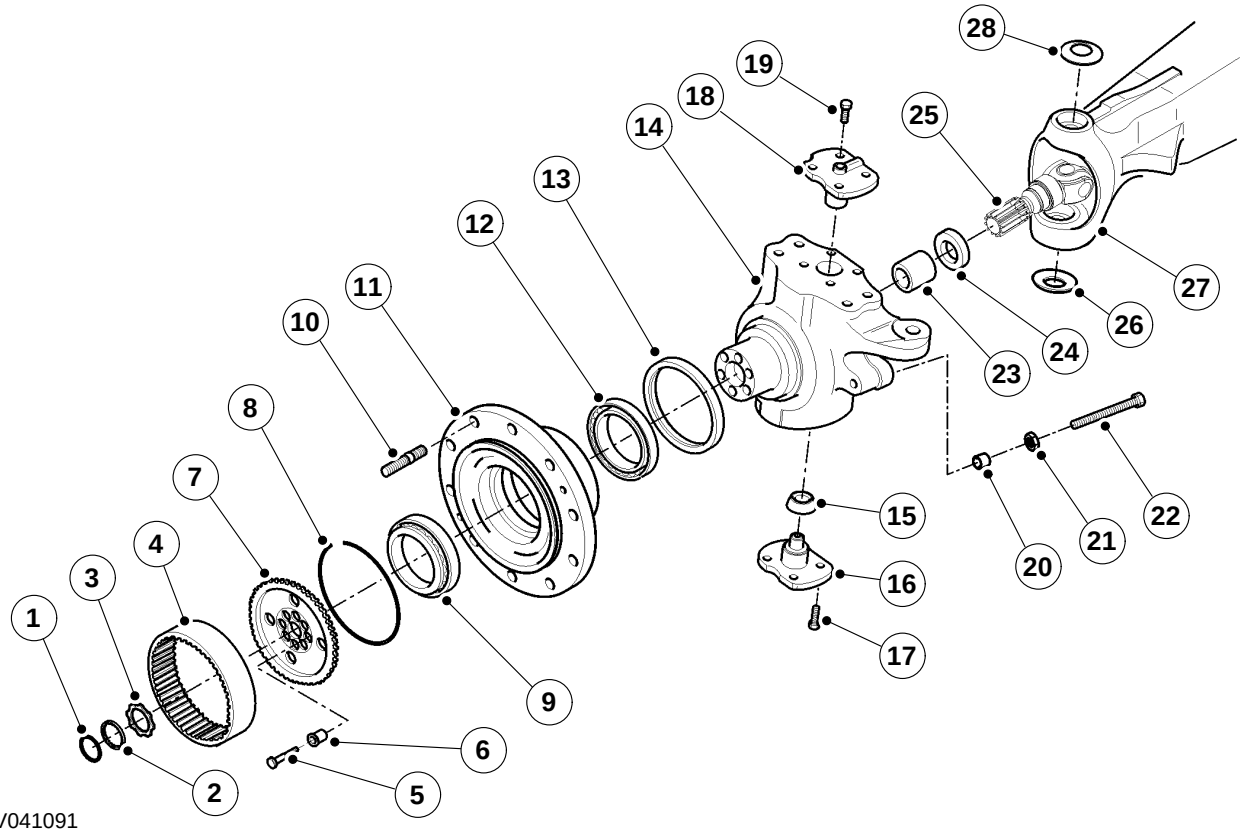


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DISASSEMBLY AND ASSEMBLY — REAR WHEEL HUB GROUP (FOUR-WHEEL STEER)

BHN1305DC

Operation: **Disassembly and Assembly of the Wheel Hub Group (Four-Wheel Steer)**	*Job Code:* **13 19 17 xx**		
Suitable lifting equipment	Standard tools, Ball joint separator, Ca715026, Ca715027, Ca119143		

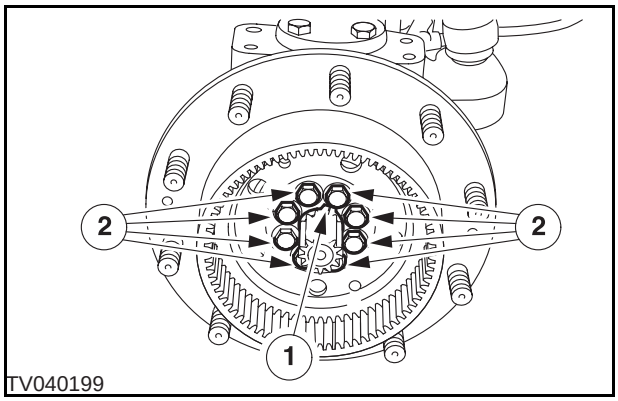


TV041091

1	Lock Ring
2	Universal-Joint Shaft Washer
3	Universal-Joint Shaft Washer
4	Epicylic Ring Gear
5	Retaining Bolt
6	Centre Bushes
7	Epicylic Hub
8	Steel Lock Ring
9	Tapper Roller Bearing
10	Stud
11	Wheel Hub
12	Tapper Roller Bearing
13	Oil Seal
14	Swivel Housing
15	Cone
16	Lower Kingpin
17	Retaining Bolt
18	Upper Kingpin
19	Retaining Bolt
20	Bush
21	Lock Nut
22	Steering Angle Adjustment Bolt
23	Bush
24	Oil seal
25	Universal-Joint Shaft End
26	Belleville washers
27	Axle
28	Belleville Washers

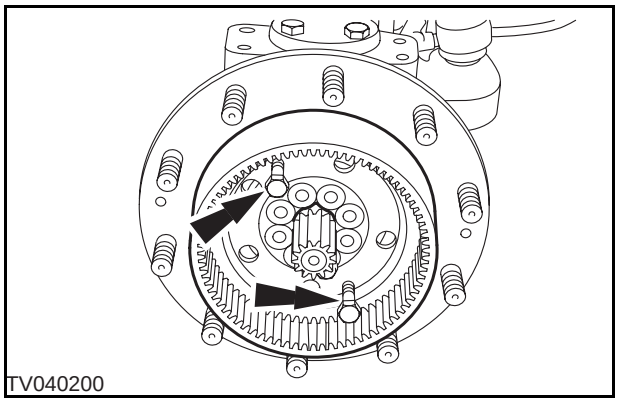
Disassembly

1. Remove the rear wheels. For additional information, refer to Section M12-01 REAR WHEEL, PAGE M12–01–5 .
2. Remove the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE N13–04–15 in this section.
3. Remove the epicyclic group circlip and spacers (1).
4. Remove the epicyclic group retaining bolts (2).

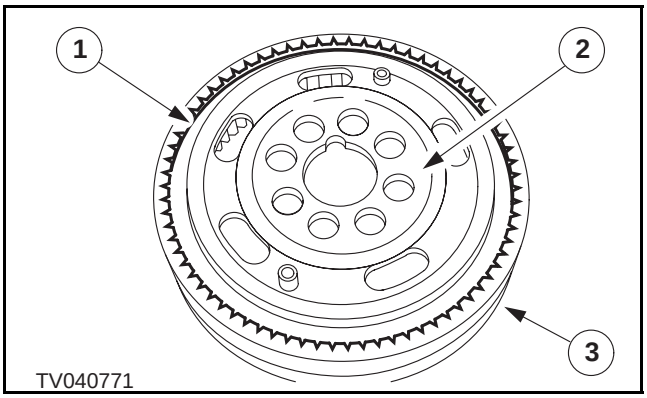


TV040199

5. Using 2 wheel carrier retaining bolts, extract the epicyclic ring gear.

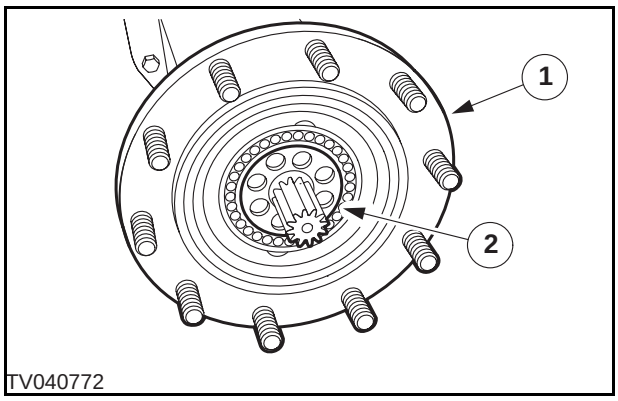

TV040200

6. Remove the snap ring (1) and remove the epicyclic gear hub (2) from the epicyclic ring gear (3).



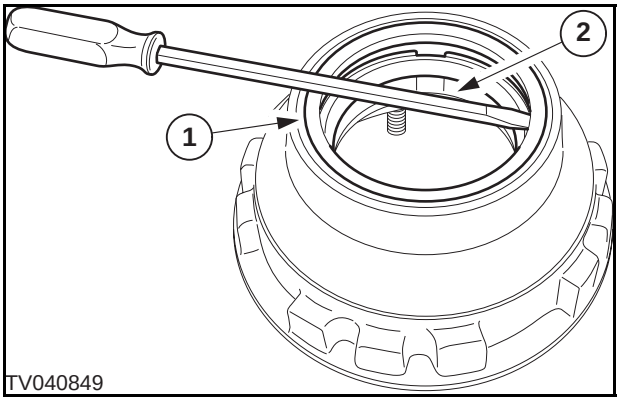
TV040771

7. Using a suitable soft faced hammer, remove the rear axle hub (1) and the outer roller bearing (2).



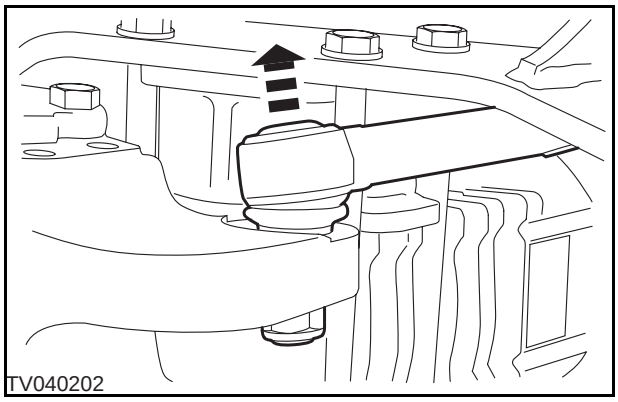
TV040772

8. Using a suitable lever, remove and discard the hub oil seal (1).
9. Remove the outer taper roller bearing and cones (2).



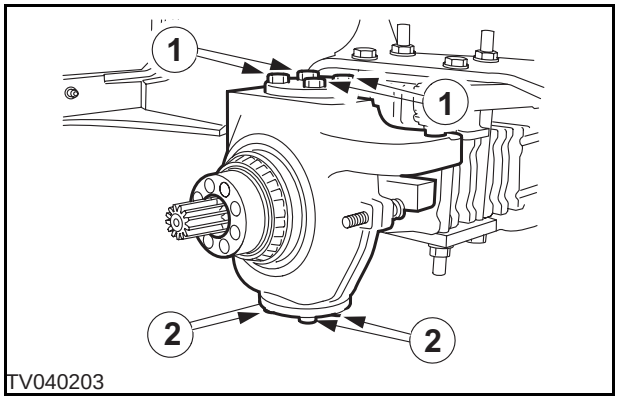
TV040849

10. Remove the retaining nut and using a suitable ball joint splitter, detach the tie rod end from the hub carrier.


TV040202

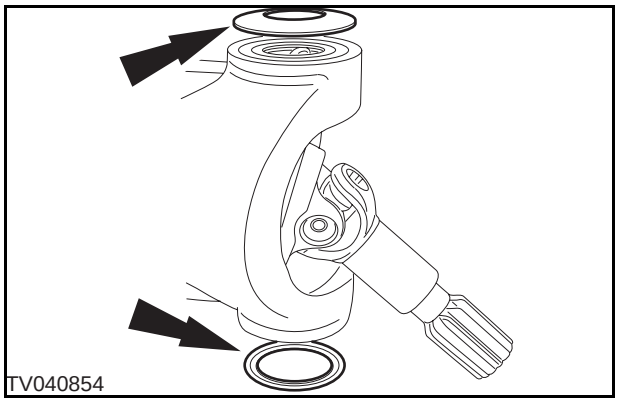
⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

11. Using suitable lifting equipment support the rear hub carrier.
12. Remove the rear hub carrier.



TV040203

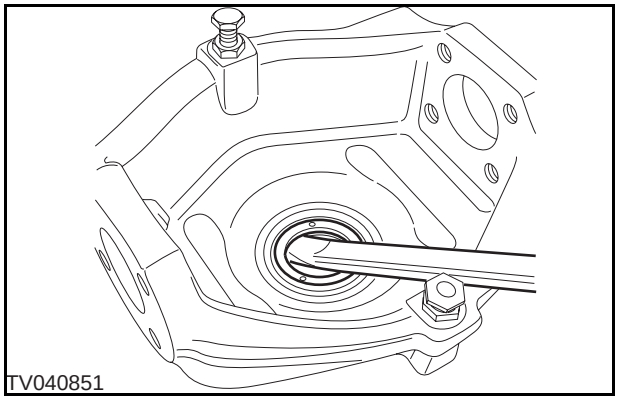
13. Remove the swivel thrust washers.


TV040854

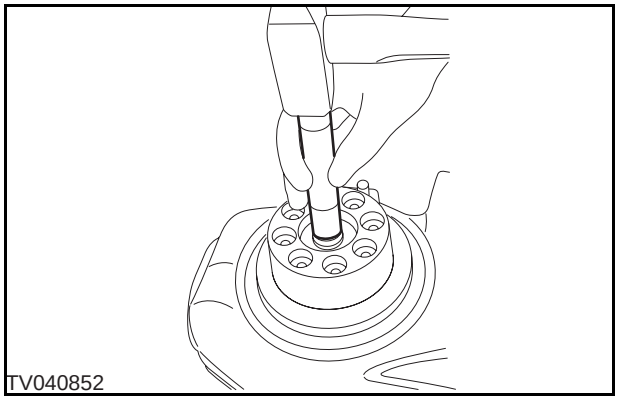
14. Position the swivel hub on a suitable flat surface. and remove the seal ring with a lever.

15. Using a suitable lever, remove the oil seal.

Note:
- Discard the oil seal.

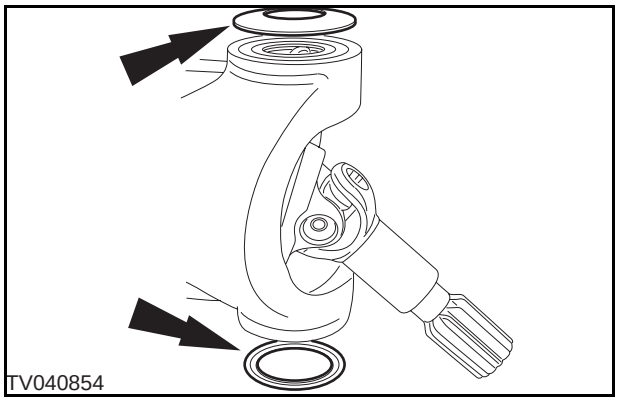

TV040851

16. Using a suitable drift, remove the swivel housing bush.

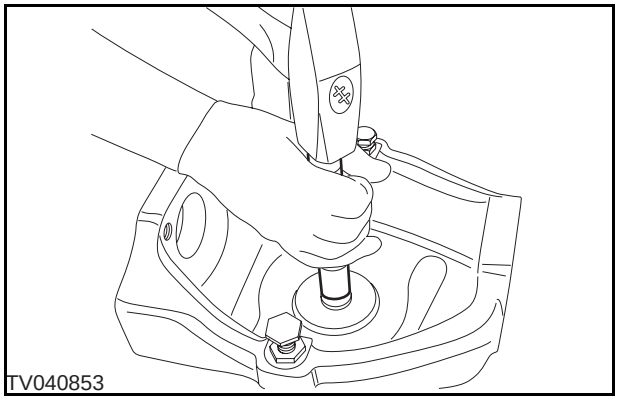

TV040852

Assembly

1. Install the swivel thrust washers.

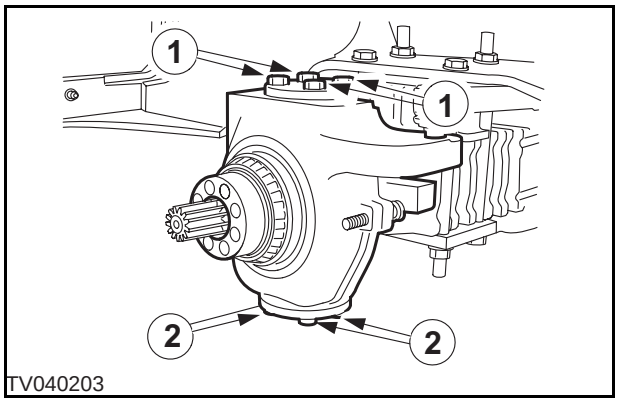

TV040854

2. Using the special tool **CA119117 — Driver for oil seal** , install the oil seal.


TV040853

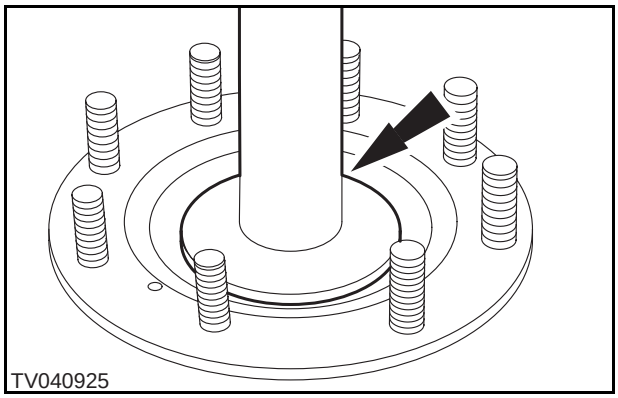
3. Install the rear hub carrier.

4. Tighten to 300Nm (221 lb.ft).



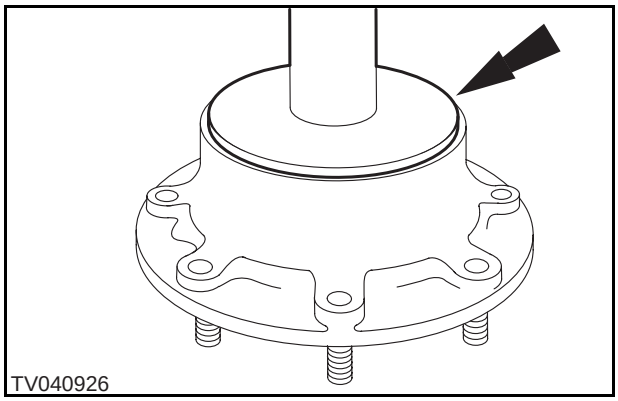
TV040203

5. Using a suitable hydraulic press and the special tool **CA715026 — Driver for bearing race** , install the inner and outer taper roller bearing cones.

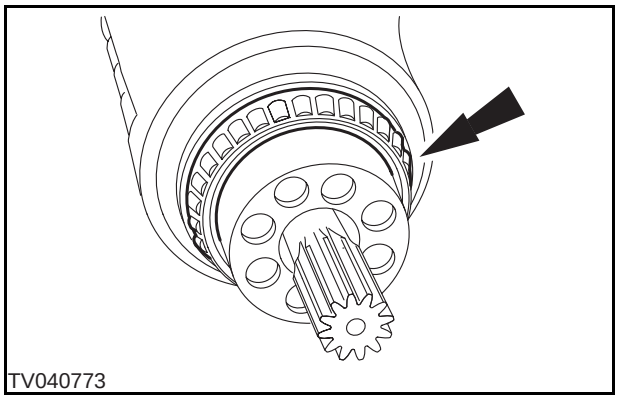

TV040925

Note:
- Lubricate the oil seal with a light grease.

6. Using the special tool **CA119087 — Driver for oil seal** , install a new hub seal.

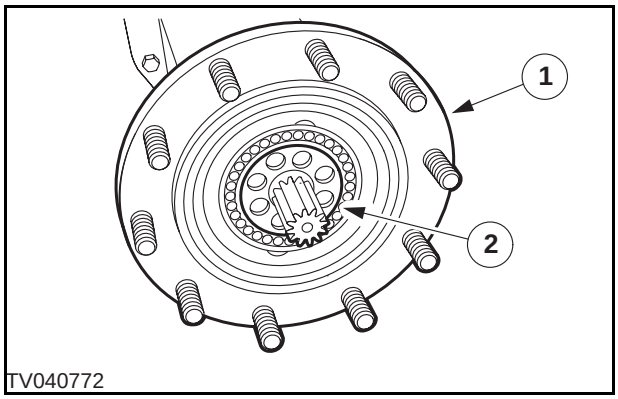

TV040926

7. Install the inner taper roller bearing.

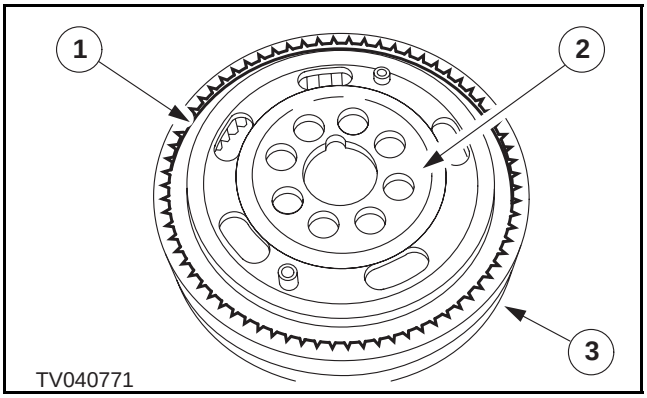

TV040773

8. Install the rear axle hub (1) .

9. Install the outer taper roller bearing (2).



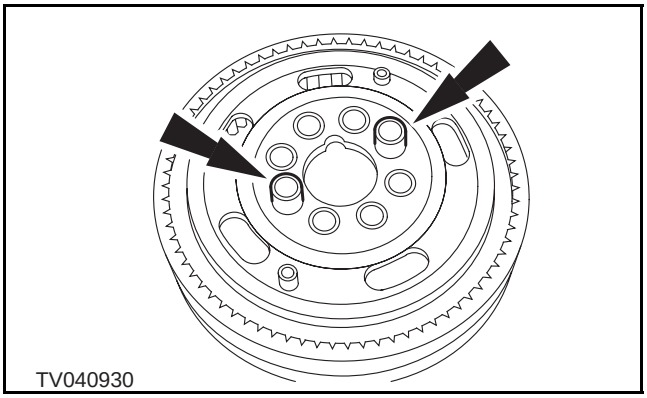
10. Install the epicyclic hub (2) to the epicyclic ring gear (3) and install the snap ring (1).



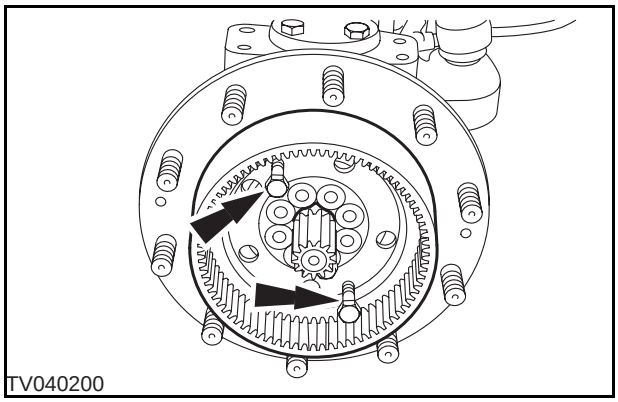
Note:

- Install two bushes slightly higher that the hub surface level to be used as dowel pins.

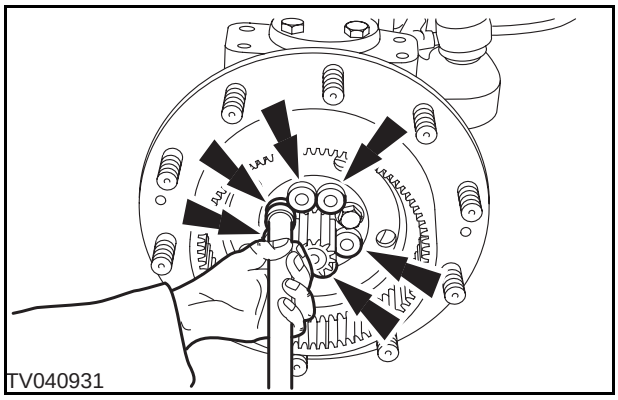
11. Using the special tool **CA715027 — Driver for bush** partially install the hub centering bushes.



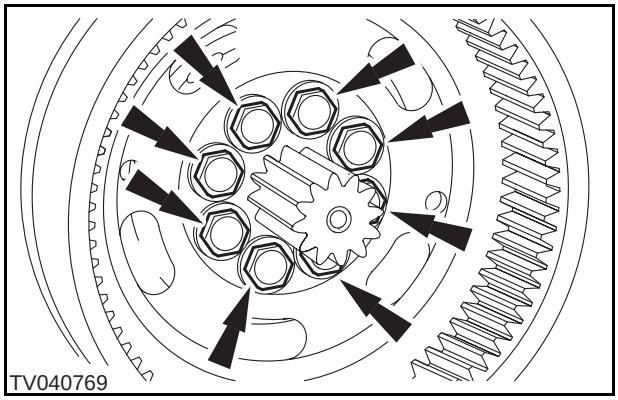
12. Assemble the epicyclic group on the wheel hub using the two protruding centering bushes as dowel pins.



13. Using the special tool **CA715027 — Driver for bush** , fully install the remaining centering bushes.



14. Install the epicyclic group retaining bolts and tighten to 230Nm (170 lb.ft)..

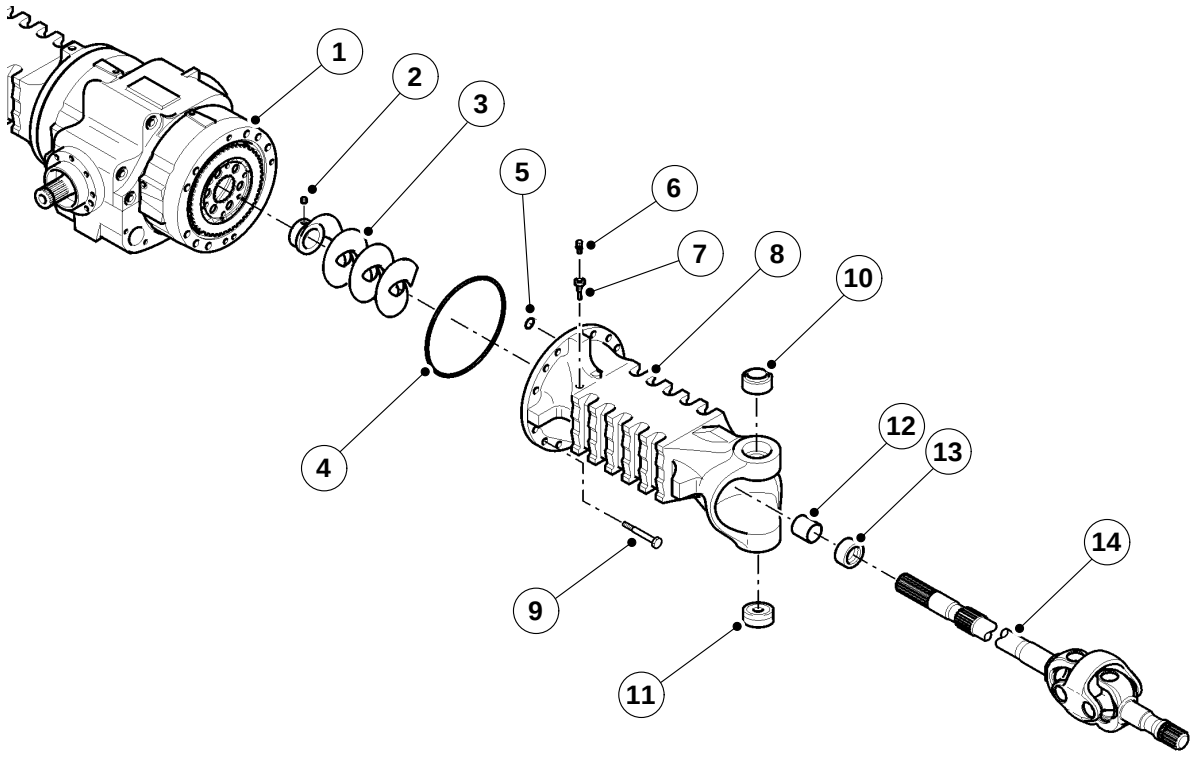


15. Install the epicyclic reduction hub. For additional information, refer to EPICYCLIC REDUCTION GEAR GROUP, PAGE N13–04–15 in this section.
16. Install the rear wheels. For additional information, refer to Section M12-01 REAR WHEEL, PAGE M12–01–5 .

DISASSEMBLY AND ASSEMBLY — AXLE BEAM TRUMPETS AND BRAKE GROUP (FOUR-WHEEL STEER)

BHN1305DD

Operation: **Disassembly and Assembly of the Axle Beam Trumpets and Brake Group (Four-Wheel Steer)**	*Job Code:* **13 18 17 xx**		
Suitable lifting equipment	Standard tools, CA715386, CA715387 CA715034 CA715505		

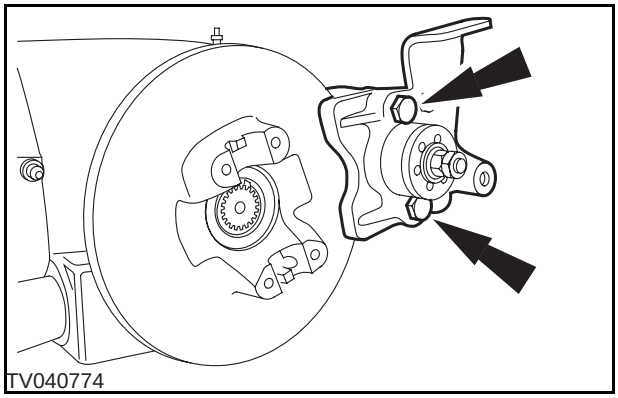


TV041107

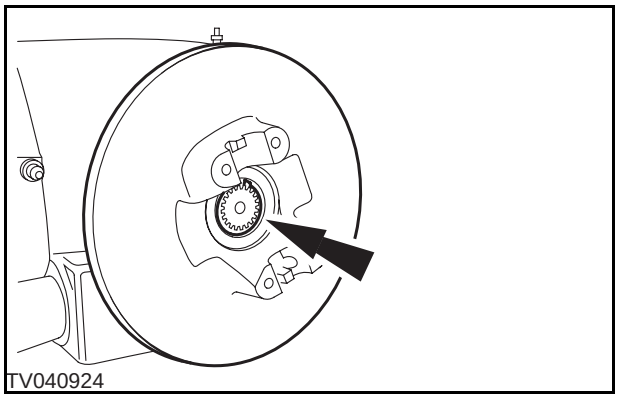
1	Central Body
2	Grub Screw
3	Auger
4	O-Ring
5	O-Ring
6	Greaser
7	Special Screw
8	Axle Beam Trumpet
9	Retaining Bolts
10	Upper King Pin Bush
11	Ball Bearing Cup
12	Bush
13	Sealing Rings
14	Universal Joint

Disassembly

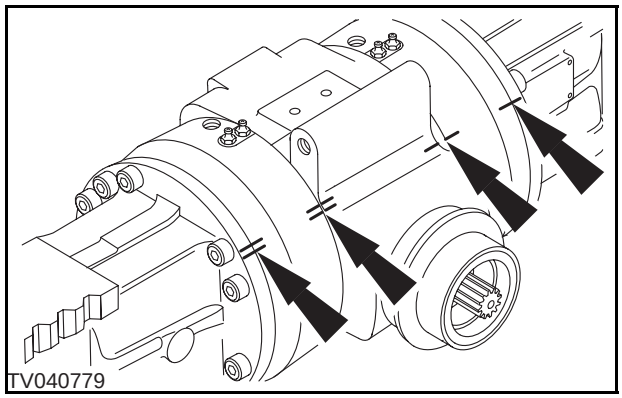
1. Remove the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE N13–04–19 in this section.
2. Drain the axle oil into a suitable container. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL in this section.
3. Remove the parking brake caliper.


TV040774

4. Using suitable circlip pliers remove the parking brake disc.


TV040924

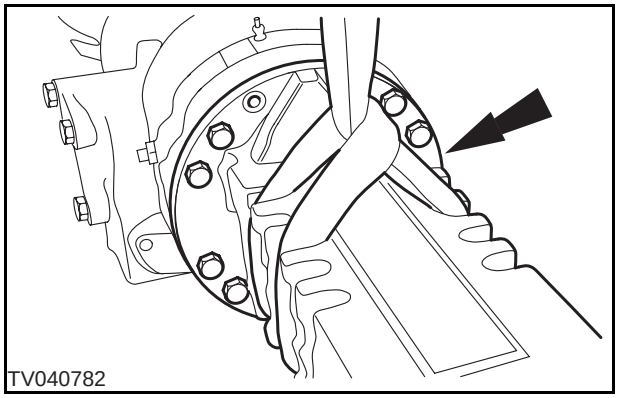
5. Mark the rear axle housing prior to disassembly to aid installation.


TV040779

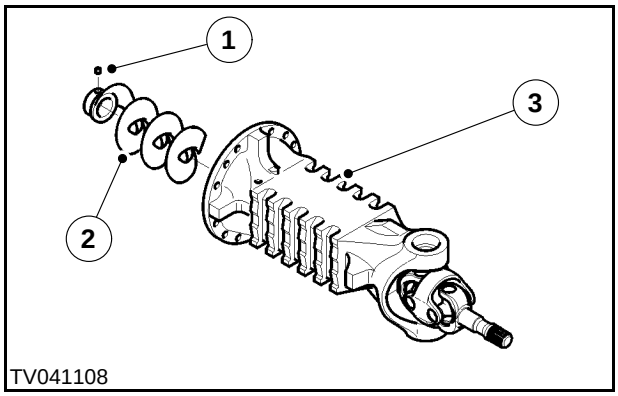
⚠ **Warning:**
- **Support the half shaft housing. Failure to follow this instruction may result in personal injury.**

6. Remove the axle beam trumpet retaining bolts and remove the axle beam trumpet housing (both sides).

   Note:
   - Remove and discard the O-ring.

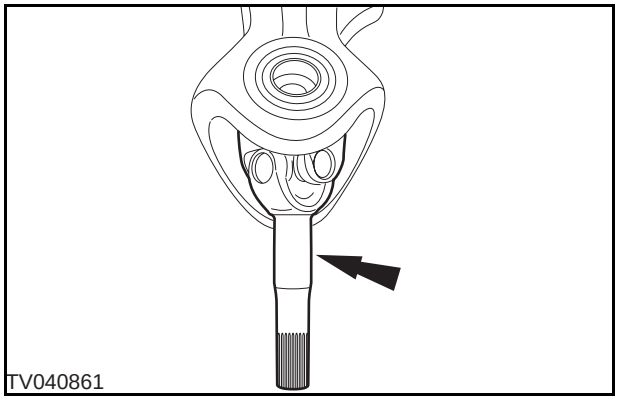

TV040782

7. Loosen the grub screw (1), and remove the auger (2) from the double universal joint (3) (both sides).



TV041108

8. Remove the two double universal joints from the axle beam trumpets (both sides).

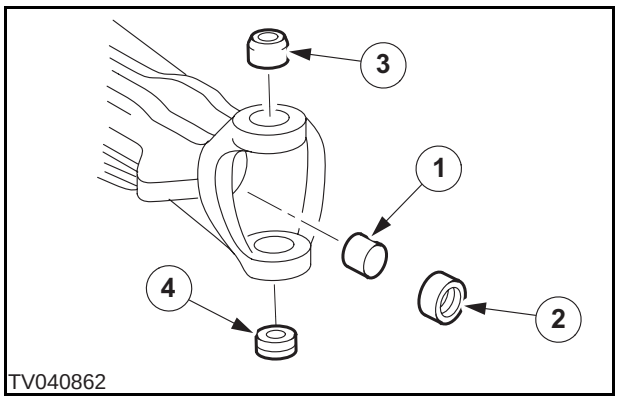

TV040861

9. Remove the oil seal (2) from the axle housing (both sides).

   Note:
   - Discard the oil seal rings.

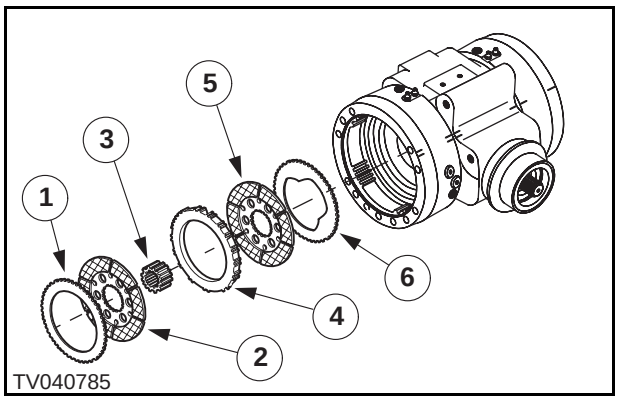
⚠ **Warning:**
- **Be careful not to damage the bush housing.**

10. Remove the bushes (1) from the axle beam trumpet housing (both sides).
11. Using a suitable extractor remove the upper king pin bush (3) and the ball bearing cup (4) from the king pin housings (both sides).



Note:
- Check that the friction discs and the fixed discs do not show any sign of burning. If damage is found new components should be installed.

12. Remove the 5 mm fixed steel disc (1).
13. Remove the outer friction disc (2).
14. Remove the brake hub (3).
15. Remove the 11 mm fixed steel disc (4).
16. Remove the inner friction disc (5).
17. Remove the piston pressure disc (6).

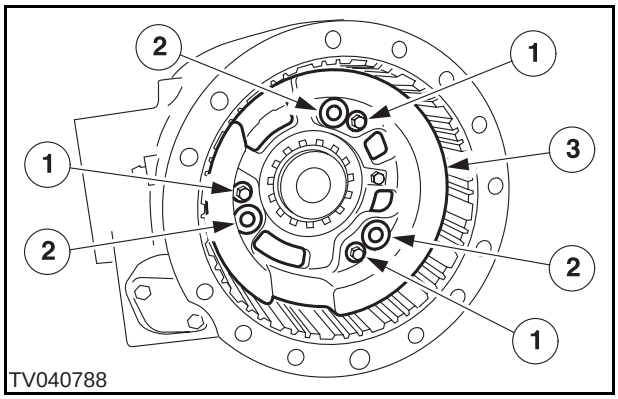


18. Remove the self-adjust retaining bolts (1) and (2).

Note:
- Recover the self-adjust components.

19. Remove the brake piston (3).

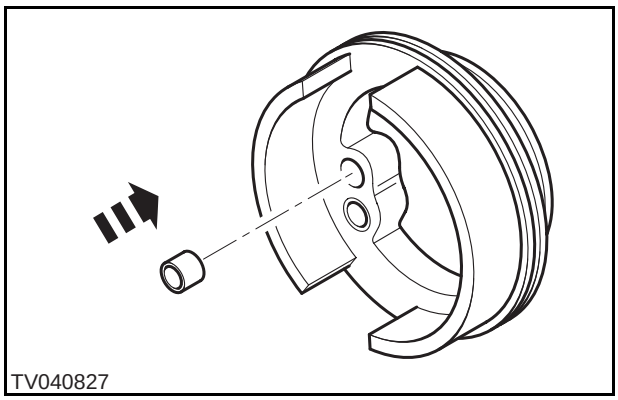
Note:
- Remove and discard the brake piston O-ring seals.



20. Repeat steps 6 to 20 to remove the remaining half shaft housing.

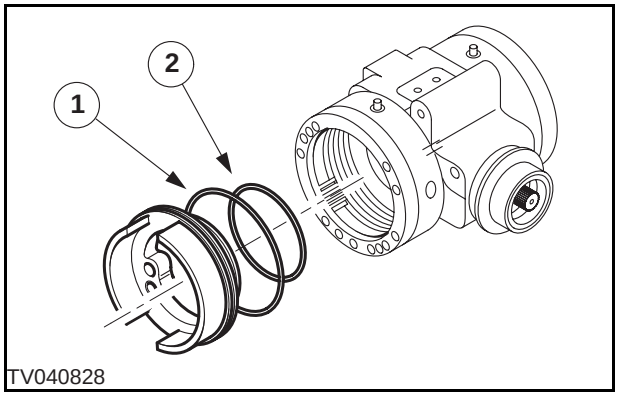
Assembly

1. Install the self-adjust bushings into the brake flange until level with the piston inner surface.


TV040827

Note:
- Lubricate the brake piston oil seals with a light grease.

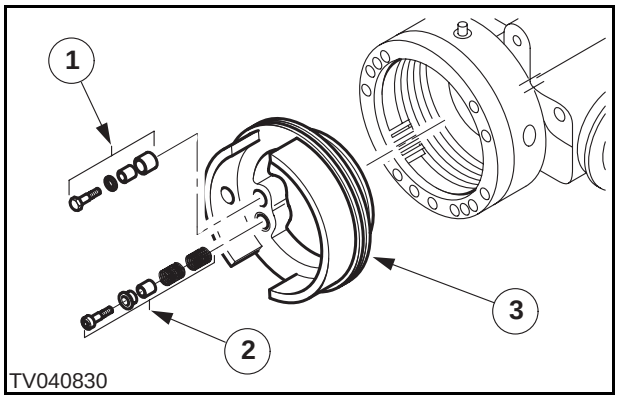
2. Install new outer (1) and inner (2) oil seals to the brake piston.



TV040828

Note:
- Lubricate the brake piston oil seals with a light grease.

3. Install the brake piston (3).
4. Install the brake piston self-adjust retaining bolt assemblies (1) and (2).
5. Tighten to 10Nm (7 lb.ft).



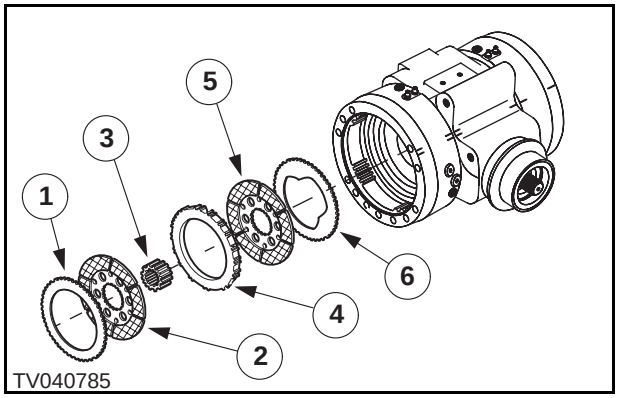
TV040830

Note:
- If new friction discs are installed, they should be soaked in suitable oil before assembling,

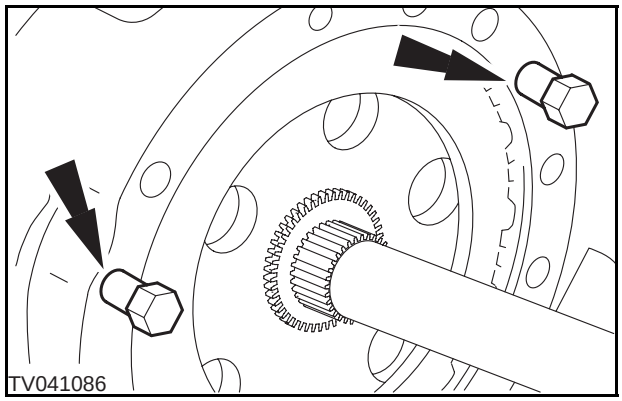
6. Install the piston pressure disc (6).
7. Install the inner friction disc (5).

Note:
- Install the fixed steel disc with the lip towards the piston.

8. Install the 11 mm fixed steel disc (4).
9. Install the brake hub (3).
10. Install the outer friction disc (2).
11. Install the 5 mm fixed steel disc (1).

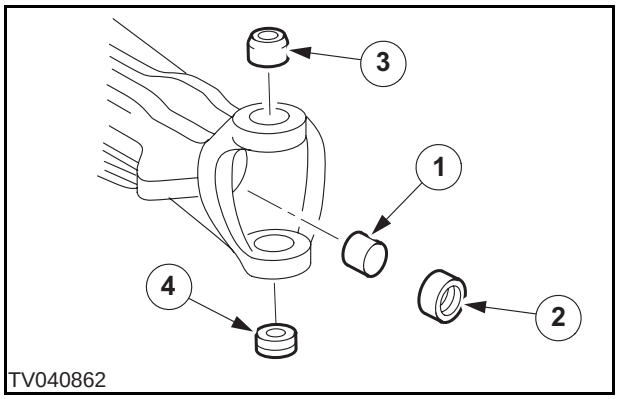


12. Remove the two brake housing retaining bolts.

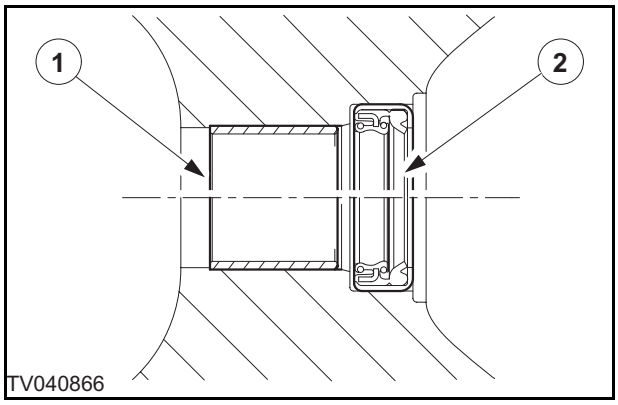


Note:
- Install new oil seals.

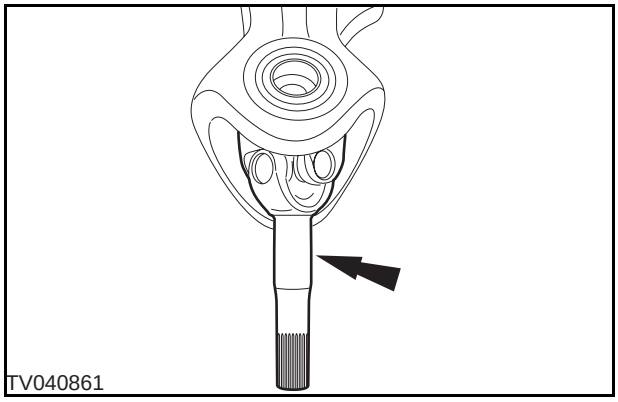
13. Using the special tool **CA715034** , install the king pin bush (3) in the axle housing (both sides).
14. Using the special tool **CA715034** , install the ball bearing cup (4) in the axle housing (both sides).
15. Using the special tool **CA715505** , install the bush (1) and the oil seal (2).



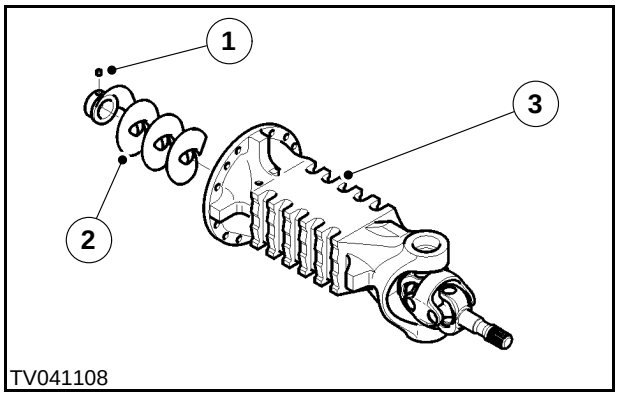
16. Install the bush (1) and the oil seal (2) as shown.



17. Install the two double Universal-Joints into the axle beam trumpet housing (both sides).



18. Install the auger (2) onto the double universal joint (3) tighten the grub screw (1) (both sides).

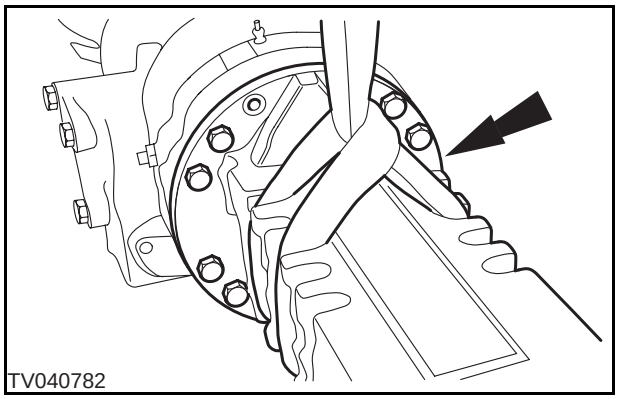


⚠ **Warning:**
- **Support the half shaft housing. Failure to follow this instruction may result in personal injury.**

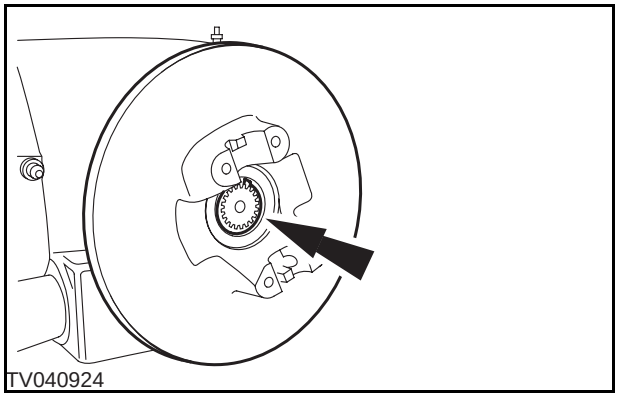
Note:
- Install a new half shaft housing O-ring.

19. Install the half shaft housing.

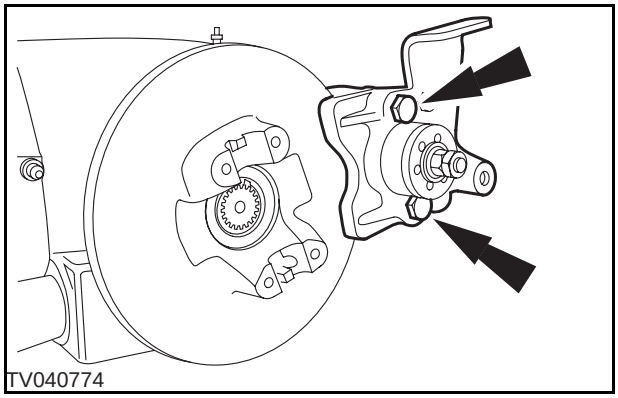
20. Tighten to 130Nm (96 lb.ft).


TV040782

21. Using the special tool **CA715386 — Driver for bush** , install the half shaft housing bushing (2).
22. Using suitable circlip pliers Install the parking brake disc.

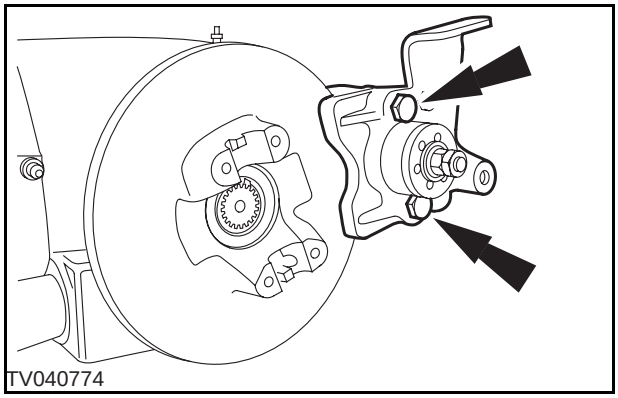

TV040924

23. Install the parking brake caliper.


TV040774

24. Tighten to 150Nm (111 lb.ft).
25. Fill the axle with oil. For further information refer to DRAINING AND FILLING AXLE HOUSING OIL in this section.

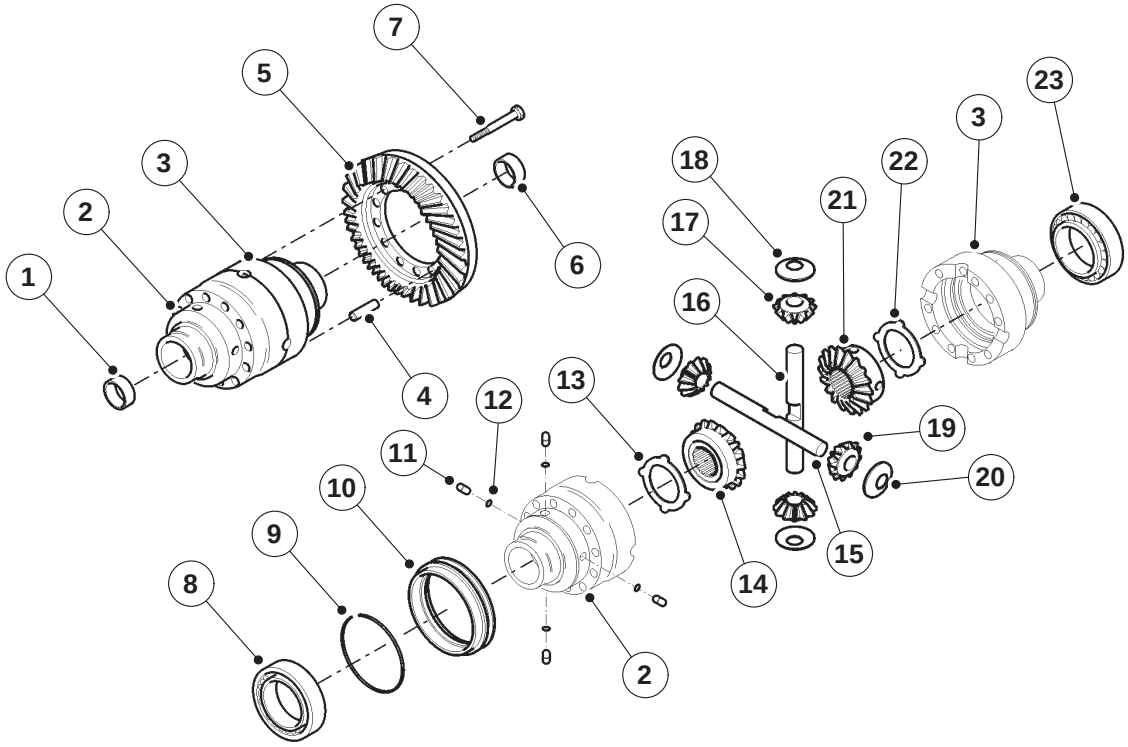
26. Install the wheel hub group. For additional information, refer to WHEEL HUB GROUP, PAGE N13–04–19 in this section.


TV040774

DISASSEMBLY AND ASSEMBLY — DIFFERENTIAL GROUP (FOUR-WHEEL STEER)

BHN1305DE

Operation: **Disassembly and Assembly of the Differential Group (Four-Wheel Steer)**	*Job Code:* **13 14 17 xx**		
None	Standard tools, CA715133		

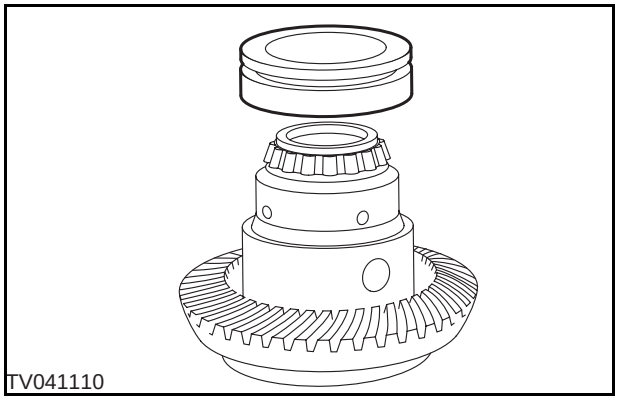


TV041109

1	Bush
2	Half Boxes
3	Half Boxes
4	Dowel Pin
5	Bevel Crown Gear
6	Bush
7	Retaining Bolt
8	Bearing Cone
9	Lock Ring
10	Sleeve
11	Pins
12	Differential Housing
13	Thrust Plate
14	Sun Gear
15	Planetary Shaft
16	Planetary Shaft
17	Planetary Gear
18	Thrust Washer
19	Planetary Gear
20	Thrust Washer
21	Sun Gear
22	Thrust Washer
23	Bearing Cone

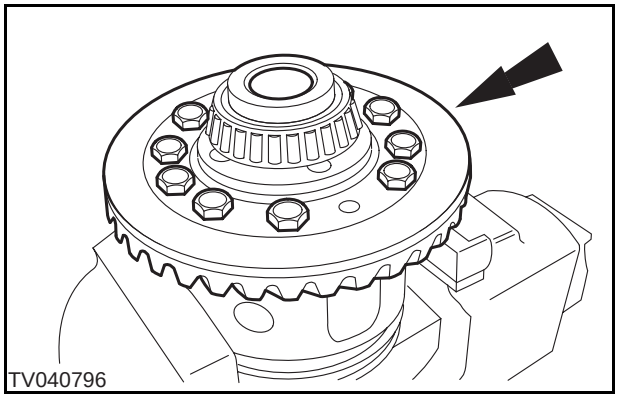
Disassembly

1. Disassemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.
2. Position the differential in a suitable vice.
3. Remove the sleeve (10), and pins (11) from the differential housing.

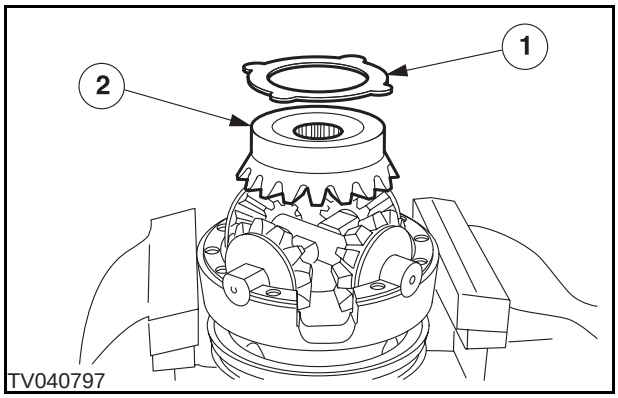

TV041110

Note:
- Mark the differential carrier prior to disassembly to aid installation.

4. Remove the crown wheel.


TV040796

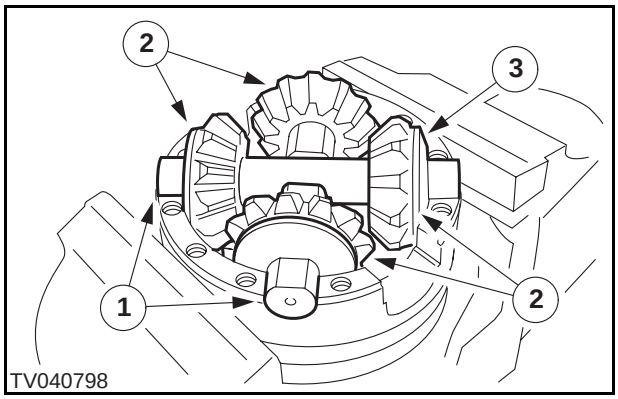
5. Remove the thrust plate (1) and sun gear (2).



TV040797

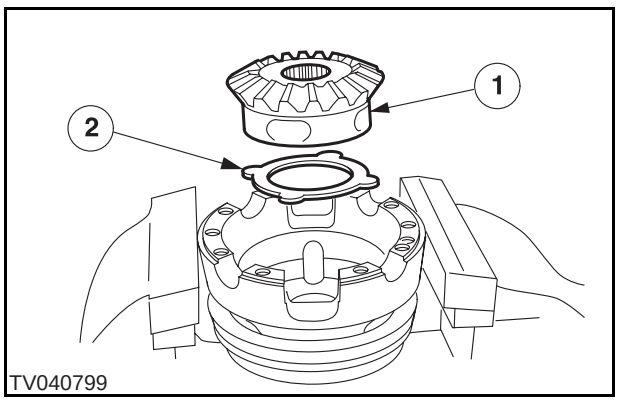
6. Remove the planetary shafts (1) and the planetary gears (2).

Note:
- Recover the thrust washers (3).



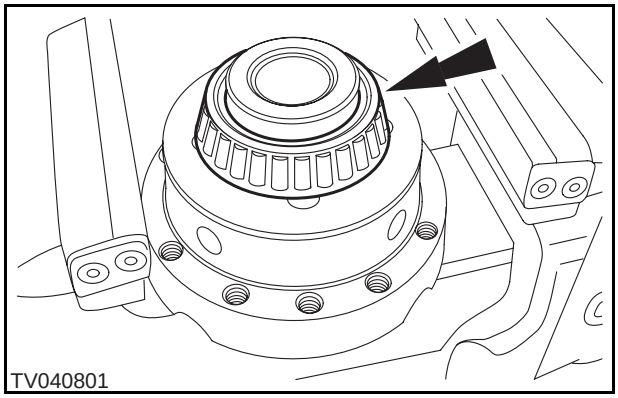
TV040798

7. Remove the sun gear (1) and thrust plate (2).

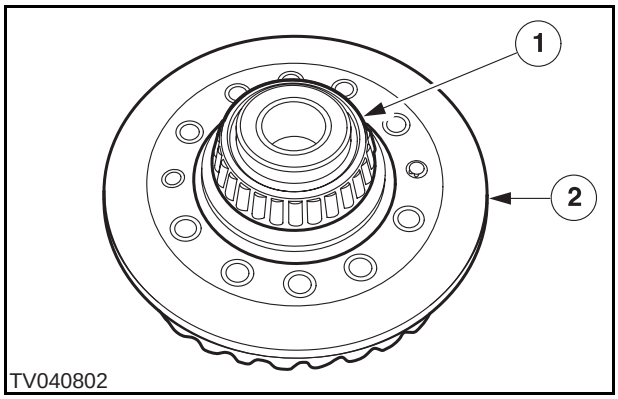


TV040799

8. Remove the snap ring (1).
9. Using a suitable puller, remove the right-hand side taper roller bearing.


TV040801

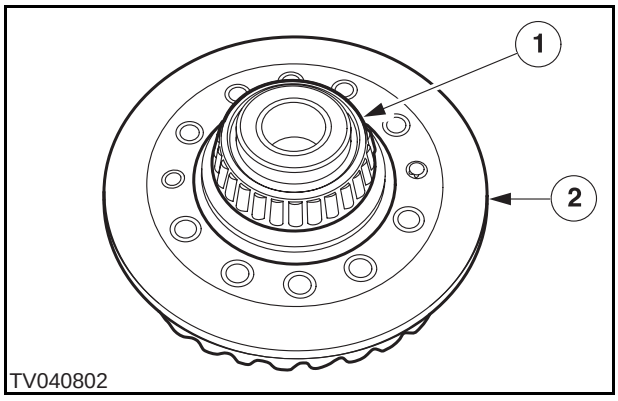
10. Using a suitable puller, remove the left-hand side taper roller bearing (1) and the crown wheel (2).



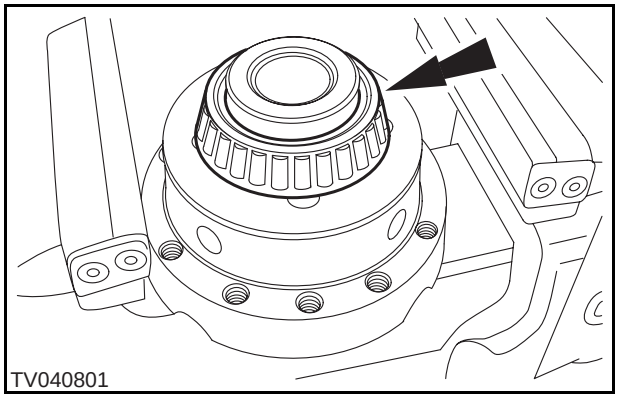
TV040802

Assembly

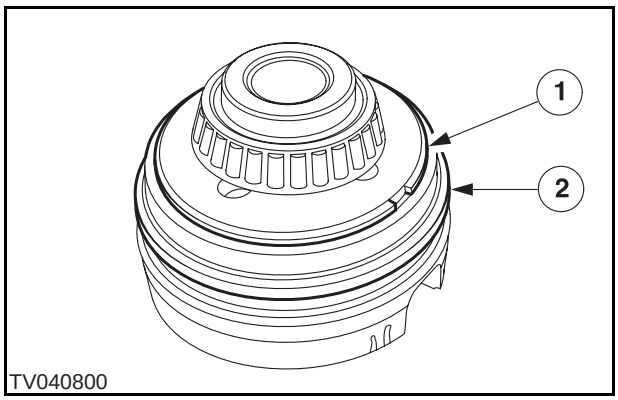
1. Using a suitable hydraulic press and the special tool **CA715133 — Driver for bearing** , install the left-hand side differential taper roller bearing (1) and the crown wheel assembly (2).



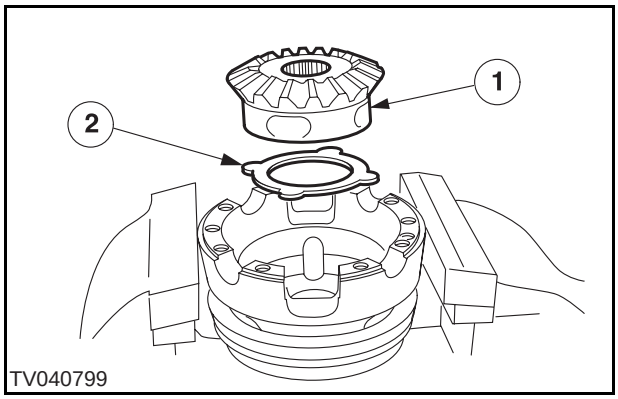
2. Using a suitable hydraulic press and the special tool **CA715133 — Driver for bearing** , install the right hand side differential taper roller bearing.



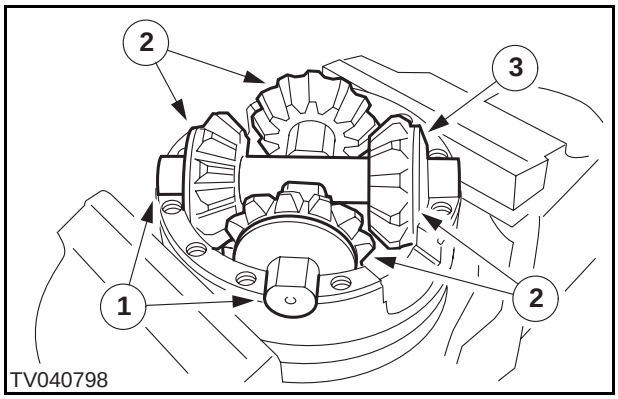
3. Install new O-ring seals and install the differential locking pins.
4. Install the differential lock selector (2).
5. Install the snap ring (1).



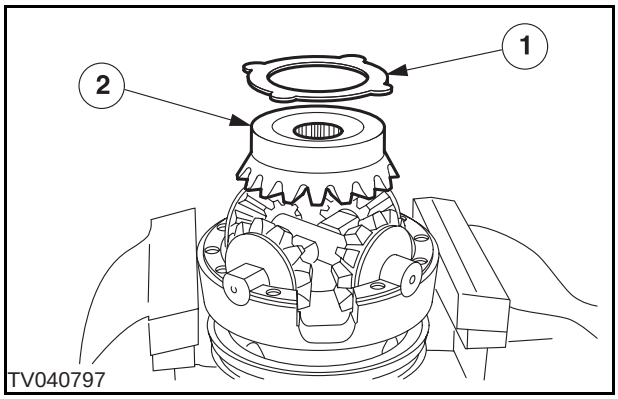
6. Install the thrust washer (2) and the sun gear (1).



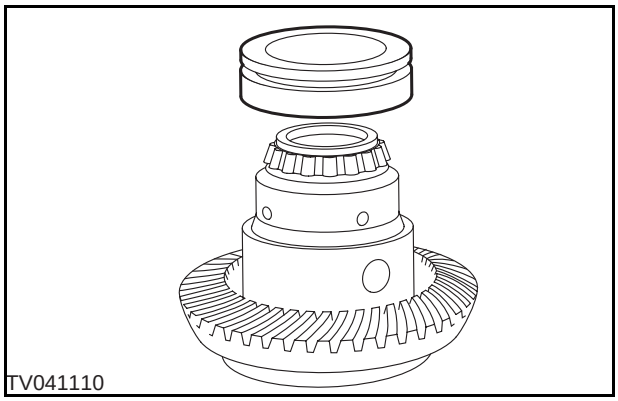
7. Install the Planetary shafts (1), planetary gears (2) and the trust washers (3).



8. Install the sun gear (2) and the thrust washer (1).



9. Install the pins (11), and sleeve (10) into the differential housing.

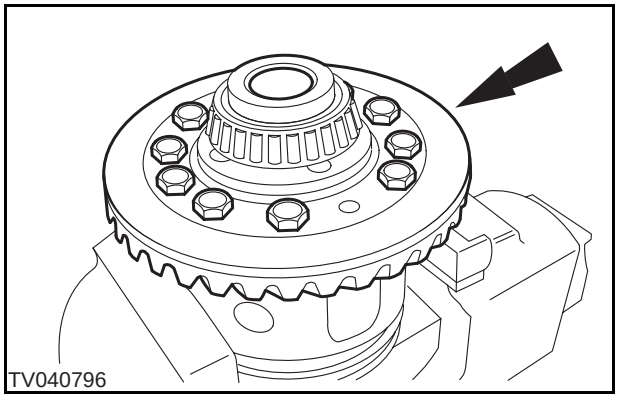


10. Install the crown wheel.

Note:

- Before installing the crown wheel retaining bolts, apply approved sealant (Loctite 270) to the bolt.

11. Tighten to 155Nm (114 lb.ft).
12. Assemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.

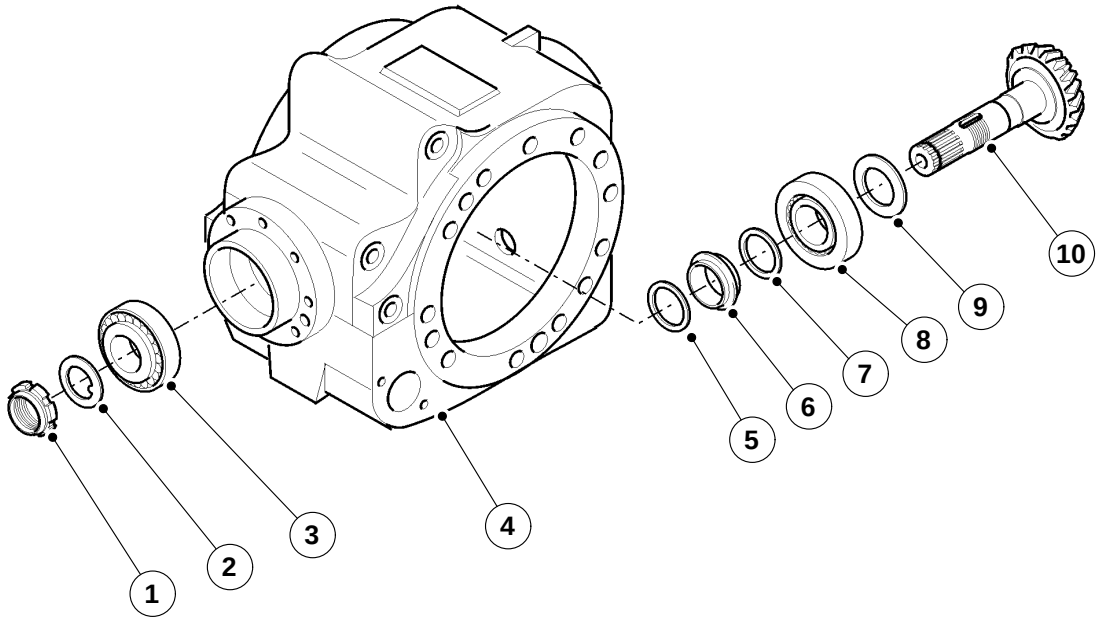

TV040796

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DISASSEMBLY AND ASSEMBLY — PINION GROUP (FOUR-WHEEL STEER)

BHN1305DF

Operation: **Disassembly and Assembly of the Pinion Group (Four-Wheel Steer)**	*Job Code:* **13 20 17 xx**		
None	Standard tools, CA119099, CA715022, CA715380, CA715128, CA715388, CA715004, Suitable measuring device		

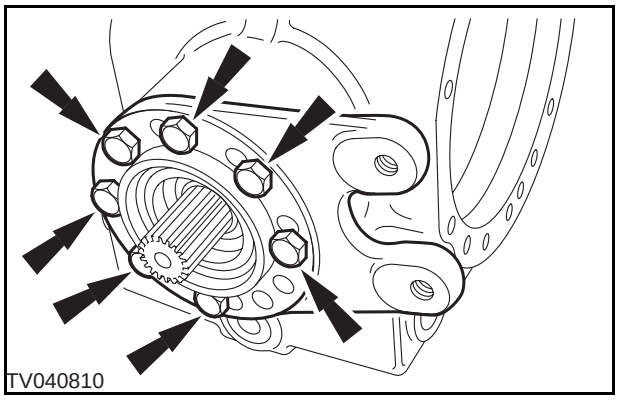


TV041096

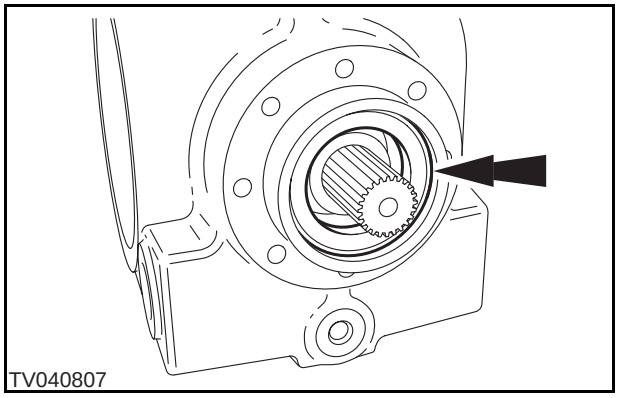
1	Bevel Pinion
2	Shim
3	Bearing Cone
4	Washer
5	Collapsible Spacer
6	Washer
7	Central Body
8	Bearing
9	Ring Nut Washer
10	Ring Nut

Disassembly

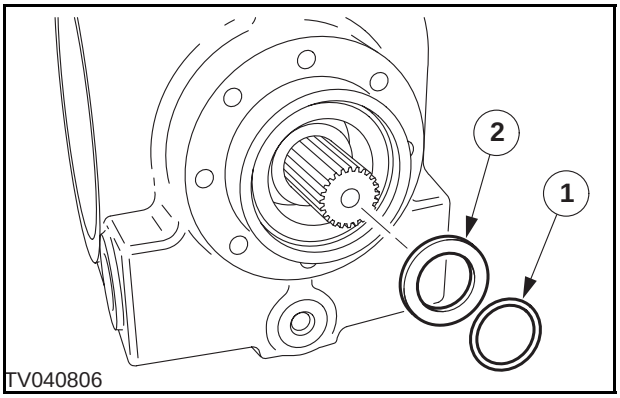
1. Disassemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.
2. Remove the parking brake caliper mounting bracket.


TV040810

3. Remove and discard the pinion sealing ring from the differential housing.


TV040807

4. Remove the O-ring (1) and the spacer (2).

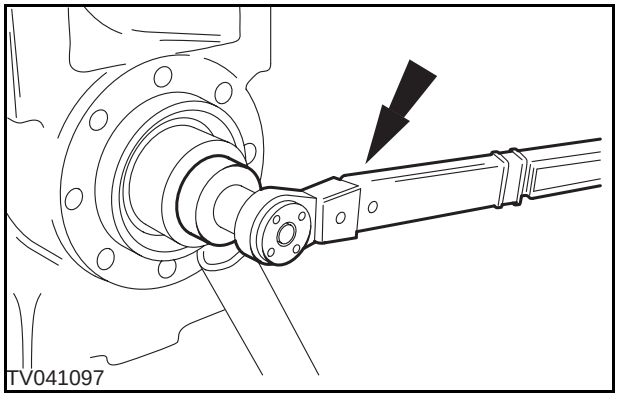


TV040806

⚠ **Caution:**
- **Release the pinion shaft retaining nut locking tabs. Failure to follow this instruction may result in damage to the machine.**

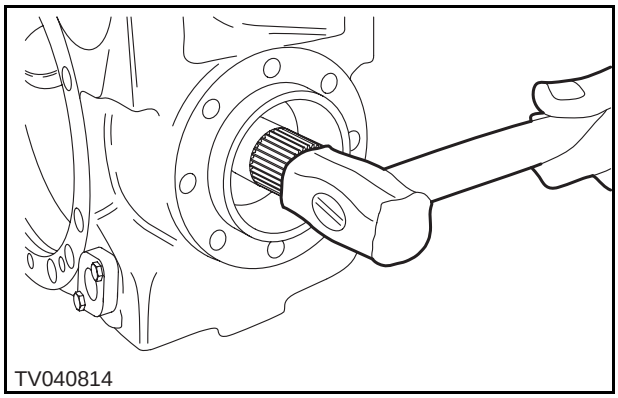
5. Using the special tools **CA119099 — Wrench for lock nut** and **CA715022 — Pinion shaft lock tool** , remove the pinion shaft retaining nut.

   Note:
   - Recover the lock washer.


TV041097

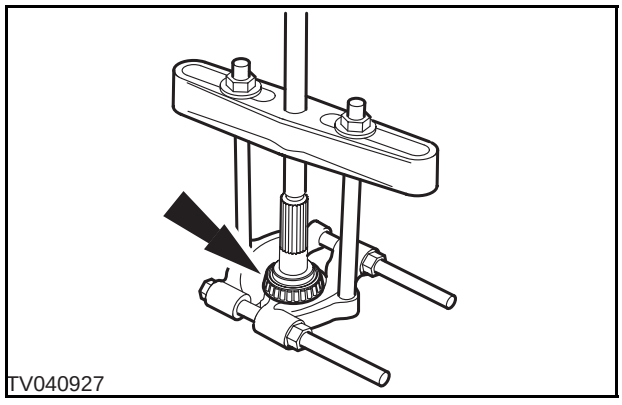
6. Using a suitable soft faced hammer, remove the pinion shaft from the differential housing.

   Note:
   - Recover the outer taper roller bearing, two washers and discard the elastic spacer.

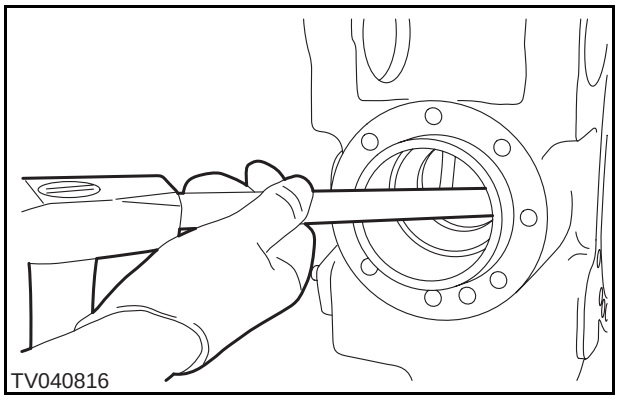

TV040814

7. Using a suitable puller, remove the taper roller bearing from the pinion shaft.

   Note:
   - Recover the pinion end float adjustment shim.

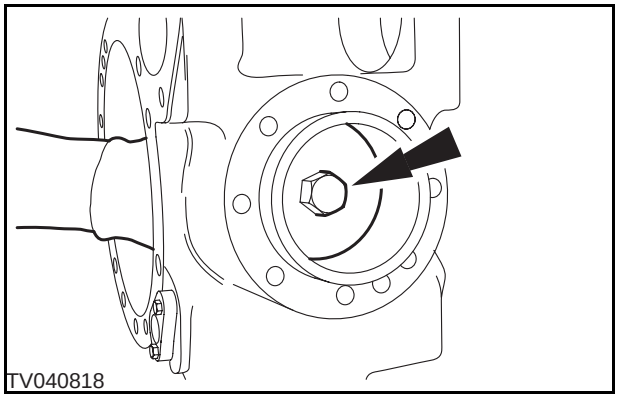

TV040927

8. Using a suitable drift, remove the pinion shaft taper roller bearing cups from the differential housing.

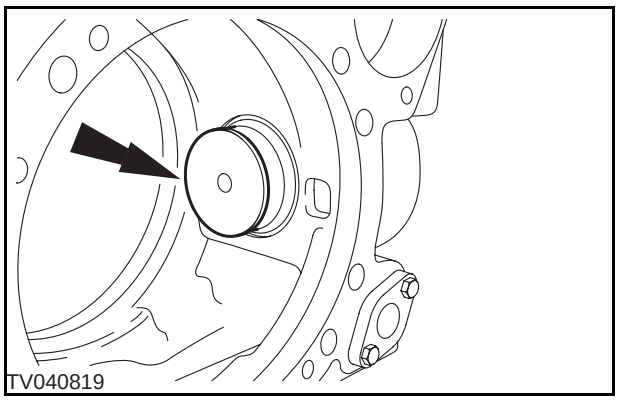


Assembly

1. Using the special tool **CA715380 — Bearing races insertion kit** install the taper roller bearing cups into the differential housing.

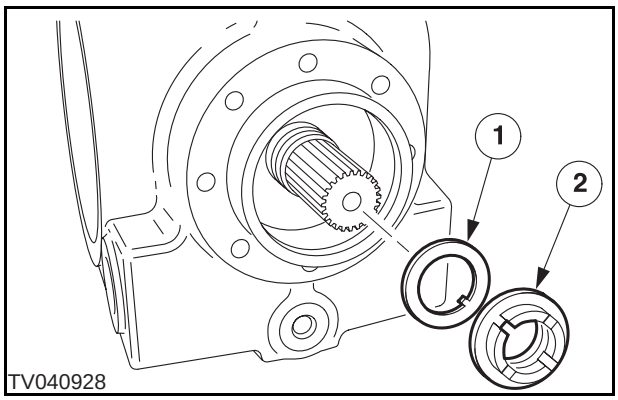

TV040818

2. Install the special tool **CA715128 — False pinion** with the pinion shaft taper roller bearings.


TV040819

⚠ **Caution:**
- **Do not overtighten.**

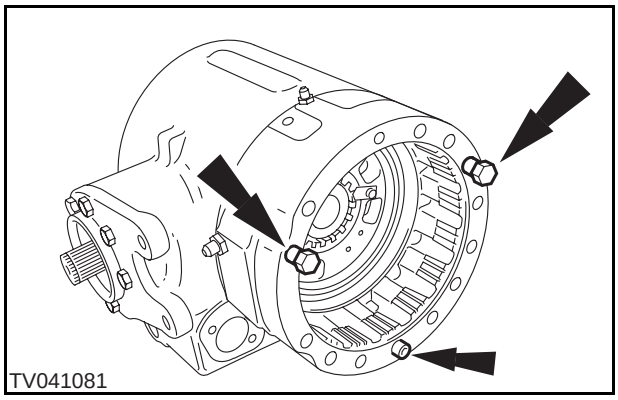
3. Install the lock washer (1) and the pinion shaft retaining nut (2)
4. Tighten until the free play is eliminated.



TV040928

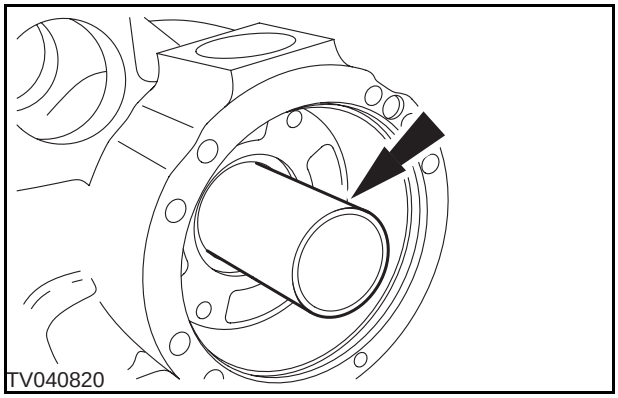
5. Install the brake left-hand side brake housing with three retaining bolts 120° apart.
6. Tighten to 79Nm.

7. Repeat steps 5 and 6 for the right-hand side brake housing.

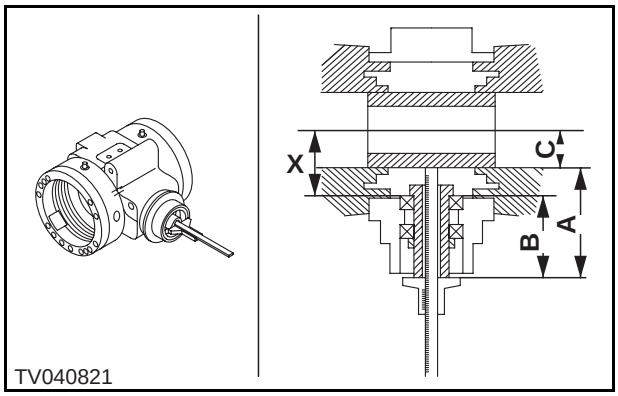

TV041081

Note:
- Ensure the false differential box is inserted in both brake housings.

8. Install the special tool **CA715388 — false differential box** into the differential housing.

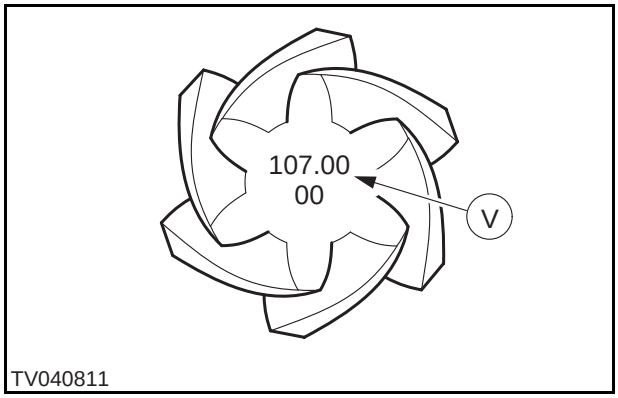

TV040820

9. Using a suitable depth gauge, measure through the false pinion (CA715128) **This measurement is "A"** .
10. Determine the value **"X"** as follows:
    X = (conical distance to be measured)
    A = (measured value)
    B = 100mm
    C = 50mm
    X = (A + C) — B
    Example: **A** = 159.9mm
    therefore: **X** = (159.9 + 50) – 100mm
    X = 109.9mm



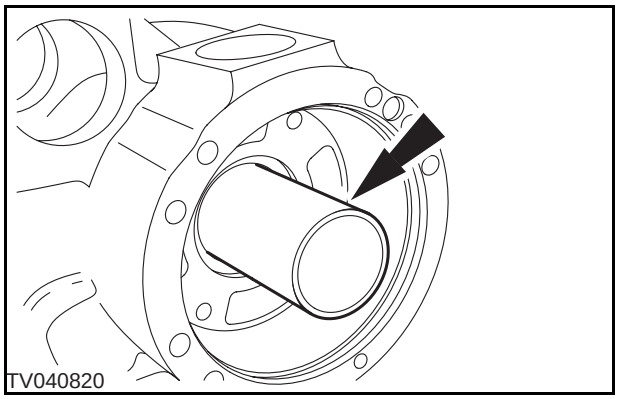
TV040821

11. Determine the pinion shaft position adjustment shim **"S"** as follows:
    subtract the value **"V"** (requested conical distance) from the calculated value **"X"** .
    S = X — V
    Example: Shim thickness **S** = 109.9 – 107.00 = 2.9mm.
    Shim thickness **"S"** = 2.9mm

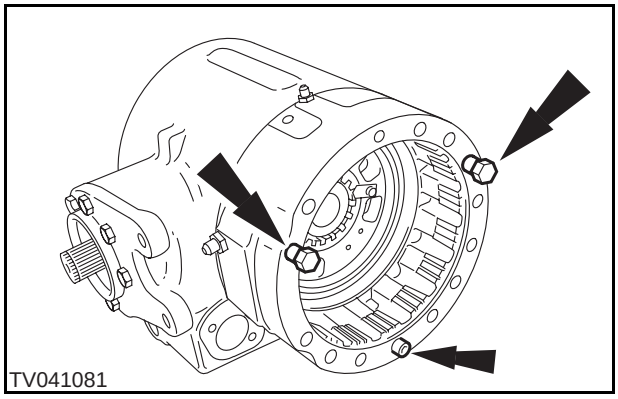


SHIM RANGE										
mm	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4

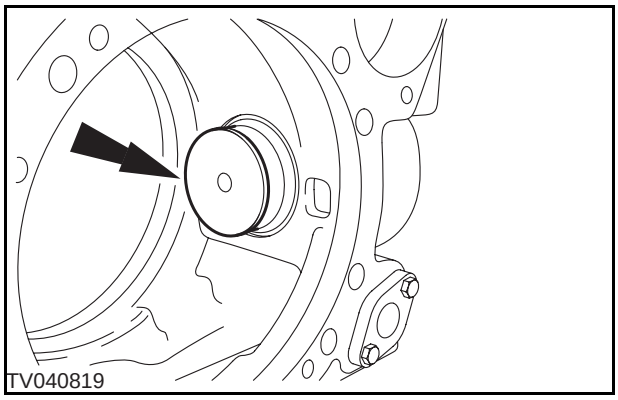
12. Remove the special tool **CA715388 — false differential box** from the differential housing.



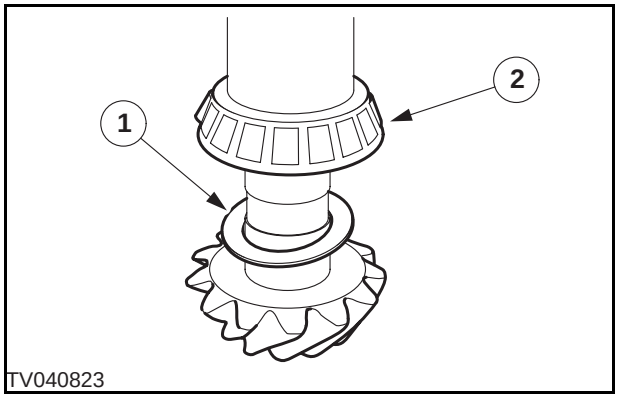
13. Remove the brake housing (both sides).



14. Remove the special tool **CA715128 — False pinion** with the pinion shaft taper roller bearings.


TV040819

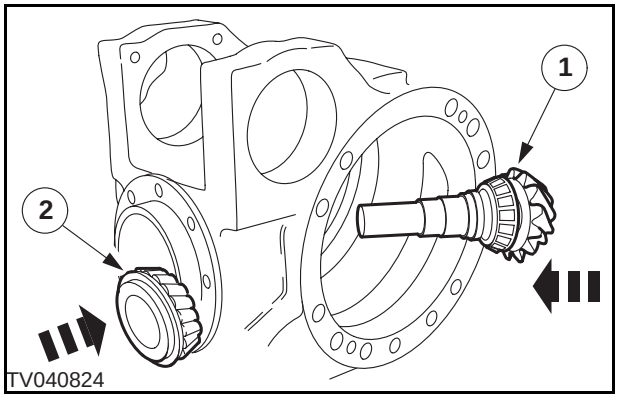
15. Install the pinion shaft adjustment shim (1) with chamfer against the gear.
16. Using a suitable hydraulic press and the special tool **CA715004 — Driver for bearing** install the rear taper roller bearing (2).



TV040823

Note:
- Always use a new elastic spacer.

17. Install the washers and the new elastic spacer onto the pinion shaft.
18. Install the pinion shaft assembly (1) and the front taper roller bearing (2) into the differential housing.

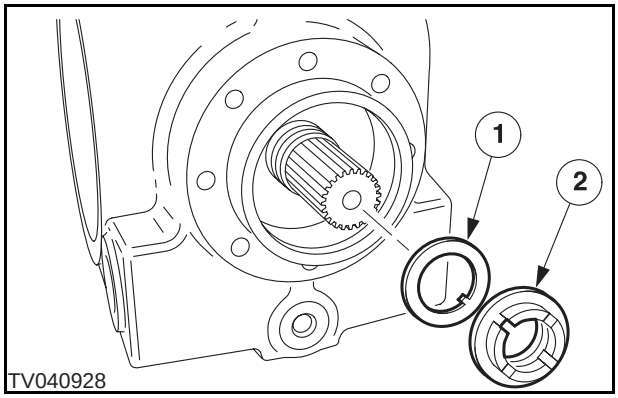


TV040824

19. Install a new lock washer (1).

Note:
- Do not tighten at this stage.

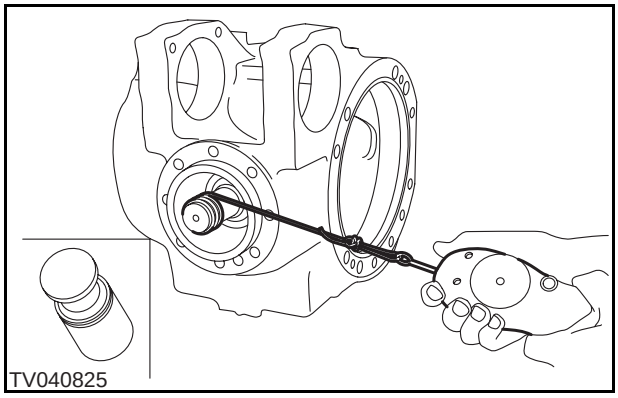
20. Install a new pinion shaft retaining nut (2).



21. Install the special tool **CA715116 — Measurement** onto the pinion shaft.

Note:
- Using a suitable soft faced hammer, settle the pinion shaft bearings.

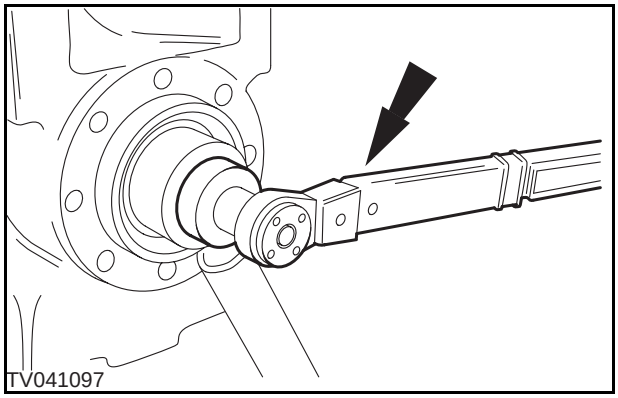
22. Using a suitable measuring device (with the cord wound on the 34.87 mm diameter of the special tool **CA715116 — measurement**), measure the pinion shaft rotational torque.
23. The rotational torque should be within the following range excluding breakaway torque.
9.2 to 13.7 daN



⚠ **Caution:**
- **If the stated rotational torque range is exceeded the elastic spacer must be replaced and the procedure repeated**

24. The adjustment is carried out by increasing the pinion shaft retaining nut torque setting gradually, being careful not to exceed the stated range.
25. Once the correct rotational torque is achieved, secure the pinion shaft retaining nut.

26. Assemble the differential housing group. For additional information, refer to DIFFERENTIAL HOUSING GROUP, PAGE N13–04–51 in this section.


TV041097

GENERAL PROCEDURE — TOE-IN ADJUSTMENT (FOUR-WHEEL STEER)

BHN1305GA

Operation: **General Procedure Toe-in Adjustment (Four-Wheel Steer)**	*Job Code:* **13 23 01 xx**		
None	Standard tools, Two one-metre-long bars		

General Procedure

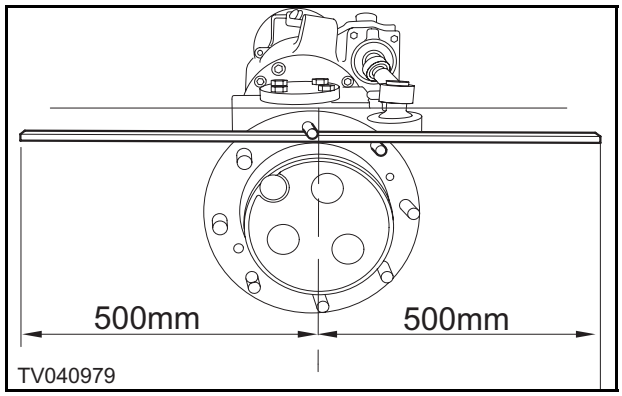
The toe-in of the rear wheels must be within ± 3mm toe-in as measured 500mm from the centre of the wheel hub.

To check the exact value of the toe-in setting, proceed as follows.

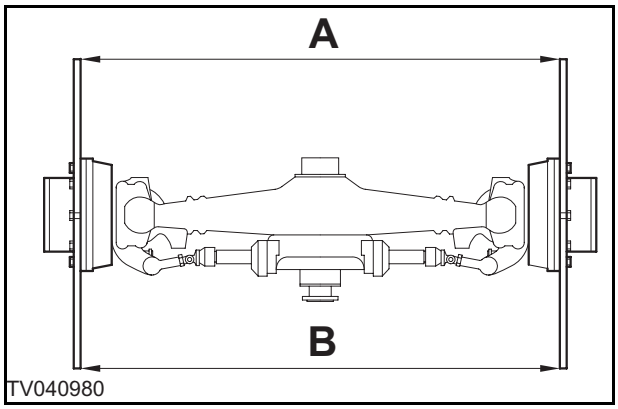
1. Remove the rear wheels. For additional information, refer to Section M12-01 REAR WHEEL, PAGE M12–01–3 .

   Note:
   - The bars must be fixed flat against the wheel hub flange and have an equal distance from the centre of the wheel hub.

2. Install two equal one-metre-long bars to the wheel side of the wheel hubs and lock in place with two wheel retaining nuts.



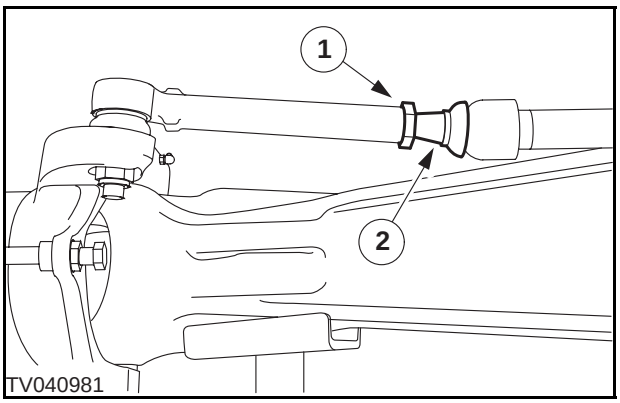
3. Measure the distance (A) between the ends of the two bars.
4. Measure the distance (B) between the ends of the two bars.
5. The distance (A) must be within ± 3mm of distance (B).



Note:

- Make sure the same number of threads are visible at the end of the left-hand and right-hand inner track rod end ball joints.

6. If it is necessary to correct the toe-in adjustment. Loosen the lock nut (1) on the left-hand and the right-hand side. Turn the inner track rod end ball joints (2) equally to achieve the specified toe-in adjustment.
7. Tighten (1) to 120Nm (86 lb. ft).

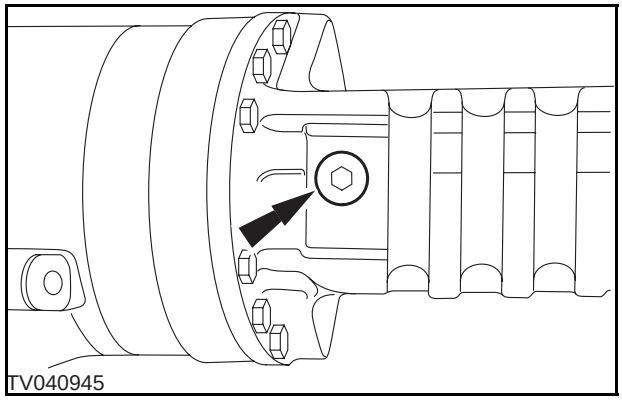


GENERAL PROCEDURE — DRAINING AND FILLING THE REAR AXLE HOUSING OIL (FOUR-WHEEL STEER) BHN1305GB

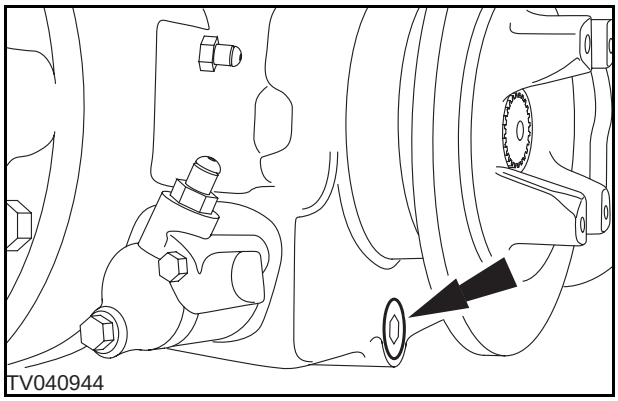
Operation: **Draining and filling the rear axle housing oil (Four-Wheel Steer)**	*Job Code:* **13 18 09 xx**		
Suitable Container	Standard tools		

Draining

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Loosen the filler/level plug to release any pressure.

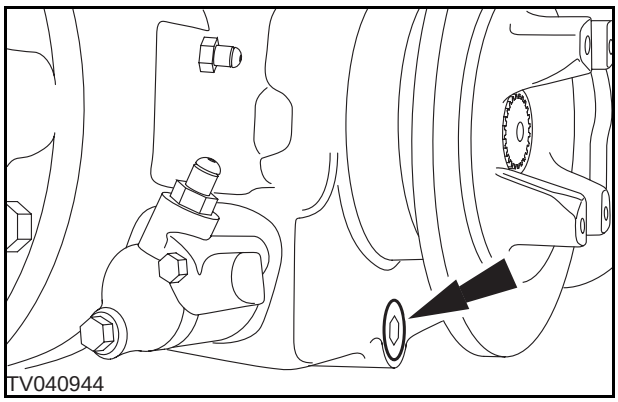

TV040945

3. Remove the drain plug and drain the oil into a suitable container.

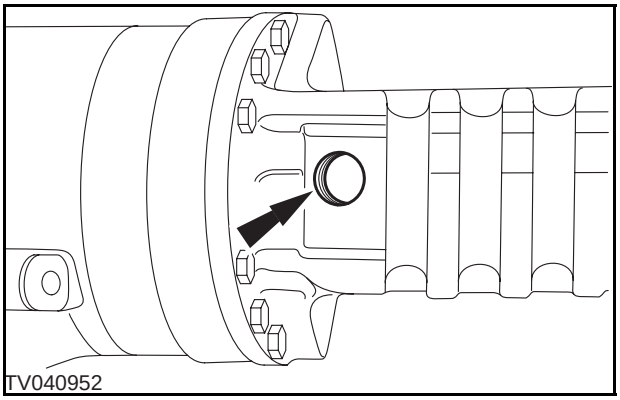

TV040944

Filling

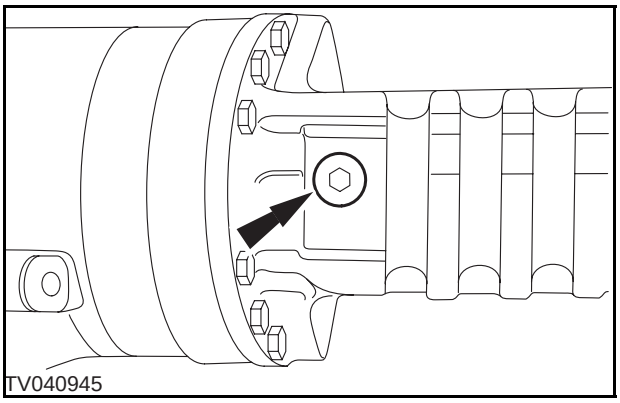
1. Install the drain plug and tighten to 60Nm (44 lb.ft)..


TV040944

2. Fill with oil until the filler/level hole level is reached.


TV040952

3. Install the filler/level plug and tighten to 60Nm.

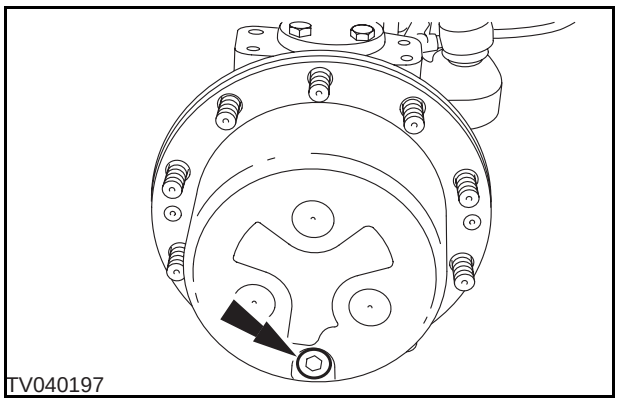

TV040945

GENERAL PROCEDURE — DRAINING AND FILLING THE HUB OIL (FOUR-WHEEL STEER)

BHN1305GC

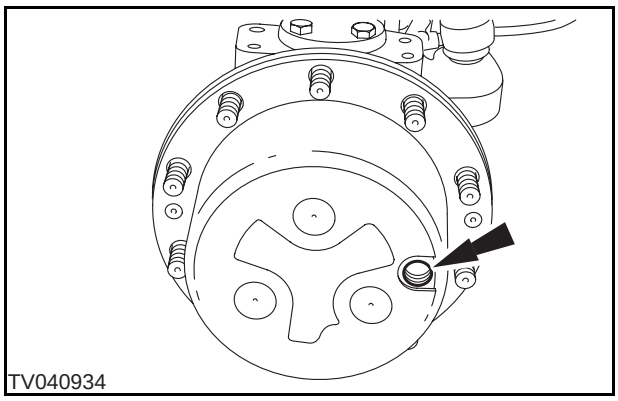
Draining

1. Remove rear the wheel. For additional information, refer to M12-01 REAR WHEEL, PAGE M12–01–5 .
2. Rotate the hub until the drain/filler plug is positioned at the top. Loosen the drain/filler plug to release any pressure.
3. Rotate the hub until the drain/filler plug is positioned at the bottom. Remove the drain/filler plug and drain the hub oil into a suitable container.


TV040197

Filling

1. Rotate the hub until the drain/filler plug is at the 3 o'clock position. Fill with oil until the drain/filler hole level is reached.
2. Install the drain/filler plug and tighten to 60Nm (44 lb.ft).
3. Install the rear wheel. For additional information, refer to M12-01 REAR WHEEL, PAGE M12–01–5 .


TV040934

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SPECIFICATIONS — FOUR-WHEEL STEER REAR AXLE

BHN1305SA

Special Tools

Tool No.	Description
CA119033	Interchangeable Handle
CA119087	Driver for Oil Seal
CA119099	Wrench for Lock Nut
CA715004	Driver for Bearing
CA715022	Pinion Shaft Lock Wrench
CA715026	Driver for Bearing Race
CA715027	Driver for Bush
CA715056	Driver for Oil Seal
CA715116	Extension for Pre-load Measurement
CA715128	False Pinion
CA715133	Driver for Bearing
CA715146	Kit for Backlash Measurement
CA715156	Driver for Oil Seal
CA715265	Wrench for Differential Housing Lock Nut
CA715386	Driver for Bush
CA715387	Driver for Oil Seal
CA715388	False Differential
CA715391	Driver for Bearing Race

General Specifications

Description	Value
Input rotation 4 wheel steer rear axle	Counter — clockwise
Dry Weight	539
Steering Angle	33° 0–2mm
Toe-in	A ±1
Bevel Gear Ratio	2.5/1
Epicyclic Reduction Gear Ratio	6.923/1
Total Ratio	17.307/1
Input Rotation	Clockwise (C.W)
Bevel Gear Set Backlash	0.20÷0.28mm
Differential Backlash	0.20 — 0.30 daN
Pinion Bearings Preloading (measured on D=34.8mm without seals	“P” = 9.22÷13.83 daN
Total Pinion-ring Gear Bearing Preloading (measured on D=34.8mm without seals)	T=(P+1.84)÷(P+2.77) daN
Brake Activation Oil	Mineral Oil
Brake Activation Oil Displacement	12 + 12cc
Max. Operating Pressure	43 bar

Capacity

System	Temperatures	Viscocity	Specification	Capacity	Notes
Rear Axle	ALL	80W	API GL4 M1135	14.5 + 1.5 + 1.5	Approved oils: Agip Rotra Multi THT, Esso Torque Fluid 62, Mobil Fluid 422 or 424

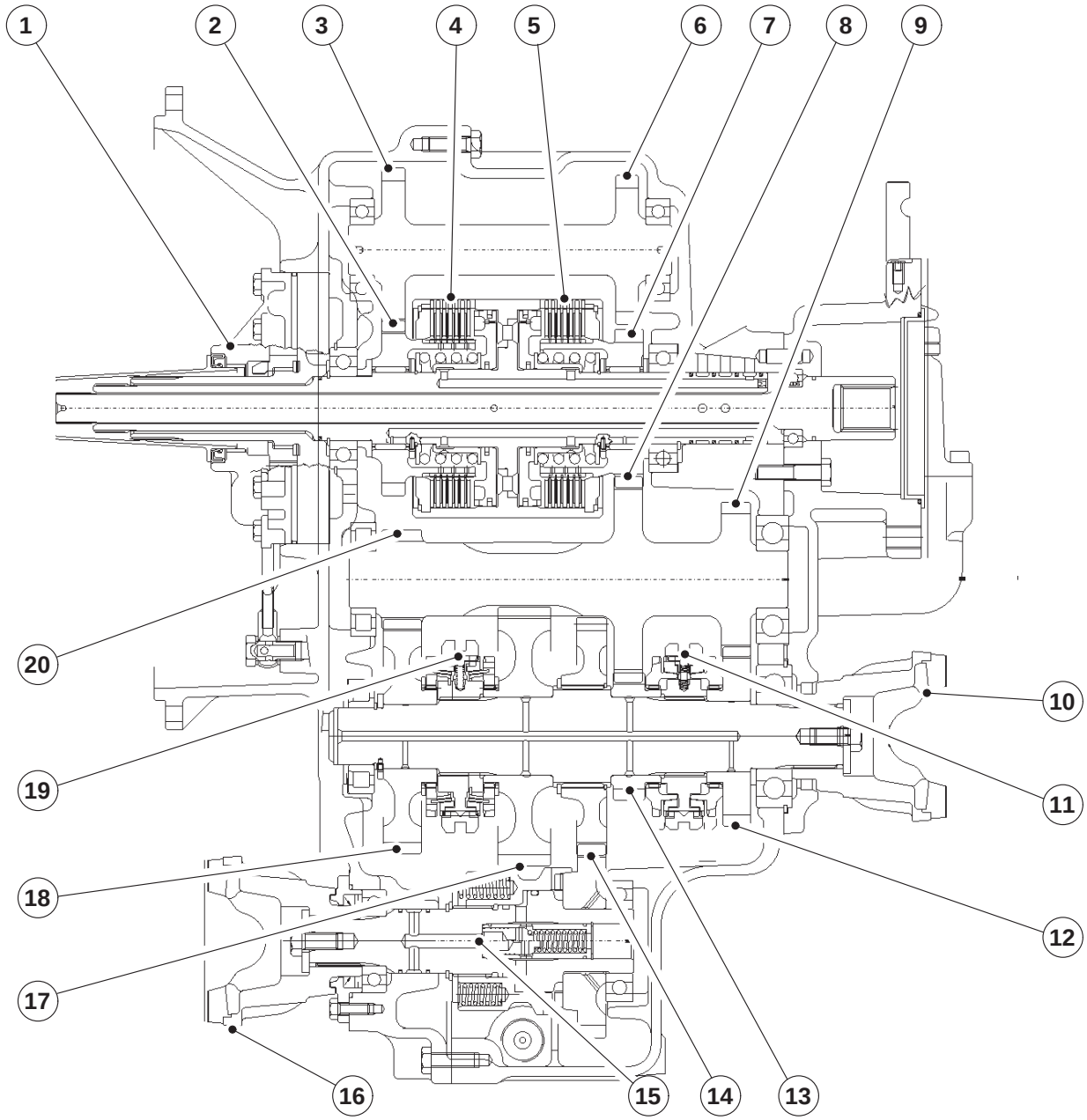
Torque Values

Description	Nm	Lb.ft
Epicyclic Gear	79	58
Wheel Hub	230	170
Hub Drain Plug	60	44
Wheel Studs	70	52
Epicyclic Reduction Hub	25	18
Brake Housing	79	58
Crown Wheel	155	114
Differential Adjustment Nut Locking Tabs	13	10
Half shaft Housing	130	96
Parking Brake Caliper Mounting Bracket	80	59
Parking Brake Caliper	150	111
Parking Brake Caliper Cable Bracket	45	33
Brake Self Adjust Bolts	10	7
Differential Lock Actuator	27.6	20
Differential Lock Cover	27.6	20
Brake Bleed Valve	10	7
Breather Union	15	11
Breather	10	7
Blanking Plug	25	18

DESCRIPTION AND OPERATION — SYNCHROSHUTTLE TRANSMISSION – CARRARO

BHN1306OA

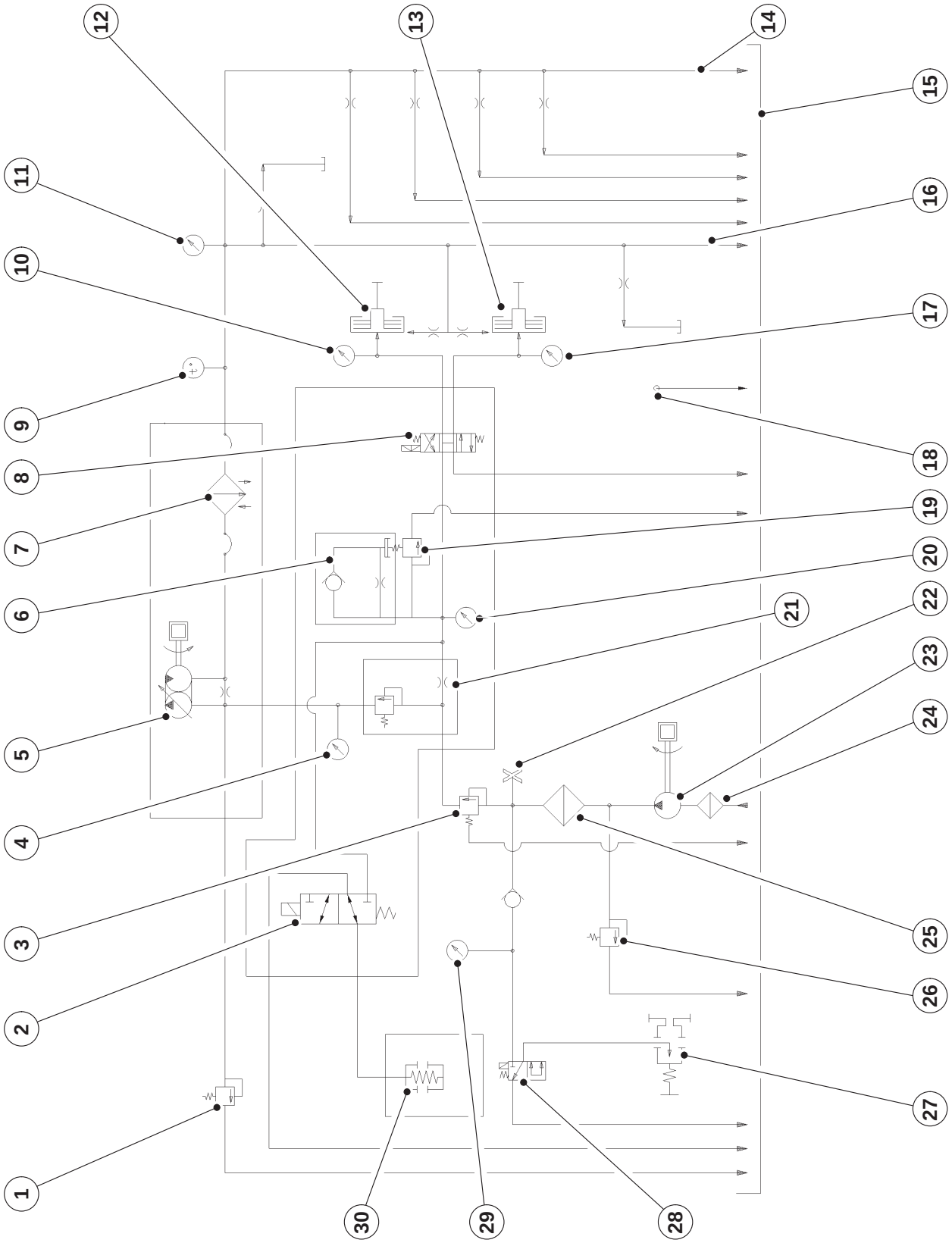
Schematic View Synchroshift Transmission – Carraro



TV051272

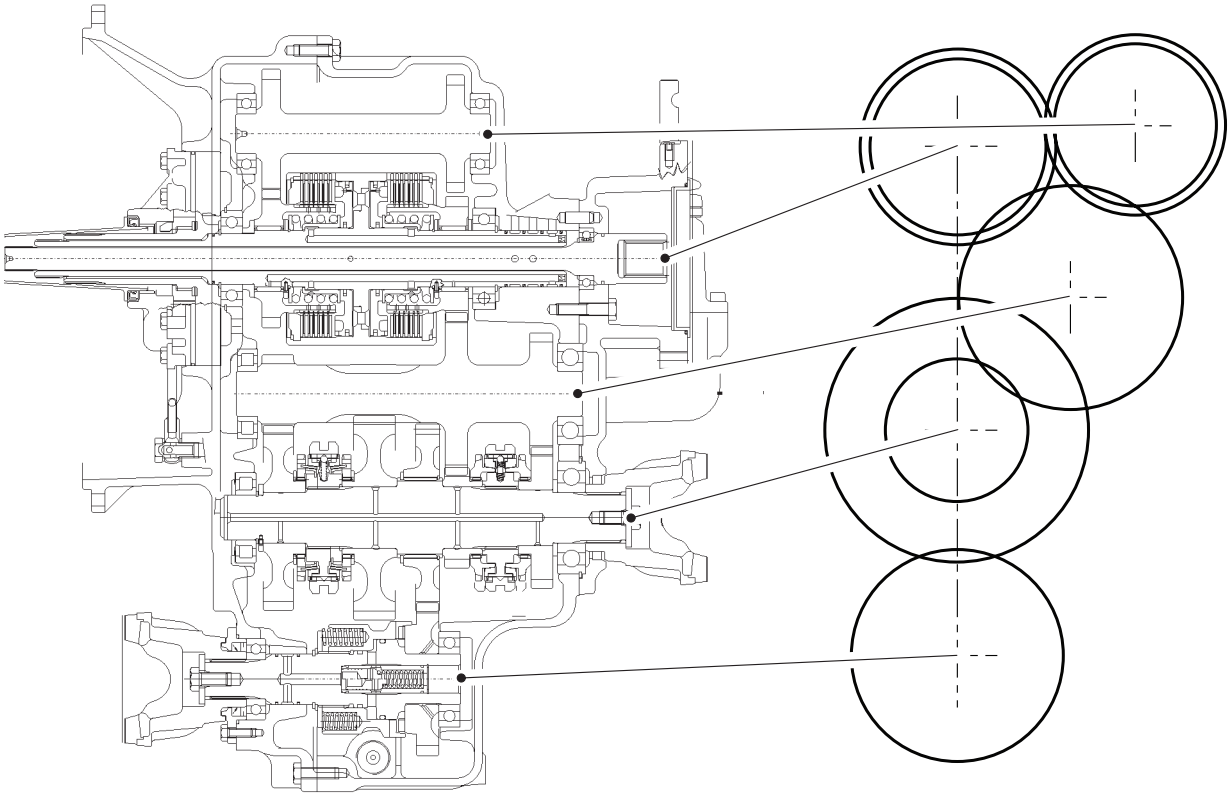
1	Transmission Oil Pump
2	Reverse Gear Drive
3	Reverse Idler Gear Driven
4	Reverse Clutch Pack
5	Forward Clutch Pack
6	Reverse Idler Gear Drive
7	Forward Gear Drive
8	Fourth Speed Gear Driven
9	Third Speed Gear Driven
10	Output Flange
11	Third/Fourth Speed Synchroniser
12	Third Speed Gear Drive
13	Fourth Speed Gear Drive
14	Four Wheel Drive (4WD) Gear Drive
15	4WD Clutch
16	4WD Output Flange
17	First Speed Gear Drive
18	Second Speed Gear Drive
19	First/Second Speed Synchroniser
20	Second Speed Gear Driven

Transmission Hydraulic Circuit



1	Torque Converter Pressure Relief Valve
2	Hydraulic Differential Lock Solenoid Valve
3	Pressure Regulator
4	Torque Converter Pressure Check Port
5	Torque Converter
6	Forward/Reverse Modulating Valve
7	Oil Cooler
8	Oil Cooler Back Temperature Thermostat Port
9	Forward Clutch Pressure Check Port
10	Oil Cooler Back Shaft Lubrication Pressure Check Port
11	Forward Clutch
12	Forward/Reverse Selection Valve
13	Reverse Clutch
14	1st, 2nd, 3rd, 4th Gear Shaft Lubrication
15	Transmission Sump
16	Forward/Reverse Shaft Lubrication
17	Reverse Clutch Pressure Check Port
18	Brake Oil Port Return To Sump
19	Modulation Relief Valve
20	Forward/Reverse Main Pressure Check Port
21	Oil Flow Divider/Pressure Regulator Valve
22	Oil Outlet Port To Brake
23	Transmission Oil Pump
24	Suction Filter
25	Spin-On Delivery Filter
26	Oil Filter Relief Valve
27	Four Wheel Drive (4WD) Engagement/Disengagement(Easy-Shift)
28	4WD Disengagement Solenoid Valve
29	4WD Pressure Check Port
30	Hydraulic Differential Lock Engagement/Disengagement

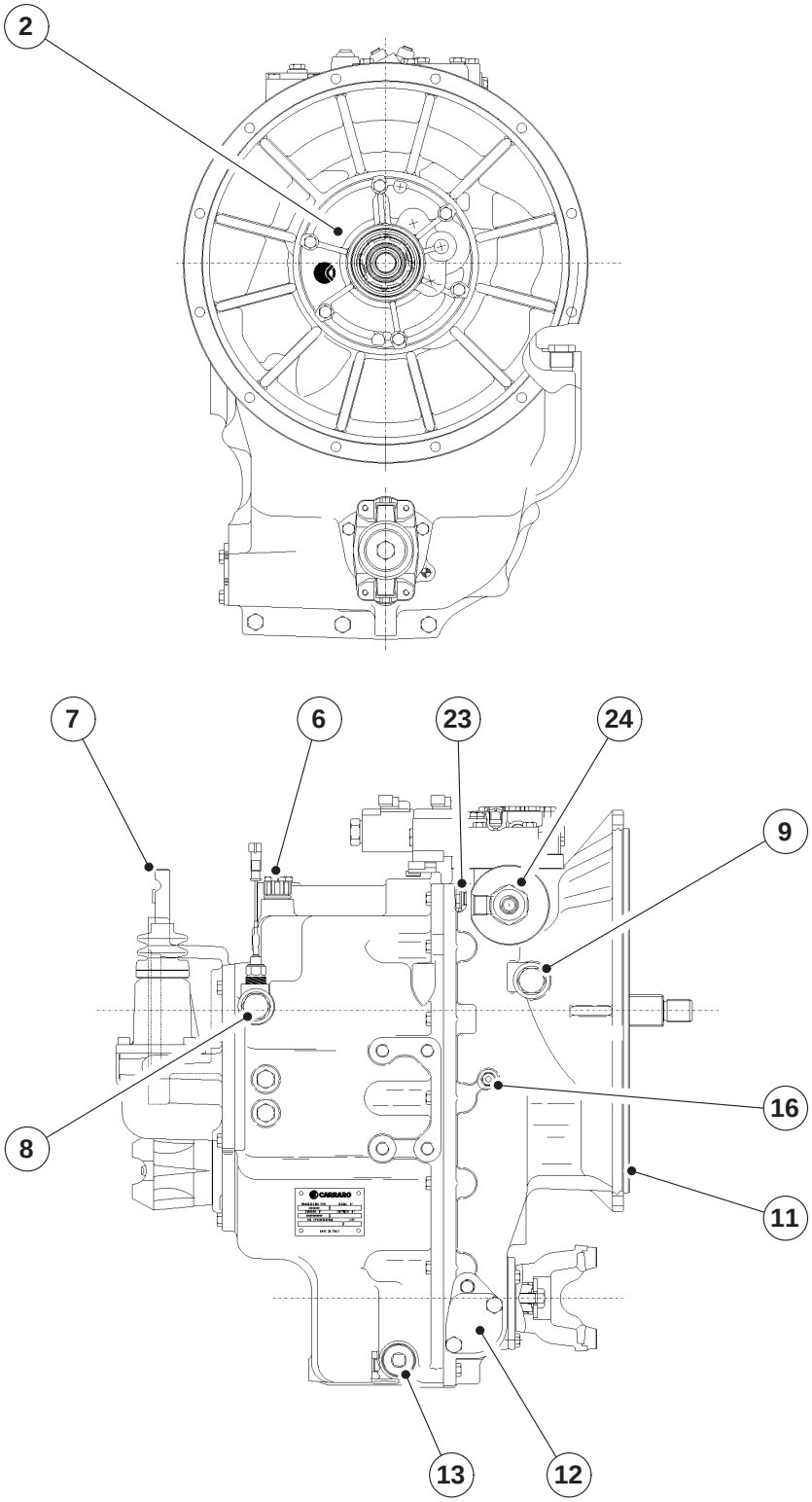
Shaft Location



TV051273

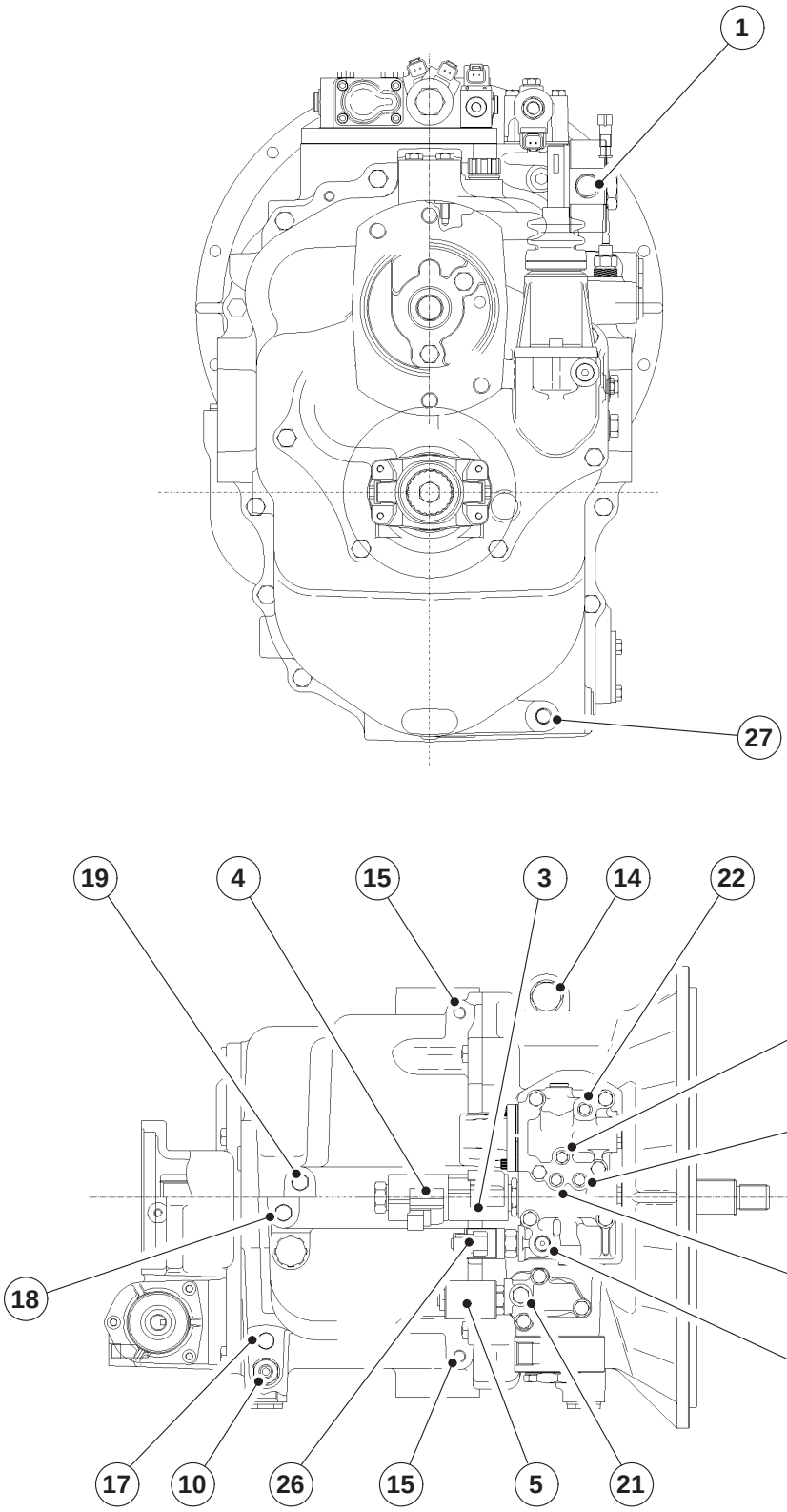
1	**Shaft A** — Input Shaft
2	**Shaft D** — Reverse Idler Shaft
3	**Shaft B** — Idler Shaft
4	**Shaft C** — Primary Shaft
5	**Shaft E** — Four Wheel Drive (4WD) Shaft

Component Location



TV051270

1	Not Shown, Spin-On Filter Oil Delivery Attachment
2	Oil Pump Assembly: max pressure 16 bar
3	Not Shown, Forward Shift Solenoid Valve 28W-12V D.C.
4	Not Shown, Reverse Shift Solenoid Valve 28W-12V D.C.
5	Not Shown, 4WD Shift Solenoid Valve 28W-12V D.C.
6	Breather Plug
7	Speed Shift Lever
8	Oil Inlet Port From Cooler
9	Oil Outlet port to Cooler
10	Not Shown, Transmission Oil Thermostat
11	SAE 3 Torque Converter Bell Housing
12	Suction Filter
13	Magnetic Oil Drain Plug (SW 1/2”)
14	Not Shown, Dipstick Fitting Hole
15	Not Shown, Lifting Attachment Eyebolt Holes
16	4th Gear Lock Out
17	Not Shown, Oil Cooler Back Pressure Check Port (0.5–3.5 bar on FWD/RVS clutch position and 0.5–5 bar on NEUTRAL clutch position
18	Not Shown, FWD Clutch Pressure Check Port (11.0–13.0 bar) max pressure in NEUTRAL (0.3 bar)
19	Not Shown, RVS Clutch Pressure Check Port (11.0–13.0 bar) max pressure in NEUTRAL (0.3 bar)
20	Not Shown, FWD/RVS Clutch Pressure Check Port (11.0–13.0 bar) max pressure in neutral (0.3 bar)
21	Not Shown, Four–Wheel Drive (4WD) Clutch Pressure Check Port at 900 RPM (13.0–14.0 bar) at 2200 RPM (13.0–15.5 bar)
22	Not Shown, Torque Converter Pressure Check Port (0.5–9.0 bar)
23	Oil Outlet Port To Brake
24	Spin-On Filter Oil Return Attachment
25	Not Shown, Hydraulic Differential Lock Supply Port
26	Not Shown, Hydraulic Differential Lock Valve
27	Not Shown, Oil Inlet Port From Brake



TV051268

1	Spin-On Filter Oil Delivery Attachment
2	Not Shown, Oil Pump Assembly: max pressure 16 bar
3	Forward Shift Solenoid Valve 28W-12V D.C.
4	Reverse Shift Solenoid Valve 28W-12V D.C.
5	4WD Shift Solenoid Valve 28W-12V D.C.
6	Not Shown, Breather Plug
7	Not Shown, Speed Shift Lever
8	Not Shown, Oil Inlet Port From Cooler
9	Not Shown, Oil Outlet port to Cooler
10	Transmission Oil Thermostat
11	Not Shown, SAE 3 Torque Converter Bell Housing
12	Not Shown, Suction Filter
13	Not Shown, Magnetic Oil Drain Plug (SW 1/2”)
14	Dipstick Fitting Hole
15	Lifting Attachment Eyebolt Holes
16	Not Shown, 4th Gear Lock Out
17	Oil Cooler Back Pressure Check Port (0.5–3.5 bar on FWD/RVS clutch position and 0.5–5 bar on NEUTRAL clutch position
18	FWD Clutch Pressure Check Port (11.0–13.0 bar) max pressure in NEUTRAL (0.3 bar)
19	RVS Clutch Pressure Check Port (11.0–13.0 bar) max pressure in NEUTRAL (0.3 bar)
20	FWD/RVS Clutch Pressure Check Port (11.0–13.0 bar) max pressure in neutral (0.3 bar)
21	Four–Wheel Drive (4WD) Clutch Pressure Check Port at 900 RPM (13.0–14.0 bar) at 2200 RPM (13.0–15.5 bar)
22	Torque Converter Pressure Check Port (0.5–9.0 bar)
23	Not Shown, Oil Outlet Port To Brake
24	Not Shown, Spin-On Filter Oil Return Attachment
25	Hydraulic Differential Lock Supply Port
26	Hydraulic Differential Lock Valve
27	Oil Inlet Port From Brake

DIAGNOSING AND TESTING — SYNCHROSHUTTLE TRANSMISSION – CARRARO

BHN1306TA

⚠ **Caution:**

- **All checks and tests must be performed with the oil at working temperature: 80 °C ±2.**

Stall test

In order to create ideal conditions for troubleshooting, the converter stall procedure must be performed first. The purpose of this test is to determine whether the torque converter and hydraulic clutch units are operating correctly. This operation will also bring the oil up to its working temperature of 80°C ±2, allowing any problems in the engine, converter or transmission to be identified. Proceed as follows:

- Check the oil level.
- Activate the parking brake to lock the wheels.
- Start the engine and keep it ticking over at idle speed (800 - 1000 [rpm]).
- Put the gear lever into 4th.
- Put the forward/reverse lever in the FORWARD position.
- Increase the engine speed for short periods to a maximum of 1500 - 1700 [rpm], to bring the oil up to working temperature.

⚠ **Caution:**

- **The converter stall test must not exceed a maximum duration of 30 seconds each time. After this 30 second period, put the forward/reverse lever in NEUTRAL for 15 seconds, then repeat the procedure. Failure to keep to these test periods may result in the oil overheating and attendant damage to the clutches, filter, converter and seals.**

- Gradually reduce the engine speed to minimum.
- Put the forward/reverse lever in NEUTRAL.

Mechanical problems

- Check that all of the transmission's internal and external mechanical parts are correctly fitted (see disassembly and assembly chapters).
- Check the efficiency of the parking brake.
- Check that the cooling system is in good operating condition.
- Check the efficiency of the engine. Make sure that the engine's idling speed is set correctly and that it complies with the maximum speed specifications under loadless conditions.

Hydraulic problems

- Check the transmission oil level
- Use the specified transmission oil
- Check that the hydraulic system is correctly filled.
- Check the efficiency of the hydraulic system. Check for oil leaks.
- Check the efficiency of the transmission's hydraulic components (converter, oil pump, filter, connections, hoses).

Pressure check

Several transmission breakdowns can be identified by running pressure checks. Irregular measurements might indicate that there is a problem. For test port locations refer to PRESSURE TESTING in this section.

Electrical problems

- Check the efficiency and correct installation of the vehicle battery.
- Check the efficiency and correct installation of all electrical components outside the transmission (wiring, cables, alternator, battery, etc.).
- Check the efficiency and correct installation of all transmission electrical components (wiring, sensors, solenoid valves, EGM/ECU, etc.)

Troubleshooting

This list of possible failures and remedies provides no more than an indication of what the problem might be and how to fix it. It should be remembered that problems are not caused by just one part, but by that part's interaction with other elements; accordingly, additional action over and above the steps described is frequently required. This list may not cover all possible problems and remedies.

Problem	Cause	Action
Vehicle does not move	• Faulty supply to solenoid valves	• Check/Replace
	• Damaged wiring connections between transmission and vehicle	• Repair/Replace
	• Oxidised contacts in electrical wiring	• Clean
	• Break in electric cable	• Replace
	• Damaged solenoids	• Replace
	• Damaged sensors	• Replace
	• Short circuits or false contacts	• Check/replace fuses
	• Incorrect oil level	• Top up
	• Check for leaks	• Repair/Top up
	• Blocked intake filter	• Clean
	• Damaged oil pump	• Replace
	• Damaged oil pump relief valve	• Replace oil pump
	• Blocked/damaged transmission filter	• Replace
	• Damaged/jammed control valve	• Replace
	• Damaged converter	• Replace
	• Oil temperature below 0°C	• Wait for oil to reach working temperature (stall test)
	• Damaged rotary seals	• Replace
	• Damaged synchronisers	• Replace
	• Blocked reverser lever	• Repair
	• Worn clutch unit	• Replace/Repair clutch unit
	• No drive transmission (broken gears, shafts, bearings, etc.)	• Check/Repair/Replace
Vehicle has reduced power transmission	• Incorrect oil temperature	• Wait for oil to reach working temperature (stall test)
	• Transmission oil overheating	• Restore acceptable temperature values
	• Incorrect operating pressure	• Check hydraulic circuit and replace (oil pump, filters, control valve)
	• Damaged converter	• Replace
	• Incorrect oil level	• Top up
	• Worn clutch unit	• Replace/Repair
	• 4WD clutch failure	• Repair/Replace 4WD shaft group
	• Overheating solenoids	• Replace
	• Damaged transmission and vehicle wiring connections	• Repair/Replace
	• Damaged sensors	• Replace

Problem	Cause	Action
Overheating	• Damaged hydraulic cooling system	• Repair
	• Dirty heat exchanger	• Clean
	• Parking brake inadvertently activated	• Release
	• Excessive dirt on axle wheel hubs	• lean
	• Seizing (broken gears, shafts, bearings, etc.)	• Check/Repair/Replace
	• Braking force outside transmission: irregular axle operation	• Check/Repair axle
	• Clutch plate drag	• Repair/Replace
	• Damaged converter	• Replace
	• Damaged oil thermostat	• Replace
	• Incorrect oil level	• Top up
	• Worn oil pump	• Replace
Wheels rotate when vehicle is raised	• Clutch plate drag	• Repair/Replace
	• Low oil temperature (high oil viscosity)	• Wait for oil to reach working temperature (stall test)
	• Incorrect oil specifications	• Replace oil and filters
	• Damaged control valve	• Replace
	• Faulty reverser locking	• Repair/Replace
Noi se	• Damaged converter	• Replace
	• Damaged oil pump	• Replace
	• Aeration/Cavitation	• Check oil level / Check oil specifications
	• Seizing (broken gears, shafts, bearings, etc.)	• Check/Repair/Replace
	• Worn clutch plates	• Replace
	• Worn synchroniser actuation unit	• Replace
	• Worn 4WD clutch	• Replace
Irregular actuation	• Damaged control valve	• Replace
	• Electrical system fault	• Repair/Replace
	• Worn clutch plates	• Replace
	• Damaged converter	• Replace
	• Low oil temperature (high oil viscosity)	• Wait for oil to reach working temperature (stall test)
	• Overheating	• See "overheating"
	• Damaged hydraulic system	• Repair/Replace
Gear remains engaged	• Damaged/jammed shuttleshaft lever	• Repair/Replace
	• Electrical system fault	• Repair/Replace
	• Damaged control valve	• Replace
	• Damaged hydraulic system	• Repair/Replace
	• Damaged clutch unit	• Repair/Replace
	• Damaged gear lever rod	• Replace
	• Damaged synchronisers	• Replace

Problem	Cause	Action
No 4WD power transmission	• Damaged 4WD clutch	• Replace
	• Hydraulic system fault	• Repair/Replace
	• Damaged control valve	• Replace
	• Faulty brake sensor	• Check/Replace
	• Electrical system fault	• Repair/Replace
Gear shift won't engage	• Damaged shifter	• Replace
	• Damaged synchronisers	• Replace

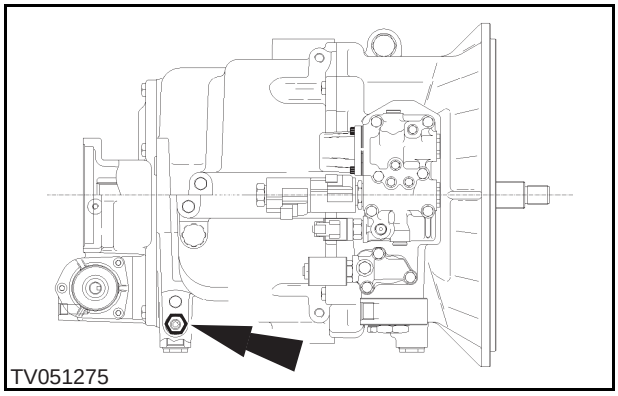
DIAGNOSING AND TESTING — SYNCHROSHUTTLE TRANSMISSION – CARRARO PRESSURE TESTING

BHN1306TB

Note:
- The transmission oil, should be at an approximate temperature of 80 Degrees Celsius during pressure tests.

Note:
- Install a suitable 9/16” - 18 UNF - 2B fitting.

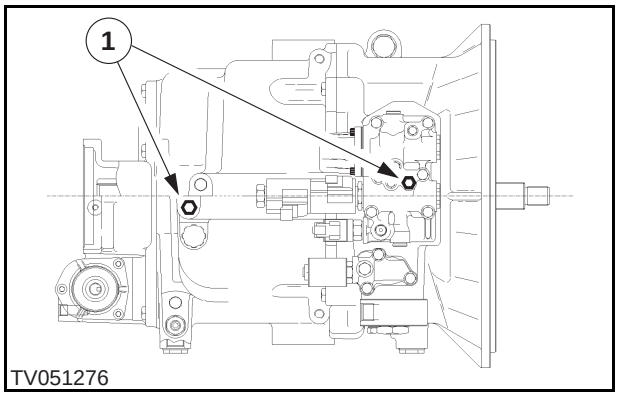
Oil cooler back pressure
- FORWARD/REVERSE clutch position — Pressure should be 0.5 to 3.5 bar at an engine speed of 900 to 2200 rpm
- NEUTRAL clutch position — Pressure should be 0.5 to 5.0 bar at an engine speed of 900 to 2200 rpm


TV051275

Note:
- Install a suitable 9/16” - 18 UNF - 2B fitting.

Forward clutch pressure
- Pressure at (1) should be 11.0 to 13.0 bar at an engine speed of 900 to 2200 rpm

Note:
- Maximum pressure in NEUTRAL should be 0.3 bar.

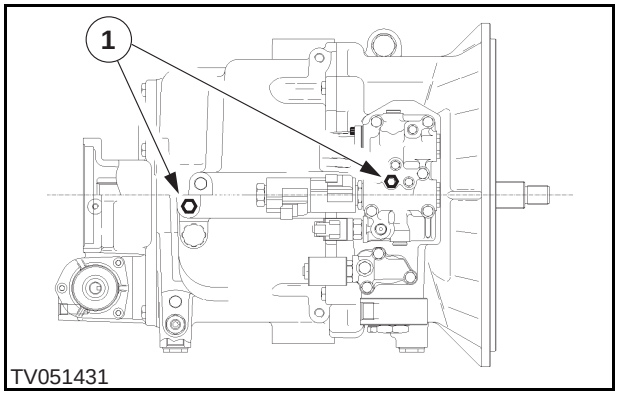


TV051276

Note:
- Install a suitable 9/16” - 18 UNF - 2B fitting.

Reverse clutch pressure
- Pressure at (1) should be 11.0 to 13.0 bar at an engine speed of 900 to 2200 rpm

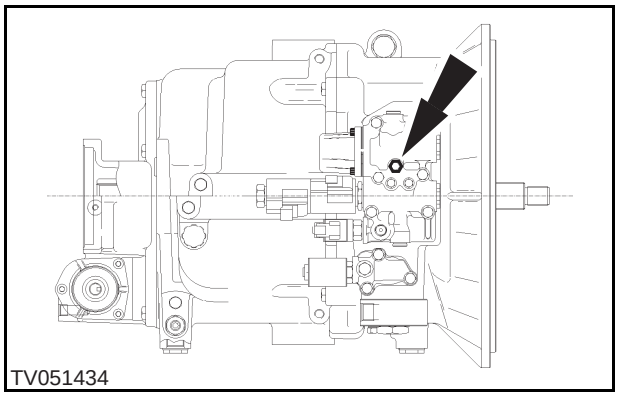
Note:
- Maximum pressure in NEUTRAL should be 0.3 bar.



Note:
- Install a suitable 9/16” - 18 UNF - 2B fitting.

Forward/reverse clutch pressure
- Pressure should be 11.0 to 13.0 bar at an engine speed of 900 to 2200 rpm

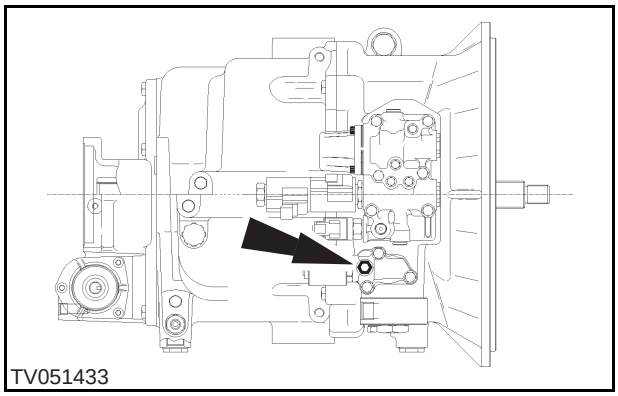
Note:
- Maximum pressure in NEUTRAL should be 0.3 bar.



Note:
- Install a suitable fitting.

Four-wheel drive (4WD) pressure

- Pressure should be 13.0 to 14.0 bar at an engine speed of **900** rpm
- Pressure should be 13.0 to 15.5 bar at an engine speed of **2200** rpm

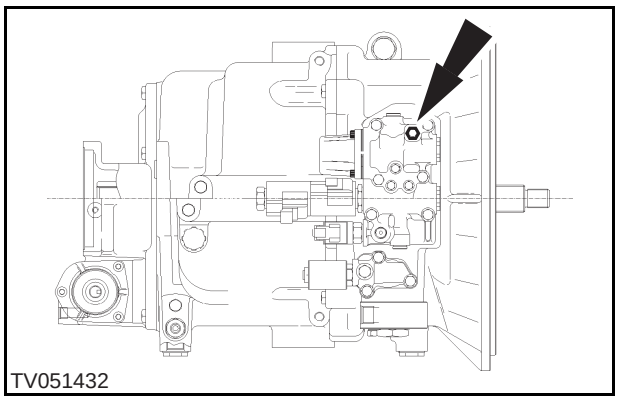

TV051433

Note:

- Install a suitable 9/16” - 18 UNF - 2B fitting.

Torque converter pressure

- Pressure should be 0.5 to 9.0 bar at an engine speed of 900 to 2200 rpm


TV051432

Note: This page intentionally left blank.

REMOVAL AND INSTALLATION — SYNCHROSHUTTLE TRANSMISSION — CARRARO

BHN1306A

Operation: **Removing and Installing the Synchroshuttle Transmission — Carraro**	*Job Code:* **13 25 13 xx**		
Suitable lifting equipment, Suitable transmission jack Suitable container (30Ltrs)	Standard tools		

Removal

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

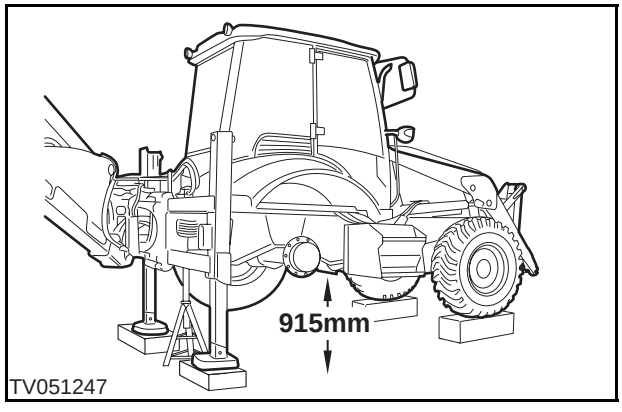
Note:
- Always install blanking plugs to any open ports to avoid contamination.

⚠ Warning:
- **This component is very heavy. Make sure the supporting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Position suitable 150mm blocks under each stabilizer and fully lower.
2. Remove the right-hand rear wheel. For additional information, refer to Section M12-01 REAR WHEEL, PAGE M12–01–5 .
3. Raise the front of the machine level to the rear.

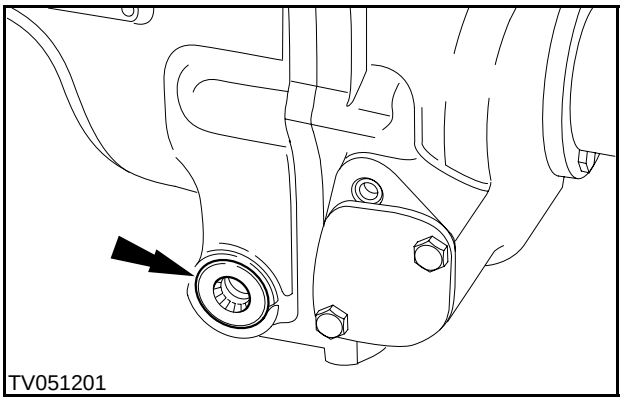
   Note:
   - Make sure there is a minimum of 875 mm clearance between the chassis and the ground.

4. Using suitable lifting equipment, support the machine.

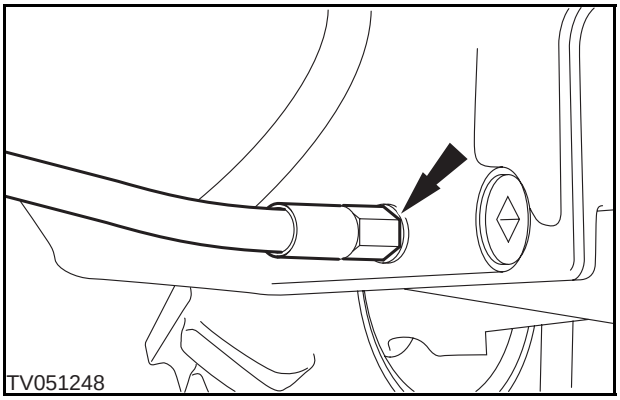


5. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

6. Remove the drain plug and drain the transmission oil into a suitable container.


TV051201

7. Install the transmission oil drain plug and a new O-ring.
   Tighten to __Nm (__ lb.ft).
8. Detach the boosted brake return hose.

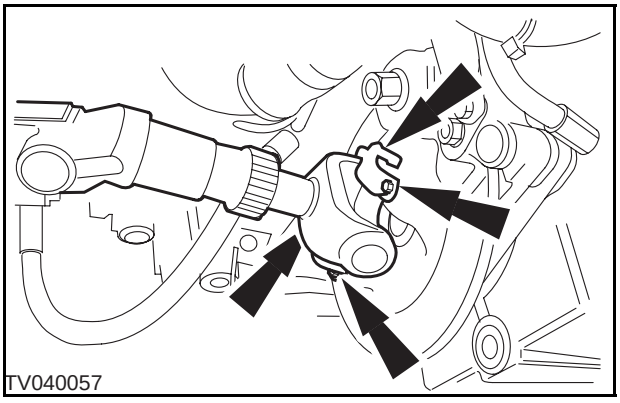

TV051248

9. Remove the parking brake caliper. For additional information, refer to Section N13-03 PARKING BRAKE CALIPER, PAGE N13–03–13 .

   ⚠ **Caution:**
   - **Secure the universal joint bearing cups to prevent contamination or damage.**

10. Remove the four retaining bolts and detach the rear propeller shaft from the rear differential. Secure it to one side.

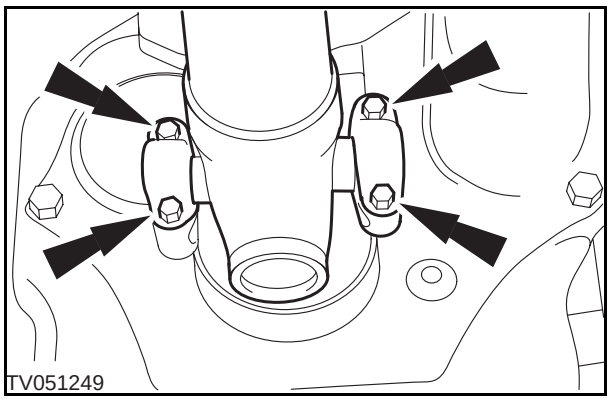
    Note:
    - Discard the retaining bolts.


TV040057

⚠ **Caution:**
- **Secure the universal joint bearing cups to prevent contamination or damage.**

11. Remove the retaining bolts and remove the rear propeller shaft from the transmission.

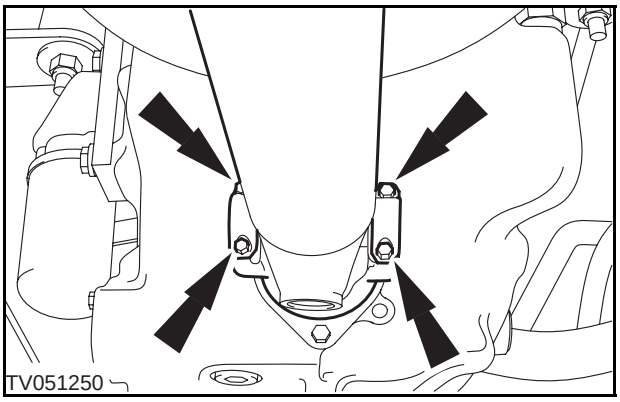
Note:
- Discard the retaining bolts.


TV051249

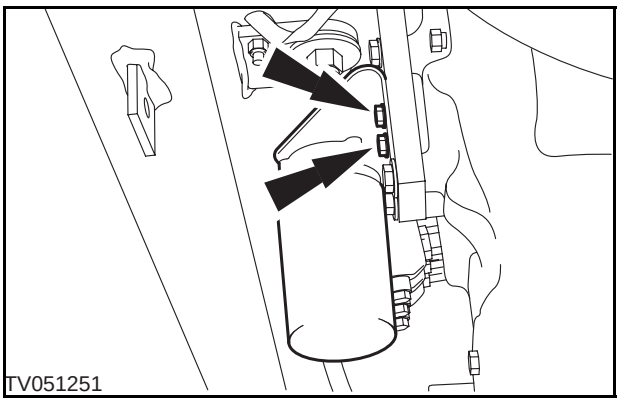
⚠ **Caution:**
- **Secure the universal joint bearing cups to prevent contamination or damage.**

12. Remove the retaining bolts and detach the front propeller shaft from the transmission.
Secure it to one side.

Note:
- Discard the retaining bolts.

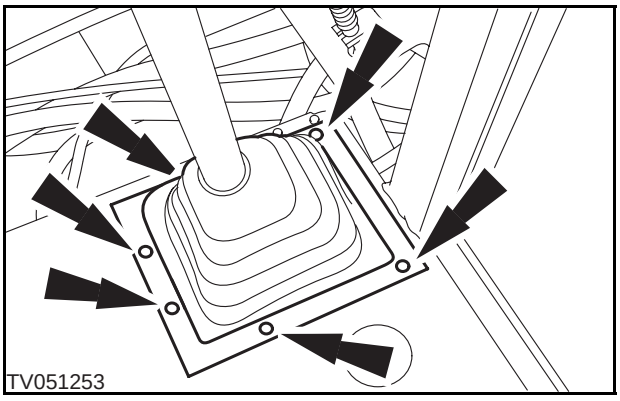

TV051250

13. Remove the retaining bolts and detach the transmission oil filter housing.

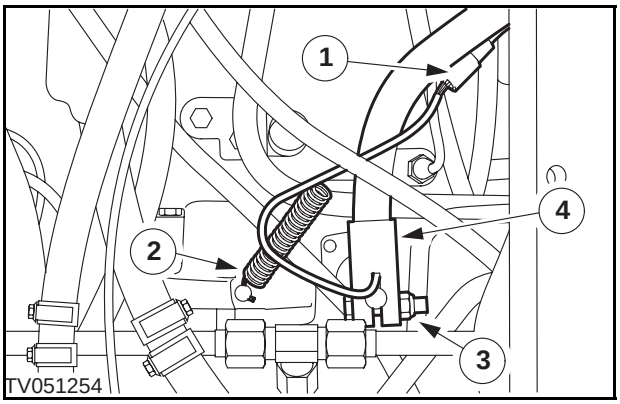

TV051251

14. Remove the cabin heater air ducting. For additional information, refer to Section H08-01 CABIN HEATER AIR DUCTING, PAGE H08–01–13 .
15. Remove the retaining clips and detach the gearshift lever boot.

    Note:
    - Discard the retaining clips.



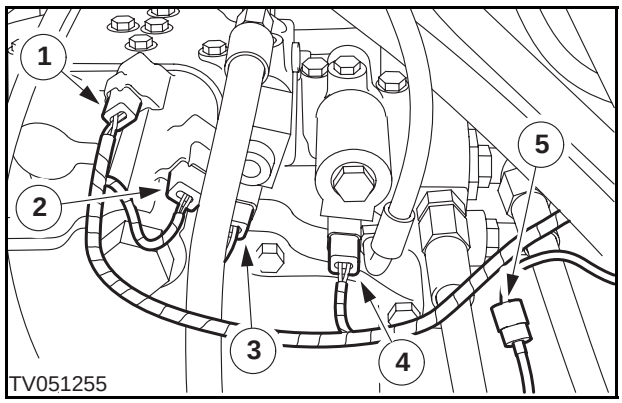
16. Disconnect the transmission dump button electrical connector (1).
17. Remove the gearshift selector lever return spring (2), retaining bolt (3) and the gearshift selector lever (4).



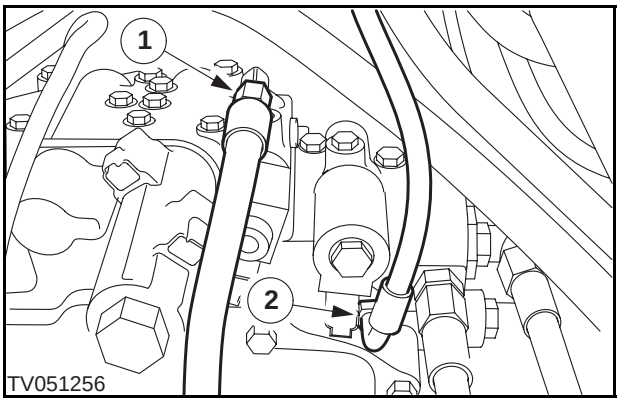
    Note:
    - Make a note of the position of the transmission wiring harness electrical connectors to aid installation.

18. Disconnect the forward solenoid electrical connector (1) and the reverse solenoid electrical connector (2).
19. Disconnect the differential lock solenoid (3), four-wheel drive solenoid (4) and the transmission temperature sender (5) electrical connectors.

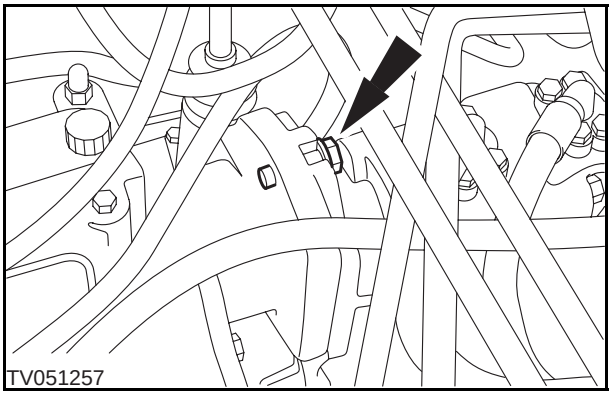
20. Position the transmission wiring harness to one side.



21. Disconnect the differential lock supply hose (1).
22. Disconnect the steering supply hose (2).



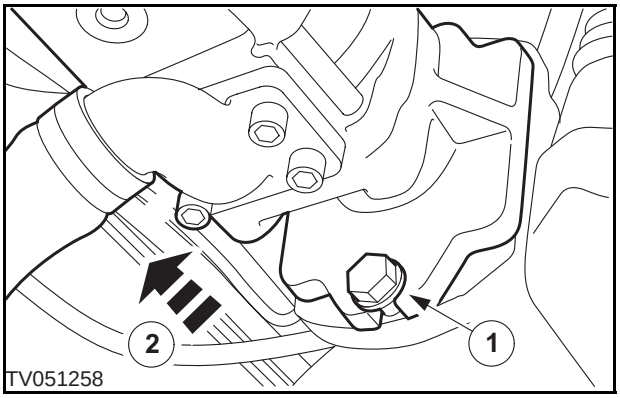
23. Remove the upper hydraulic oil pump retaining bolt.



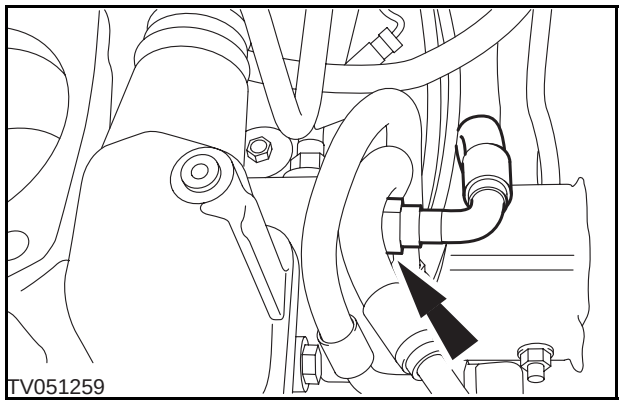
24. Remove the lower hydraulic oil pump retaining bolt (1).

    ⚠ **Warning:**
    - **Take extreme care, this component is very heavy. Failure to follow this instruction may result in personal injury.**

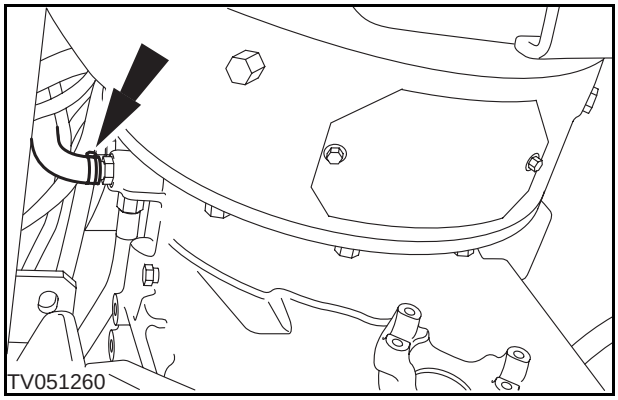
25. Detach the hydraulic oil pump (2) from the transmission and secure it to one side.



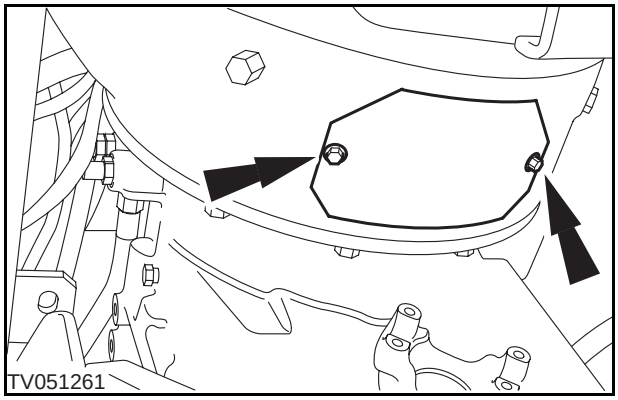
26. Disconnect the transmission oil cooler inlet pipe.



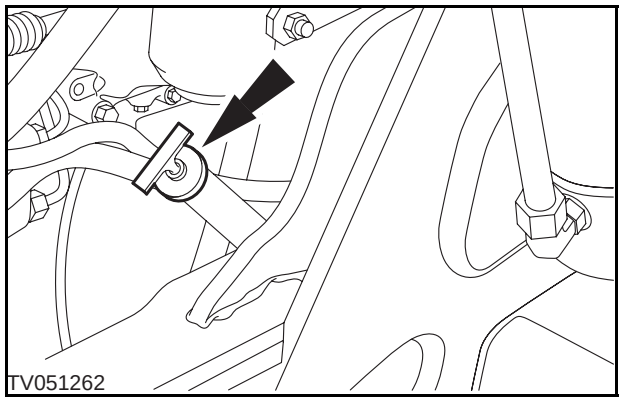
27. Disconnect the transmission oil cooler outlet pipe.



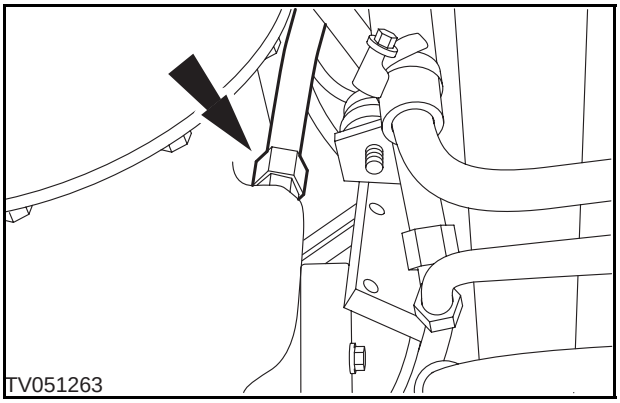
28. Remove the torque converter housing cover plate.



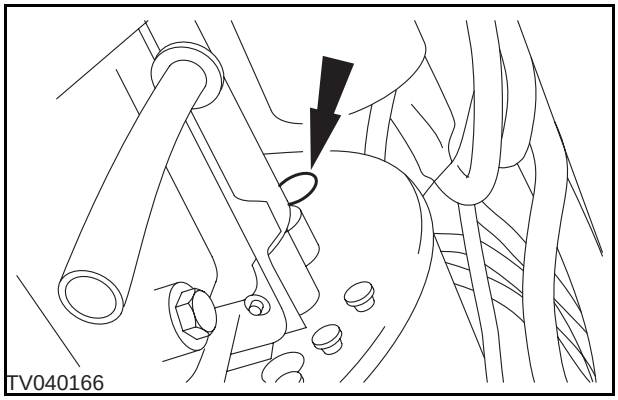
29. Remove the transmission oil level dipstick.



30. Detach the transmission oil filler tube.

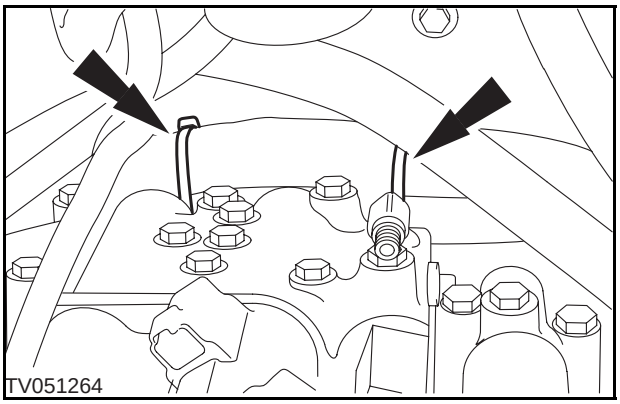


31. Using the access hole remove the eight torque converter retaining bolts.



⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

32. Using suitable lifting equipment, support the engine.
33. Cut the cable ties and position the wiring harness and hydraulic hoses to one side.

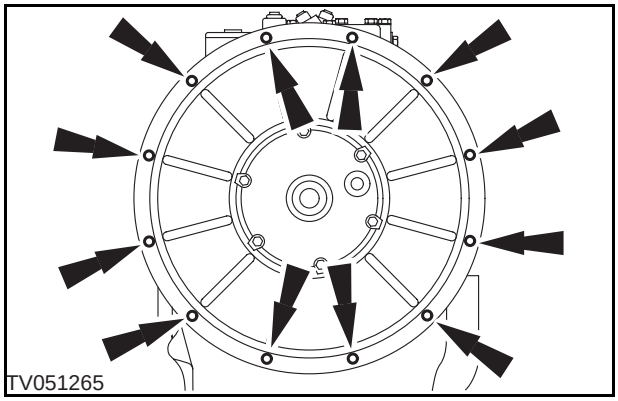


⚠ **Warning:**
- **Secure the transmission to the transmission jack. Failure to follow this instruction may result in personal injury.**

34. Using a suitable transmission jack, support the transmission.

Note:
- Transmission shown removed for clarity.

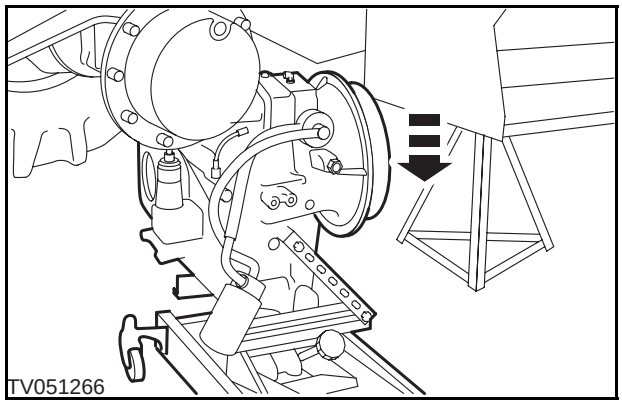
35. Remove the transmission retaining bolts.


TV051265

⚠ Warning:
- **Take extreme care when removing the transmission from the engine. Failure to follow this instruction may result in personal injury.**

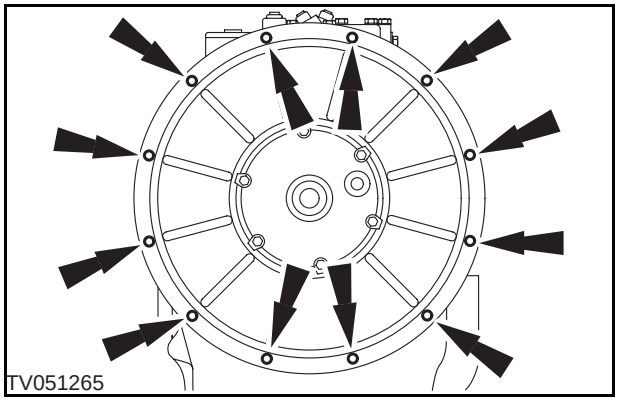
⚠ Caution:
- **Make sure the torque converter is removed with the transmission.**

36. Remove the transmission from the engine.
    Remove the transmission from the right-hand side of the machine.

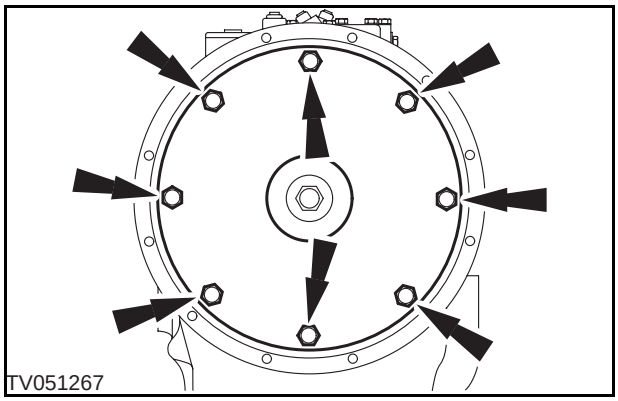

TV051266

Installation

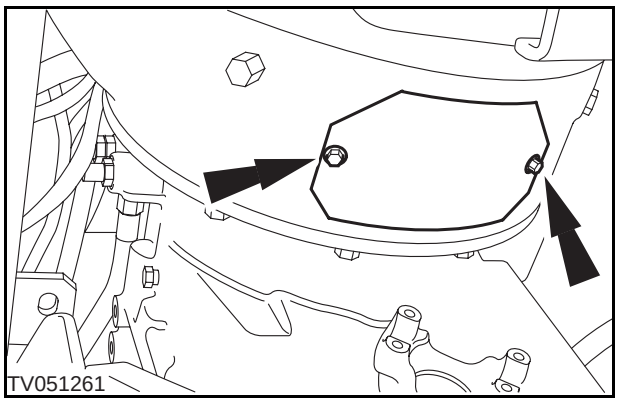
1. To install, reverse the removal procedure.
   Tighten to 71Nm (52 lb.ft).



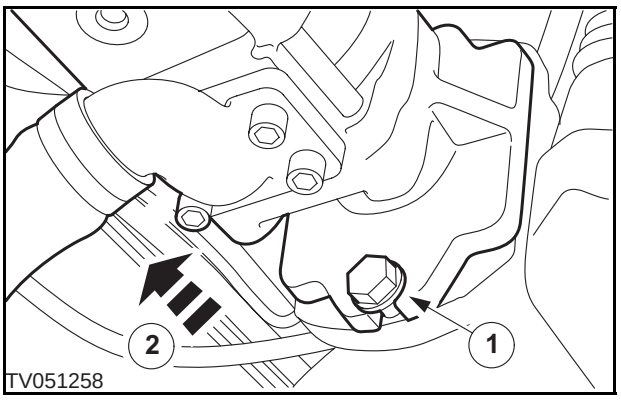
2. Tighten to 41Nm (30 lb.ft).



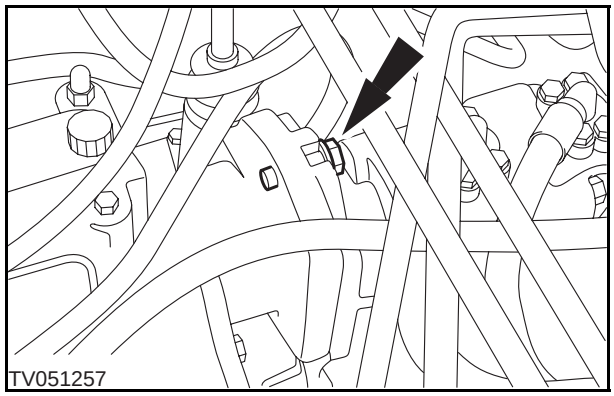
3. Tighten to 30Nm (22 lb.ft).



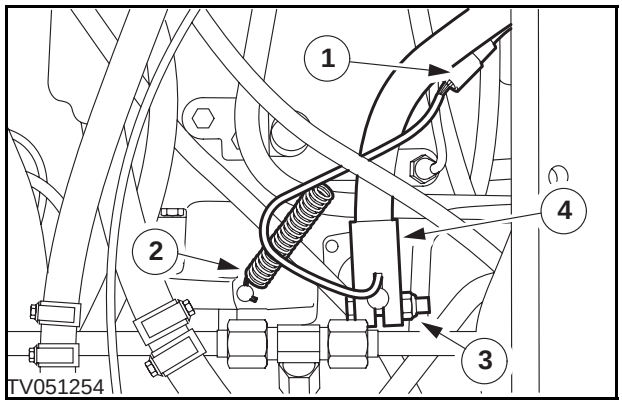
4. Tighten retaining bolt (1) to 98Nm (72 lb.ft).



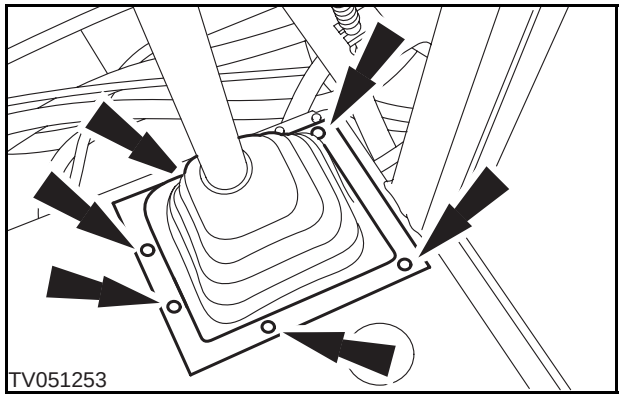
5. Tighten to 100Nm (75 lb.ft).



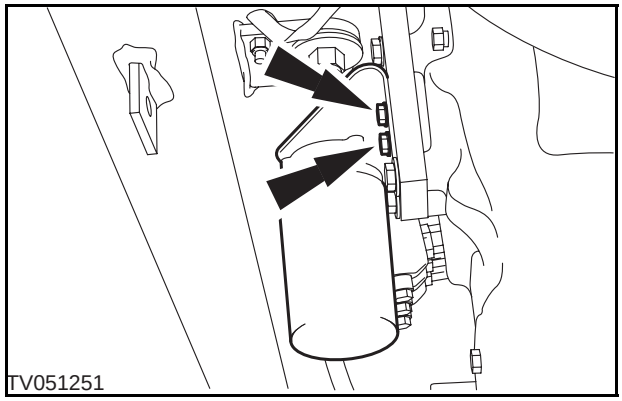
6. Tighten (3) to 60Nm (45 lb.ft).



7. Install new retaining clips.

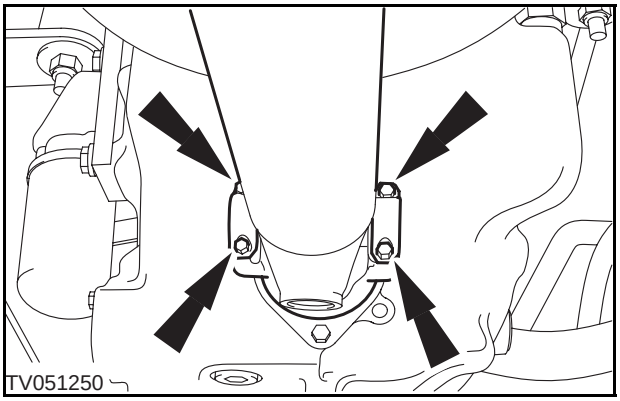


8. Tighten to 40Nm (30 lb.ft).



Note:
- Install new retaining bolts.

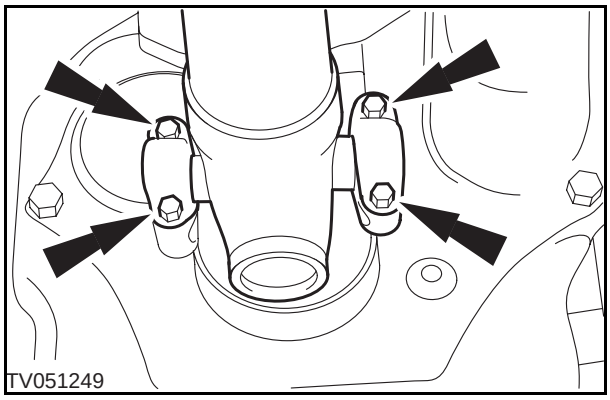
9. Tighten to 47Nm (35 lb.ft).



⚠ Caution:
- **Make sure the propeller shaft universal joints are in line. Failure to follow this instruction may result in damage to the machine.**

Note:
- Install new retaining bolts.

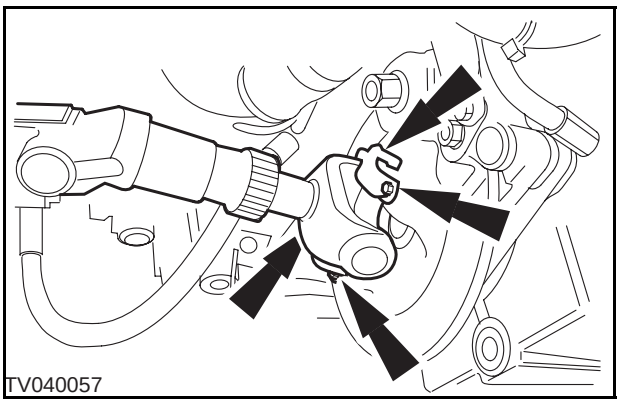
10. Tighten to 47Nm (35 lb.ft).



⚠ Caution:
- **Make sure the propeller shaft universal joints are in line. Failure to follow this instruction may result in damage to the machine.**

Note:
- Install new retaining bolts.

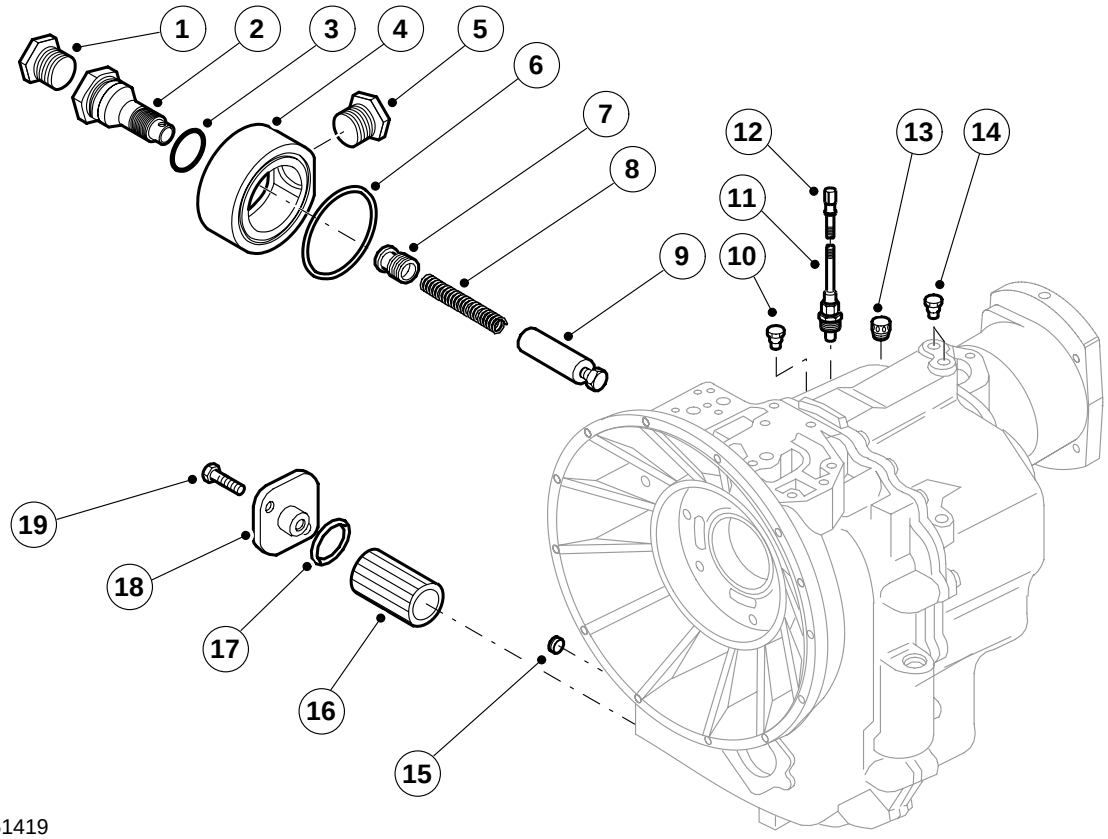
11. Tighten to 47Nm (35 lb.ft).



DISASSEMBLY AND ASSEMBLY — PLUGS AND FILTERS

BHN1306DA

Operation: **Disassembly and Assembly of the Plugs and Filters**	*Job Code:* **13 54 17 xx**		
None	Standard tools, Suitable puller		



TV051419

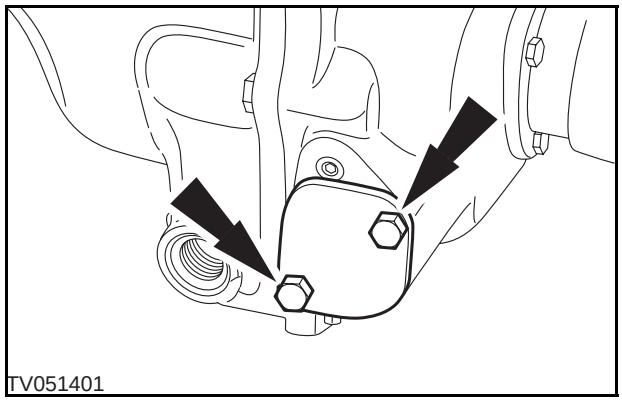
1	Plug
2	Connector
3	O-ring Seal
4	Adaptor
5	Plug
6	O-ring Seal
7	Spool
8	Spring
9	Four-Wheel Drive (4WD) Priority Valve
10	Plug
11	Oil Temperature Sensor
12	Oil Temperature Sensor Electrical Connector
13	Breather
14	Plug
15	Drain Plug
16	Suction Strainer
17	O-ring Seal
18	Suction Strainer Cover Plate
19	Retaining Bolts

Disassembly

Note:
- Make a note of the position of any hydraulic hoses prior to disconnection to aid installation.

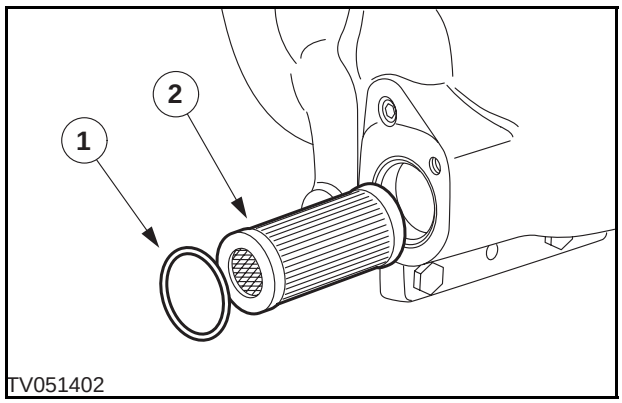
Note:
- Always install blanking plugs to any open ports to avoid contamination.

1. Remove the retaining bolts and remove the suction strainer cover.


TV051401

2. Remove the O-ring seal (1) and the suction strainer (2).

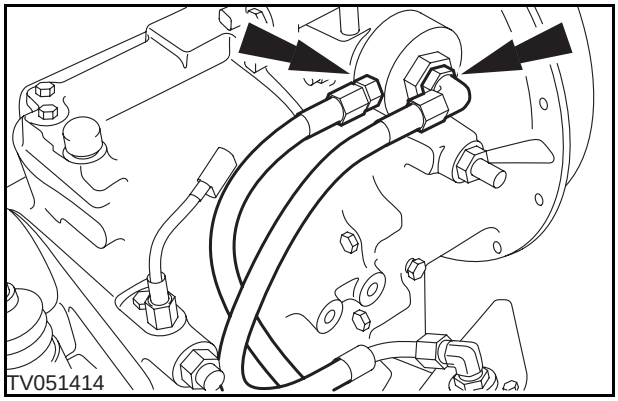
Note:
- Discard the O-ring seal.



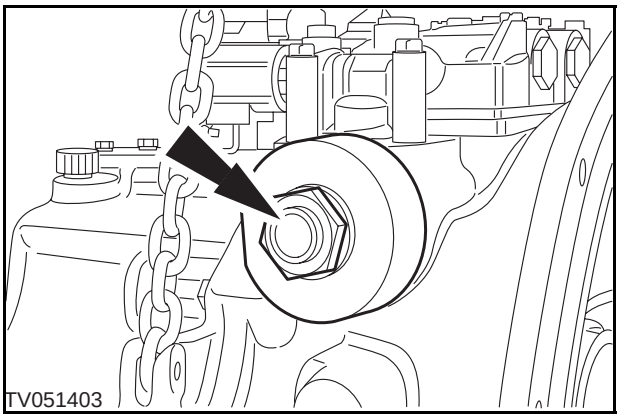
TV051402

3. Disconnect the oil filter lines.

Note:
- Discard the O-ring seal.

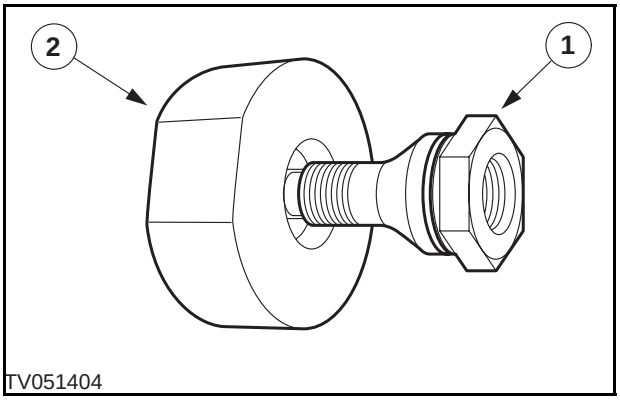

TV051414

4. Remove the adaptor from the transmission housing.



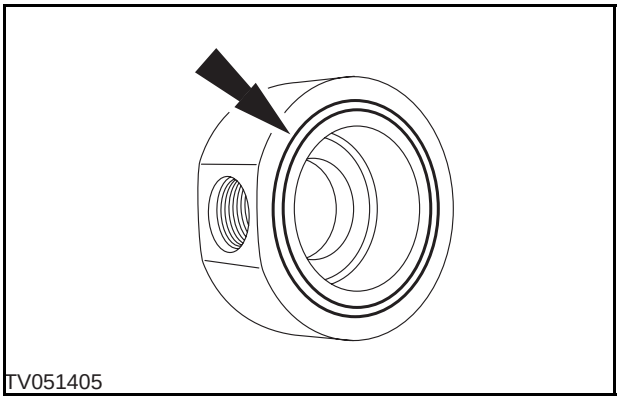
5. Remove the connector (1) from the adaptor (2).

Note:
- Discard the O-ring seal.

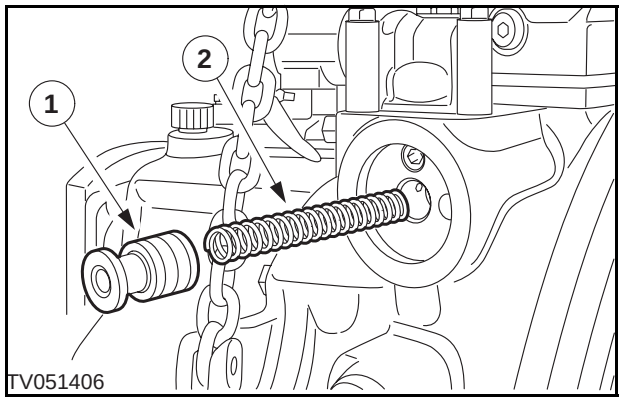


6. Remove the O-ring seal from the adaptor.

Note:
- Discard the O-ring seal.



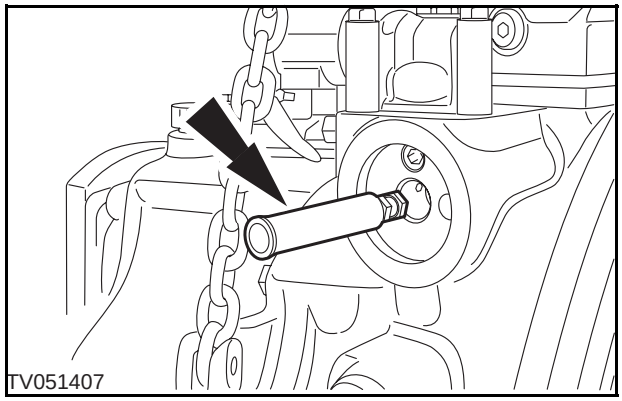
7. Remove the spool (1) and the spring (2).



8. Using a suitable puller, remove the 4WD priority valve.

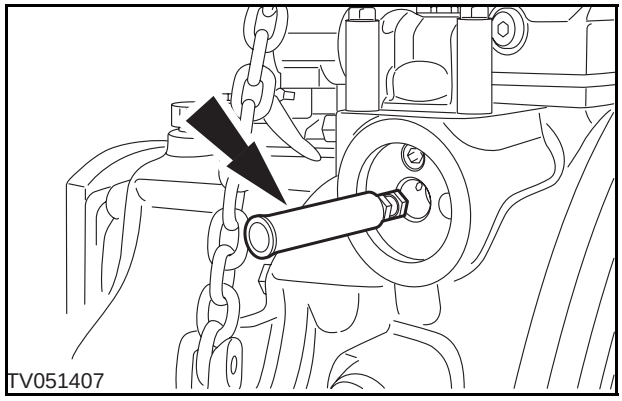
⚠ Caution:

- **Do not try to disassemble or adjust the 4WD priority valve. If any parts are faulty, install a new 4WD priority valve.**

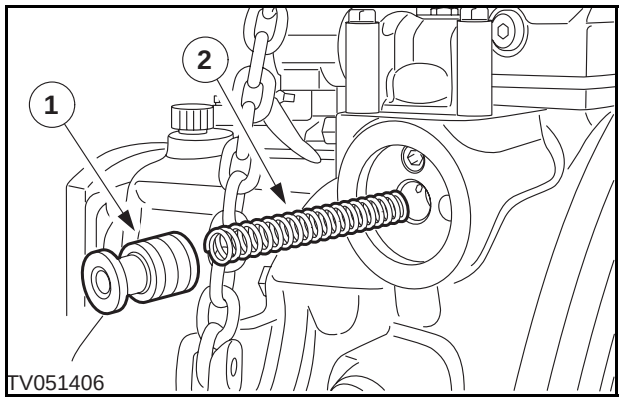


Assembly

1. Install the 4WD priority valve.

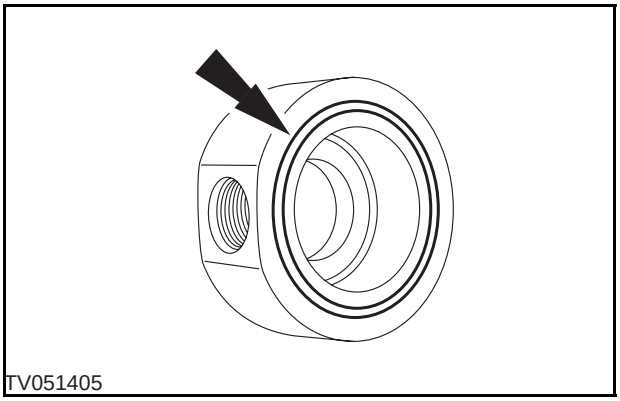


2. Install the spring (2) and spool (1).



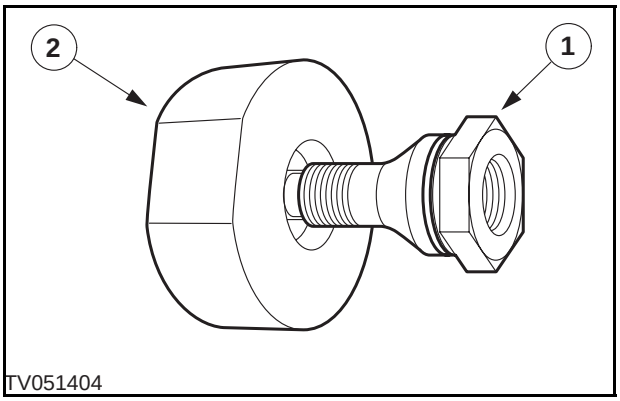
Note:
- Install a new O-ring seal.

3. Install the O-ring seal to the adaptor.


TV051405

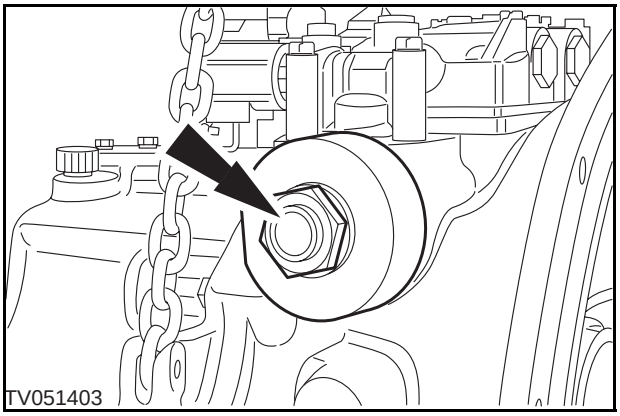
Note:
- Install a new O-ring seal.

4. Install the connector (1) into the adaptor (2).

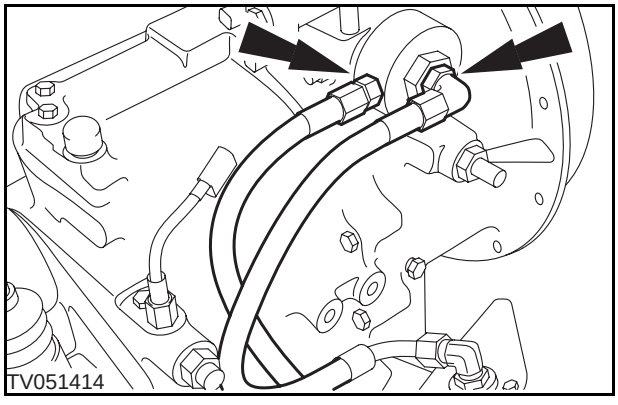


TV051404

5. Install the adaptor to the transmission housing. Tighten to 50Nm (37 lb.ft).

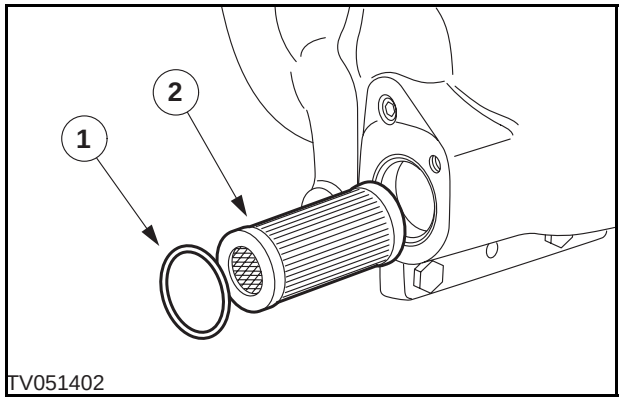

TV051403

6. Install the oil filter supply and return lines.

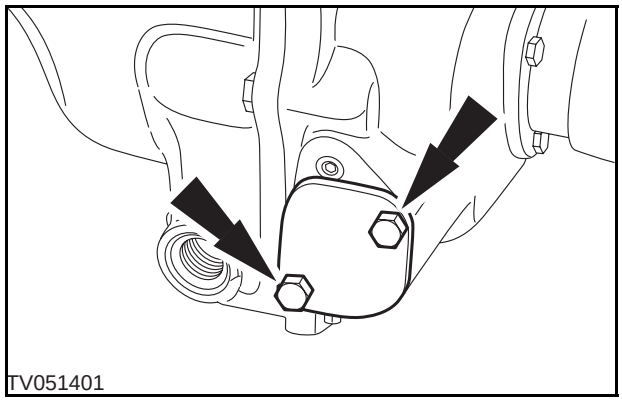

TV051414

Note:
- Install a new O-ring seal.

7. Install the suction strainer (2) and the O-ring seal (1).



8. Install the suction strainer cover and the retaining bolts.
   Tighten to 23Nm (7 lb.ft).

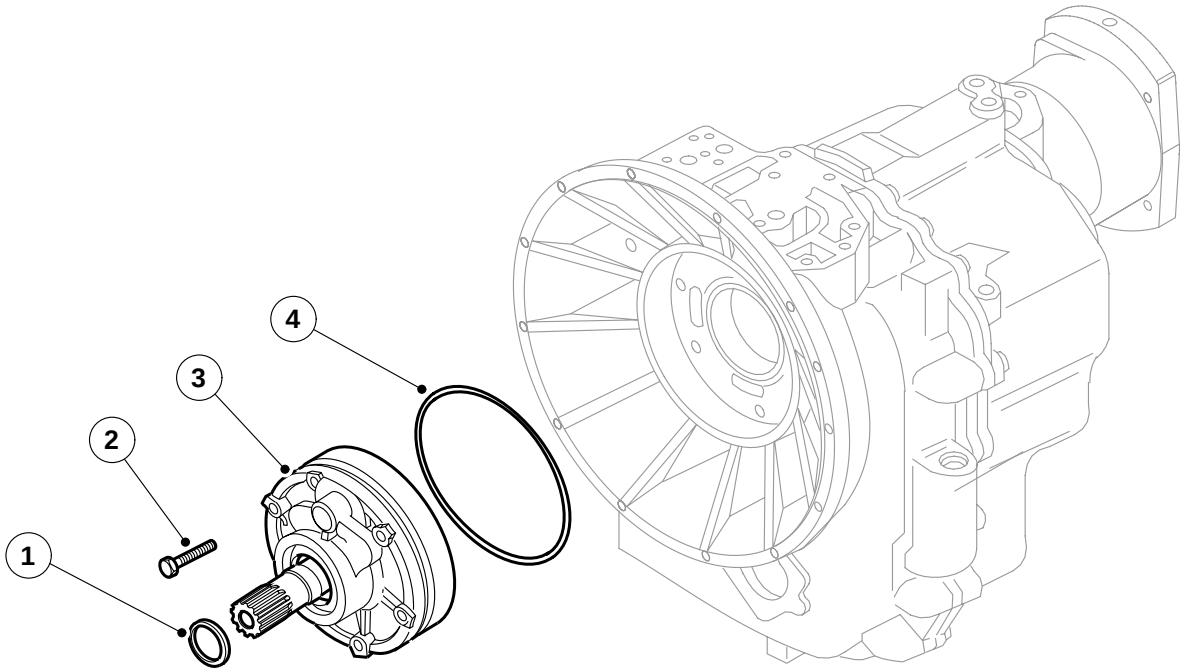


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DISASSEMBLY AND ASSEMBLY — TRANSMISSION OIL PUMP

BHN1306DB

Operation: **Disassembly and Assembly — Transmission Oil Pump**	*Job Code:* **13 55 17 xx**		
None	Standard tools,		

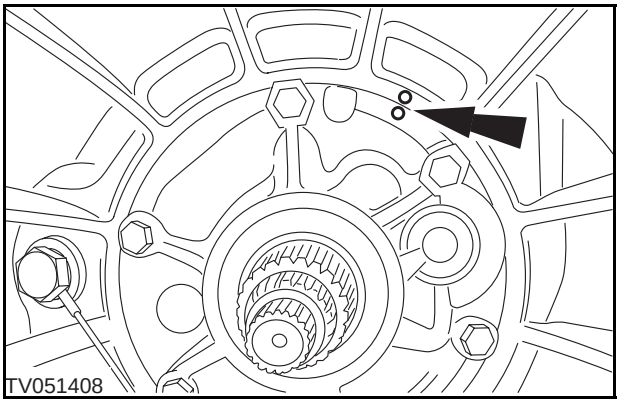


TV051420

1	Oil Seal
2	Retaining Bolts
3	Transmission Oil Pump
4	O-ring Seal

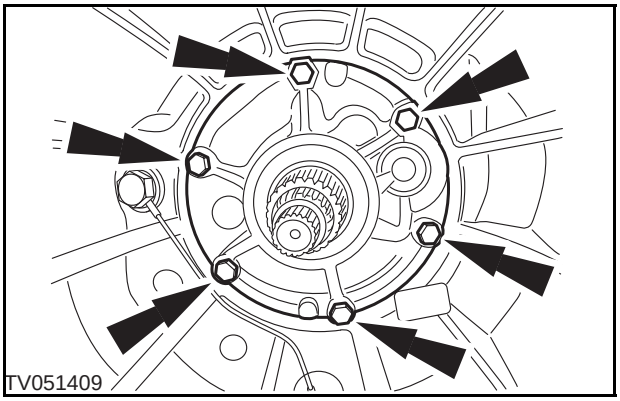
Disassembly

1. Mark the transmission oil pump and the transmission front housing prior to removal to aid installation.


TV051408

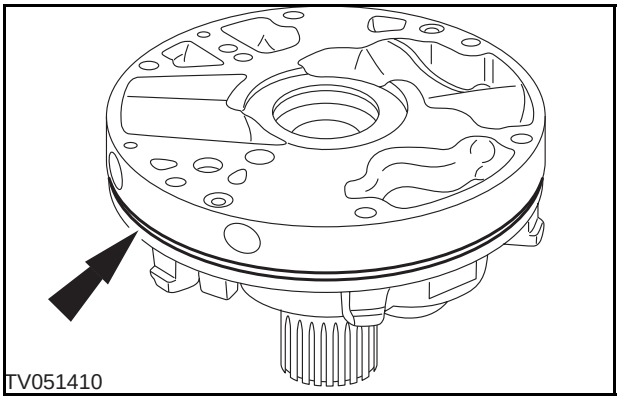
2. Remove the retaining bolts and remove the oil pump.

Note:
- The only serviceable component within the oil pump assembly is the shaft oil seal. If the oil pump is faulty or damaged it must be replaced.


TV051409

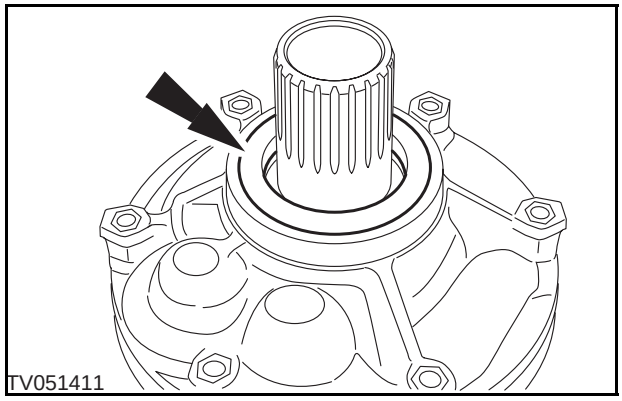
3. Remove the O-ring seal.

Note:
- Discard the O-ring seal.


TV051410

4. Remove the shaft oil seal.

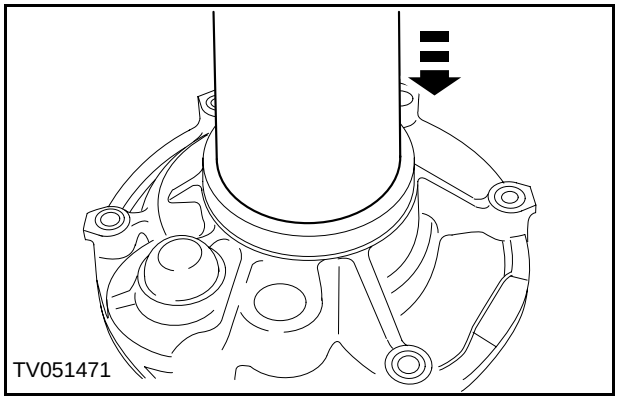
Note:
- Discard the oil seal.


TV051411

Assembly

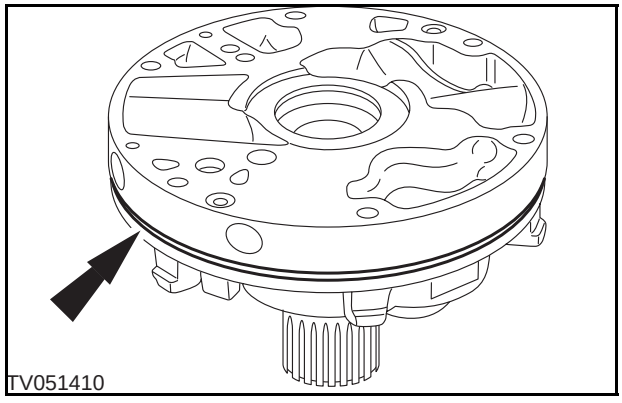
Note:
- Use a new oil seal.

1. Using special tool number **CA715409 — driver** , install the shaft oil seal.

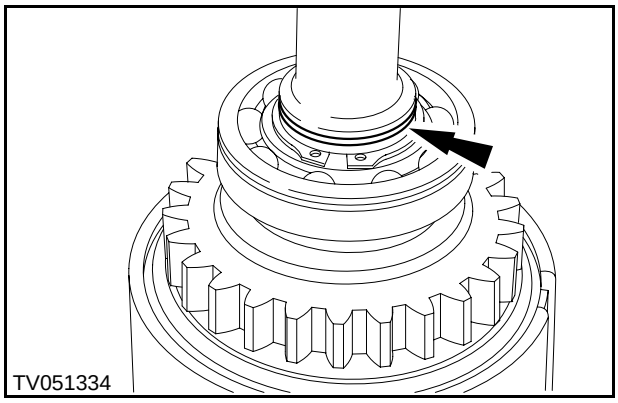

TV051471

Note:
- Use a new O-ring seal.

2. Install the O-ring seal.

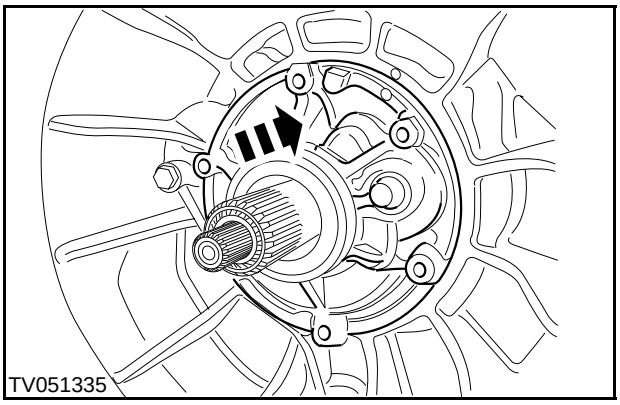

TV051410

3. Lubricate the input shaft sealing ring.

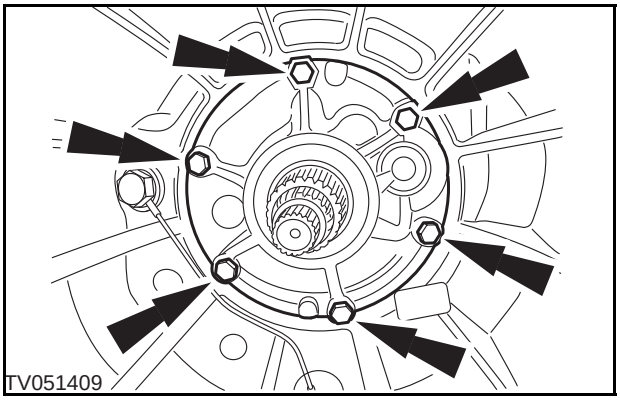


⚠ **Caution:**
- **If a new pump is being installed, make sure the oil passageways in the oil pump casing and the transmission housing are aligned. Failure to follow this instruction may result in failure of the oil pump.**

4. Install the oil pump making sure that the reference marks on the oil pump and the casing are correctly aligned.



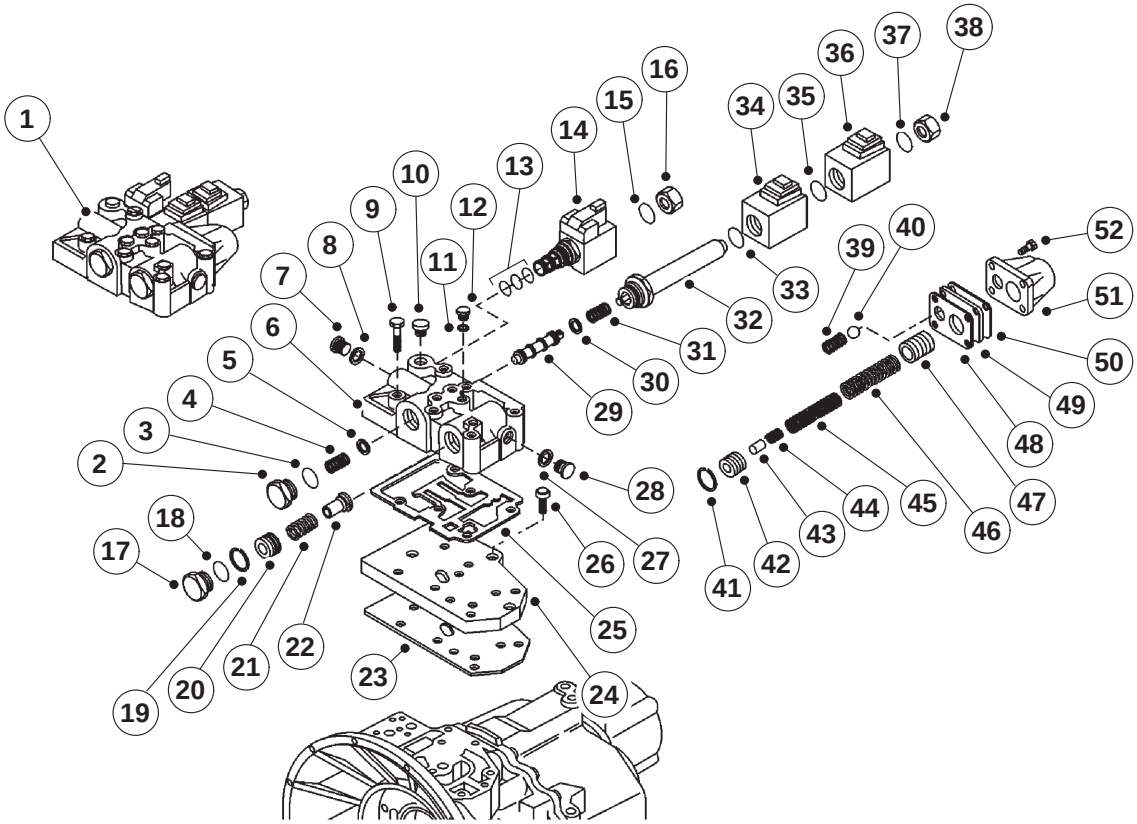
5. Install the transmission oil pump retaining bolts. Tighten to 23Nm (17 ft.lbs).



DISASSEMBLY AND ASSEMBLY — HYDRAULIC CONTROL VALVE

BHN1306DD

Operation: **Disassembly and Assembly — Hydraulic Control valve**	*Job Code:* **13 56 17 xx**		
None	Standard tools,		



TV051422

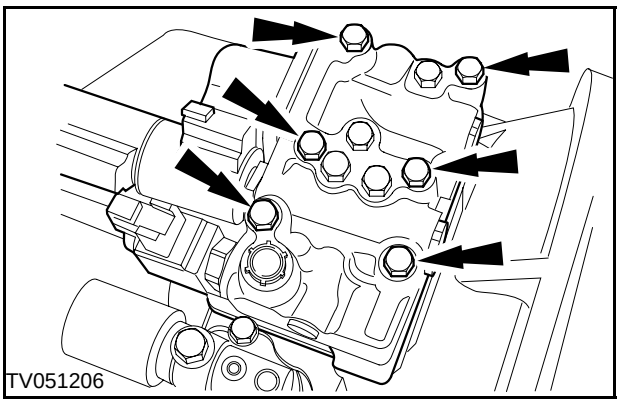
1	Control Valve
2	Retaining Plug
3	O-Ring Seal
4	Spring
5	Washer
6	Distributor Body
7	Retaining Plug
8	Washer
9	Retaining Bolt
10	Retaining Plug
11	Copper Washer
12	Retaining Plug
13	O-Ring Seals
14	Differential Lock Solenoid Valve
15	O-Ring
16	Retaining Nut
17	Retaining Plug
18	O-Ring Seal
19	Circlip
20	Piston
21	Spring
22	Bush
23	Lower Gasket
24	Feeding Plate
25	Upper Gasket
26	Retaining Bolt

27	Copper Washer
28	Retaining Plug
29	Piston
30	Washer
31	Spring
32	Solenoid Pipe
33	O-Ring Seal
34	Reverse Solenoid
35	O-Ring Seal
36	Forward Solenoid
37	O-Ring
38	Retaining Nut
39	Spring
40	Ball
41	Snap Ring
42	Inward Piston
43	Pin
44	Spring
45	Spring
46	Spring
47	Outward Piston
48	Plate Gasket
49	Plate
50	Plate Gasket
51	Valve Cover
52	Retaining Bolt

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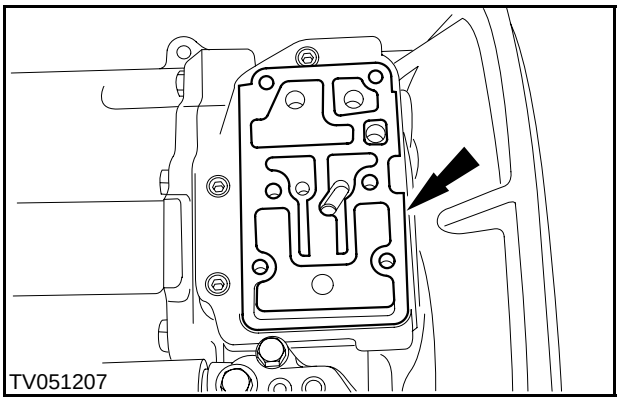
Disassembly

1. Remove the retaining bolts and remove the hydraulic control valve.

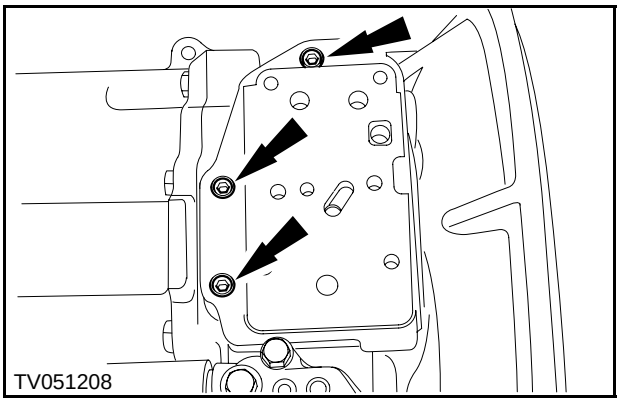

TV051206

2. Remove the upper gasket.

Note:
- Discard the gasket.

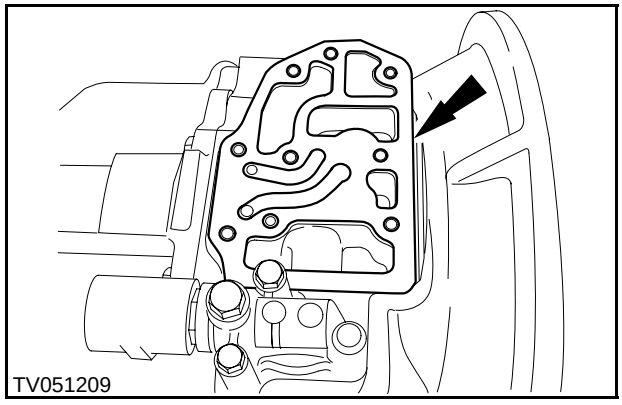

TV051207

3. Remove the retaining bolts and remove the feeding plate.


TV051208

4. Remove the lower gasket.

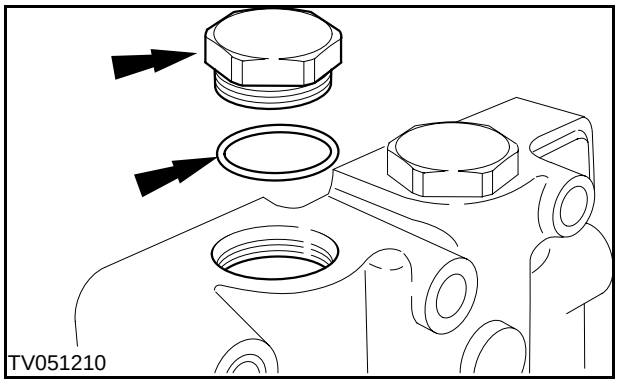
   Note:
   - Discard the gasket.


TV051209

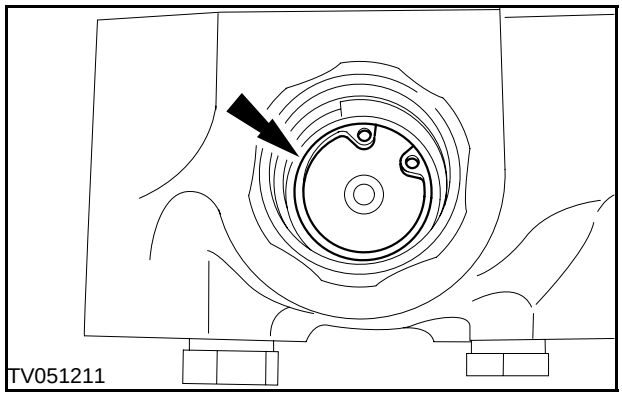
   Note:
   - Using a vice fitted with soft jaws.

5. Secure the distributor body and remove the retaining plug.

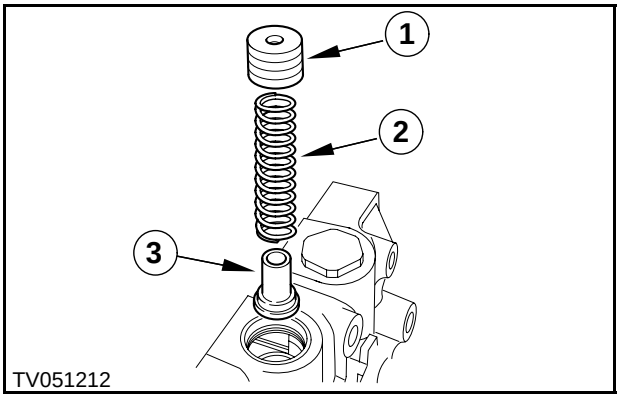
   Note:
   - Discard the O-ring seal.


TV051210

6. Using suitable circlip pliers, remove the circlip.

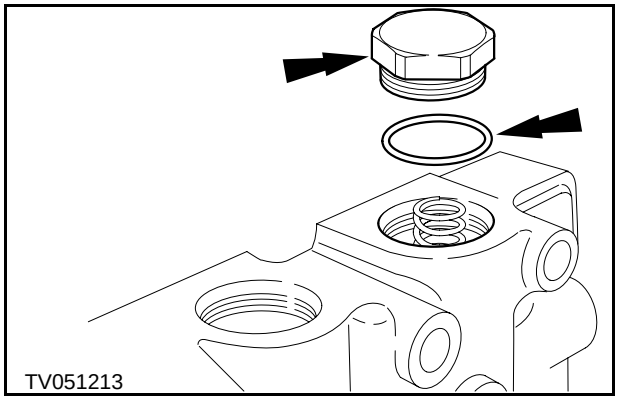

TV051211

7. Remove the piston (1).
8. Remove the spring (2).
9. Remove the bush (3).

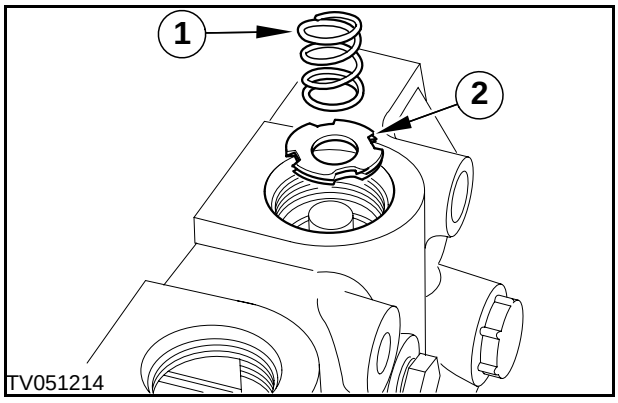


10. Remove the retaining plug.

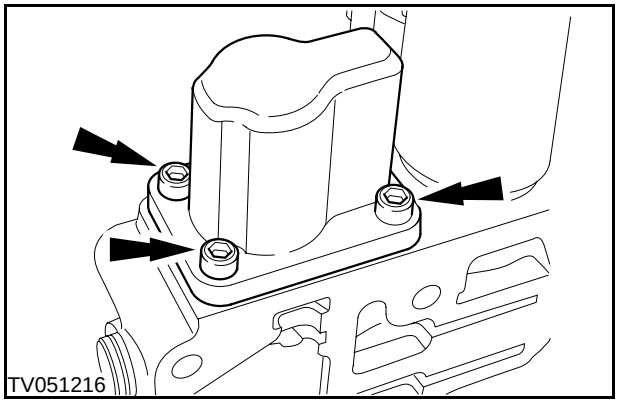
Note:
- Discard the O-ring seal.



11. Remove the spring (1).
12. Remove the washer (2).

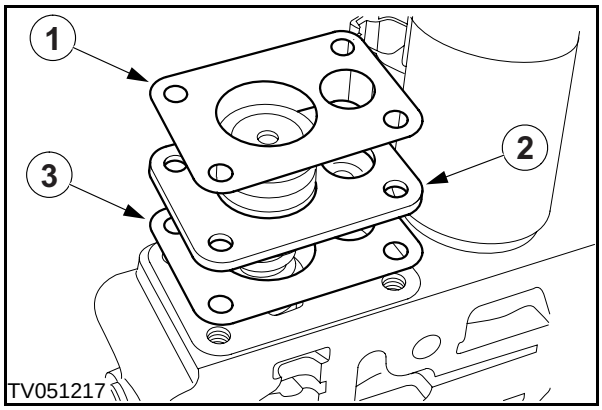


13. Remove the retaining bolts and remove the valve cover assembly.

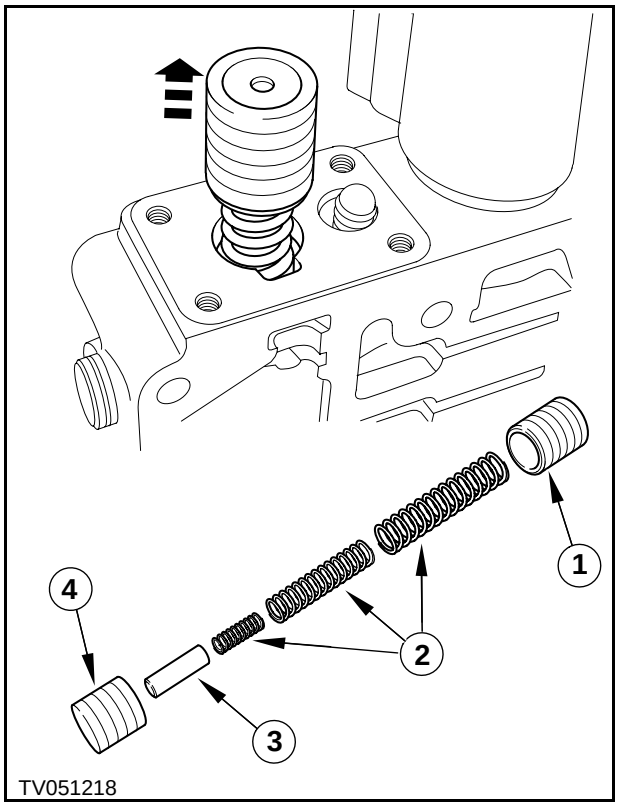


14. Remove the upper gasket (1), plate (2) and lower gasket (3).

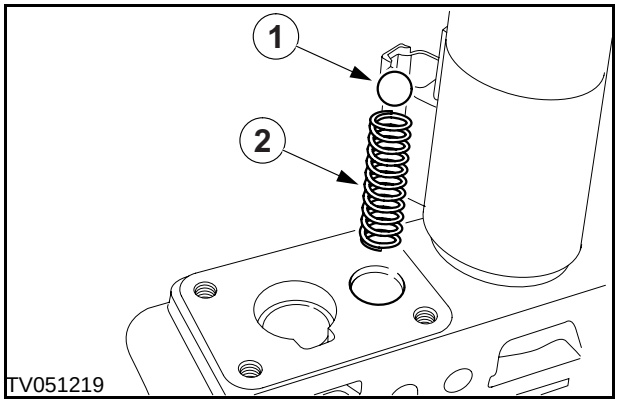
    Note:
    - Discard the gaskets.



15. Remove the outer piston (1).
16. Remove the springs (2).
17. Remove the pin (3).
18. Remove the inner piston (4).

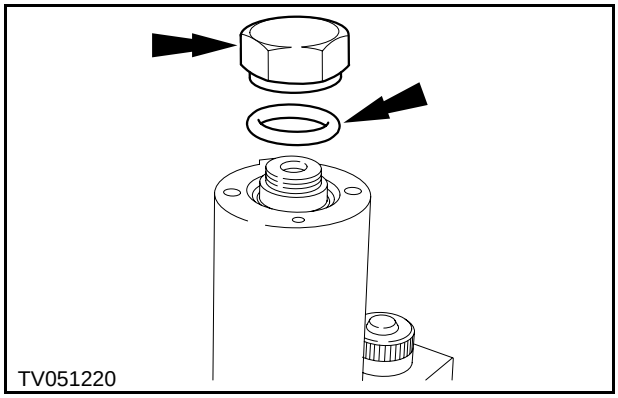


19. Remove the ball (1) and the spring (2).



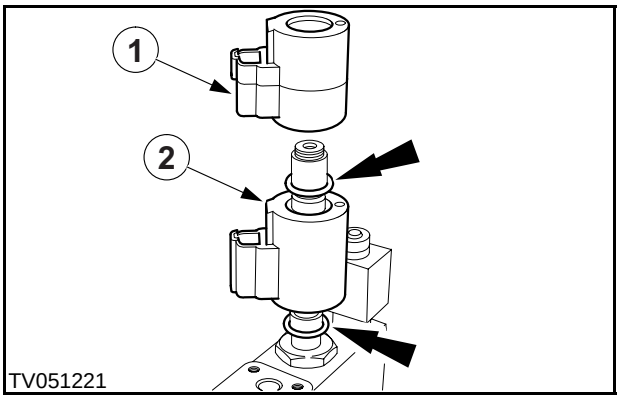
20. Remove the retaining nut.

Note:
- Discard the O-ring seal.

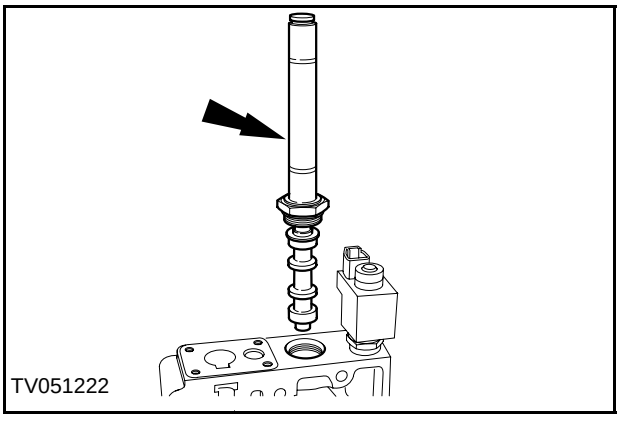


21. Remove the forward solenoid (1) and the reverse solenoid (2).

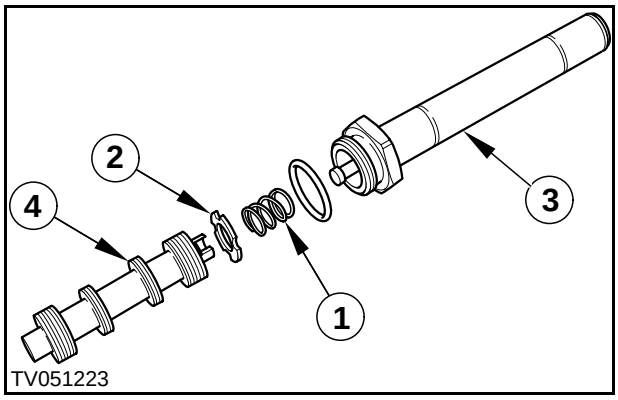
Note:
- Discard the O-ring seals.



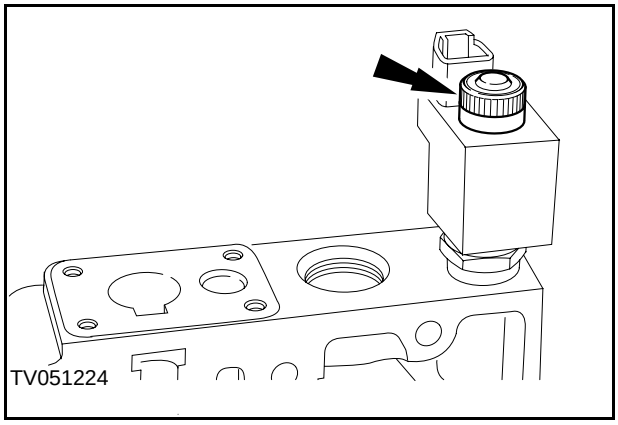
22. Remove the solenoid pipe assembly.



23. Disassemble the piston from the solenoid pipe. Compress the spring (1) using the washer (2). Whilst holding the washer firmly against the solenoid tube (3), release the spool (4) from the solenoid tube.

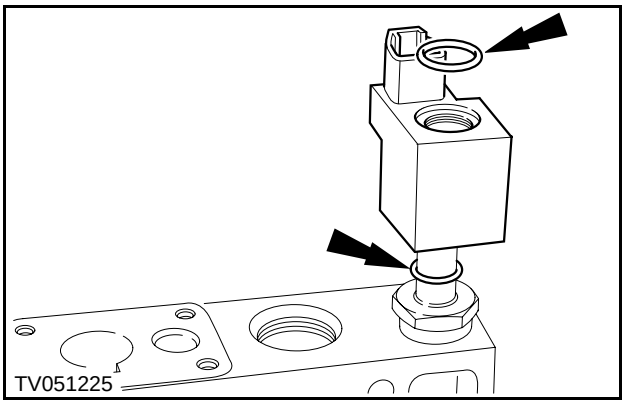


24. Remove the differential lock solenoid retaining nut.



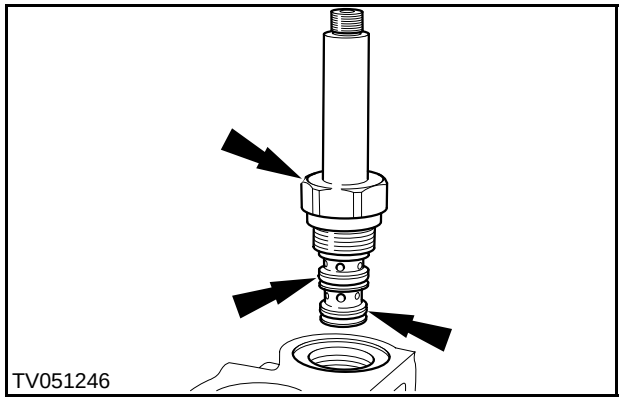
25. Remove the differential lock solenoid.

Note:
- Discard the O-ring seals.



26. Remove the spool from the valve block.

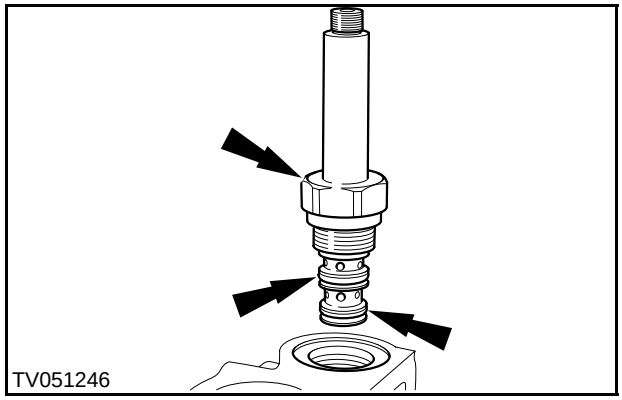
Note:
- Discard the O-ring seals.



Assembly

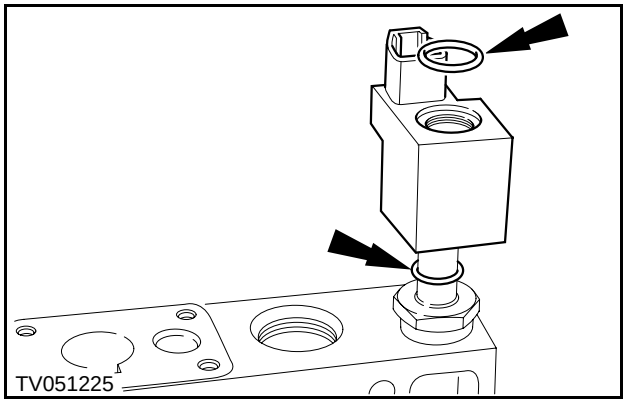
Note:
- Install new O-ring seals.

1. Install the spool into the valve block.
   Tighten to 27Nm (20 lb.ft).

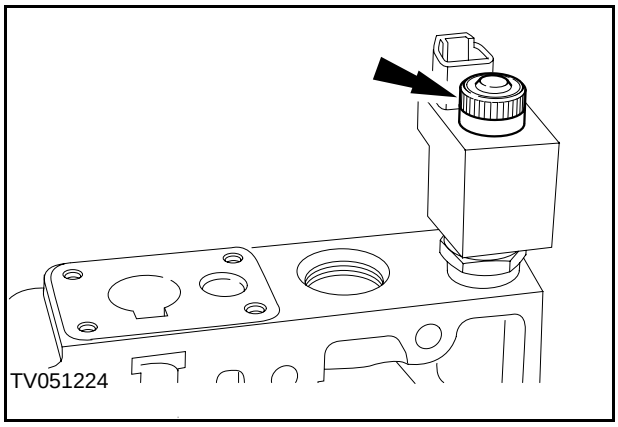


Note:
- Install new O-ring seals.

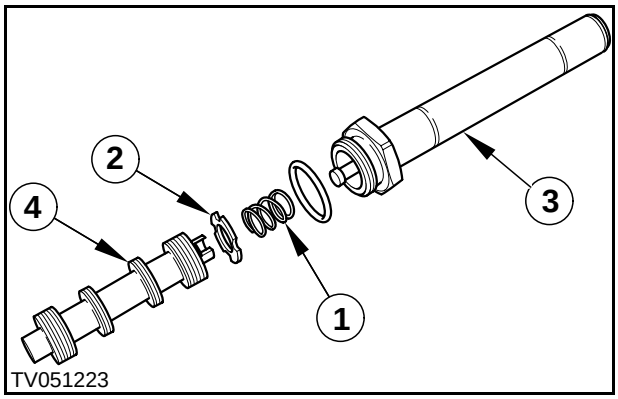
2. Install the differential lock solenoid.



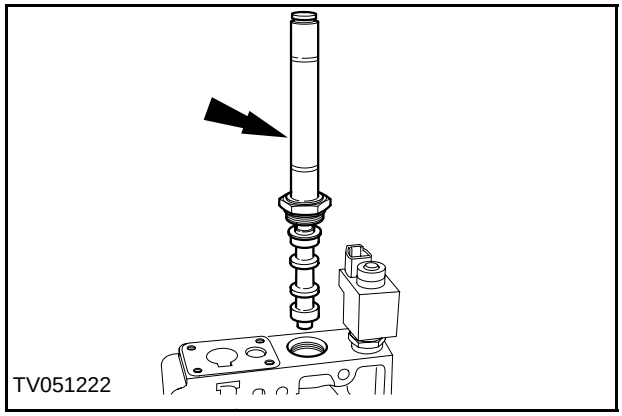
3. Install the retaining nut.
   Tighten to 7Nm (5 lb.ft).



4. Assemble the piston and the solenoid pipe. Compress the spring (1) using the washer (2). Holding the washer firmly against the solenoid tube (3), engage the spool (4) into the solenoid tube.

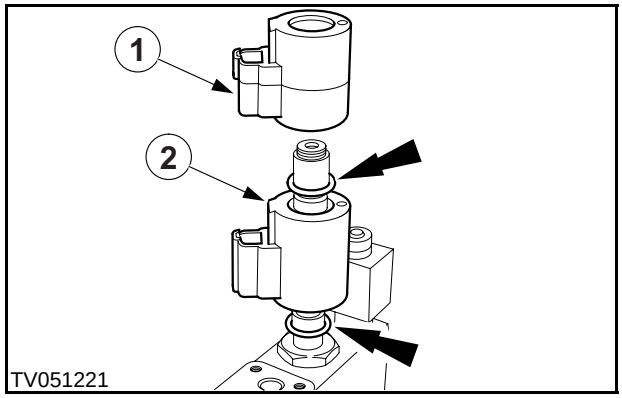


5. Install the solenoid pipe assembly.
   Tighten to 24Nm (18 lb.ft).



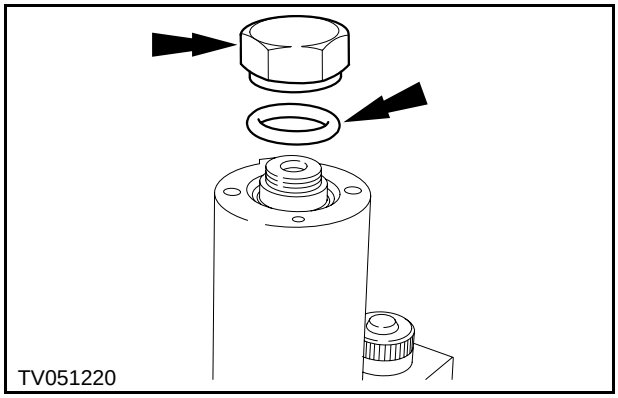
Note:
- Install new O-ring seals.

6. Install the forward (1) and reverse solenoid (2).

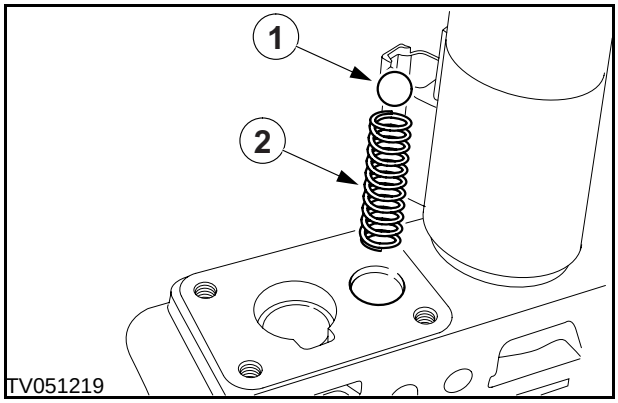


Note:
- Install new O-ring seals.

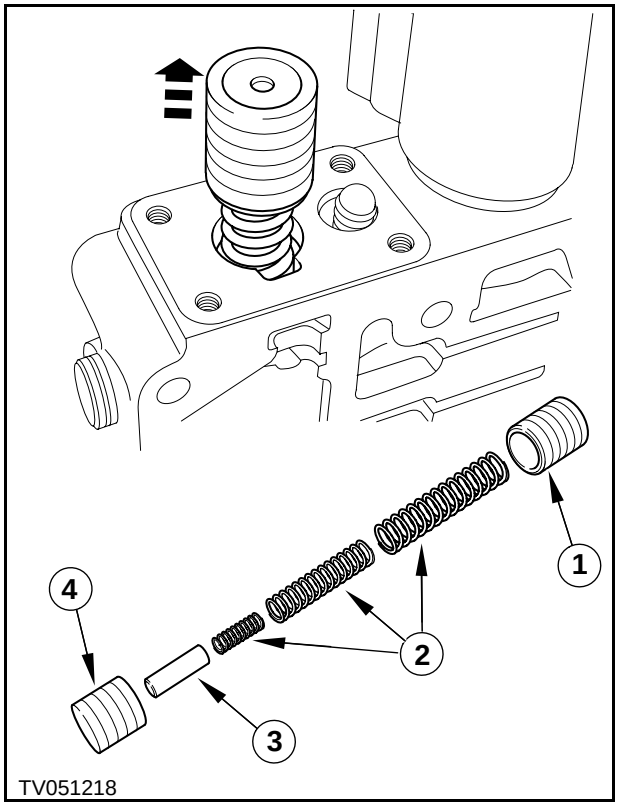
7. Install the retaining nut.
   Tighten to 10Nm (7 lb.ft).



8. Install the spring (2) and the ball (1).

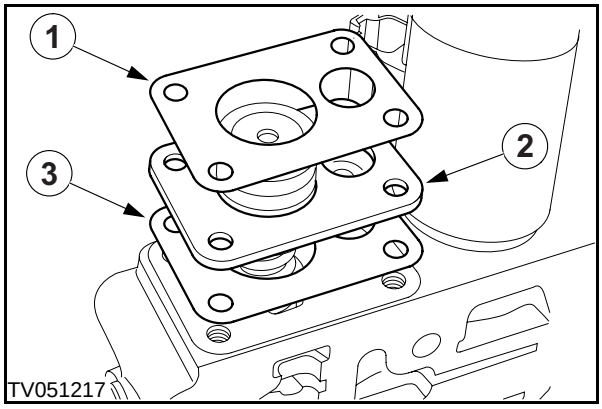


9. Install the inner piston (4).
10. Install the pin (3).
11. Install the springs (2).
12. Install the outer piston (1).

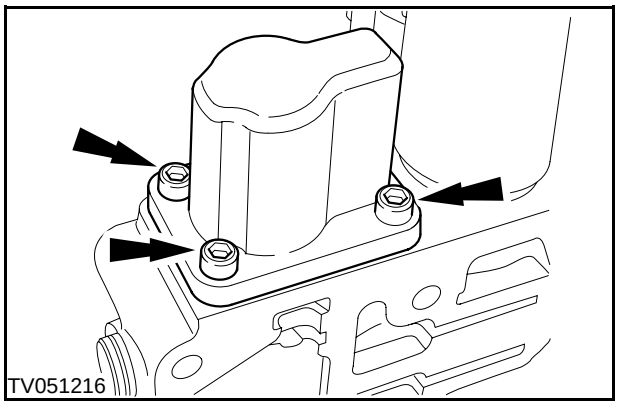


Note:
- Install new gaskets.

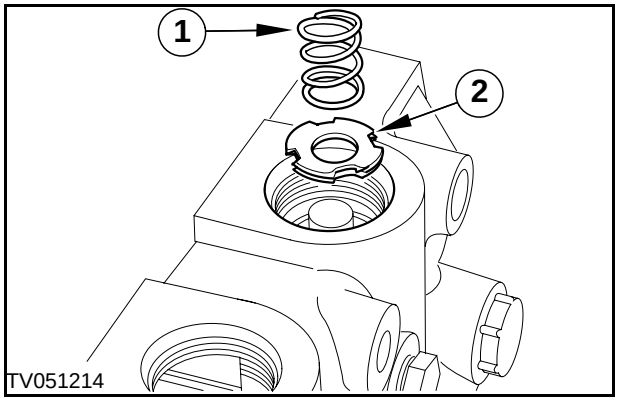
13. Install the valve plate (2), upper gasket (1) and lower gasket (3).



14. Install the valve cover assembly and the retaining bolts.
    Tighten to 11Nm (8 lb.ft).

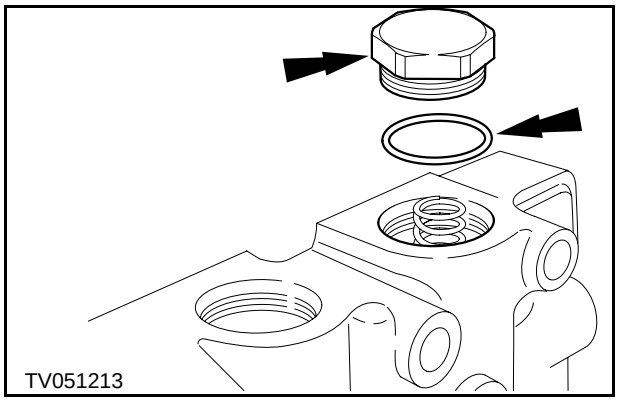


15. Install the washer (2).
16. Install the spring (1).

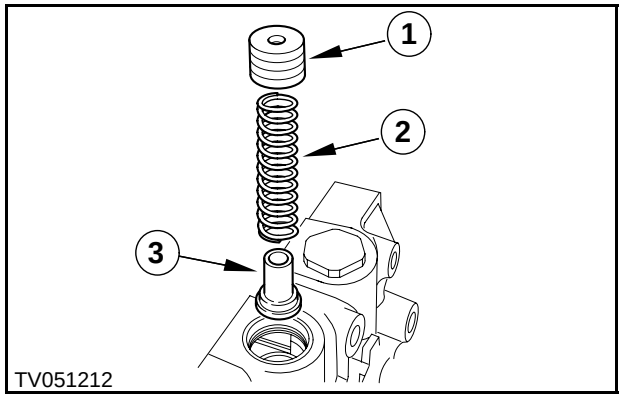


Note:
- Install a new O-ring seal.

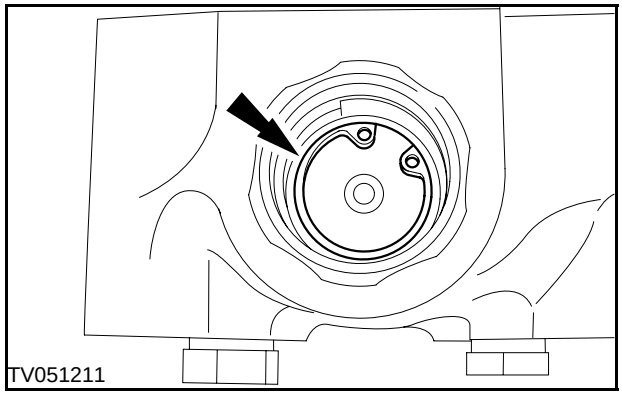
17. Install the retaining plug and O-ring seal.
    Tighten to 24Nm (18 lb.ft).



18. Install the bush (3).
19. Install the spring (2).
20. Install the piston (1).



21. Using suitable circlip pliers, install the circlip.

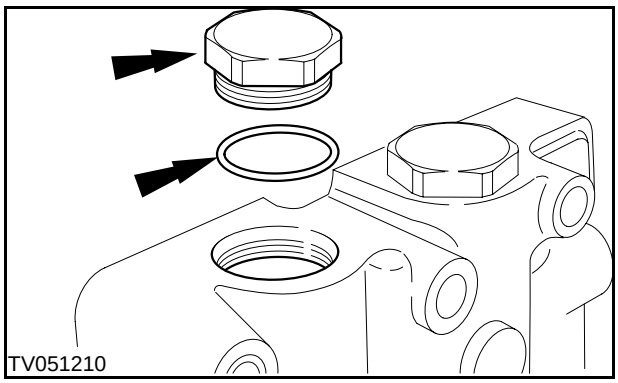


Note:
- Using a vice fitted with soft jaws.

22. Secure the distributor body.

Note:
- Install a new O-ring seal.

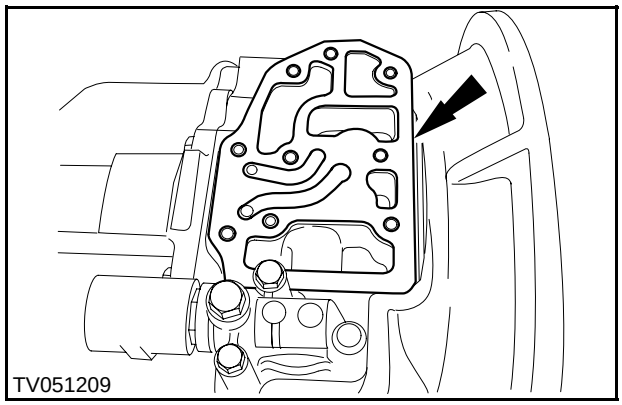
23. Install the retaining plug.
    Tighten to 24Nm (18 lb.ft).



Note:
- Make sure all component mating faces are clean.

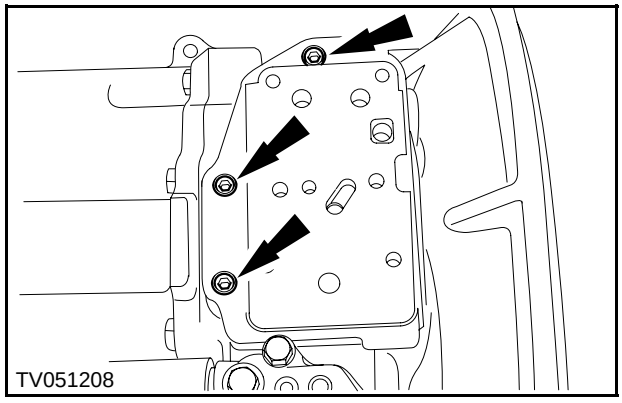
Note:
- Install a new gasket.

24. Install the lower gasket.


TV051209

Note:
- Make sure all component mating faces are clean.

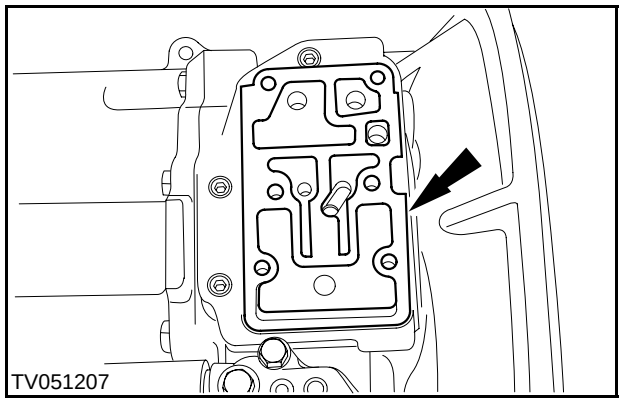
25. Install the hydraulic control valve feeding plate. Tighten to 23Nm (17 ft.lb).


TV051208

Note:
- Make sure all component mating faces are clean.

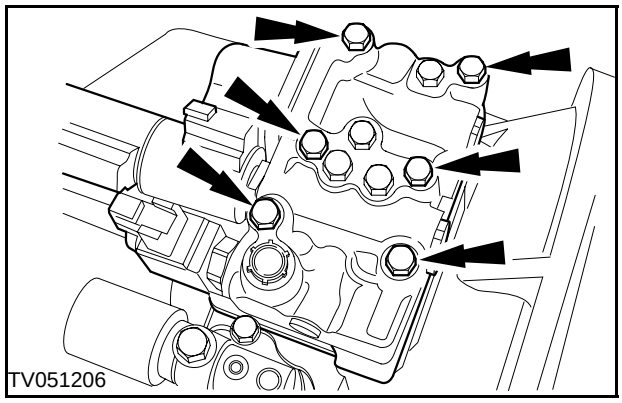
Note:
- Install a new gasket.

26. Install the upper gasket.


TV051207

Note:
- Make sure all component mating faces are clean.

27. Install the hydraulic control valve.
    Tighten to 23Nm (17 lb.ft).

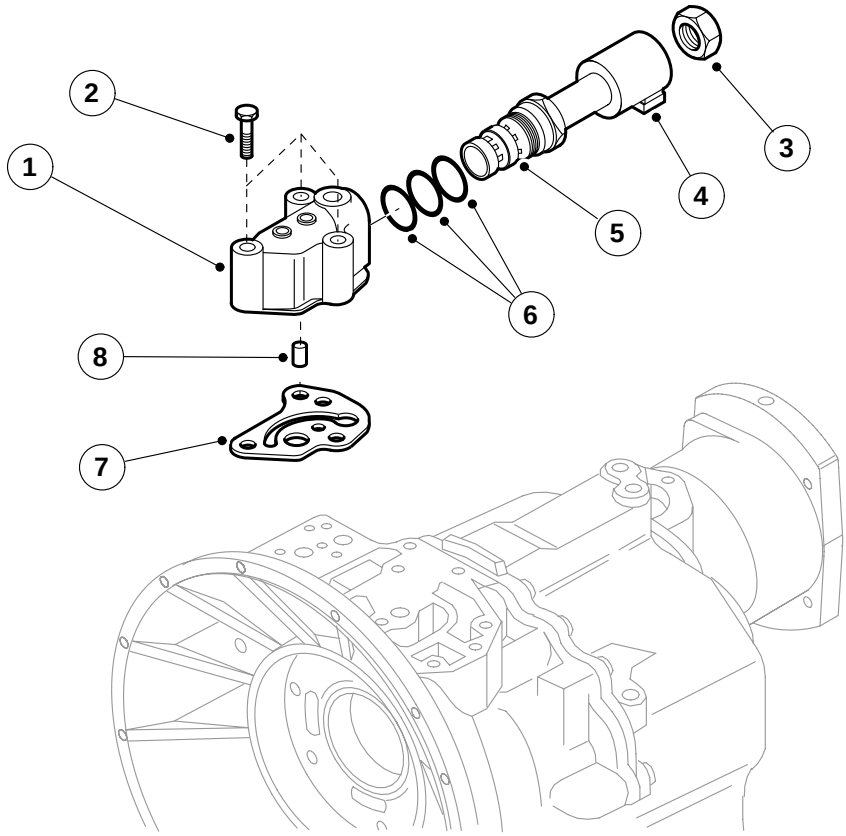

TV051206

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DISASSEMBLY AND ASSEMBLY — FOUR WHEEL DRIVE SOLENOID VALVE

BHN1306DE

Operation: **Disassembly and Assembly — Four wheel drive solenoid valve**	*Job Code:* **13 57 17 xx**		
None	Standard tools,		

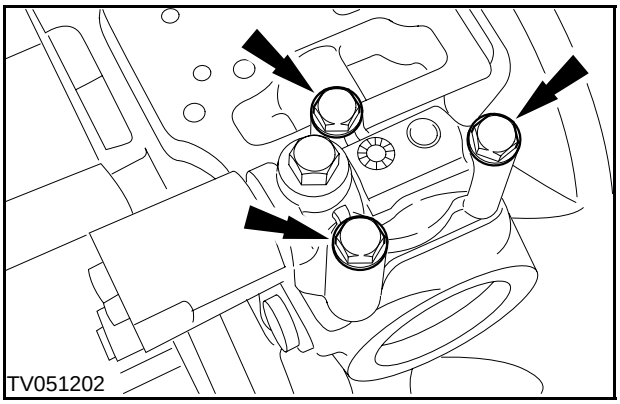


TV051424

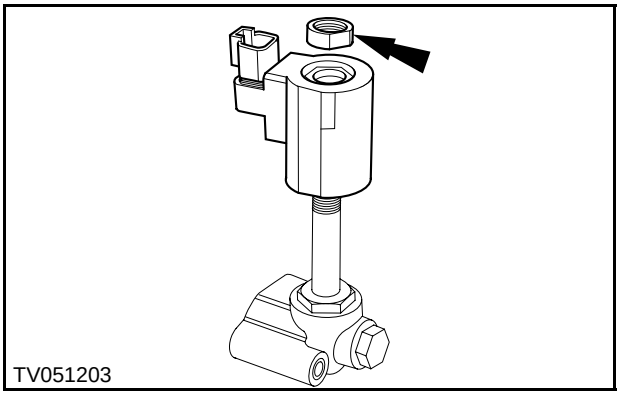
1	Solenoid Housing
2	Retaining Bolts
3	Retaining Nut
4	Solenoid
5	Solenoid Pipe
6	O-ring Seals
7	Gasket
8	Check Valve

Disassembly

1. Remove the retaining bolts and remove the four wheel drive solenoid valve.

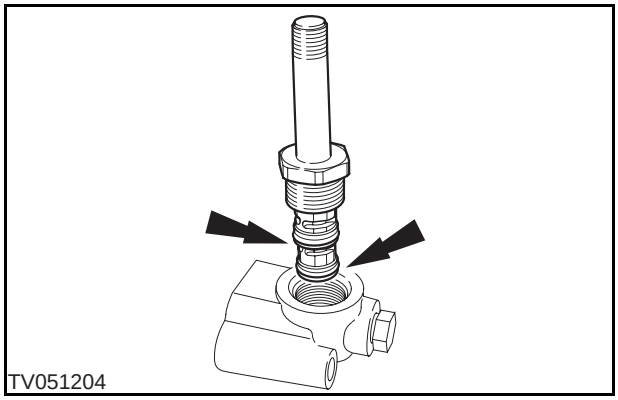

TV051202

2. Remove the retaining nut and remove the solenoid.


TV051203

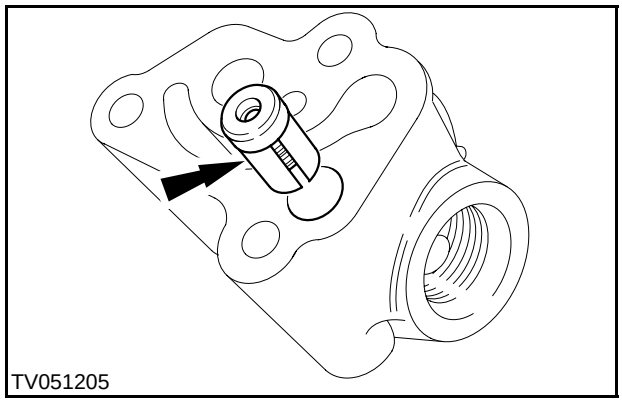
3. Remove the solenoid pipe.

Note:
- Discard the O-ring seals.


TV051204

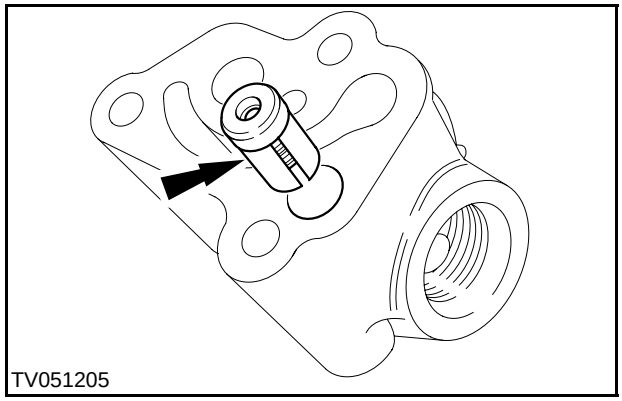
4. Remove the check valve from the valve block.

Note:
- The check valve is a non serviceable item.


TV051205

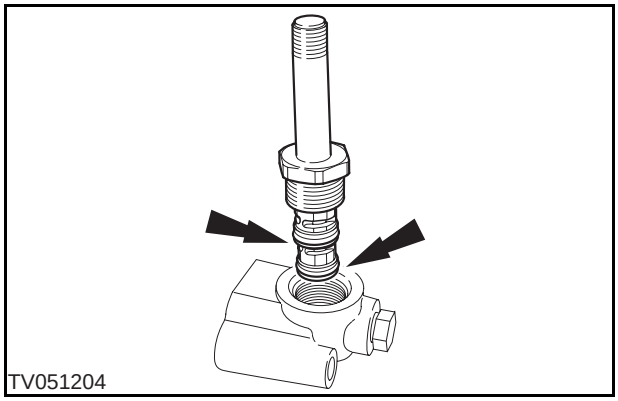
Assembly

1. Install the check valve into the valve block.

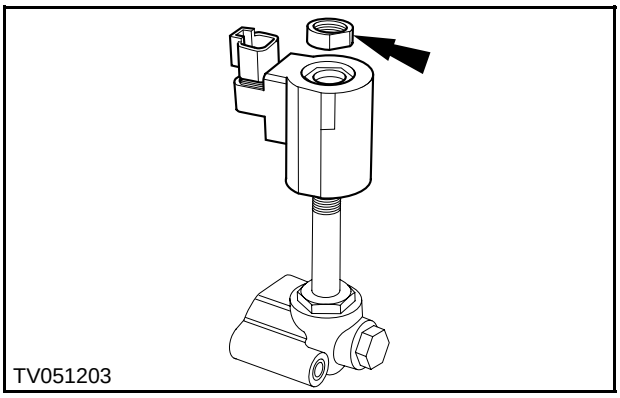

TV051205

Note:
- Install new O-ring seals.

2. Install the solenoid pipe into the valve block. Tighten to 24Nm (18 ft.lb).


TV051204

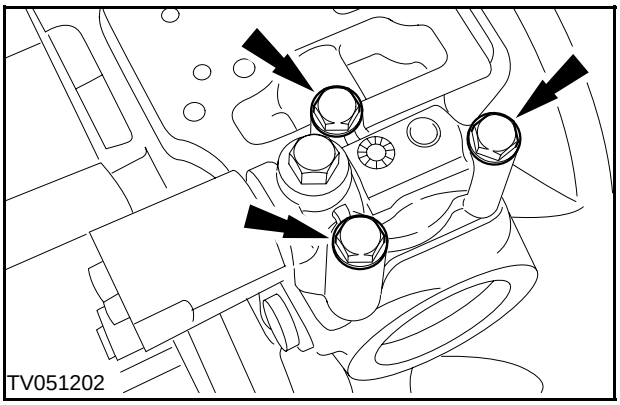
3. Install the solenoid onto the solenoid pipe and secure with the retaining nut.
   Tighten to 8Nm (6 lb.ft).



Note:
- Make sure all component mating faces are clean.

Note:
- Install a new gasket.

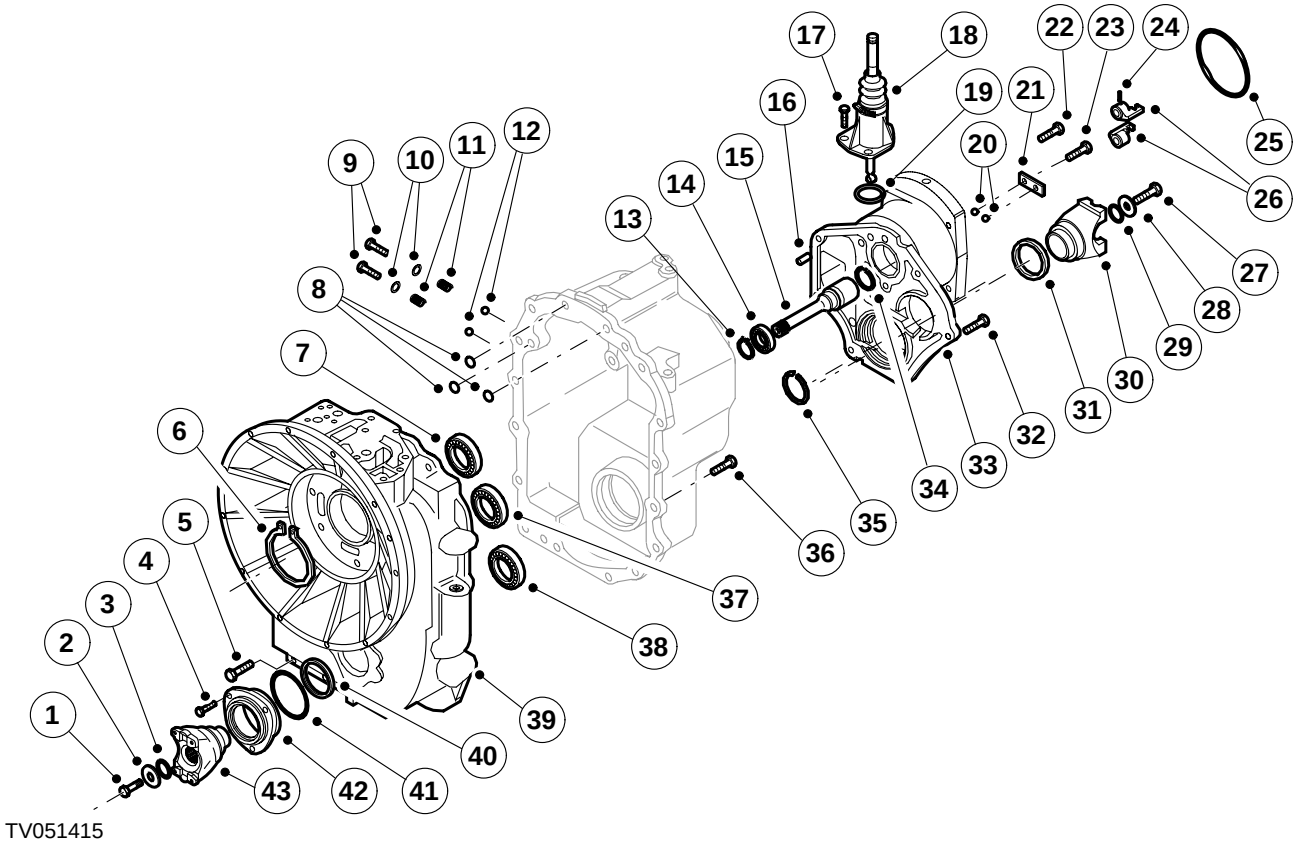
4. Install the four wheel drive solenoid valve onto the transmission housing and secure with the retaining bolts.
   Tighten to 23Nm (17 lb.ft).



DISASSEMBLY AND ASSEMBLY — TRANSMISSION HOUSING

BHN1306DF

Operation: **Disassembly and Assembly of the Transmission Housing**	*Job Code:* **13 34 17 xx**		
Suitable lifting equipment	Standard tools, Suitable puller, CA715496, CA715354		



TV051415

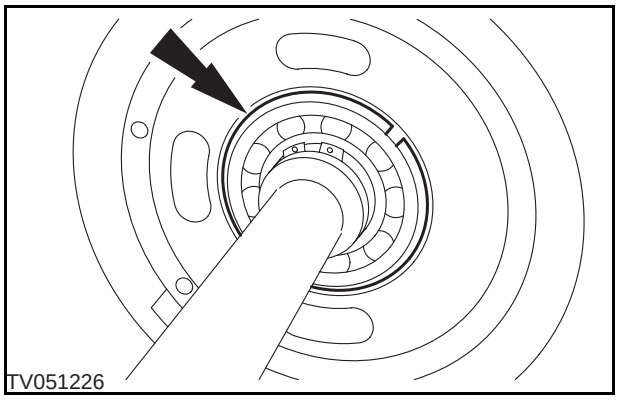
1	Retaining Bolt
2	Washer
3	O-Ring Seal
4	Retaining Bolt
5	Retaining Bolt
6	Circlip
7	Bearing
8	O-Ring Seal
9	Retaining Plugs
10	Washer
11	Spring
12	Detent Balls
13	Circlip
14	Bearing
15	Hydraulic Pump Drive Shaft
16	Dowel
17	Retaining Bolt
18	Shifter Tower Assembly
19	O-Ring Seal
20	Detent Balls
21	Plate
22	Retaining Bolt

23	Retaining bolt
24	Roll Pin
25	O-Ring Seal
26	Shift Collar
27	Retaining Bolt
28	Washer
29	O-Ring Seal
30	2WD Shaft Flange
31	Oil Seal
32	Reatining Bolt
33	Cover
34	Teflon Seal
35	Thrust Washer
36	Retaining Bolt
37	Bearing
38	Bearing
39	Transmission Front Housing
40	Oil Seal
41	O-Ring Seal
42	4WD Flange Seal Carrier
43	4WD Drive Shaft Flange
44	Transmission Rear Housing

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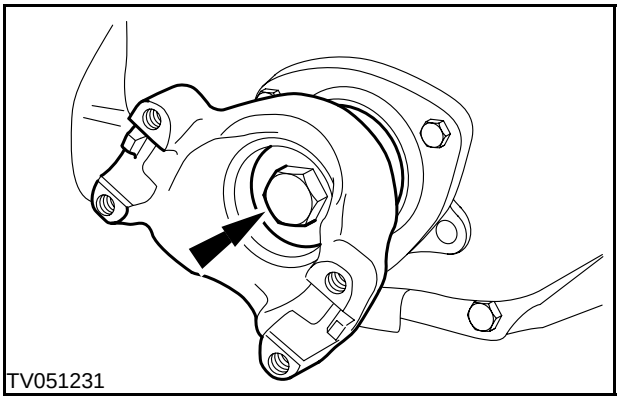
Disassembly

1. Remove the transmission oil pump. For additional information, Refer to TRANSMISSION OIL PUMP, PAGE N13–06–39 in this section.
2. Using suitable snap ring pliers, remove the input shaft bearing snap ring.

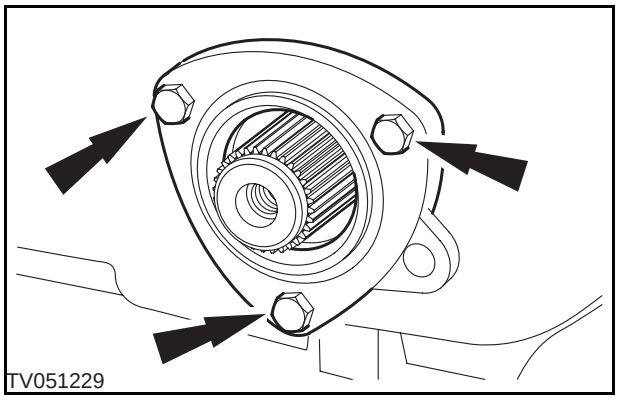

TV051226

3. Remove the retaining bolt and remove the four wheel drive (4WD) shaft flange.

   Note:
   - Discard the O-ring seal.


TV051231

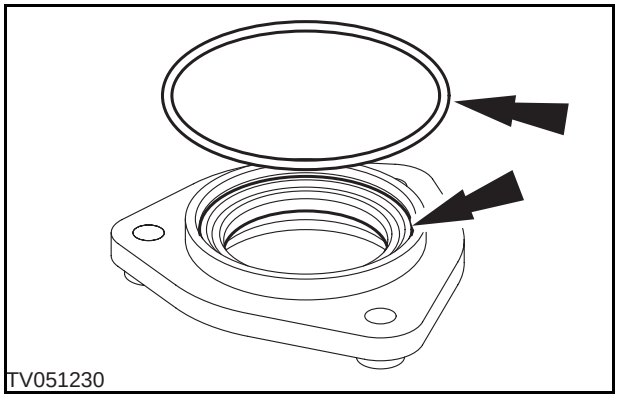
4. Remove the retaining bolts and remove the 4WD flange seal carrier.


TV051229

5. Remove the O-ring seal and the oil seal from the 4WD flange seal carrier.

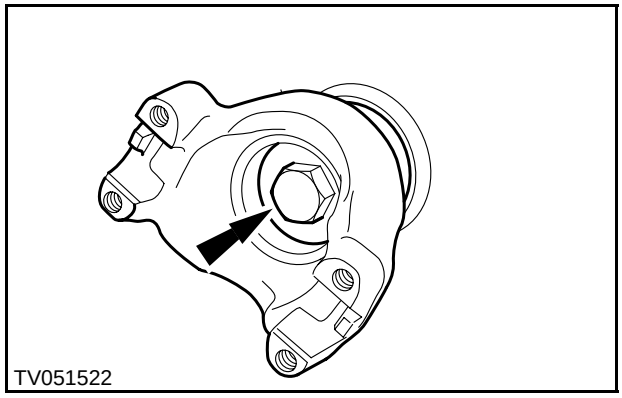
   Note:
   - Discard the O-ring seal.

   Note:
   - Discard the oil seal.

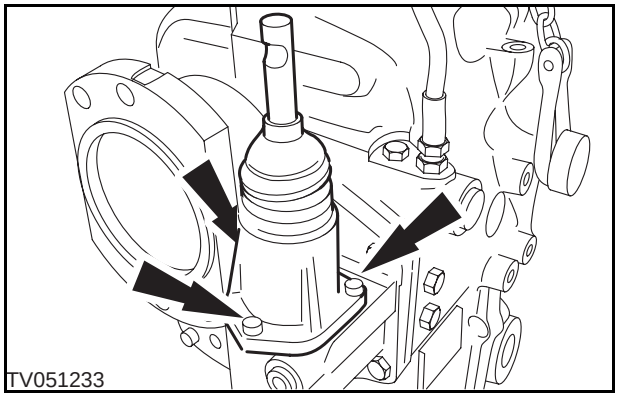

TV051230

6. Remove the retaining bolt and remove the two wheel drive (2WD) shaft flange.

   Note:
   - Discard the O-ring seal.

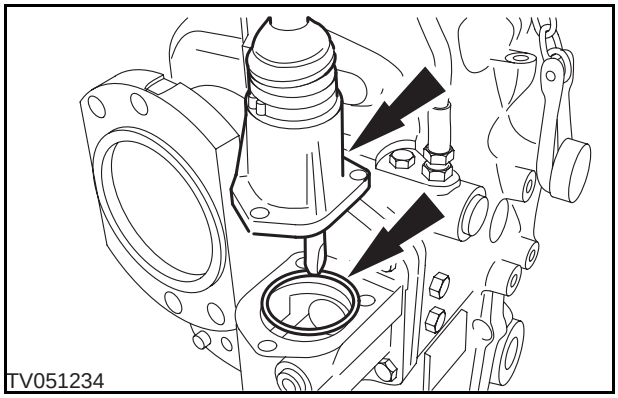

TV051522

7. Remove the three shifter tower assembly retaining bolts.

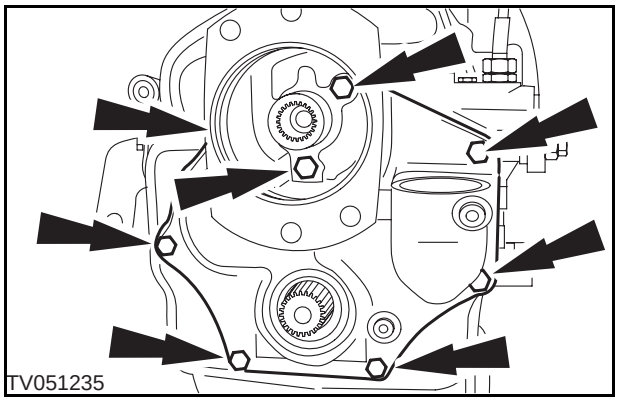

TV051233

8. Remove the shifter tower assembly.

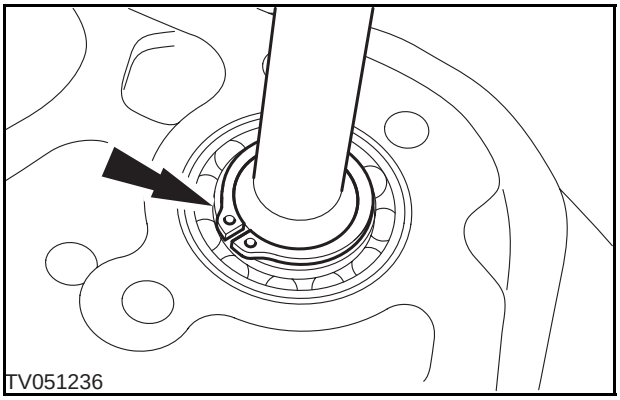
   Note:
   - Discard the O-ring seal.


TV051234

9. Remove the eight retaining bolts and remove the transmission rear cover.

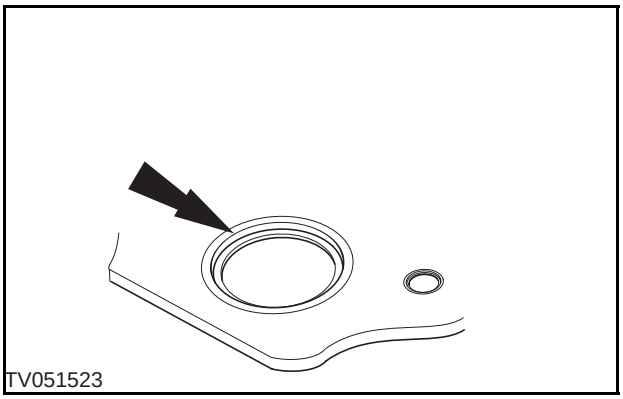

TV051235

10. Using suitable circlip pliers, remove the circlip and remove the hydraulic pump drive shaft.

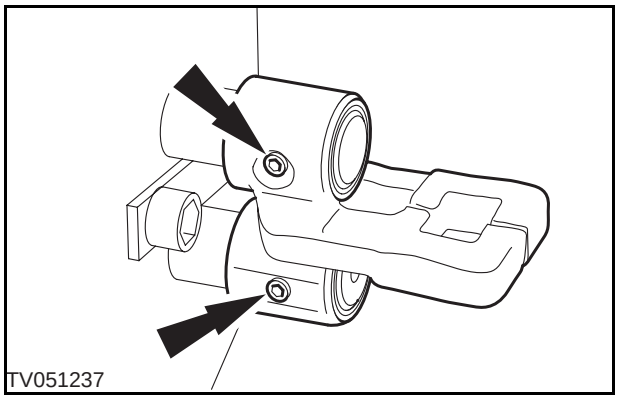

TV051236

11. Remove the 2WD flange oil seal.

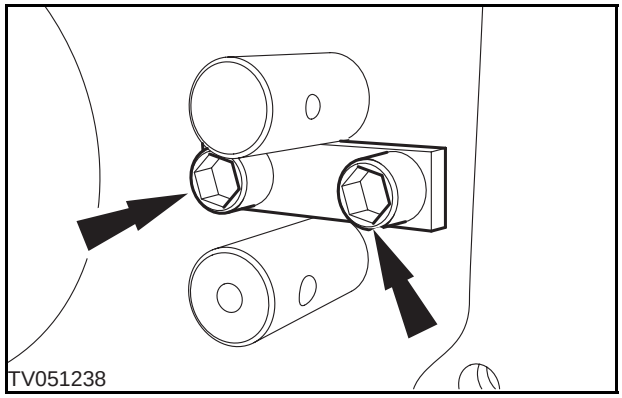
Note:
- Discard the oil seal.


TV051523

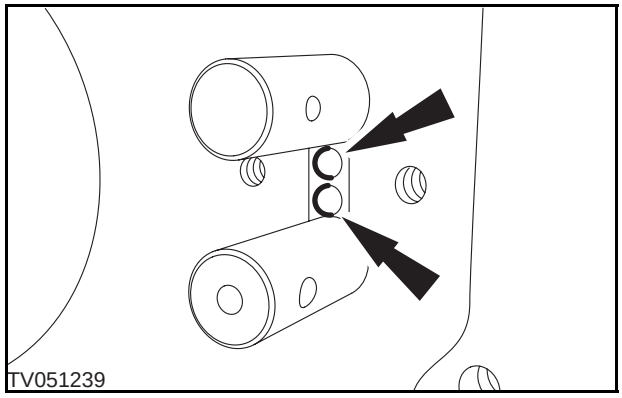
12. Using a suitable punch, remove the roll pins and remove the shift collars.


TV051237

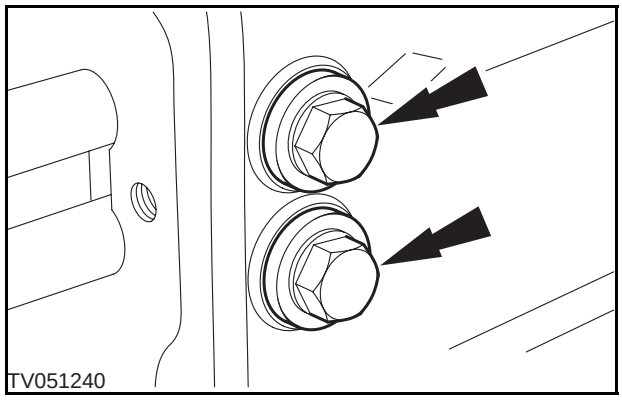
13. Remove the retaining bolts and remove the detent balls retaining plate.


TV051238

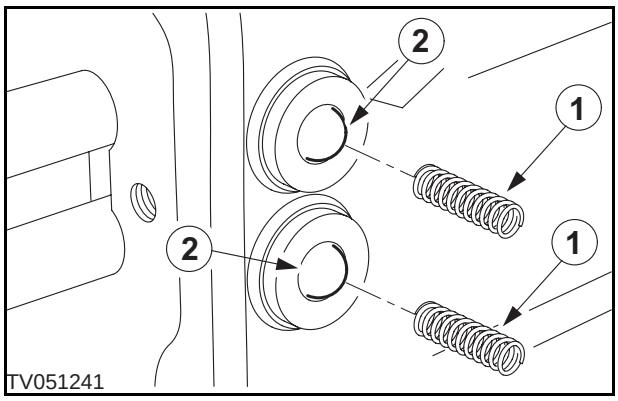
14. Remove the detent balls.


TV051239

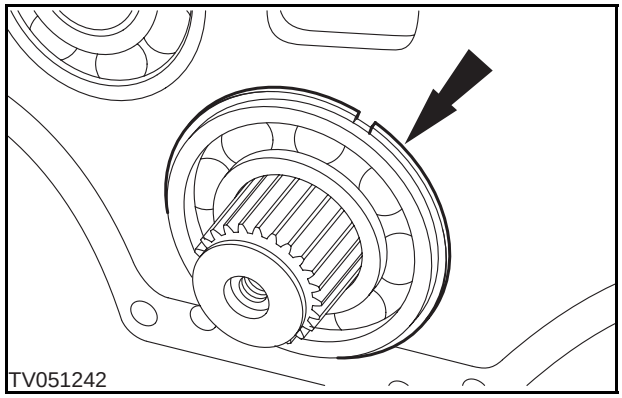
15. Remove the detent spring and ball retaining plugs.



16. Remove the detent springs (1) and detent balls (2).

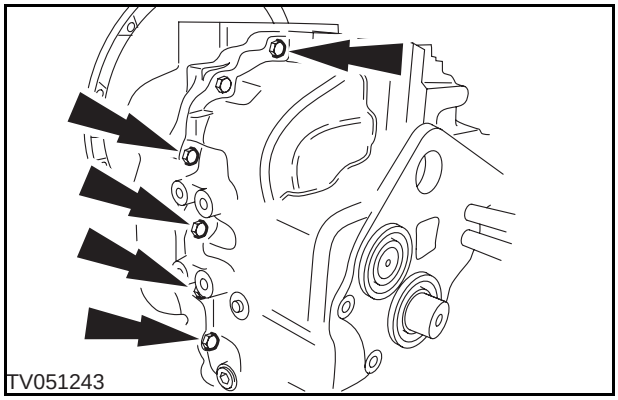


17. Using suitable snap ring pliers, remove the input shaft bearing snap ring.



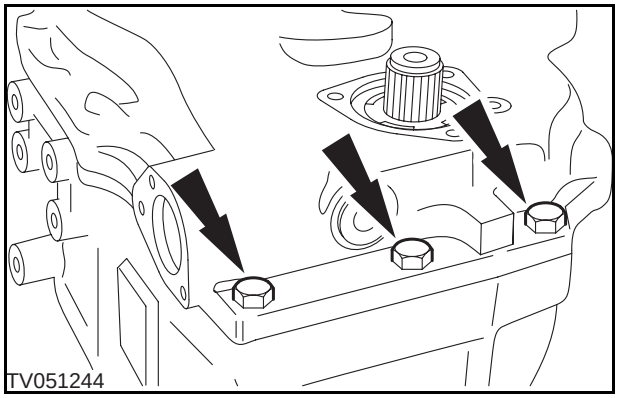
18. Remove the nine rear facing front transmission housing retaining bolts.

Note:
- Leave one bolt in each side at this stage.



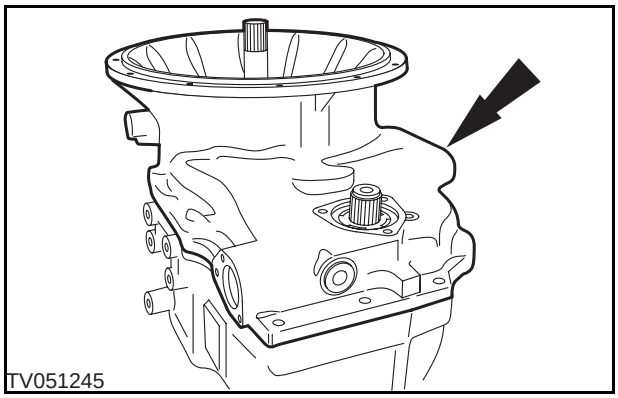
⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

19. Using suitable lifting equipment, raise the transmission.
20. Using suitable supporting equipment, support the transmission on it's rear face.
21. Remove the two rear facing transmission housing retaining bolts.
22. Remove the forward facing front transmission housing retaining bolts.

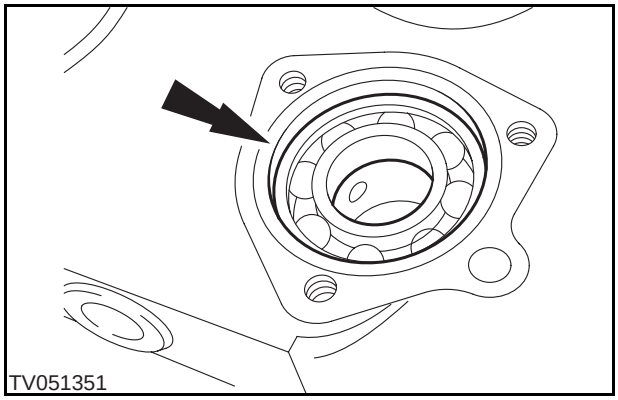

TV051244

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

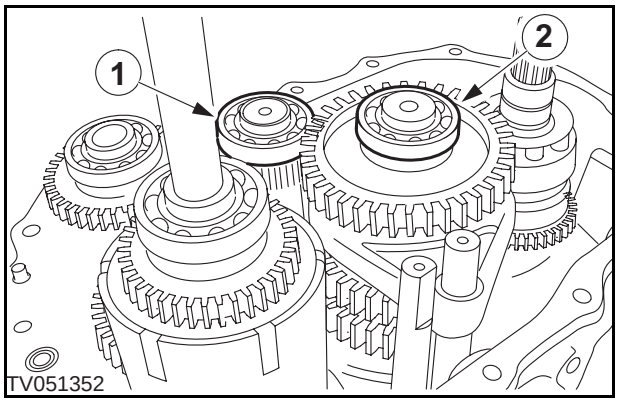
23. Using suitable lifting equipment, remove the front transmission housing.


TV051245

24. Remove the 4WD output shaft bearing.

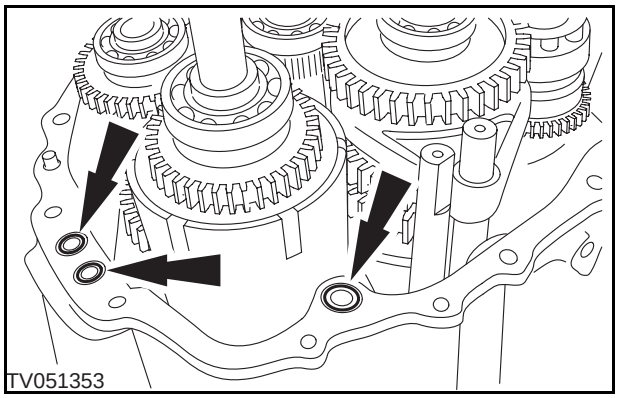

TV051351

25. Remove the primary shaft B (1) and the secondary shaft C (2) bearings.



26. Remove the O-ring seals from the front transmission housing.

Note:
- Discard the O-ring seals.

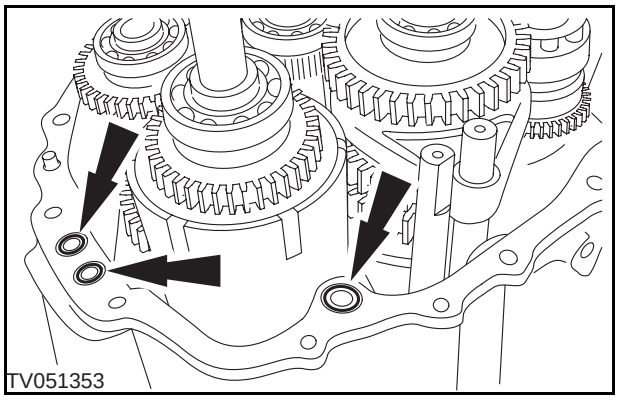


Assembly

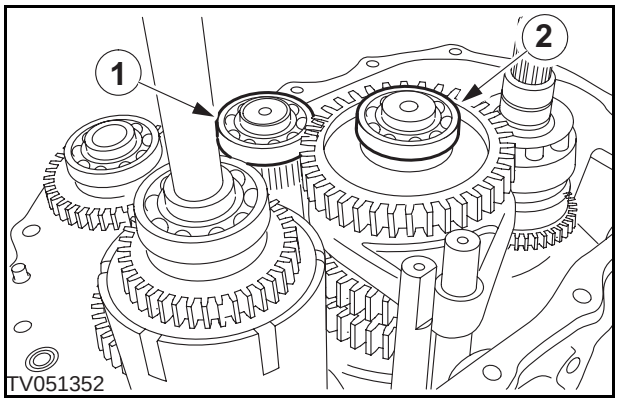
Note:
- Make sure all component mating faces are clean.

Note:
- Install new O-ring seals.

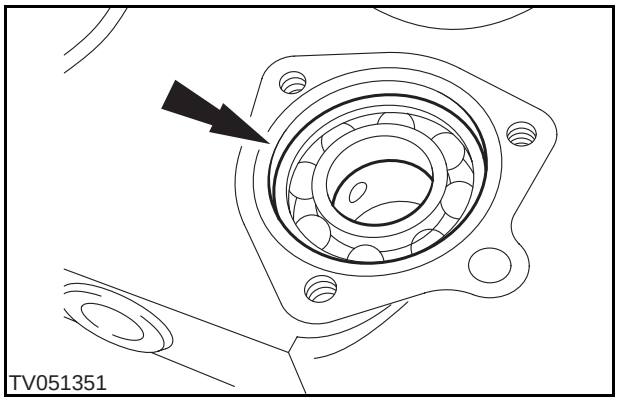
1. Install the O-ring seals into the rear transmission housing.



2. Install the primary shaft B (1) and secondary shaft C (2) bearings.

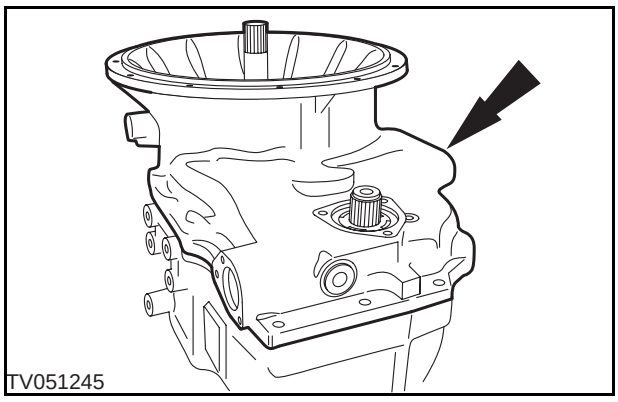


3. Install the 4WD output shaft bearing.

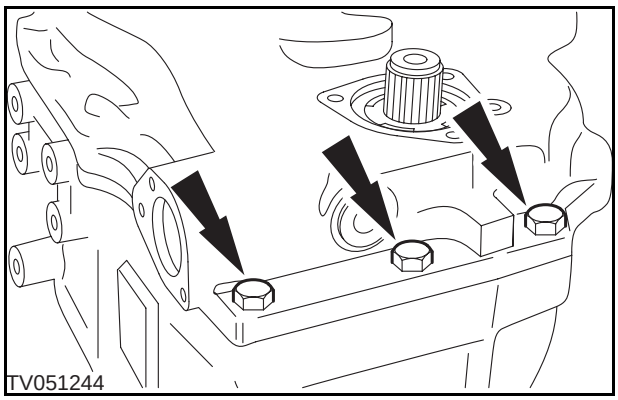


⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

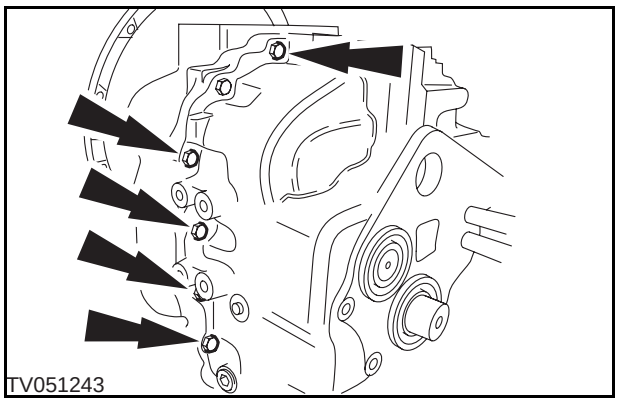
4. Apply a thin bead of approved sealant to the transmission housing mating face. Refer to SPECIFICATIONS, PAGE N13–06–145 in this section.
5. Using suitable lifting equipment, install the front transmission housing.



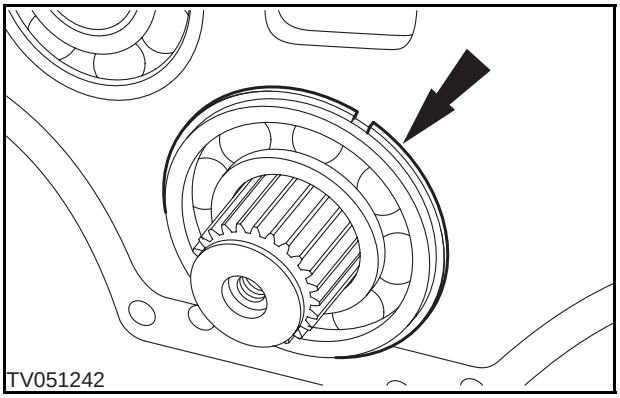
6. Install the forward facing front transmission housing retaining bolts.
   Tighten to 50Nm (37 lb.ft).



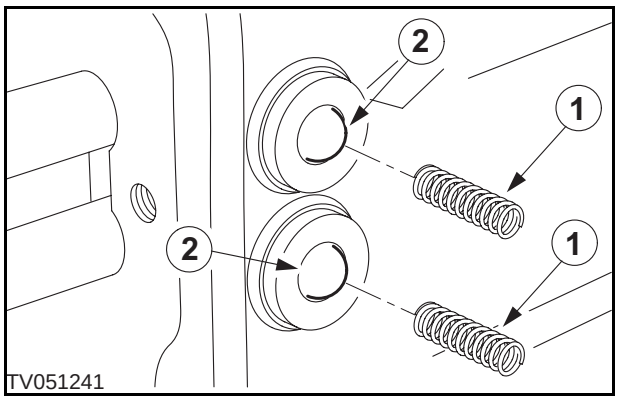
7. Install the nine rear facing front transmission housing retaining bolts.
   Tighten to 50Nm (37 lb.ft).



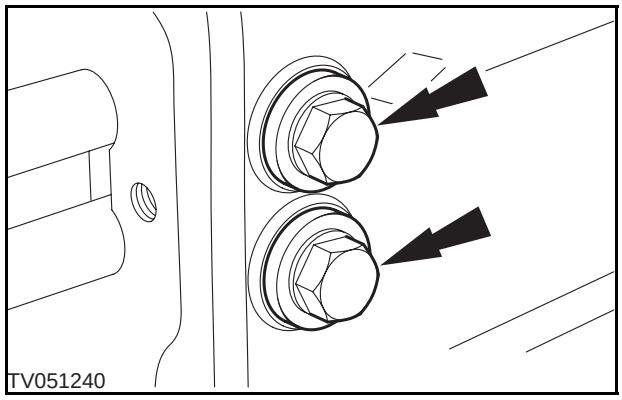
8. Using suitable snap ring pliers, install the snap ring.



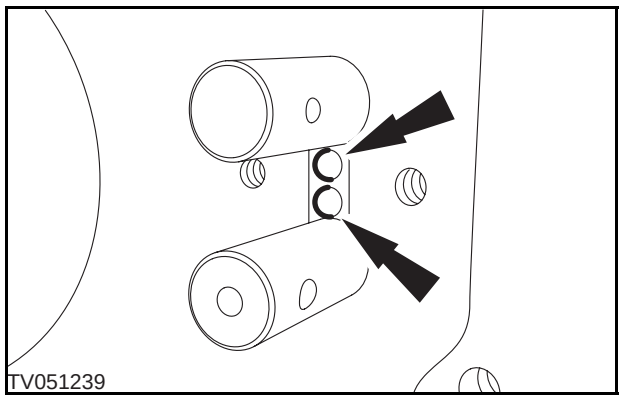
9. Install the detent springs (1) and balls (2).



10. Install the detent ball and spring retaining plugs.
    Tighten to 80Nm (60 lb.ft).



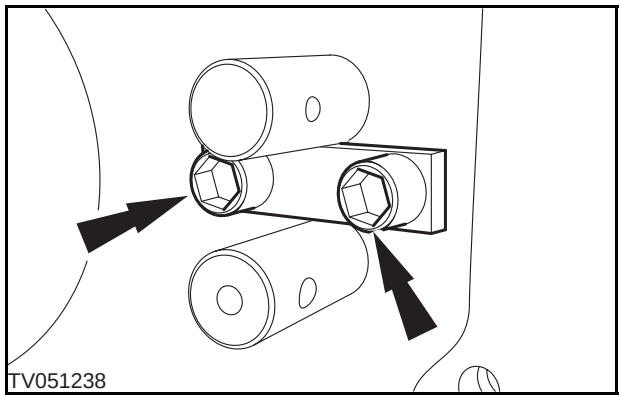
11. Install the detent balls.



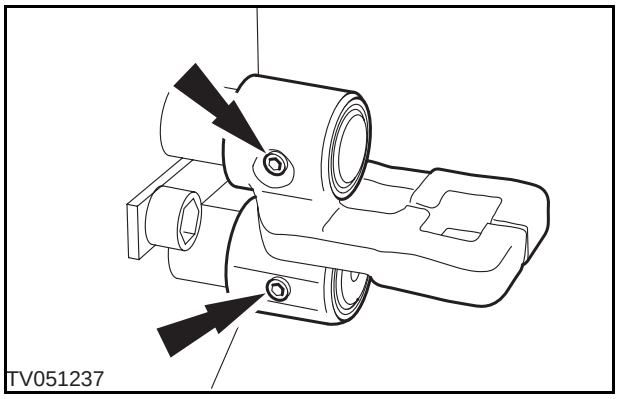
Note:

- Before installing the retaining bolts, apply the approved thread sealant.. Refer to SPECIFICATIONS, PAGE N13–06–145 in this section.

12. Install the detent balls retaining plate and the retaining bolts.
    Tighten to 50Nm (37 lb.ft).

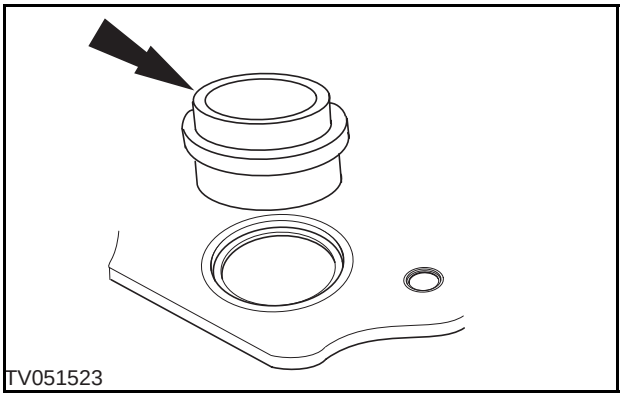


13. Install the shift collars and roll pins.

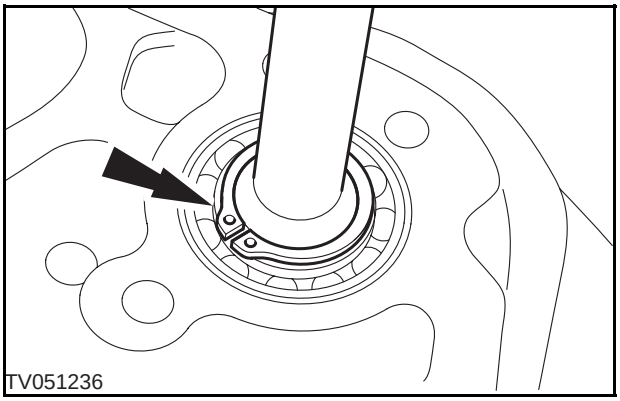

TV051237

Note:
- Install a new oil seal.

14. Using the special tool **CA715496 — Driver** , install the 2WD oil seal.


TV051523

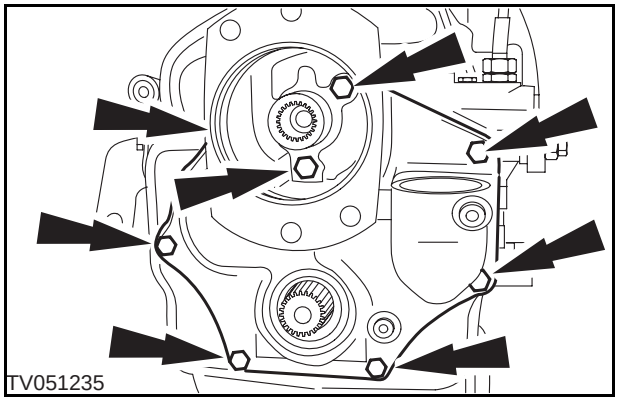
15. Using a soft faced hammer, install the hydraulic pump drive shaft and using suitable circlip pliers, install the circlip.


TV051236

Note:
- Make sure all component mating faces are clean.

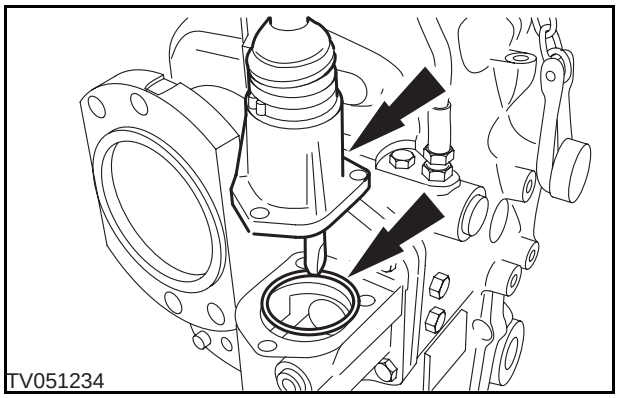
16. Apply a thin bead of approved sealant to the transmission rear cover mating face. Refer to SPECIFICATIONS, PAGE N13–06–145 in this section.

17. Install the transmission rear cover and the eight retaining bolts.
    Tighten to 50Nm (37 lb.ft).

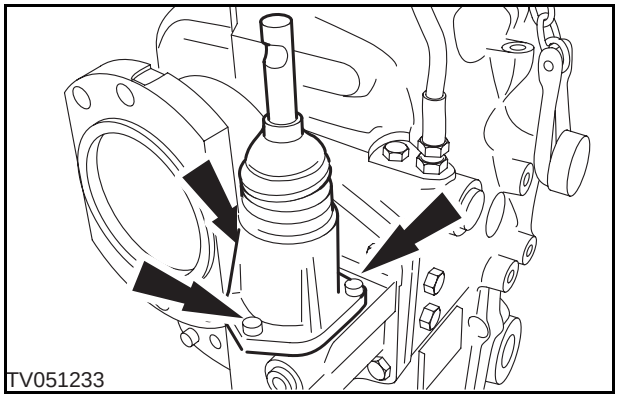

TV051235

Note:
- Install a new O-ring seal.

18. Locate the shift lever into the shift collars and install the shifter tower assembly.

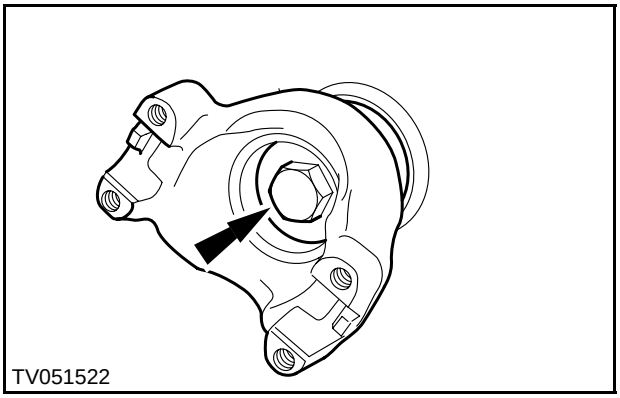

TV051234

19. Install the three shifter tower assembly retaining bolts.
    Tighten to 23Nm (17 lb.ft).


TV051233

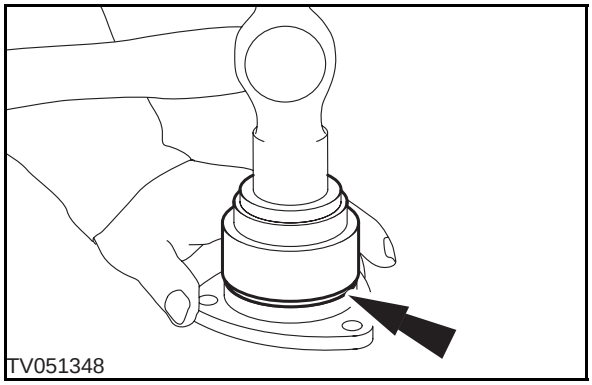
Note:
- Install a new O-ring seal.

20. Install the 2WD shaft flange and retaining bolt. Tghten to 139Nm (102 lb.ft).


TV051522

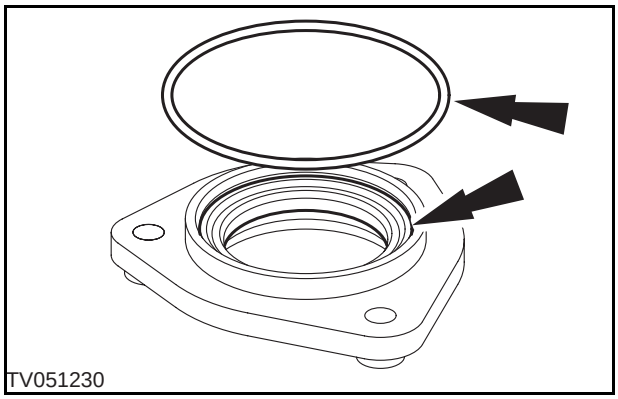
Note:
- Install a new oil seal.

21. Using the special tool **CA715354 — Driver** , install the oil seal into the 4WD flange seal carrier.

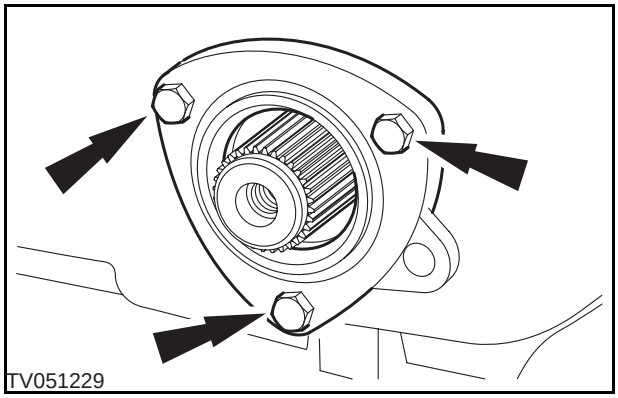

TV051348

Note:
- Install a new O-ring seal.

22. Install the O-ring seal onto the 4WD flange seal carrier.

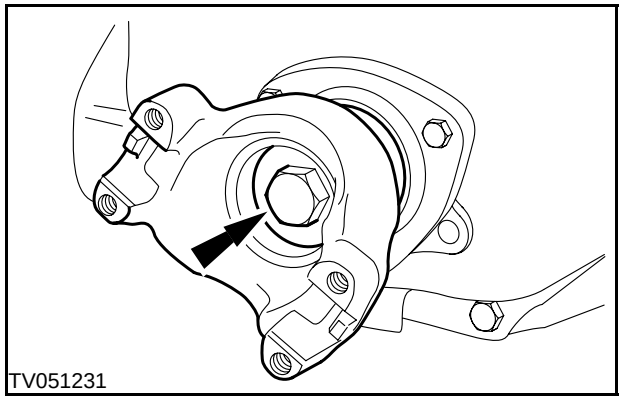

TV051230

23. Install the 4WD flange seal carrier and the retaining bolts.
    Tighten to 23Nm (17lb.ft).

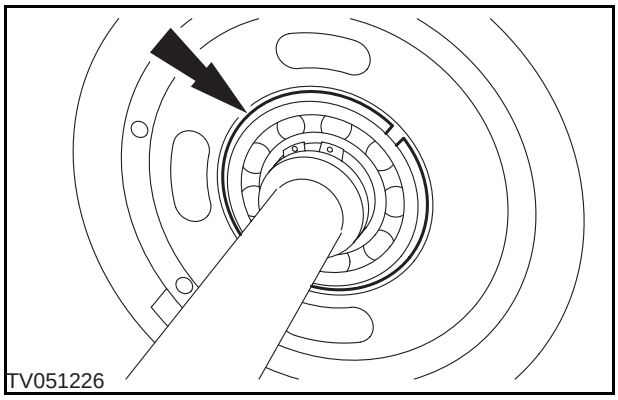


Note:
- Install a new O-ring seal.

24. Install the 4WD flange and the retaining bolt.
    Tghten to 139Nm (102 lb.ft).



25. Using suitable snap ring pliers, install the input shaft bearing snap ring.



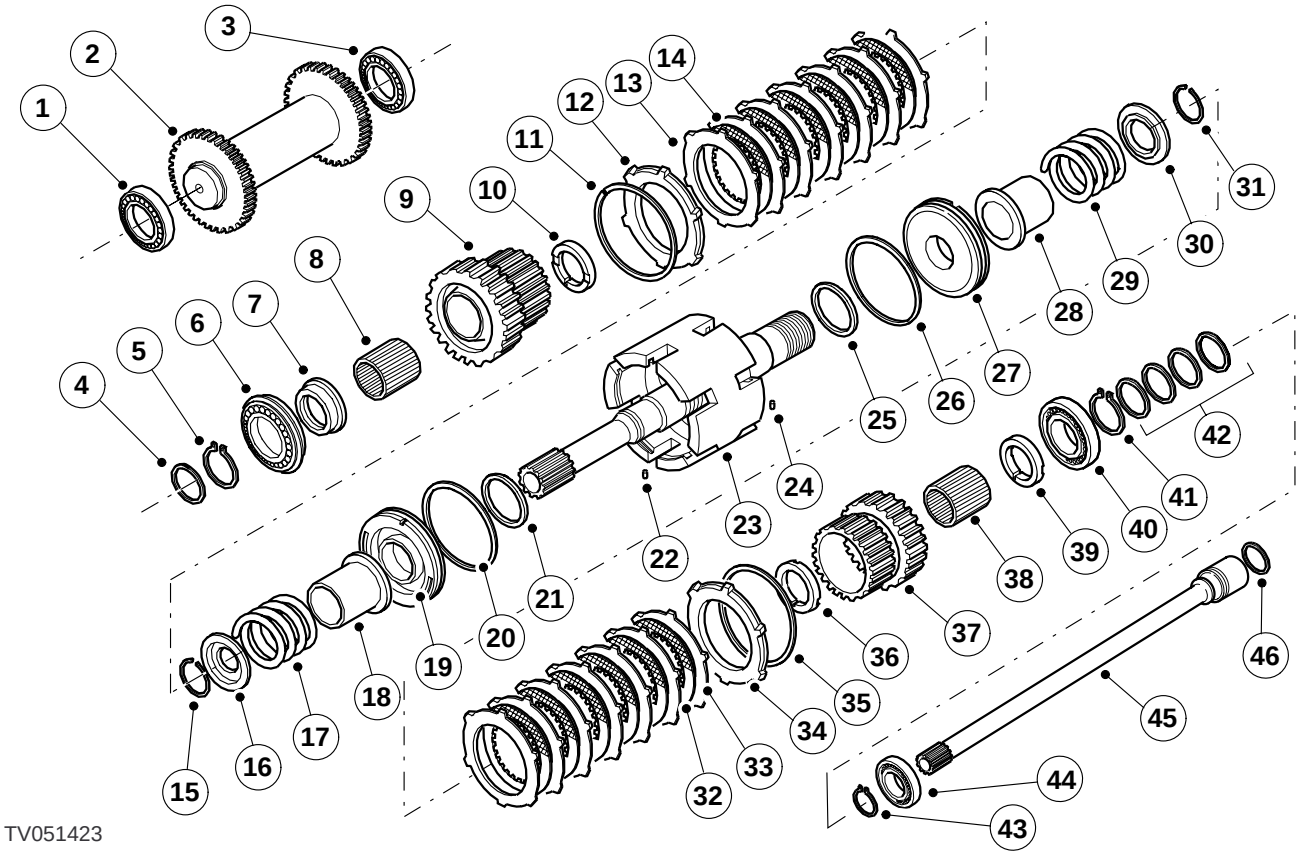
26. Install the transmission oil pump. For additional information, Refer to TRANSMISSION OIL PUMP, PAGE N13–06–39 in this section.

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DISASSEMBLY AND ASSEMBLY — INPUT SHAFT AND IDLER SHAFT

BHN1306DG

Operation: **Disassembly and Assembly-Input Shaft A and Reverse Idler Shaft D**	*Job Code:* **13 58 17 xx**		
Suitable lifting equipment	Standard tools, Clutchpack retaining clips Suitable puller, CA715358, CA715499, CA715415, CA715495, CA715497, CA715356, CA715046, CA715743, CA715746, CA715745, CA715623,		



TV051423

1	Bearing
2	Idler Shaft
3	Bearing
4	Teflon Seals
5	Circlip
6	Bearing
7	Spacer
8	Needle Bearing
9	Gear
10	Spacer
11	Snap Ring
12	Clutch Plate Lock ring
13	Clutch Plate, Driving
14	Clutch Plate, Driven
15	Snap Ring
16	Cover
17	Spring
18	Sleeve
19	Piston
20	Seals
21	Seals
22	Roll pin
23	Input Shaft

24	Roll Pin
25	Seals
26	Seals
27	Piston
28	Sleeve
29	Spring
30	Cover
31	Snap Ring
32	Clutch Plate, Driven
33	Clutch Plate, Driving
34	Clutch Plate Lock Ring
35	Snap Ring
36	Spacer
37	Gear
38	Needle Bearing
39	Spacer
40	Bearing
41	Circlip
42	Teflon Seals
43	Circlip
44	Bearing
45	Hydraulic Pump Drive Shaft
46	Teflon Seal

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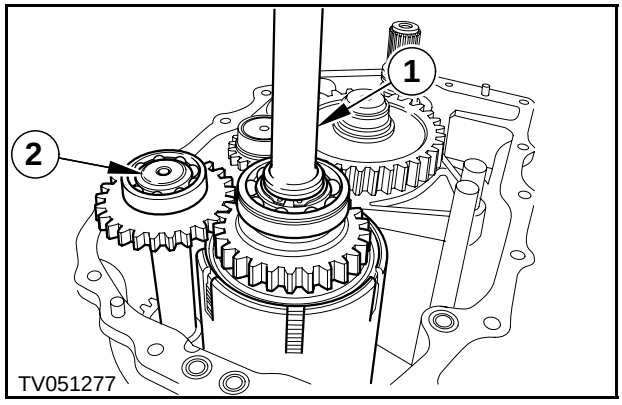
Disassembly

⚠ Warning:
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Remove the front half of the transmission housing. For additional information, refer to TRANSMISSION HOUSING, PAGE N13–06–65 in this section.

Note:
- The input shaft A and the idler shaft B must be removed from the transmission housing together.

2. Remove the input shaft A (1) and the idler shaft B (2) from the transmission housing.

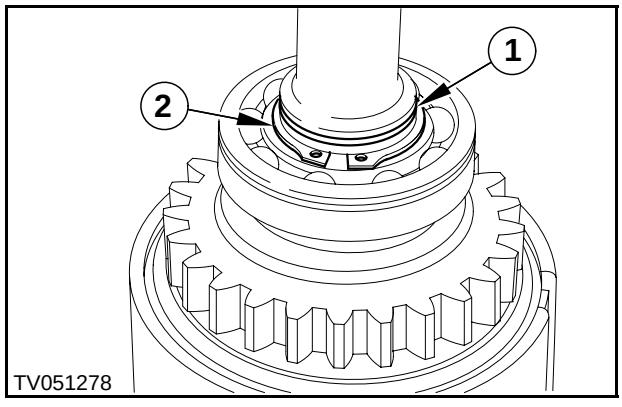


Note:
- Using a vice fitted with soft jaws.

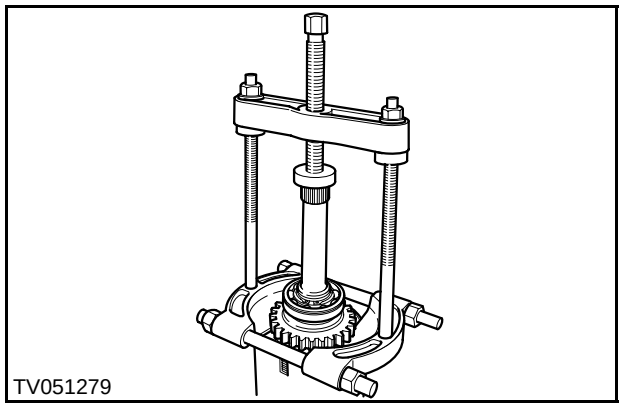
3. Secure the input shaft assembly with the reverse clutch up.
4. Remove the Teflon seal (1).

Note:
- Discard the Teflon seal.

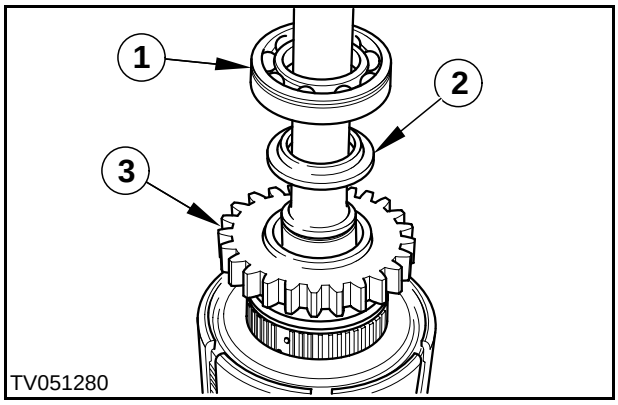
5. Using suitable circlip pliers, remove the circlip (2).



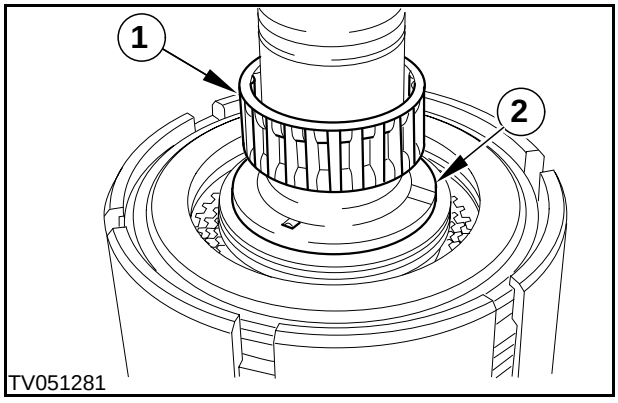
6. Using a suitable puller, release the gear from the shaft.



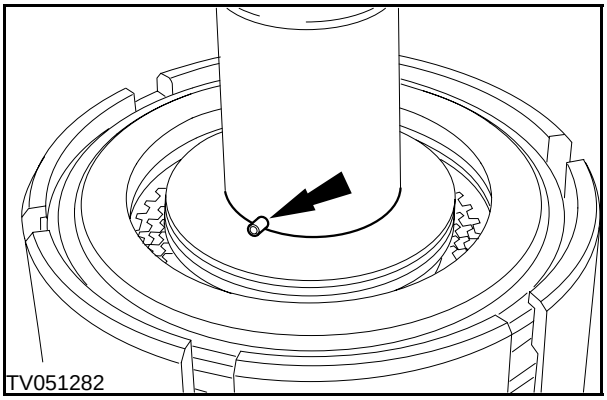
7. Remove the bearing (1), thrust washer (2) and the reverse gear (3).



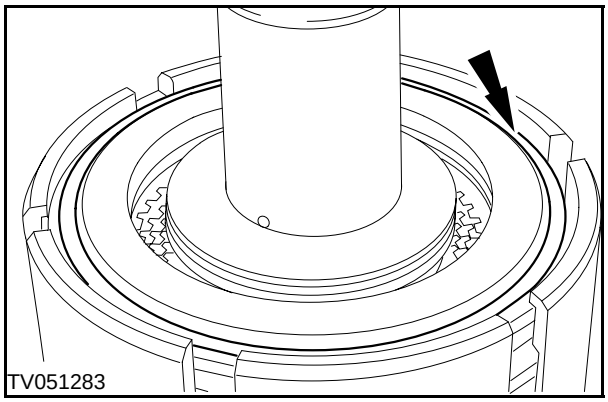
8. Remove the needle roller bearing (1).
9. Remove the thrust washer (2).



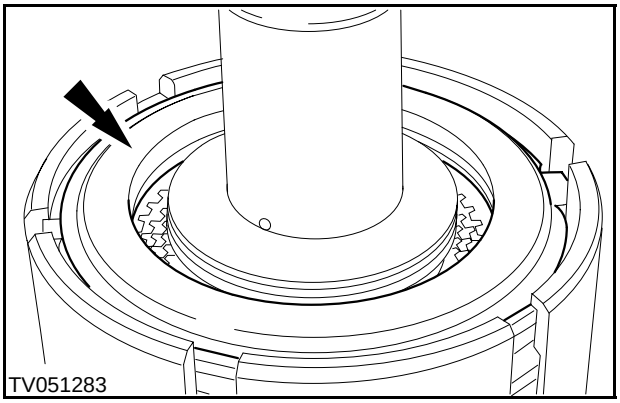
10. Remove the roll pin.



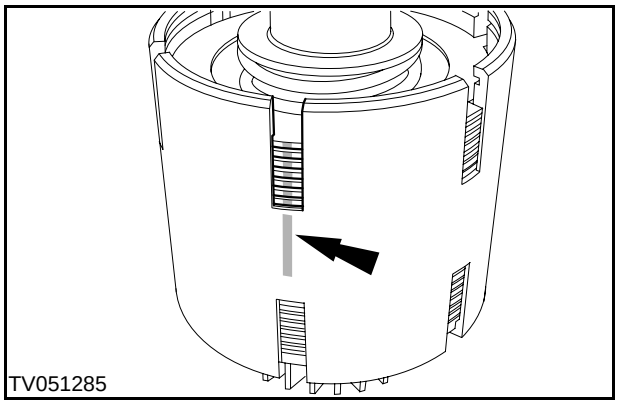
11. Using suitable snap ring pliers, remove the snap ring.



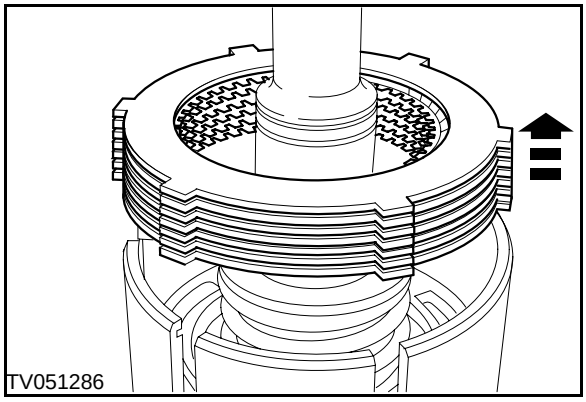
12. Remove the clutch pack cover plate.



13. Mark the clutch plates, friction discs and the friction bell housing.

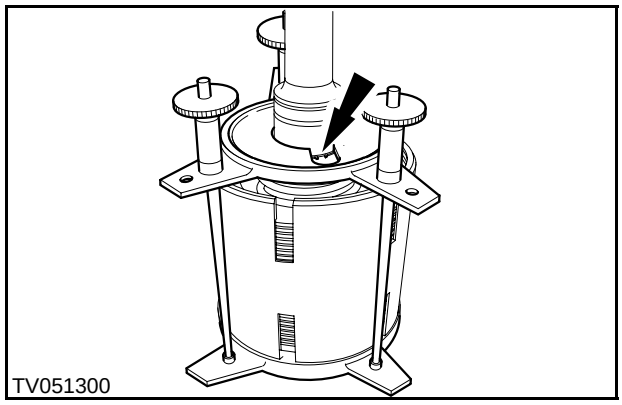


14. Remove the seven drive plates and the six friction plates.

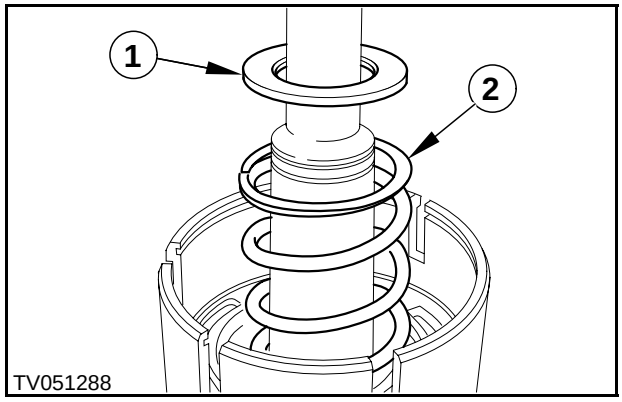


15. Using the special tool **CA715358 — clutch assembly/disassembly,** compress the spring cover.

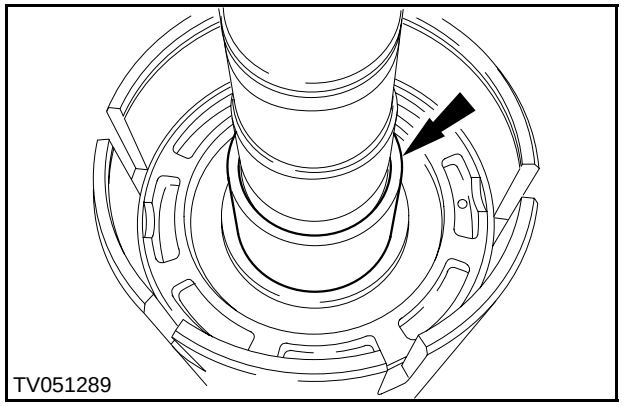
16. Using suitable circlip pliers, remove the snap ring.



17. Remove the spring cover (1).
18. Remove the spring (2).

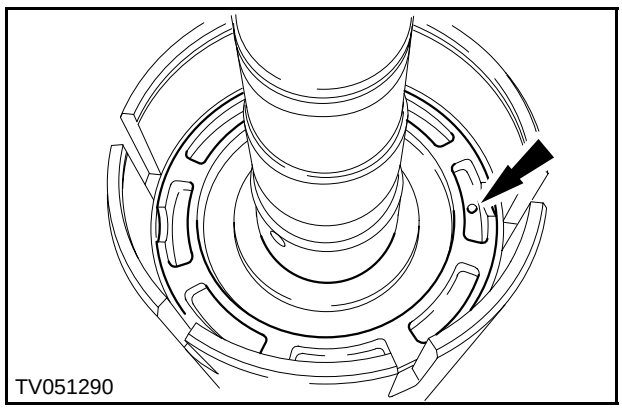


19. Remove the sleeve.



Note:
- Use compressed air through the piston delivery hole to lift the piston.

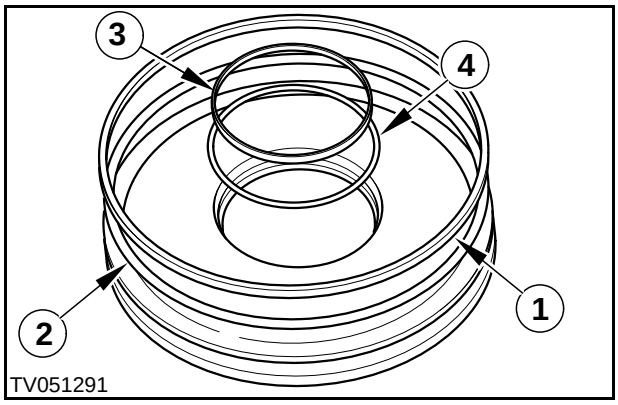
20. Remove the clutch piston.



21. Remove the outer Teflon seal (1) and the outer O-ring seal (2).

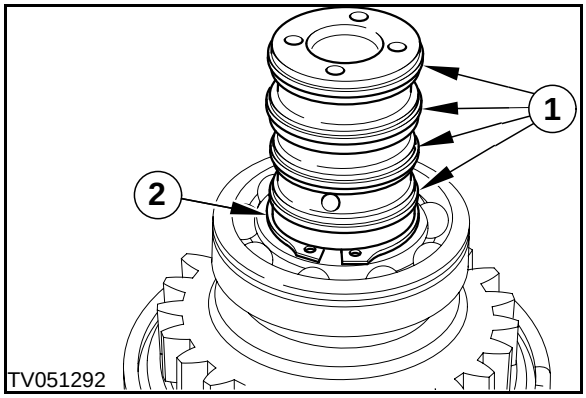
22. Remove the inner Teflon seal (3) and the inner O-ring seal (4).

    Note:
    - Discard the Teflon seals and O-ring seals.



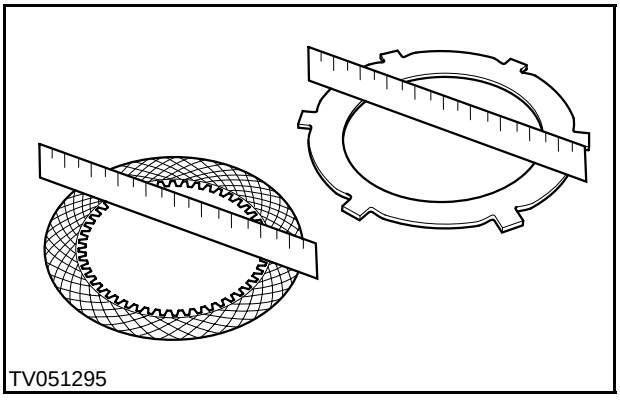
23. Turn the shaft over.
24. Remove the Teflon seal (1)
25. Using suitable snap ring pliers, remove the snap ring (2).

    Note:
    - Discard the seals.

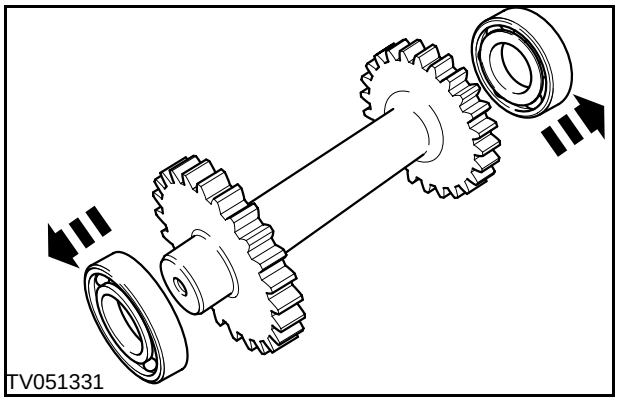


26. Repeat steps 5 to 22 to disassemble the forward clutch.
27. Using a suitable steel straight edge, check the flatness of both the drive plates and the friction plates from both clutch packs.

    Note:
    - Any plates found to be warped, damaged or worn must be replaced.



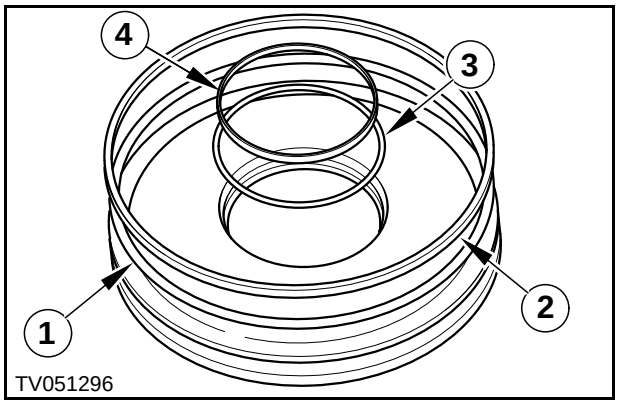
28. Using a suitable puller, remove the bearings from the idler shaft.



Assembly

Note:
- Install new Teflon seals and O-ring seals.

1. Install the outer O-ring seal (1) and the outer Teflon seal (2).
2. Install the inner O-ring seal (3) and the inner Teflon seal (4).

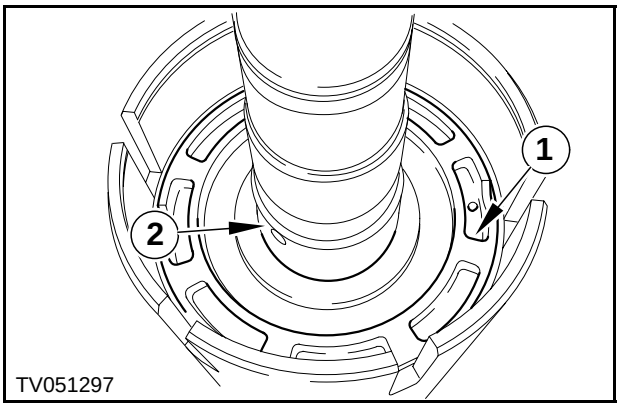


Note:
- Using a vice fitted with soft jaws.

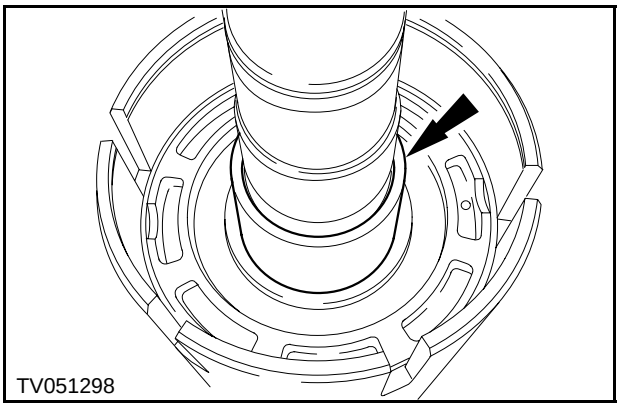
3. Secure the input shaft assembly with the reverse clutch up.

Note:
- Apply a thin film of grease to the seals to assist in assembly.

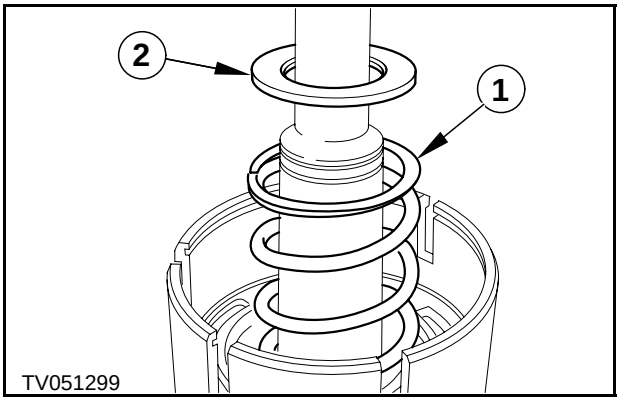
4. Using the special tool **CA715499 — protector** , (2), install the clutch piston (1) into the friction bell housing.



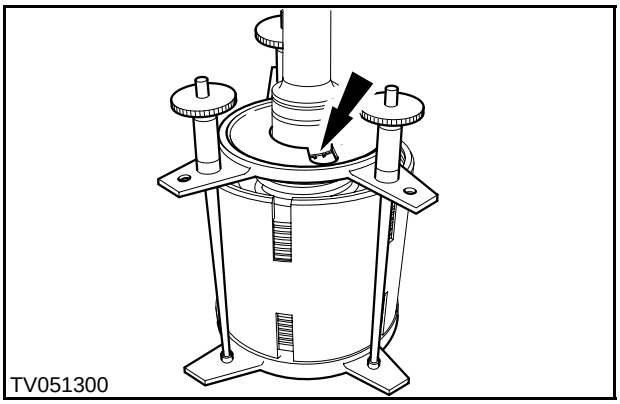
5. Install the sleeve onto the input shaft.



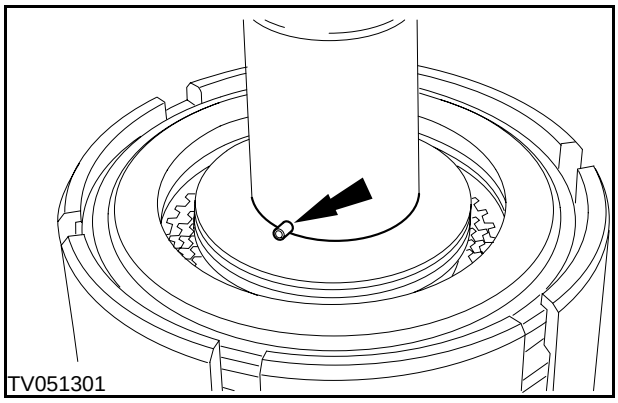
6. Install the spring (1).
7. Install the spring cover (2).



8. Using the special tool **CA715358 — clutch assembly/disassembly** , compress the spring.
9. Using suitable snap ring pliers, install the snap ring.

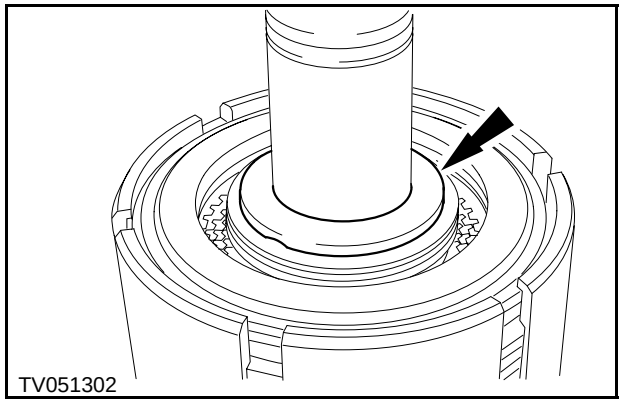


10. Install the roll pin.

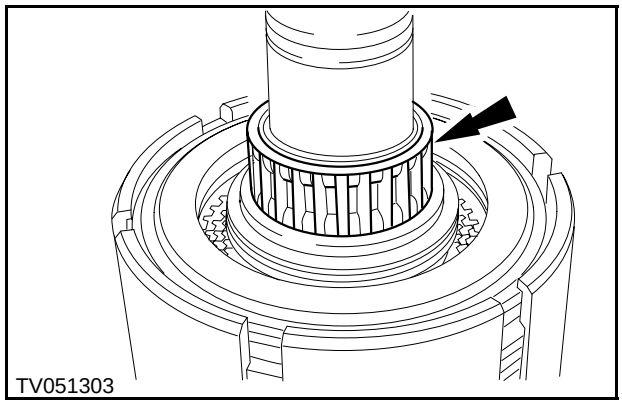


11. Install the thrust washer.

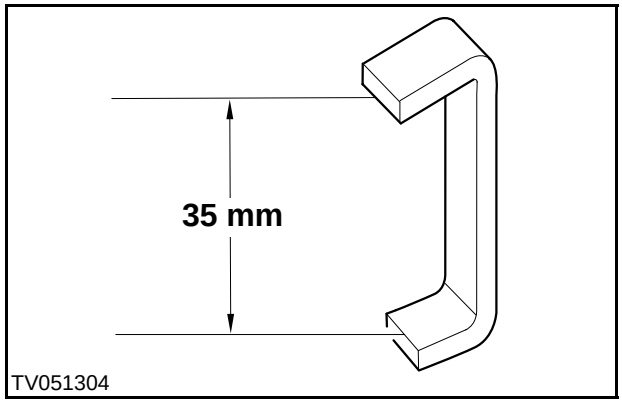
Note:
- Make sure the notch in the inner edge of the thrust washer fits over the roll pin and that the oil grooves in the thrust washer are facing downwards.


TV051302

12. Install the needle roller bearing.

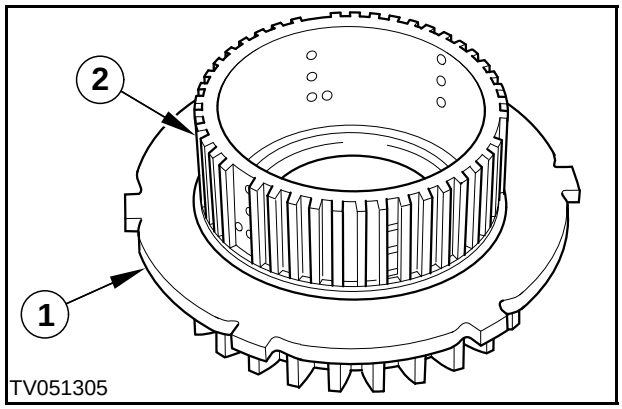

TV051303

13. Make two 'clutch pack retaining clips' from 2 mm aluminium sheet.



TV051304

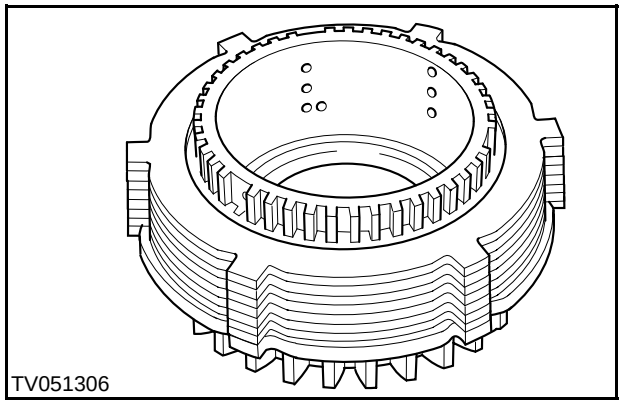
14. Install the clutch plate lock ring (1) onto the gear (2).



Note:

- Alternate the drive plates and the friction plates until the correct amount of plates are installed. The first and last plates are steel.

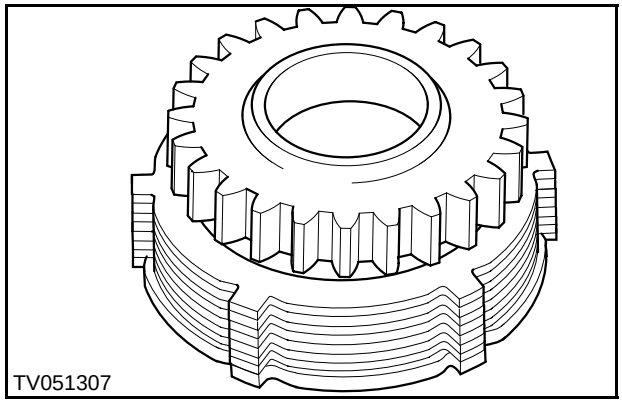
15. Install the seven drive plates and the six friction plates.



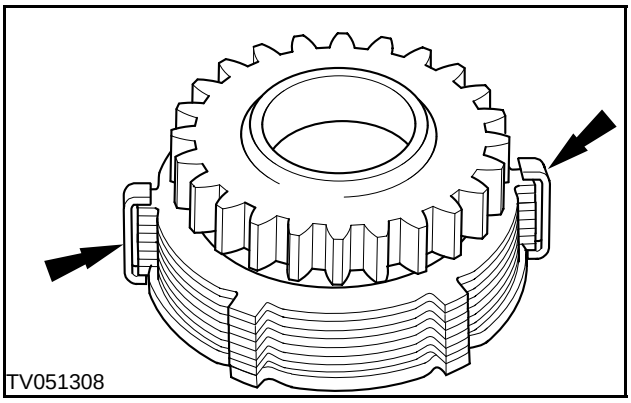
16. Turn the clutch and gear assembly over.

Note:

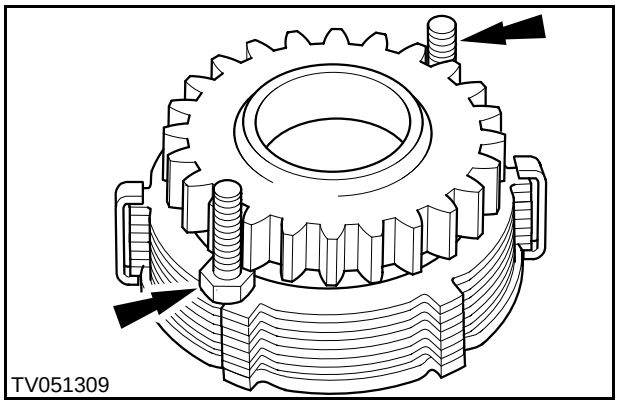
- Make sure all six clutch friction plates have engaged the splines on the gear.



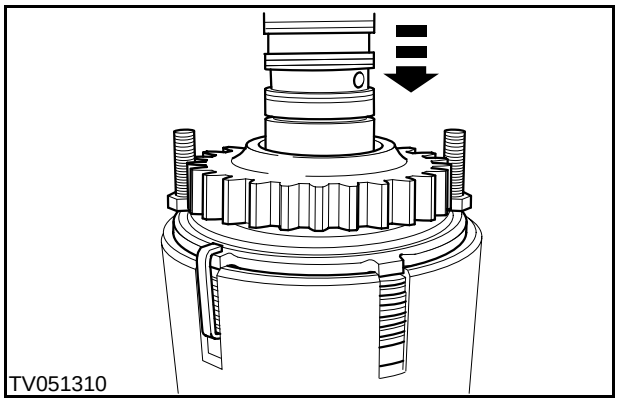
17. Install the two clutch pack retaining clips.


TV051308

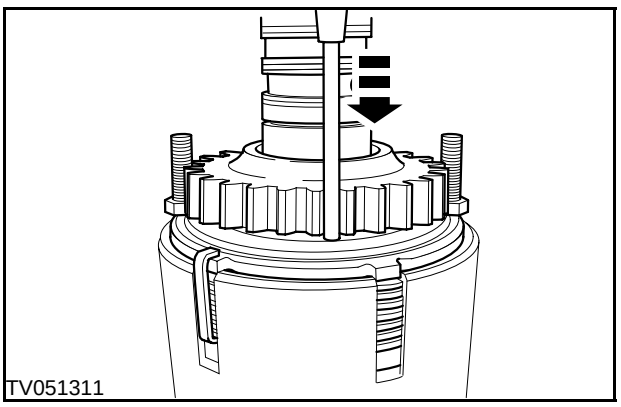
18. Place the heads of two retaining bolts under the gear teeth.


TV051309

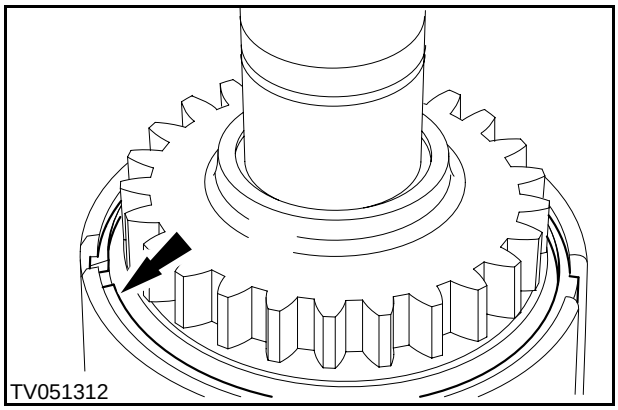
19. Install the clutch and gear assembly.


TV051310

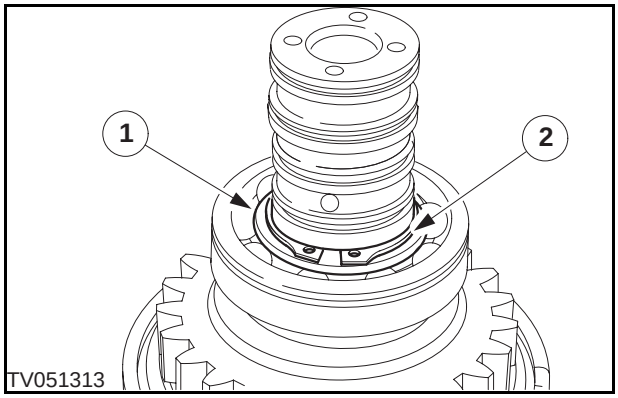
20. Using a suitable punch, carefully install the clutch pack cover.
21. Remove the two retaining bolts and the clutch pack retainers.


TV051311

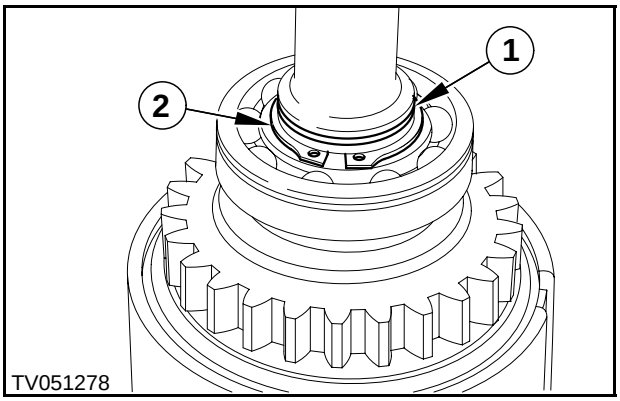
22. Using suitable circlip pliers, install the snap ring.



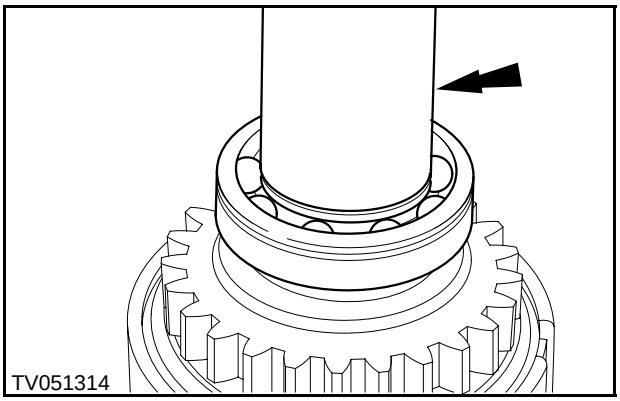
23. Install the thrust washer.



24. Using suitable circlip pliers, install the circlip (2).



25. Using a suitable bearing heater, heat the bearing to 80 to 100ºC.
26. Using the special tool **CA715004 — driver** , install the bearing into the input shaft.

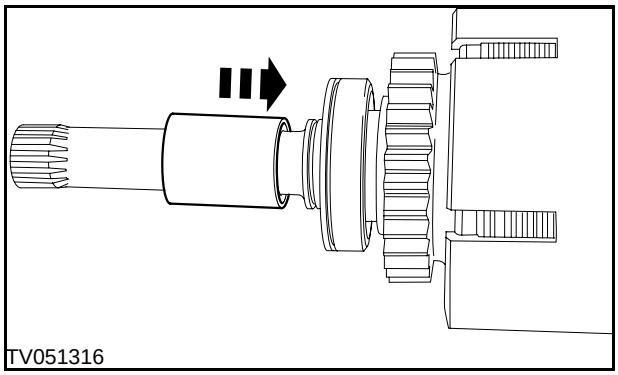


⚠ **Caution:**
- **Take care not to damage the Teflon seal. If the Teflon seal is damaged, it must be replaced. Failure to follow this instruction may result in damage to the transmission.**

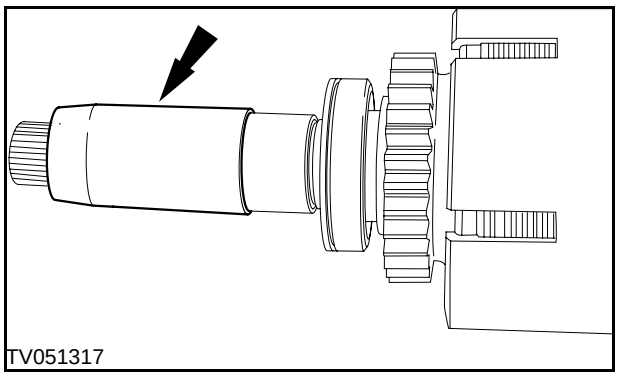
Note:
- Install new Teflon seals.

27. Install the Teflon seal onto the input shaft.
28. Install the special tool **CA715415/7 – spacer** , onto the shaft.

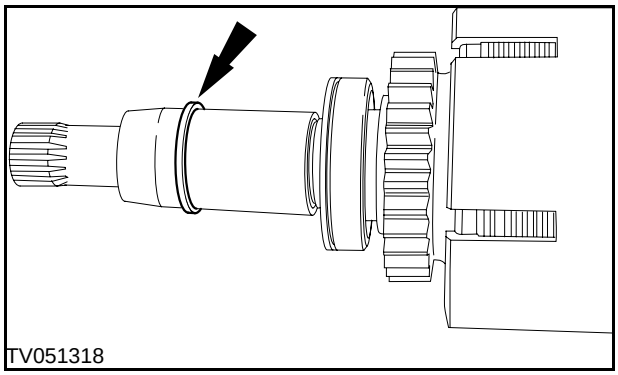
Note:
- Make sure the deep internally chamfered end is facing towards the clutch.


TV051316

29. Install the special tool **CA715495 — expander/protector** , over the special tool **CA715415/7 – spacer** .

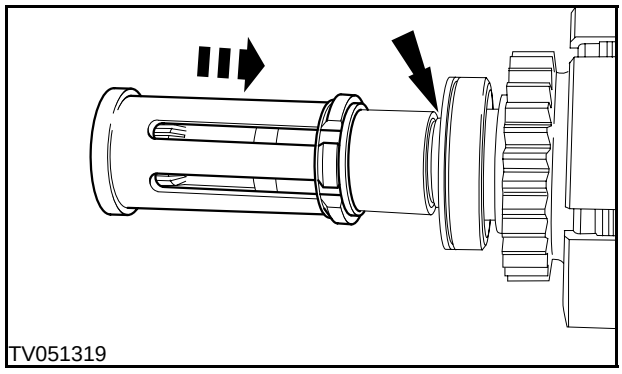

TV051317

30. Heat the Teflon seal to 60 to 80ºC.
31. Install the Teflon seal onto the special tool **CA715495 — expander/protector** .


TV051318

32. Install the special tool **CA715497 – pusher** , over the special tool **CA715495 — expander/protector** .
33. Install the Teflon seal.

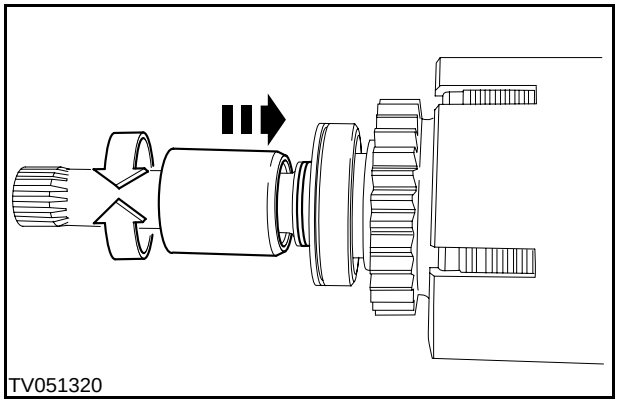
34. Remove the special tools.


TV051319

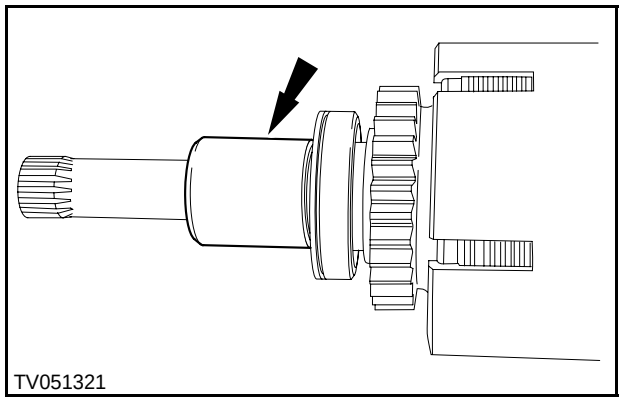
Note:
- Make sure the deep internally chamfered end is facing towards the clutch.

35. Using the special tool **CA715356 — gauger** , resize the Teflon seal.

Note:
- Make sure the seal is correctly seated in the groove.


TV051320

36. Remove the special tool. Re-install the special tool **CA715356 — gauger** using the narrow internally chamfered end facing towards the clutch. Leave the gauger in place for 15 minutes until the seal has cooled.
    Remove the special tool.

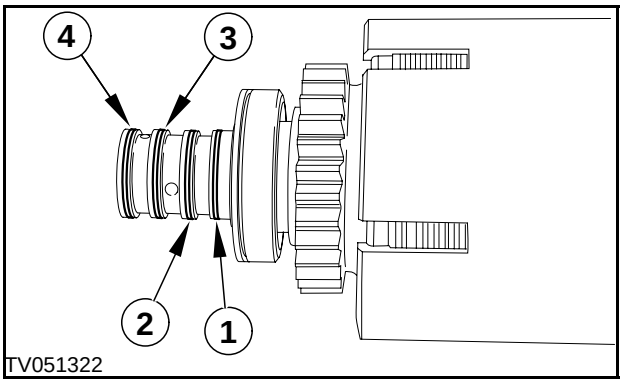

TV051321

37. Turn the input shaft over with the forward clutch up.
38. Repeat steps 1 to 21 to assemble the forward clutch
39. Using the special tool **CA715046 — driver** , install the bearing.

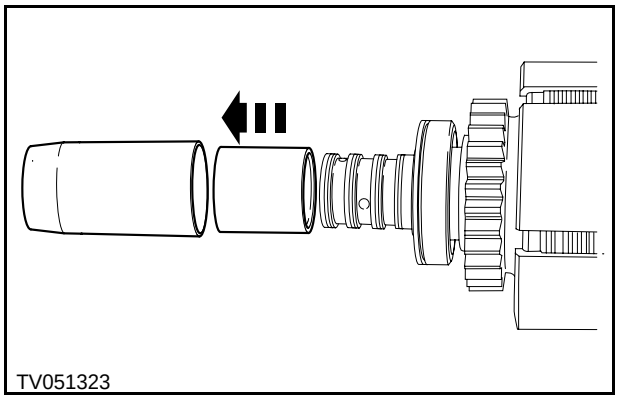
⚠ **Caution:**
- **Take care not to damage the Teflon seal. If the Teflon seal is damaged, it must be replaced. Failure to follow this instruction may result in damage to the transmission.**

Note:
- Install new Teflon seals.

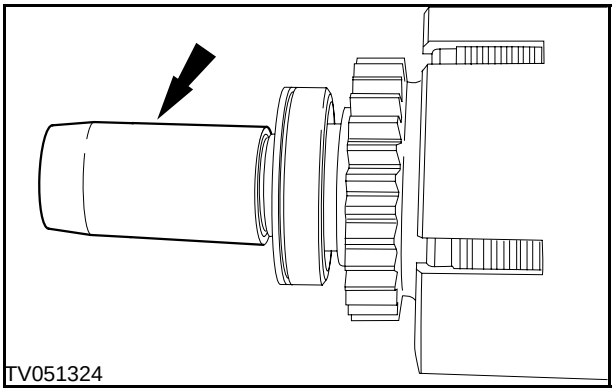
40. The Teflon seals must be installed in the order indicated, using the following instructions.



41. Install the special tool **CA715743/1 – spacer** , into the special tool **CA715743–expander/protector** .

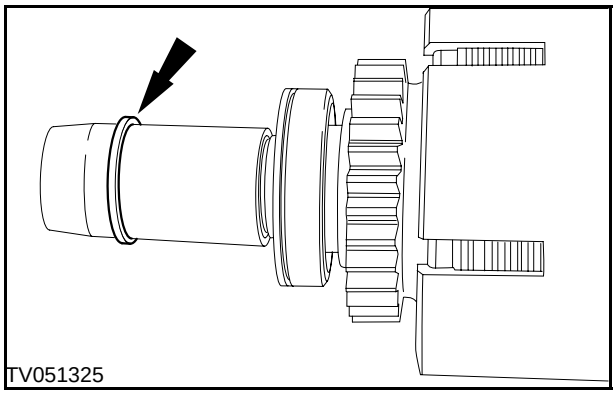


42. Install the assembled special tools onto the shaft.

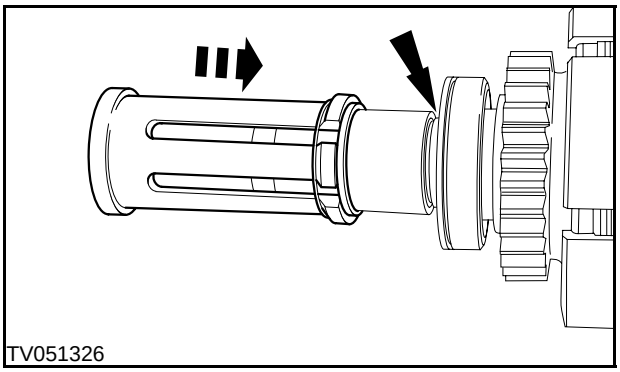


43. Heat the Teflon seal to 60 to 80ºC.

44. Install the Teflon seal onto the special tool **CA715743–expander/protector** .



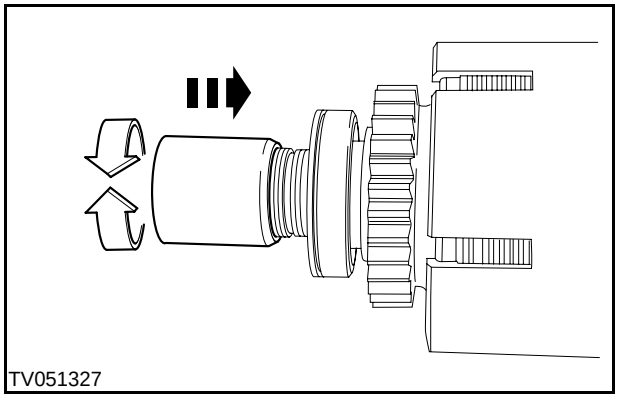
45. Install the special tool **CA715746 – pusher** , over the special tool **CA715743 — expander/protector** .
46. Install the Teflon seal.
47. Remove the special tools.



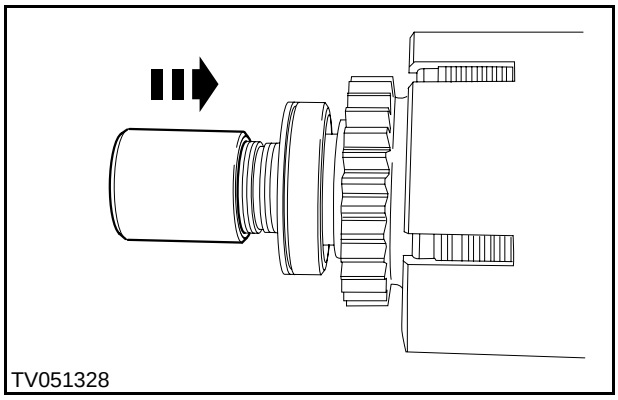
Note:
- Make sure the deep internally chamfered end is facing towards the clutch.

48. Using the special tool **CA715745 — gauger** , resize the Teflon seal.

Note:
- Make sure the Teflon seal is correctly seated in the groove.

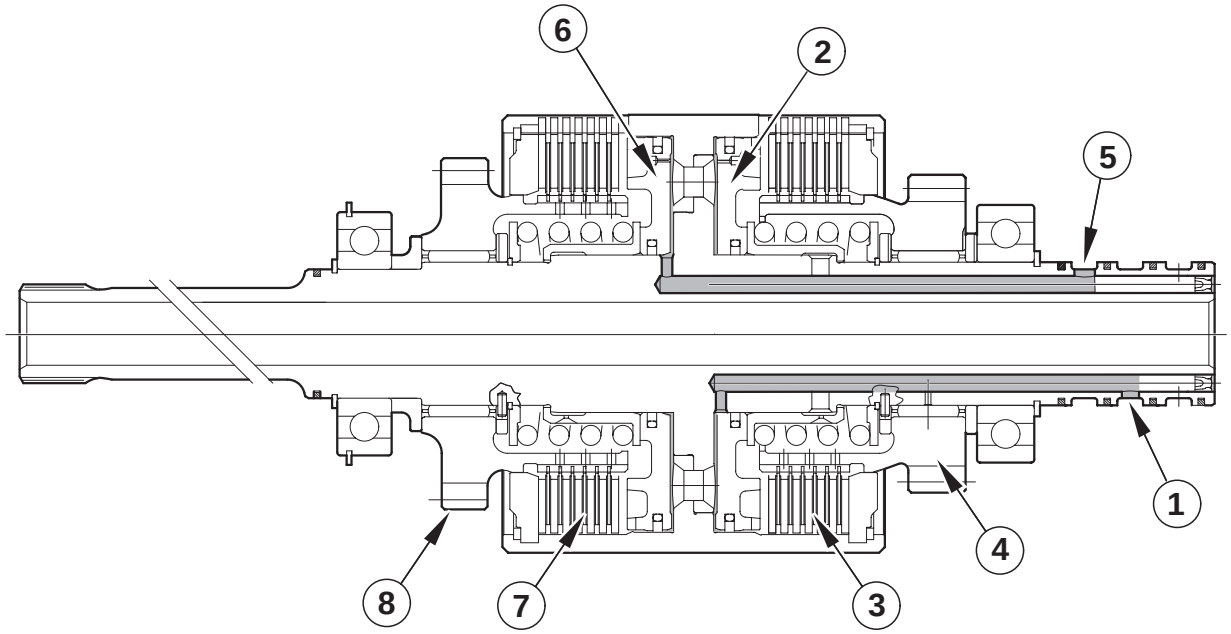


49. Remove the special tool.
    Re-install the special tool **CA715356 — gauger** , using the narrow internally chamfered end facing towards the clutch. Leave the gauger in place for 15 minutes until the seal has cooled.
    Remove the special tool.


TV051328

50. Repeat steps 41 to 49 to install the remaining Teflon seals. Use the spacers identified below for each of the Teflon seals.
    2nd Teflon seal: **CA715743/2**
    3rd Teflon seal: **CA715743/3**
    4th Teflon seal: **CA715743/4**
51. Test the functionality of the clutches. Apply compressed air (at approximately 6 bar) to the forward clutch hydraulic passageway (1) in the shaft. The forward clutch piston (2) will move and the forward clutch plates (3) will close, locking the forward drive gear (4).
52. Apply compressed air (at approximately 6 bar) to the reverse clutch hydraulic passageway (5) in the shaft. The reverse clutch piston (6) will move and the reverse clutch plates (7) will close, locking the reverse drive gear (8).

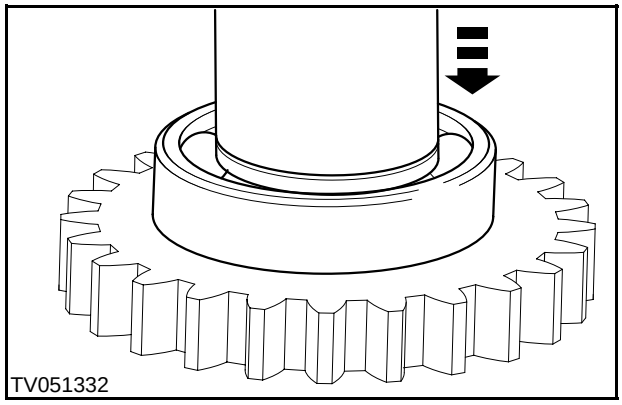
    Note:
    - If either clutch does not work correctly, disassemble the faulty clutch and establish the cause. Assemble the clutch and re-test.



TV051329

1	Forward Clutch Hydraulic Passageway
2	Forward Clutch Piston
3	Forward Clutch Plates
4	Forward Drive Gear
5	Reverse Clutch Hydraulic Passageway
6	Reverse Clutch Piston
7	Reverse Clutch Plates
8	Reverse Drive Gear

53. Using the special tool **CA715623 — driver** , install the two bearings onto the idler shaft.

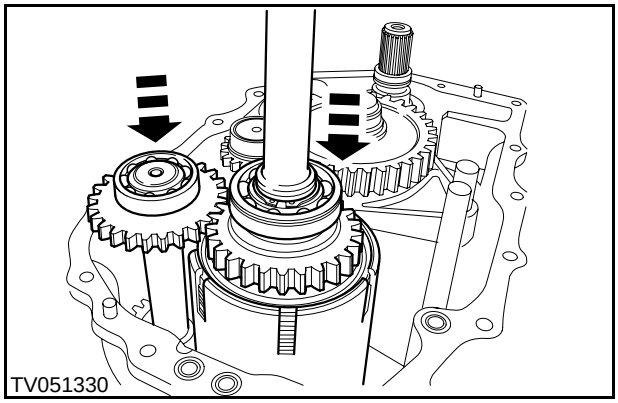


TV051332

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

Note:
- The input shaft A and the idler shaft B must be installed together.

54. Install the input shaft A and the idler shaft B.


TV051330

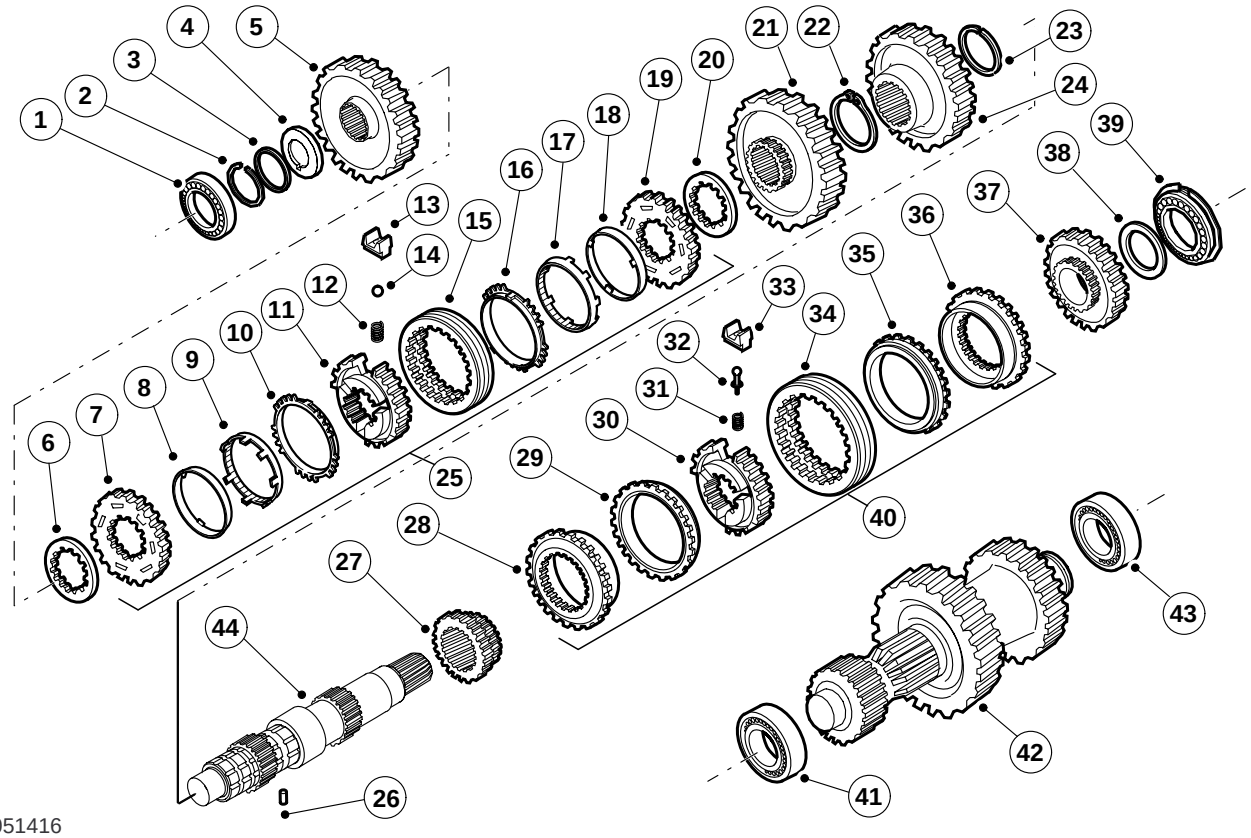
55. Install the rear half of the transmission housing. For additional information, refer to TRANSMISSION HOUSING, PAGE N13–06–65 in this section.

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DISASSEMBLY AND ASSEMBLY — SHAFTS C AND B

BHN1306DH

Operation: **Disassembly and Assembly of the Primary shaft C and the Secondary Shaft B**	*Job Code:* **13 59 17 xx**		
Suitable lifting equipment	Standard tools Suitable feeler gauges Suitable bearing heater Suitable puller CA715496 CA71549 CA715004		



TV051416

1	Bearing
2	Snap Ring
3	Shim
4	Thrust Washer
5	Second Speed Gear
6	Spacer
7	Synchroniser Ring
8	Steel Ring
9	Sintered Ring
10	Tapered Friction Ring
11	Synchroniser Hub
12	Spring
13	Plates
14	Ball
15	Sleeve
16	Tapered Friction Ring
17	Sintered Ring
18	Steel Ring
19	Synchroniser Ring
20	Spacer
21	First Speed Gear
22	Circlip
23	Snap Ring

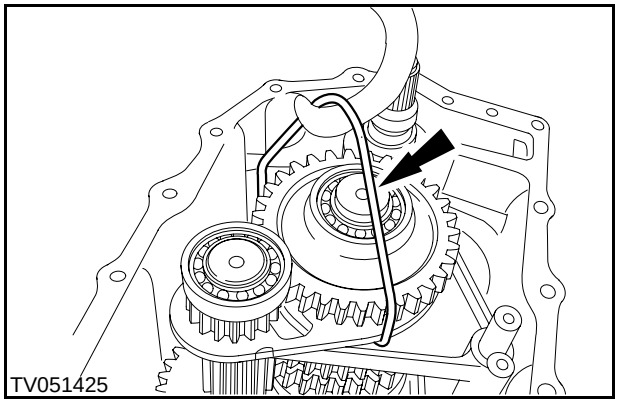
24	4WD Gear
25	First/Second Speed Synchroniser Assembly
26	Roll Pin
27	Fourth Speed Gear
28	Clutch Ring
29	Friction Ring
30	Synchroniser Hub
31	Spring
32	Ball
33	Plates
34	Sleeve
35	Tapered Friction Ring
36	Clutch Ring
37	Third Speed Gear
38	Thrust Washer
39	Bearing
40	Synchroniser Assembly
41	Bearing
42	Primary Shaft
43	Bearing
43	Bearing
44	Secondary Shaft

Note: This page intentionally left blank.

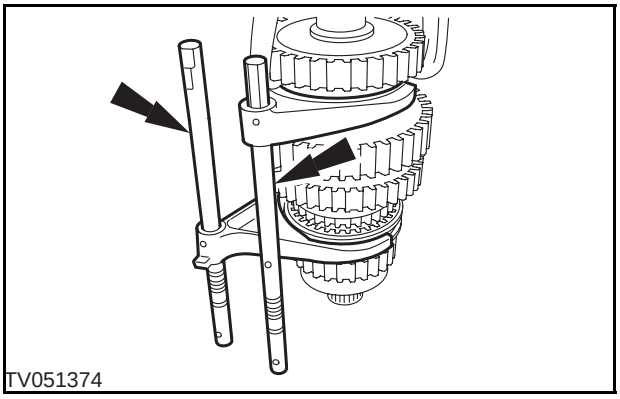
Disassembly

⚠ Warning:
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

1. Using the special tool **CA715496 — B and C shaft hooks** , remove the primary shaft B and the secondary shaft C from the transmission, complete with gear selector forks.

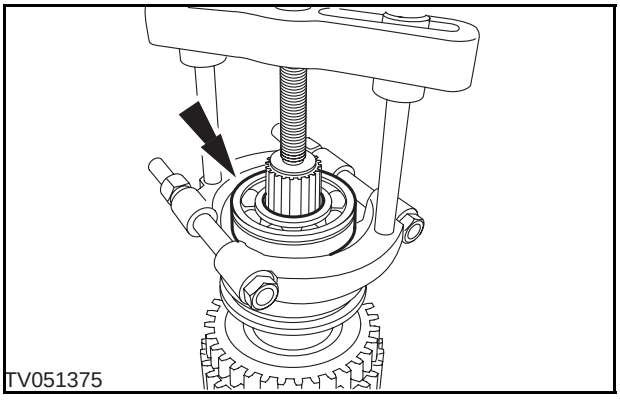


2. Remove the gear selector forks.

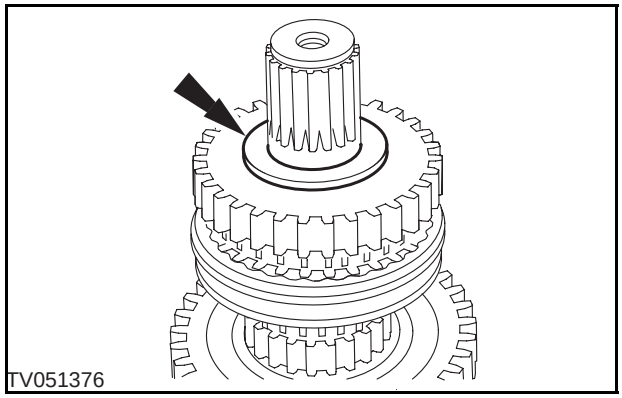


Note:
- Using a vice fitted with soft jaws.

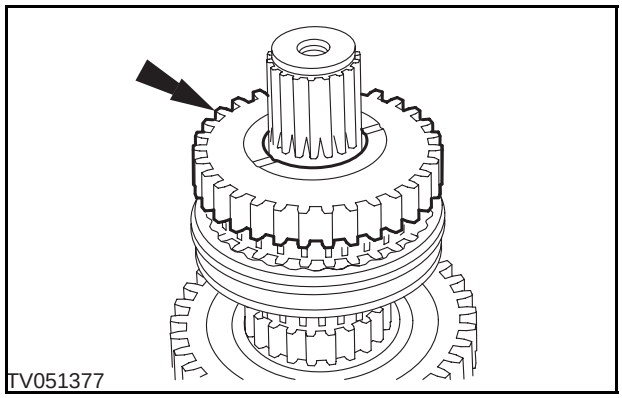
3. Secure the shaft.
4. Using a suitable puller, remove the secondary shaft bearing.



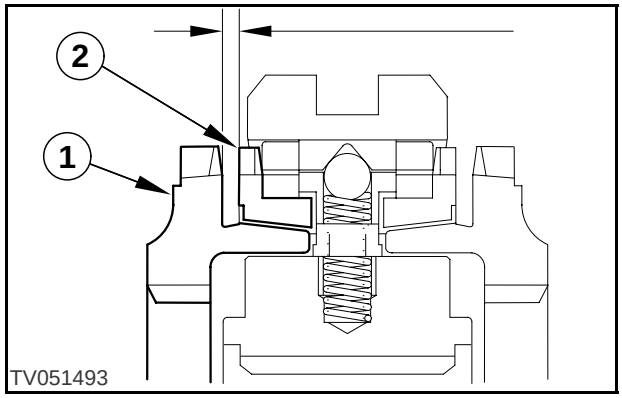
5. Remove the thrust washer.



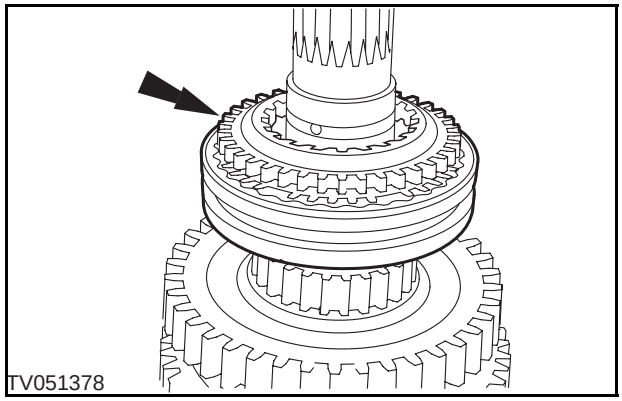
6. Remove the third speed gear.



7. Assess the serviceability of the synchroniser. Using a suitable feeler gauge, measure the clearance between the clutch ring (1) and the tapered friction ring (2). The clearance with used parts in good condition should be approximately 1.0mm. If the clearance is 0.5mm or less, a new synchroniser assembly must be installed.

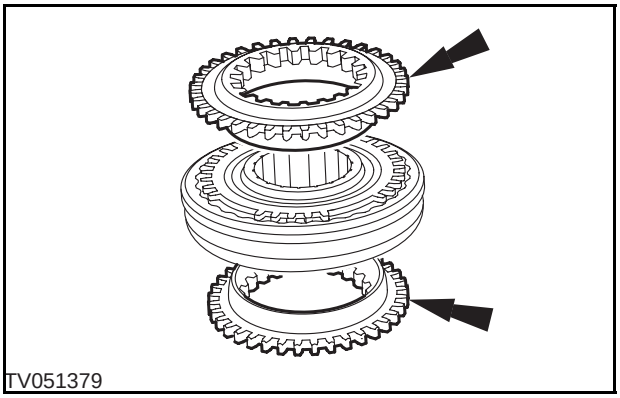


8. Remove the third/fourth speed synchroniser assembly.

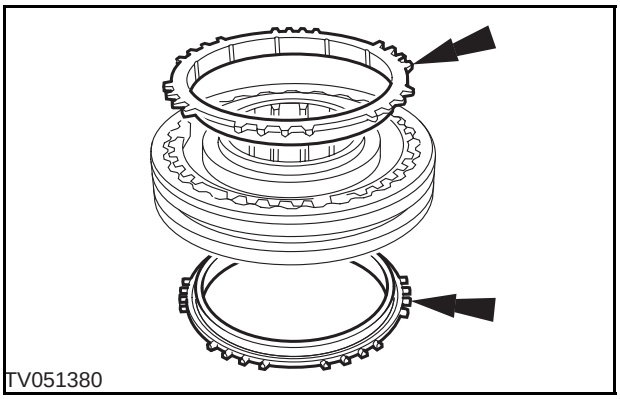


Note:
- There are no serviceable parts within the synchroniser assembly. Disassembly of the synchroniser should only be carried out for inspection purposes.

9. Remove the clutch rings from each side of the synchroniser assembly.


TV051379

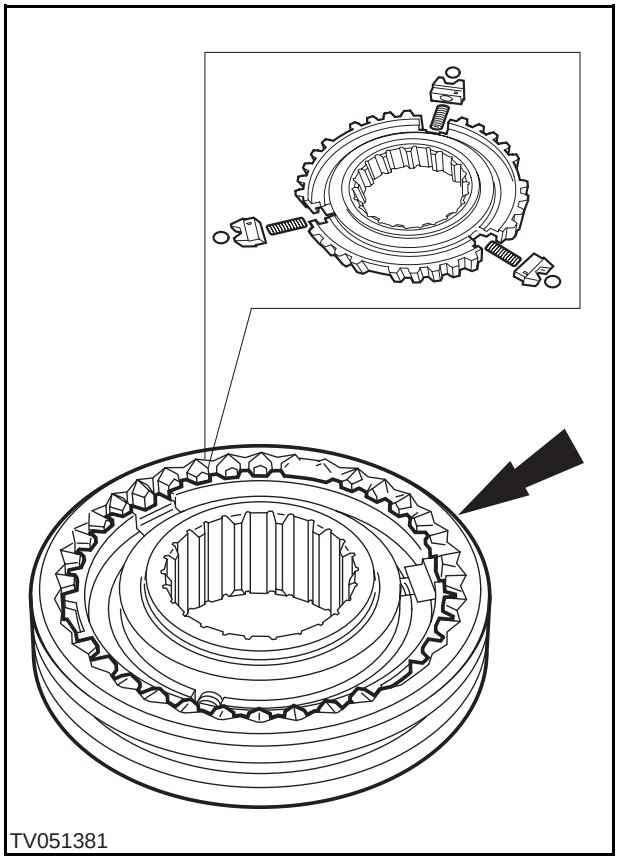
10. Remove the tapered friction rings from each side of the synchroniser assembly.


TV051380

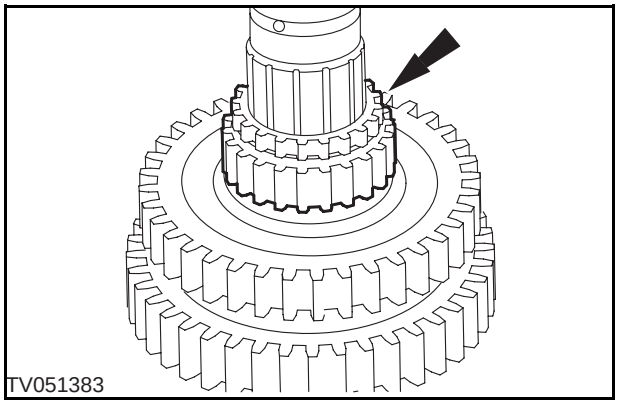
⚠ **Caution:**

- **When the sleeve is removed from the synchroniser hub the springs, plates and detent balls will be released under pressure. Make sure the parts are not lost.**

11. Remove the sleeve from the synchroniser hub assembly.


TV051381

12. Remove the fourth speed gear.

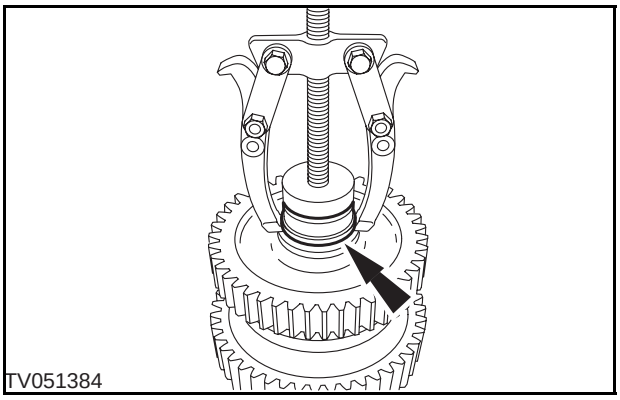

TV051383

13. Turn the shaft over so that the 2nd gear end is uppermost.

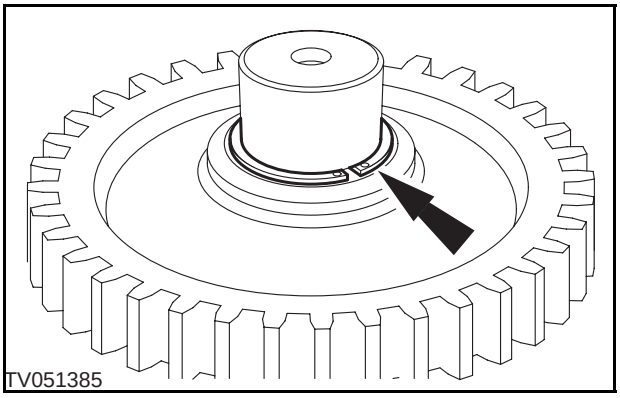
⚠ **Caution:**

- **Do not try to remove the bearing and gear together as there is a snap ring between them. Failure to follow this instruction may result in damage to the transmission.**

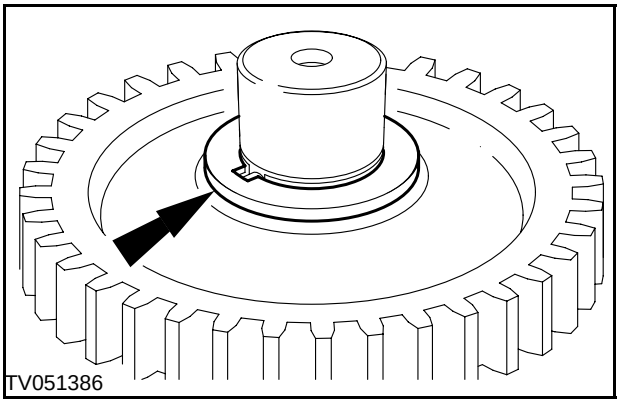
14. Using a suitable puller, remove the bearing inner race.



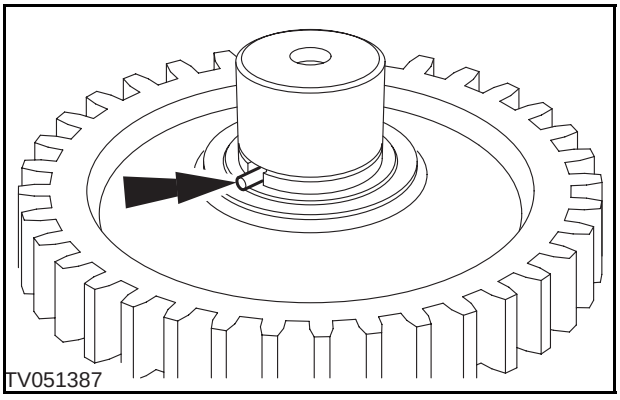
15. Using suitable circlip pliers, remove the circlip.



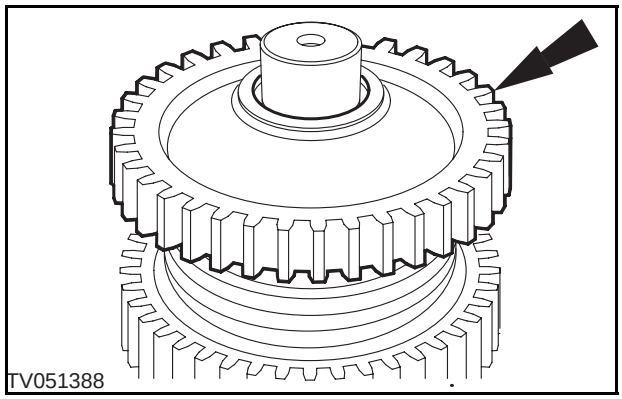
16. Remove the spacer and shims.



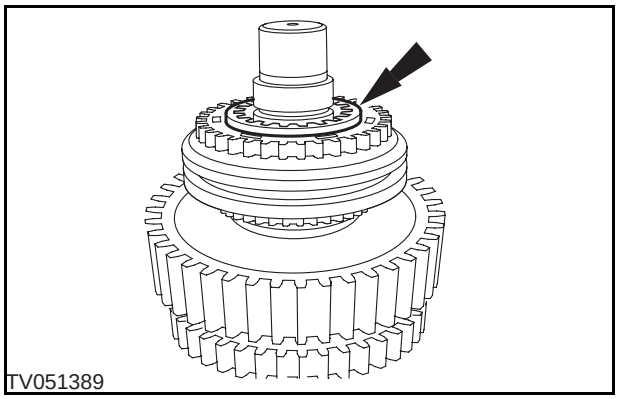
17. Remove the roll pin.



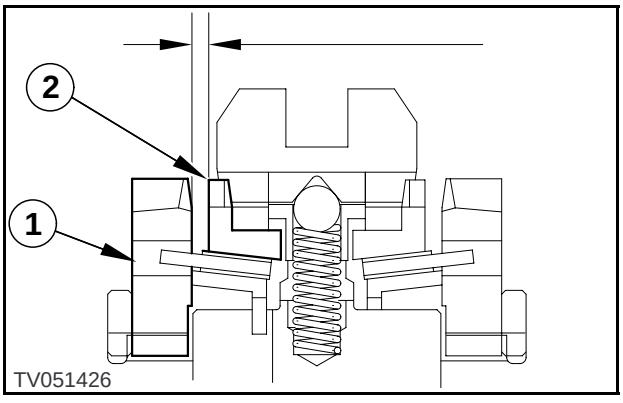
18. Remove the second speed gear.



19. Remove the spacer.



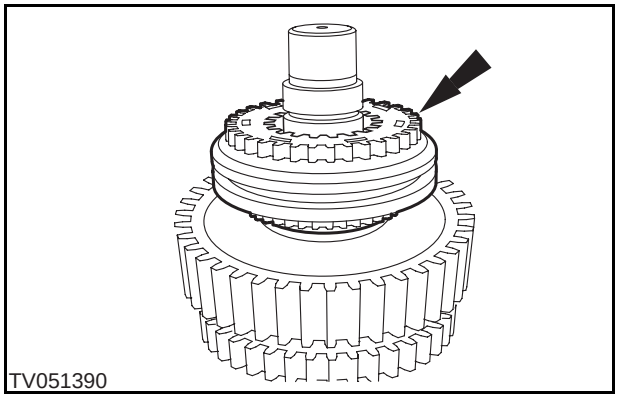
20. Check the serviceability of the synchroniser assembly.
    Using a suitable feeler gauge, measure the clearance between the synchroniser ring (1) and the friction ring (2). The clearance with used parts in good condition should be approximately 1.0mm. If the clearance is 0.5mm or less, a new synchroniser assembly must be installed.



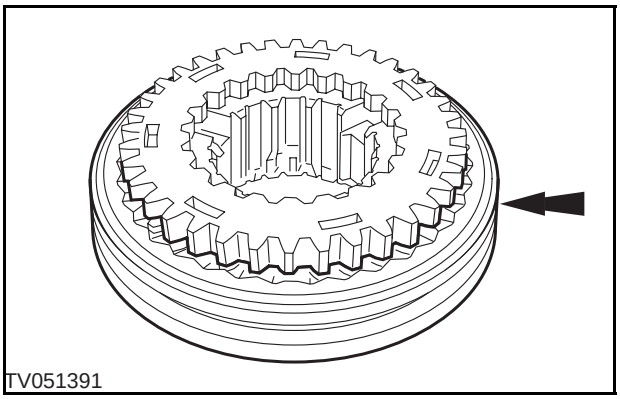
21. Turn the synchroniser over.
22. Repeat step 19 for the other side of the synchroniser assembly.

Note:
- There are no serviceable parts within the synchroniser assembly. Further disassembly should only be carried out for inspection purposes.

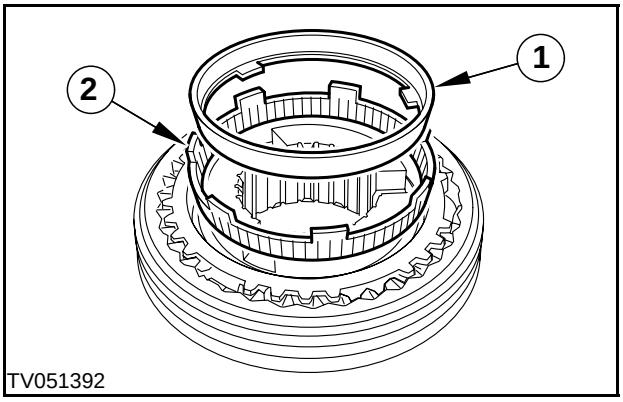
23. Remove the first/second speed synchroniser assembly.


TV051390

24. Remove the synchroniser ring.

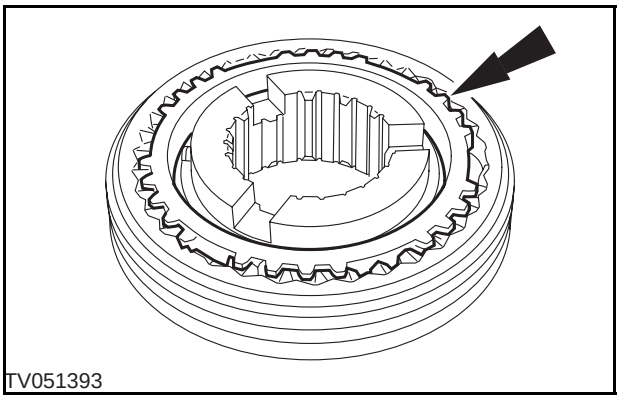

TV051391

25. Remove the steel ring (1) and the sintered ring (2).

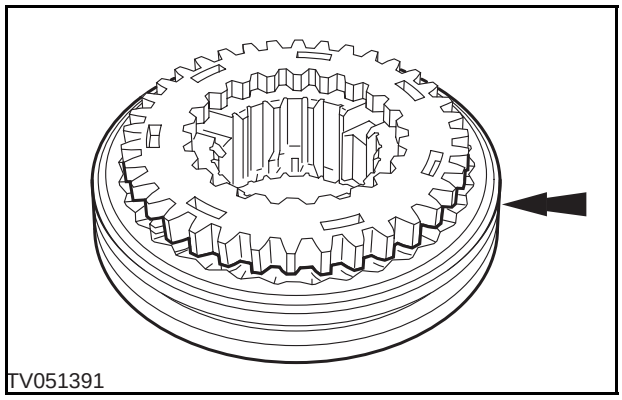


TV051392

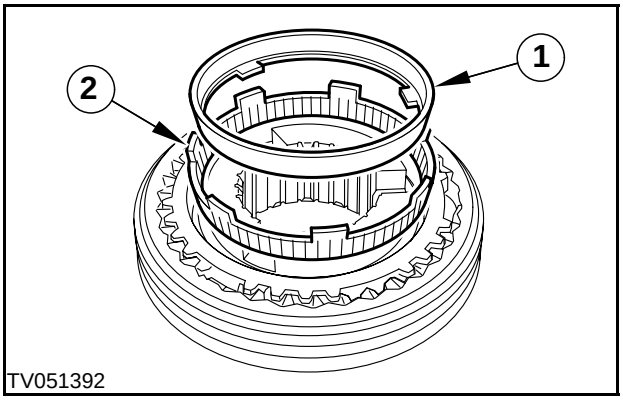
26. Remove the tapered friction ring.


TV051393

27. Turn the synchroniser assembly over.
28. Remove the synchroniser ring.

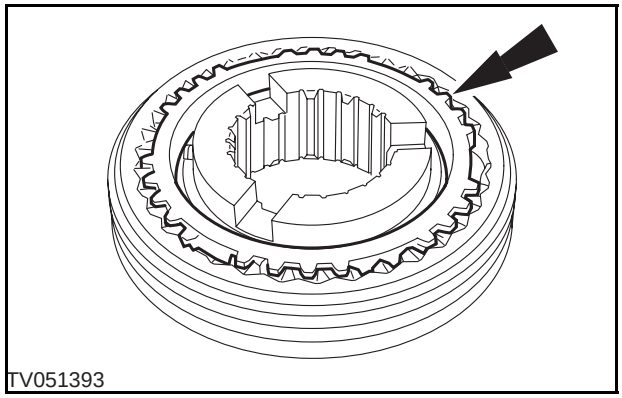

TV051391

29. Remove the steel ring (1) and the sintered ring (2).



TV051392

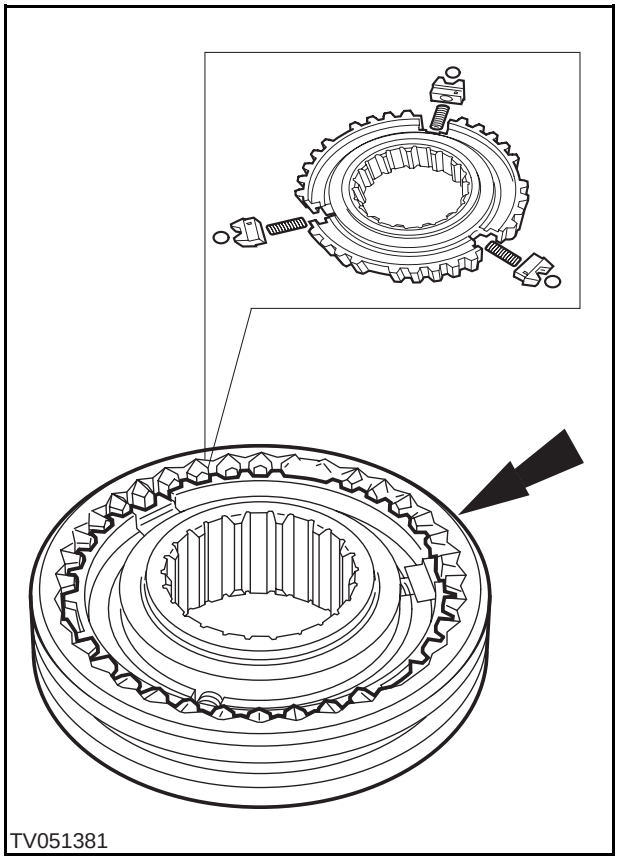
30. Remove the tapered friction ring.


TV051393

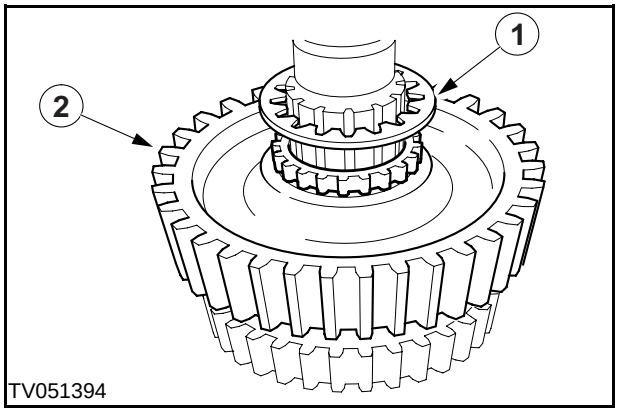
⚠ **Caution:**

- **When the sleeve is removed from the synchroniser hub the springs, plates and detent balls will be released under pressure. Make sure the parts are not lost.**

31. Remove the sleeve from the synchroniser hub assembly.

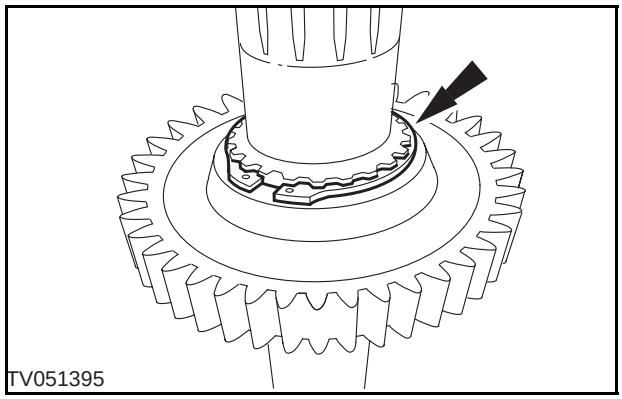

TV051381

32. Remove the spacer (1) and the first speed gear (2).

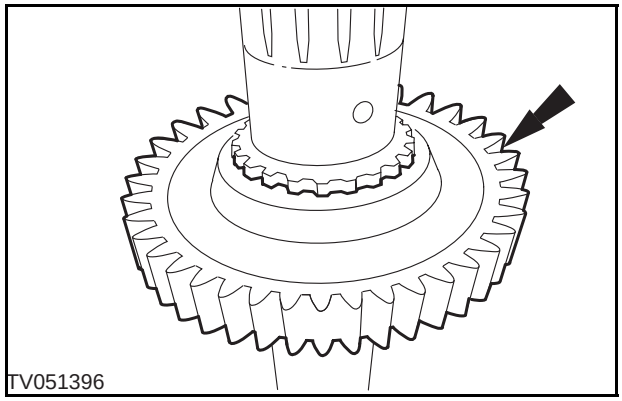


TV051394

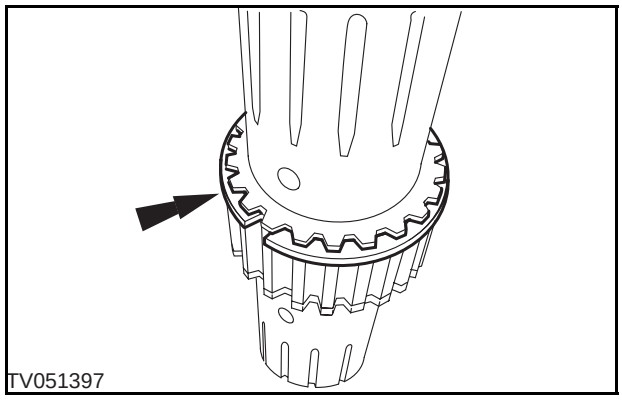
33. Using suitable circlip pliers, remove the circlip.


TV051395

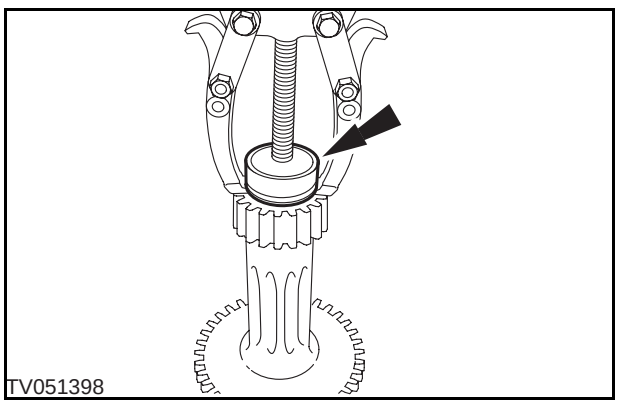
34. Remove the 4WD gear.


TV051396

35. Turn the shaft over and secure in the vice.
36. Using suitable snap ring pliers, remove the snap ring.

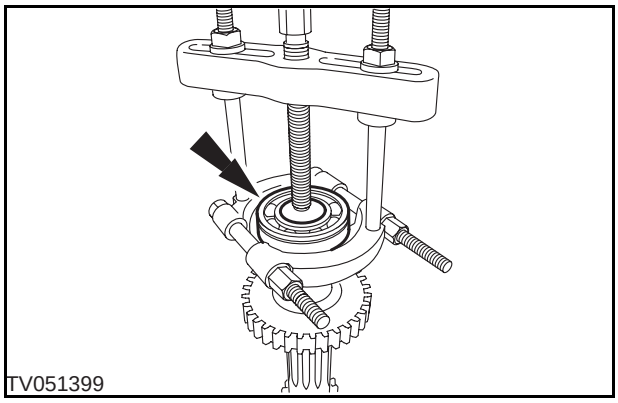

TV051397

37. Secure the secondary shaft B in a soft jawed vice.
38. Using a suitable puller, remove the bearing inner race.


TV051398

39. Turn the shaft over and secure in the vice.

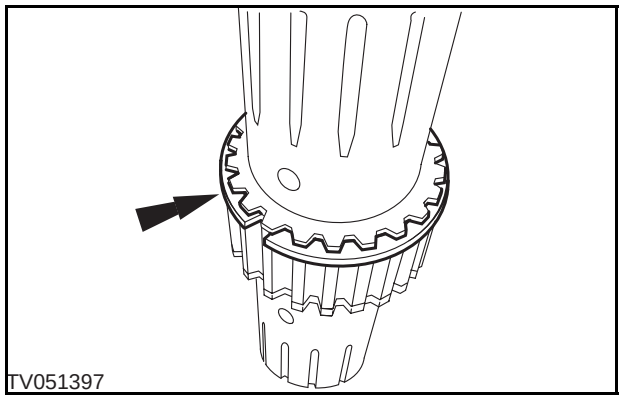
40. Using a suitable puller, remove the bearing.


TV051399

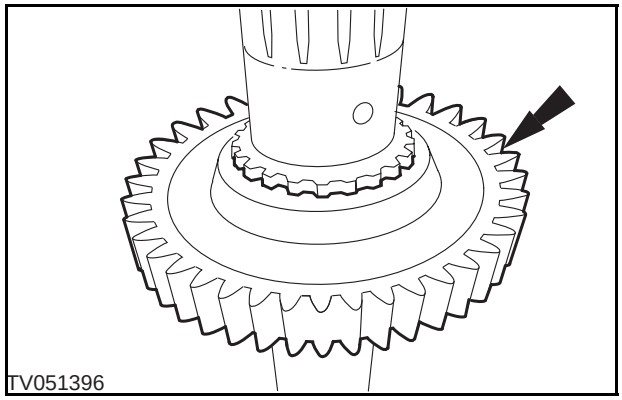
Assembly

Note:
- Using a vice fitted with soft jaws.

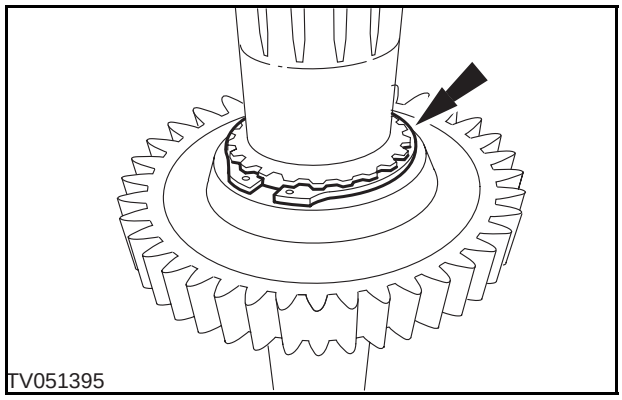
1. Secure the secondary shaft.
2. Using suitable snap ring pliers, install the snap ring.


TV051397

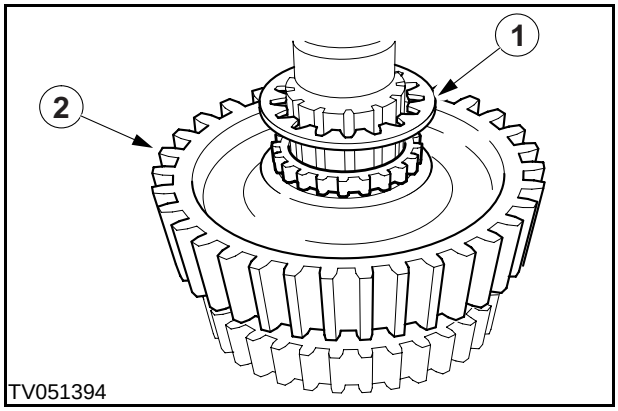
3. Turn the shaft over and secure in a soft jawed vice.
4. Install the 4WD gear.


TV051396

5. Using suitable circlip pliers, install the circlip.

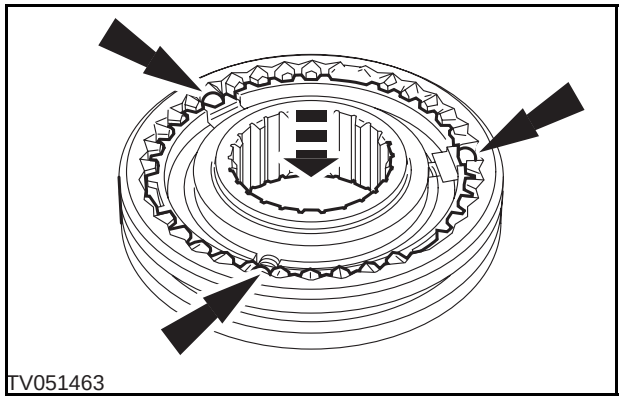

TV051395

6. Install the first speed gear (2) and the spacer (1).



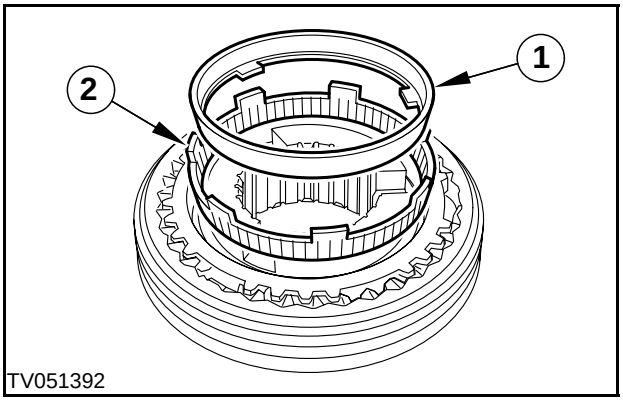
TV051394

7. Assemble the first/second speed synchroniser.
   - Install the springs in the hub, and the plates on the springs. The plates are not yet pushed down into the sleeve and are holding the hub out of the sleeve. The balls are loose in the recess of the plates.
   - Using a suitable punch or screwdriver, push the balls onto the flat plates and to push the plates down so that the balls are on the flat faces of the teeth, but not into the detent grooves. When all the balls are in position push the hub and the plates down until the balls move into the detent holes.


TV051463

Note:
- Lubricate with clean transmission oil.

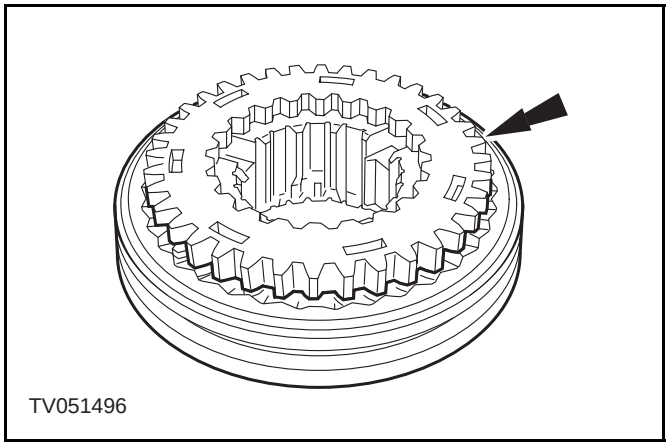
8. Install the sintered ring (2) and the steel ring (1).



TV051392

Note:
- Make sure the flat side of the synchroniser ring is facing upwards. Failure to follow this instruction may result in damage to the transmission.

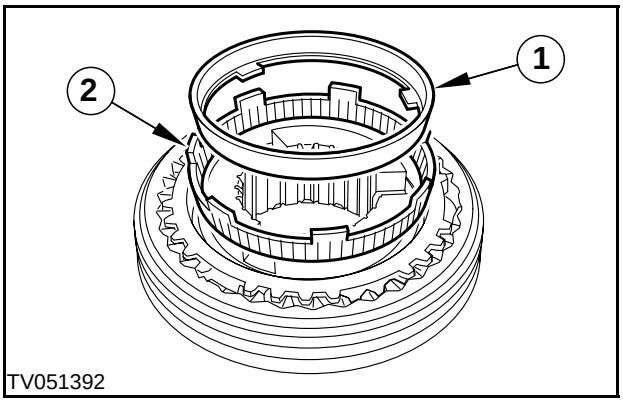
9. Install the synchroniser ring.


TV051496

10. Turn the synchroniser assembly over in the vice.

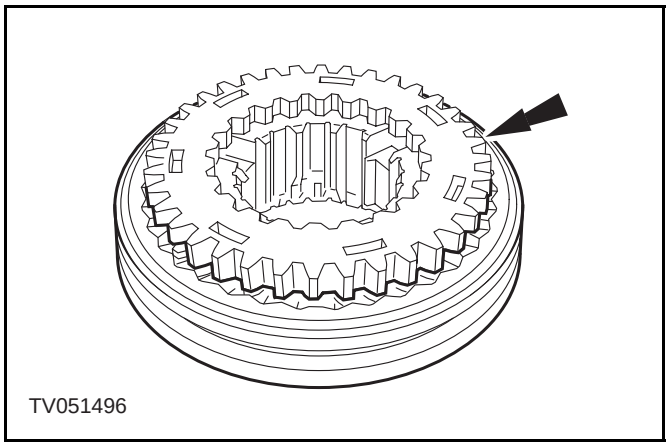
Note:
- Lubricate with clean transmission oil.

11. Install the sintered ring (2) and the steel ring (1).

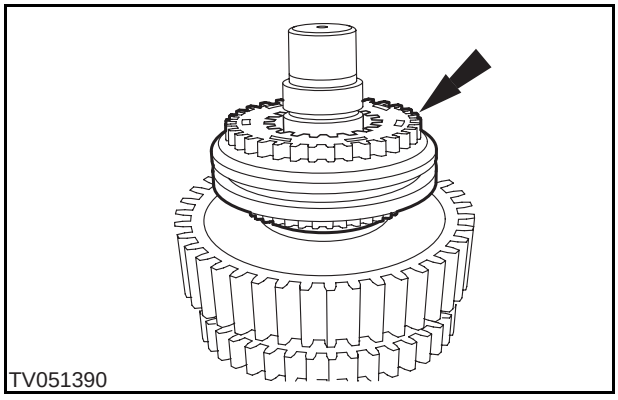


Note:
- Make sure the flat side of the synchroniser ring is facing upwards. Failure to follow this instruction may result in damage to the transmission.

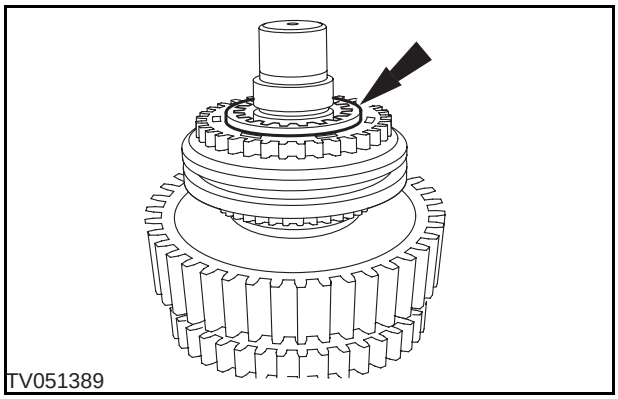
12. Install the synchroniser ring onto the synchroniser assembly.



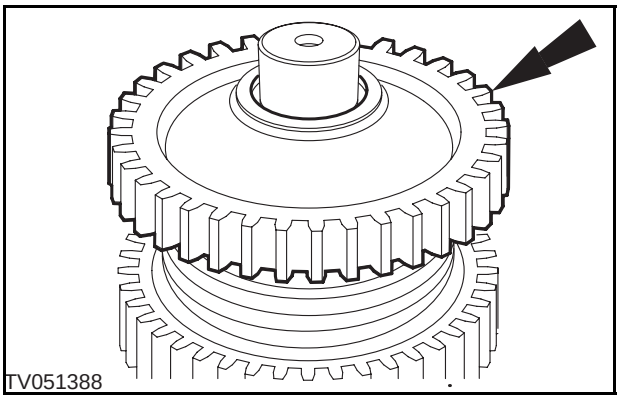
13. Install the first/second speed synchroniser assembly.



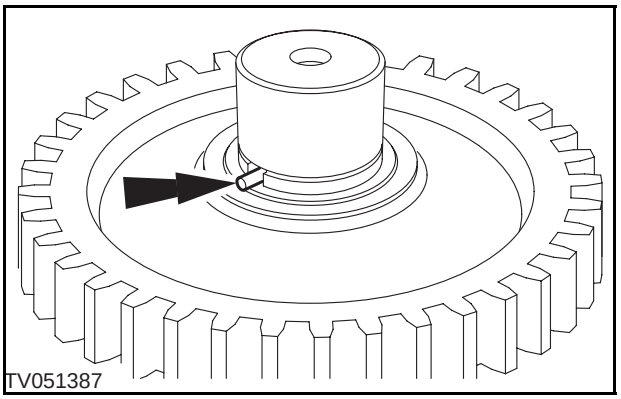
14. Install the spacer.


TV051389

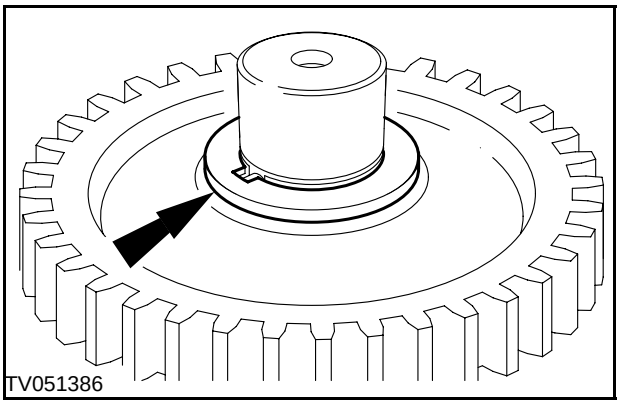
15. Install the second speed gear.


TV051388

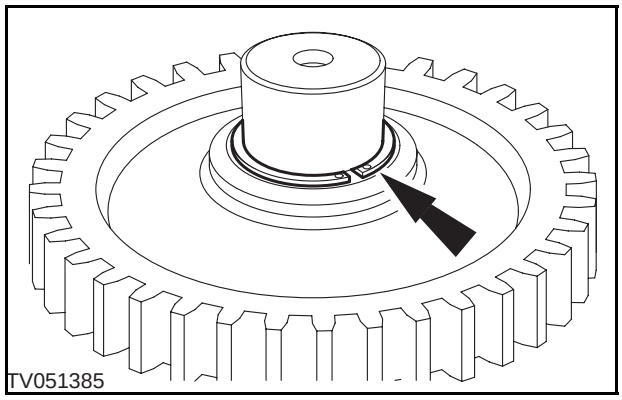
16. Install the roll pin.


TV051387

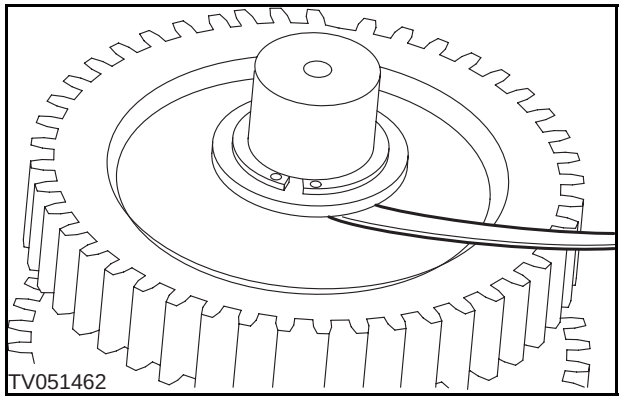
17. Install the shims and spacer.


TV051386

18. Using suitable snap ring pliers, install the snap ring.



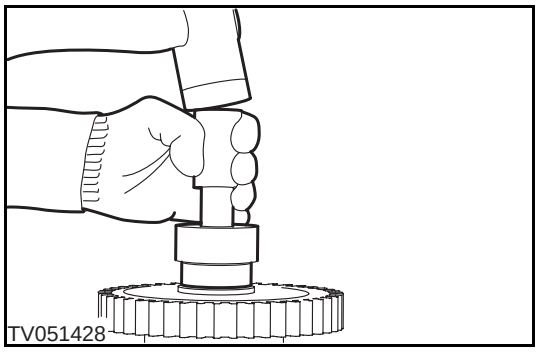
19. Using suitable feeler gauges, measure the backlash between the lower shim and the gear: the value must be between 0.2 to 0.42 MM



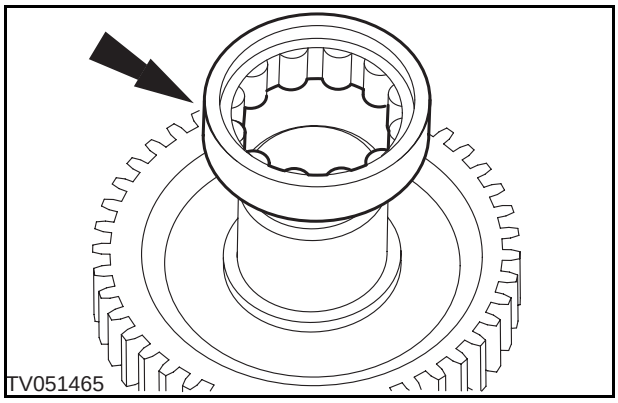
20. If the backlash is more than the value prescribed, remove the snap ring and the washer, using the shims in the chart to reach the prescribed value.

Shims Range				
Specs./Thick. MM	0.05	0.1	0.3	0.5

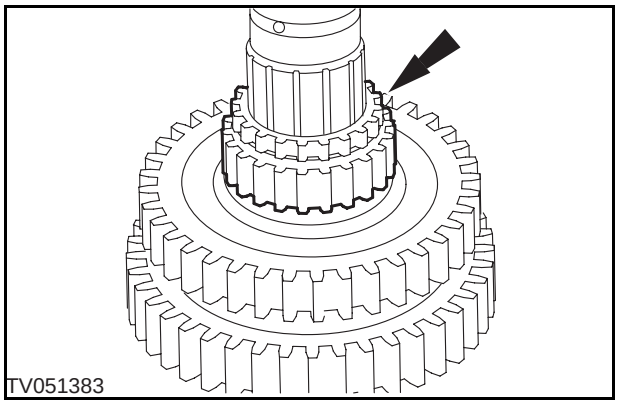
21. Using a suitable bearing heater, heat the inner race of the bearing to 80 to 100°C.
22. Using special tool **CA71549 — Driver** , install the inner race of the bearing.



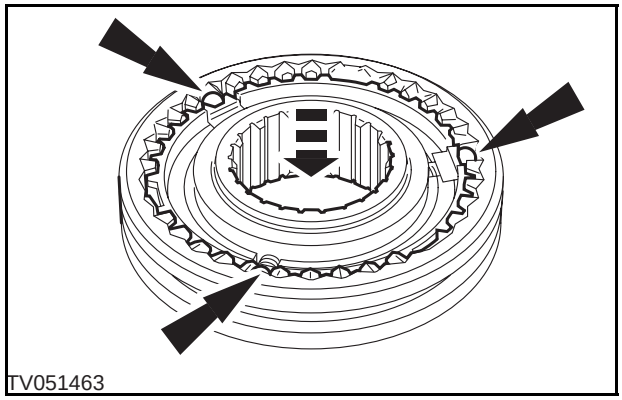
23. Install the bearing outer race.


TV051465

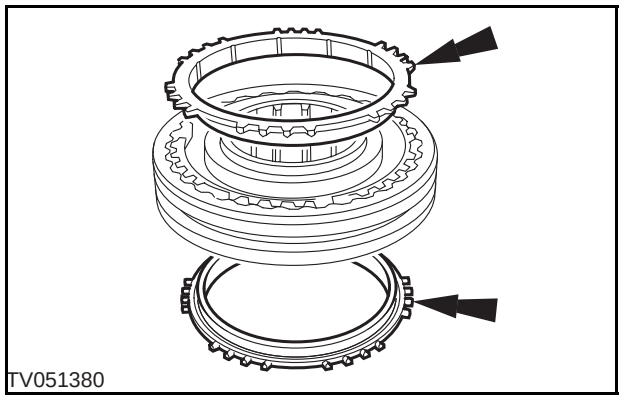
24. Turn the shaft over in the vice.
25. Install the fourth speed gear.


TV051383

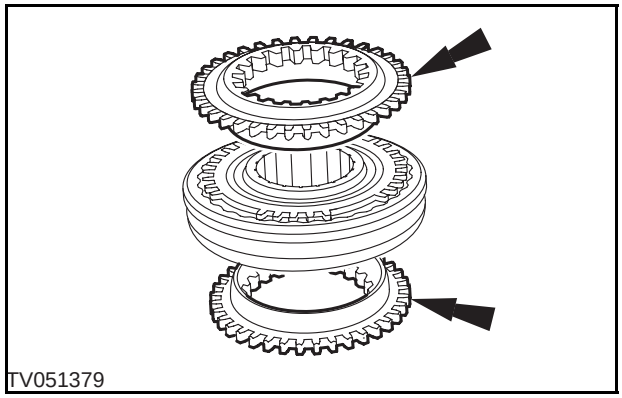
26. Assemble the third/fourth speed synchroniser.
    - Install the springs in the hub, and the plates on the springs. The plates are not yet pushed down into the sleeve and are holding the hub out of the sleeve. The balls are loose in the recess of the plates.
    - Using a suitable punch or screwdriver, push the balls onto the flat plates and to push the plates down so that the balls are on the flat faces of the teeth, but not into the detent grooves. When all the balls are in position push the hub and the plates down until the balls move into the detent holes.


TV051463

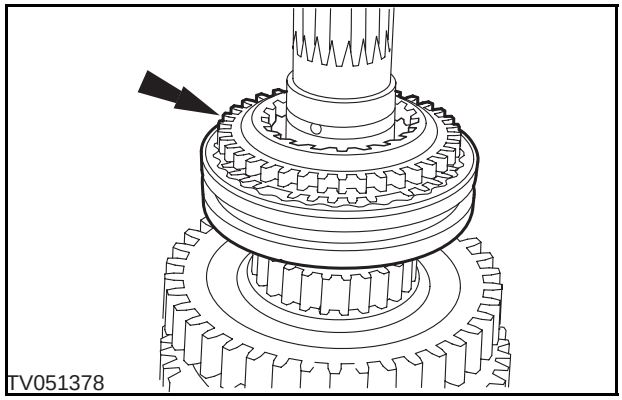
27. Install the tapered friction rings to each side of the synchroniser assembly.


TV051380

28. Install the clutch rings to each side of the synchroniser assembly.

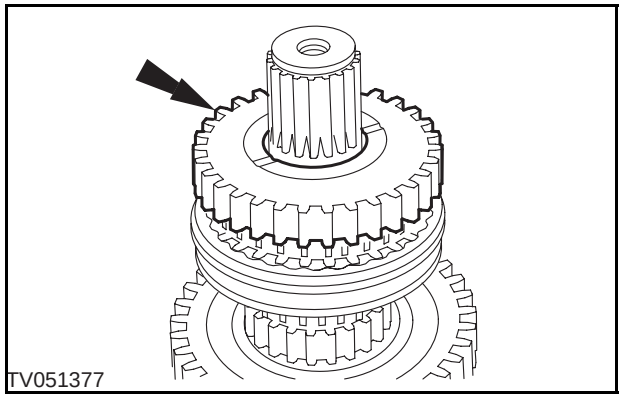

TV051379

29. Install the third/fourth speed synchroniser on to the shaft.


TV051378

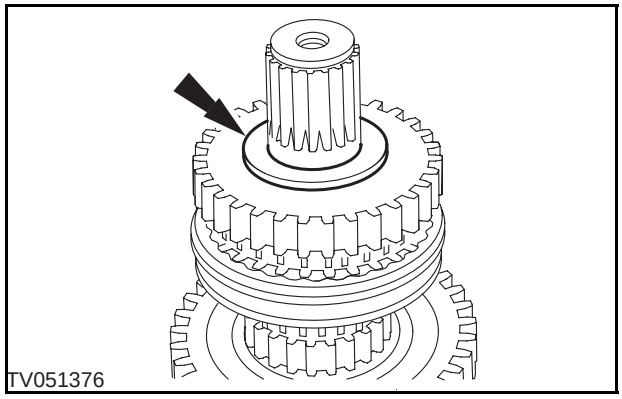
Note:
- Lubricate with clean transmission oil.

30. Install the third speed gear.

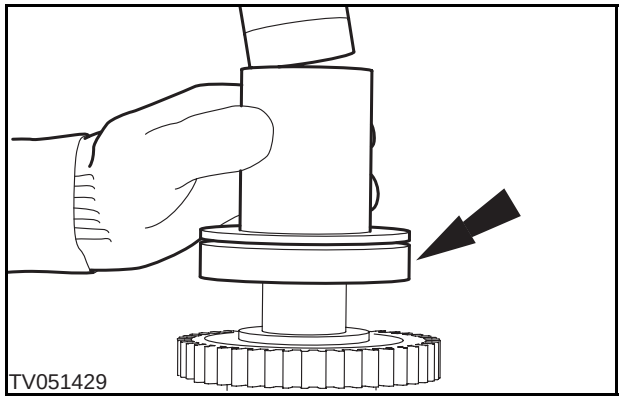

TV051377

Note:
- Lubricate with clean transmission oil.

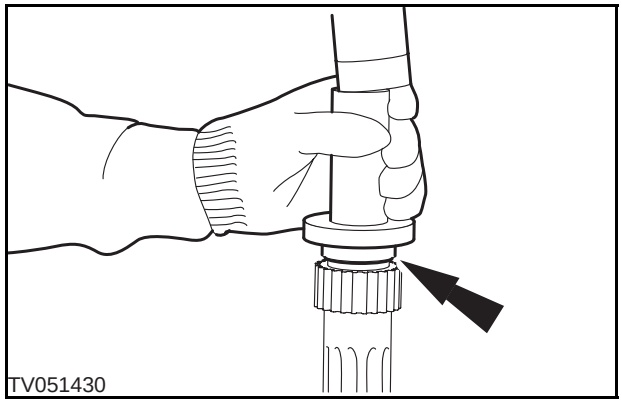
31. Install the thrust washer.


TV051376

32. Using a suitable bearing heater, heat the bearing to 80 to 100°C.
33. Install the bearing.

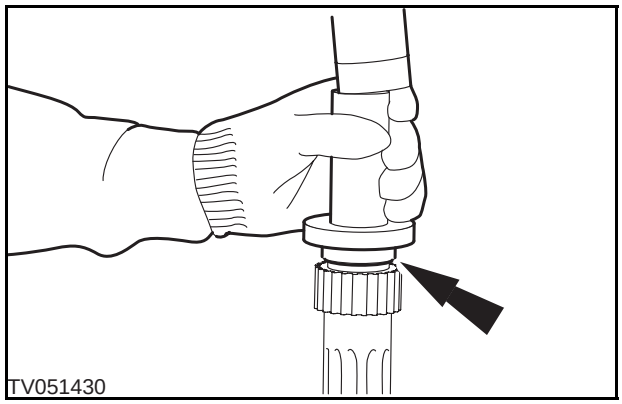

TV051429

34. Using a suitable bearing heater, heat the bearing inner race to 80 to 100°C.
35. Secure the primary shaft in a soft jawed vice with 3rd gear uppermost.
36. Using the special tool **CA715149 — Driver** , install the bearing inner race.

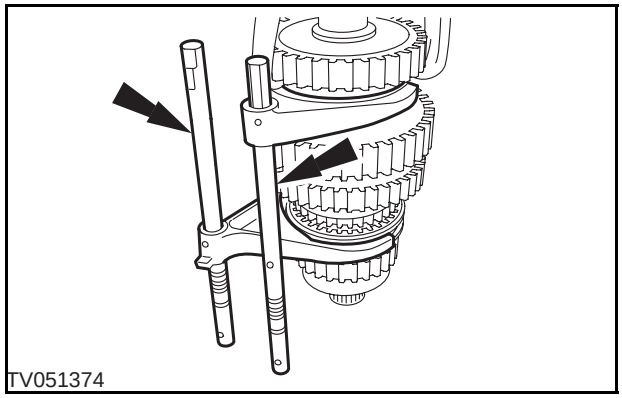

TV051430

37. Turn the primary shaft over in the vice.
38. Using a suitable bearing heater, heat the bearing inner race to 80 to 100°C.

39. Using the special tool **CA715004 — Driver** , install the bearing.

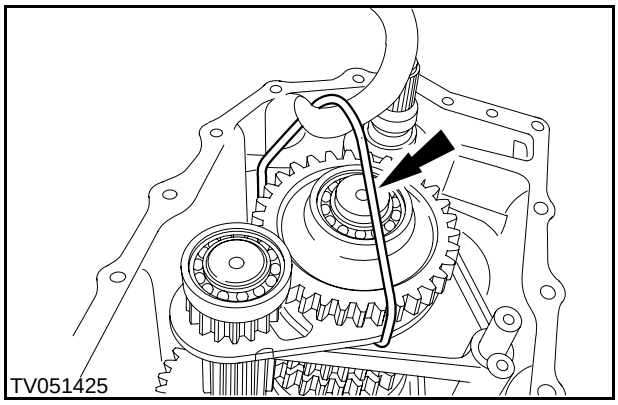

TV051430

40. Install the gear selector forks.


TV051374

⚠ **Warning:**
- **This component is very heavy. Make sure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

41. Using the special tool **CA715496 — B and C shafts hook** , install the primary shaft B and the secondary shaft C into the transmission housing complete with selector forks.

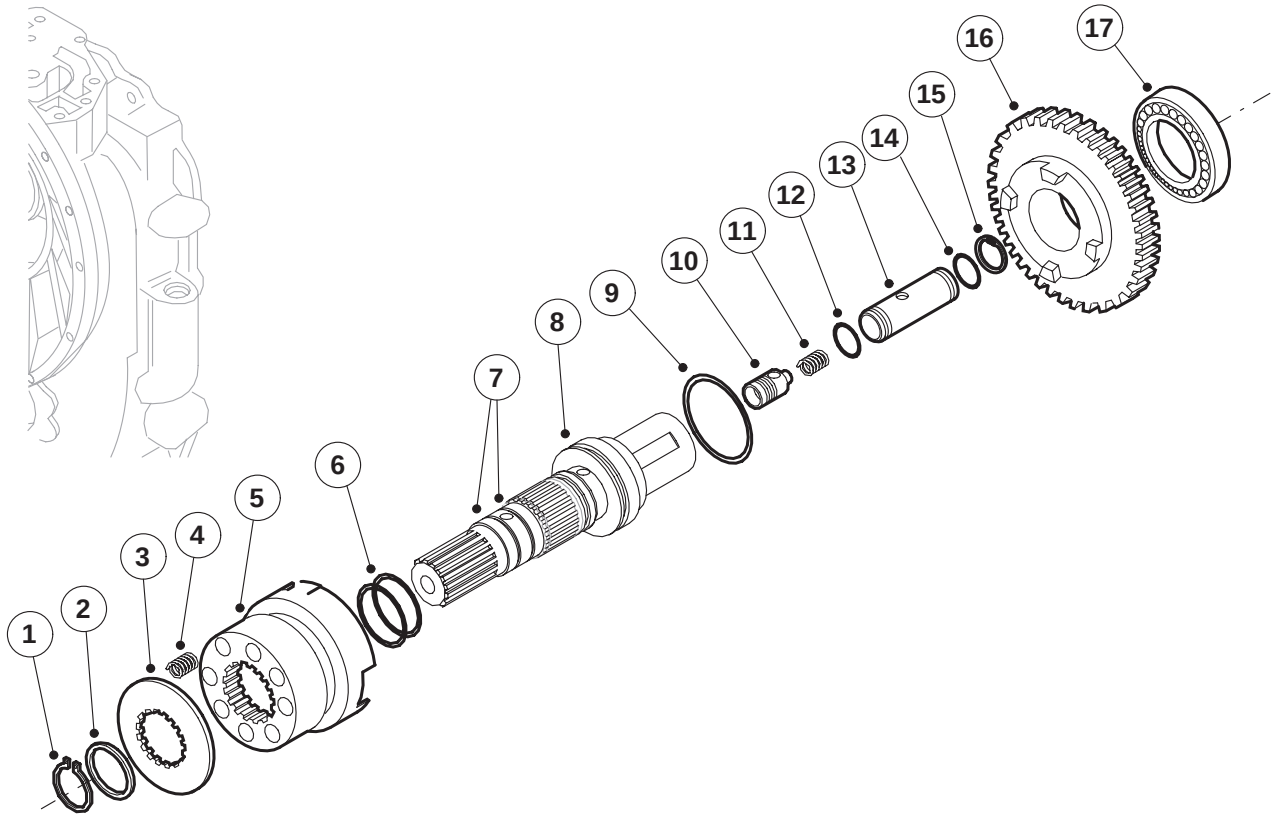

TV051425

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DISASSEMBLY AND ASSEMBLY — FOUR WHEEL DRIVE SHAFT (E)

BHN1306DJ

Operation: **Disassembly and Assembly — Four Wheel Drive Shaft (E)**	*Job Code:* **13 60 17 xx**		
None	Standard tools, Suitable puller		

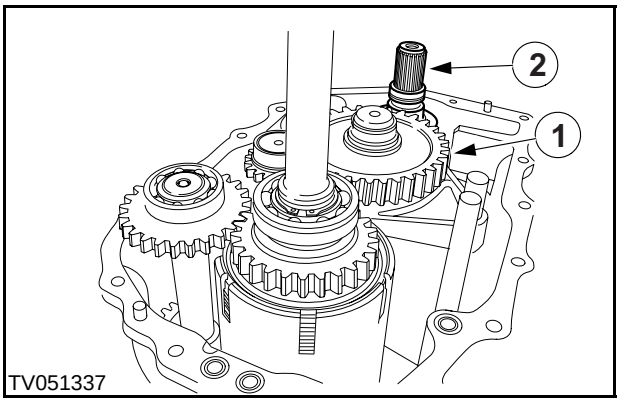


TV051417

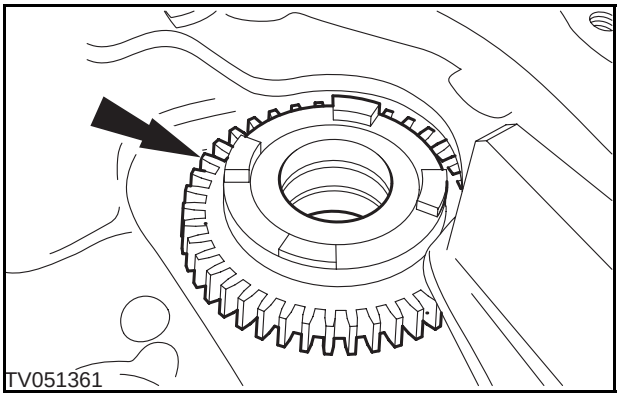
1	Circlip
2	Washer
3	Spring Retainer
4	Springs
5	Sleeve
6	O-ring Seals
7	Teflon Seals
8	Four Wheel Drive Shaft
9	O-ring Seal
10	Valve
11	Spring
12	O-ring Seal
13	Cylinder
14	O-ring Seal
15	Circlip
16	Four Wheel Drive Clutch Gear
17	Four Wheel Drive Shaft Bearing

Disassembly

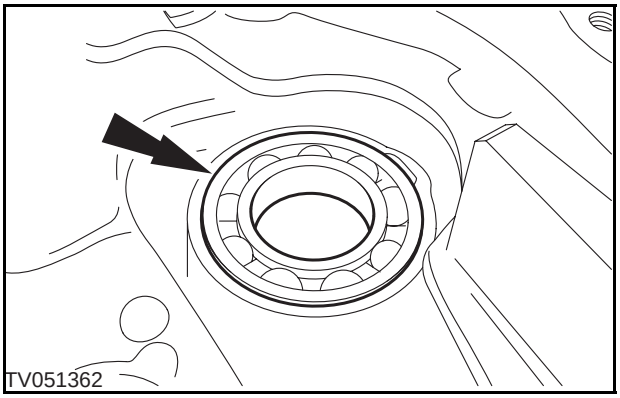
1. Remove the rear half of the transmission housing. For additional information, refer to TRANSMISSION HOUSING, PAGE N13–06–65 in this section.
2. Remove shaft C (1). For additional information refer, to SHAFTS B-C, PAGE N13–06–105 in this section.
3. Remove shaft E (2) from the transmission housing.



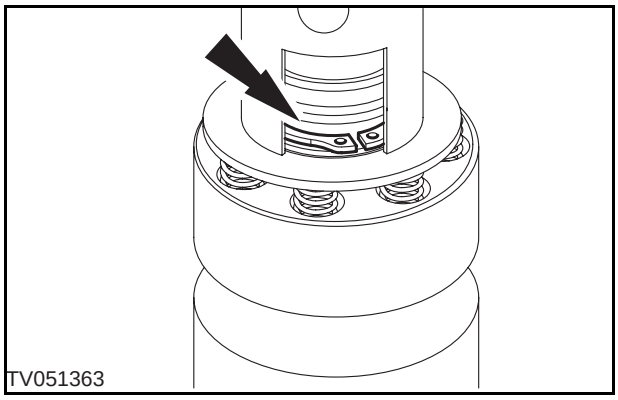
4. Remove the four wheel drive (4WD) clutch gear.



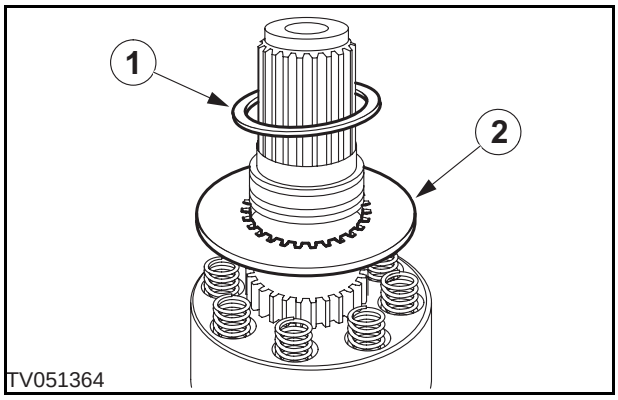
5. Remove the four wheel drive shaft bearing.



6. Using special tool **CA715493 – Compressor** , compress the springs and remove the snap ring.

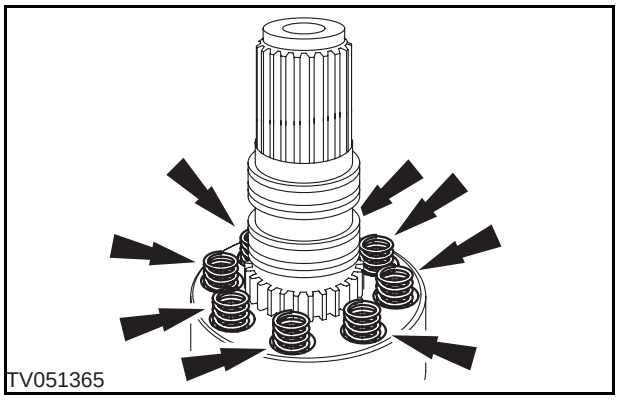

TV051363

7. Remove the washer (1) and spring retainer (2).

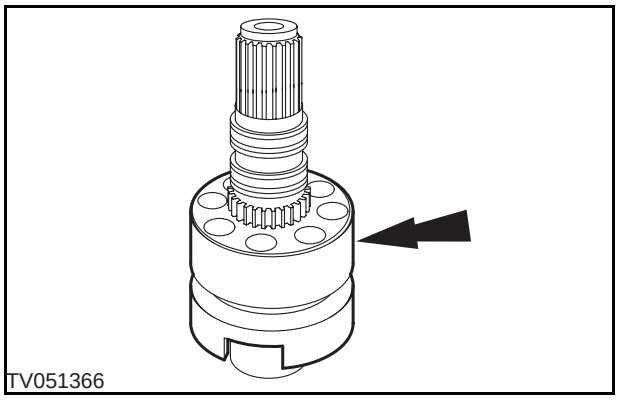


TV051364

8. Remove the springs.


TV051365

9. Remove the sleeve.

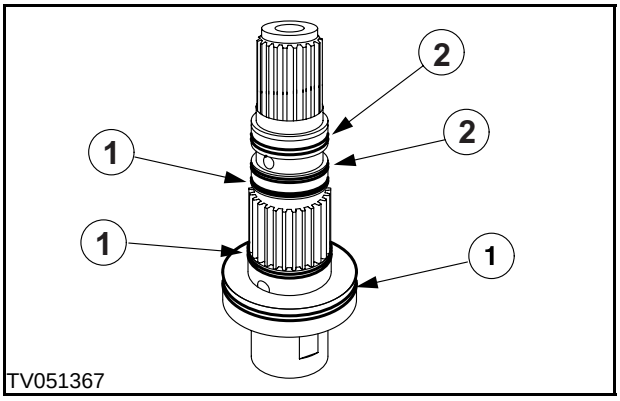

TV051366

10. Remove the O-ring seals (1).

Note:
- Discard the O-ring seals

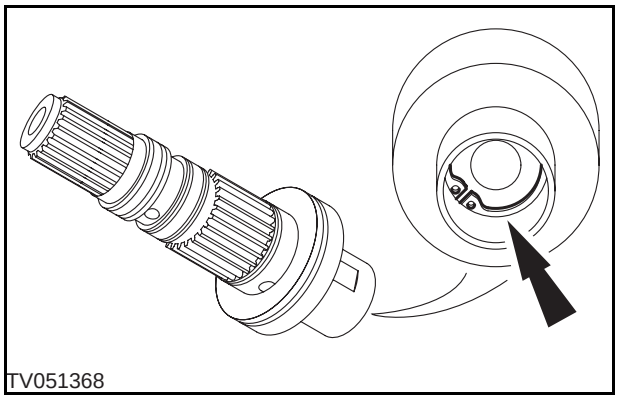
11. Remove the Teflon Seals (2).

Note:
- Discard the Teflon Seals.

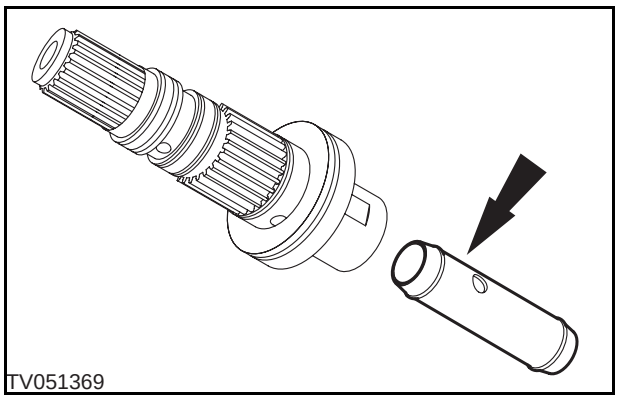


TV051367

12. Turn the shaft.
13. Using suitable circlip pliers, remove the circlip.

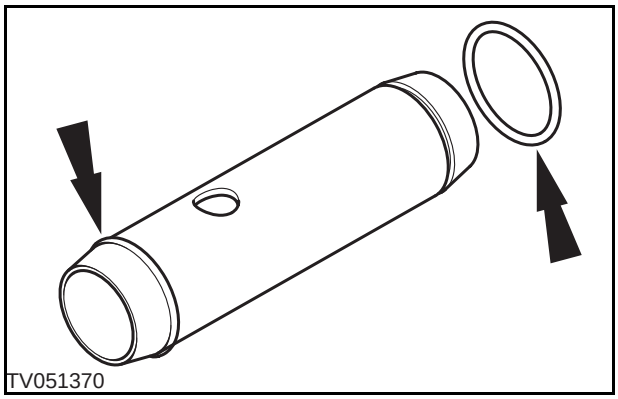

TV051368

14. Remove the cylinder.

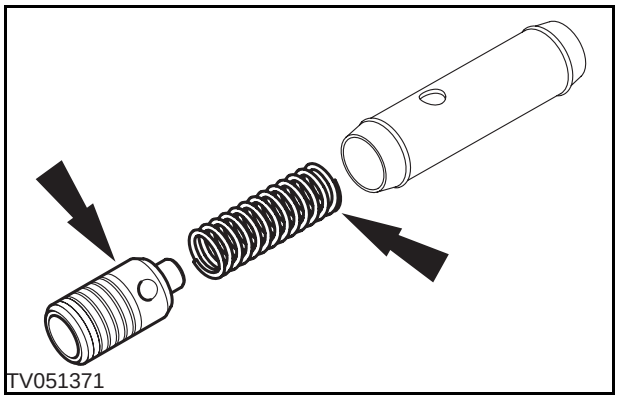

TV051369

15. Remove the O-ring seals from the cylinder.

Note:
- Discard the O-ring seals.

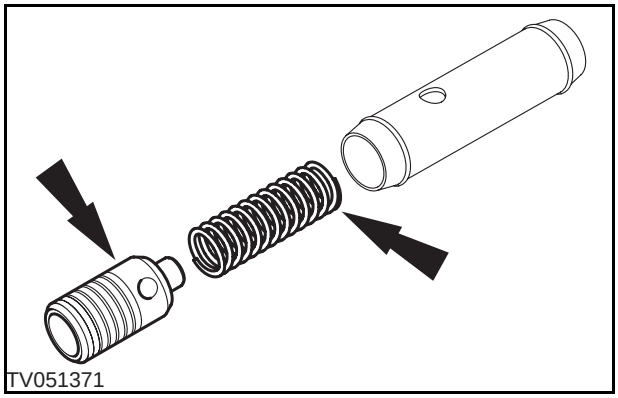

TV051370

16. Remove the valve and spring from the cylinder.


TV051371

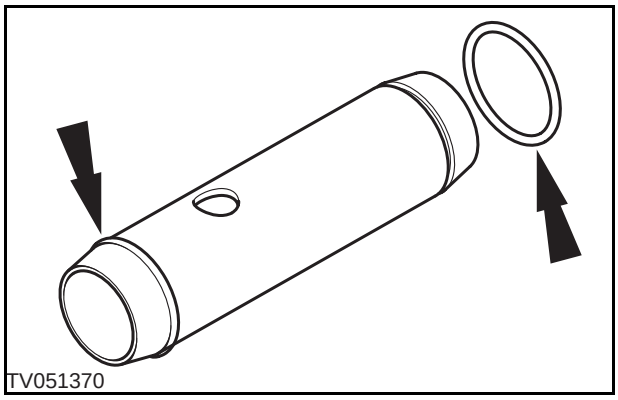
Assembly

1. Assemble the spring and valve into the cylinder.

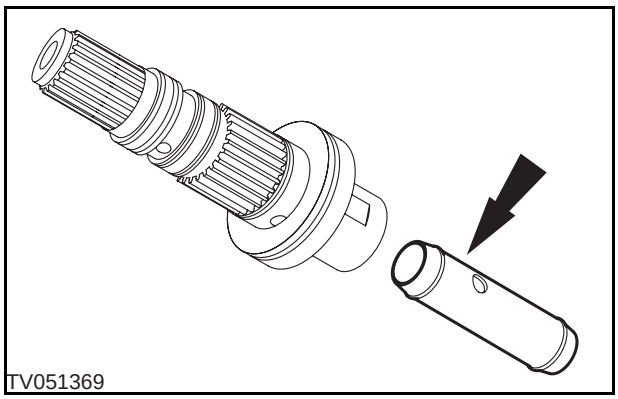

TV051371

Note:
- Use new O-ring seals.

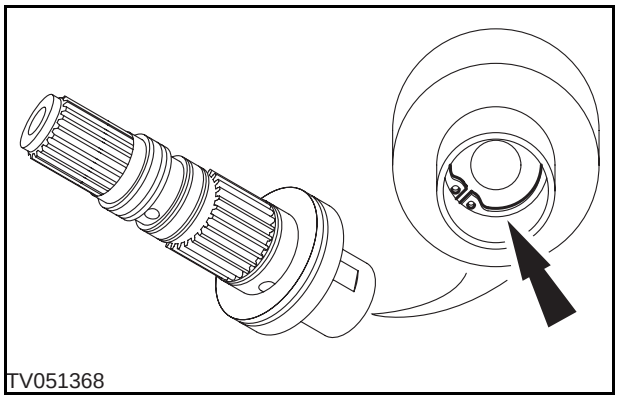
2. Install the O-ring seals onto the cylinder.


TV051370

3. Install the cylinder into the shaft.

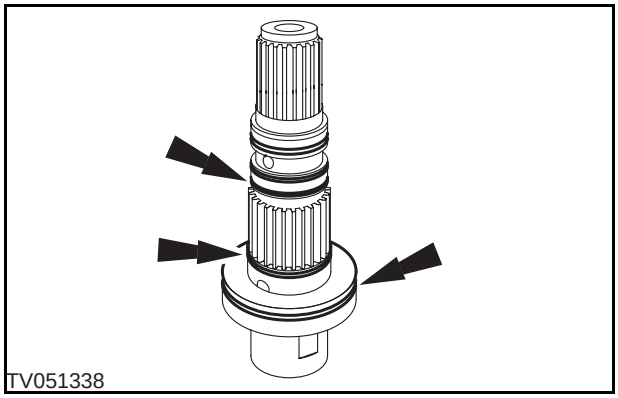

TV051369

4. Install the circlip.

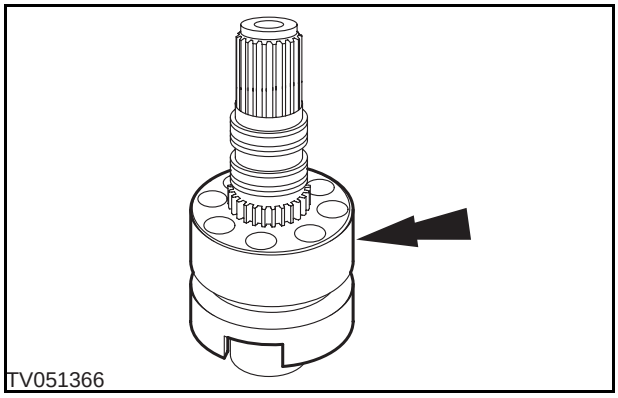

TV051368

Note:
- Use new O-ring seals.

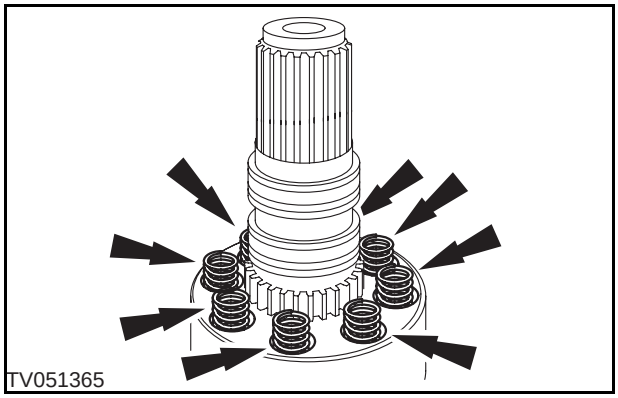
5. Install the O-ring seals onto the shaft.


TV051338

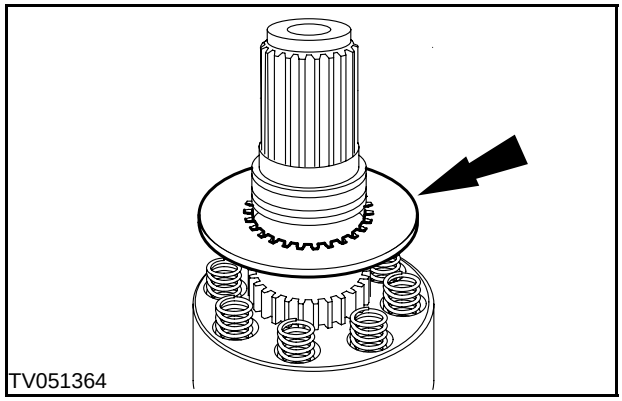
6. Install the sleeve onto the shaft.


TV051366

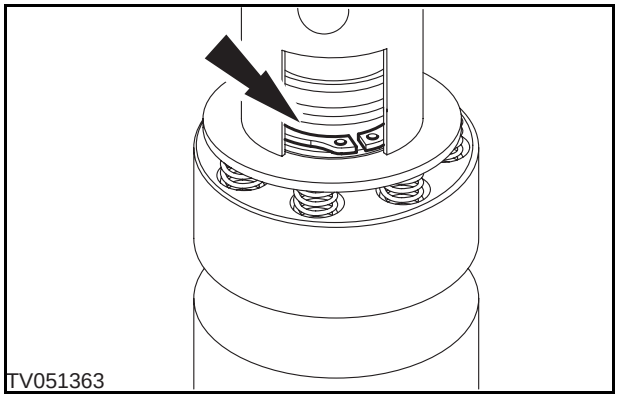
7. Install the springs into the holes in the sleeve.


TV051365

8. Install the spring retainer.


TV051364

9. Position the washer and the circlip on the shaft. Using special tool **CA715493 — Compressor** , compress the spring retainer until the circlip can be installed into the groove.

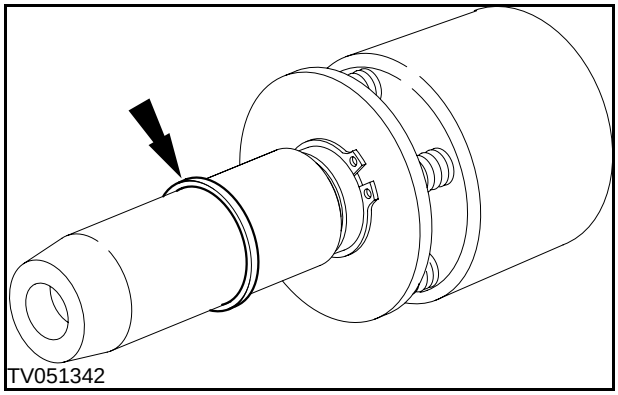

TV051363

Note:
- Use a new Teflon seal.

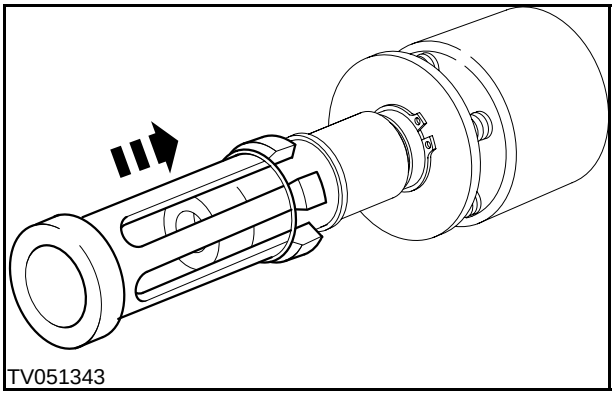
10. Install the inner of the two teflon seals onto the shaft.

⚠ Caution:
- **It is important that the teflon seal is fitted as described in the following steps. Failure to do so will result in premature failure of the seal and subsequent damage to the transmission. Take care not to damage the seal at any time during the installation procedure. If the seal is damaged a new seal must be fitted.**

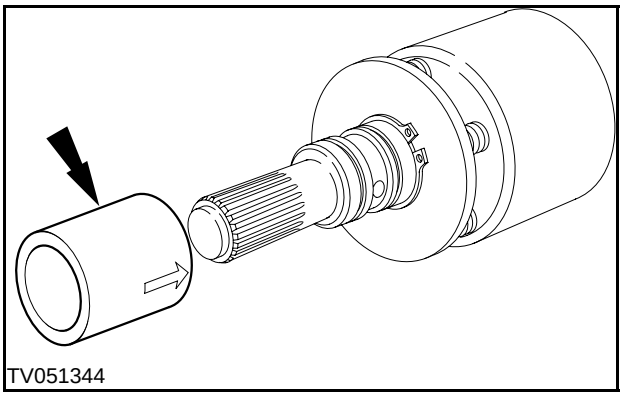
11. Place the special tool **CA715263 — Expander/protector** , onto the shaft. The expander/protector will stop in the correct position to install the Teflon sealing ring in the groove.
12. Heat the teflon seal to 60 – 80ºC (140 – 176ºF) and install it onto the expander/protector.


TV051342

13. Using the special tool **CA715497 — Pusher** , slide the sealing ring along until it drops into the groove in the shaft. Remove the special tools from the shaft.

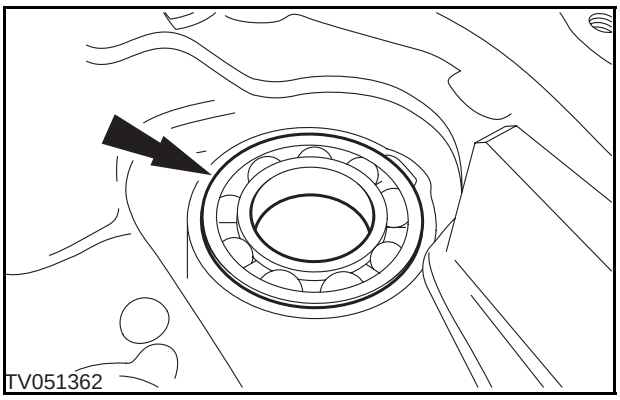

TV051343

14. Install the special tool **CA715356 – Gauger** , onto the shaft with the deep internal chamfer on the inside of the tool up against the seal. Using a twisting motion, push the tool backwards and forwards over the seal. This will ensure the seal is properly seated in the groove.
15. Turn the gauger around and slide the end with the narrow chamfer over the shaft and seal ring. Leave the seal compressor in place for 15 minutes until the sealing ring has cooled and is properly sized and seated in the groove. Remove the seal compressor.

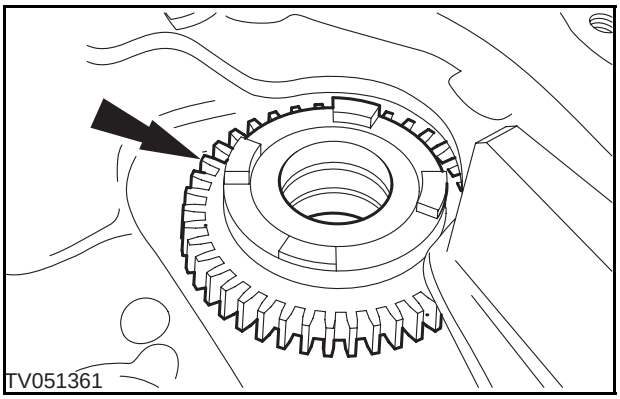

TV051344

Note:
- Use a new Teflon seal.

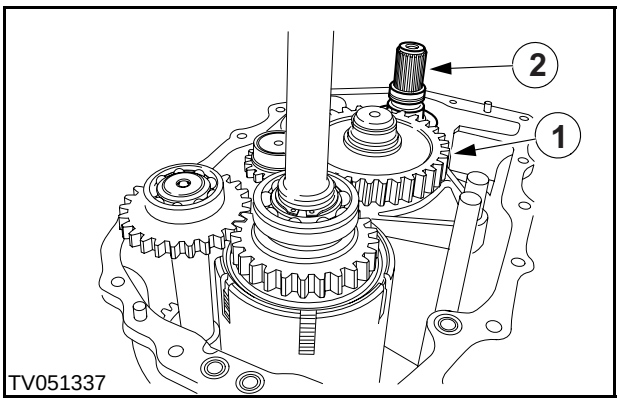
16. Using special tool **CA715257 — Expander/Protector** , fit the outer of the two teflon seals using the same method.
17. Install the four wheel drive shaft bearing.


TV051362

18. Install the four wheel drive clutch gear.



19. Lubricate the bearing housing in the transmission housing and Install shaft C (1). For additional information, refer toSHAFTS B-C, PAGE N13–06–105 in this section.
20. Install shaft E (2).

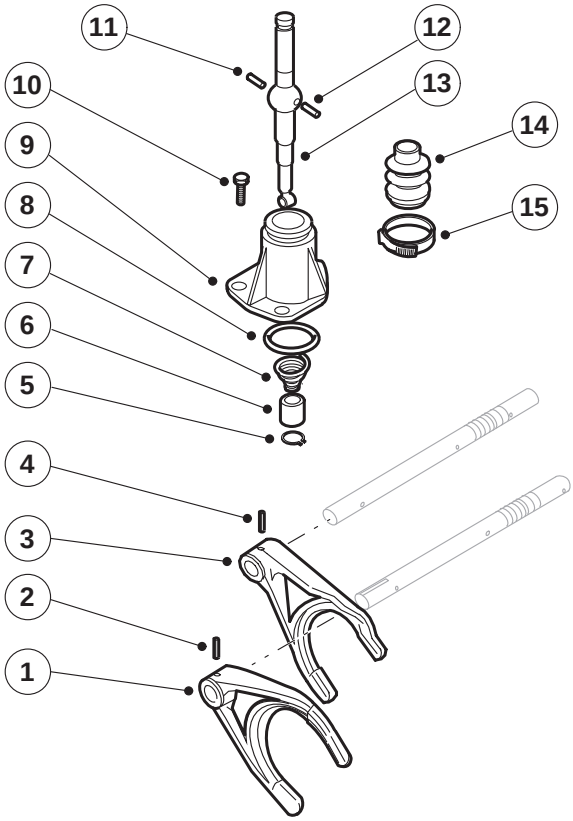


21. Install the front half of the transmission housing. For additional information, refer to TRANSMISSION HOUSING, PAGE N13–06–65 in this section.

DISASSEMBLY AND ASSEMBLY — SPEED CONTROLS

BHN1306GA

Operation: **Disassembly and Assembly of the Speed Controls**	*Job Code:* **13 61 17 xx**		
None	Standard tools		



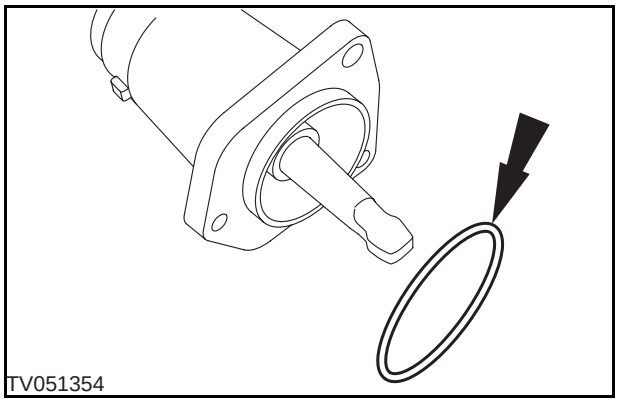
TV051418

1	Third and Fourth Gear Control Fork
2	Roll Pin
3	First and Second Gear Control Fork
4	Roll Pin
5	Circlip
6	Bushing
7	Spring
8	O-Ring Seal
9	Shifter Tower Assembly
10	Retaining Bolts
11	Roll Pin
12	Roll Pin
13	Shift Lever
14	Boot
15	Retaining Clip

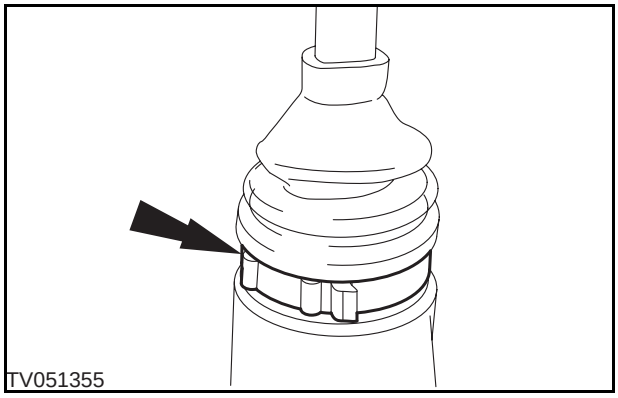
Disassembly

1. Remove the O-ring seal.

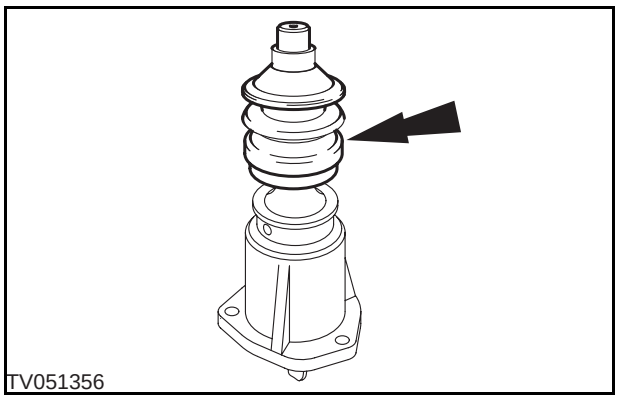
Note:
- Discard the O-ring seal.


TV051354

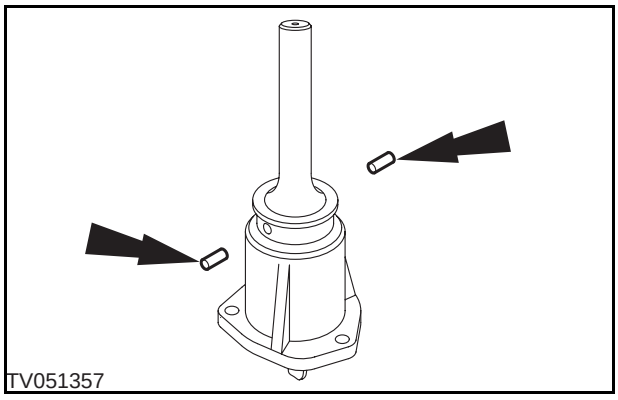
2. Remove the boot retaining clip.


TV051355

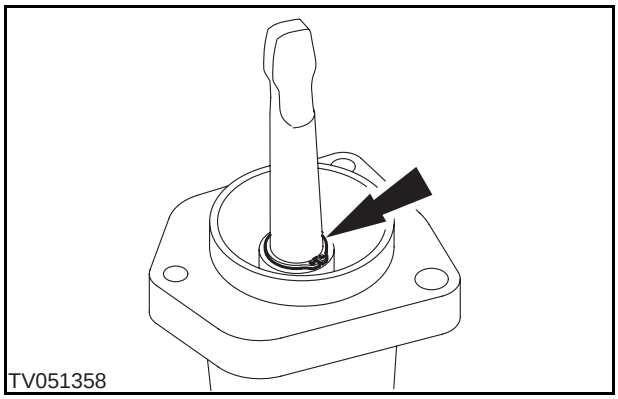
3. Remove the boot.


TV051356

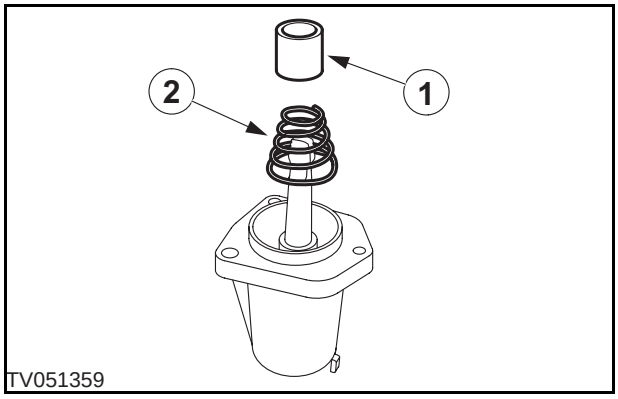
4. Remove the roll pins.


TV051357

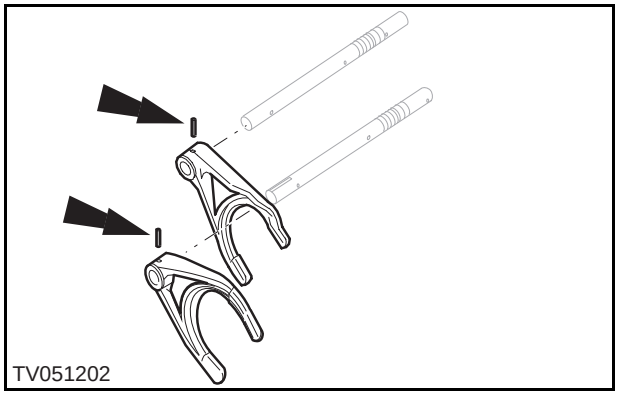
5. Using suitable circlip pliers, remove the circlip.



6. Remove the bushing (1) and spring (2).

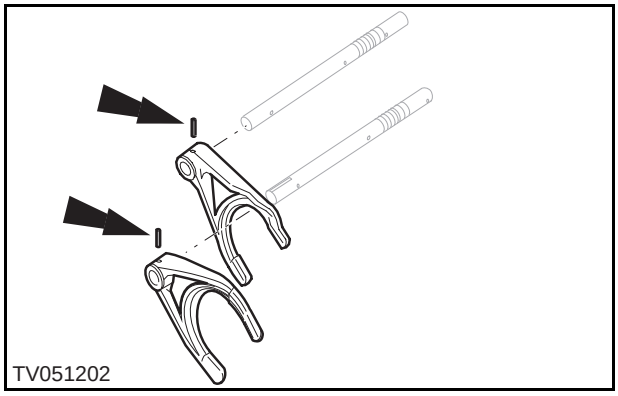


7. Using a suitable punch, remove the roll pins securing the gear control forks.

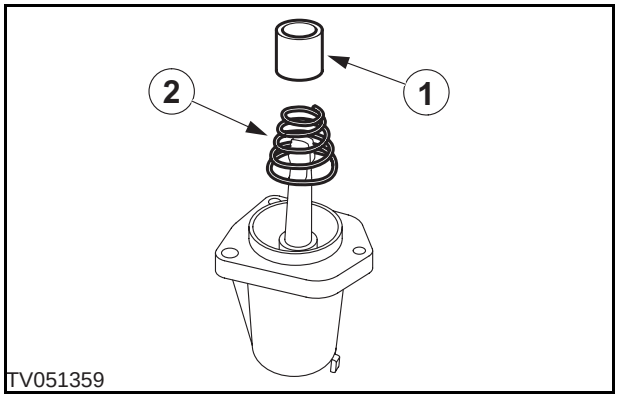


Assembly

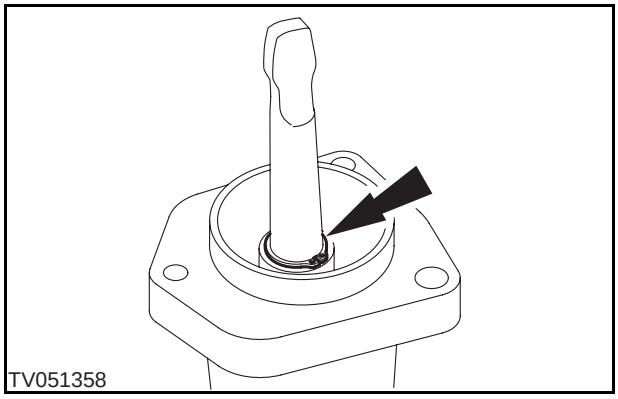
1. Using a suitable punch, install the roll pins securing the gear control forks.



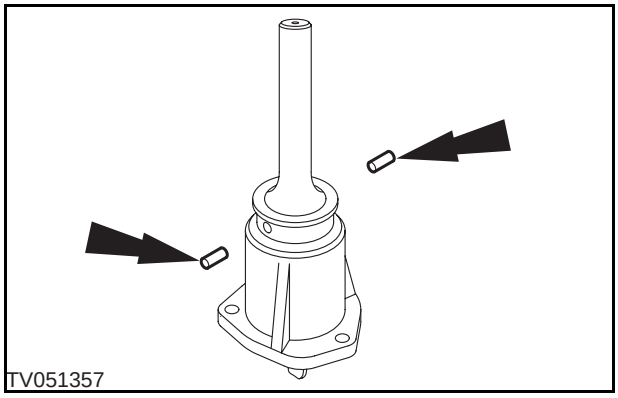
2. Install the spring (2) and bushing (1) onto the shift lever.



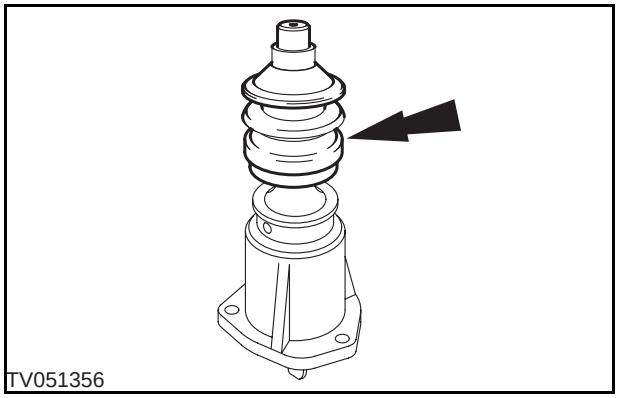
3. Using suitable circlip pliers, install the circlip.



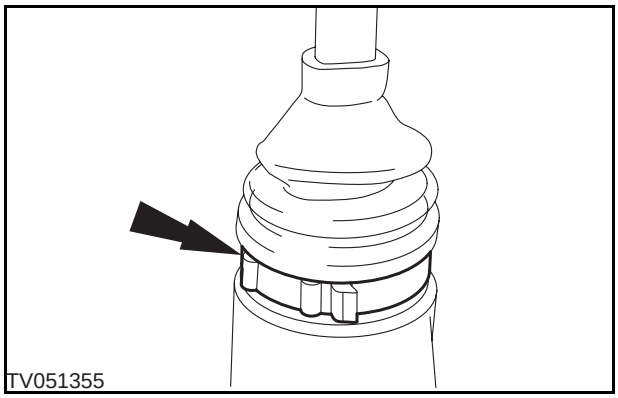
4. Using a suitable punch, Install the roll pins.



5. Install the boot.

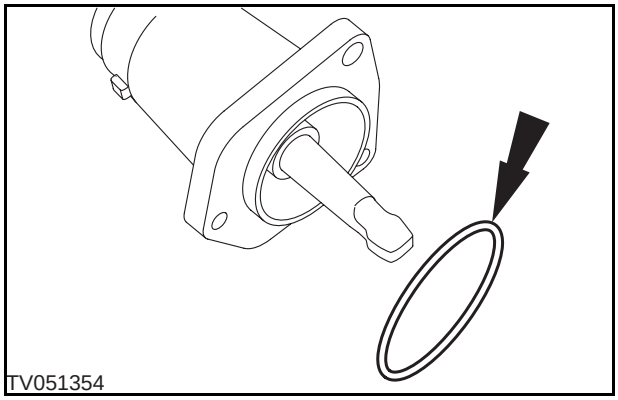

TV051356

6. Install the boot retaining clip.


TV051355

Note:
- Install a new O-ring seal.

7. Install the O-ring seal.


TV051354

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SPECIFICATIONS — SYNCHROSHUTTLE TRANSMISSION — CARRARO

BHN1306SA

Special Tools

Special Tool No.	Description
CA119033	Handle
CA715004	Driver
CA715046	Driver
CA715149	Driver
CA715257	Protection
CA715263	Protection
CA715354	Driver
CA715356	Gauger
CA715358	Clutch D & A
CA715409	Driver
CA715493	Snap Ring D & A
CA715495	Protection & Shims
CA715496	B & C Shafts Hook
CA715497	Pusher
CA715499	Protection
CA715501	Driver
CA715623	Driver
CA715743	Protection & Shims
CA715745	Gauger
CA715746	Pusher

General Information

Transmission	Syncroshuttle
Make	Carraro
Model	TLB1 UP 4WD
Carraro Pt. No.	CA641868
Terex Pt. No.	_____
Transmission Dry Weight	208 Kg
Max input speed	3000 rpm
Output/4WD shaft ratio	0.800
Suction oil filtering capacity	250 µm
Filtering capacity and delivery oil filter type	10 µm - AGV BETA 2.2
Engine flange type	SAE 3
Rear output flange type	END YOKE 1410
PTO shaft	14T D.P. 12/24 SAE C
PTO flange type	SAE C 127-2 Bolt

Recommended Lubricants

Oil Company	ATF
TOTAL FINA®	HY-Tran (CASE MS1207)
TOTAL FINA®	HY-Tran ULTRA (CASE MS1209) (CNH MAT 3505)
TOTAL FINA®	HY-Tran PLUS (CASE MS1223)
PAKELO®	Special Transmission Fluid
MOBIL®	Mobil fluid 424
CHEVRON TEXACO®	Textran 7045
PETROL OFISI® (Turkish)	PO ATF 2

Recommended Adhesive and Sealants

Application	Loctite®	Superbond®	Technical Characteristics	Strength
Transmission housing	510	529	Flat surface sealing	High
Transmission rear cover	518	539	Uneven sealing surface	High
Detent balls retaining plate	542	321	Locking of threaded parts	Medium

Torque Values

Description	Nm	Lb.ft
Transmission to engine	71	52
Torque converter	41	30
Transmission housing	50	37
Detent ball retaining plugs	80	60
Detent ball retaining plate	50	37
Transmission rear cover	50	37
Shift tower assembly	23	17
Four wheel drive (4WD) flange	139	102
Two wheel drive (2WD) flange	139	102
4WD flange seal carrier	23	17
Front propeller shaft	47	35
Rear propeller shaft	47	35
Transmission oil pump	23	17
4WD solenoid pipe	24	18
4WD solenoid	8	6
4WD solenoid valve	23	17
Differential lock solenoid spool	27	20
Differential lock solenoid	7	5
Forward/reverse solenoid pipe	24	18
Forward/reverse solenoid	10	7
Control valve cover	11	8
Control valve retaining plug	24	18
Feeding plate	23	17
Hydraulic control valve	23	17
Transmission oil temperature sender	30	22

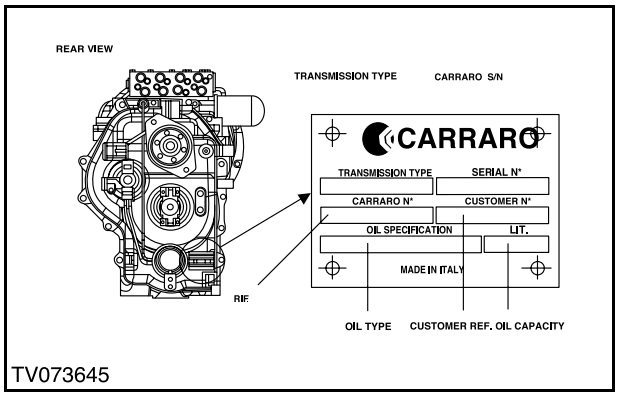
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DESCRIPTION AND OPERATION — CARRARO POWERSHIFT TRANSMISSION

BHN1307OA

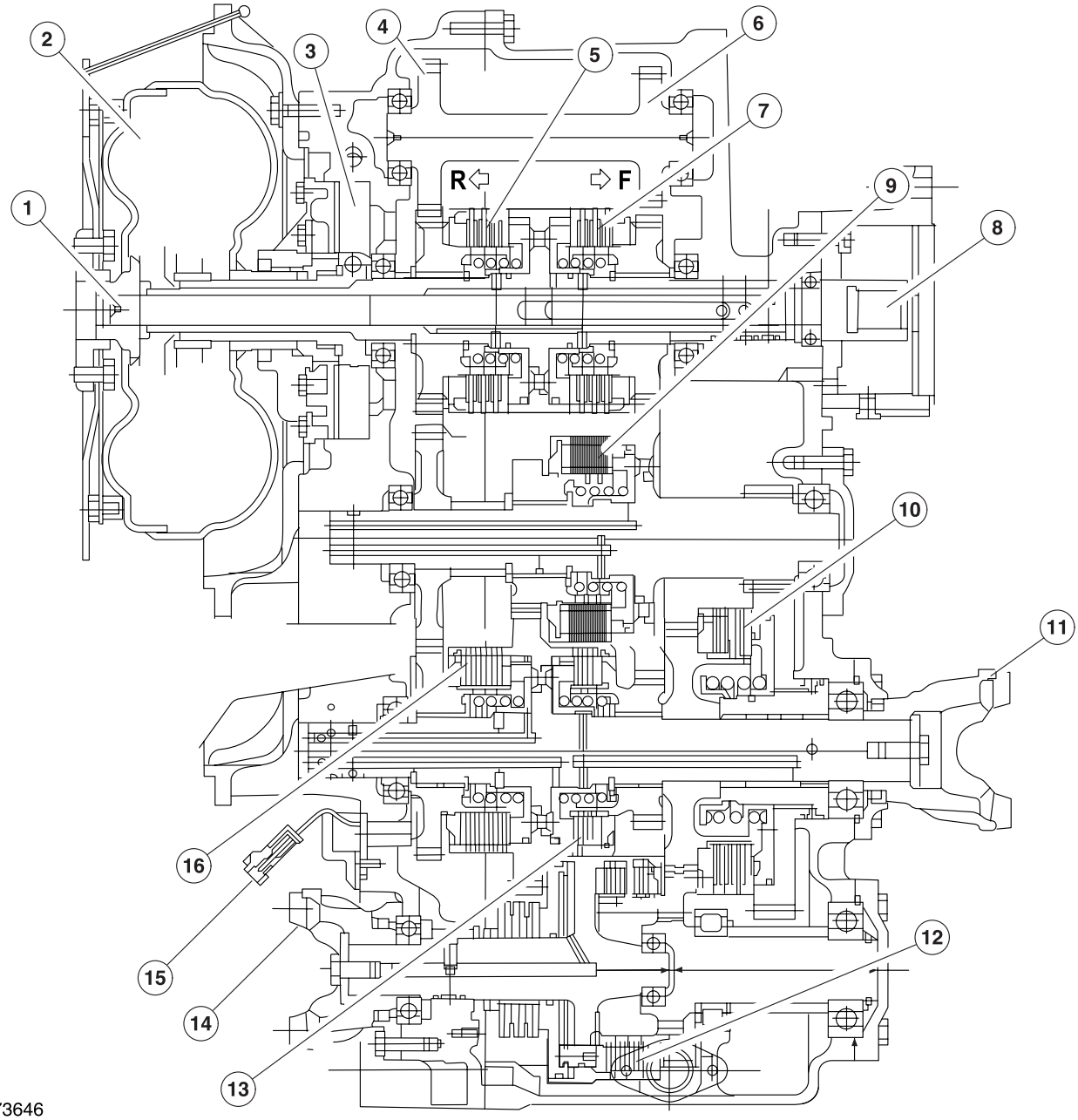
Identification Of The Unit

- Model and type of the unit
- Unit serial number



TV073645

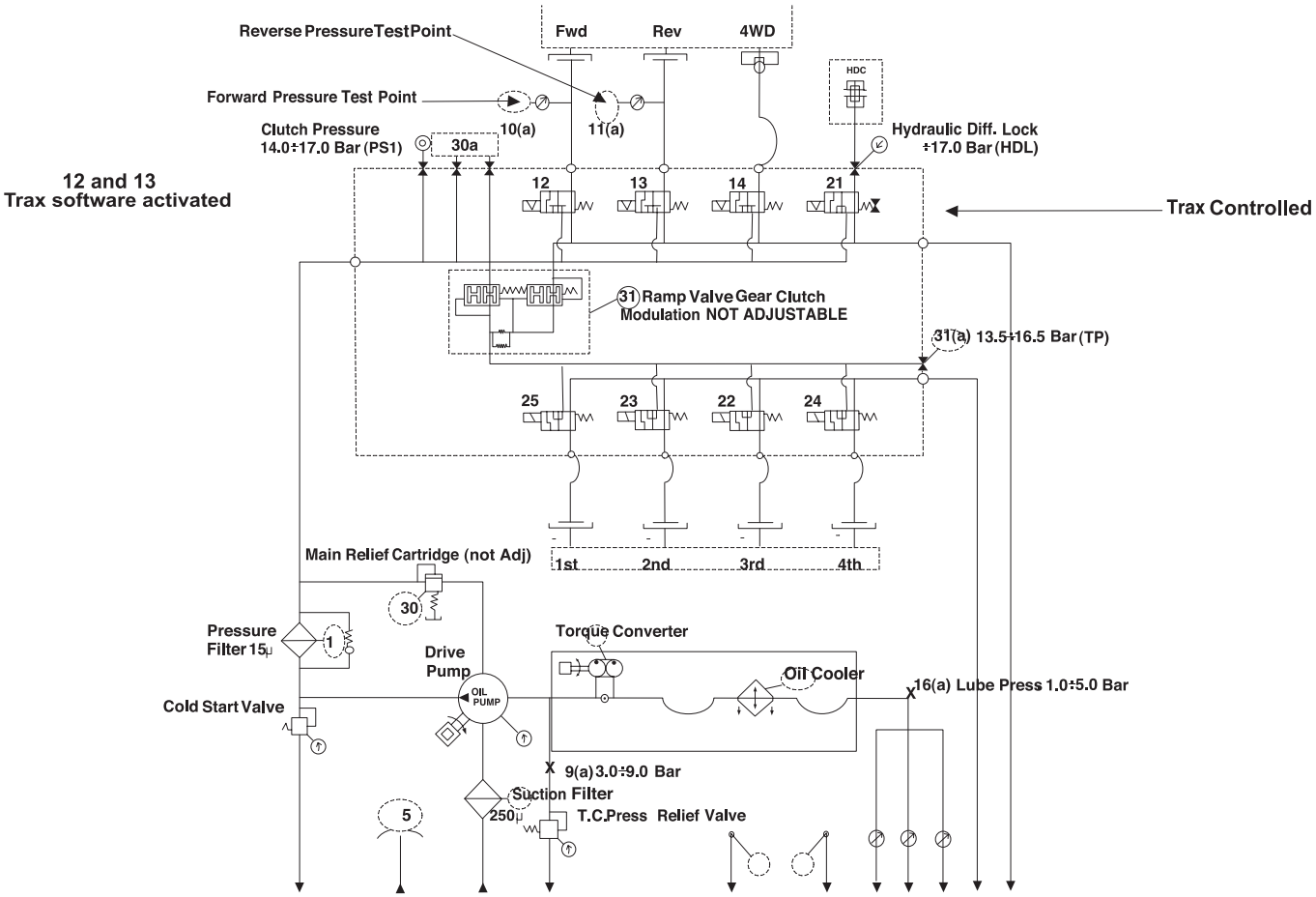
Schematic View Powershift Transmission



TV073646

1	Input Drive Shaft
2	Torque Converter
3	Charge Pump
4	Reverse Drive Gear
5	Reverse Drive Clutch
6	Forward Drive Gear
7	Forward Drive Clutch
8	Power Take Off
9	2nd Speed Clutch and Gear
10	1st Speed Clutch and Gear
11	Rear Output Coupling
12	4 Wheel Drive Clutch
13	4th Speed Clutch and Gear
14	Front Output Coupling
15	Speed Sensor
16	3rd Speed Clutch and Gear

Transmission Hydraulic Circuit



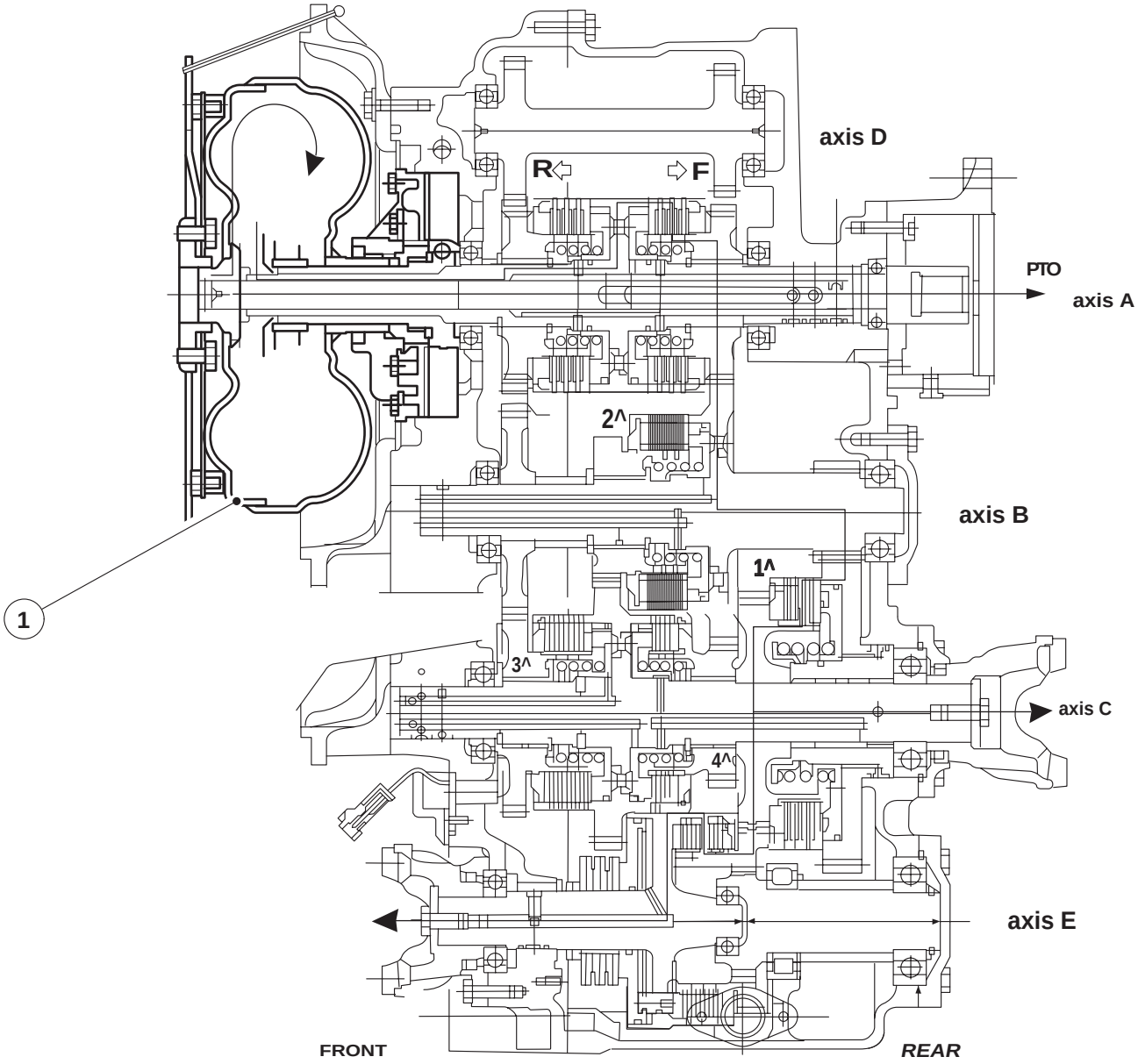
TV073647

The transmission and torque converter function together through a common hydraulic system.
The charging pump draws oil through the suction oil strainer and directs it to the oil filter.
Protecting the filter from system pressure in excess of 3.45 Bar (50 PSI) is a by-pass valve .
A pressure regulating valve maintains the pressure for the control valve and clutches at 18.5 bar (268 PSI) and excess oil is returned to the torque converter circuit.
The torque converter is protected from pressures over 5.5 bar (80 PSI) by a safety valve located internally in the charge pump.
After leaving the torque converter, the oil flows through the oil cooler then on to lubricate and cool the transmission bearings and clutches. The oil drains back to the transmission sump under gravity.
The transmission is composed of five main assemblies.

1	The torque converter and charging pump drive section
2	The input or directional clutches
3	The range clutches
4	The output section
5	The transmission controls

Transmission Assembly and Controls

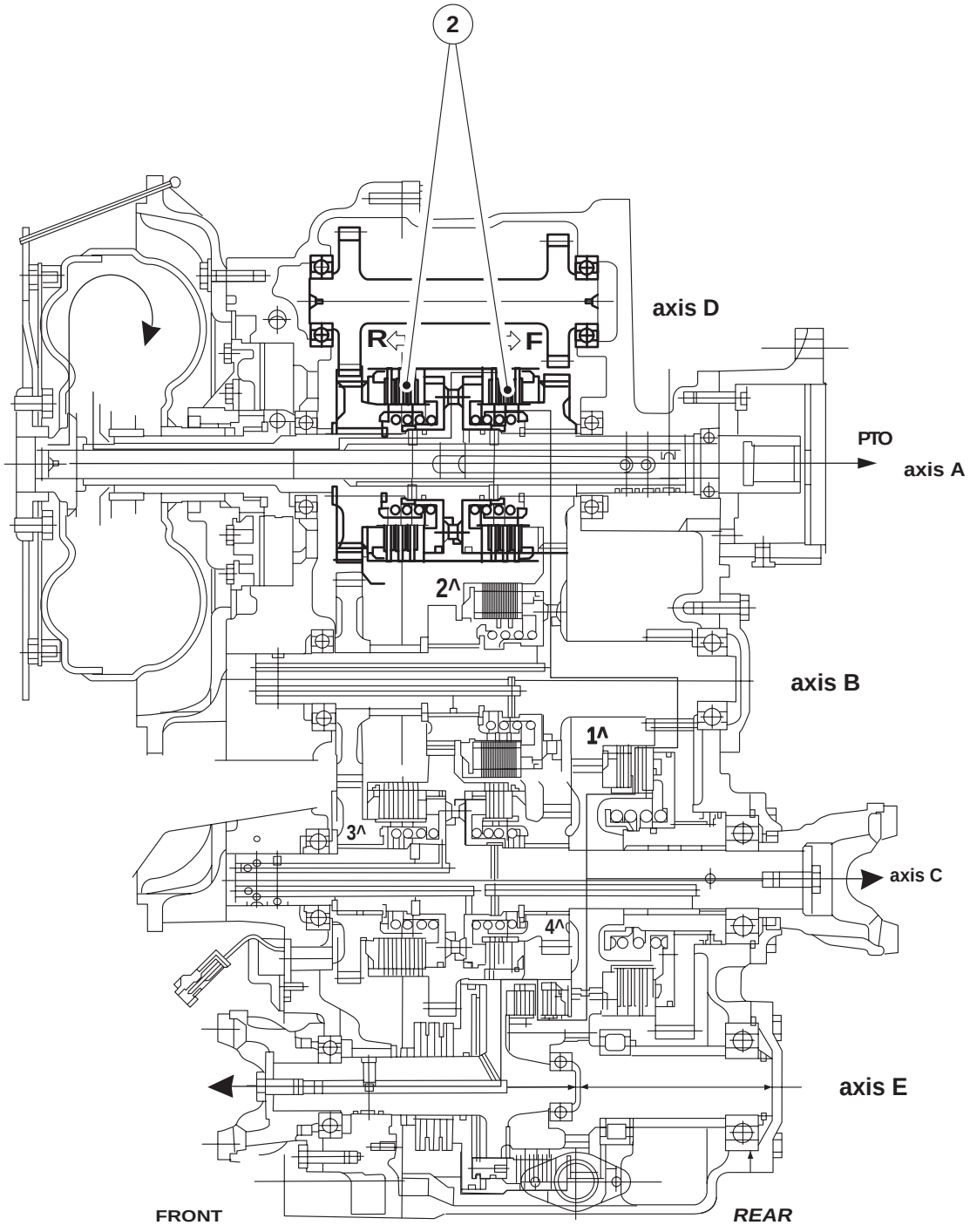
1. The Torque Converter and Charging Pump Drive Section



TV073862

Engine power is transmitted from the engine flywheel to the impeller through the impeller cover.
This element is the charging portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components with the torque converter which results in torque multiplication.
The impeller can be compared to a centrifugal pump in that it picks up fluid at its centre and discharges at its outer diameter.
The torque converter turbine is mounted opposite the to impeller and is connected to the turbine shaft or directional clutch shaft. This element receives fluid at its outer diameter and discharges at its centre.
The stator of the torque converter is located between the impeller and turbine elements, at the centre of there diameters. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element.
This recirculation will make the converter multiply torque.
The stator can also freewheel when the impeller and turbine RPM are similar to each other allowing a fluid coupling operation in order to achieve a high speed on the road. This in turn means less heat is generated and fuel consumption is reduced.
The torque converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall).
Therefore we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing. In the impeller cover a splined shaft is installed which runs inside the turbine shaft to drive a hydraulic pump which is fitted at the back of the transmission. Since the shaft is connected to the centre of the impeller cover, the hydraulic pump speed will be the same as engine speed.
The rear side of the impeller cover has a tanged drive which drives the transmission charging pump located in the converter housing. The transmission charging pump speed is also the same as the engine speed and provides fluid under pressure to allow engagement of the various clutches.

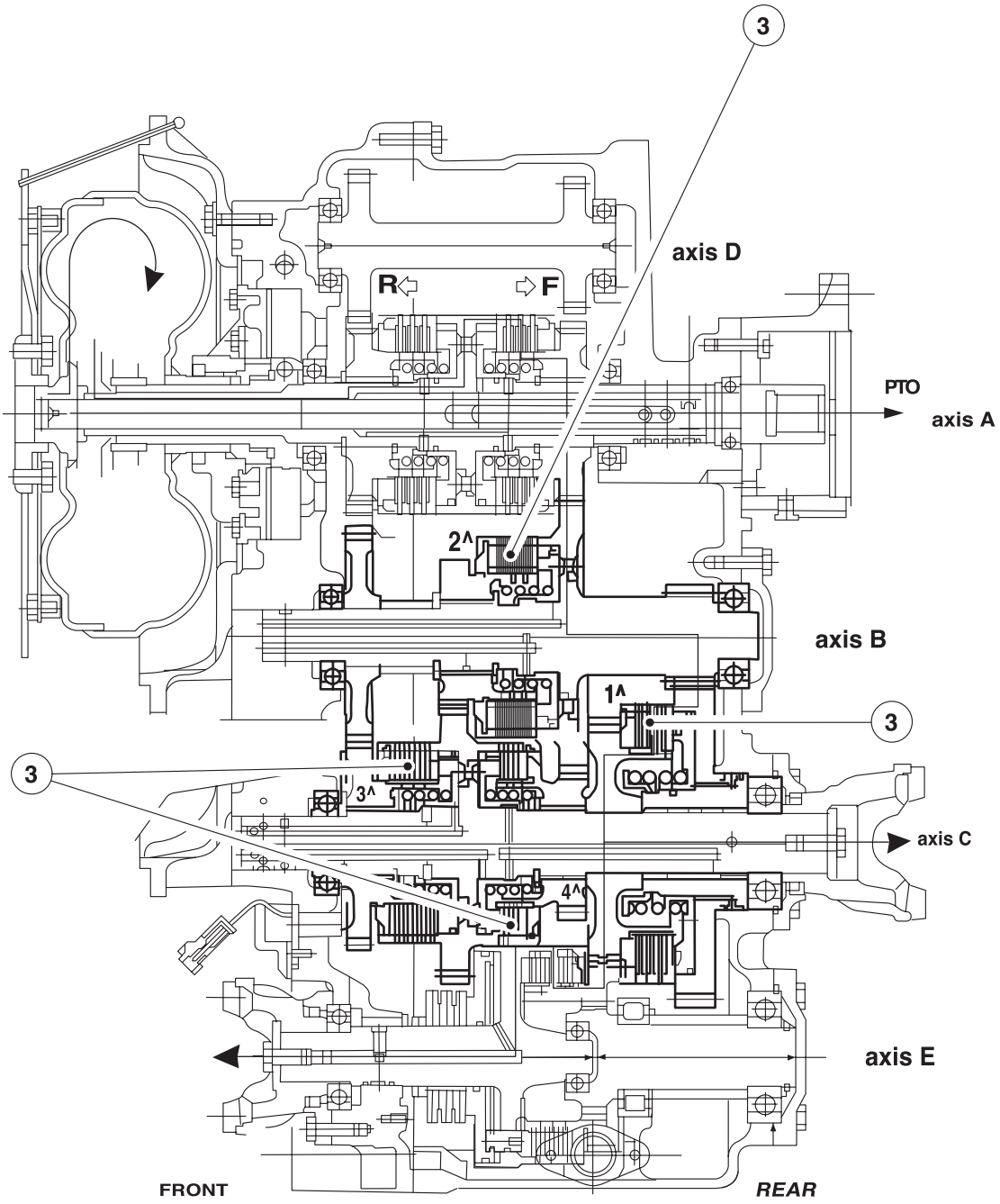
2. Input or Directional Clutches



TV073863

The turbine shaft driven from the turbine transmits power to the forward or reverse clutches.
These clutches consist of a drum with splines and a bore to receive a hydraulic actuated piston.
The piston is oil tight by the use of sealing rings, also these pistons have drain orifices for a quick release when the clutch is being disengaged. A steel disc with external splines is inserted into the drum and rests against the piston. Next, a friction disc with teeth at the internal diameter is inserted.
Discs are alternated until the required total is achieved. A backing plate is then inserted and secured with a snap ring. A hub with outer diameter teeth is inserted into the discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.
To engage the clutch, the control valve which is fitted on the top of the transmission will direct oil under pressure through tubes and passages to the selected clutch shafts.
Oil seals are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.
Pressure of the oil forces the piston and discs against the backing plate. The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows them to drive as one unit.
When the clutch is released, a return spring will push the piston back and oil will drain back via the control valve into the transmission sump.
The powershift transmission has one reverse clutch and one forward clutch.
This, in combination with the four range clutches, results in the transmission having 4 forward speeds and 3 reverse speeds.
The engagement of the directional clutches is modulated; which means that clutch pressure is built up gradually. This will enable the unit to make forward, reverse shifts while the vehicle is still moving and will allow smooth engagement of drive. The forward and reverse clutches are modulated by the Trax software. The modulation of the gear clutches is controlled by a ramp valve in the control valve. The 4WD clutch and differential lock are not modulated

3. The Range Clutches

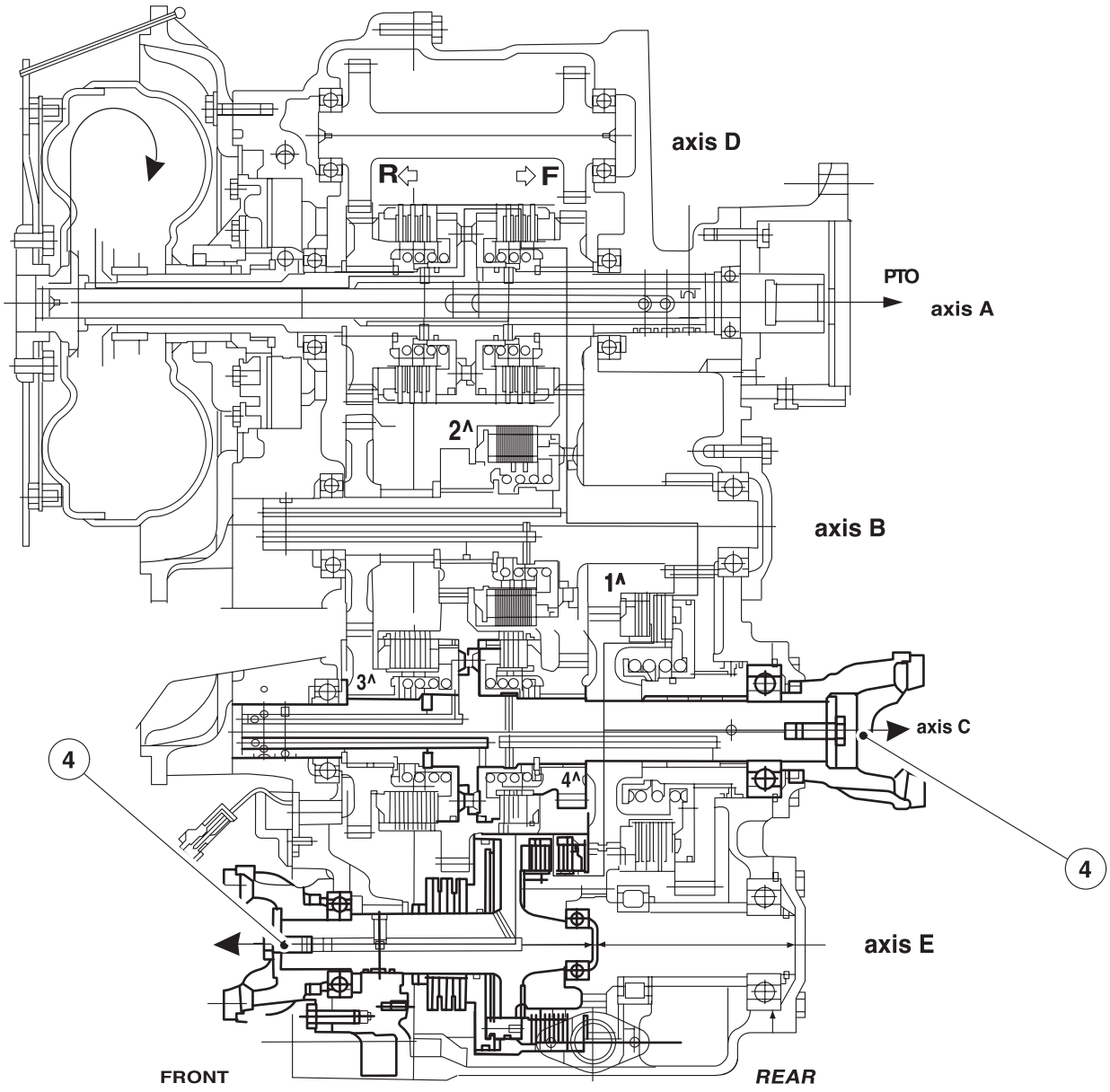


TV073864

Once a directional clutch is engaged, power is transmitted to the range clutches.
Operation and actuation of the range clutches is similar to the directional clutches.
The engagement of the range clutches is also modulated to enable a smooth engagement.

The modulation for these clutches is achieved by means of a ramp valve fitted in the control valve. This is controlled manually by a spring and which limits oil flow to the clutch during gear changes.

4. The Output Section



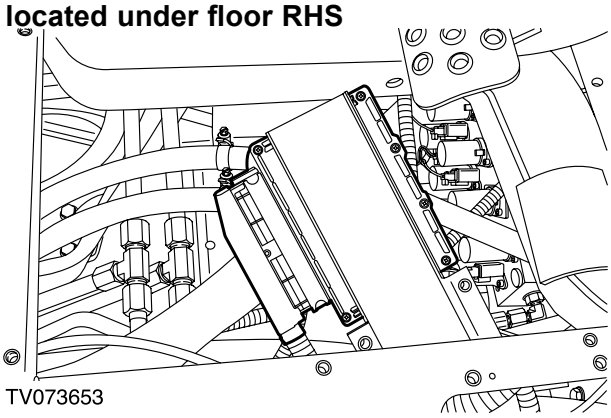
TV073865

With a range clutch engaged power is finally transmitted to the output shafts.
The powershift transmission has a upper output at the rear of the transmission , and a lower output at the front side. Output rotation of the rear upper output is the same engine rotation when the forward clutch is engaged, while output rotation of the front output is the opposite as the engine rotation with the forward clutch engaged.

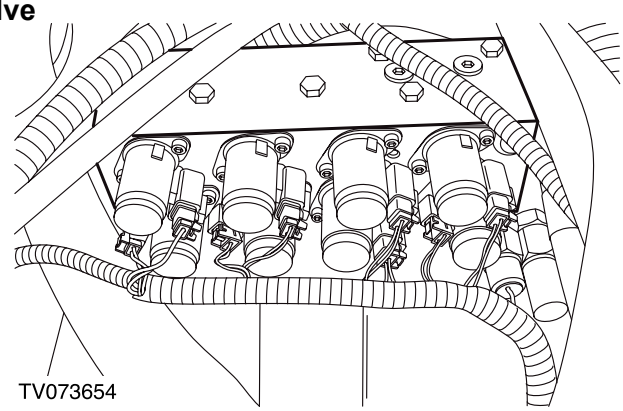
The lower front output has a four wheel drive clutch to enable four-wheel drive / two wheel drive to be selected.
The clutch is similar to the other clutches. The four wheel drive clutch is controlled electrically. The clutch is engaged with an electrical signal through a solenoid located in the transmission control valve.

5. The Transmission Controls

Transmission EGM / ECU located under floor RHS



Transmission control valve



Operation of the transmission control valve is as follows:

(Refer to transmission hydraulic circuit)

The control valve has 8 solenoids, and a ramp valve.

Regulated pressure between 14 bar — 18.5 bar dependent on the engine RPM is directed to the control valve.

In the control valve the pressure is then directed to the solenoid activated spool valves. When a gear is selected a solenoid for the relevant gear is activated this lifts a spool valve allowing fluid into the clutch activating the gear.

As the gear is activated, the ramp valve will give a smooth progressive engagement of the gear.

When forward is selected the forward proportional solenoid is activated.

When reverse is selected the reverse proportional solenoid is activated. The power flow goes through a reverse idler changing the rotation of the transmission.

The smooth engagement of the forward and reverse clutches is controlled by the Trax software.

Range is selected as follows:

When the 1st speed solenoid is activated this will shift the spool engaging the 1st speed clutch.

As each speed is selected the previous speed clutch disengages.

The clutches also have modulation which operates as follows:

When the range is changed, oil will flow through the ramp valve to the chosen range clutch engaging the clutch in a progressive manner. This protects the transmission from harsh gear changes and excessive strain on the transmission.

The control valve also controls the front lower output (four-wheel drive) clutch. If the solenoid is activated this will shift the spool engaging the (four-wheel drive) clutch.

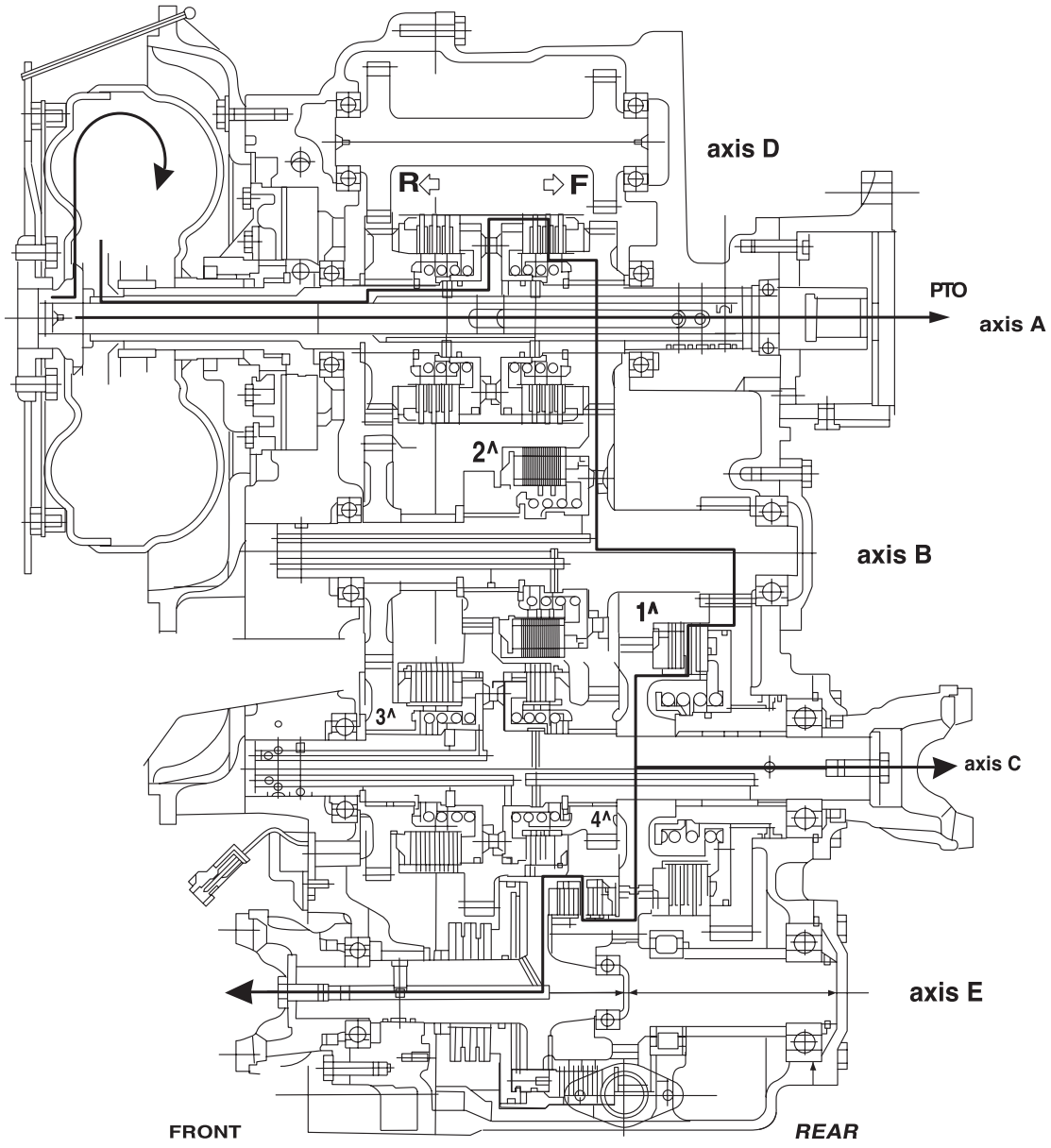
The ECU has an input from a speed sensor. The sensor measures the speed of the rear output shaft. This information is used in the electronic gear selector to determine shift logic. Since the sensor picks up output gear speed, the signal will be in direct relation to the turbine speed if any directional clutch is engaged.

Control Valve Solenoid Activation

Transmission Gear	Activated Solenoids							Engaged Clutches
	Direction Solenoids		Range Solenoids				Four-Wheel Drive Solenoid	
	F	R	1	2	3	4		
F1	■		■					Forward , 1st
F2	■			■				Forward 2nd
F3	■				■			Forward 3rd
F4	■					■		Forward 4th
R1		■	■					1st Reverse
R2		■		■				2nd Reverse
R3		■			■			3rd Reverse
Four-Wheel Drive							■	Four-Wheel Drive
■	= Active Solenoid							

Power Flows

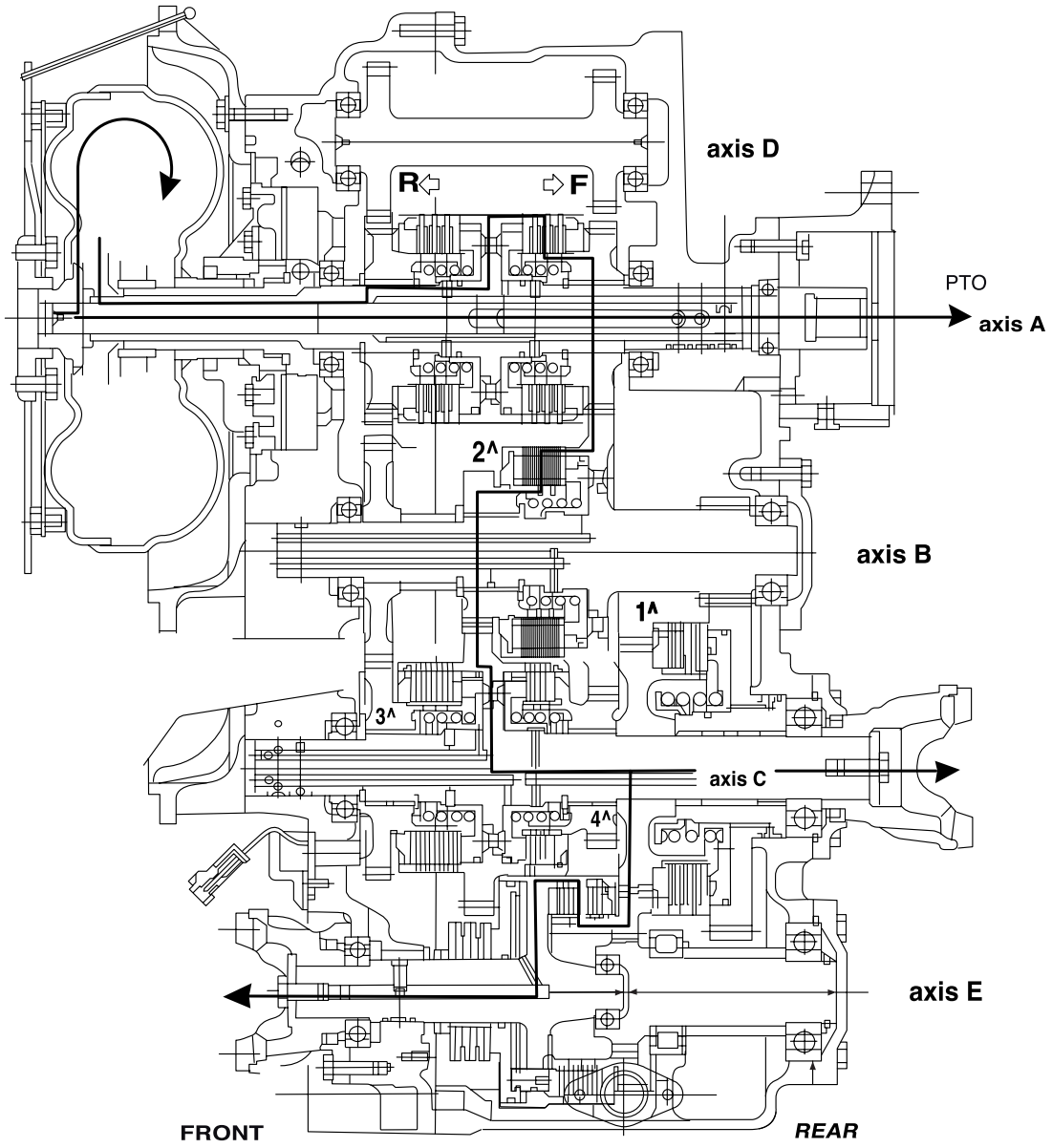
1st Gear — Forward clutch engaged



TV073648

When 1st gear forward is engaged the forward clutch is locked, this then will transmit the power from the torque convertor on axis A through axis B onto the 1st speed clutch on axis C. The 1st speed clutch is locked this then transmits the power to the rear output shaft, if 4WD is selected the power is also directed to the front output shaft on axis E.

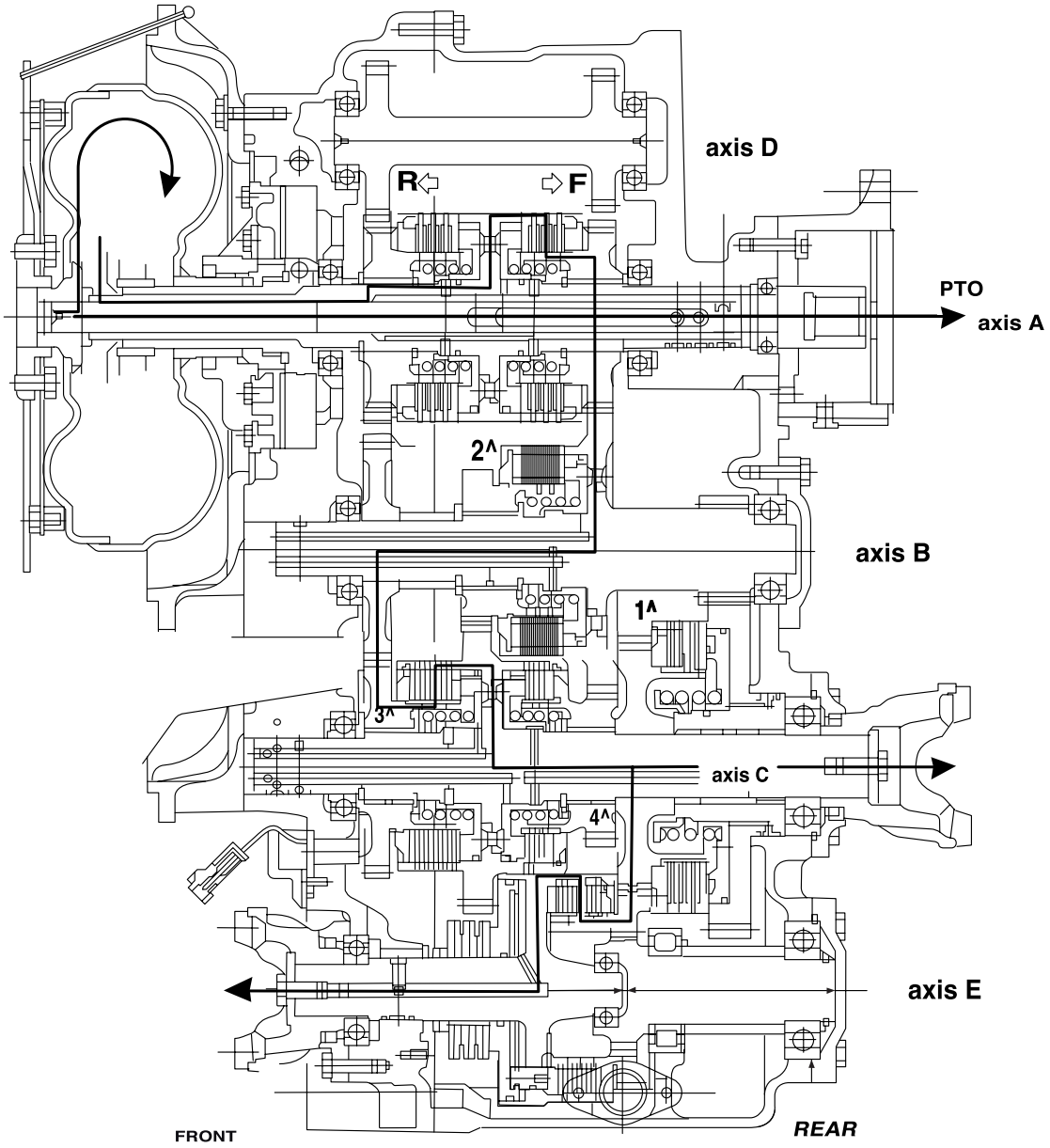
2nd Gear — Forward clutch engaged



TV073650

When 2nd gear forward is engaged the forward clutch is locked, this then will transmit the power from the torque convertor on axis A through axis B onto the 2nd speed clutch. The 1st speed clutch will be disengaged and the 2nd speed clutch is locked this transmits the power to the rear output shaft axis C, if 4WD is selected the power is also directed to the front output shaft on axis E.

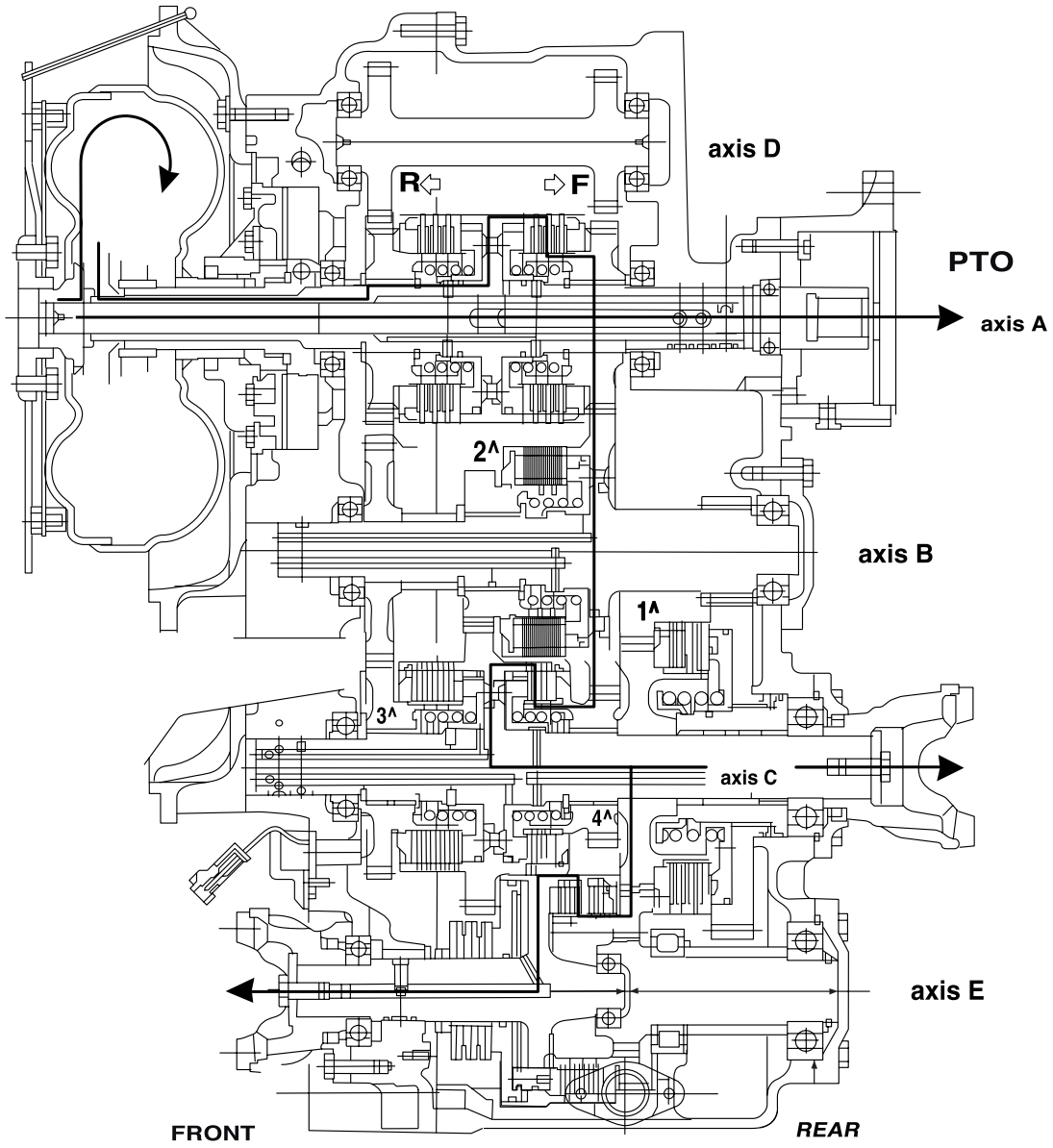
3rd Gear — Forward clutch engaged



TV073651

When 3rd gear forward is engaged the forward clutch is locked, this then will transmit the power from the torque convertor on axis A through axis B onto axis C. The 2nd speed clutch will be disengaged and the 3rd speed clutch is locked this transmits the power to the rear output shaft axis C, if 4WD is selected the power is also directed to the front output shaft on axis E.

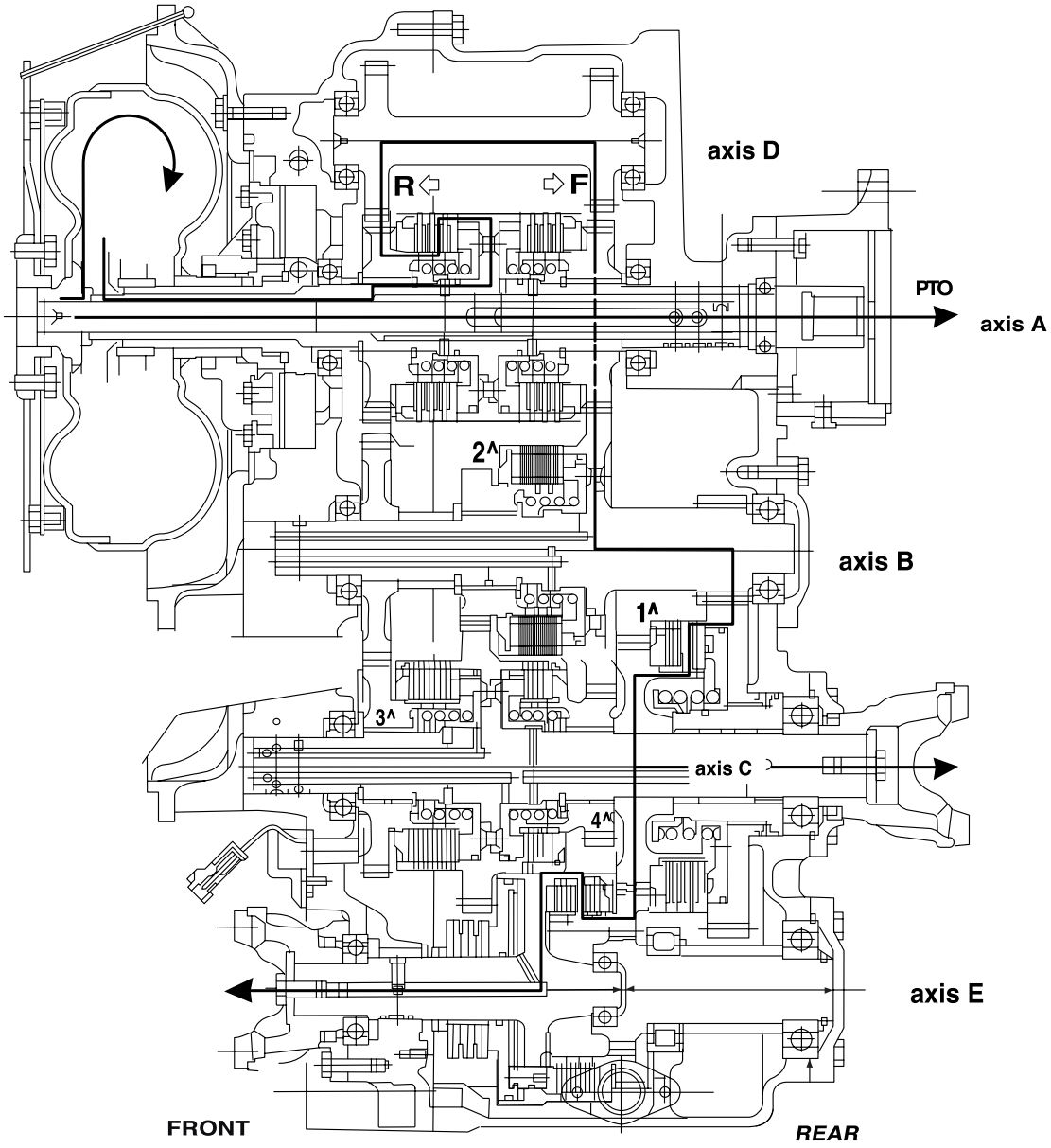
4th Gear — Forward clutch engaged



TV073652

When 4th gear forward is engaged the forward clutch is locked, this then will transmit the power from the torque convertor on axis A through axis B onto axis C. The 3rd speed clutch will be disengaged and the 4th speed clutch is locked this transmits the power to the rear output shaft axis C, if 4WD is selected the power is also directed to the front output shaft on axis E. When 4th gear is selected on the transmission control the transmission will enter an automatic mode. The transmission ECU will select the gear relevant to the rear output shaft speed and make gear changes the speed increases.

Reverse 1st Gear — Reverse engaged



TV073649

When 1st gear reverse is engaged the reverse clutch is locked, this then will transmit the power from the torque convertor on axis A through axis D. This axis reverses the direction onto axis B. The 1st speed clutch is locked this transmits the power to the rear output shaft axis C, if 4WD is selected the power is also directed to the front output shaft on axis E.

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DIAGNOSING AND TESTING — CARRARO POWERSHIFT TRANSMISSION

BHN1307TA

The following information is presented as an aid to isolate and determine the specific problem area in a transmission that is not functioning correctly.
When diagnosing a transmission problem, it should be kept in mind that the transmission is only the central unit of a group of related powertrain components. Proper operation of the transmission depends on the condition and correct functioning of the other components of the group. Therefore, to properly diagnose a suspected problem in the transmission, it is necessary to consider the transmission fluid, charging pump, torque converter, transmission assembly, oil cooler, filter, connection lines, and controls, including the engine as a complete system.
By analysing the description and operation together with the information in this section and the pressure testing section, it should be possible to identify and correct any malfunction which may occur in the system.

Diagnosing Procedures

In addition to the mechanical and electrical components, all of which must be in the proper condition and functioning correctly, the correct functioning of the hydraulic circuit is most important. Transmission fluid is the “life blood” of the transmission. It must be supplied in an adequate quantity and delivered to the system at the correct pressures to ensure converter operation, to engage and hold the clutches from slipping and to cool and lubricate the working components.
Faults fall into three general categories: mechanical, hydraulic and electrical.

Stall Test

Use a stall test to identify whether the transmission, torque converter, or the engine is the malfunctioning component when a complaint of poor performance is made.

Transmission Pressure Checks

Transmission problems can be isolated by the use of pressure tests. When the stall test indicates slipping clutches, then measure clutch pack pressure to determine if the slippage is due to low pressure or clutch plate friction material failure.
In addition, converter charging pressure and transmission lubrication pressure may also be measured.

Mechanical And Electrical Checks

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- Check the parking brake for correct adjustment.
- Ensure all lever linkages are properly connected and adjusted in each segment and at all connecting points.
- The controls are actuated electrically. Check the wiring and electrical components.
- Ensure that all components of the cooling system are in good condition and operating correctly.
- The radiator must be clean to maintain the proper operating temperatures for the engine and transmission. Clean the radiator, if necessary using compressed air.
- The engine must be operating correctly. Ensure that it is correctly tuned and adjusted to the correct idle and maximum no-load governed speed specifications.

Hydraulic Check

Note:

- The transmission fluid must be at the operating temperatures of 80° C (180° F) to achieve correct fluid level and pressure readings.

⚠ Caution:

- **Do not attempt to make these checks with cold oil.**

Also, before checking the transmission clutches, torque converter, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:
Check the oil level in the transmission. The transmission fluid must be at the correct (full level). All clutches and the converter and its fluid circuit lines must be fully charged (filled) at all times.
To raise the oil temperature to this specification it is necessary to either operate (work) the vehicle or run the engine with torque converter at “stall”. (Refer to torque converter stall procedure).

Torque Converter Stall Procedure

⚠ Caution:
- **If the operating pressures at idle are too low, do not carry out this test.**

⚠ Caution:
- **Do not operate the torque converter at stall condition longer than 30 seconds at one time, shift to neutral for 15 seconds and repeat the procedure until desired temperature is reached. Excessive temperature 120°C (250°F) maximum will cause damage to transmission clutches, fluid, torque converter, and oil seals.**

⚠ Caution:
- **If the engine RPM recorded by the tachometer exceeds the maximum specified RPM, reduce the engine RPM to idle immediately. Clutch slippage is indicated.**

Permitted Torque Converter Stall Speeds

	860 Elite
Maximum no-load engine RPM	2350 ± 25
Stall against the hydraulics @ 225 bar	2300 ± 25
Stall against the transmission	2200 ± 25
Stall against transmission and the hydraulics	2000 ± 50
Stall against the transmission, hydraulics and the steering	2000 ± 50

Note:
- Transmission fluid level and engine coolant level must be correct. Both fluids must be at normal operating temperature

Note:
- The transmission fluid must be at the operating temperature of 80° C (180° F) to achieve the correct readings.

Note:
- Check the engine is capable of obtaining the specified maximum no-load engine RPM before stall testing.

⚠ Caution:
- **Be careful that the vehicle does not move unexpectedly when operating the engine and torque converter at stall RPM.**

1. Put the vehicle against a solid barrier, such as a wall, apply the parking brake, service brakes and block the wheels.
2. Start the engine.
3. Select the highest gear and increase the engine speed to the maximum RPM until the tachometer reading stabilizes.
4. Put the directional control lever in FORWARD (or REVERSE, as applicable).
5. Read the stall speed RPM on the tachometer.

Problem	Possible Cause	Action
Stall speed to high	• Low oil level	• CHECK the oil level (should always be checked prior to stall testing).
	• Low clutch pressure(s).	• CHECK clutch pressure(s).
	• Slipping clutch(es).	• CHECK clutch(es).
Stall speed too low	• Engine maximum no-load RPM speed too low.	• CHECK engine controls and performance.
	• Internal damage within the torque converter.	• REPAIR/REPLACE the torque converter.
Low clutch pressure	• Low oil level.	• FILL to proper level.
	• Clutch pressure regulating valve stuck open.	• CLEAN valve spool and housing.
	• Faulty charging pump.	• REPLACE charging pump.
	• Broken or worn clutch shaft or piston sealing rings.	• REPLACE sealing rings.
Low charging pump output	• Low oil level.	• FILL to correct oil level.
	• Suction screen blocked.	• CLEAN suction screen and charging pump.
	• Defective charging pump.	• REPLACE charging pump.
Overheating	• Dirty oil cooler.	• CLEAN oil cooler.
	• Restriction in cooler lines.	• CHANGE cooler lines.
	• Low oil level.	• FILL to correct oil level.
	• Worn oil sealing rings.	• REMOVE, DISASSEMBLE and REBUILD torque converter assembly.
	• Worn charging pump.	• REPLACE.
Noisy torque converter	• Worn charging pump.	• REPLACE.
	• Worn or damaged bearings.	• A complete DISASSEMBLY will be necessary to determine which bearing is faulty.
Lack of power	• Low engine RPM at torque converter stall.	• CHECK engine governor.
	• See “Overheating” and make same checks.	• MAKE corrections as explained in “Overheating”.

Problem	Cause	Action
Vehicle does not move	Faulty supply to the solenoid valves	Check / Replace
	Damaged wiring connection between transmission and vehicle	Repair / Replace
	Oxidised contacts in the electrical wiring	Clean
	Break in electrical harness	Replace
	Damaged solenoids	Replace
	Damaged sensors	Replace
	Short circuits or false contacts	Check / Replace fuses
Valid for TLB2	Irregular functioning of the electronic gear management (EGM / ECU)	Replace EGM / ECU
	Incorrect oil Level	Top up
	Check for leaks	Repair / Top up
	Blocked intake filter	Clean
	Damaged oil pump	Replace
	Damaged oil pump relief valve	Replace oil pump
	Blocked / damaged transmission filter	Replace
	Damaged / jammed control valve	Replace
	Damaged converter	Replace
	Oil temperature below 0ºC	Wait for the oil to reach working temperature (stall test)
	Damaged rotary seals	Replace

Problem	Cause	Action
Vehicle has reduced power transmission	Incorrect oil temperature	Wait for the oil to reach working temperature (stall test)
	Transmission oil overheating	Restore acceptable temperature values
	Incorrect operating pressure	Check hydraulic circuit and replace (oil pump, filters, control valve)
	Damaged converter	Replace
	Incorrect oil level	Top up
	Worn clutch unit	Replace / Repair
	4WD clutch failure	Repair / Replace 4WD shaft group
	Overheating solenoids	Replace
	Damaged transmission and vehicle wiring connections	Repair / Replace
	Damaged EGM / ECU logic	Replace EGM / ECU
	Damaged sensors	Replace
Overheating	Damaged hydraulic cooling system	Repair
	Dirty heat exchanger	Clean
	Parking brake inadvertently activated	Release
	Excessive dirt on axle wheel hubs	Clean
	Seizing (broken gears, shafts, bearings, etc)	Check / Repair / Replace
	Braking force outside transmission: irregular axle operation	Check / Repair axle
	Clutch plate drag	Repair / Replace
	Damage converter	Replace
	Damaged oil thermostat	Replace
	Incorrect oil level	Top up
	Worn oil pump	Replace

Problem	Cause	Action
Wheels rotate when machine is raised	Clutch plate drag	Repair / Replace
	Low oil temperature (high oil viscosity)	Wait for oil to working temperature (stall test)
	Incorrect oil specifications	Replace oil and filters
	Damaged control valve	Replace
	Faulty reverse locking	Repair / Replace
Noise	Damaged converter	Replace
	Seizing (broken gears, shafts, bearings, etc.)	Check / Repair / Replace
	Worn clutch plates	Replace
	Worn synchroniser actuation unit	Replace
	Worn 4WD clutch	Replace
Irregular actuation	Damaged control valve	Replace
	Electrical system fault	Repair / Replace
	Worn clutch plates	Replace
	Damaged converter	Replace
	Low oil temperature (high oil viscosity)	Wait for the oil to reach working temperature (stall test)
	Overheating	See overheating
	Faulty EGM / ECU operation	Replace EGM / ECU
	Damaged hydraulic system	Repair / Replace
Gear remains engaged	Damaged / jammed shuttleshaft lever	Repair / Replace
	Electrical system fault	Repair / Replace
	Damaged control valve	Replace
	Damaged hydraulic system	Repair / Replace
	Damaged clutch unit	Repair / Replace
	Irregular EGM / ECU operation	Replace EGM / ECU
No 4WD power transmission	Damaged 4WD clutch	Replace
	Hydraulic system fault	Repair / Replace
	Damaged control valve	Replace
	Faulty brake sensor	Check / Replace
	Electrical system fault	Repair / Replace
	Faulty EGM / ECU operation	Replace EGM / ECU
Gear Shift won’t engage	Damaged clutch unit	Repair / Replace
	Damaged hydraulic system	Repair / Replace
	Damaged control valve	Replace
	Damaged pressure sensors	Check / Replace
	Electrical system fault	Repair / Replace
	Irregular EGM / ECU operation	Replace EGM / ECU

Fault Codes

Trax (Transmission EGM / ECU) Diagnostics — Startup

When the TRAX controller is connected to the vehicle, at key on :

- If for 0.5 seconds all the gear lamps come on, then the ECU is working OK. (at least the power supply and the dash board connection is ok)
- If this does not illuminate the transmission may have developed a fault, then follow these 5 steps.

1	Checkfor a12 volt supply at pin 1,2,5,8,34.
2	Check the ground at pin at 29.
3	Check the dashboard connection.
4	Try to connect via a serial line
5	Substitute the ECU

Error Codes

The Powershift transmission controller has an inbuilt diagnostic facility. This facility utilises a blink code that will be displayed via the**Transmission Status** lamp.

The Trax controller continuously monitors the inputs and outputs if a problem occurs then an error / blink code will be display via the **Transmission Status** lamp

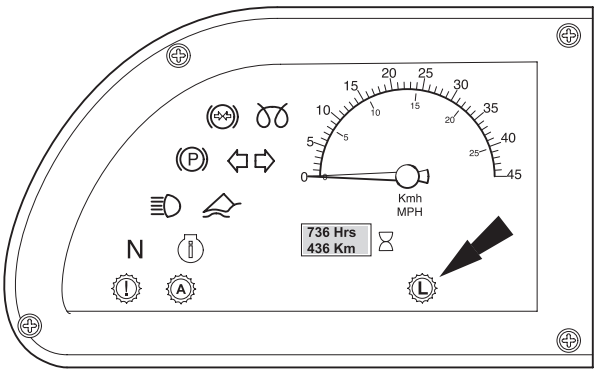
In order to eliminate confusion the error / blink codes can only be displayed one at a time, if two or more errors have occurred then the priority code will be shown first.

Using a Carraro-Terex service tool all codes can be displayed at the same time.

Blink Codes / CTC Codes

Error / blink codes are displayed with a numeric code called CTC (Carraro Trouble Code) of two digits (except CTC 2 no errors). The first digit is represented with a long pulse, the second digit with a short pulse. So four long pulses followed by two short pluses this means error / blink code 42 is active.

The illustration shows the position of the dash board mounted blink light.



TV074030

The table below lists the error / blink codes.

CTC	Meaning	Reaction	Action
2	No errors	None	No action
21	Main ring pressure not ok, or main ring pressure switch failure	Vehicle down	1. Check for continuity between the sensor and ECU pin n.44 2. Check for continuity between sensor and ground 3. Remove the sensor and check the pressure is over 11 bar with the engine running 4. Replace the sensor
23	Engine speed rpm not correct	Use 1600 rpm as default, degraded modulation performance	Check for continuity between engine alternator output for the frequency speed signal and pin 53 ECU
25	FNR lever input pattern error	Vehicle down	1. Check the for continuity between the direction lever and ECU pin 18,46,19,47 2. Check power supply and ground continuity 3. Replace the lever
32	Temperature signal temperature to high over 110º C	No action	1. Cool the transmission 2. Check the transmission cooling system
33	Temperature signal temperature to low below — 20º C	No action	Warm up the transmission
36	Temperature signal sensor failure	Use 60º C as default, degraded modulation performance	1. Check the continuity between the sensor and ECU pin 43 2. Check the continuity between the sensor and ground 3. Replace the sensor
42	Temperature sensor signal to high, temperature sensor not correctly connected		
43	Temperature sensor signal to low, temperature sensor short circuited to ground		
53	Power supply over voltage	No action ECU damaged over 40 V	1. Check power supply to the ECU pins 1,2,5,8,34 2. Admitted range 10 V — 16 V 3. Check the ground continuity ECU pin 29
54	Power supply under voltage	Vehicle down	
57	PWM 1 Forward clutch proportional solenoid over current	Forward direction down	1. Check wiring of the FWD solenoid 2. Check continuity to the ECU pin 3,12 3. Replace the solenoid
58	PWM 4 Reverse clutch proportional solenoid over current	REV Direction down	1. Check wiring of the REV solenoid 2. Check continuity to the ECU pin 7,41 3. Replace the solenoid
CTC	**Meaning**	**Reaction**	**Action**

61	Digital out 1–2 First and second gear solenoids over current	1st and 2nd gear down	1. Check wiring of the 1st and 2nd gear solenoids 2. Check continuity to the ECU pin 9,37 3. Replace 1st and 2nd gear solenoids
62	Digital out 3–4 Third and forth gear solenoids over current	3rd and 4th gear down	1. Check wiring of the 3rd and 4th gear solenoids 2. Check continuity to the ECU pin 10,38 3. Replace 3rd and 4th gear solenoids
64	Digital out 7–8 Auto and transmission status lamps over current	Auto and status lamps down	1. Check wiring of lamps auto and transmission status 2. Check continuity to the ECU pin 42,14 3. Replace auto and transmission status lamps
71	PWM 1 Forward clutch proportional solenoid measured current over reference current / reference current over zero, measured current zero	Forward direction down	Same as CTC 57
77	PWM 4 Reverse clutch proportional solenoid measured current over reference current / reference current over zero, measured current zero	Reverse direction down	Same as CTC 58
88	Serial line communication error	None	Check serial line continuity, then restart ECU
89	Minor internal recoverable ECU error	None	Restart ECU
99	Unrecoverable ECU error	None	Substitute ECU

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DIAGNOSING AND TESTING — CARRARO POWERSHIFT TRANSMISSION PRESSURE TESTING

BHN1307TB

⚠ **Warning:**

- **Do not work on or around hydraulic systems without wearing safety glasses. Failure to follow this instruction, may result in personal injury.**

Note:

- All pressure tests to completed with the transmission at 80°C.

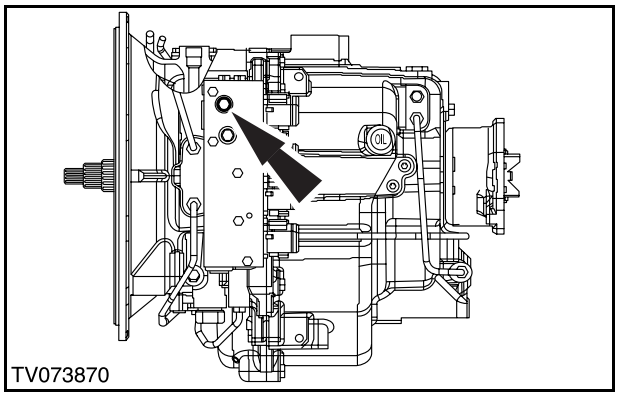
Note:

- All temperature and pressure test ports have 9/16” - 18 UNF-2B.

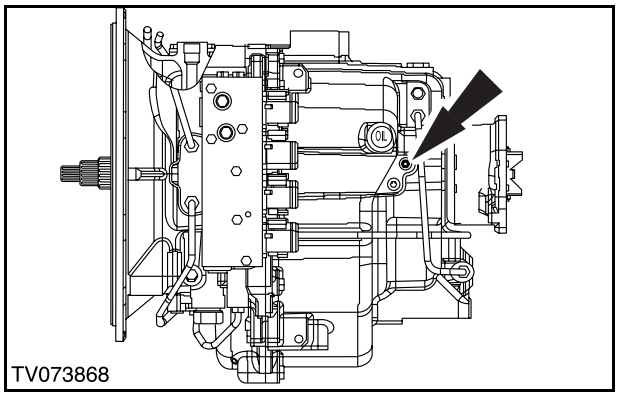
Measure pressures at 900 — 2200 RPM engine speed with the oil temperature at 80°C.
Pump acceptance criteria on bench test : 19 ltr per min total pump flow at 900 rpm measured before filter.

1	Torque Converter pressure test port
2	Forward clutch pressure test port
3	Reverse clutch pressure test port
4	Lubrication pressure test port
5	Gear pressure test port
6	Control valve pressure test port
7	Differential lock pressure test port

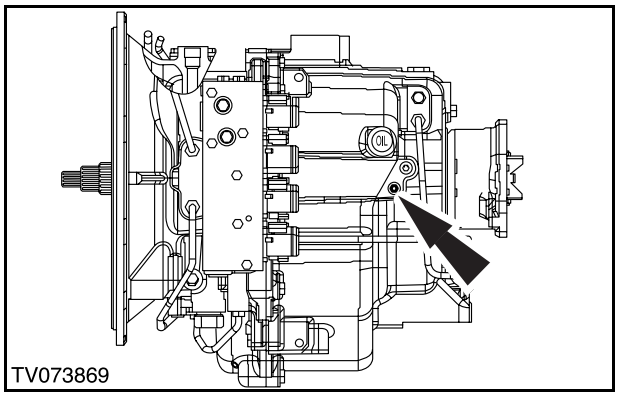
1. **Gear pressure test port** Transmission top view



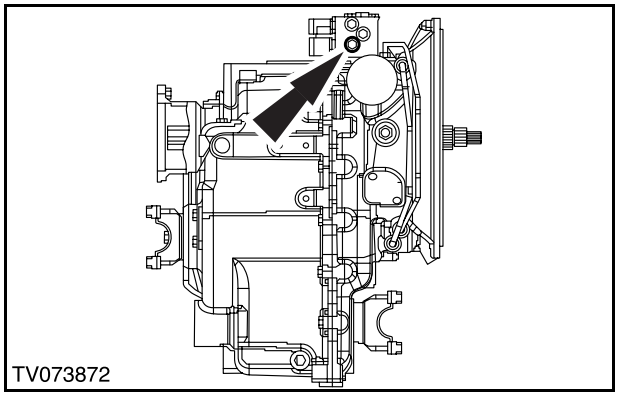
2. **Forward clutch pressure test port** Transmission top view
   - Select forward first
   - Pressure should be 13.5 – 16.5 bar
   - Max pressure 0.3 bar in neutral



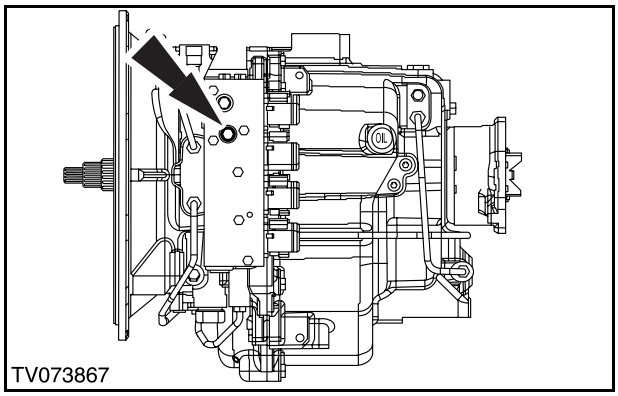
3. **Reverse clutch pressure test port** Transmission top view
   - Select reverse first
   - Pressure should be 13.5 – 16.5 bar
   - Max pressure 0.3 bar in neutral



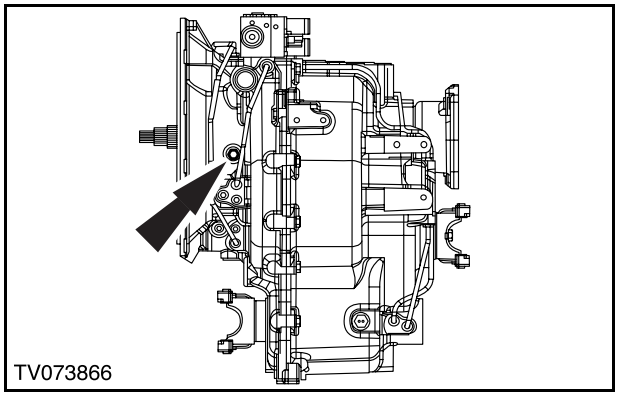
4. **Differential lock pressure test port** Transmission right side view
   - Pressure should be 14 — 17 bar



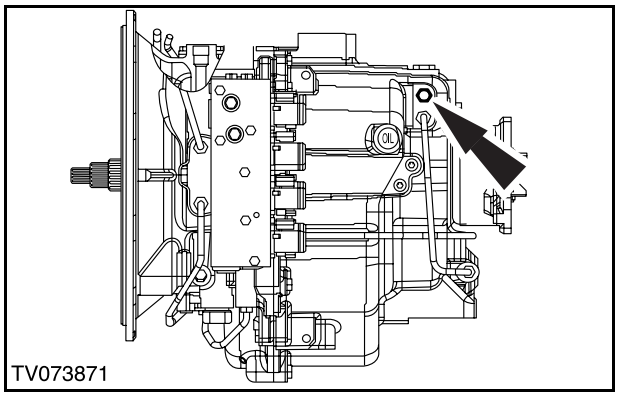
5. **Control valve pressure test port** Transmission top view
   - Pressure should be 14 — 17 bar



6. **Torque converter inlet pressure test port** Transmission left hand side view
   - Pressure should read between 3.0 — 9.0 bar.


TV073866

7. **Lubrication pressure test port** Transmission top view
   - Pressure should be 1 — 5 bar on neutral clutch position
   - Pressure should be 1 — 5 bar on FWD / REV clutch position


TV073871

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REMOVAL AND INSTALLATION — CARRARO POWERSHIFT TRANSMISSION

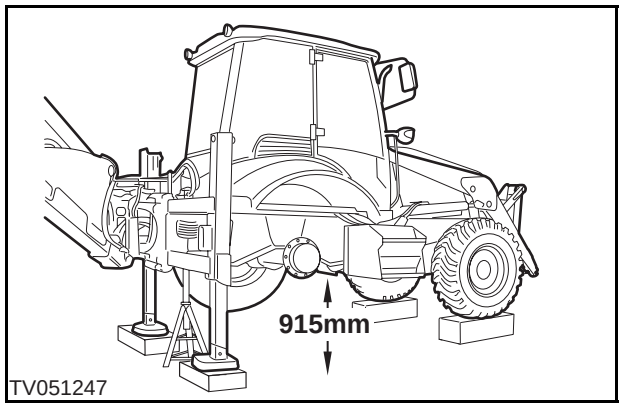
BHN1307RA

Operation: **Removing and Installing the Powershift Transmission**	*Job Code:* **xx xx xx xx**		
Suitable lifting equipment, Suitable transmission jack	Standard tools		

Removal

1. Park the machine on firm level ground.
2. Position 150mm blocks under each stabiliser and fully lower. Raise the front of the machine to the same level and position 150 mm blocks under each front wheel.
3. Remove the right-hand rear wheel. For additional information, refer to Section M12-01 REAR WHEEL, PAGE M12–01–5 .
4. Support the machine.

   Note:
   - Ensure there is at least 915mm clearance between the ground and the chassis .

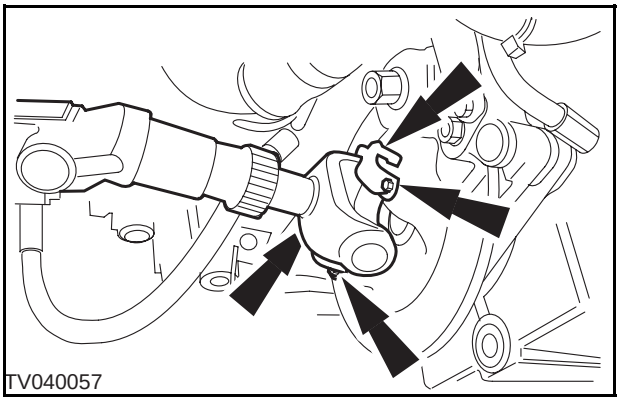


5. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .

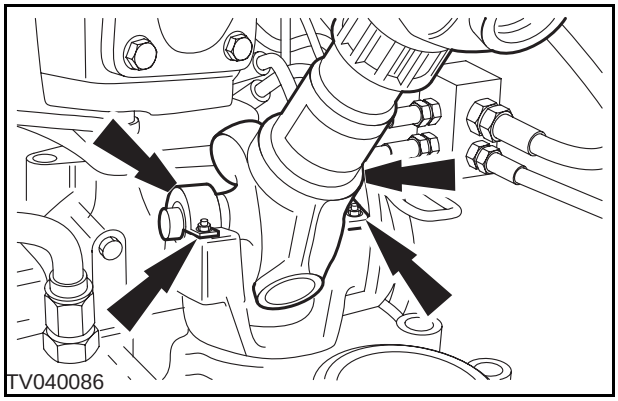
   Note:
   - Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

6. Drain the transmission fluid into a suitable container.
7. Install the transmission drain plug and a new O-ring.
8. Tighten to 44Nm (32 lb.ft).

9. Detach the rear propeller shaft from the rear axle.


TV040057

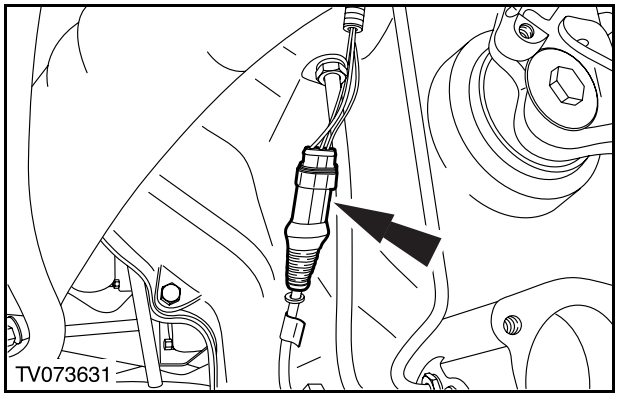
10. Remove the rear propeller shaft from the transmission.


TV040086

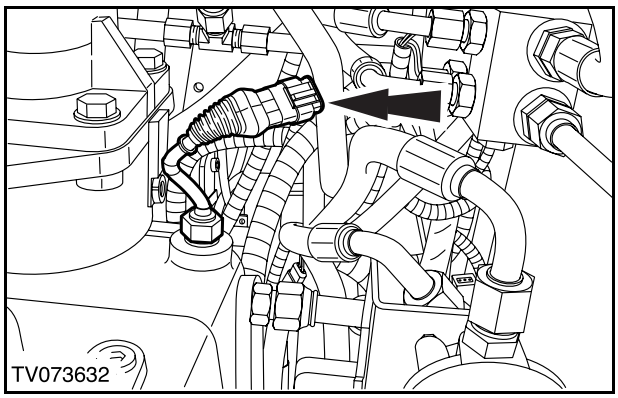
⚠ **Caution:**
- **Secure the universal joint bearing cups to prevent contamination or damage.**

Note:
- Remove and discard the retaining bolts.

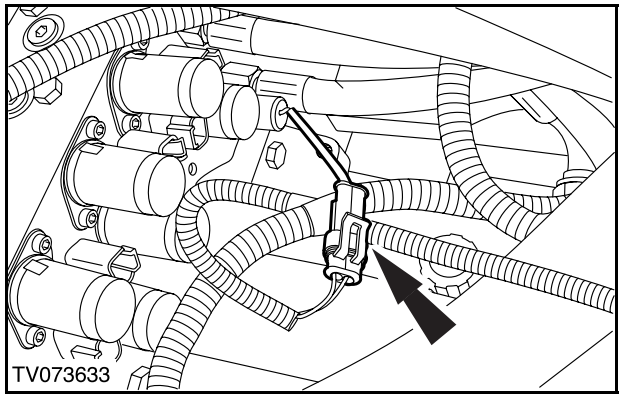
11. Disconnect the speed sensor electrical connector.


TV073631

12. Disconnect the transmission temperature sensor electrical connector.



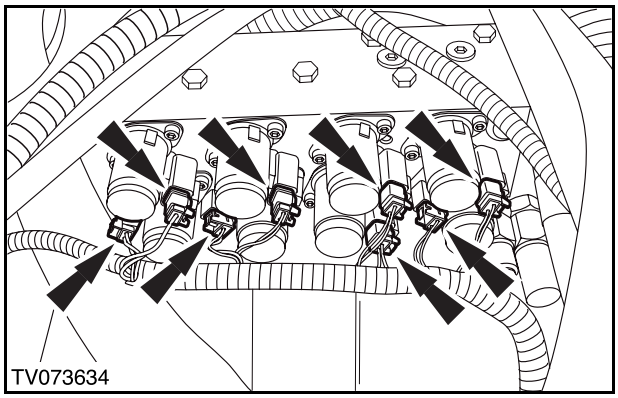
13. Remove the cabin heater air ducting. For additional information, refer to Section H08-01 CABIN HEATER AIR DUCTING, PAGE H08–01–13 .
14. Disconnect the transmission fluid pressure sensor electrical connector.



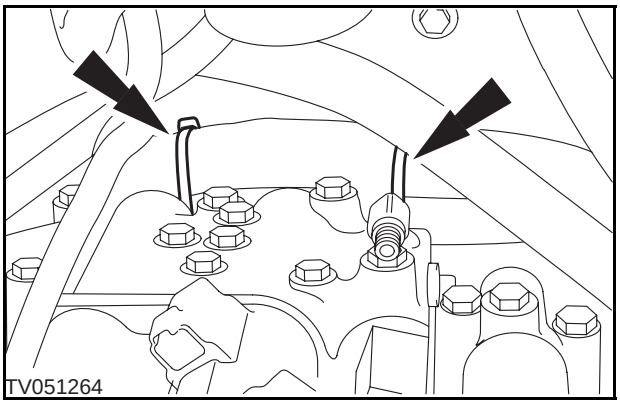
Note:

- Make a note of the position of any electrical connectors prior to disconnection to aid installation.

15. Disconnect the 8 transmission valve block electrical connectors.



16. Remove the wiring harness cable ties.



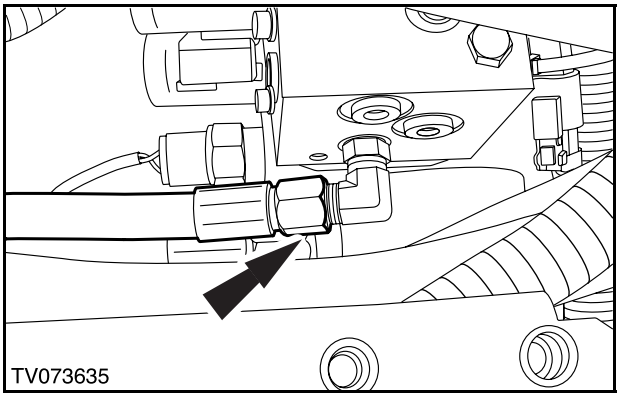
⚠ **Caution:**

- **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

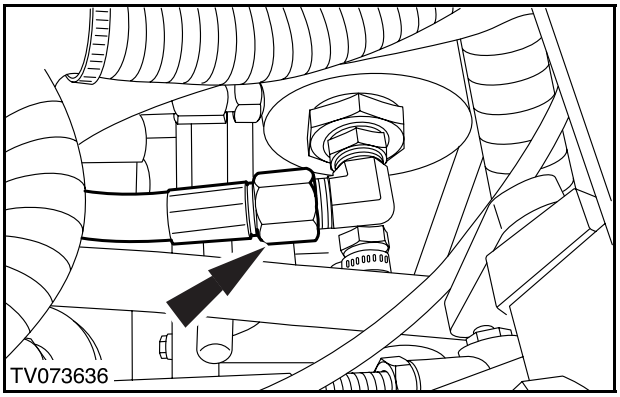
Note:

- Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

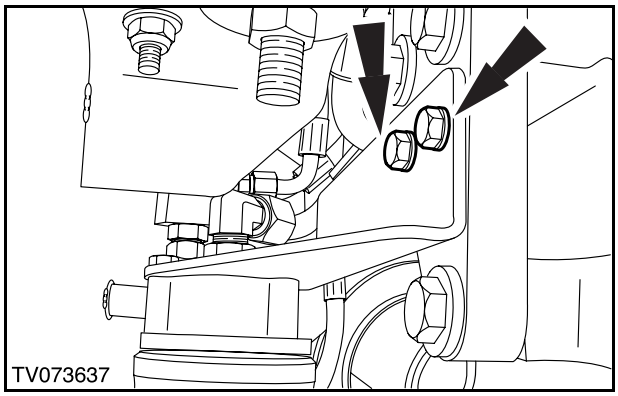
17. Disconnect the differential lock hydraulic feed hose from the differential lock.



18. Disconnect the oil filter feed hose from the transmission.



19. Detach the oil filter mounting bracket from the transmission mounting bracket and position to one side.



⚠ **Caution:**

- **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

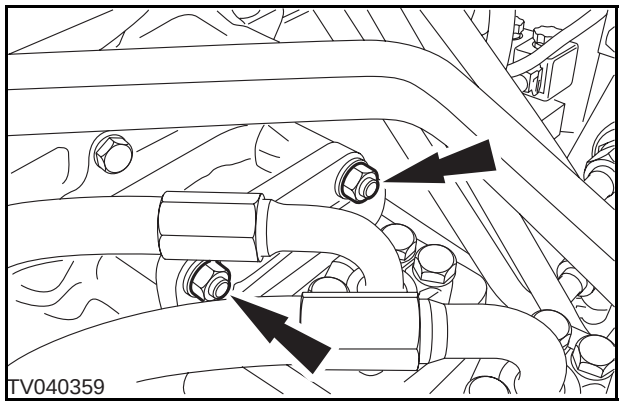
Note:

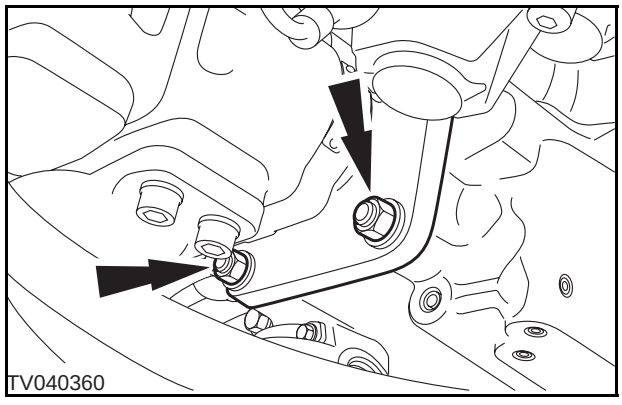
- Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

Note:

- Support the hydraulic pump using suitable straps.

20. Release the hydraulic pump from the rear of the transmission and position to one side.





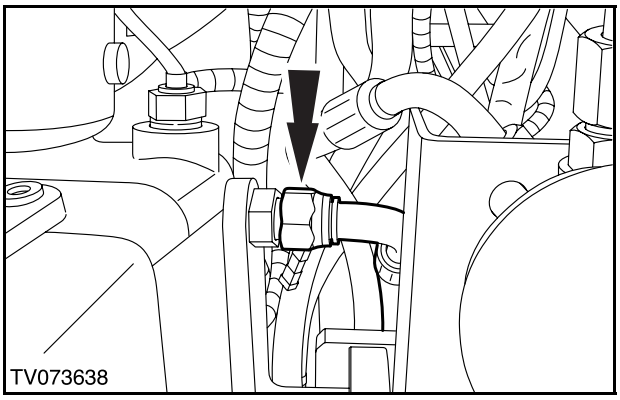
⚠ **Caution:**

- **Clean around any hoses or pipe work prior to being disturbed. Blank-off any resulting apertures to prevent the ingress of dirt or foreign objects which may result in damage to the machine.**

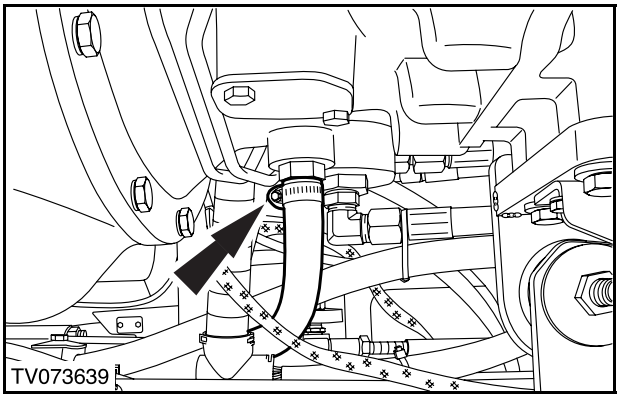
Note:

- Be prepared for some fluid loss. Collect the fluid in a suitable container and dispose of the fluid in an appropriate manner.

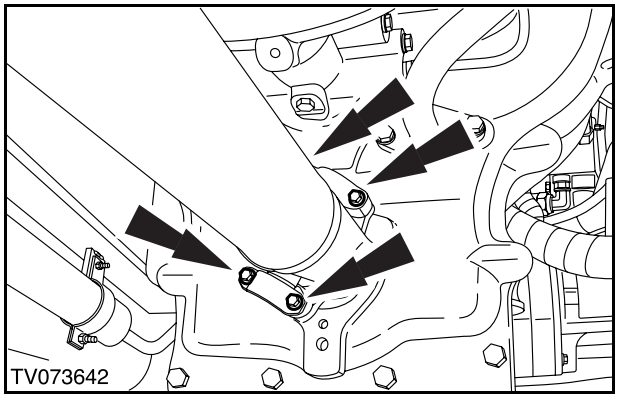
21. Release the oil cooler inlet hose.



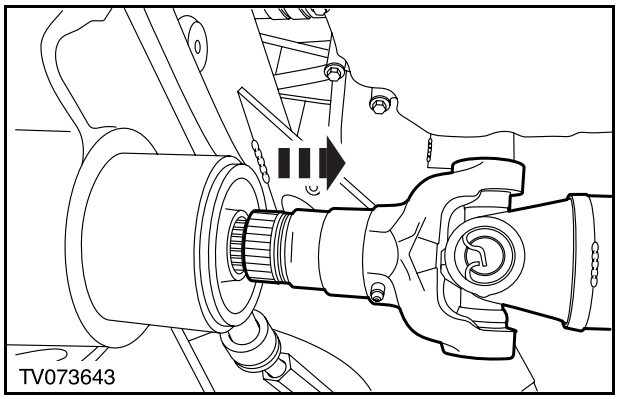
22. Release the oil cooler outlet hose.



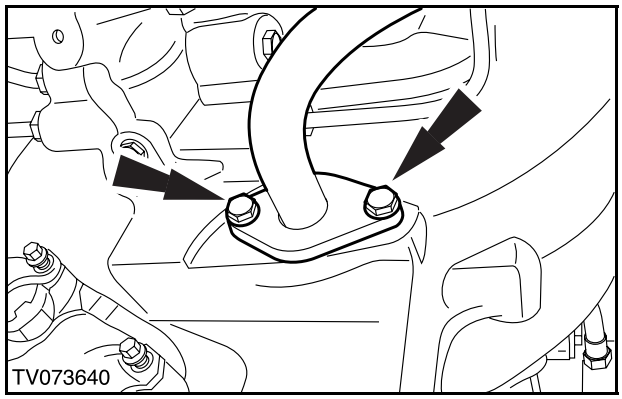
23. Detach the front propeller shaft from the transmission.



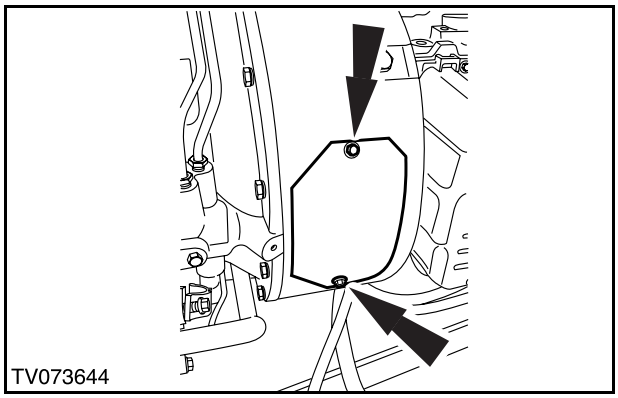
24. Remove the front propeller shaft.



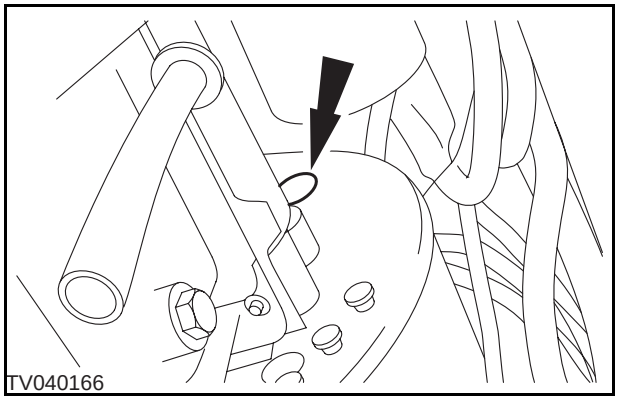
25. Remove the dipstick / oil filler tube from the transmission.



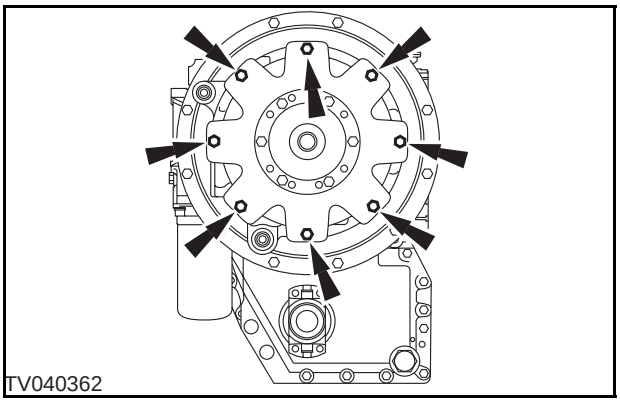
26. Remove the torque converter housing cover plate.



27. Remove the torque converter bolt access hole blanking plug.



28. Using the access hole remove the torque converter retaining bolts.

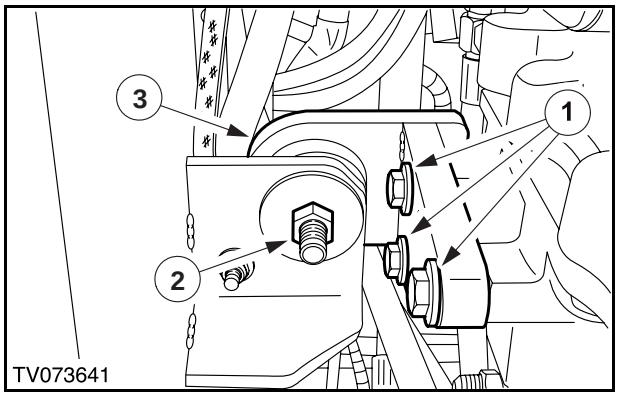


⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

29. Position a suitable transmission jack under the transmission and secure the bell housing using suitable straps or chains.
30. Position a suitable jack under the engine and support.
31. Reposition the hydraulic hoses and wiring harness for access to the mounting bolts.

Note:
- Left-hand side shown, right-hand side similar.

32. Remove the transmission rear mounting bracket retaining bolts (1) and the mounting bolts (2) remove the mounting brackets (3).



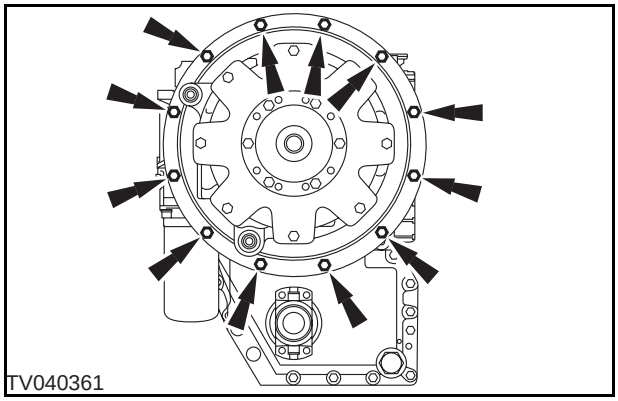
33. Remove the transmission mounting brackets and secure the rear of the transmission to the transmission jack.

Note:
- Position of the earth straps

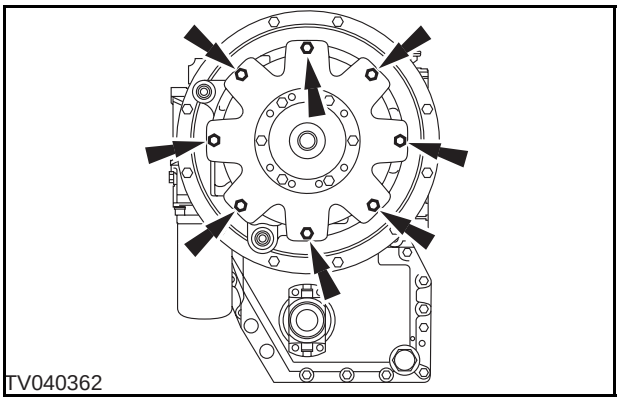
34. Remove the transmission retaining bolts.
35. Detach the transmission from the engine.
36. Lower the transmission and withdraw from the machine.

Installation

1. To install, reverse the removal procedure.
2. Tighten to 71 Nm (52 lb.ft).

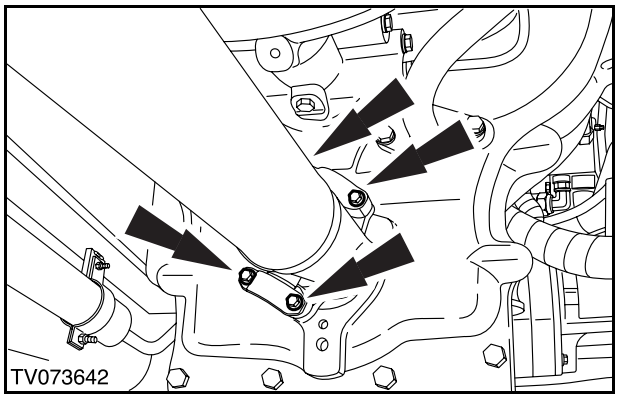

TV040361

3. Tighten to 41 Nm (30 lb.ft).

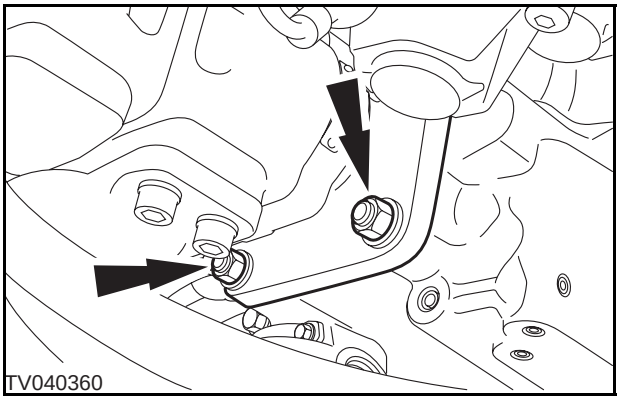

TV040362

Note:
- Install new propeller shaft retaining bolts.

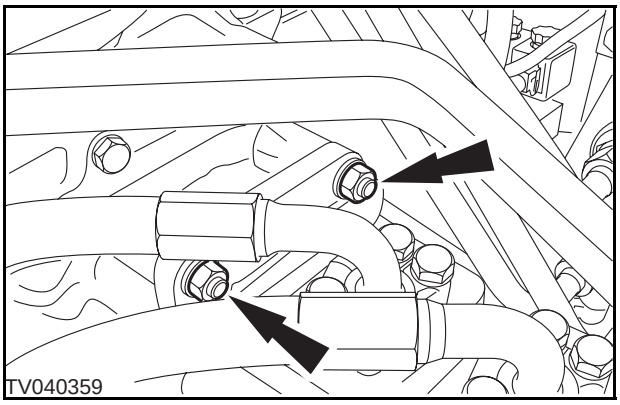
4. Tighten to 47 Nm (35 lb.ft).


TV073642

5. Tighten to 98Nm (72 lb.ft).

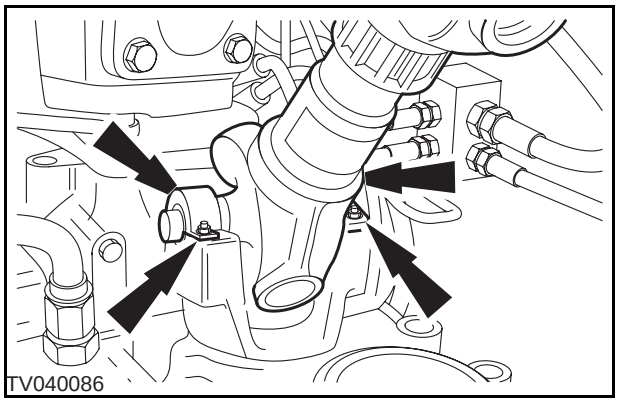

TV040360

6. Tighten to 98Nm. (72 lb.ft).


TV040359

Note:
- Install new retaining bolts.

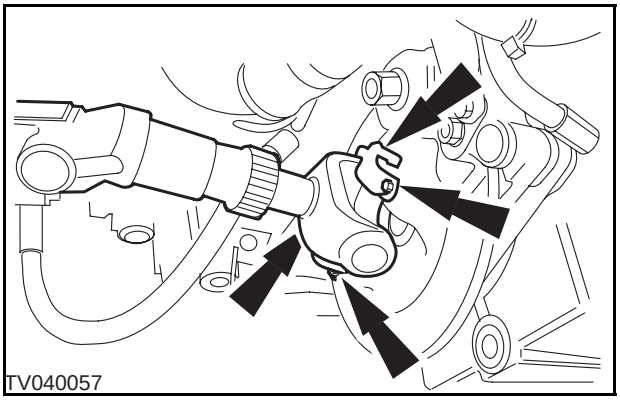
7. Tighten to 47 Nm (35 lb.ft).


TV040086

⚠ **Caution:**
- **Make sure the propeller shaft universal joints are in line. Failure to follow this instruction may result in damage to the machine.**

Note:
- Install new retaining bolts.

8. Tighten to 47Nm (35 lb.ft).


TV040057

DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT TRANSMISSION

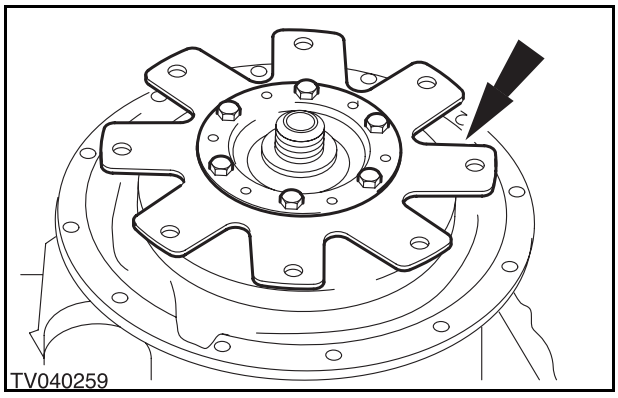
BHN1307DA

Operation: **Disassembly and Assembly of the Powershift Transmission**	*Job Code:* **xx xx xx xx**		
Suitable lifting equipment	Standard tools, Locally fabricated transmission housing lifting tool, Suitable puller, Bearing heater		

Disassembly

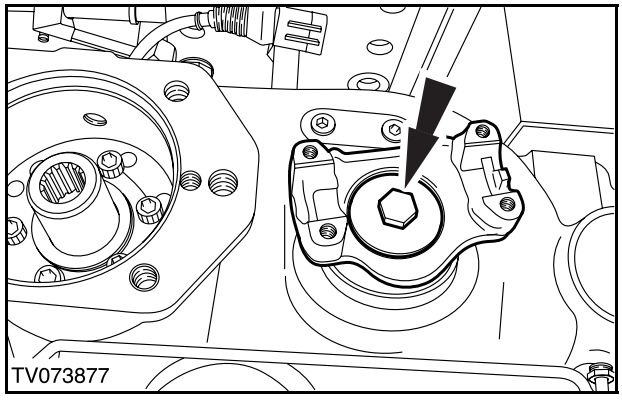
Note:
- Mount the transmission to a suitable stand

1. Remove the torque converter.

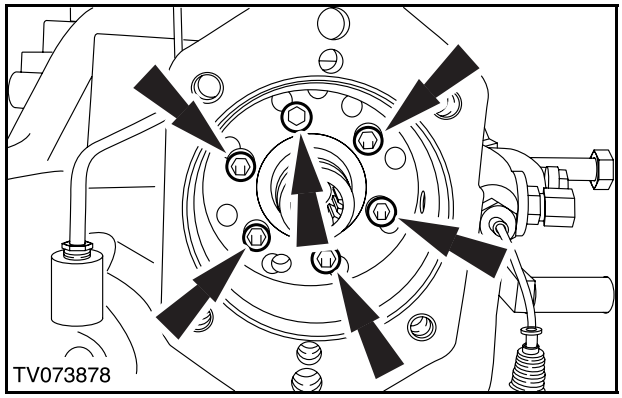


2. Remove and discard the transmission oil filter.
3. Remove the rear drive flange retaining bolt. Recover the washer, O-ring seal and remove the rear drive flange.

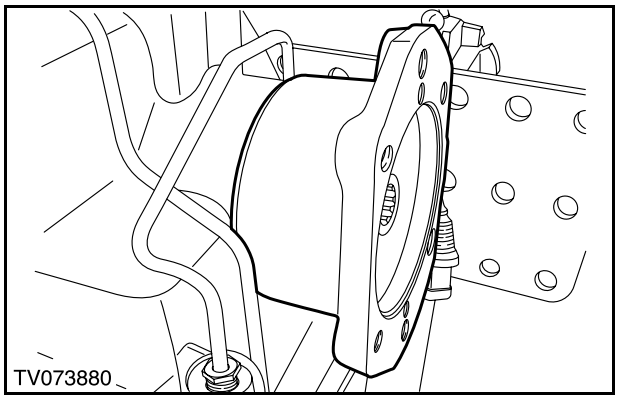
Note:
- Remove and discard the rear drive flange seal.



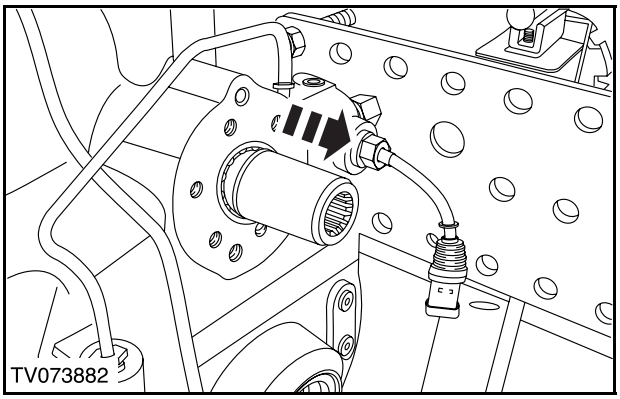
4. Remove the power take off flange retaining bolts.



5. Remove the power take off flange.

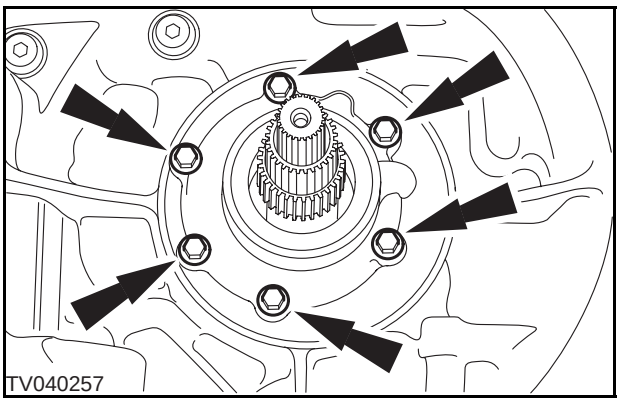


6. Remove the power take off drive shaft.

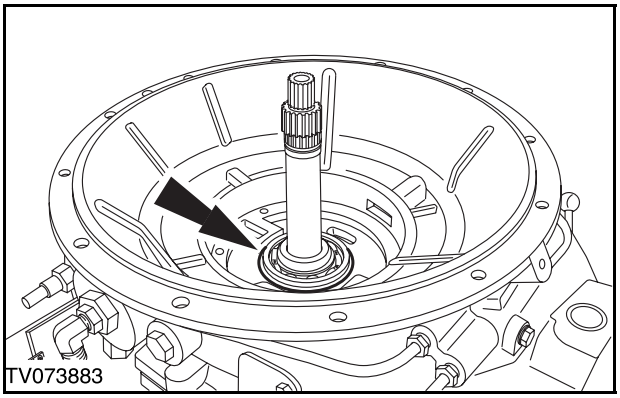


Note:
- Mark the position of the transmission oil pump to aid reassemble.

7. Remove the transmission oil pump retaining bolts and then remove the transmission oil pump.

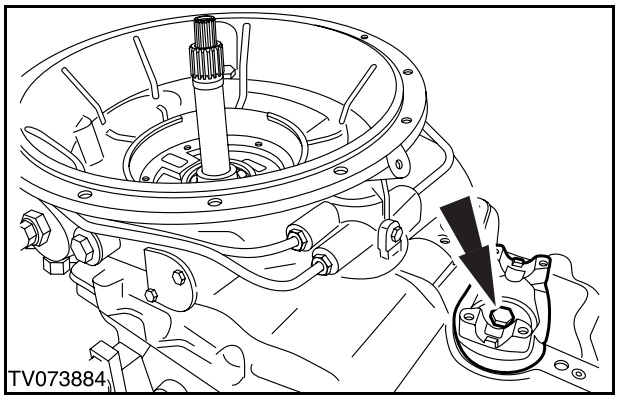


8. Using suitable snap ring pliers, remove the input shaft bearing snap ring.



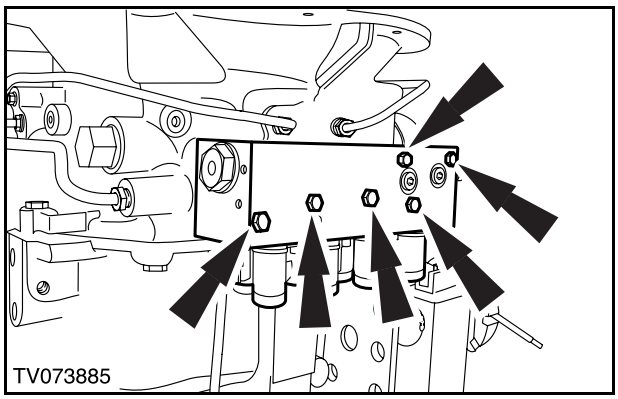
9. Remove the four-wheel drive flange retaining bolt. Recover the washer, O-ring seal and remove the four-wheel drive flange.

Note:
- Remove and discard the 4WD flange oil seal.

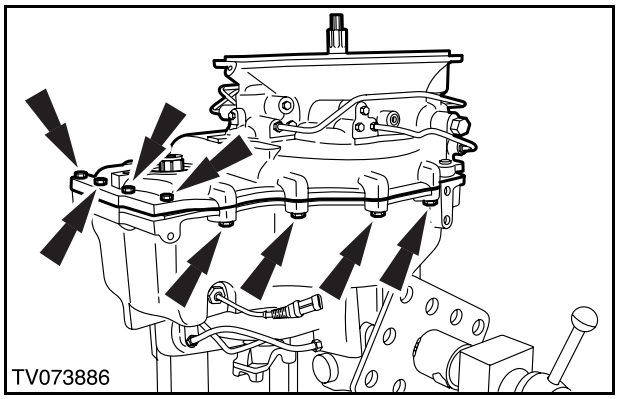


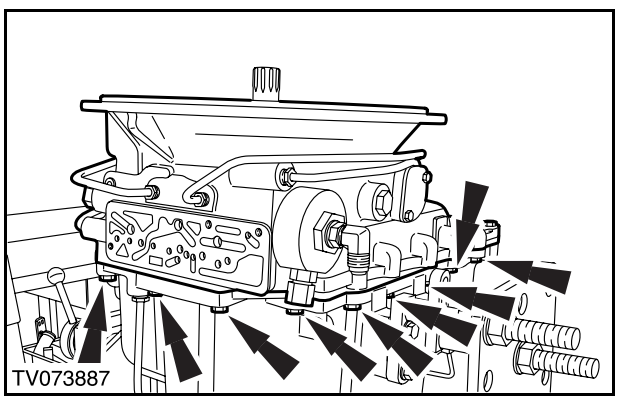
10. Remove the solenoid block.

Note:
- Remove and discard the gasket.



11. Remove the front casing retaining bolts.

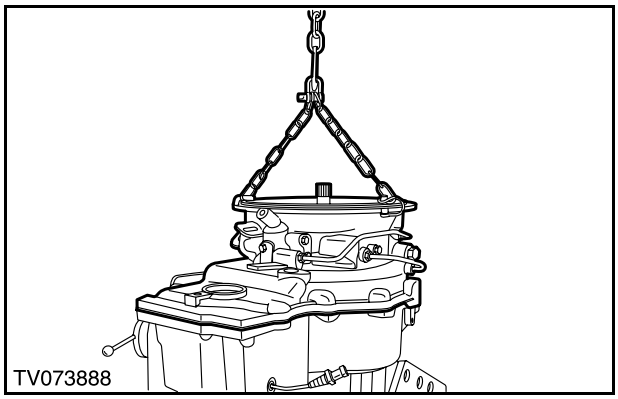




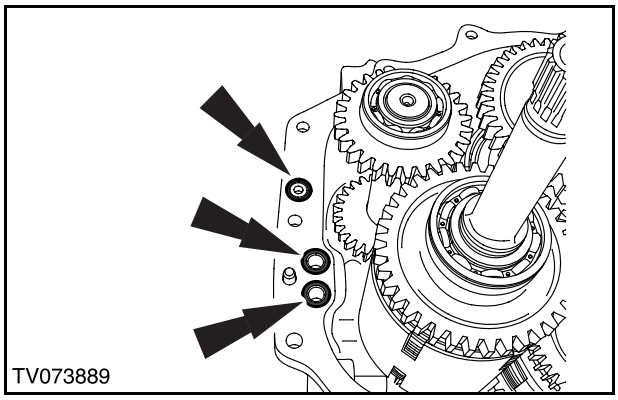
⚠ **Warning:**

- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

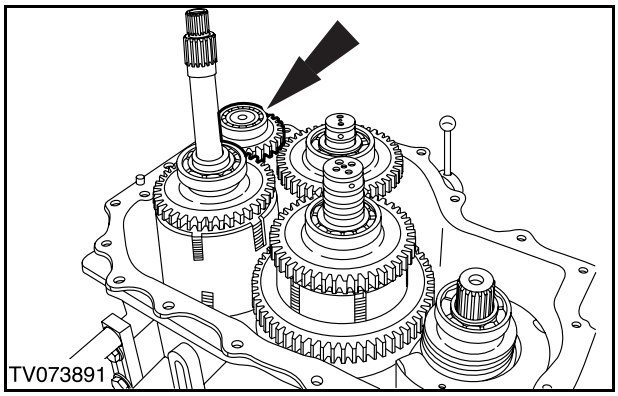
12. Remove the front casing .



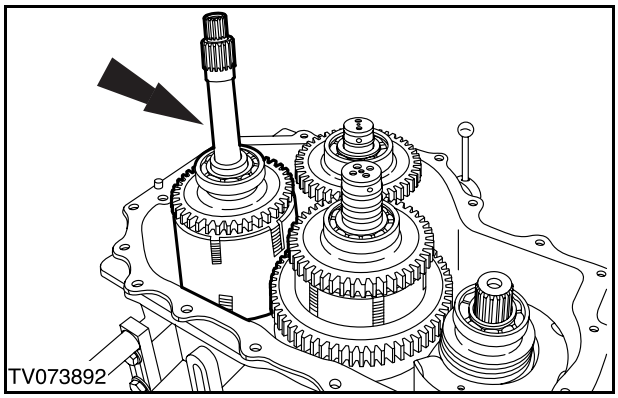
13. Remove and discard the O-ring seals.



14. Remove the reverse idler shaft.



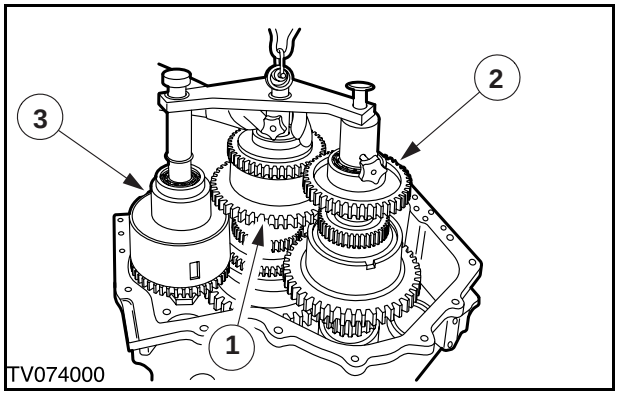
15. Remove the input shaft forward and reverse clutch assembly.



16. Remove the oil retaining cover.

Note:
- Using the Carraro CA715732 special tool

17. Remove the third and fourth clutch assembly (1) with the second clutch assembly (2) complete with the four wheel drive clutch (3).



Assembly

Note:
- Install new O-ring seals.

⚠ Caution:
- **Take care not to damage the sealing rings.**

⚠ Caution:
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

⚠ Caution:
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

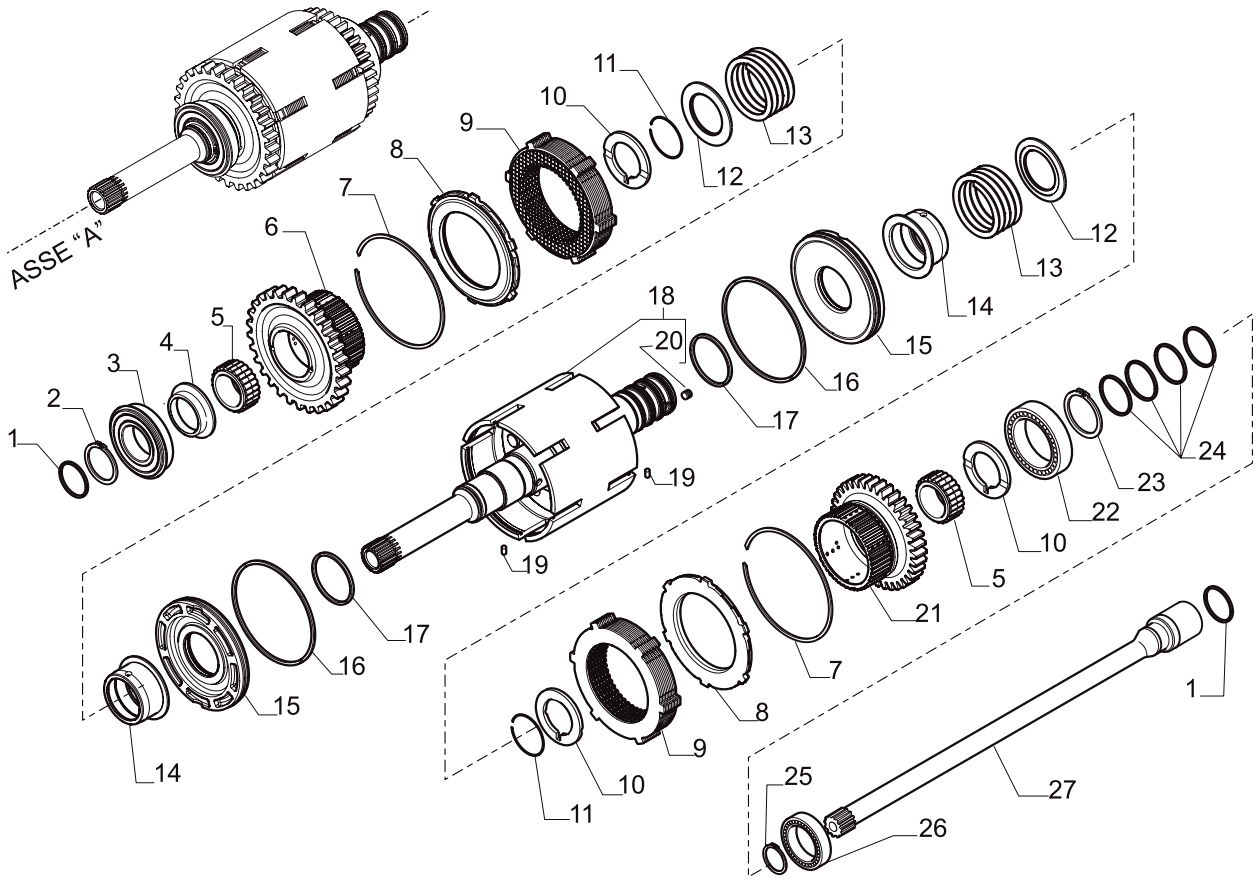
Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

1. To assemble, reverse the disassembly procedure.

DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT FORWARD AND REVERSE CLUTCHES

BHN1307DB

Operation: **Disassembly and Assembly of the Forward and Reverse Clutches**	*Job Code:* **xx xx xx xx**		
None	Standard tools, Clutch piston spring compressor		

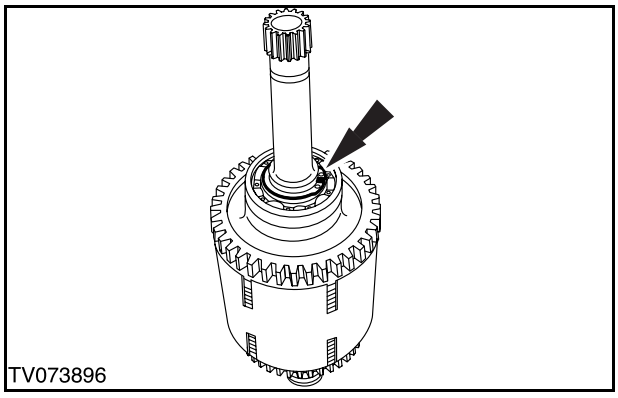


TV073895

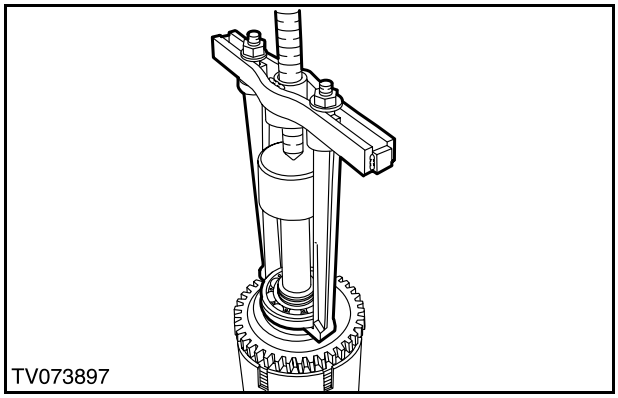
1	Seal ring
2	Snap ring
3	Bearing
4	Spacer
5	Needle bearing bush
6	Gear Z37 (rvs)
7	Lockring
8	Clutch plate lockring
9	Clutch kit
10	Thrust washer
11	Lockring
12	Lock-spring cover
13	Spring
14	Clutch sleeve
15	Clutch piston
16	Seal ring
17	Seal ring
18	Inner shaft
19	Split pin
20	Rivet
21	Gear Z37 (fwd)
22	Bearing
23	Snap ring
24	Seal ring
25	Snap ring
26	Bearing
27	PTO transmission shaft

Disassembly — Reverse clutch

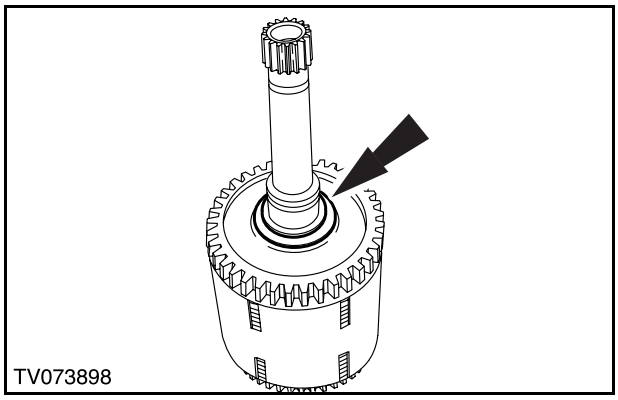
1. Remove the circlip.


TV073896

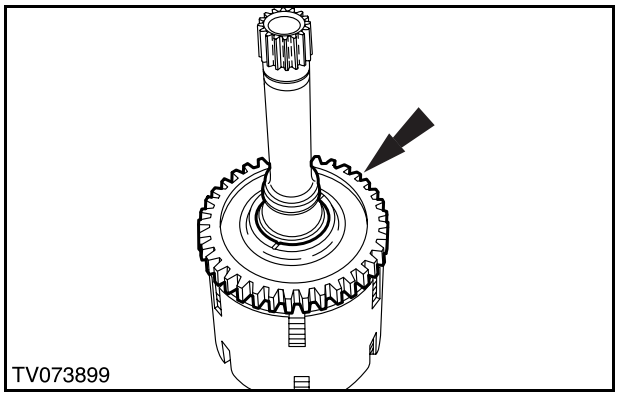
2. Using a suitable puller release the bearing from the shaft.


TV073897

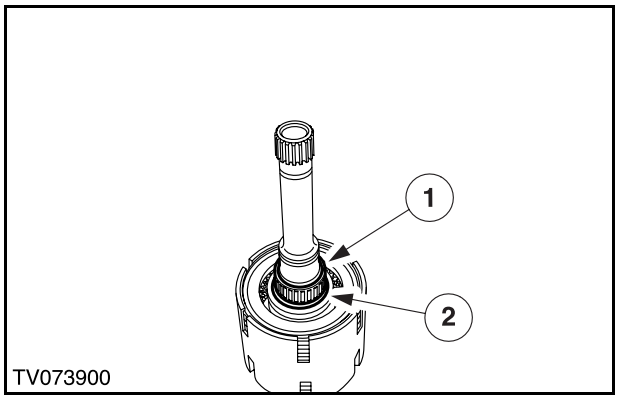
3. Remove the spacer.


TV073898

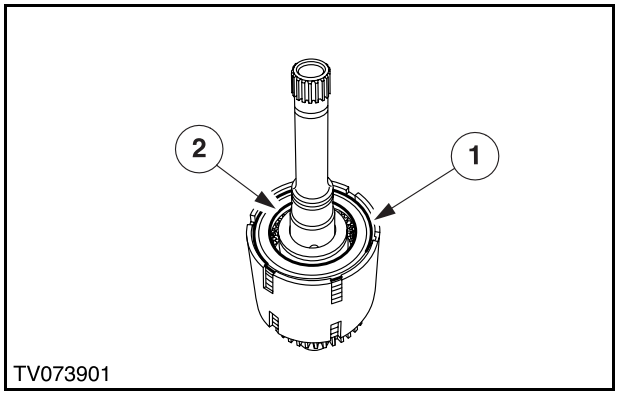
4. Remove the reverse drive gear.


TV073899

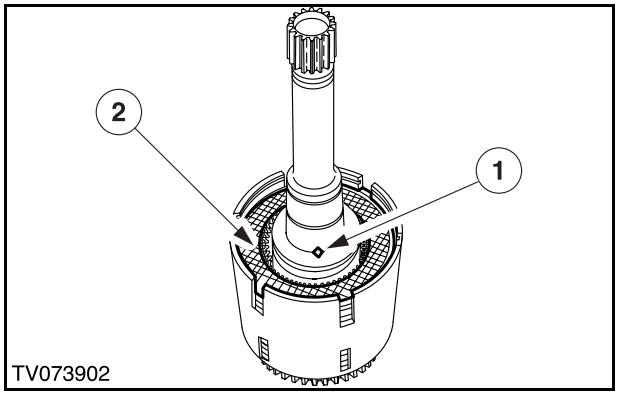
5. Remove the needle bearing bush (1) and the thrust washer (2).



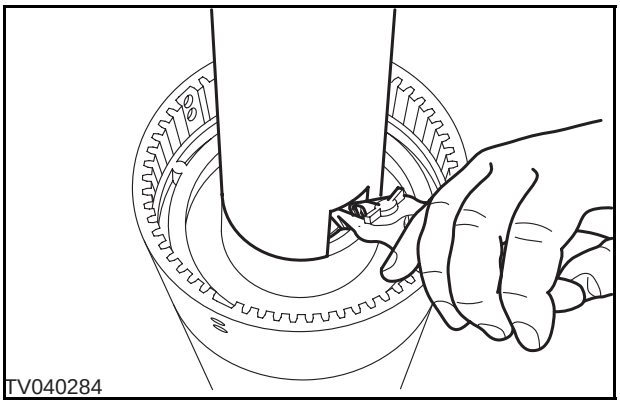
6. Remove the snap ring (1) and the retaining ring (2).



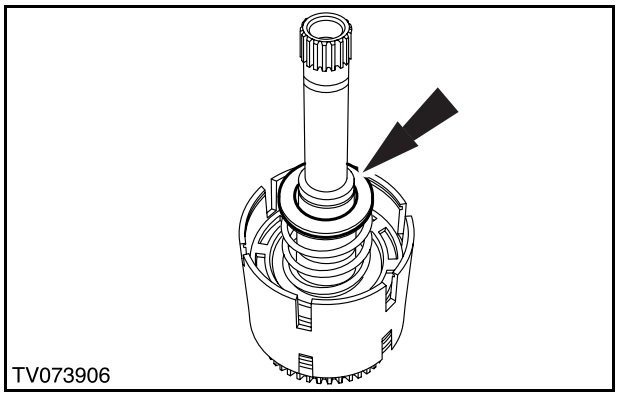
7. Remove the roll pin (1) and the clutch pack (2).



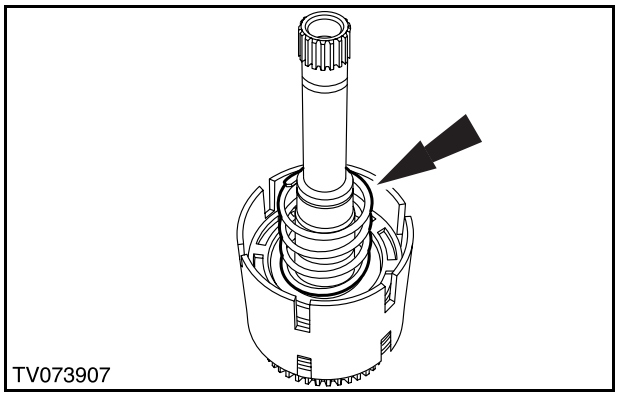
8. Using a suitable hydraulic press, compress the piston return spring.
9. Using suitable circlip pliers, release the piston return spring retaining circlip.



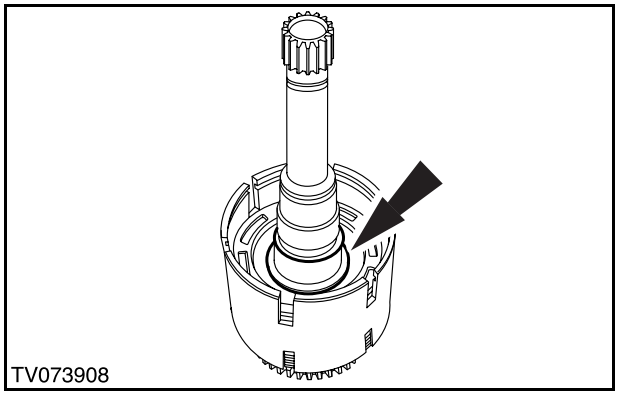
10. Remove the retaining ring



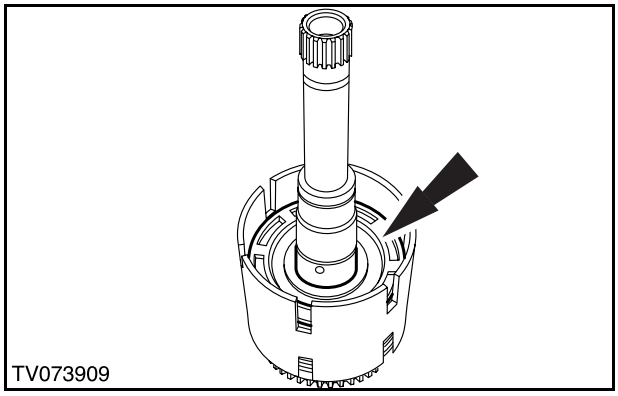
11. Remove the spring.



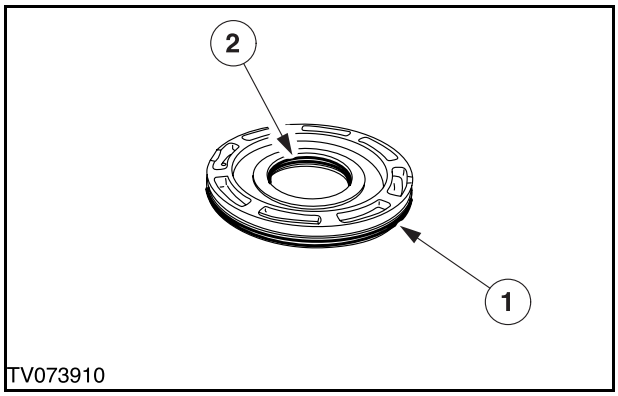
12. Remove the clutch sleeve.



13. Remove the clutch piston



14. Remove and discard the clutch piston outer seal (1) and inner seal (2).

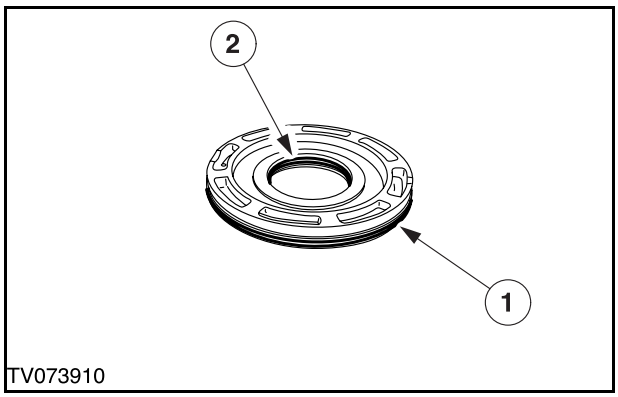


Assembly reverse clutch

Note:
- Install new seals.

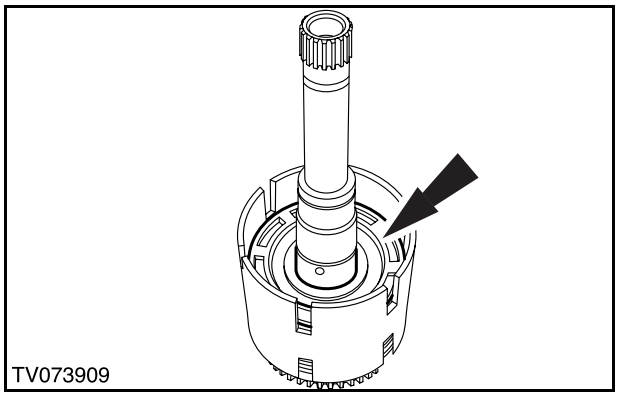
1. Install the clutch piston outer seal (1) and inner seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

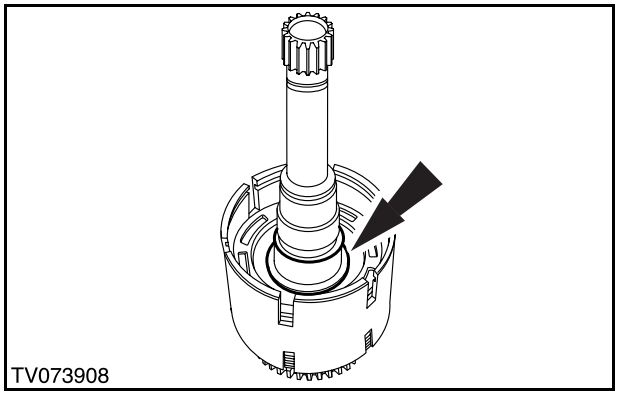


⚠ **Caution:**
- **Take care not to damage the sealing rings.**

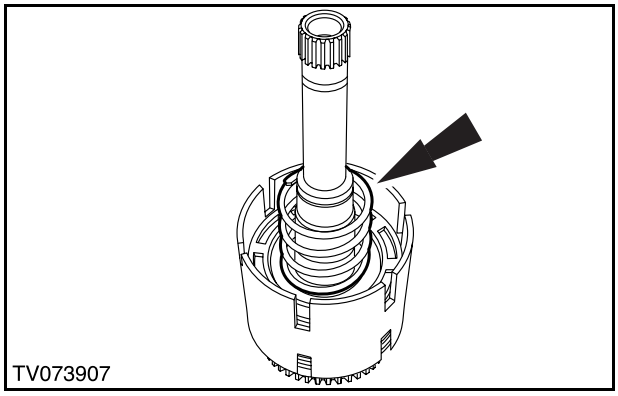
2. Install the clutch piston into the clutch drum.



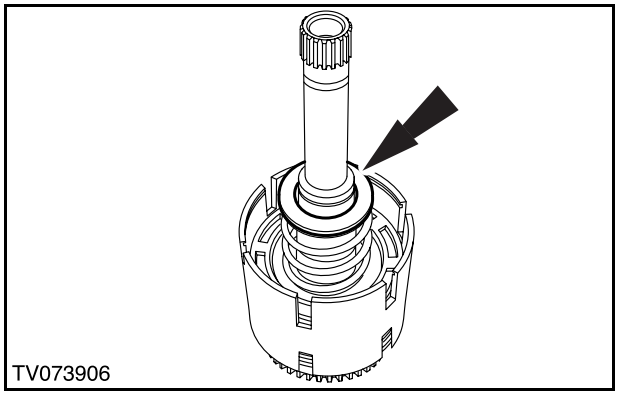
3. Install the clutch sleeve.



4. Install the piston return spring.

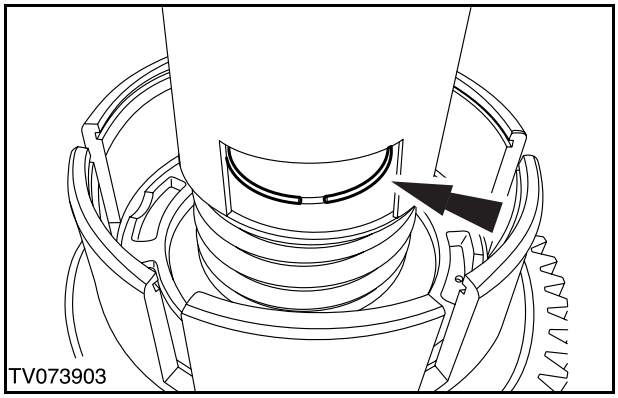


5. Install the retaining ring.



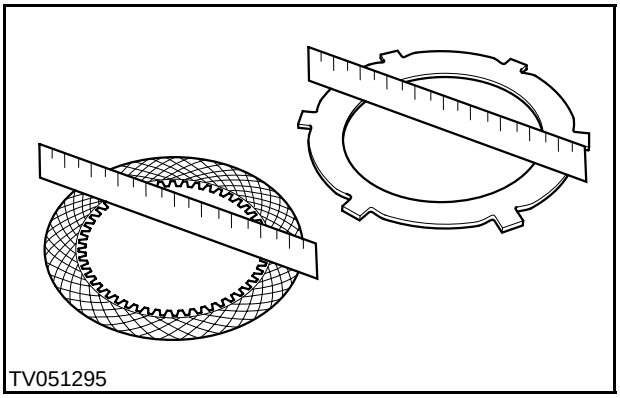
6. Using a suitable hydraulic press, compress the piston return spring.
7. Using suitable snap ring pliers, install the circlip.

Note:
- Make sure the snap ring is correctly located in the groove.



8. Using a suitable steel straight edge, check the flatness of both the drive plates and the friction plates from the clutch pack.

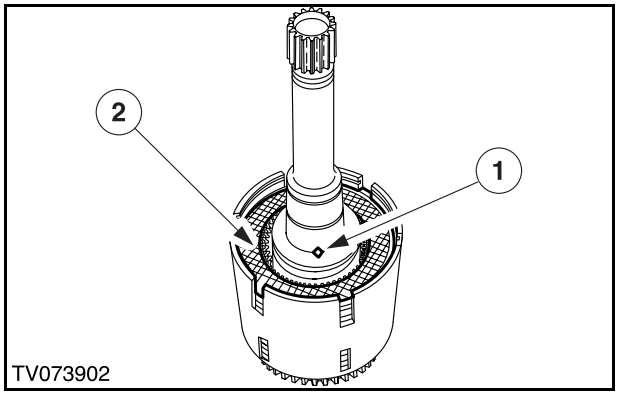
Note:
- Any plates found to be warped, damaged or worn must be replaced


TV051295

Note:
- Soak new friction discs in transmission oil before assembly.

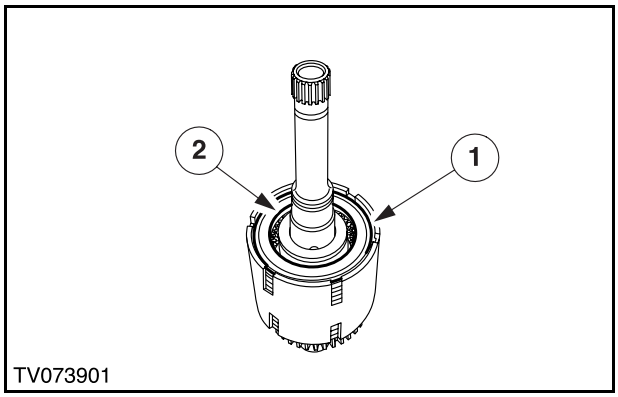
Note:
- Alternate the friction and steel discs until the correct amount of discs are installed.

9. Install the clutch pack (2) and roll pin (1).



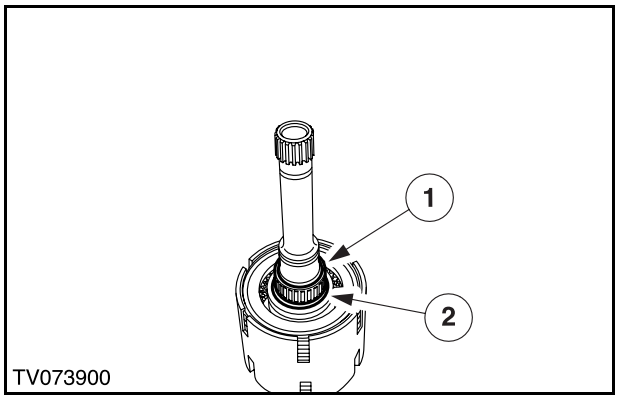
TV073902

10. Install the retaining ring (2) and the snap ring (1).



TV073901

11. Install the spacer (2) and the bearing (1).

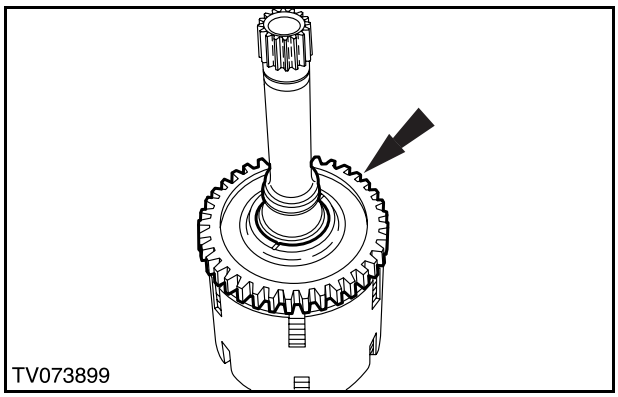


⚠ **Caution:**
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

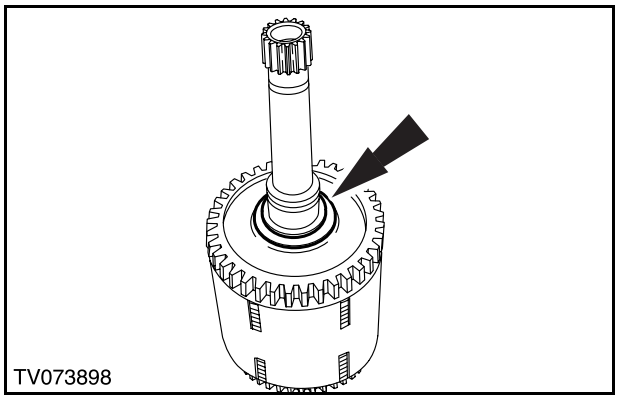
⚠ **Caution:**
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

12. Install the reverse drive gear.



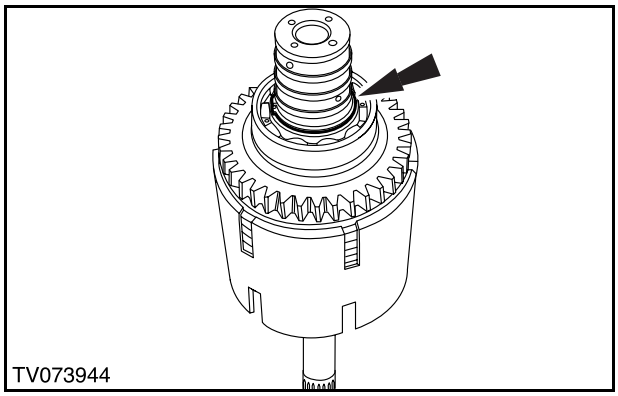
13. Install the spacer.



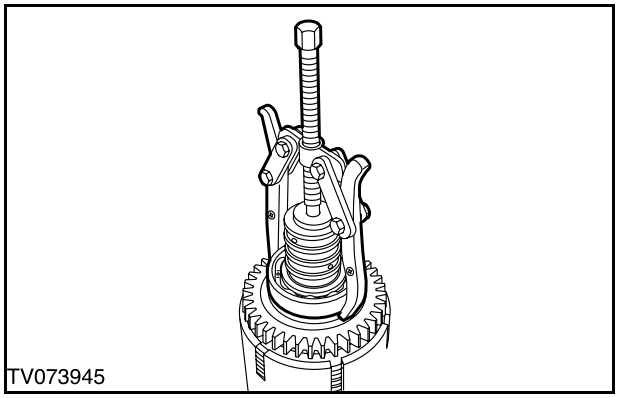
14. Using a suitable hydraulic press and sleeve install the bearing.
15. Install the circlip.

Disassembly Forward clutch

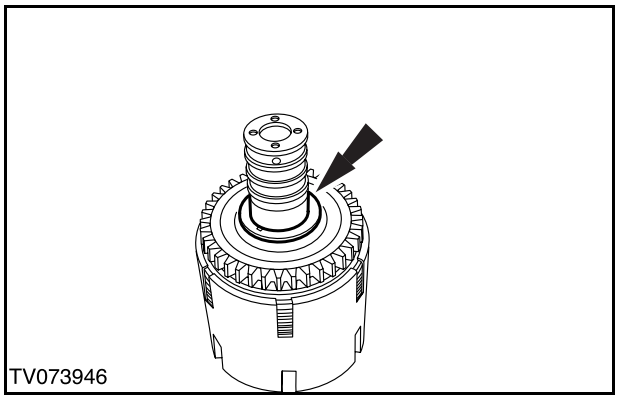
1. Remove the circlip.



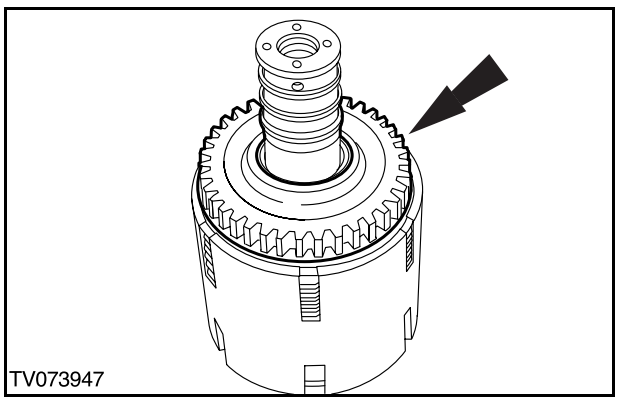
2. Using a suitable puller release the bearing from the shaft.



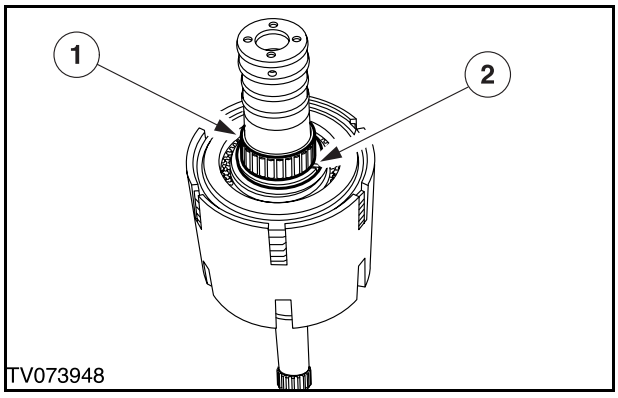
3. Remove the spacer.



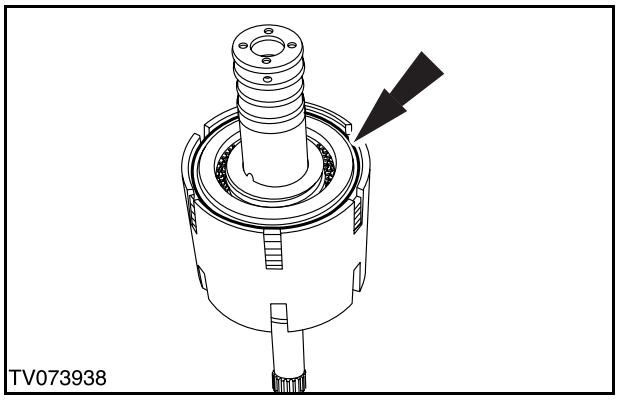
4. Remove the forward drive gear.



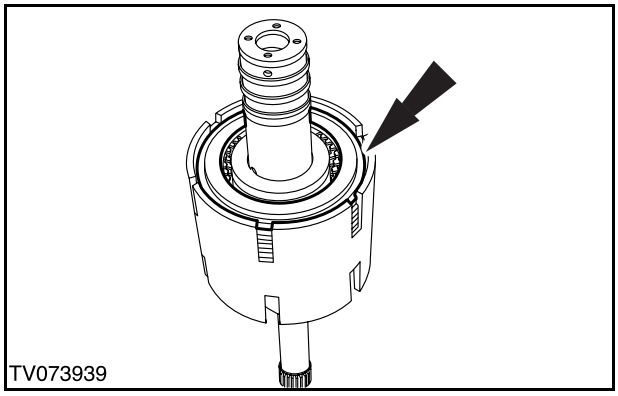
5. Remove the needle bearing bush (1) and the spacer (2).



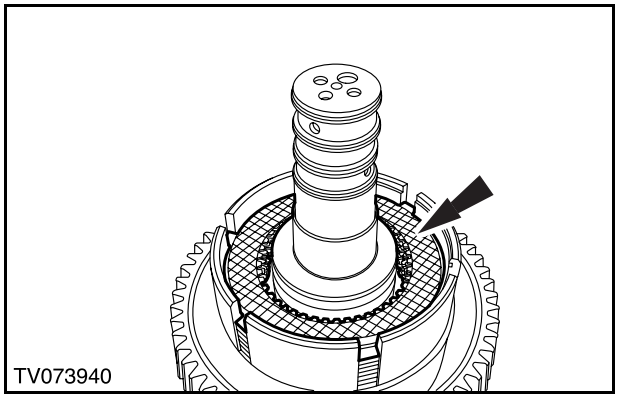
6. Remove the snap ring.



7. Remove the retaining ring.

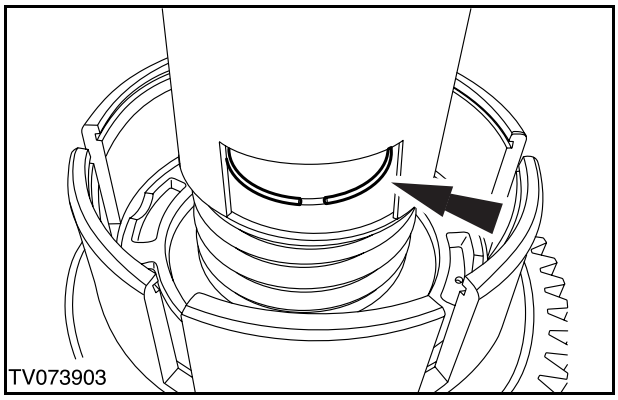


8. Remove the roll pin and clutch pack.

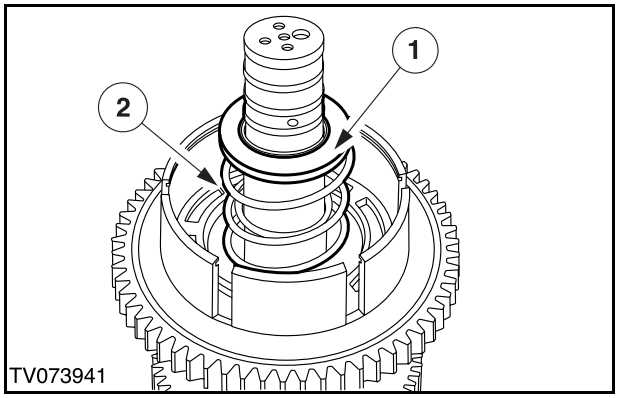


9. Using a suitable hydraulic press, compress the piston return spring.

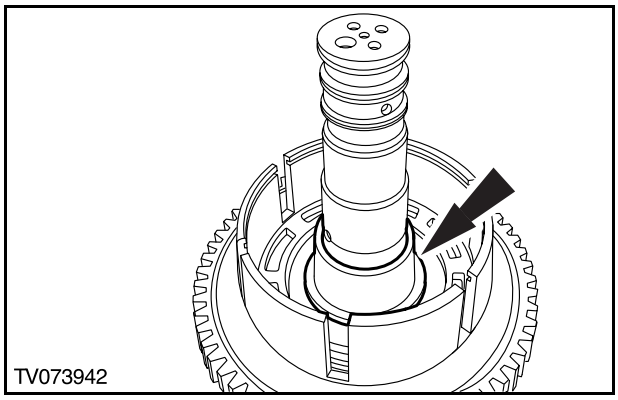
10. Using suitable circlip pliers, release the piston return spring retaining circlip.



11. Remove the retaining ring (1) and the spring (2).



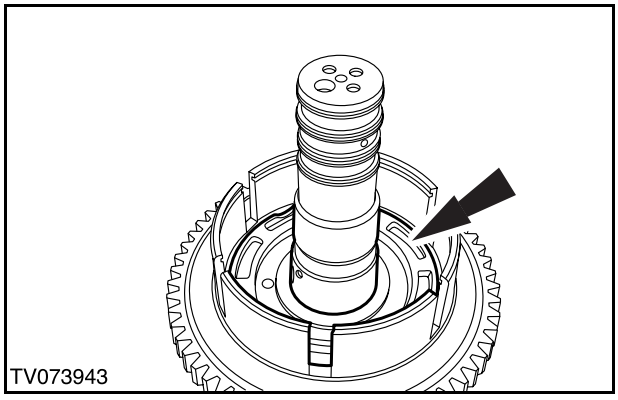
12. Remove the clutch sleeve.



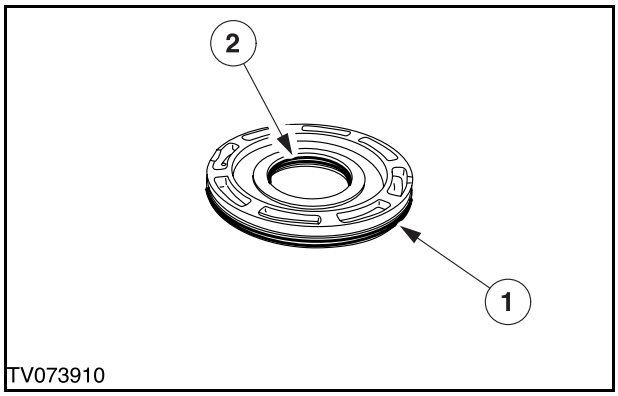
Note:

- The position of the piston in the clutch.

13. Remove the clutch piston assembly.



14. Remove and discard the clutch piston outer seal (1) and inner seal (2).

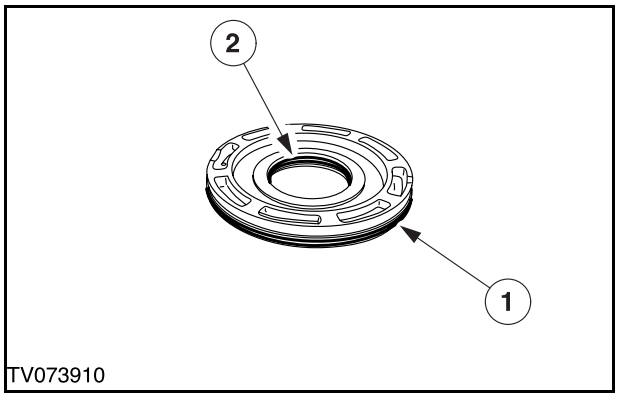


Assemble forward clutch

Note:
- Install new seals.

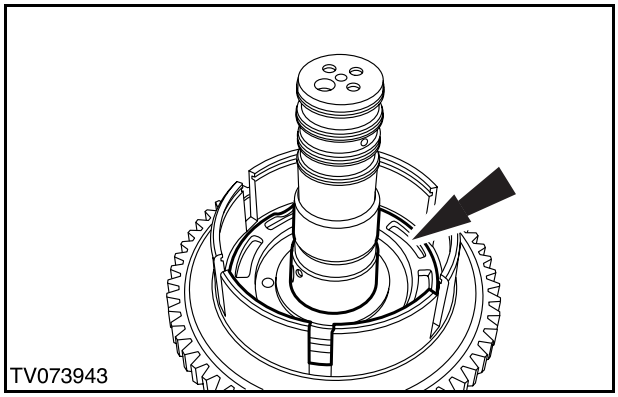
1. Install the clutch piston inner seal (1) and outer seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

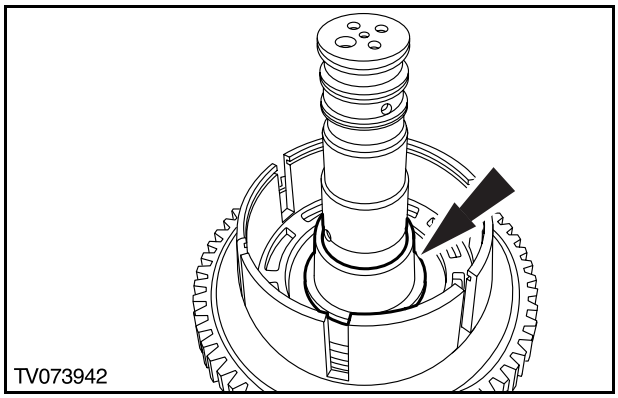


⚠ **Caution:**
- **Take care not to damage the sealing rings.**

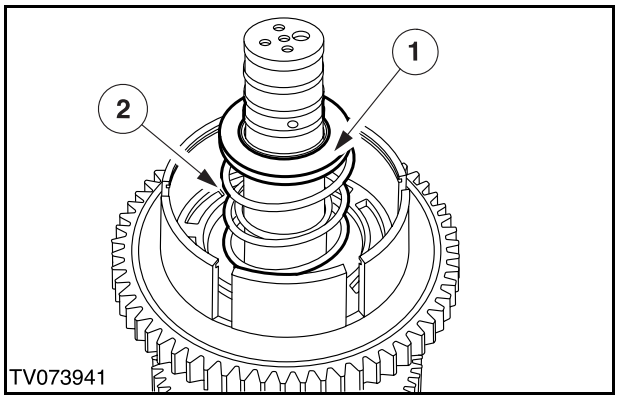
2. Install the clutch piston into the clutch drum.



3. Install the clutch sleeve.

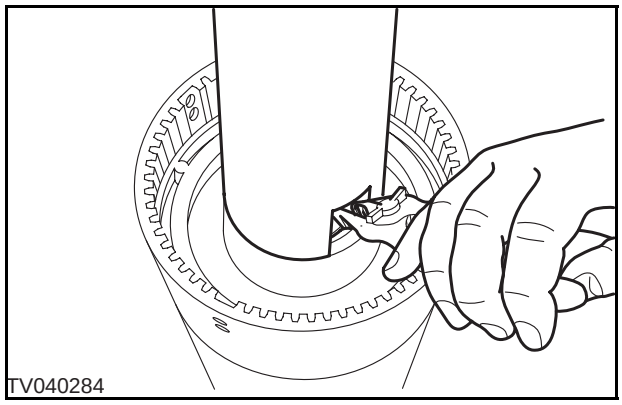


4. Install the piston return spring (1) and the retaining ring (2).



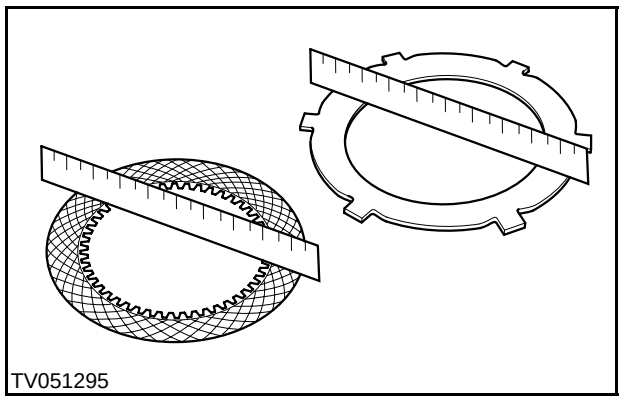
5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable snap ring pliers, install the snap ring.

Note:
- Make sure the snap ring is correctly located in the groove.



7. Using a suitable straight edge, check the flatness of both the drive plates and the friction plates from the clutch pack.

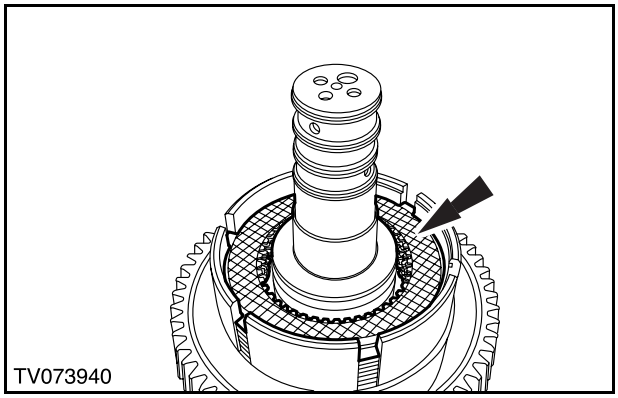
Note:
- Any plates found to be warped, damaged or worn must be replaced.



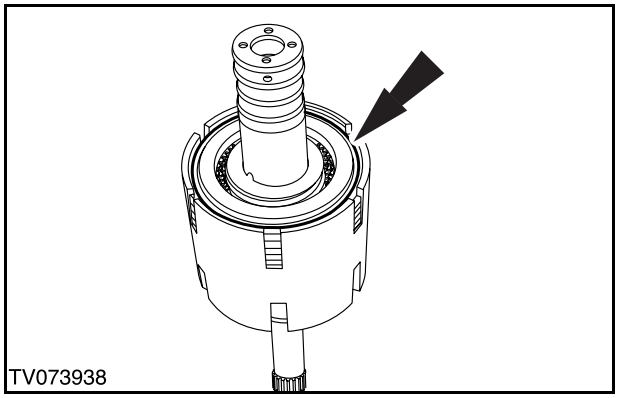
Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed.

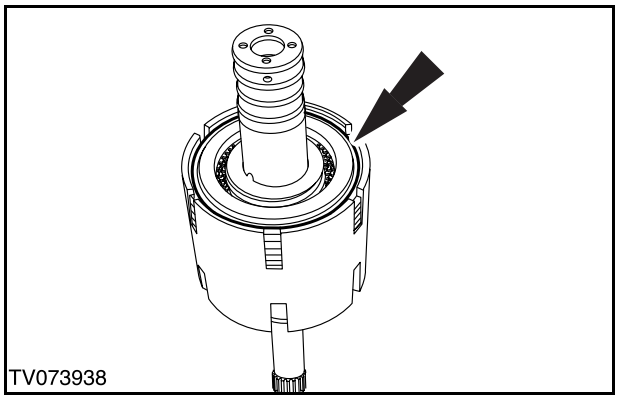
8. Install the clutch pack and the roll pin.



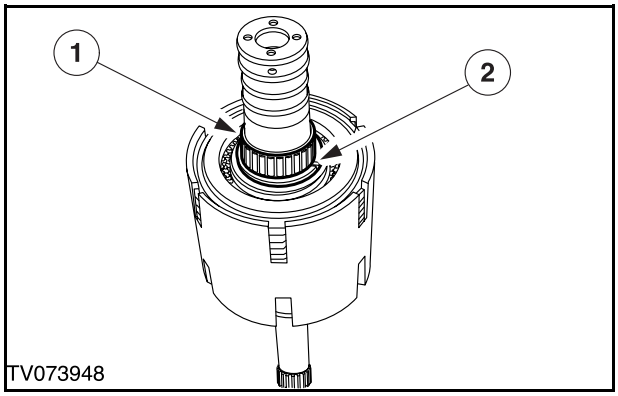
9. Install the retaining ring.



10. Install the snap ring.



11. Install the spacer (2) and the needle bearing bush(1).

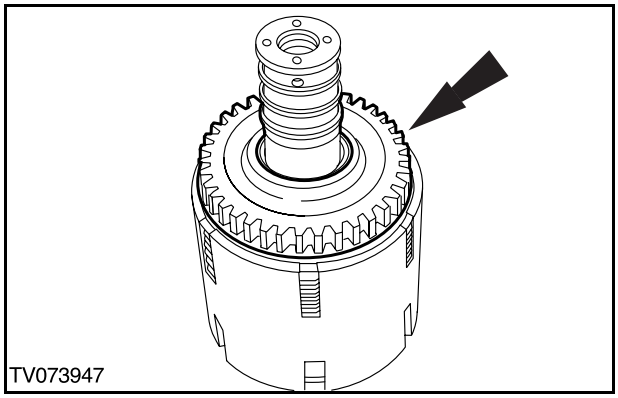


⚠ **Caution:**
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

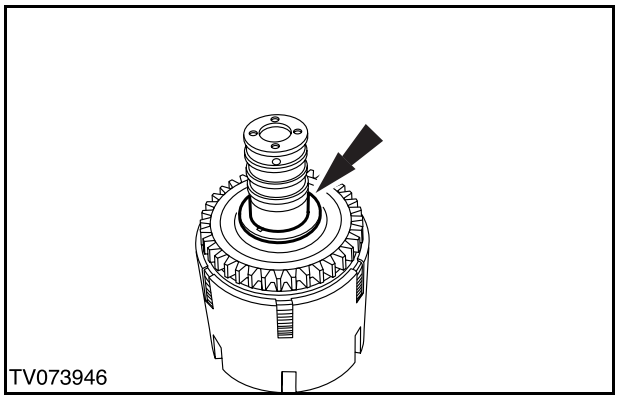
⚠ **Caution:**
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

12. Install the forward drive gear.



13. Install the spacer.



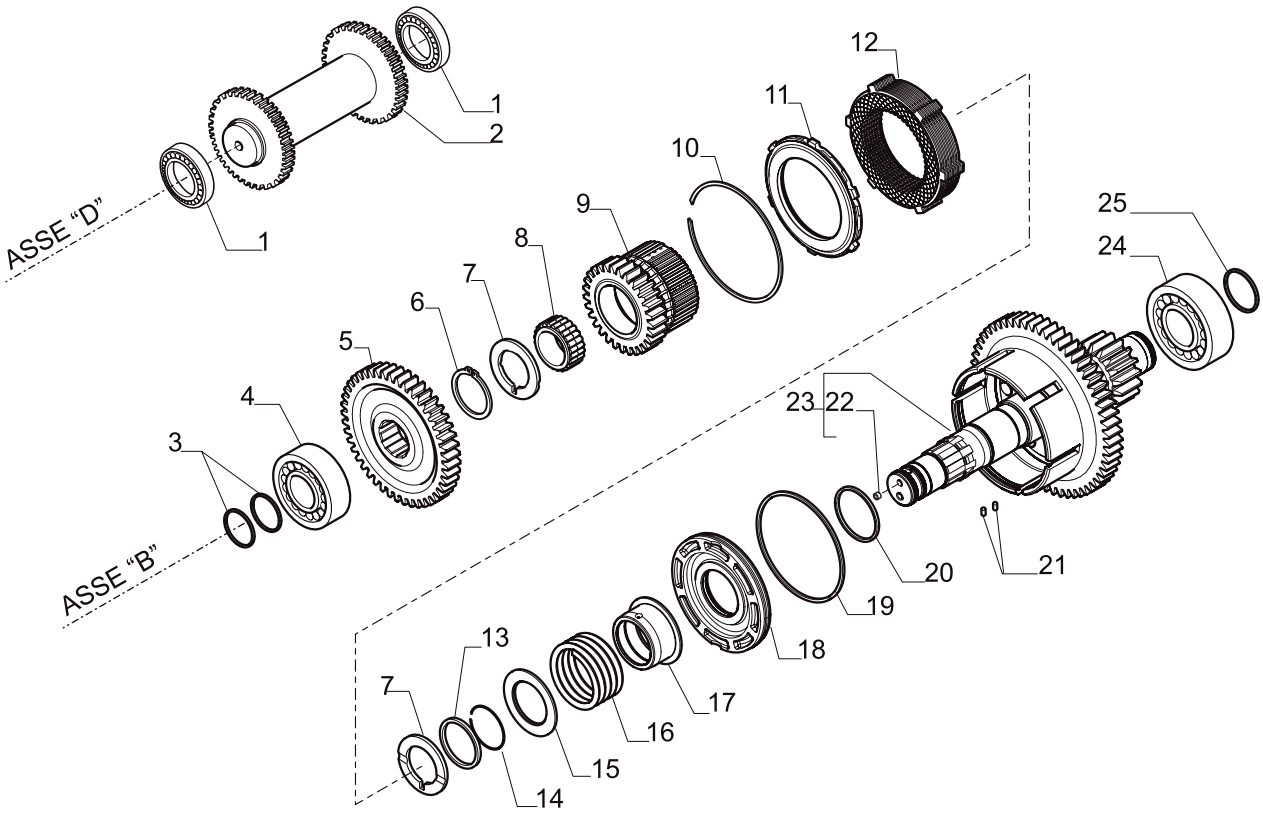
14. Using a suitable hydraulic press and sleeve install the bearing.
15. Install the cir-clip.

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DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT 2ND SPEED CLUTCH

BHN1307DC

Operation: **Disassembly and Assembly of the 2nd Speed Clutch**	*Job Code:* **xx xx xx xx**		
None	Standard tools, Clutch piston spring compressor		

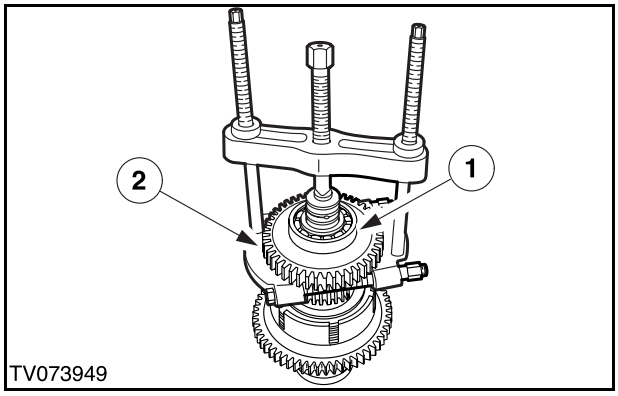


TV073911

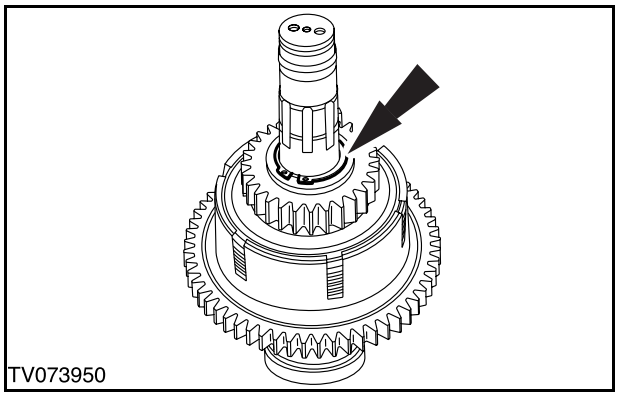
1	Bearing
2	Reverse shaft
3	Seal ring
4	Bearing
5	Gear Z45
6	Snap ring
7	Thrust washer
8	Needle bearing bush
9	Gear Z28
10	Lockring
11	Clutch plate lockring
12	Clutch kit
13	Thrust washer
14	Lockring
15	Lock spring cover
16	Spring
17	Clutch sleeve
18	Clutch piston
19	Seal ring
20	Seal ring
21	Split pin
22	Rivet
23	Shaft
24	Bearing
25	Seal ring

Disassembly

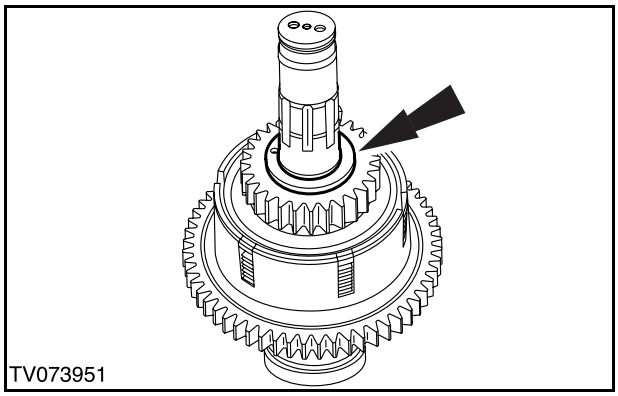
1. Using a suitable puller, remove the bearing (1) and the gear (2).



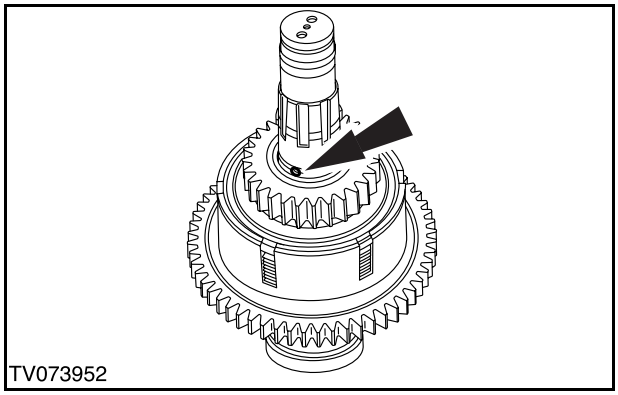
2. Using suitable circlip pliers, remove the clutch gear circlip.


TV073950

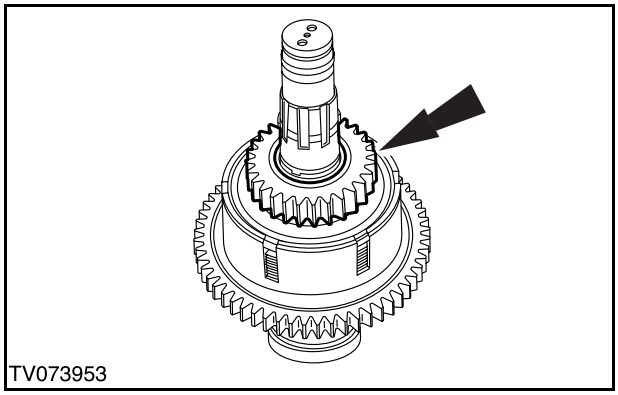
3. Remove the spacer.


TV073951

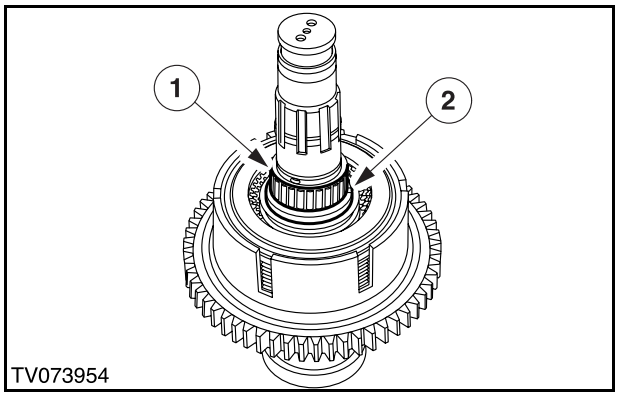
4. Remove the roll pin.


TV073952

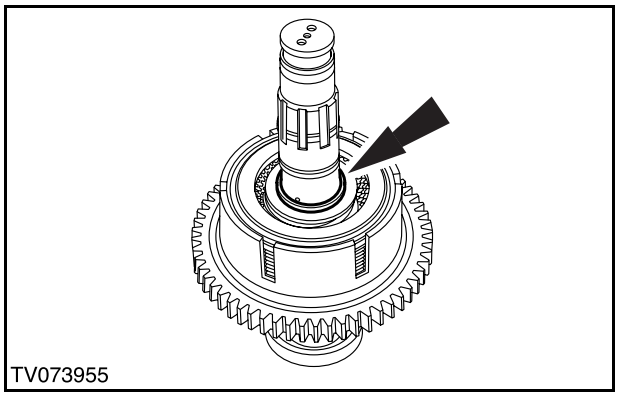
5. Remove the gear.


TV073953

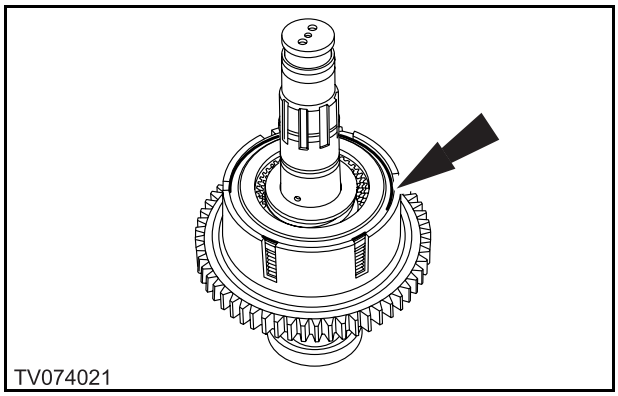
6. Remove the needle bearing bush (1) and the spacer (2).



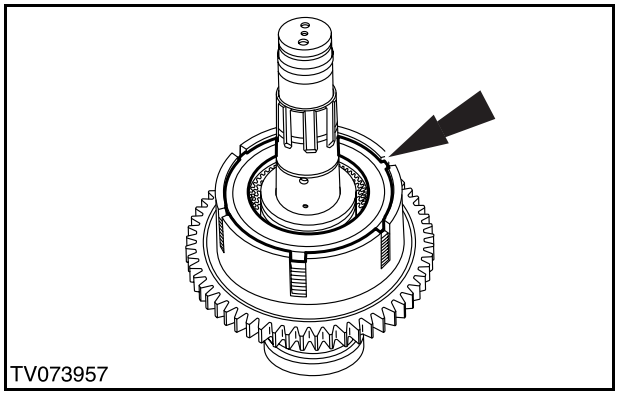
7. Remove the spacer.



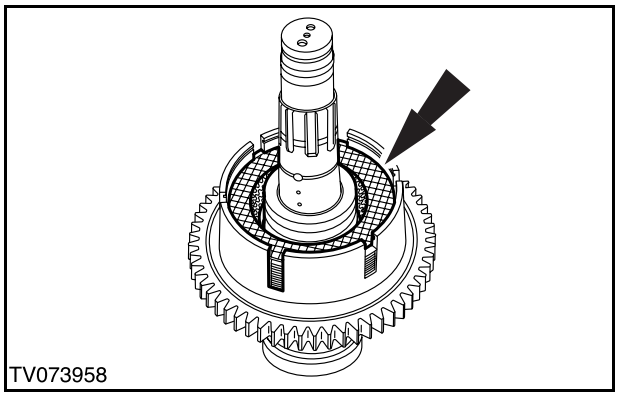
8. Remove the snap ring.



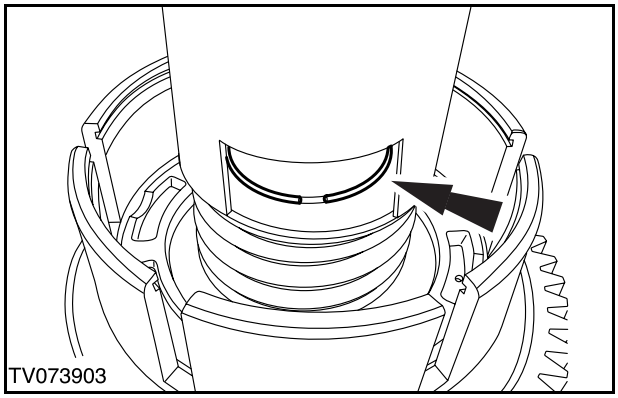
9. Remove the retaining ring.



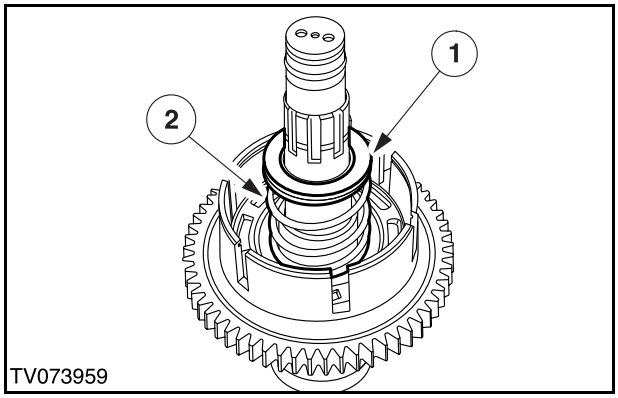
10. Remove the clutch pack.



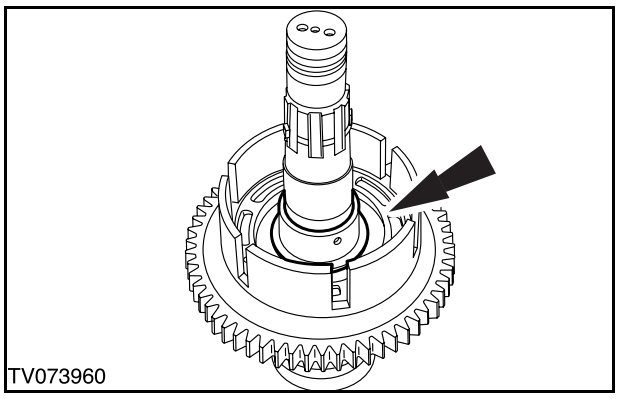
11. Using a suitable hydraulic press, compress the piston return spring.
12. Using suitable snap ring pliers, release the piston return spring retaining snap ring



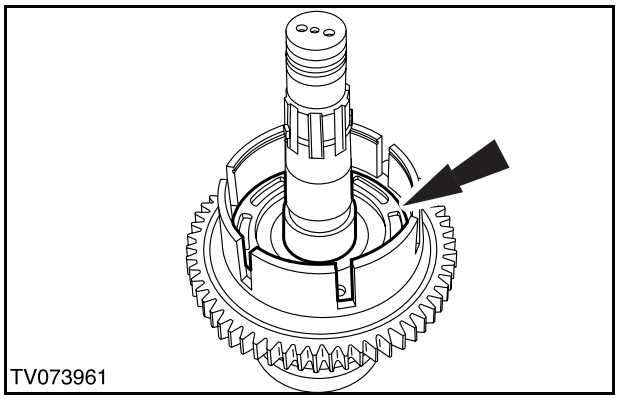
13. Remove the retaining ring (1) and the spring (2).



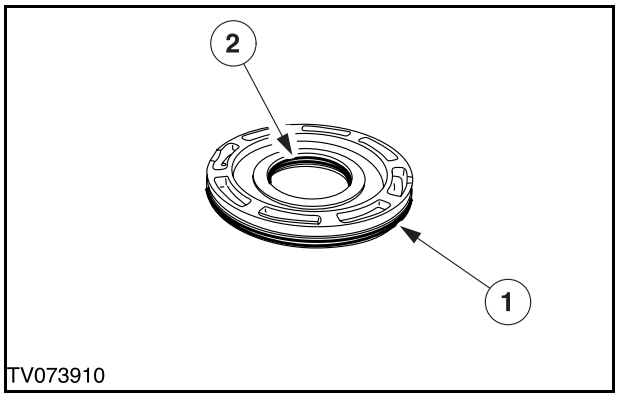
14. Remove the clutch sleeve.



15. Remove the piston.


TV073961

16. Remove and discard the clutch piston outer seal (1) and inner seal (2).

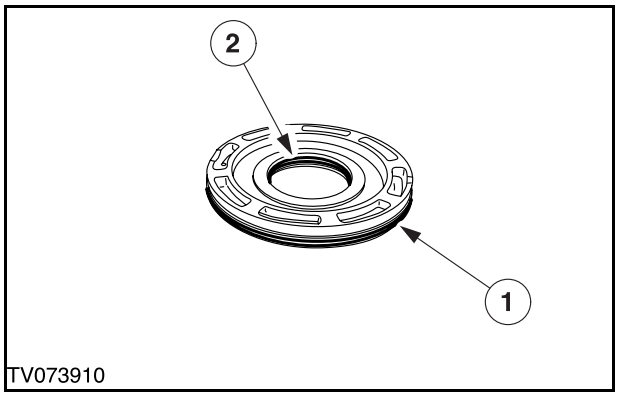


TV073910

Assembly

Note:
- Install new seals.

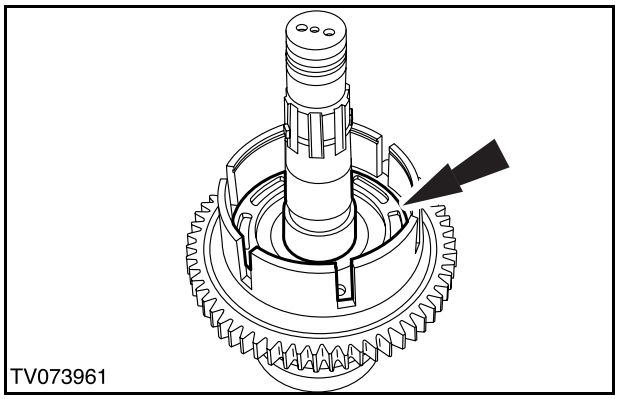
1. Install clutch piston inner seal (1) and outer seal (2).



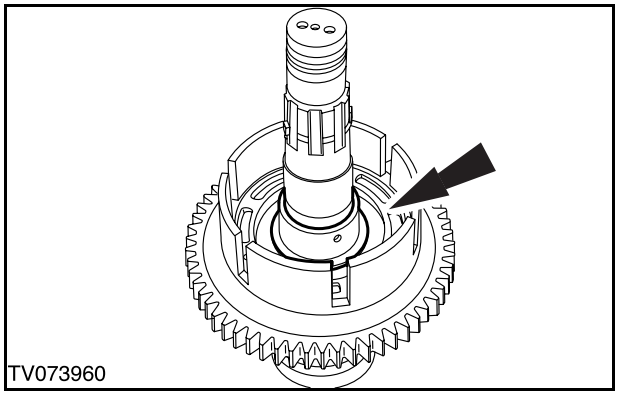
⚠ **Caution:**
- **Take care not to damage the sealing rings.**

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

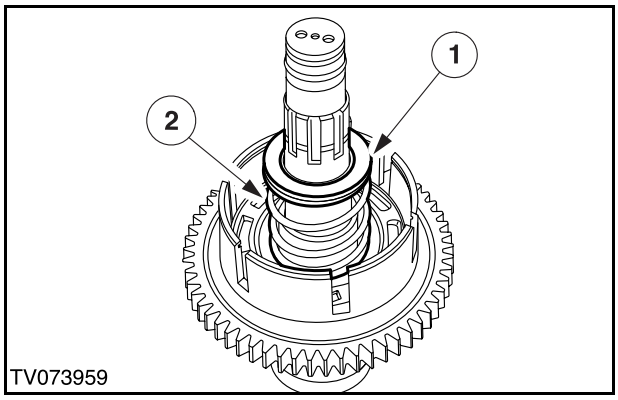
2. Install the clutch piston into the clutch drum.



3. Install the clutch sleeve.



4. Install the piston return spring (2), spring retaining ring (1).

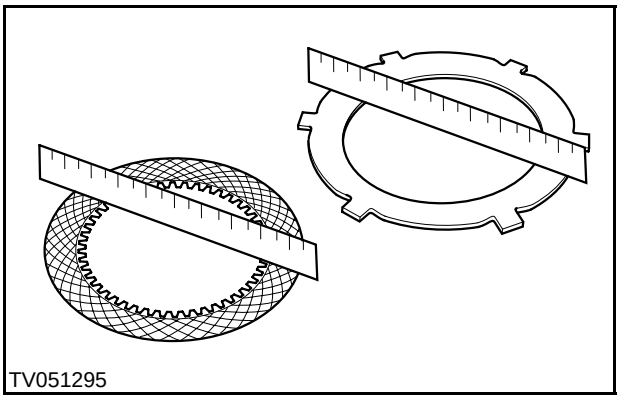


5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable snap ring pliers, install the snap ring.

Note:
- Make sure the snap ring is correctly located in the groove.

7. Using a suitable steel straight edge, check the flatness of both the drive plates and the friction plates from the clutch pack.

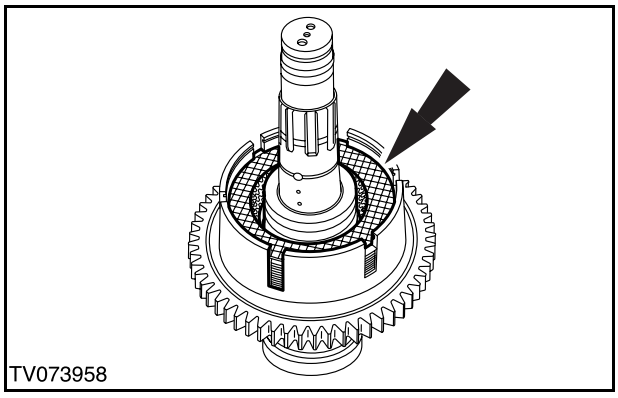
Note:
- Any plates found to be warped, damaged or worn must be replaced.



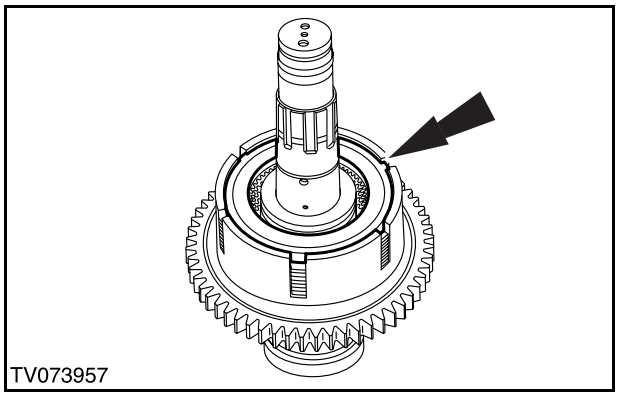
Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed.

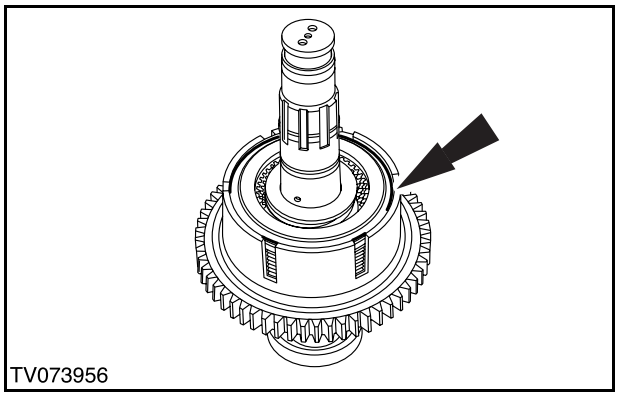
8. Install the clutch plates.



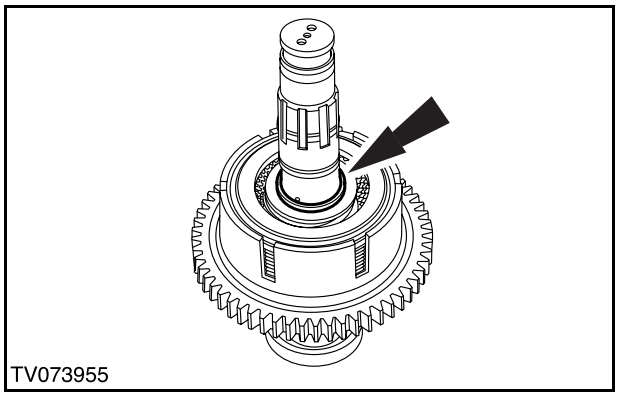
9. Install the clutch retaining plate.



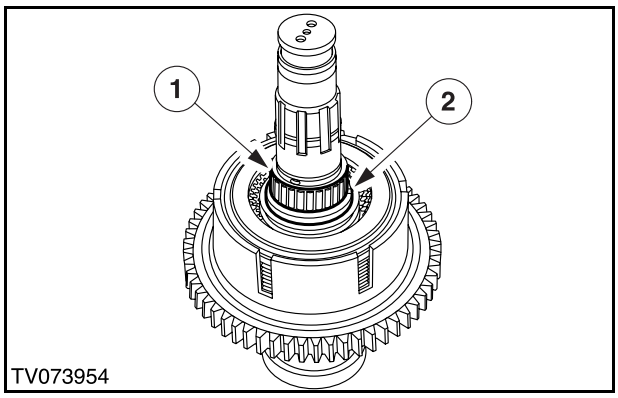
10. Install the snap ring.



11. Install the spacer.



12. Install the spacer (2) and the bearing (1).

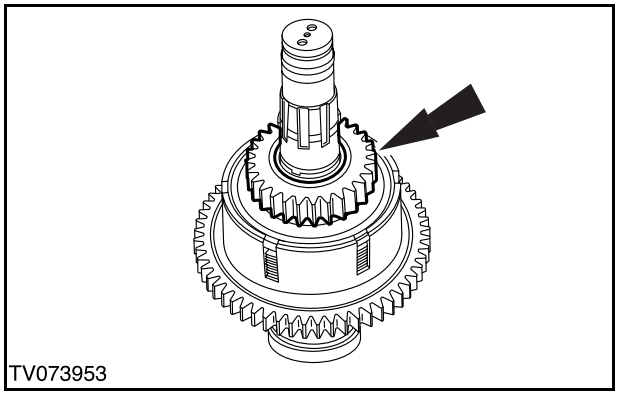


⚠ **Caution:**
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

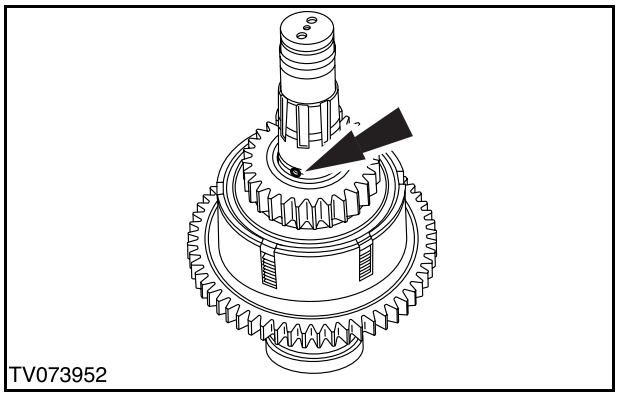
⚠ **Caution:**
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

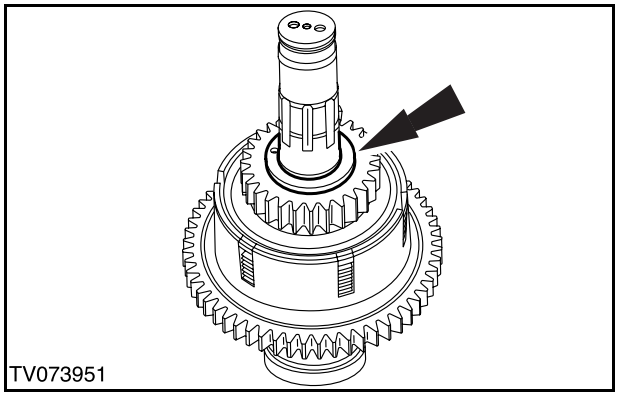
13. Install the 2nd gear.


TV073953

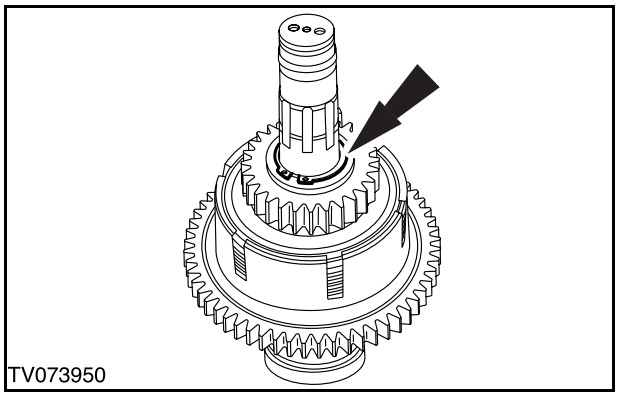
14. Install the roll pin.


TV073952

15. Install the spacer.


TV073951

16. Using suitable circlip pliers, install the clutch gear circlip.



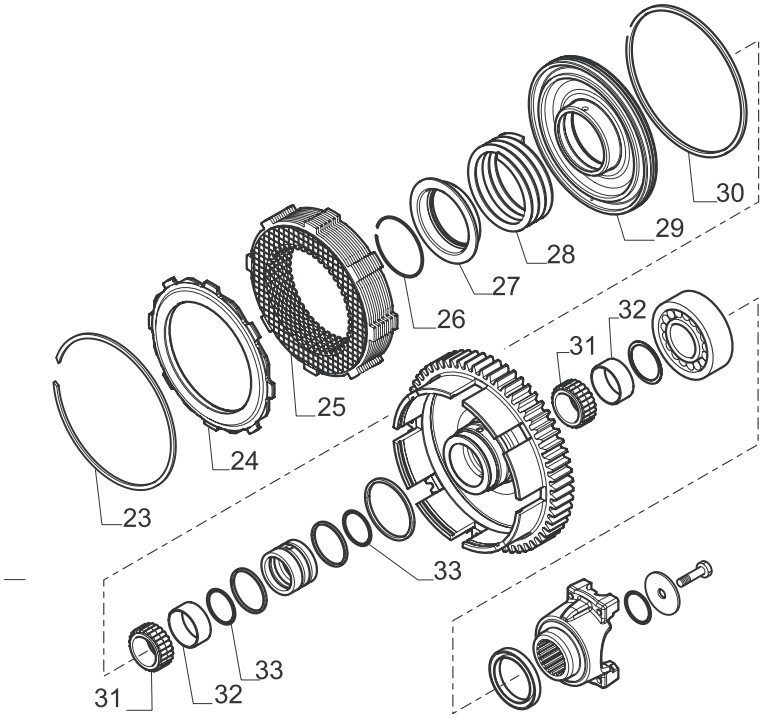
17. Using a suitable hydraulic press and sleeve, install the gear and bearing.

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DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT 1ST CLUTCH

BHN1307DD

Operation: **Disassembly and Assembly of the 1st Speed Clutch**	*Job Code:* **xx xx xx xx**		
None	Standard tools		

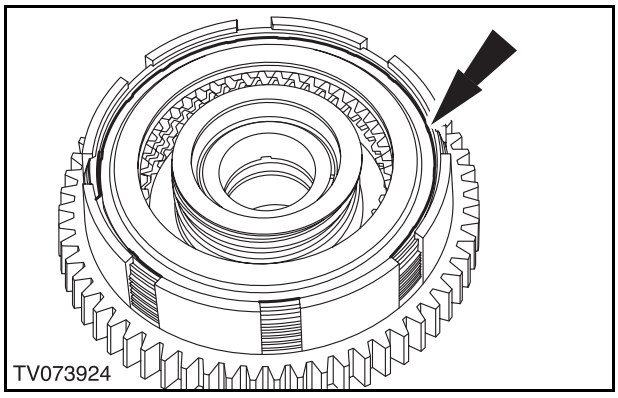


TV073918

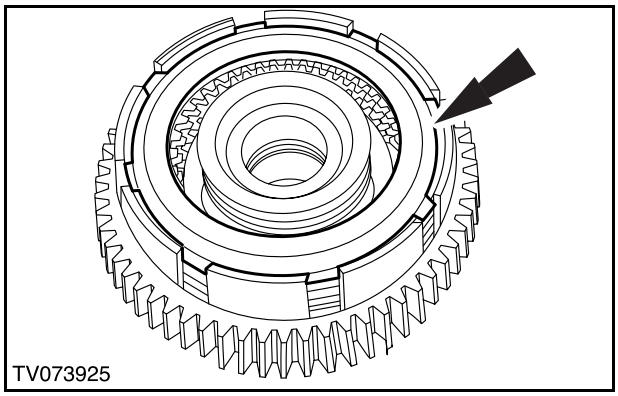
23	Locking ring
24	Clutch plate lockring
25	Clutch kit
26	Lockring
27	Lock-spring cover
28	Spring
29	Clutch piston
30	Seal ring
31	Needle bearing bush
32	Bush
33	O-ring

Disassembly

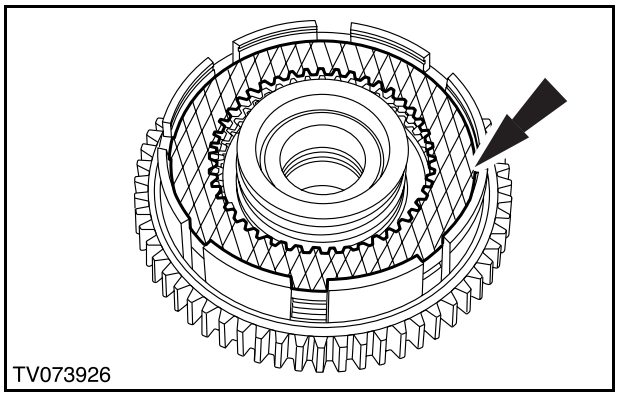
1. Remove the snap ring.



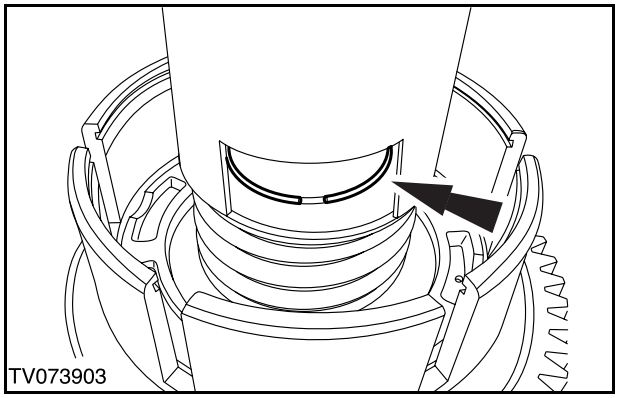
2. Remove the retaining plate.



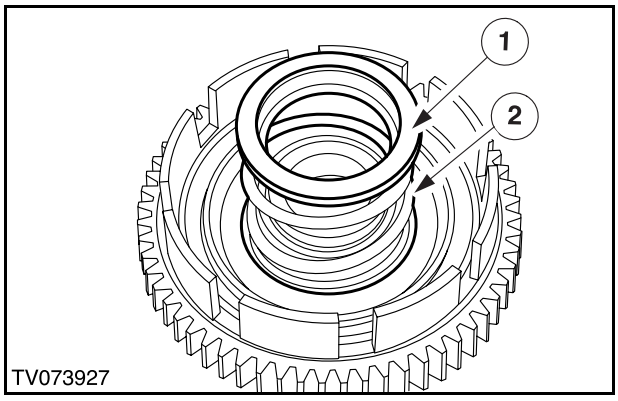
3. Remove the clutch pack.



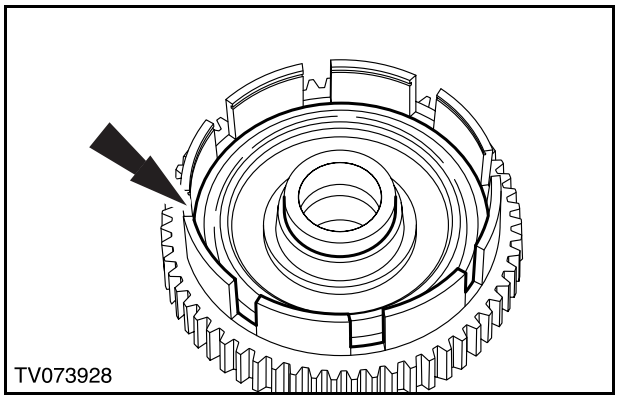
4. Using a suitable hydraulic press, compress the piston return spring.
5. Using suitable snap ring pliers release the piston return spring retaining snap ring.



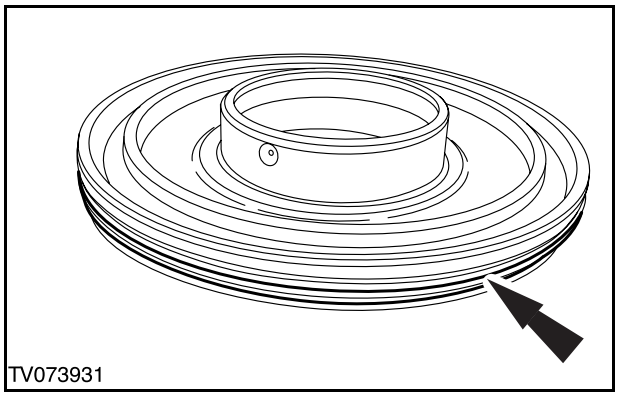
6. Remove the retaining ring (1) and the spring (2).

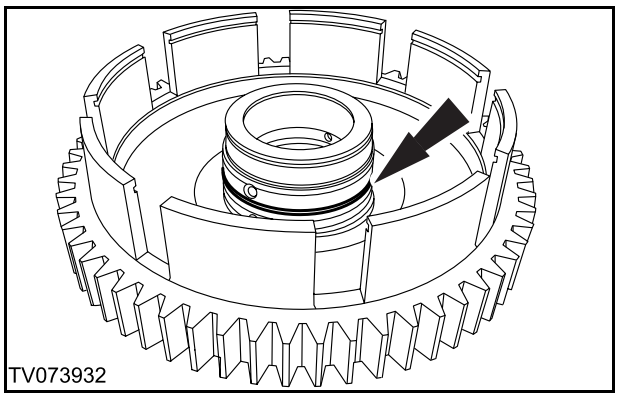


7. Remove the piston.



8. Remove and discard the piston seals.

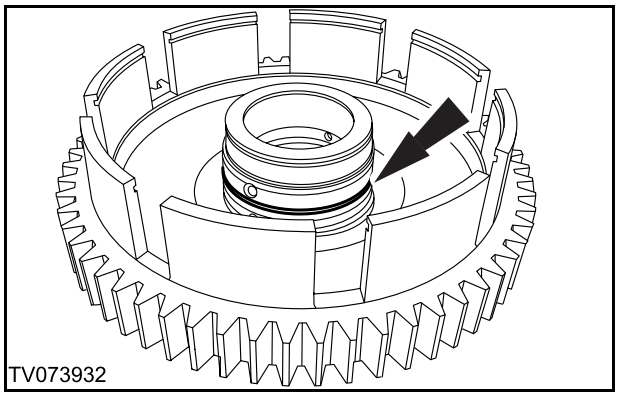




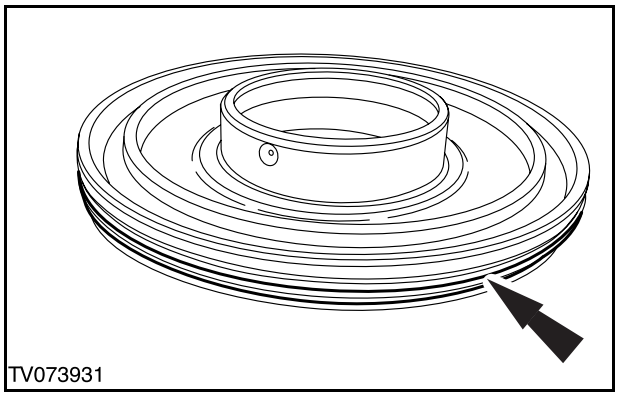
Assembly

Note:
- Install new seals.

1. Install the clutch piston inner seal.

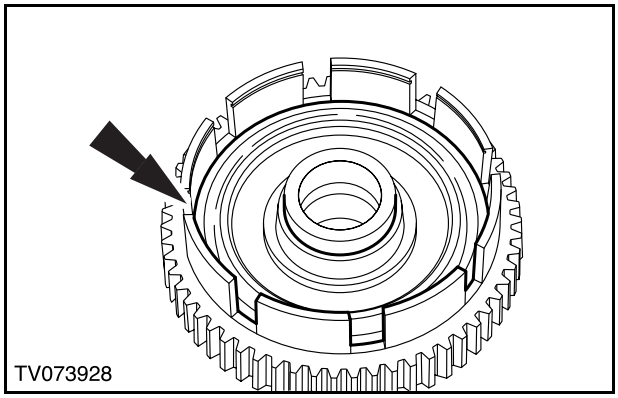

TV073932

2. Install the clutch piston outer seal.

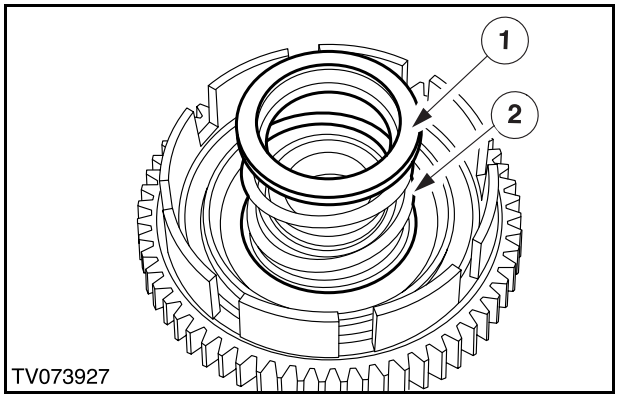

TV073931

⚠ **Caution:**
- **Take care not to damage the seals.**

3. Install the clutch piston into the clutch drum.


TV073928

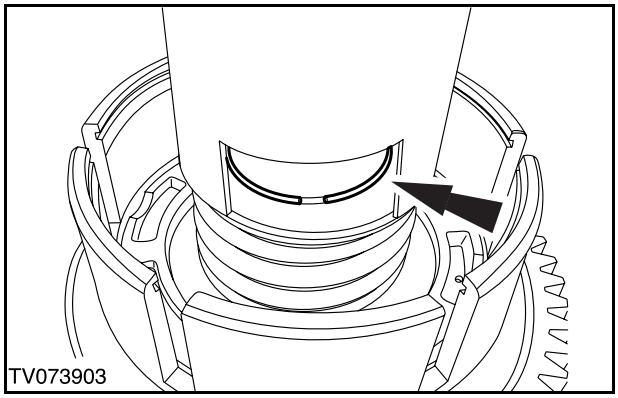
4. Install the spring (2) and the retaining ring (1).



TV073927

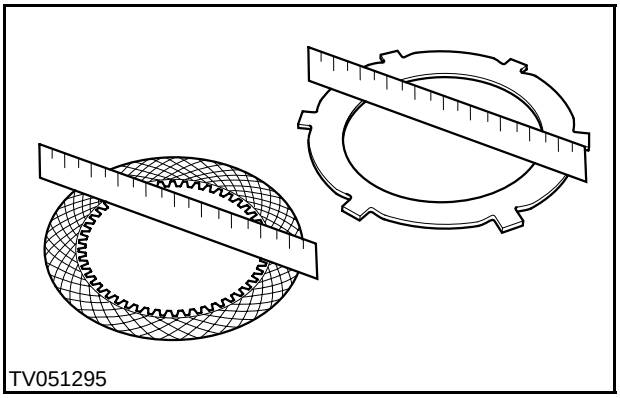
5. Using a suitable hydraulic press, and special tool compress the piston return spring.
6. Using suitable snap ring pliers, install the snap ring.

Note:
- Make sure the snap ring is correctly positioned in the groove.


TV073903

7. Using a suitable straight edge, check the flatness of both the drive plates and the friction plates from the clutch pack.

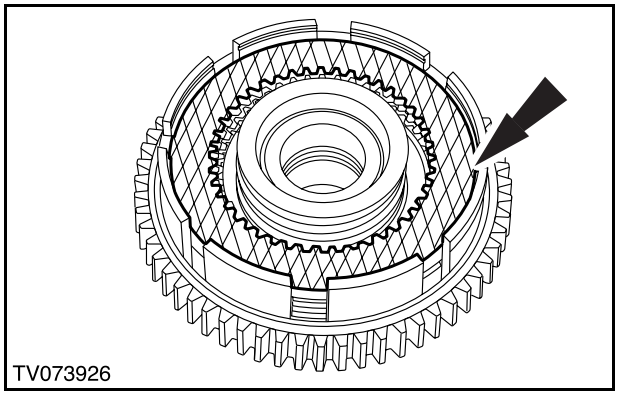
Note:
- Any plates found to be warped, damaged or worn must be replaced.


TV051295

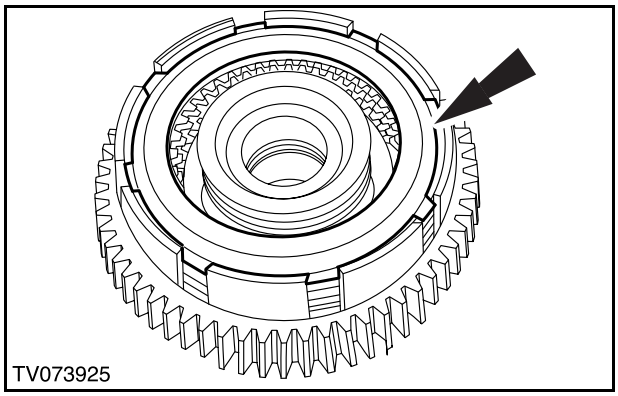
Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed.

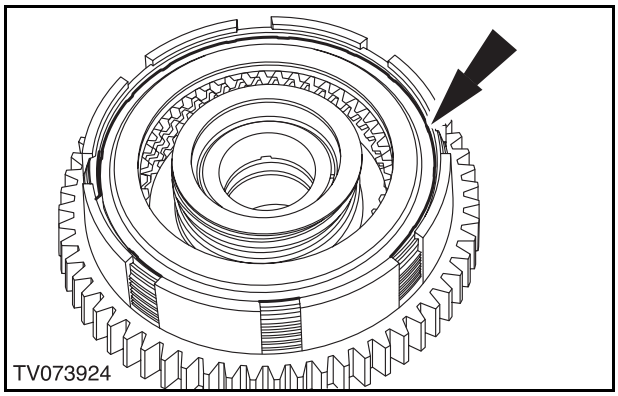
8. Install the clutch plates.


TV073926

9. Install the clutch retaining plate.



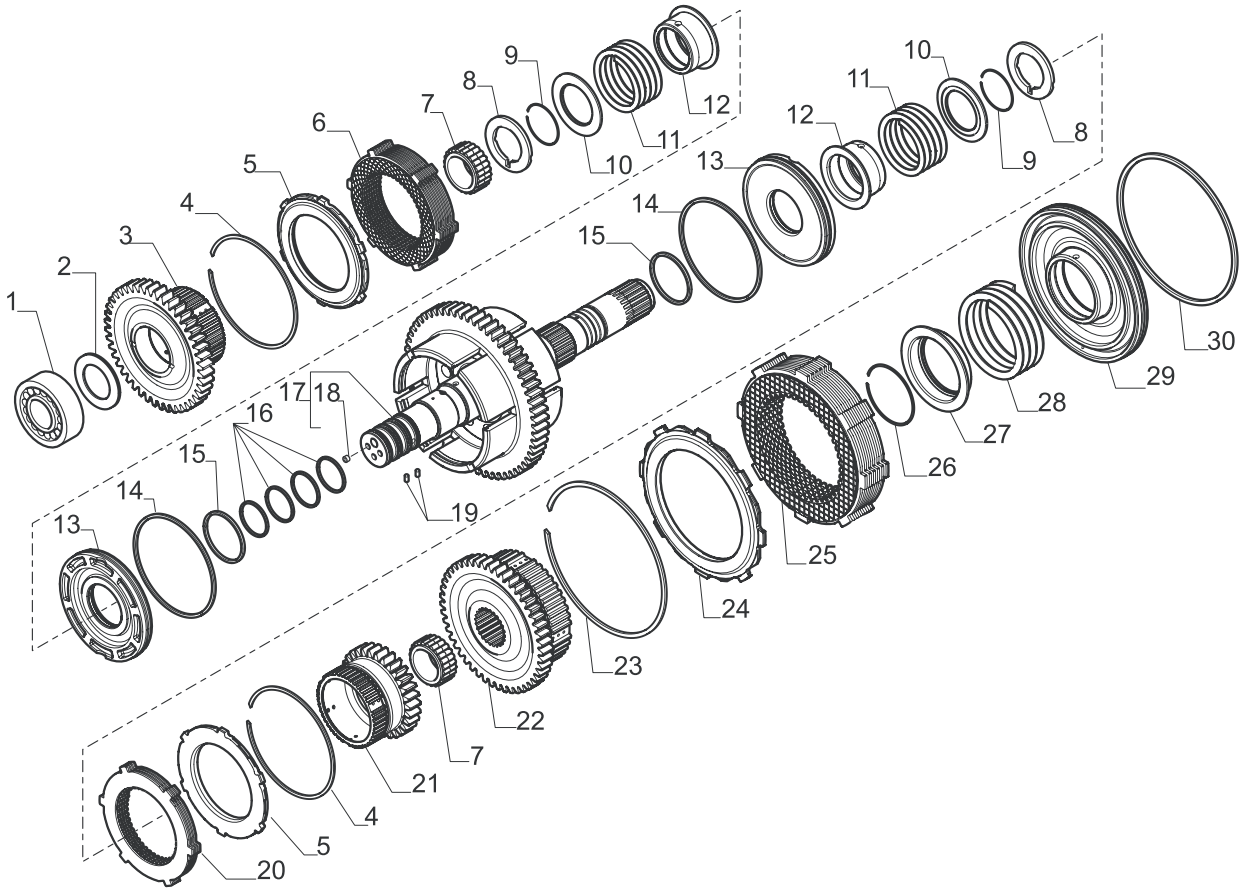
10. Install the snap ring.



DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT 3RD AND 4TH SPEED CLUTCHES

BHN1307DE

Operation: **Disassembly and Assembly of the 3rd and 4th speed Clutch**	*Job Code:* **xx xx xx xx**		
None	Standard tools, Bearing heater		



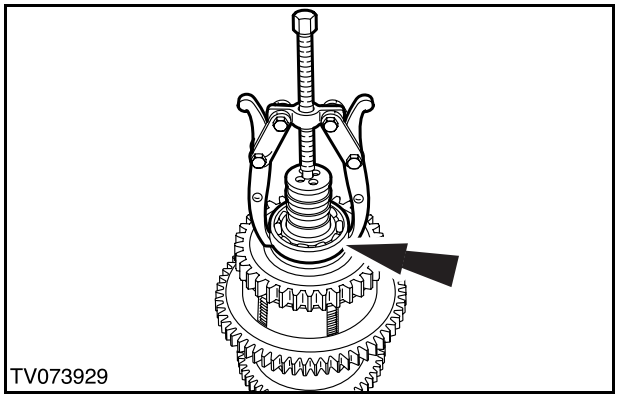
TV073912

1	Bearing
2	Thrust washer
3	Gear Z44
4	Lockring
5	Clutch plate lockring
6	Clutch kit
7	Needle bearing bush
8	Thrust washer
9	Lockring
10	Lock-spring cover
11	Spring
12	Clutch sleeve
13	Clutch piston
14	Seal ring
15	Seal ring
16	Seal ring
17	Shaft Z60
18	Rivet
19	Split pin
20	Clutch kit
21	Gear Z30
22	Gear Z51

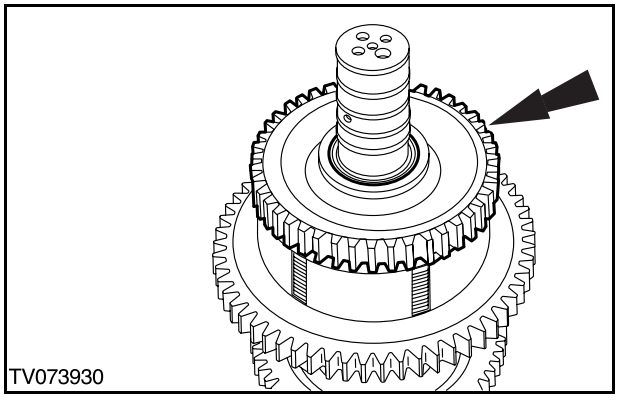
Disassembly

3rd speed clutch

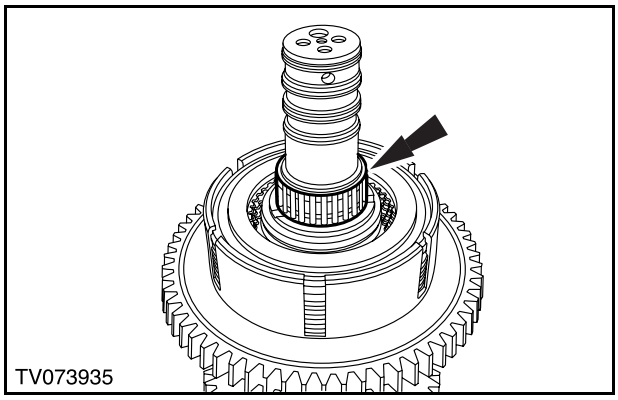
1. Using a suitable puller, remove the bearing and spacer.



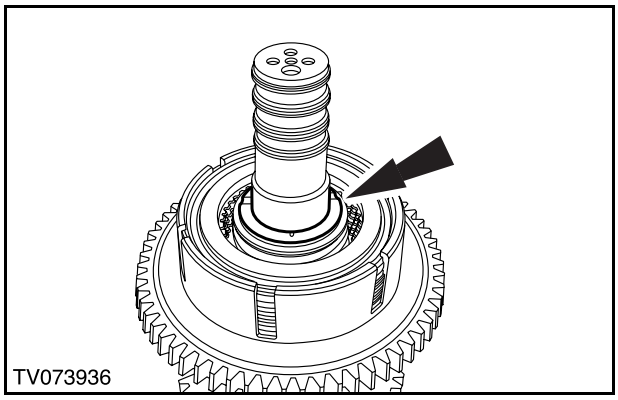
2. Remove the 3rd speed gear and bearing.



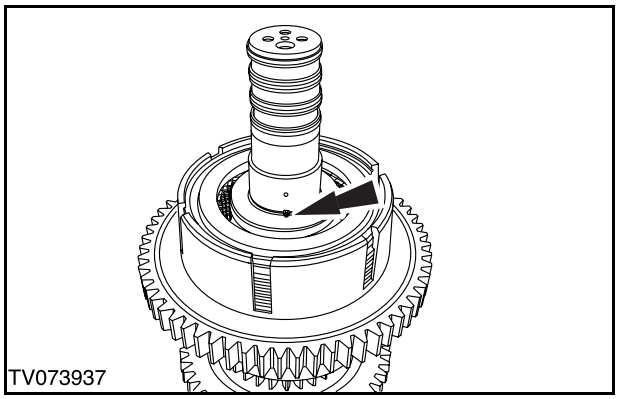
3. Remove the bearing.



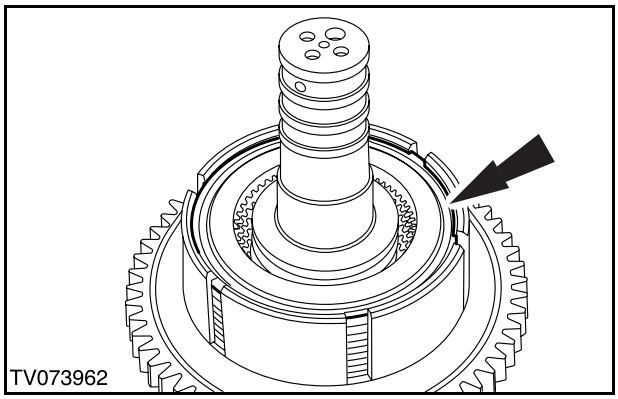
4. Remove the spacer



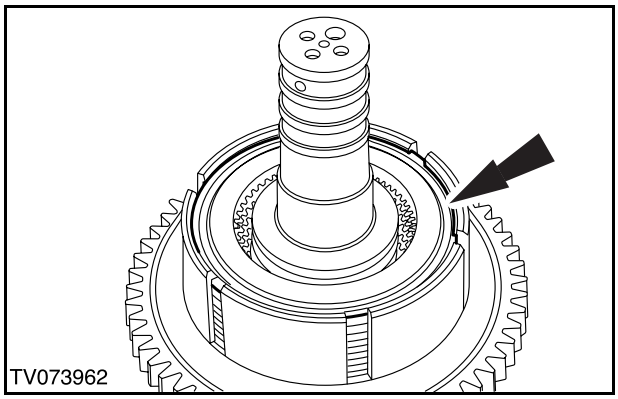
5. Remove the roll pin.



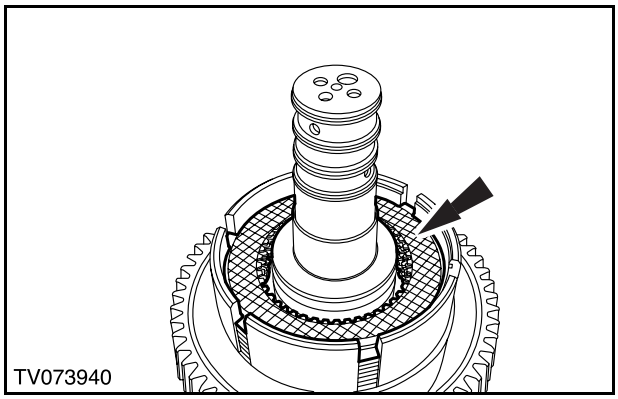
6. Remove the snap ring.



7. Remove the retaining plate.

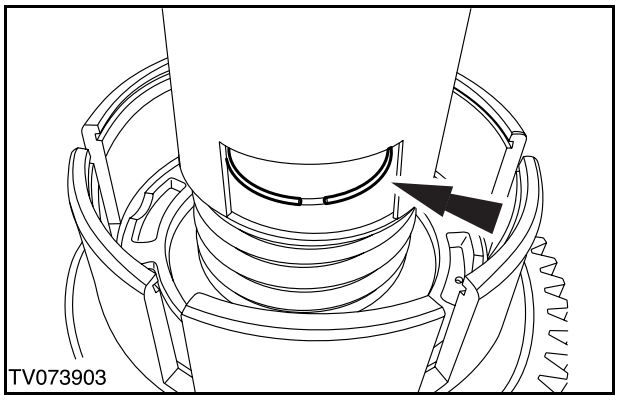


8. Remove the clutch pack.

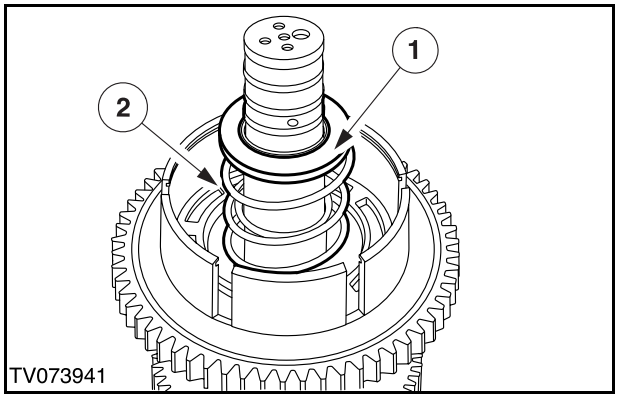


9. Using a suitable hydraulic press, compress the piston return spring.

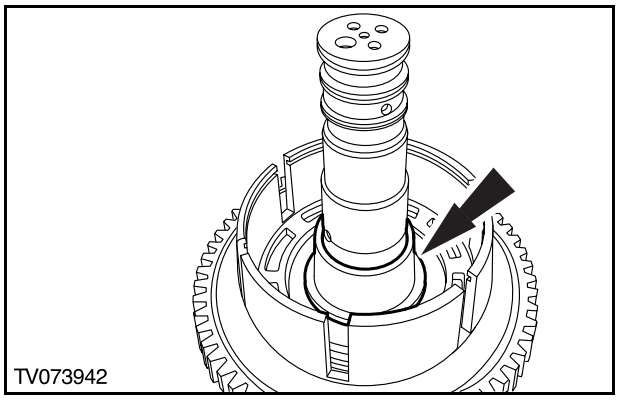
10. Using suitable snap ring pliers release the piston return spring retaining snap ring.



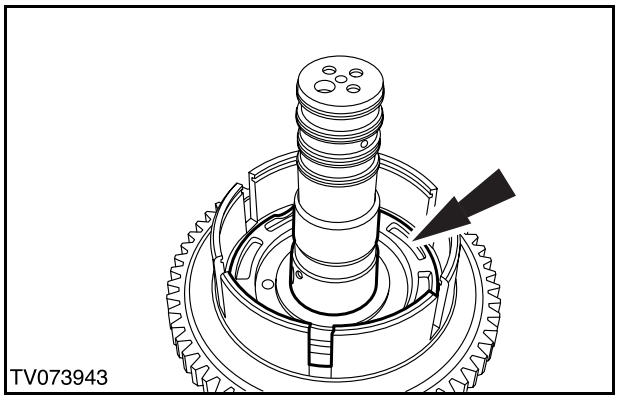
11. Remove the retaining ring (1) and the spring (2)



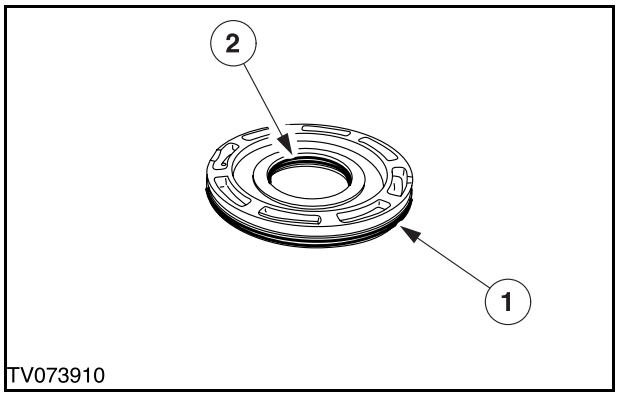
12. Remove the clutch sleeve.



13. Remove the piston.



14. Remove and discard the clutch piston outer seal (1) and inner seal (2).

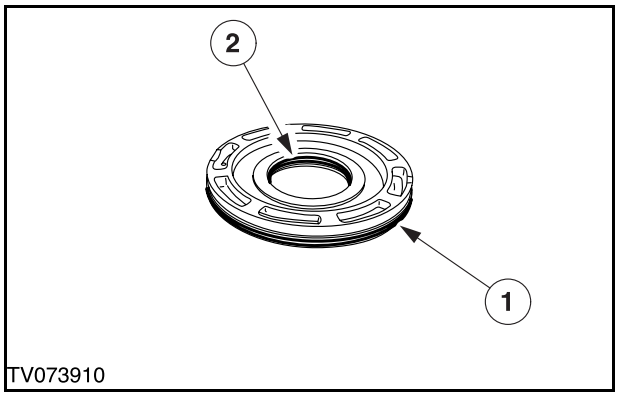


Assembly 3rd speed clutch

Note:
- Install new seals.

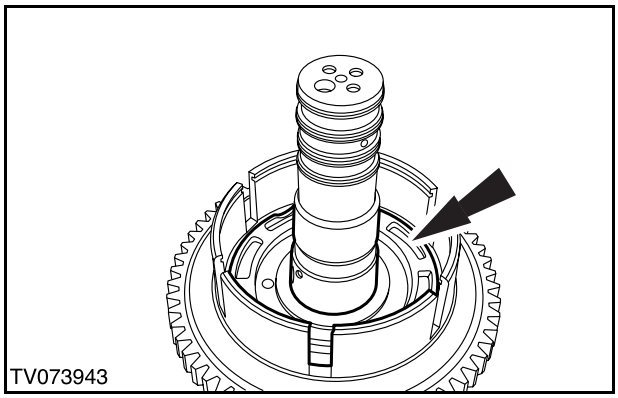
1. Install clutch piston outer seal (1) and inner seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

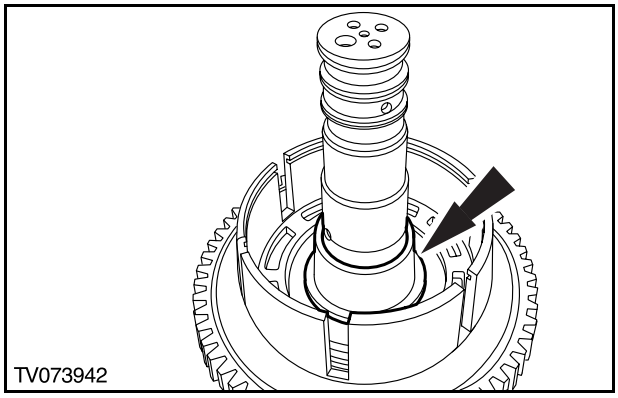


⚠ **Caution:**
- **Take care not to damage the seals.**

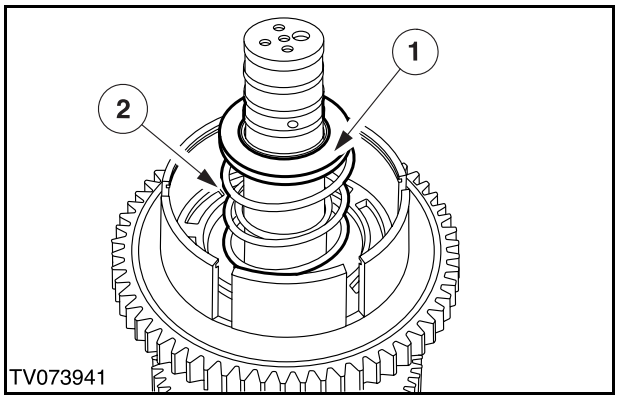
2. Install the clutch piston into the clutch drum.



3. Install the clutch sleeve.

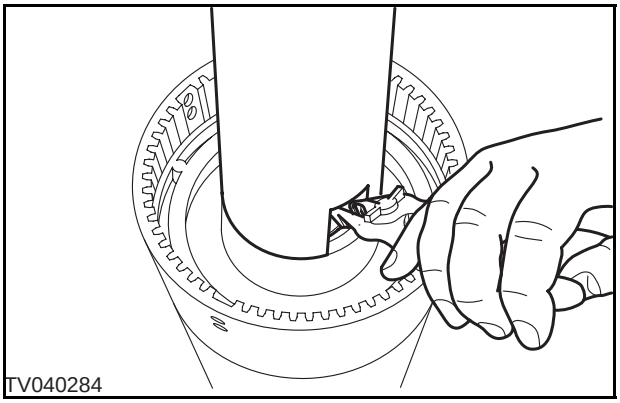


4. Install the piston return spring (2), retaining ring (1).



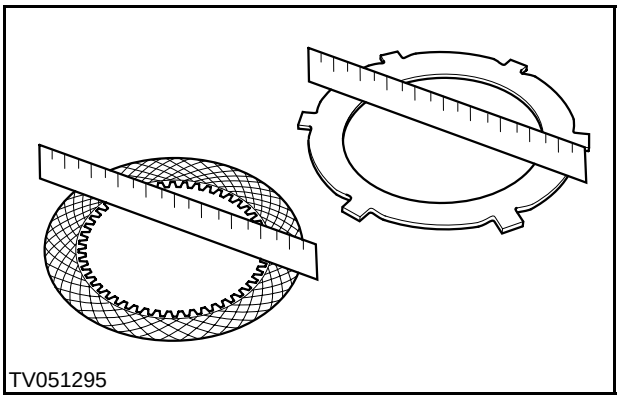
5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable snap ring pliers, install the snap ring.

Note:
- Make sure the snap ring is correctly positioned in the groove.



7. Using a suitable steel straight edge, check the flatness of both the drive plates and the friction plates from the clutch pack.

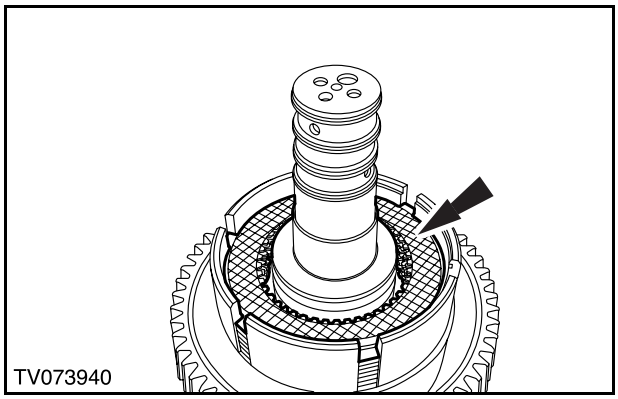
Note:
- Any plates found to be warped, damaged or worn must be replaced.



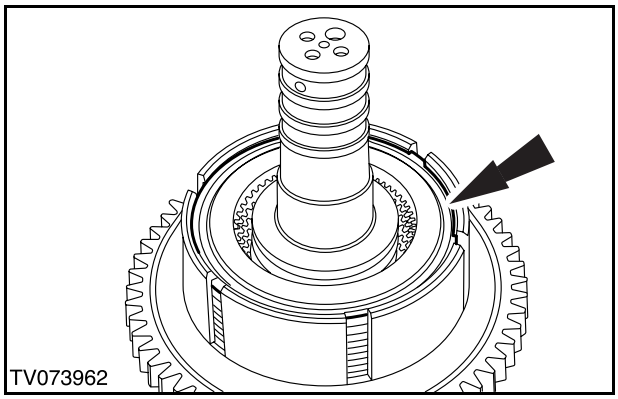
Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed.

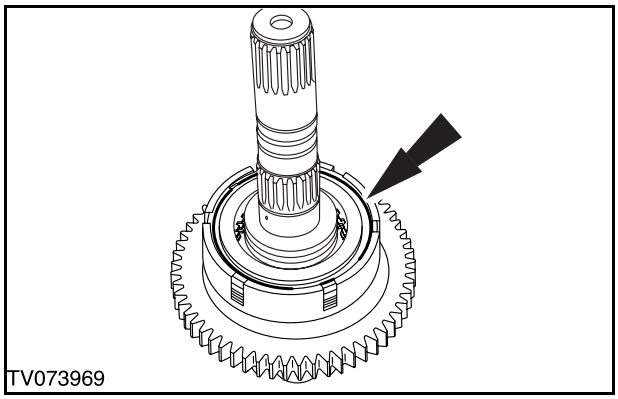
8. Install the clutch plates.



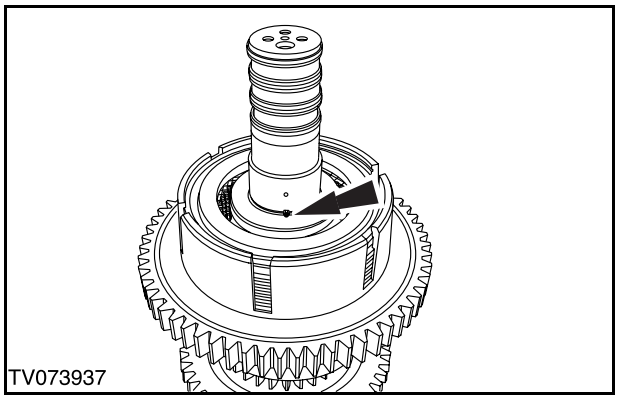
9. Install the retaining plate.



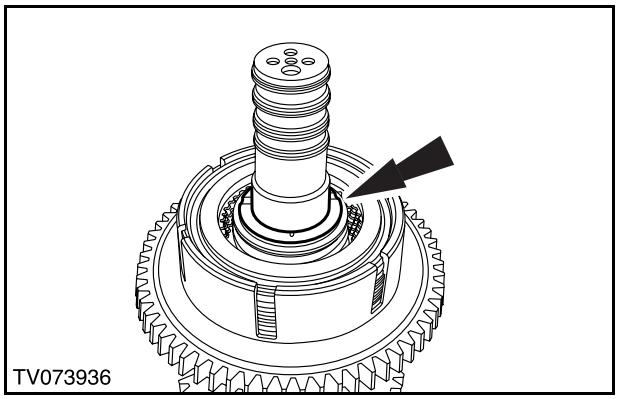
10. Install the snap ring.



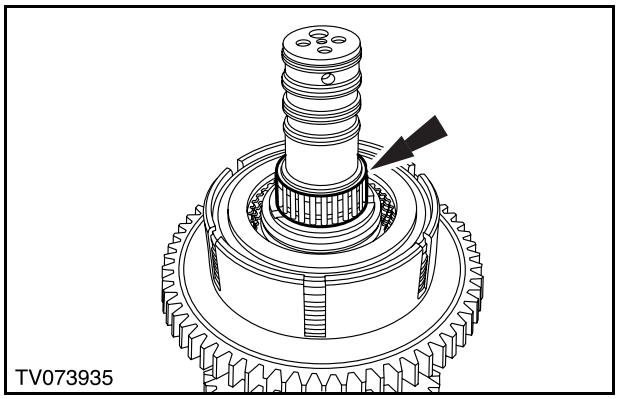
11. Install the roll pin.



12. Install the spacer.



13. Install the bearing.

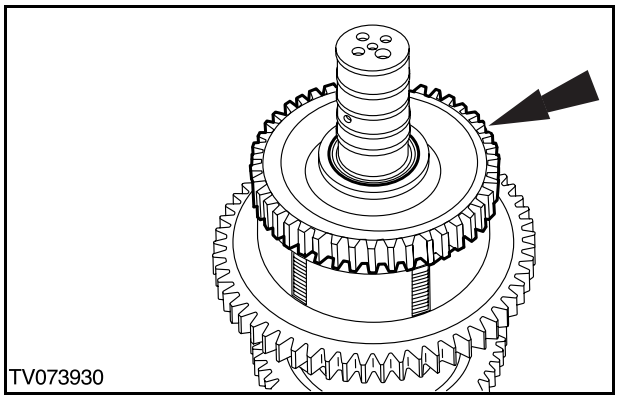


⚠ Caution:
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

⚠ Caution:
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

14. Install the 3rd speed drive gear and bearing.

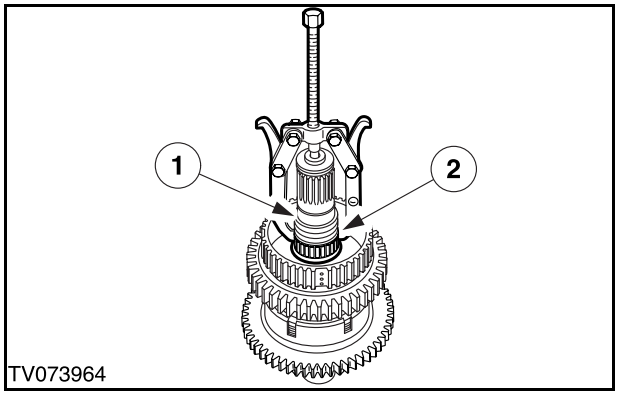


15. Using a suitable hydraulic press and sleeve install the spacer and bearing.

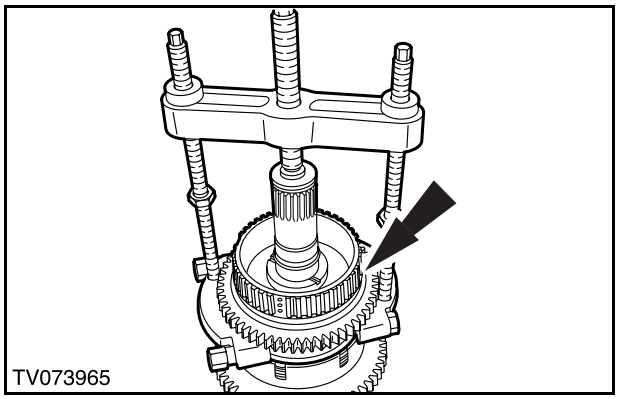
Disassembly

4th speed clutch

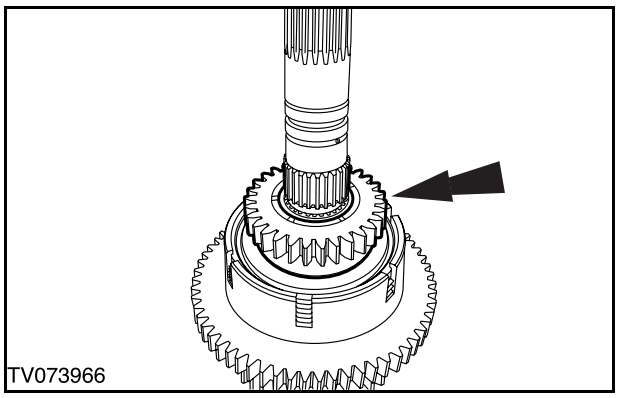
1. Using a suitable bearing puller remove the bearing (1) and the oil sleeve (2).



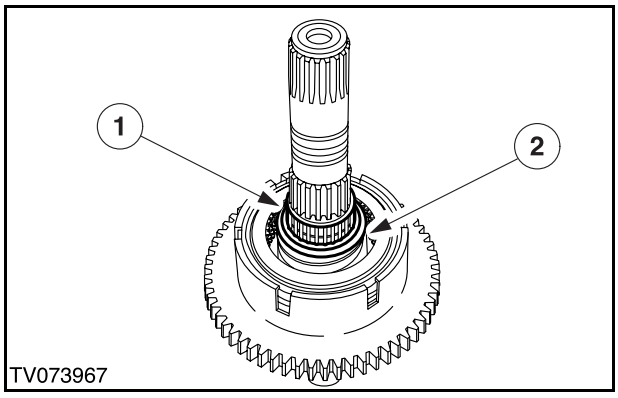
2. Using a suitable bearing puller remove the 1st speed gear and bearing.



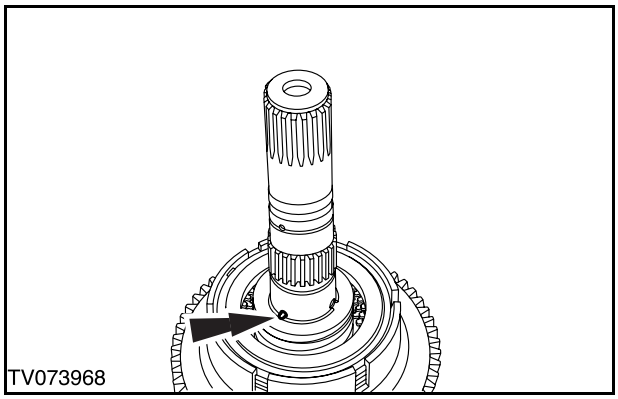
3. Remove the gear.



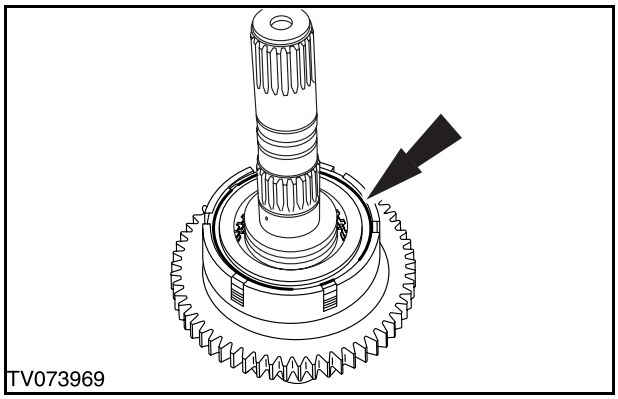
4. Remove the bearing (1) and the spacer (2).



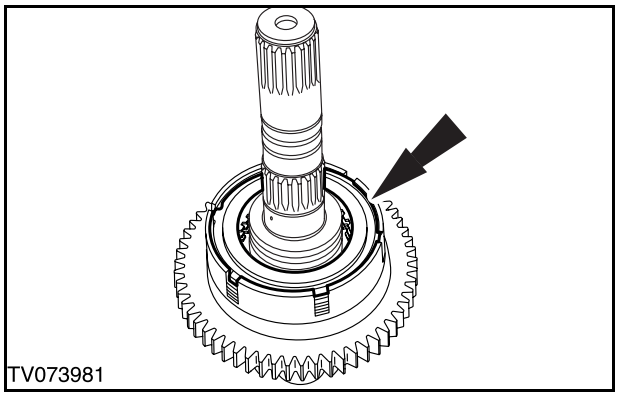
5. Remove the roll pin.



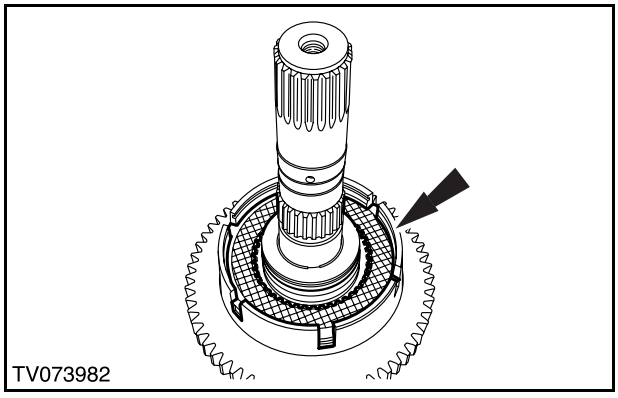
6. Remove the snap ring.



7. Remove the retaining plate.

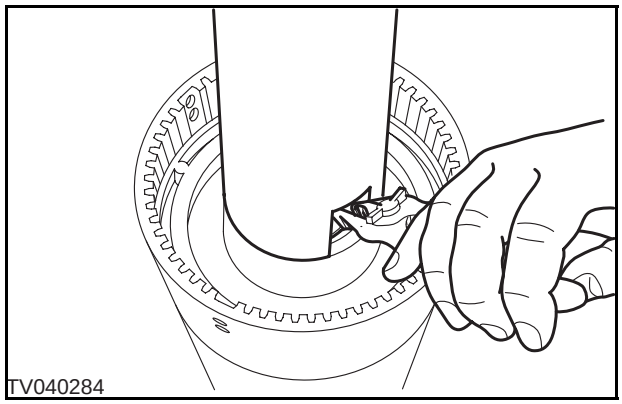


8. Remove the clutch pack.

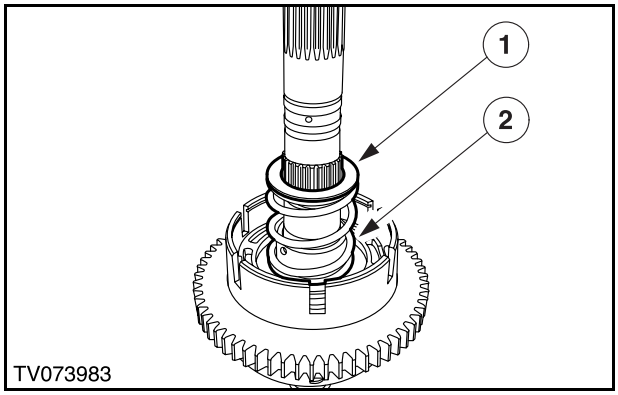


9. Using a suitable hydraulic press compress the piston return spring.

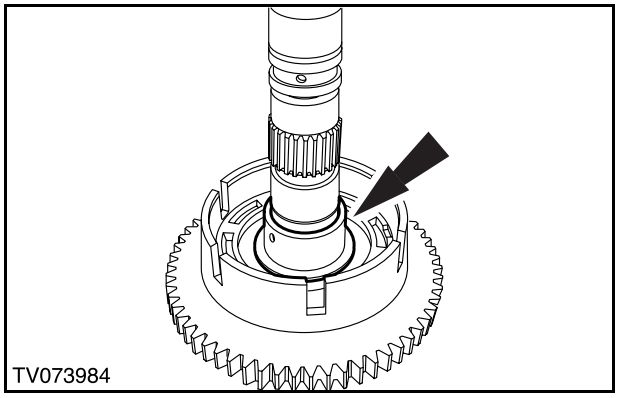
10. Using suitable snap ring pliers, release the piston return spring retaining snap ring.



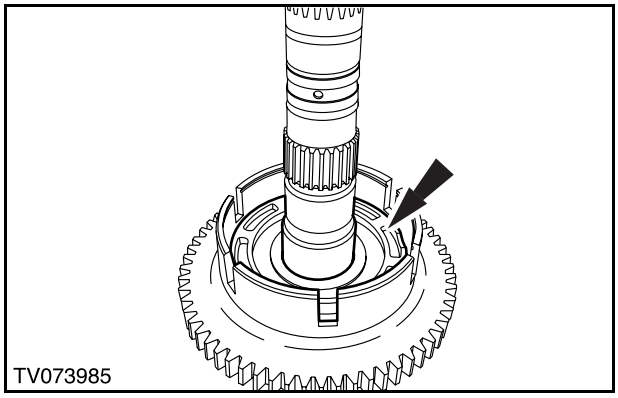
11. Remove the retaining ring (1) and the spring (2).



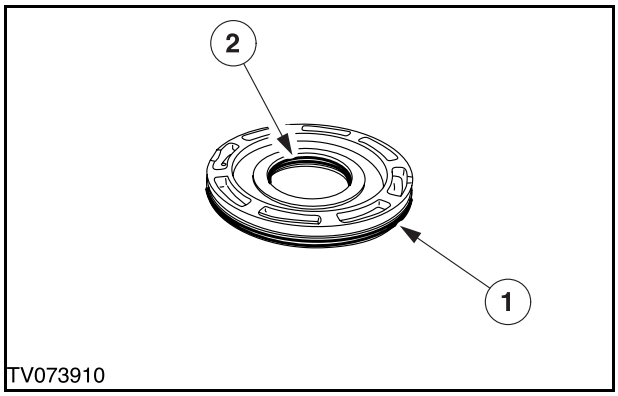
12. Remove the clutch sleeve.



13. Remove the piston.



14. Remove and discard the outer seal (1) and the inner seal (2).

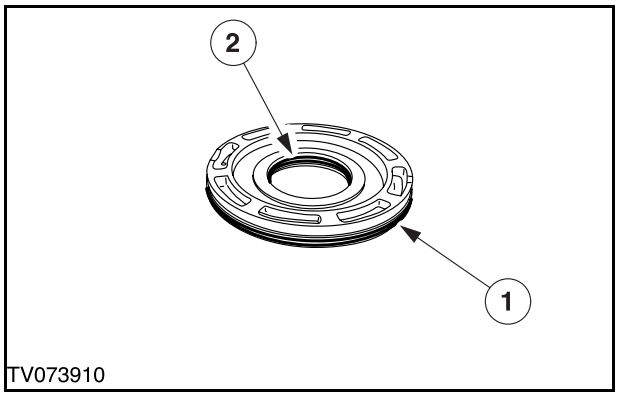


Assembly 4th speed clutch

Note:
- Install new seals.

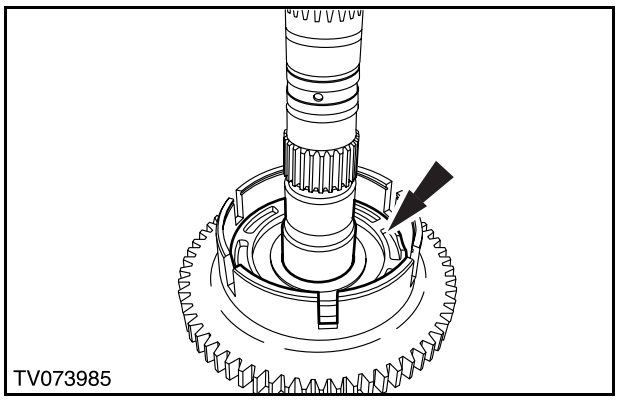
1. Install clutch piston outer seal (1) and inner seal (2).

Note:
- The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size until the new seal is flush with the outer diameter of the piston.

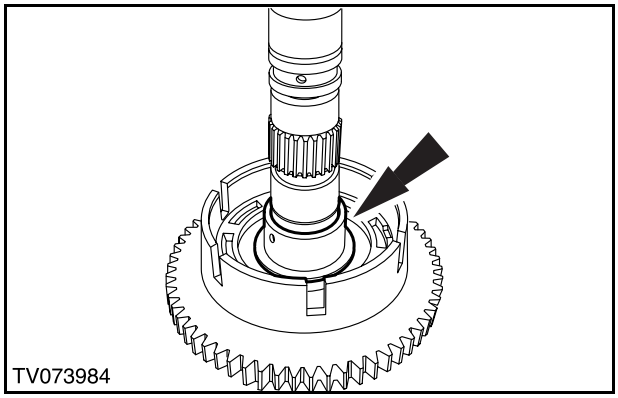


⚠ Caution:
- **Take care not to damage the seals.**

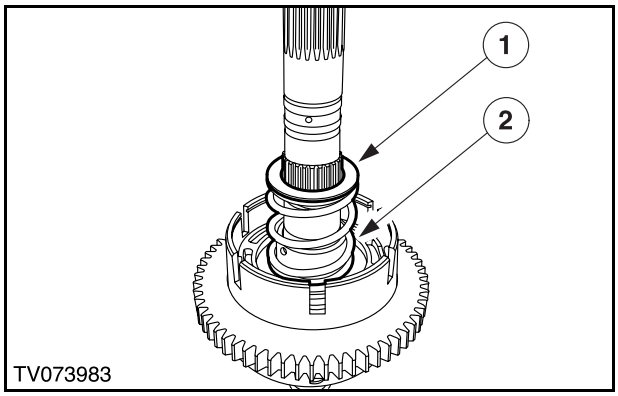
2. Install the clutch piston into the clutch drum.



3. Install the clutch sleeve.



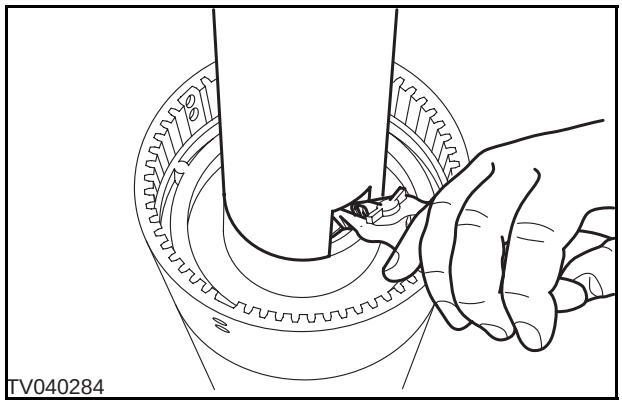
4. Install the piston return spring (2), retaining ring (1).



5. Using a suitable hydraulic press, compress the piston return spring.
6. Using suitable snap ring pliers, install the snap ring.

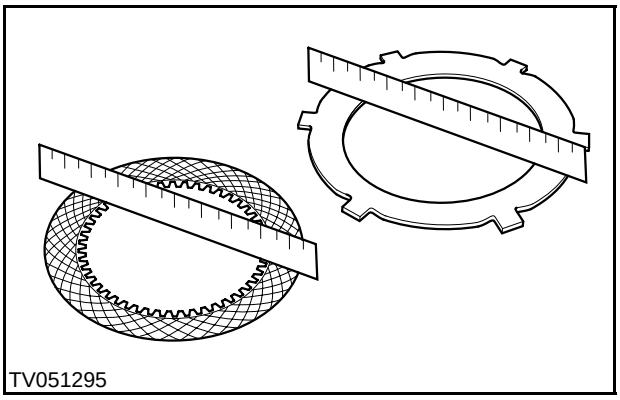
Note:

- Make sure the snap ring is correctly positioned in the groove.



7. Using a suitable steel straight edge, check the flatness of both the drive plates and the friction plates from the clutch pack.

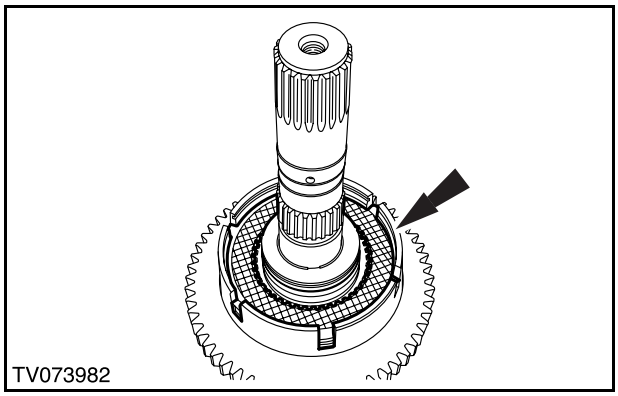
Note:
- Any plates found to be warped, damaged or worn must be replaced.


TV051295

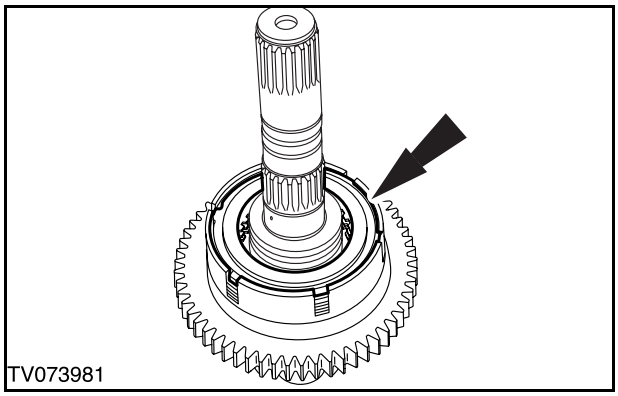
Note:
- Soak new friction discs in transmission oil before assembly.

Note:
- Alternate the friction and steel discs until the correct amount of discs are installed.

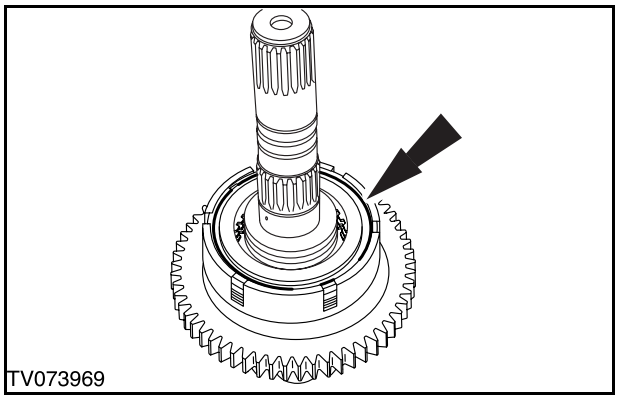
8. Install the clutch plates.


TV073982

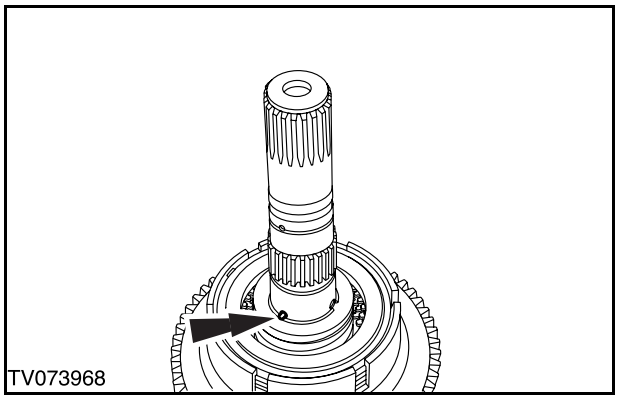
9. Install the retaining plate.


TV073981

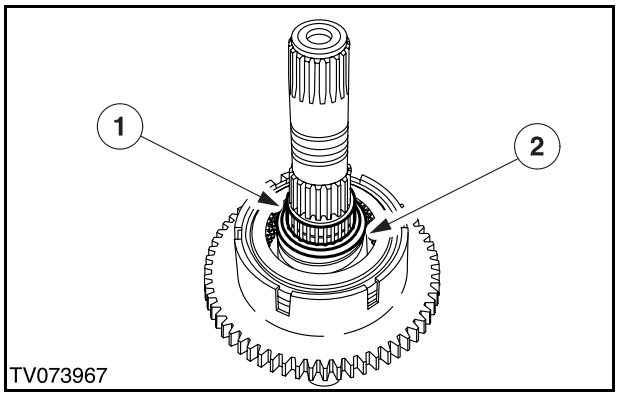
10. Install the snap ring.



11. Install the roll pin.



12. Install the spacer (2) and the bearing (1).

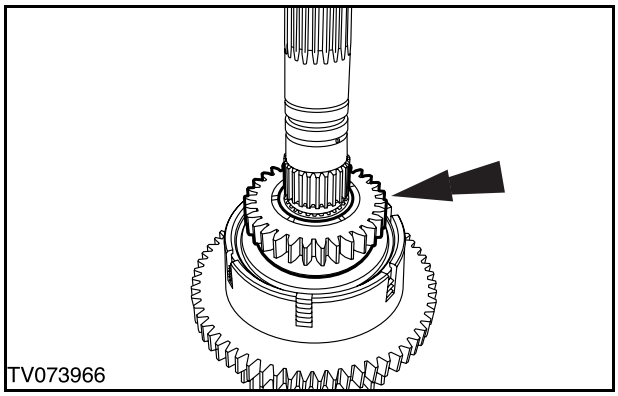


⚠ Caution:
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

⚠ Caution:
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

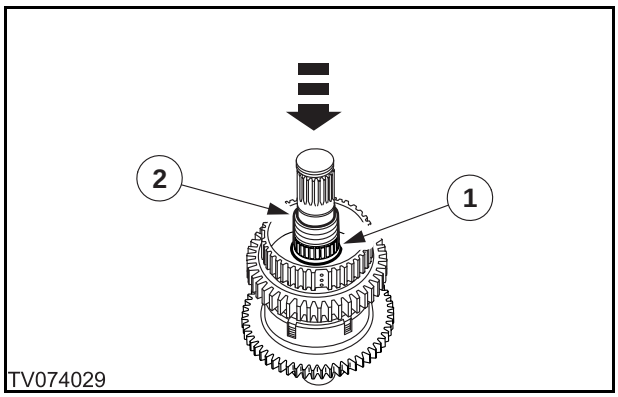
Note:
- Align the splines on the clutch gear with the internal teeth of the steel discs.

13. Install the 4th speed drive gear.



⚠ Caution:
- **Take care not to damage the sealing ring.**

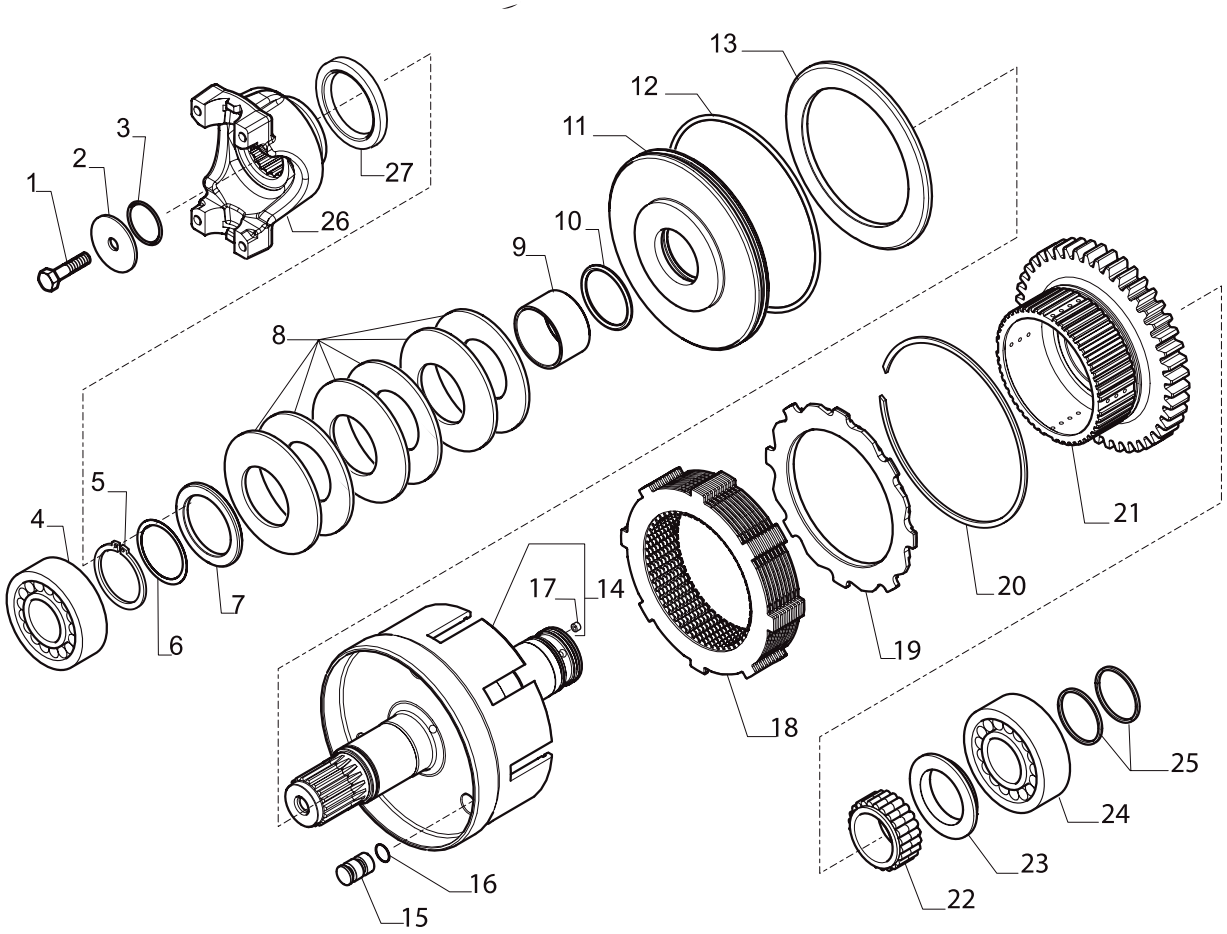
14. Using a suitable hydraulic press and sleeve install the oil sleeve (2) and the bearing (1).



DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT 4WD CLUTCH

BHN1307DF

Operation: **Disassembly and Assembly of the 4WD Clutch**	*Job Code:* **xx xx xx xx**		
None	Standard tools, Suitable puller		

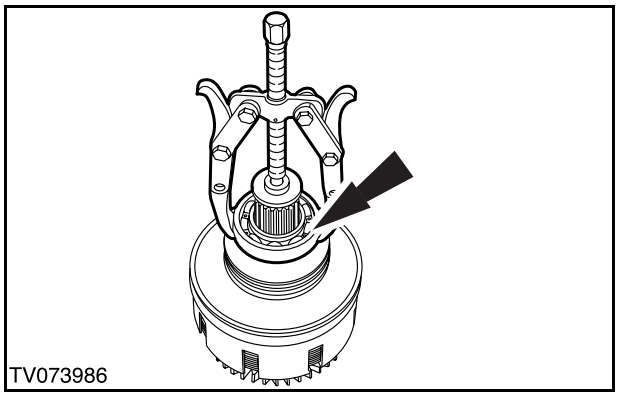


TV073914

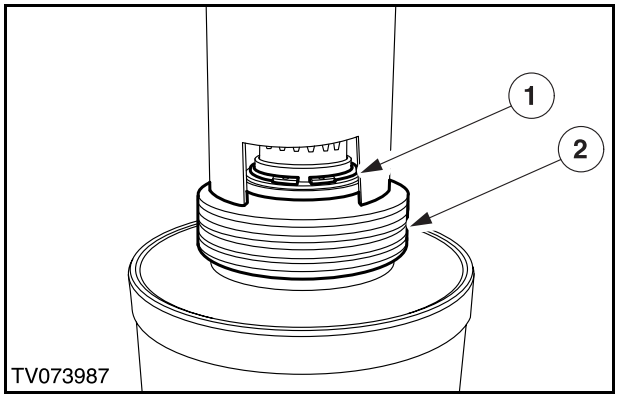
1	Bolt M12x25
2	Washer
3	O-ring
4	Bearing
5	Snap ring
6	Shim 0.1mm
6	Shim 0.3mm
6	Shim 0.5mm
7	Thrust washer
8	Belleville washer
9	Spacer
10	O-ring
11	Clutch piston
12	O-ring
13	Brake plate
14	4WD shaft kit
15	Brake pin
16	O-ring
17	Rivet D6
18	Clutch kit (4WD)
19	Lockring
20	Lockring
21	Gear Z41
22	Needle bearing bush
23	Thrust washer
24	Bearing
25	Seal ring D45
26	Flange
27	Seal ring

Disassembly

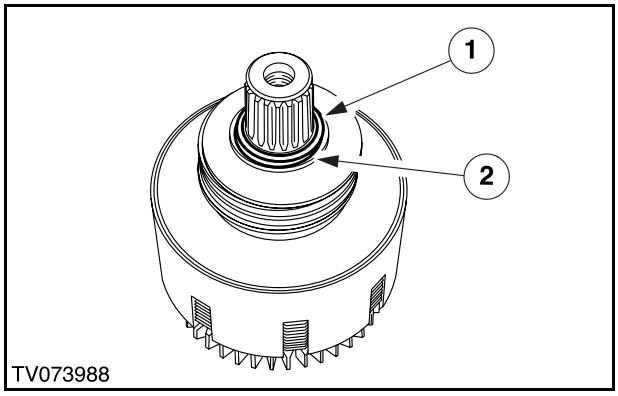
1. Using a suitable bearing puller remove the bearing.



2. Using a suitable press release the pressure on the belleville washers (1) and remove the snap ring (2) from the shaft.



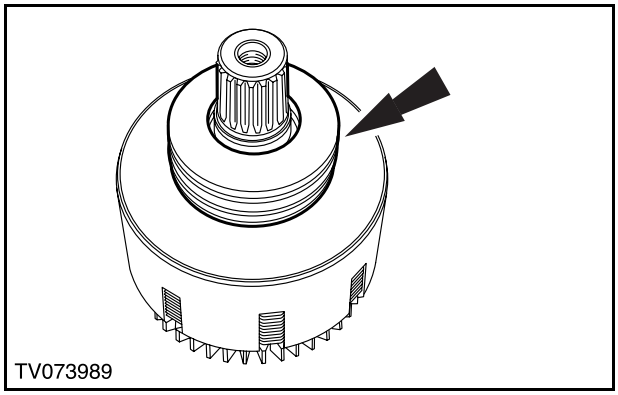
3. Remove the washer (1) and the shimming (2).



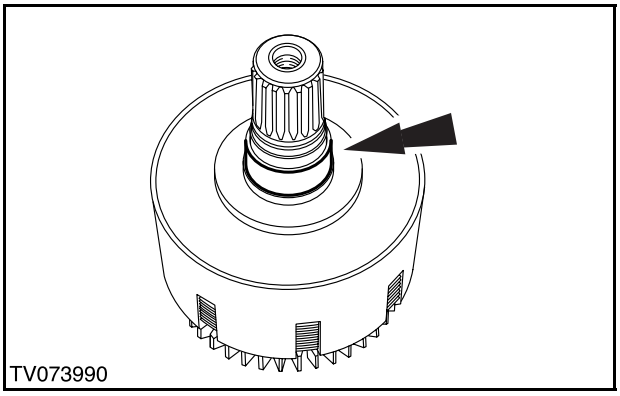
Note:

- The orientation of the belleville washers

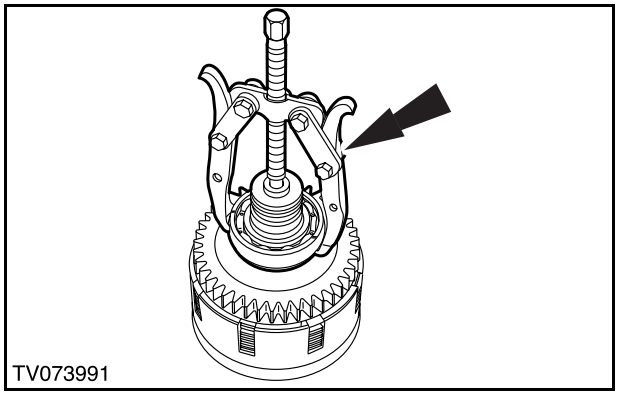
4. Remove the Belleville washers.



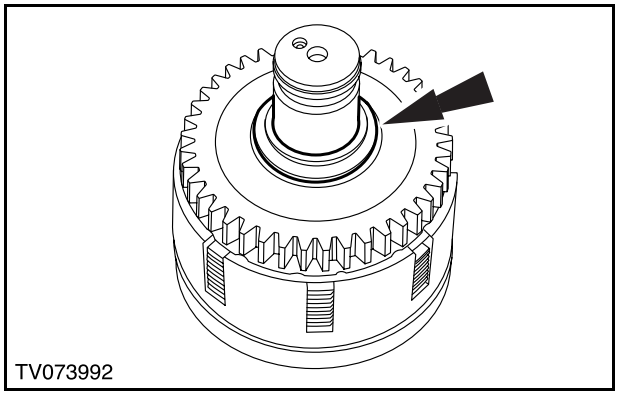
5. Remove the sleeve.


TV073990

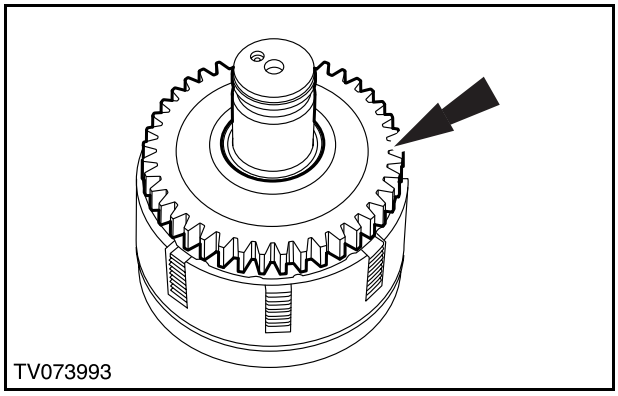
6. Using a suitable bearing puller remove the bearing.


TV073991

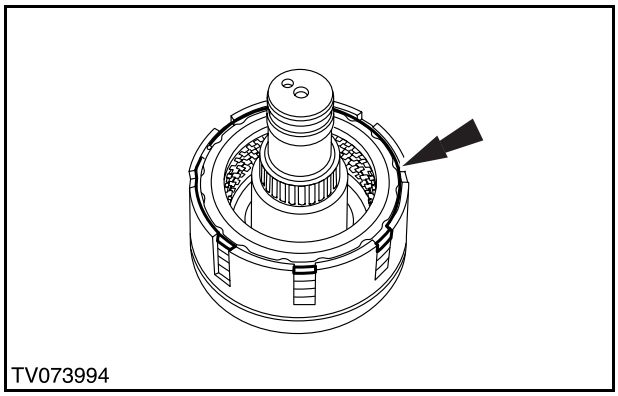
7. Remove the spacer.


TV073992

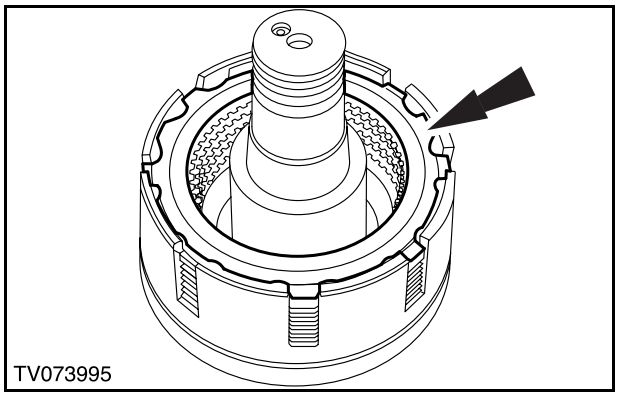
8. Remove the gear.


TV073993

9. Remove the snap ring.

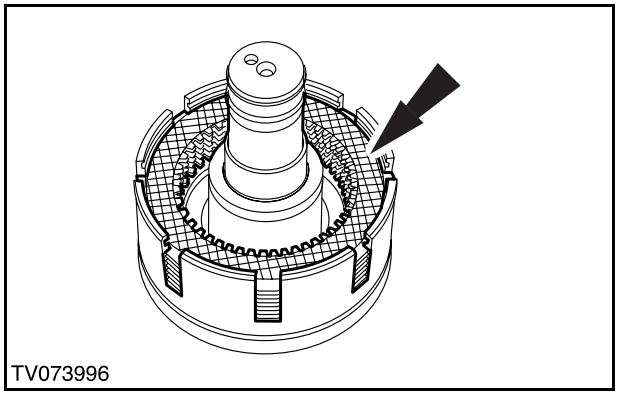

TV073994

10. Remove the retaining plate.

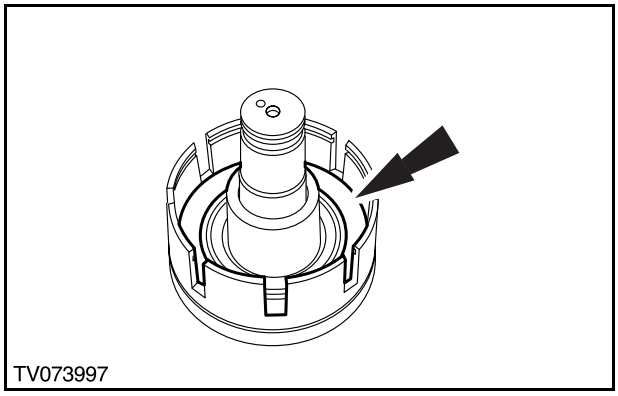

TV073995

Note:
- Note the plate orientation.

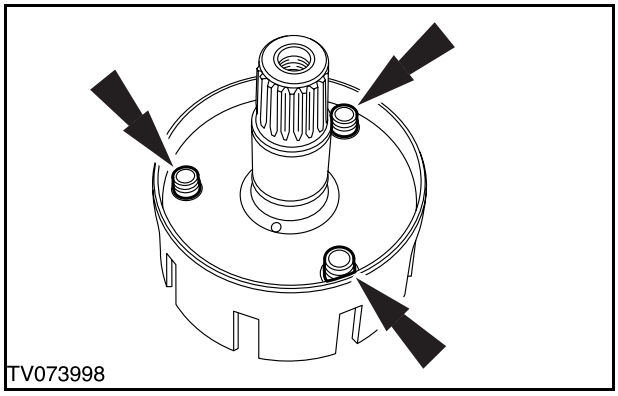
11. Remove the clutch pack.


TV073996

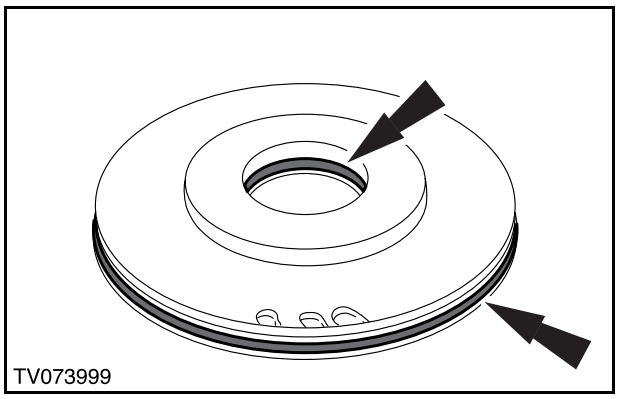
12. Remove the spacer. When the spacer is removed push the dowels down releasing the piston.


TV073997

13. Remove the dowels.


TV073998

14. Remove the clutch piston seals.


TV073999

Assembly

⚠ **Caution:**
- **Take care not to damage the sealing rings.**

Note:
- Install new seals.

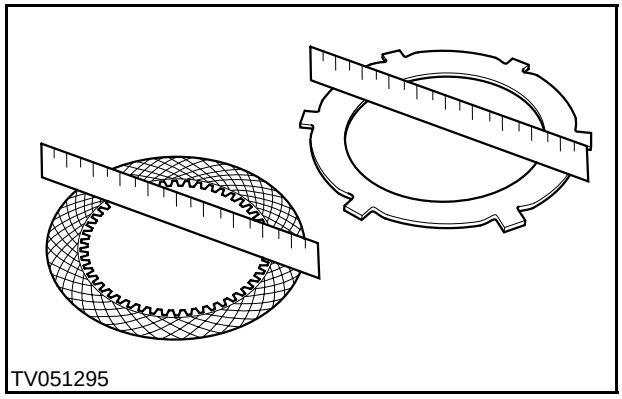
Note:
- Soak new friction discs in transmission oil before assembly.

1. To assemble, reverse the disassembly procedure.

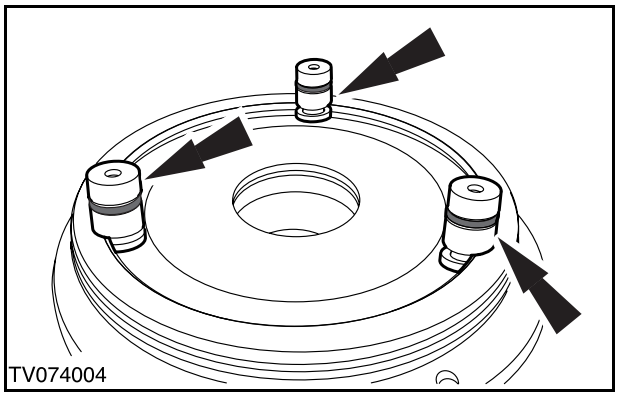
   Note:
   - The clutch piston inner and outer seals must be re-sized. Sizing is best accomplished by rotating the piston while holding a round object against the new sealing ring. Re-size untill the new seal is flush with the outer diameter of the piston.

2. Using a suitable steel straight edge, check the flatness of both the drive plates and the friction plates from the clutch pack.

Note:
- Any plates found to be warped, damaged or worn must be replaced

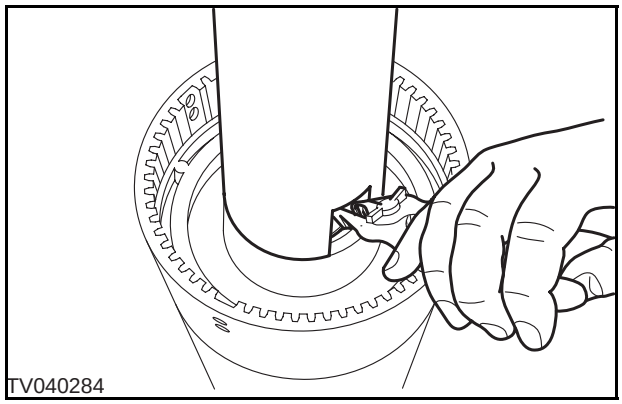

TV051295

3. Ensure dowels are fitted into the piston


TV074004

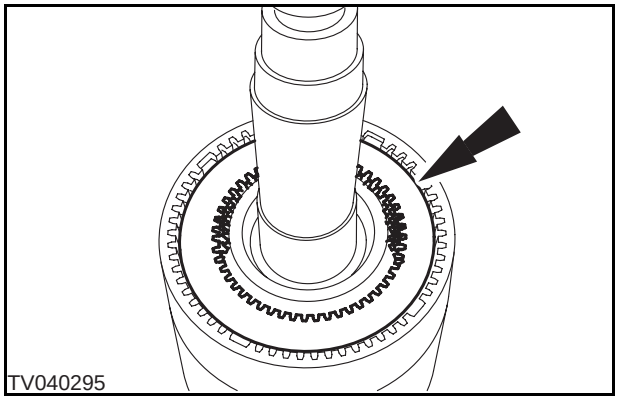
4. Using suitable snap ring pliers, install the snap ring.

Note:
- Make sure the snap ring is correctly located in the groove.


TV040284

Note:

- Alternate the friction and steel discs until the correct amount of discs are installed.

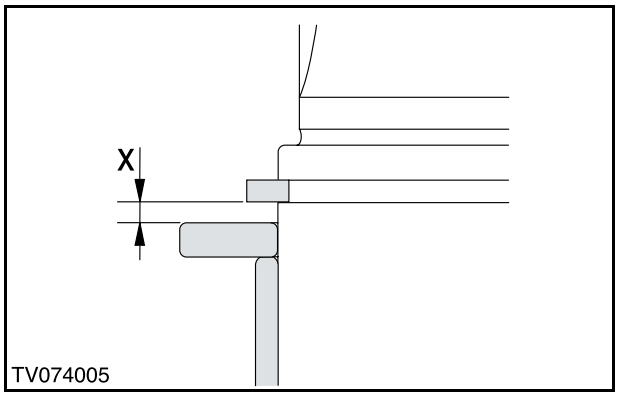

TV040295

⚠ **Caution:**
- **Make sure the clutch gear splines are fully installed. Failure to follow this instruction may result in damage to the transmission.**

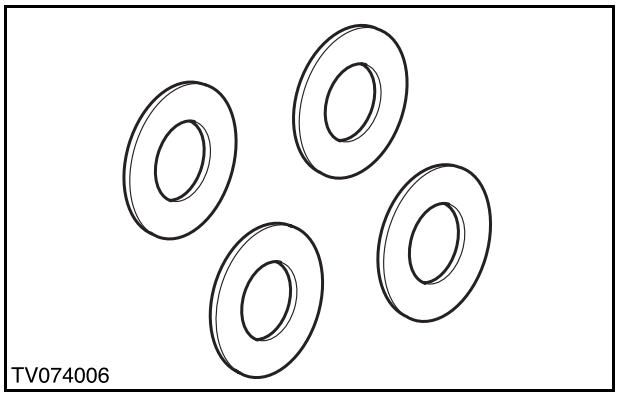
⚠ **Caution:**
- **Do not force this operation. Failure to follow this instruction may result in damage to the transmission.**

Note:
- Align the splines on the clutch gear with the internal teeth of the friction discs.

5. When the circlip has been installed on the output shaft a measurement must be taken and shimmed.



Using a thickness gauge measure quote X between the washer and the lock ring
Subtract from quote X fixed quote S1(S1=1.80mm)
The result S is the thickness of shims which has to be inserted between the washer and the lock ring.
S = X _ S1 = X (1.80mm)
Selection of shims



Shims Range			
Thickness mm	0.1	0.3	0.5

Select the shim of thickness value S from the range of available shims.

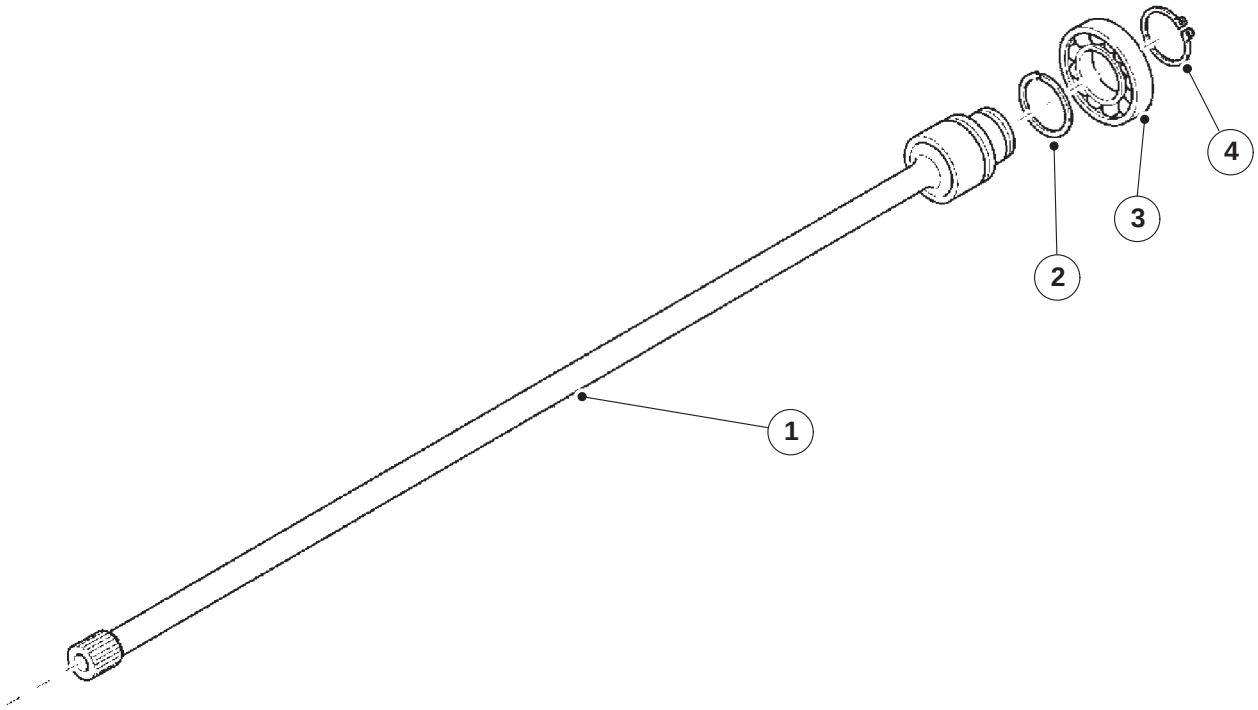
Note:
- Choose a shim so that a guaranteed stroke of 1.70 — 1.90 is achieved

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DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT HYDRAULIC PUMP DRIVE SHAFT

BHN1307DJ

Operation: **Disassembly and Assembly of the Hydraulic Pump Drive Shaft**	*Job Code:* **xx xx xx xx**		
None	Standard tools, Suitable puller		

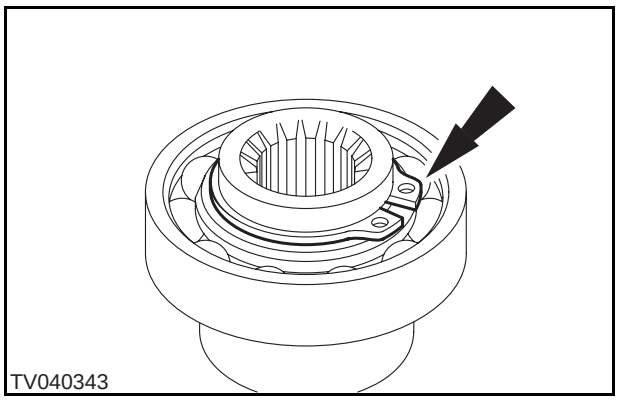


TV040569

1	Charging Pump drive shaft
2	Sealing ring
3	Charging Pump drive shaft bearing
4	Charging Pump drive shaft bearing circlip

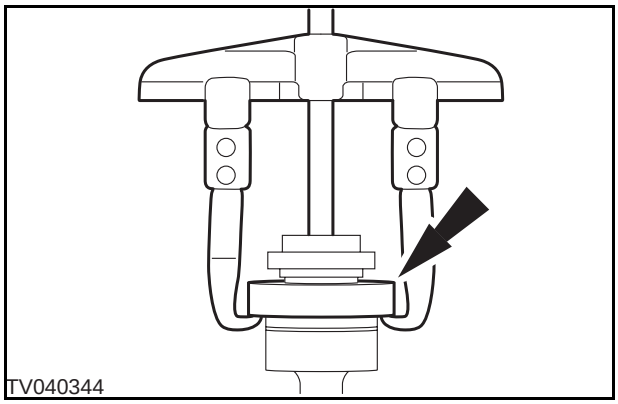
Disassembly

1. Using suitable circlip pliers, remove the charging pump drive shaft bearing circlip.

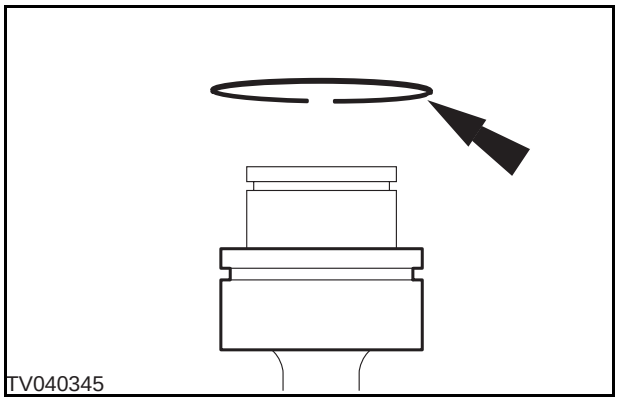


TV040343

2. Using a suitable puller, remove the hydraulic pump drive shaft bearing.

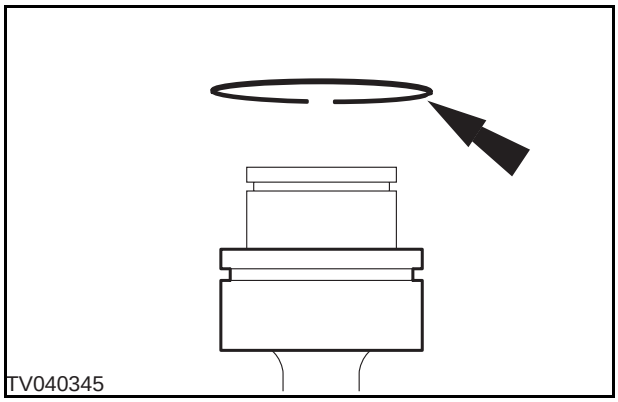

TV040344

3. Remove and discard the seals from the hydraulic pump drive shaft.

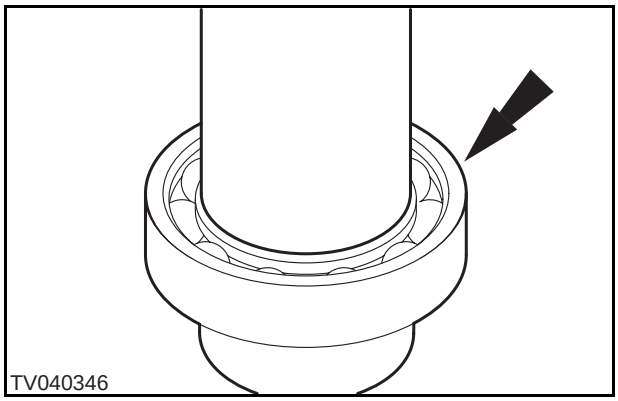

TV040345

Assembly

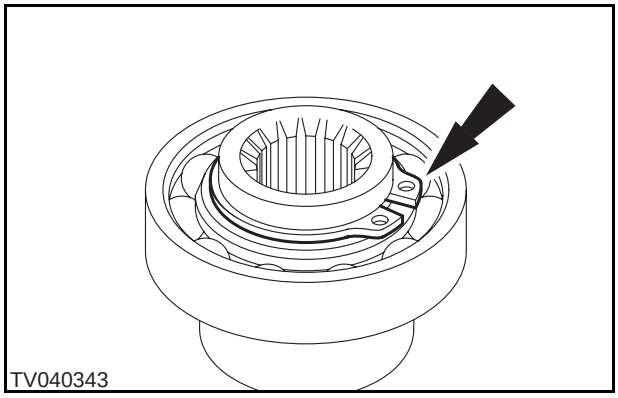
1. Install the seals on the hydraulic pump drive shaft.



2. Using a suitable press, install the hydraulic pump drive shaft bearing.



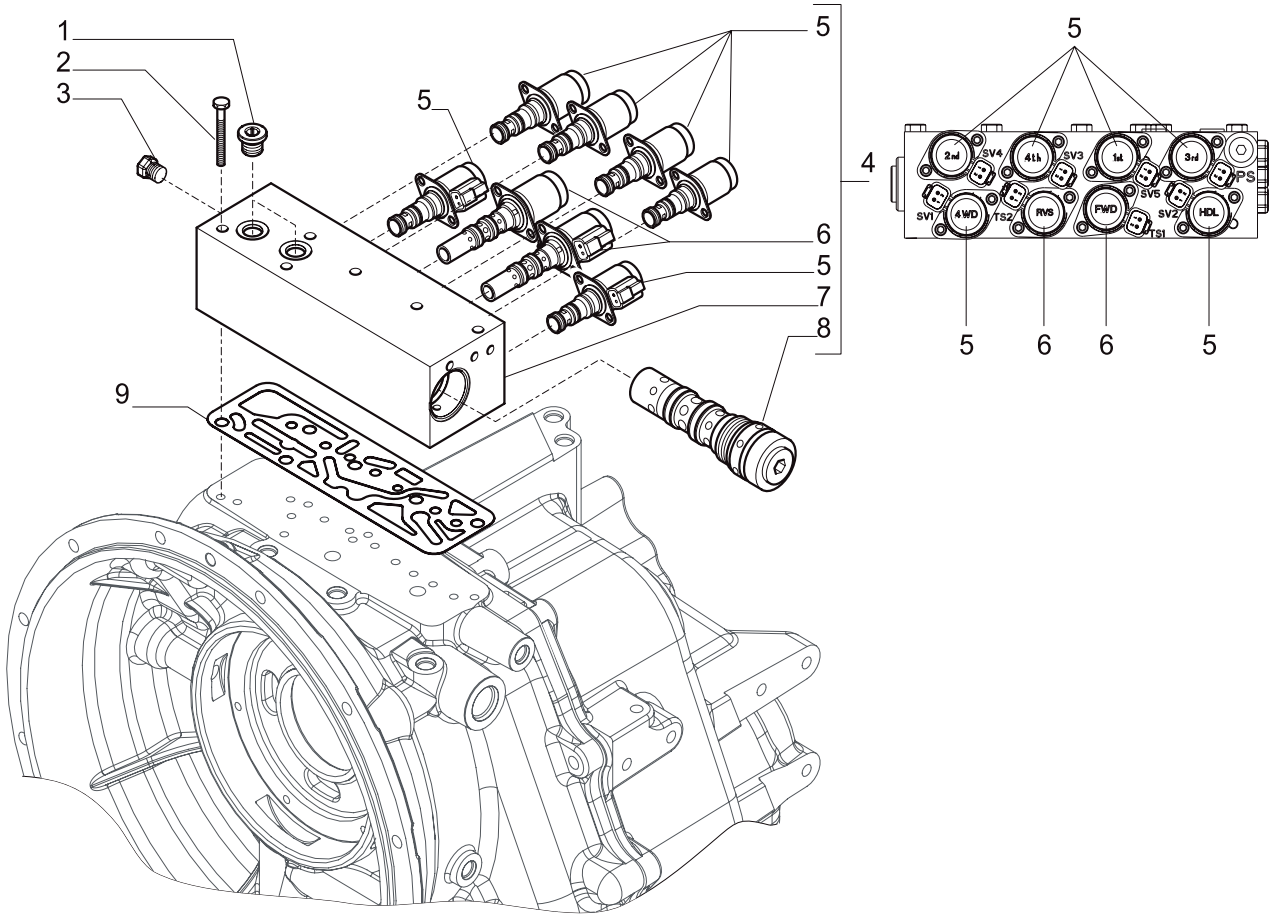
3. Using suitable circlip pliers, install the charging pump drive shaft bearing circlip.



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DISASSEMBLY AND ASSEMBLY — CARRARO POWERSHIFT TRANSMISSION CONTROL VALVE

BHN1307DL



TV073915

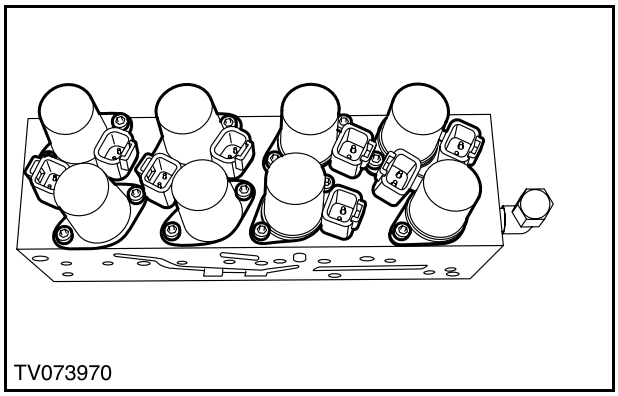
1	Plug
2	Bolt m8x90
3	Plug
4	Control valve
5	On-off valve
6	Proportional valve
7	Valve block
8	Ramp valve
9	Gasket

Disassembly

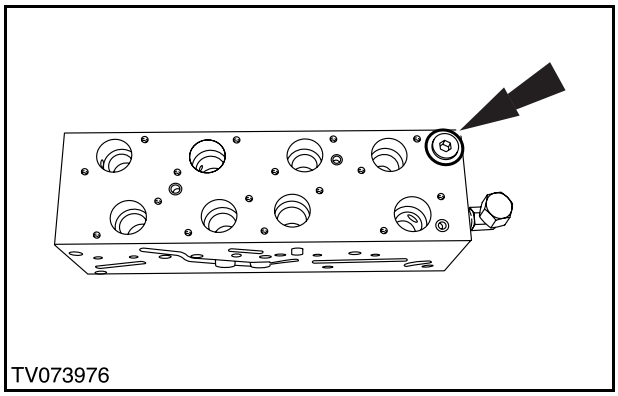
Note:

- The position of the hydraulic control valves.

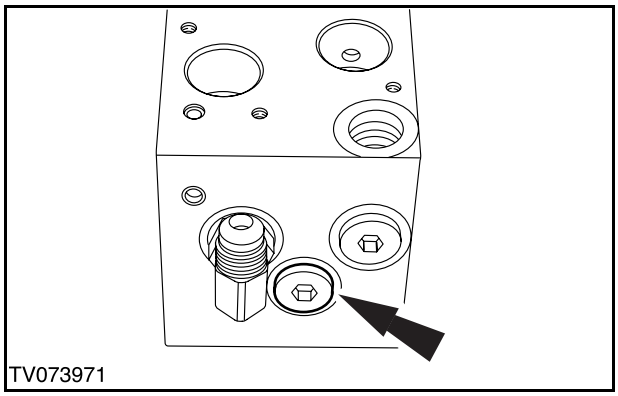
1. Remove the 8 hydraulic control valves.


TV073970

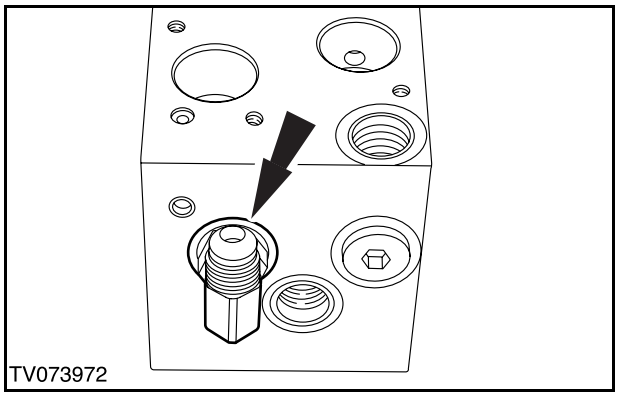
2. Remove the plug.


TV073976

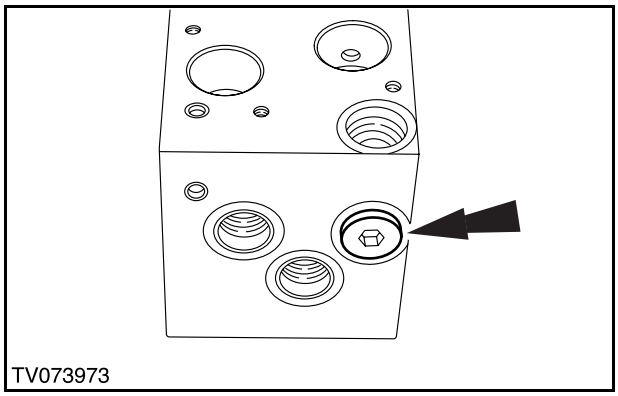
3. Remove the boom lock outlet port plug (P).


TV073971

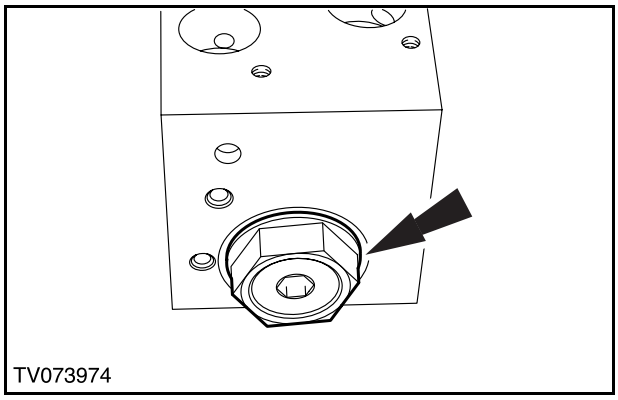
4. Remove the hydraulic differential lock union (HDL).


TV073972

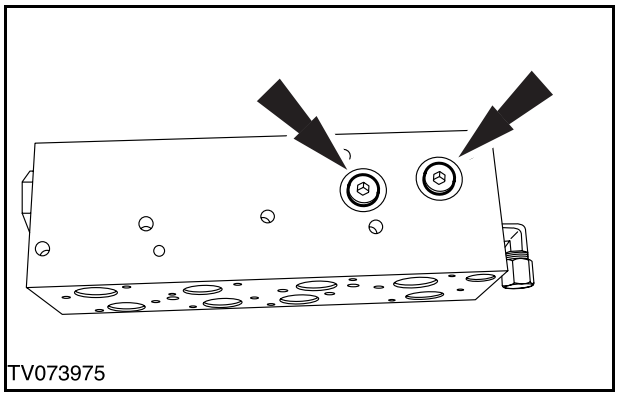
5. Remove the brake outlet port (X).


TV073973

6. Remove the ramp valve.


TV073974

7. Remove the supply and gear pressure check port plugs.


TV073975

Assembly

Note:
- Always fit new O-ring seals and gaskets

8. To assemble, reverse the disassembly procedure.

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GENERAL PROCEDURE — CARRARO POWERSHIFT CLEANING AND INSPECTION AFTER TRANSMISSION REPAIR

BHN1307GB

After the repaired transmission has been installed in the machine, the oil cooler, and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgement must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain the entire system thoroughly.
2. Disconnect and clean all hydraulic lines. Where feasible, hydraulic lines should be removed from the machine for cleaning.
3. Replace oil filter elements cleaning out filter cases thoroughly.
4. The oil cooler must be thoroughly cleaned. The cooler should be “back flushed” with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, the cooler assembly should be removed from the machine for cleaning, using oil, compressed air, and steam cleaner for that purpose. DO NOT use flushing compounds for cleaning purposes.
5. Reassemble all components and use only the specified type of oil.
   Fill the transmission through the filler opening until fluid comes up to the oil level check port.
   Run the engine for 2 minutes at low RPM to prime the torque converter and hydraulic lines.
   Check the transmission oil with the engine running at idle RPM and add oil as necessary.
   Check the transmission oil level when the transmission is at the operating temperature 80 °C (176°F).
6. Check all drain plugs, lines, connections, etc. for leaks and tighten where necessary.

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SPECIFICATIONS — CARRARO POWERSHIFT TRANSMISSION

BHN1307SA

Special Tools

Special Tool Number	Description
CA119033	Handle
CA715004	Driver
CA715046	Driver
CA715149	Driver
CA715356	Gauger
CA715358	Clutch assembly / disassembly
CA715409	Driver
CA715494	Check
CA715495	Protection shims
CA715497	Pusher
CA715499	Protection
CA715501	Driver
CA715623	Driver
CA715732	Shaft B,C,E raising tool
CA715743	Protection shims
CA715744	Protection shims
CA715745	Gauger
CA715748	Pusher
CA716009	Gauger
CA716010	Protection
CA716018	Protection shims
CA716019	Pusher
CA716020	Gauger
CA716021	Extractor

General Information

Transmission	Power Shift
Make	Carraro
Model	TLB2
Power rating	85KW at 2200 RPM
Max, input torque Nm	800
Max, speed RPM	2400
TC pump drive configuration	W300
Flywheel HSG dimensions	SAE 3 STD
Output yokes	1410 Half round type
Front output yoke from engine CL drop	340 mm
Rear output yoke from engine CL drop	170 mm
Coaxial pump drive	SAE C 2 & 4 bolts — spline B/B
Pump drive torque capacity	Full engine torque
Solenoid electric voltage (V)	12
Modulation FWD / REV	Proportional hydraulic, electrically controlled
Gear shifting	Proportional hydraulic, electrically controlled
Speed gears	4 FWD — 3 REV
Dipstick port	Left hand side
Cooler in / out port	Right hand side
MFD sizing	Capable to hold 1st gear @ stall

Capacity

System	Temperatures	Viscocity	Specification	Capacity	Notes
Powershift Transmission	ALL	10W	ATF	23 (Total System)	Check oil level with engine running at idle. Approved oils: Chevron Texaco textran 7045 Total Fina HY-Tran

Temperature Specifications

- Normal operating temperature 80° (176°F).
- Maximum allowed transmission temperature 120°C (248°F).

Torque Values

Note:

- All threads must be lubricated before assembly.

Description	Nm	Lb.ft
Transmission Bell Housing	71	52
Torque Converter	41	30
Propeller Shaft	47	35
Hydraulic Pump	98	72
Transmission/Converter Housing	45	33
Output Flange	380	280
Transmission Housing Plug	17	13
Four-wheel Drive Flange	380	280
Charging Pump	23	17
Torque Converter Drive Plates	37	27
Transmission Oil Filter Adapter	23	17
Transmission Oil Filter	34	25
Transmission Control Valve	22	16
Transmission Control Valve Cover	6	4
Wiring Harness Connector Mounting Nut	7	5
Transmission Air Breather	38	28

Torque Chart (Bolts)

Note:

- (Based in VDI 2230, μ = 0,14 and CCI standard)

Metric			**Inch**		
Class 8,8	Torque		Grade 5	Torque	
	Nm	lbft		Nm	lbft
M5 x 0,8 M8 x 1,25 M10 x 1,5	5 — 6 20 — 25 40 — 50	3,7 — 4,4 14,7 — 18,4 29,5 — 36,8	0,5000	87 — 95	64,1 — 70,0

Torque Chart (O-Ring Port Plugs)

Metric			**Inch**		
Size	Torque		Size	Torque	
	Nm	lbft		Nm	lbft
M10 x 1 M22 x 1,5 M33 x 2	8 — 10 48 — 60 112 — 140	5,9 — 7,4 35,4 — 44,2 82,5 — 103,2	1,3125 — UN	112 — 140	82,5 — 103,2

Torque Chart (Pipe Plugs)

Metric			**Inch**		
Size	Torque		Size	Torque	
	Nm	lbft		Nm	lbft
M22 x 1,5 UNI 7707	48 — 60	35,4 — 44,2	0,1250 — 27 NPTF	9 — 13	6,6 — 9,6

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ENGINE

P14
SECTION

DESCRIPTION AND OPERATION — ENGINE P14–01–1
REMOVAL AND INSTALLATION — ENGINE P14–01–3
REMOVAL AND INSTALLATION — ENGINE P14–01–15
REMOVAL AND INSTALLATION — RADIATOR P14–01–27
REMOVAL AND INSTALLATION — FUEL TANK P14–01–31
REMOVAL AND INSTALLATION — AIR CLEANER P14–01–33
REMOVAL AND INSTALLATION — EXHAUST PIPE P14–01–35
REMOVAL AND INSTALLATION — EXHAUST SILENCER P14–01–37
GENERAL PROCEDURE — THROTTLE ADJUSTMENT P14–01–39
GENERAL PROCEDURE — DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM P14–01–41
SPECIFICATIONS — ENGINE P14–01–43

DESCRIPTION AND OPERATION — ENGINE

BHP1401OA

For additional information, refer to the Perkins Engine Manual.

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REMOVAL AND INSTALLATION — ENGINE

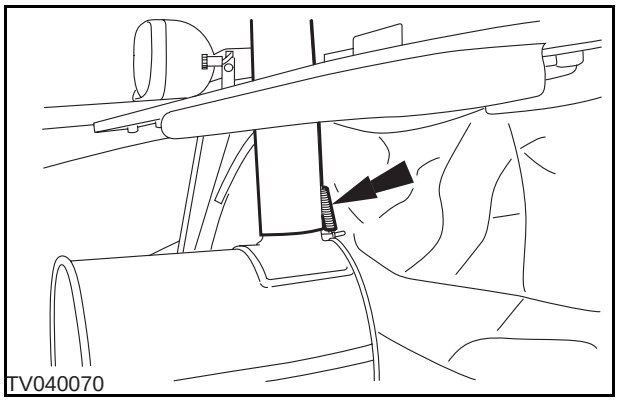
BHP1401RA

Operation: **Removing and Installing the Engine**	*Job Code:* **14 10 13 xx**		
Suitable lifting equipment, Suitable jack	Standard tools		
Vehicles with Air Conditioning			
Vehicles without Air Conditioning			

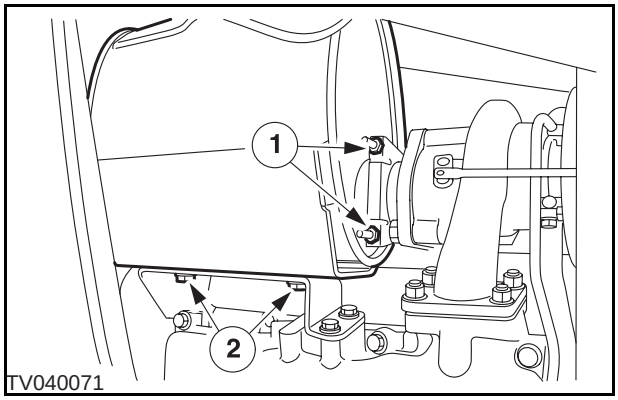
Removal

All vehicles

1. Remove the front tool box. For additional information, refer to Section K10-01 HARDNOSE/TOOLBOX, PAGE K10–01–3 .
2. Remove the hood. For additional information, refer to Section K10-01 HOOD, PAGE K10–01–5 .
3. Drain the cooling system. For additional information, refer to DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM, PAGE P14–01–41 in this section.
4. Remove the air cleaner. For additional information, refer to AIR CLEANER, PAGE P14–01–33 in this section.
5. Detach the exhaust stack spring and remove the exhaust stack.


TV040070

6. Loosen the exhaust silencer clamp (1).
7. Remove the exhaust silencer (2).



TV040071

Vehicles with Air Conditioning (A/C)

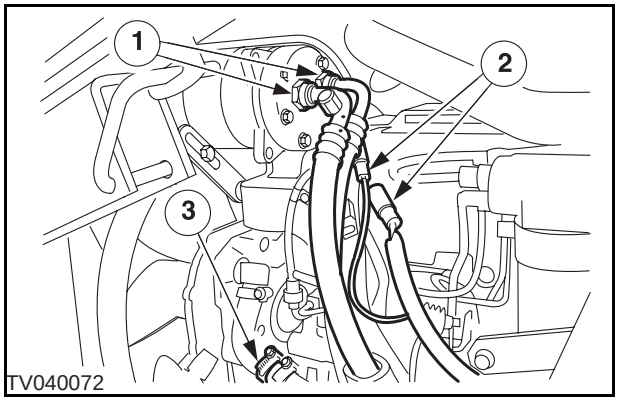
8. Evacuate the A/C system. For additional information, refer to Section H08-01 AIR CONDITIONING RECOVERY AND CHARGING, PAGE H08–01–45 .

Note:
- Install blanking plugs to avoid contamination.

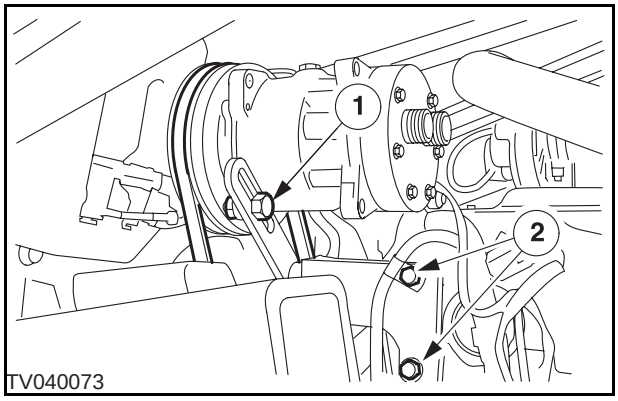
9. Disconnect the A/C pipes from the A/C compressor (1).

Note:
- Remove and discard the O-ring seals.

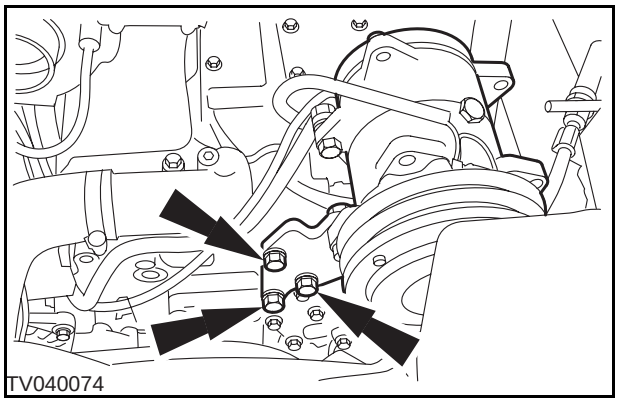
10. Disconnect the A/C electro–magnetic clutch and glow plug wire electrical connectors (2).
11. Disconnect the engine coolant hose (3).



12. Loosen the A/C accessory drive belt tensioner adjustment bolt and remove the accessory drive belt from the A/C compressor (1).
13. Remove the A/C compressor bracket retaining bolts (2).



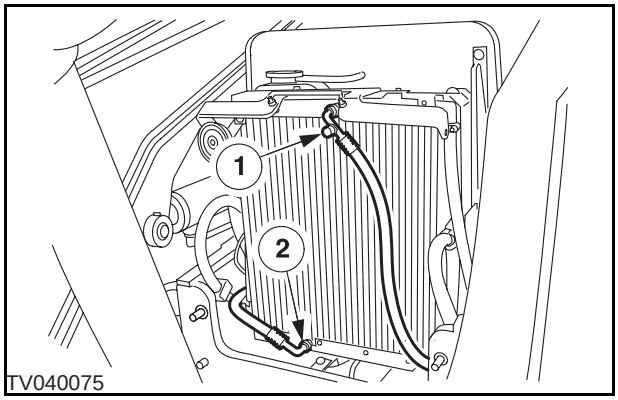
14. Remove the A/C compressor and mounting bracket.



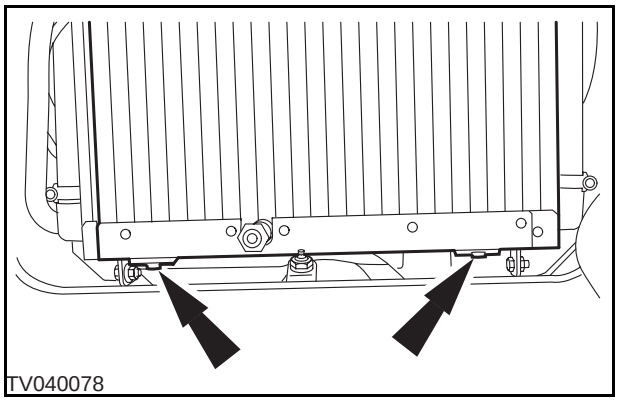
15. Disconnect the A/C inlet hose from the condensor (1).
16. Disconnect the A/C outlet hose from the condensor (2).

Note:
- Install blanking plugs to avoid contamination.

Note:
- Remove and discard the O-ring seals.

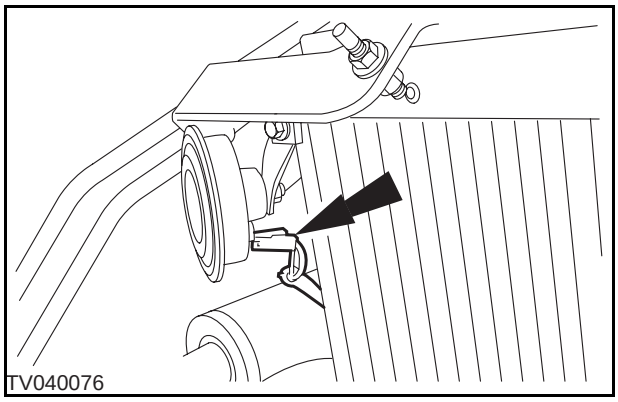


17. Remove the A/C condensor lower retaining bolts.

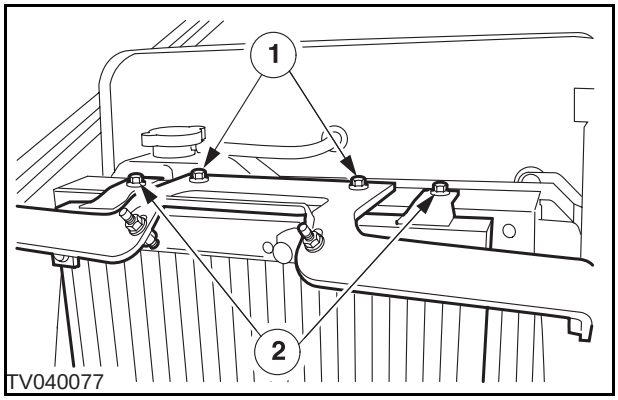


All Vehicles

18. Disconnect the horn electrical connectors.

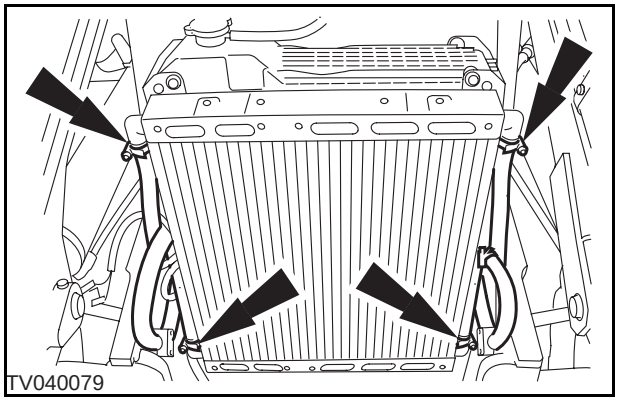


19. Remove the radiator support bracket (1).
20. Remove the A/C condensor (if equipped) (2).

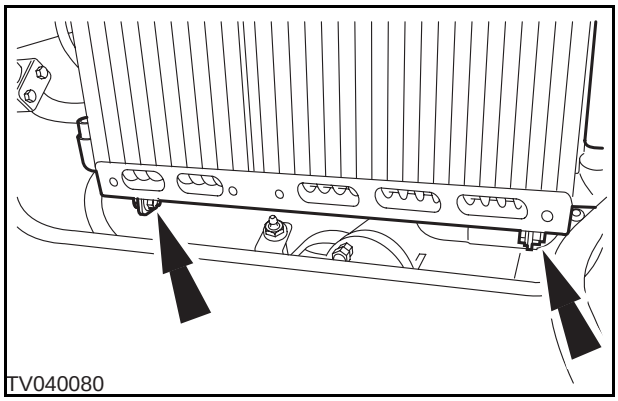


Note:
- Install blanking plugs to avoid contamination.

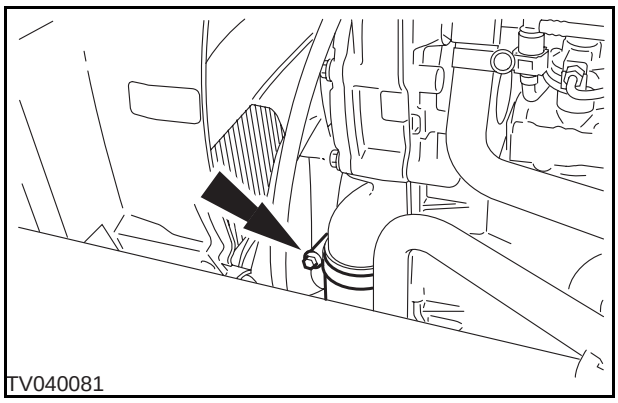
21. Disconnect the oil cooler pipes from the oil cooler.


TV040079

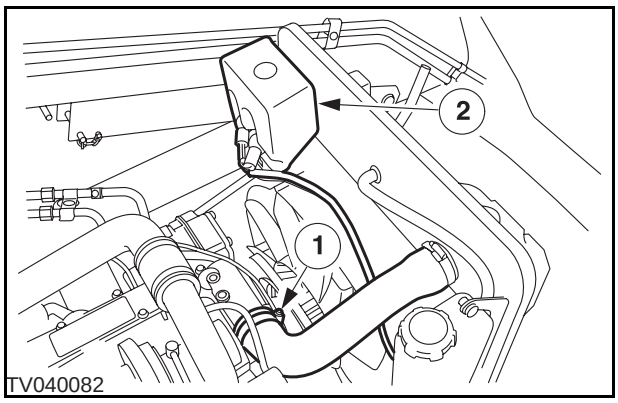
22. Remove the oil cooler.


TV040080

23. Disconnect the radiator bottom coolant hose from the water pump.

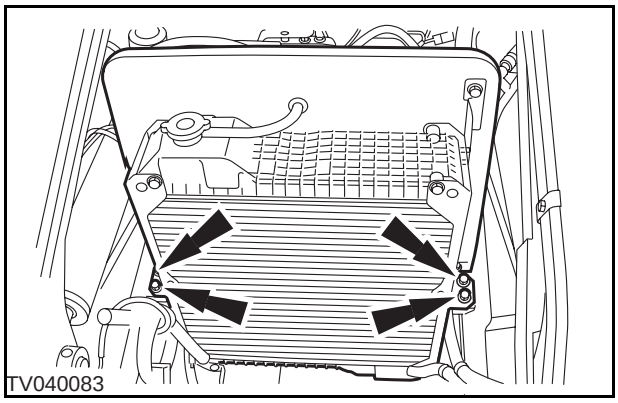

TV040081

24. Disconnect the radiator top hose from the thermostat housing (1).
25. Detach the windshield washer bottle from the cooling fan shroud and position it to one side (2).

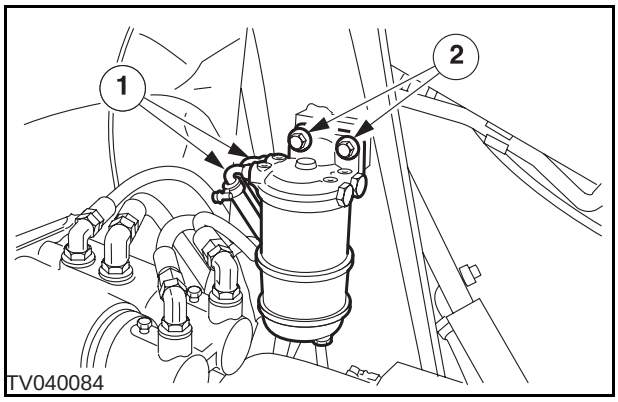


TV040082

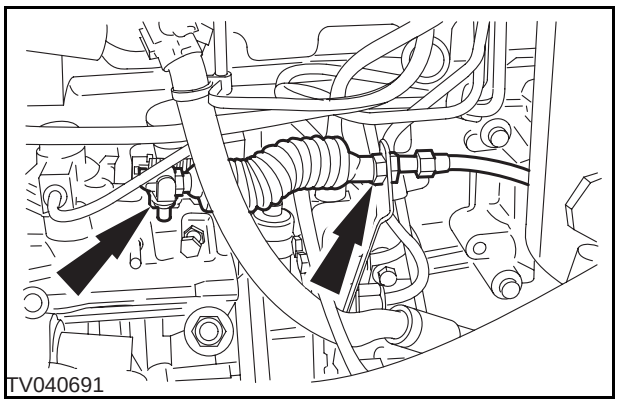
26. Remove the radiator assembly.



27. Disconnect the fuel filter fuel supply and return lines (1).
28. Remove the fuel filter assembly (2).



29. Loosen the throttle cable adjuster nut and disconnect the throttle cable from the fuel injection pump.

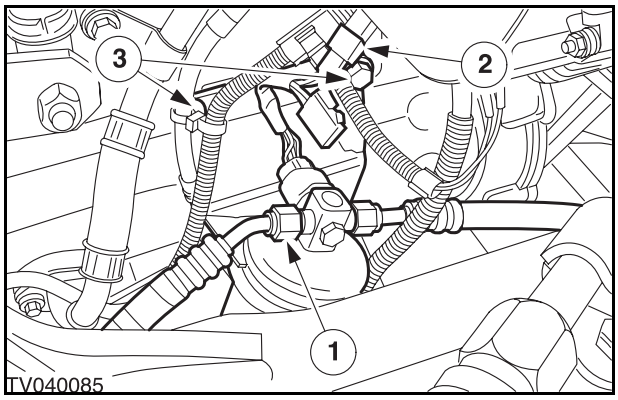


Vehicles with Air Conditioning (A/C)

Note:
- Install blanking plugs to avoid contamination.

30. Disconnect the A/C pipe from the A/C filter/drier (1).
31. Disconnect the A/C filter/drier electrical connectors (2).

32. Detach the A/C filter/drier and position it to one side.

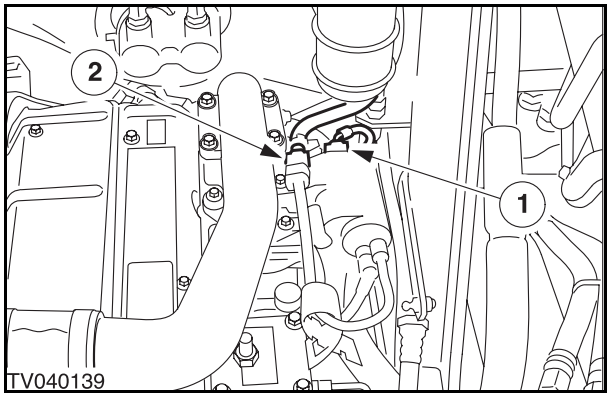


All Vehicles

33. Disconnect the fuel pump electrical connectors (1).

    Note:
    - Install blanking plugs to avoid contamination.

34. Disconnect the fuel pipe from the fuel pump (2).

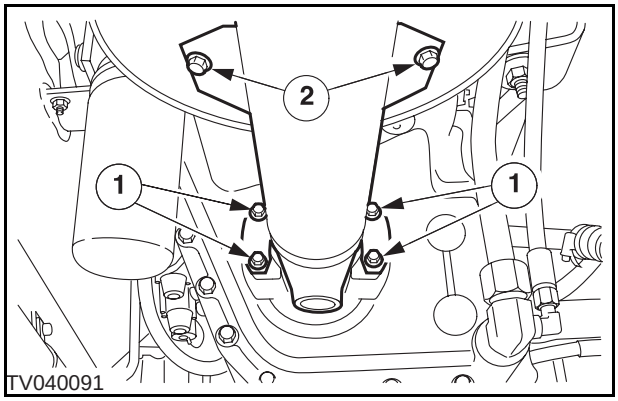


35. Remove the cab heater ducting. For additional information, refer to Section H08-01 CAB HEATER AIR DUCTING, PAGE H08–01–13 .

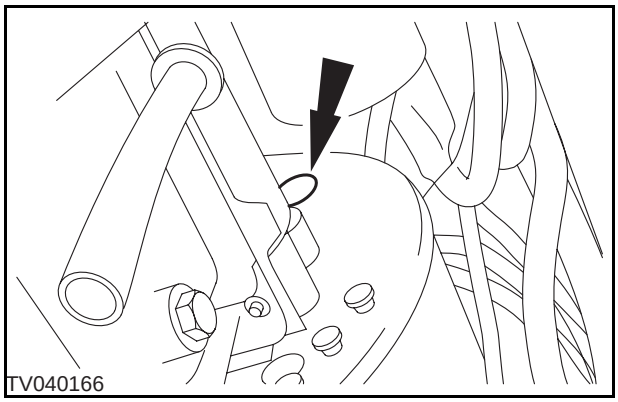
    ⚠ **Caution:**
    - **Secure the universal joint bearing cups to prevent contamination or damage.**

    Note:
    - Remove and discard the retaining bolts.

36. Remove the front propeller shaft (1) and secure it to one side.
37. Remove the access cover (2).

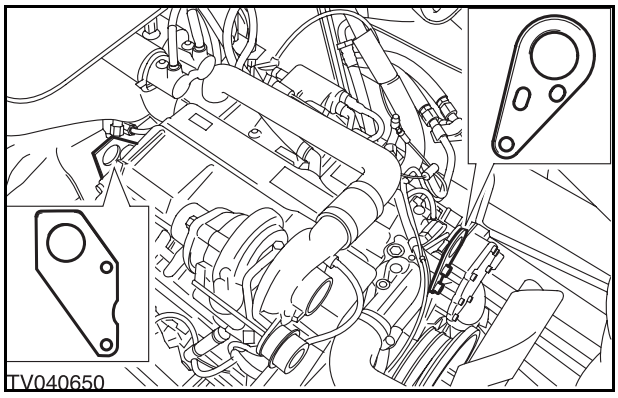


38. Using the access hole, remove the torque converter retaining bolts.



⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

39. Attach the engine lifting eyes to the engine.



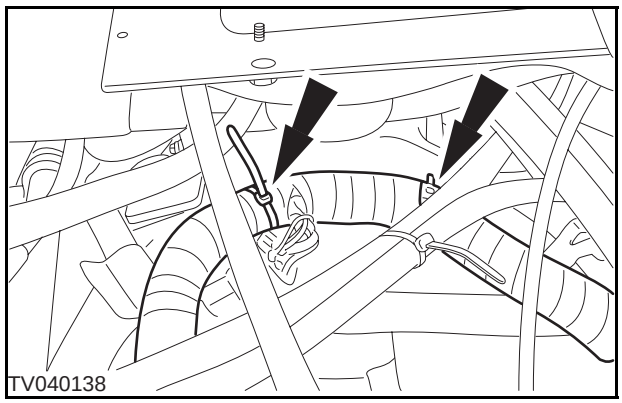
Note:
- To aid removal of the engine, it is necessary to raise the front of the engine approximately 80mm higher than the rear .

40. Attach the suitable lifting equipment to the engine lifting eyes and support the engine.

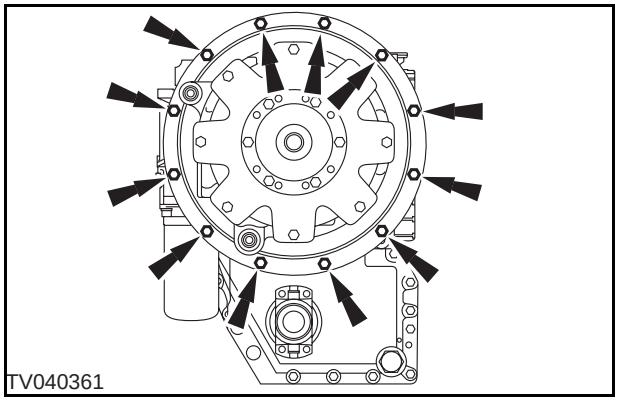
⚠ **Warning:**
- **Secure the transmission to the transmission jack. Failure to follow this instruction may result in personal injury.**

41. Using a suitable transmission jack, support the transmission.

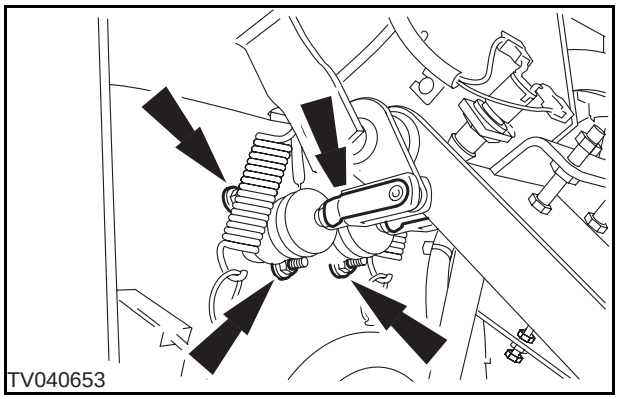
42. Cut the cable ties and position the wiring harness to one side.



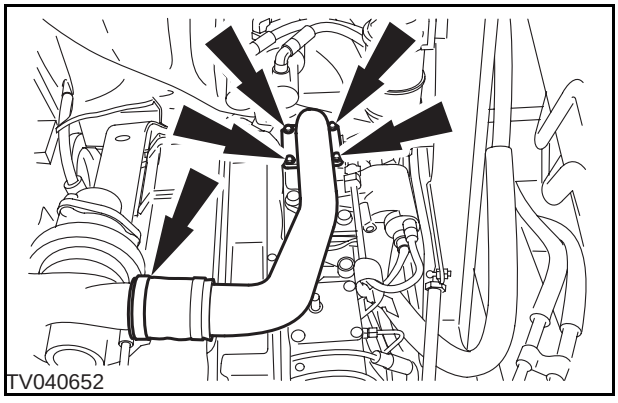
43. Remove the transmission retaining bolts.



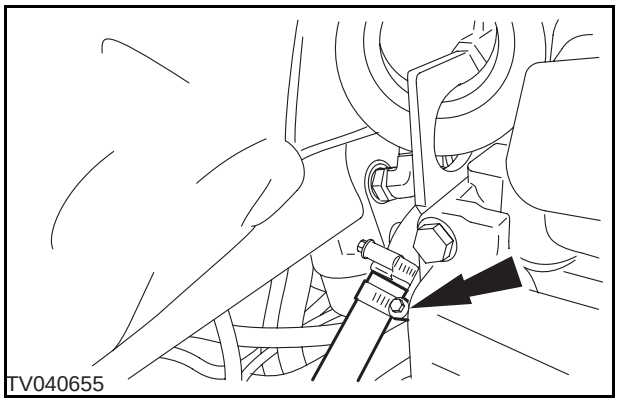
44. Loosen the brake master cylinder.



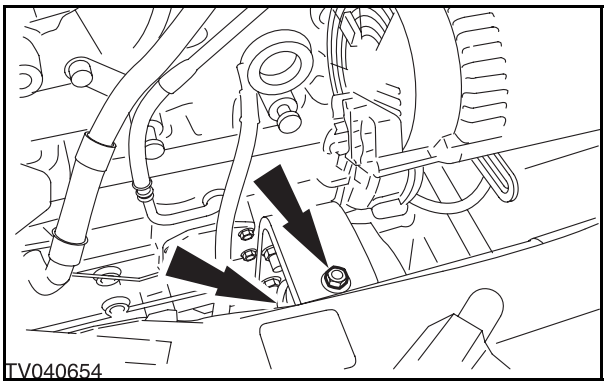
45. Remove the turbocharger outlet tube retaining bolts.
46. Disconnect the turbocharger outlet tube from the turbocharger.



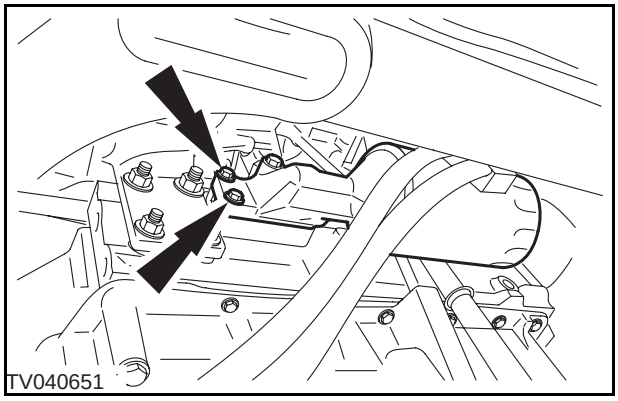
47. Disconnect the coolant hose from the rear of the engine.



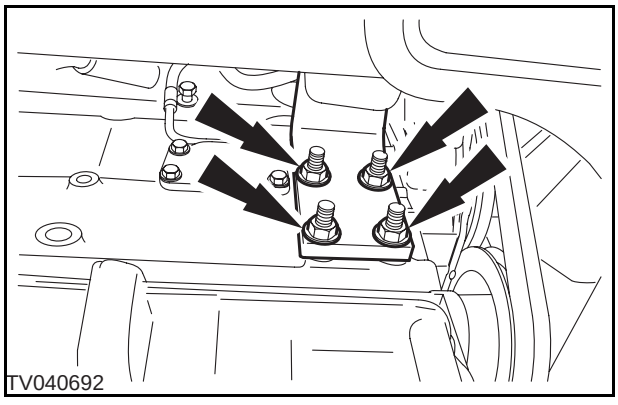
48. Remove the engine mount retaining bolts. (right-hand side shown, left-hand side similar).



49. Remove the oil filter housing.



50. Remove the engine mounting brackets from the engine. (left-hand side shown, right-hand side similar).



⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

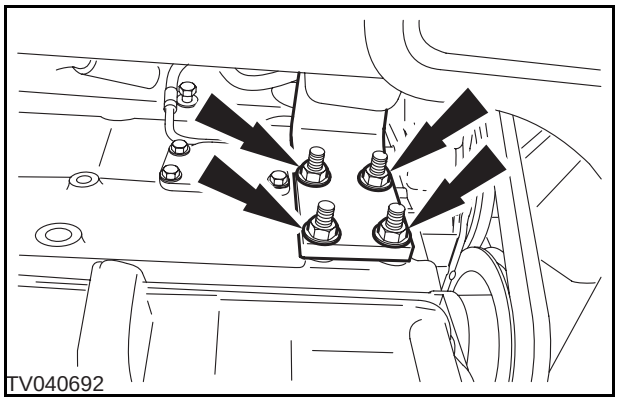
⚠ **Caution:**
- **Ensure the torque converter is remains with the transmission.**

51. Remove the engine.

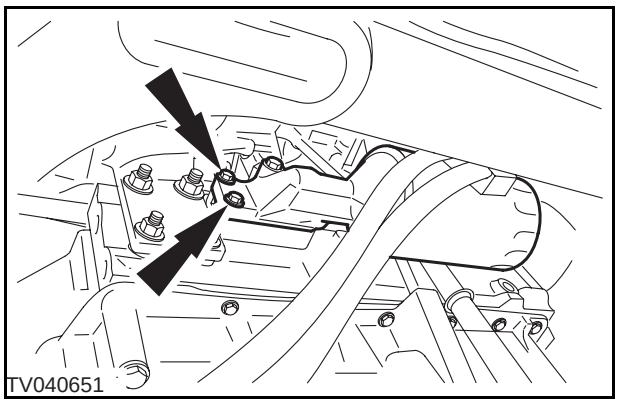
Installation

Note:
- Install new O-ring seals.

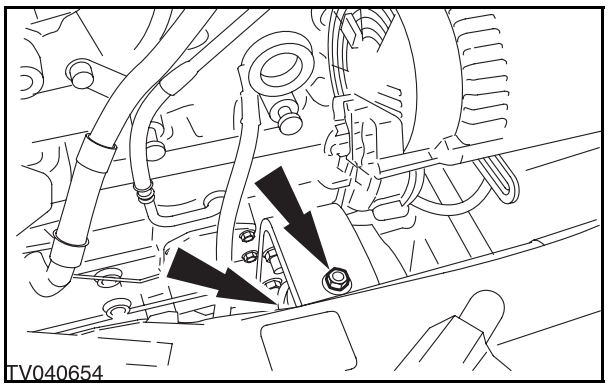
1. To install, reverse the removal procedure.
2. Tighten to 98Nm (72 lb.ft).


TV040692

3. Tighten to 25Nm (18 lb.ft).

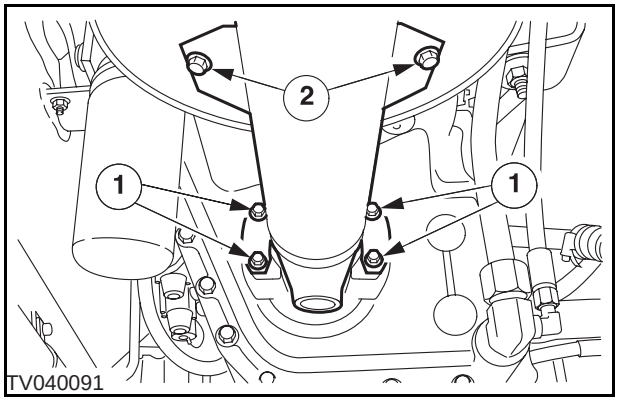

TV040651

4. Tighten to 56Nm (41 lb.ft).

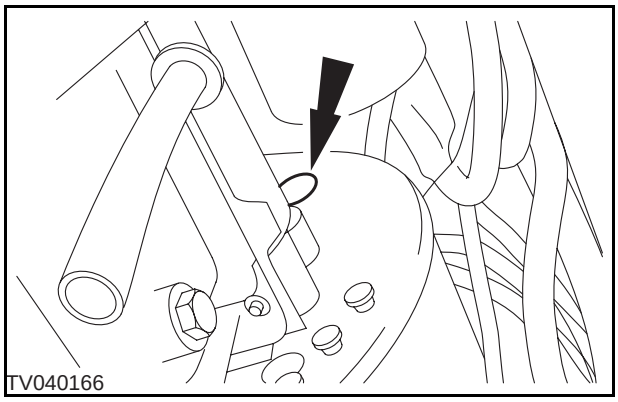

TV040654

Note:
- Install new retaining bolts.

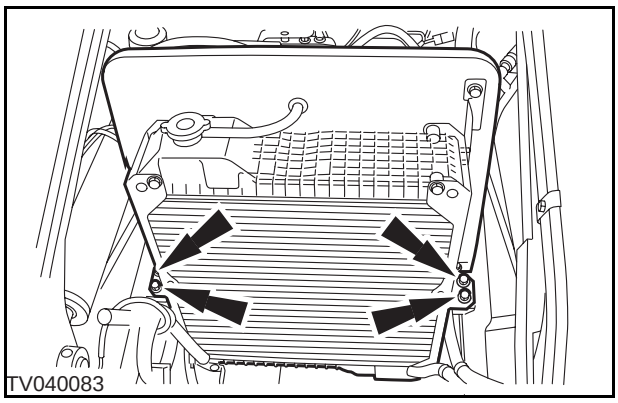
5. Tighten to (1) 47Nm (34 lb.ft).



6. Tighten to 41Nm (30 lb.ft).



7. Tighten to 98Nm (72 lb.ft).



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REMOVAL AND INSTALLATION — ENGINE

BHP1401RE

Operation: **Removing and Installing the Engine**	*Job Code:* **14 10 13 xx**		
Suitable lifting equipment, Suitable jack	Standard tools		
Vehicles with Air Conditioning			
Vehicles without Air Conditioning			

Removal

All vehicles

1. Remove the front tool box. For additional information, refer to Section K10-01 HARDNOSE/TOOLBOX, PAGE K10–01–3 .
2. Remove the hood. For additional information, refer to Section K10-01 HOOD, PAGE K10–01–5 .
3. Drain the cooling system. For additional information, refer to DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM, PAGE P14–01–41 in this section.
4. Remove the air cleaner. For additional information, refer to AIR CLEANER, PAGE P14–01–33 in this section.
5. Remove the exhaust silencer. For additional information, refer to EXHAUST SILENCER REMOVAL AND INSTALLATION, PAGE P14–01–37 in this section.

Vehicles with Air Conditioning (A/C)

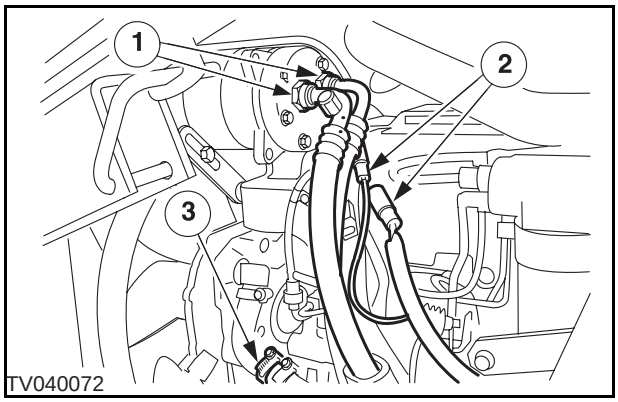
6. Evacuate the A/C system. For additional information, refer to Section H08-01 AIR CONDITIONING RECOVERY AND CHARGING, PAGE H08–01–45 .

   Note:
   - Install blanking plugs to avoid contamination.

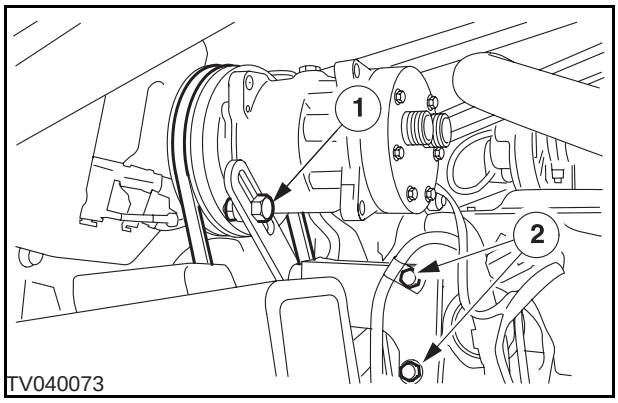
7. Disconnect the A/C pipes from the A/C compressor (1).

   Note:
   - Remove and discard the O-ring seals.

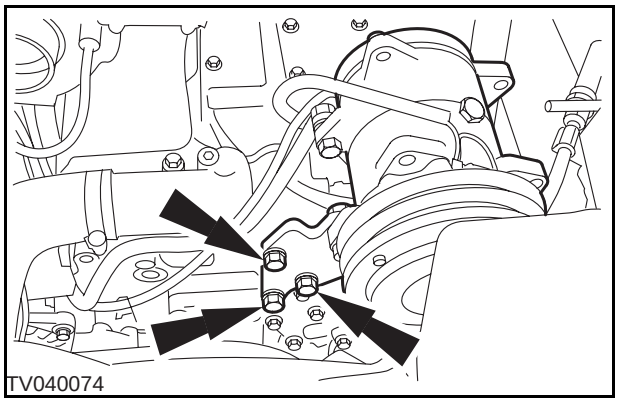
8. Disconnect the A/C electro–magnetic clutch and glow plug wire electrical connectors (2).
9. Disconnect the engine coolant hose (3).



10. Loosen the A/C accessory drive belt tensioner adjustment bolt and remove the accessory drive belt from the A/C compressor (1).
11. Remove the A/C compressor bracket retaining bolts (2).



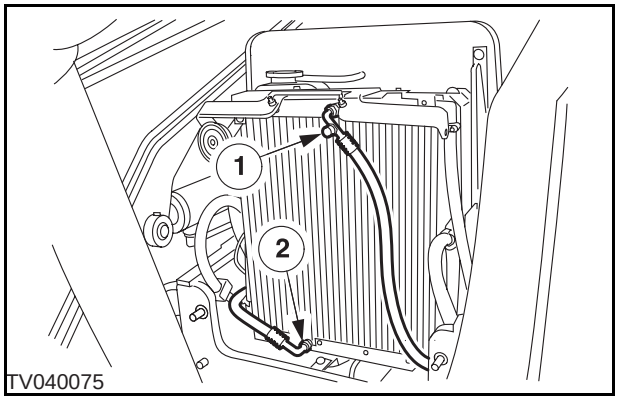
12. Remove the A/C compressor and mounting bracket.



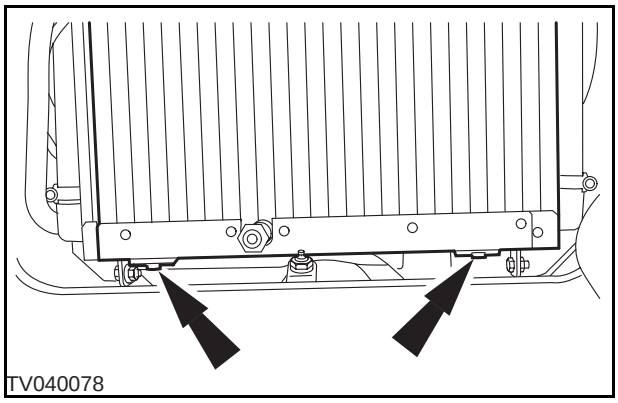
13. Disconnect the A/C inlet hose from the condensor (1).
14. Disconnect the A/C outlet hose from the condensor (2).

Note:
- Install blanking plugs to avoid contamination.

Note:
- Remove and discard the O-ring seals.

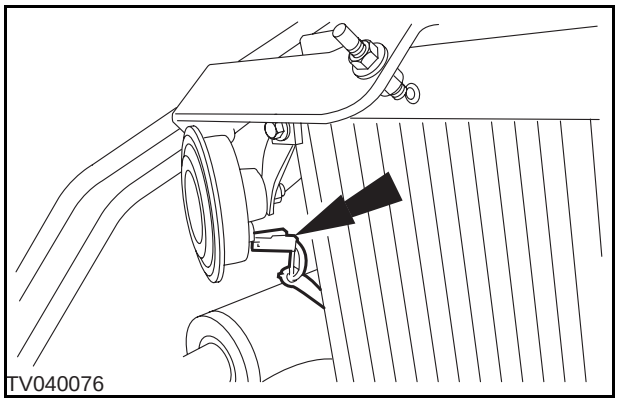


15. Remove the A/C condensor lower retaining bolts.

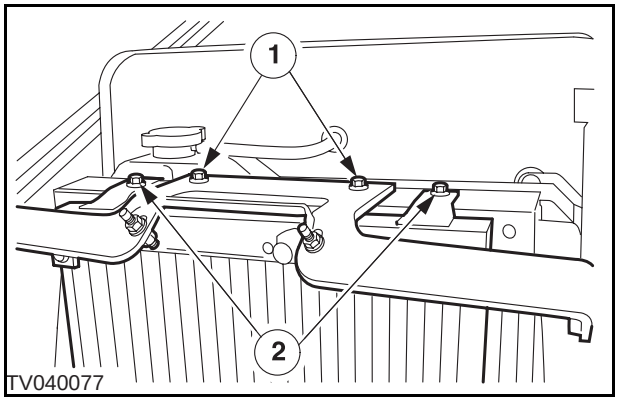

TV040078

All Vehicles

16. Disconnect the horn electrical connectors.


TV040076

17. Remove the radiator support bracket (1).
18. Remove the A/C condensor (if equipped) (2).

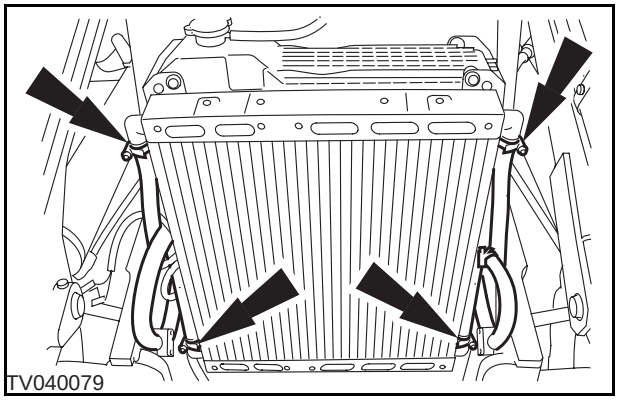


TV040077

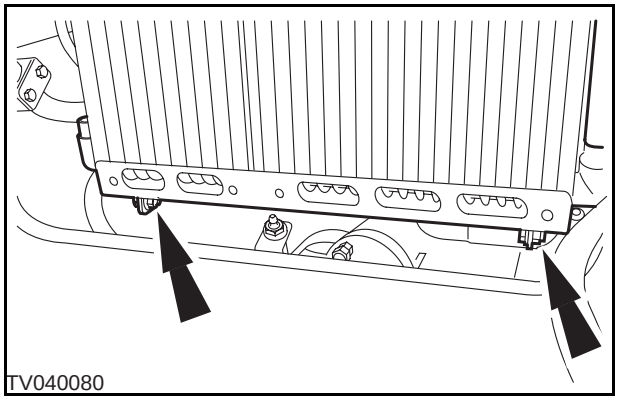
Note:

- Install blanking plugs to avoid contamination.

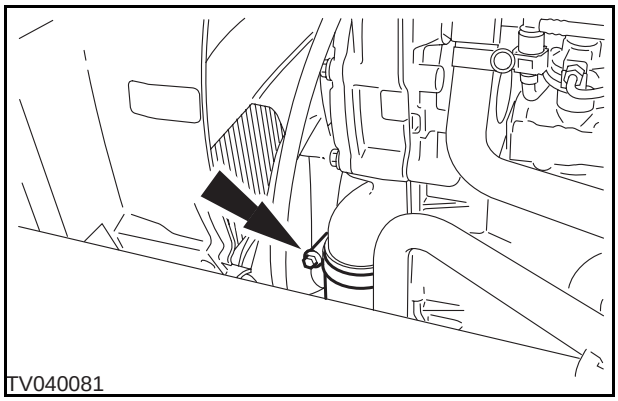
19. Disconnect the oil cooler pipes from the oil cooler.


TV040079

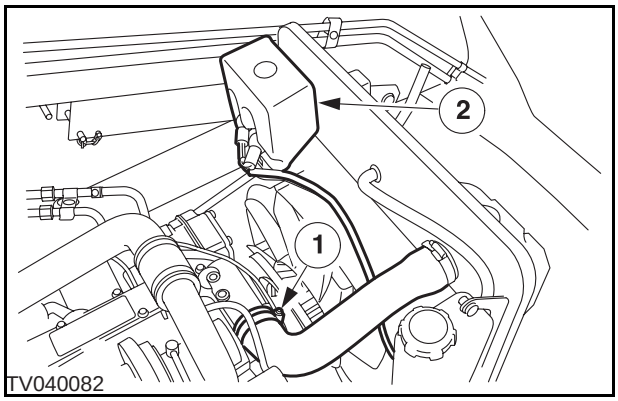
20. Remove the oil cooler.


TV040080

21. Disconnect the radiator bottom coolant hose from the water pump.

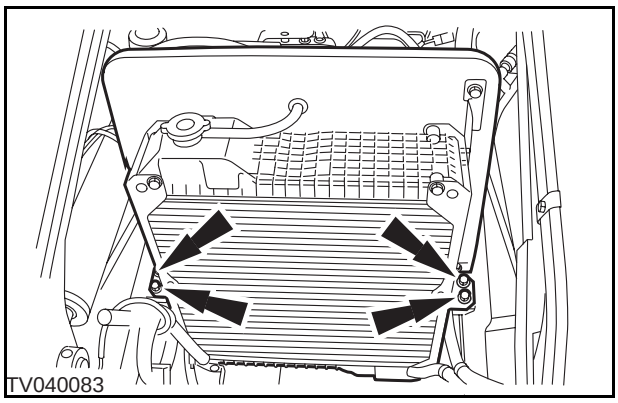

TV040081

22. Disconnect the radiator top hose from the thermostat housing (1).
23. Detach the windshield washer bottle from the cooling fan shroud and position it to one side (2).



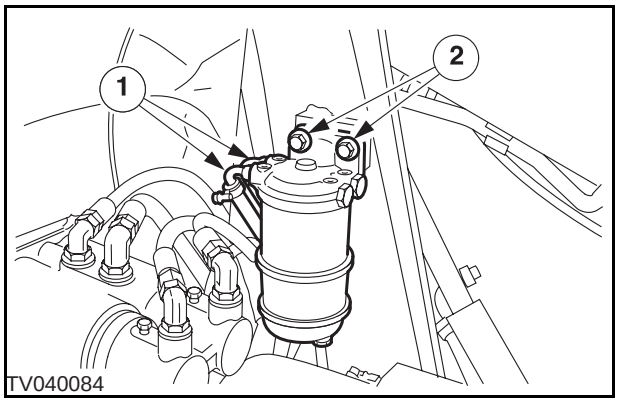
TV040082

24. Remove the radiator assembly.

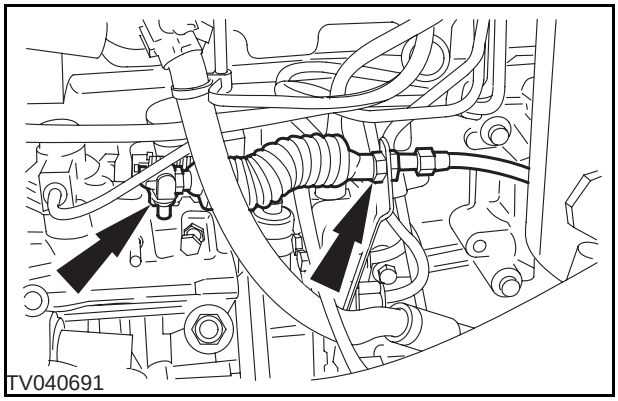

TV040083

25. Disconnect the fuel filter fuel supply and return lines (1).

26. Remove the fuel filter assembly (2).



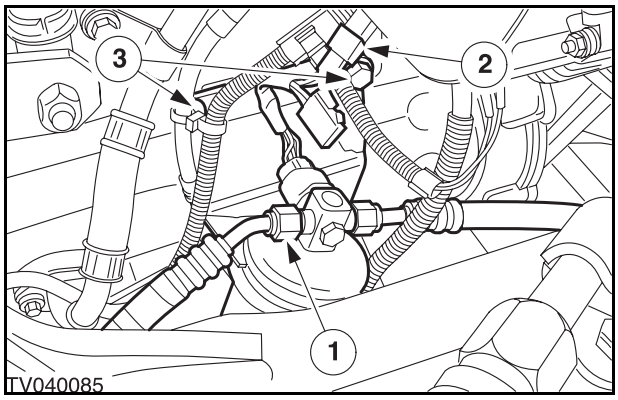
27. Loosen the throttle cable adjuster nut and disconnect the throttle cable from the fuel injection pump.



Vehicles with Air Conditioning (A/C)

Note:
- Install blanking plugs to avoid contamination.

28. Disconnect the A/C pipe from the A/C filter/drier (1).
29. Disconnect the A/C filter/drier electrical connectors (2).
30. Detach the A/C filter/drier and position it to one side.

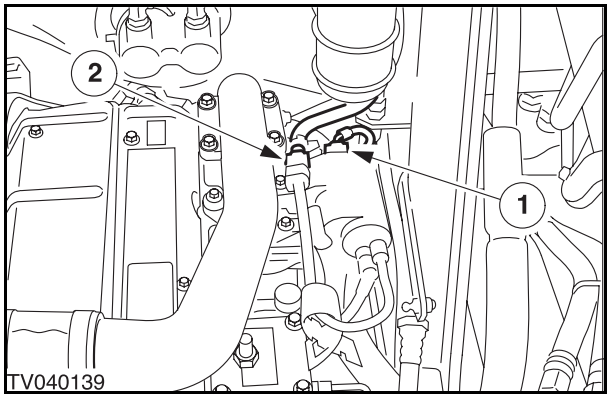


All Vehicles

31. Disconnect the fuel pump electrical connectors (1).

Note:
- Install blanking plugs to avoid contamination.

32. Disconnect the fuel pipe from the fuel pump (2).

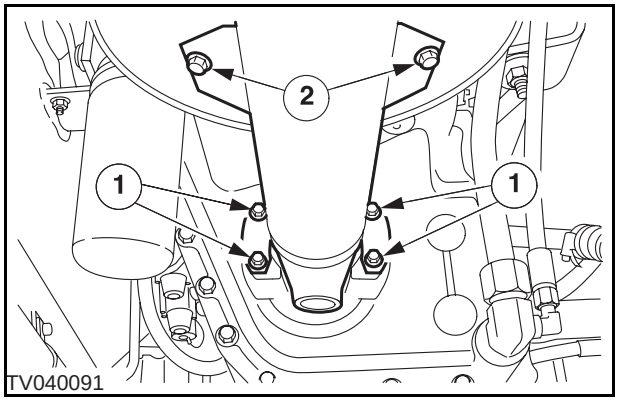


33. Remove the cab heater ducting. For additional information, refer to Section H08-01 CAB HEATER AIR DUCTING, PAGE H08–01–13 .

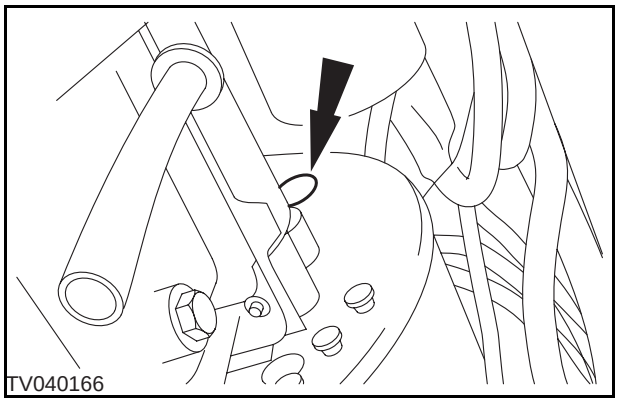
⚠ Caution:
- **Secure the universal joint bearing cups to prevent contamination or damage.**

Note:
- Remove and discard the retaining bolts.

34. Remove the front propeller shaft (1) and secure it to one side.
35. Remove the access cover (2).

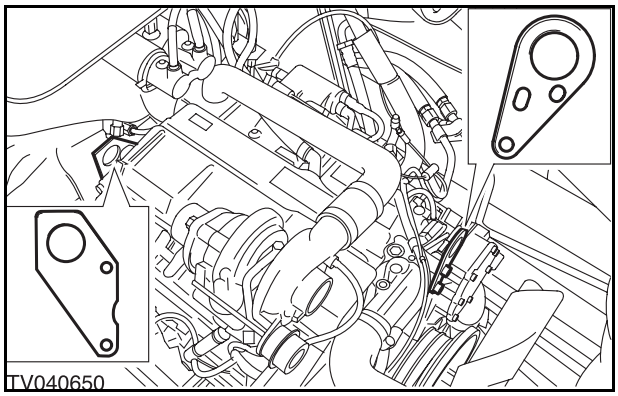


36. Using the access hole, remove the torque converter retaining bolts.



⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

37. Attach the engine lifting eyes to the engine.

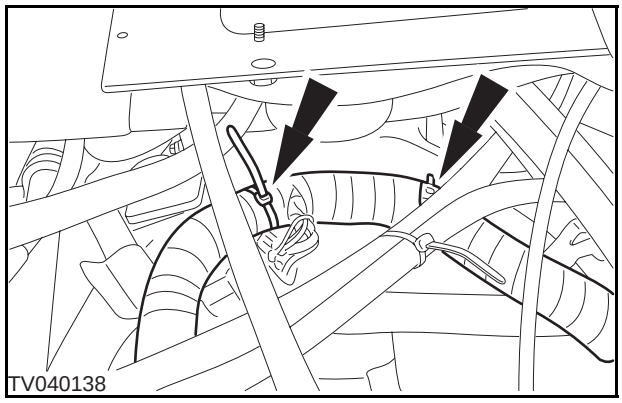

TV040650

Note:
- To aid removal of the engine, it is necessary to raise the front of the engine approximately 80mm higher than the rear .

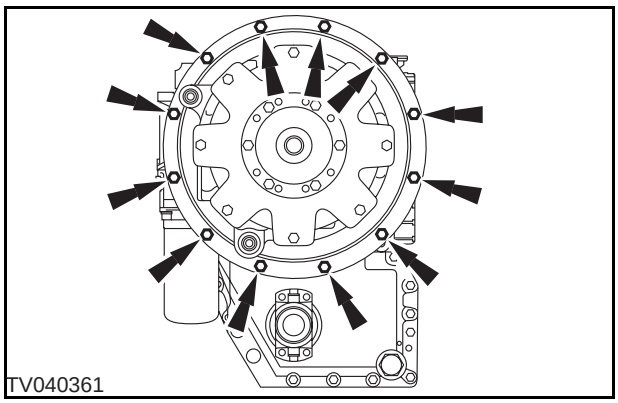
38. Attach the suitable lifting equipment to the engine lifting eyes and support the engine.

⚠ **Warning:**
- **Secure the transmission to the transmission jack. Failure to follow this instruction may result in personal injury.**

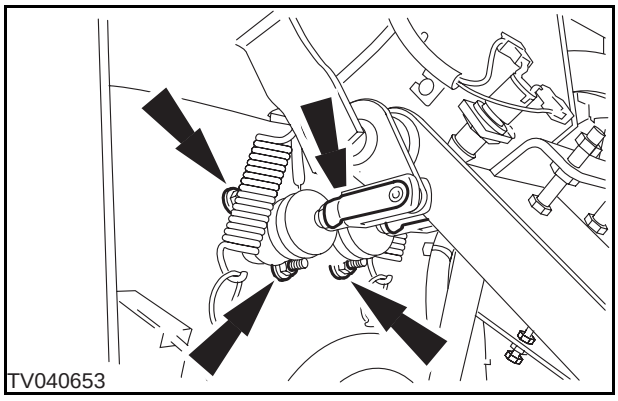
39. Using a suitable transmission jack, support the transmission.
40. Cut the cable ties and position the wiring harness to one side.


TV040138

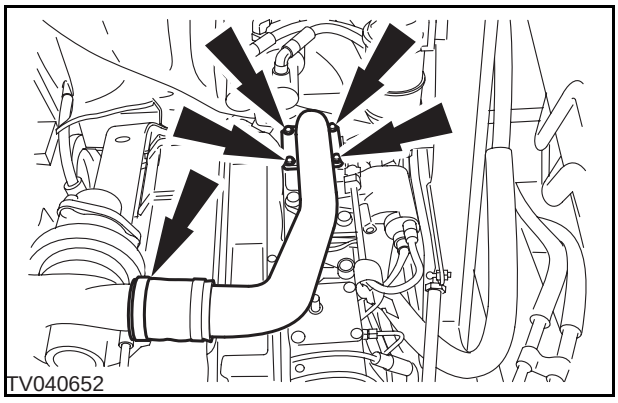
41. Remove the transmission retaining bolts.


TV040361

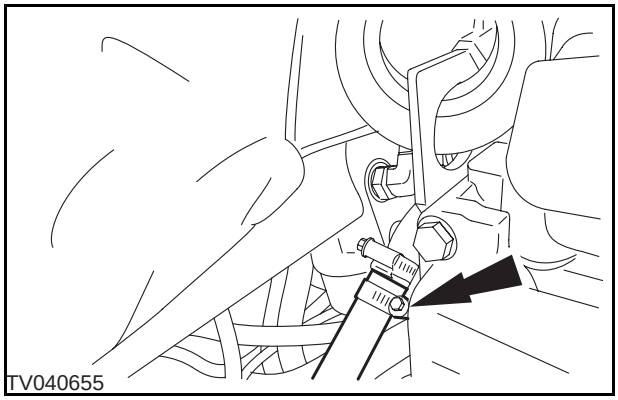
42. Loosen the brake master cylinder.



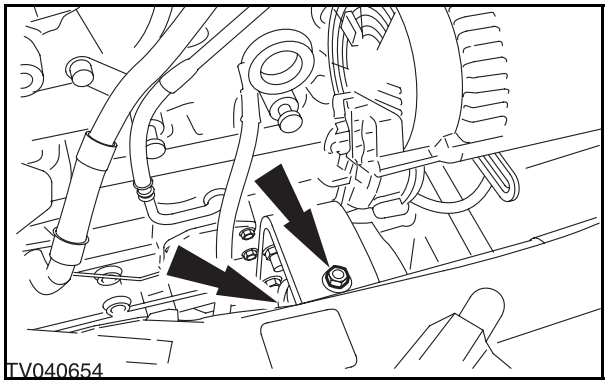
43. Remove the turbocharger outlet tube retaining bolts.
44. Disconnect the turbocharger outlet tube from the turbocharger.



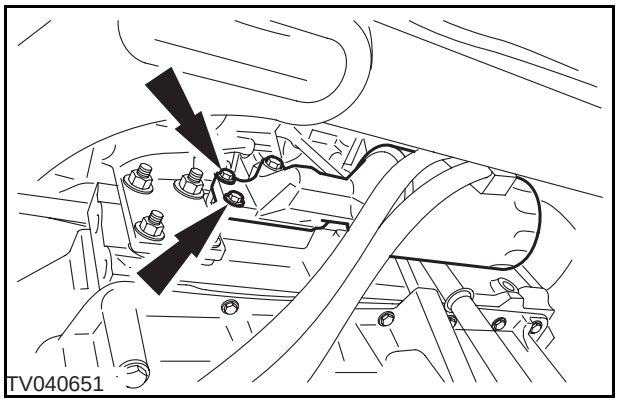
45. Disconnect the coolant hose from the rear of the engine.



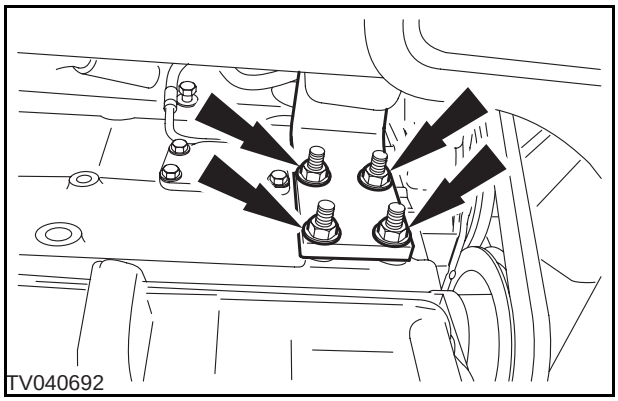
46. Remove the engine mount retaining bolts. (right-hand side shown, left-hand side similar).



47. Remove the oil filter housing.



48. Remove the engine mounting brackets from the engine. (left-hand side shown, right-hand side similar).



⚠ **Warning:**
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

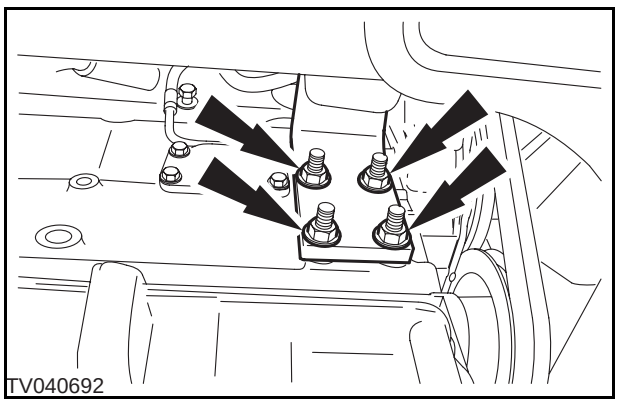
⚠ **Caution:**
- **Ensure the torque converter is remains with the transmission.**

49. Remove the engine.

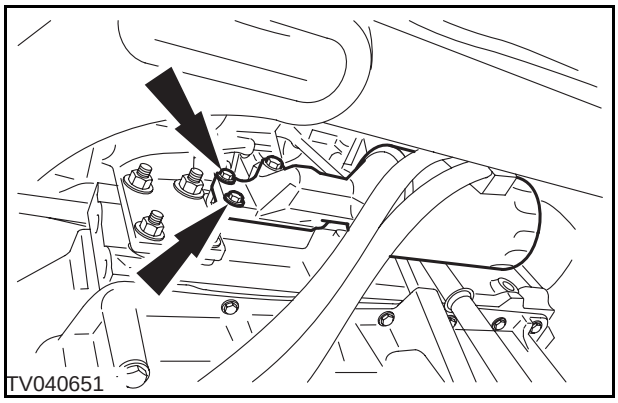
Installation

Note:
- Install new O-ring seals.

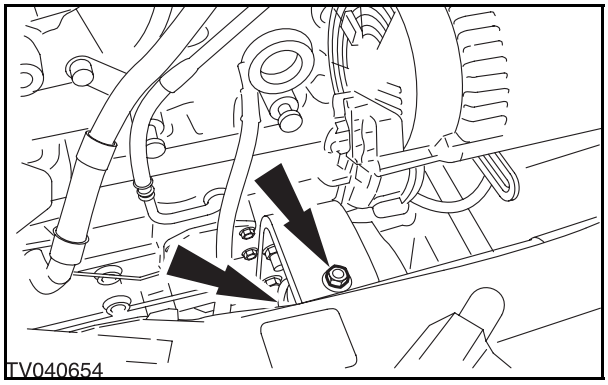
1. To install, reverse the removal procedure.
2. Tighten to 98Nm (72 lb.ft).



3. Tighten to 25Nm (18 lb.ft).

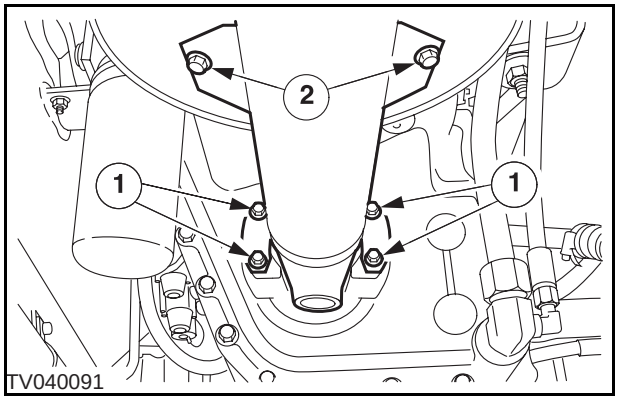


4. Tighten to 56Nm (41 lb.ft).

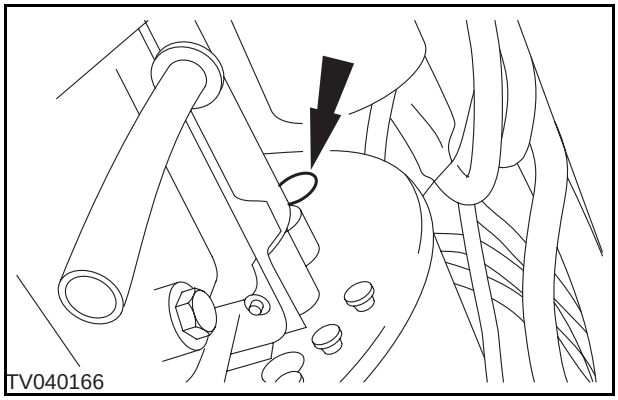


Note:
- Install new retaining bolts.

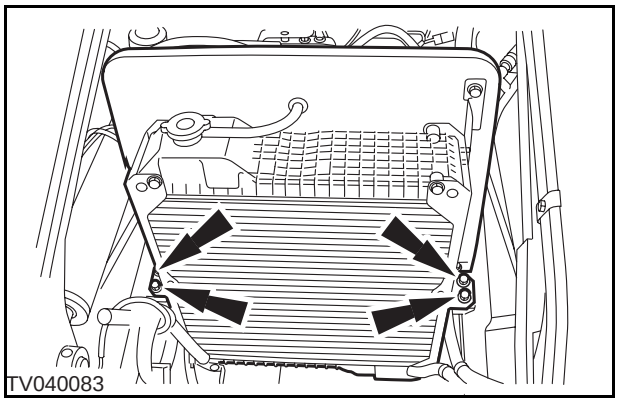
5. Tighten to (1) 47Nm (34 lb.ft).



6. Tighten to 41Nm (30 lb.ft).



7. Tighten to 98Nm (72 lb.ft).



Note: This page intentionally left blank.

REMOVAL AND INSTALLATION — RADIATOR

BHP1401RB

Operation: **Removing and Installing the Radiator**	*Job Code:* **14 04 13 xx**		
Suitable container	Standard tools		
Vehicles with air conditioning			
Vehicles without air conditioning			

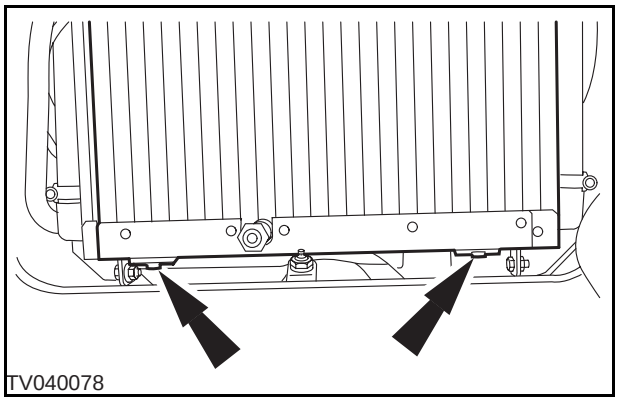
Removal

All Vehicles

1. Drain the cooling system. For additional information, refer to DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM in this section.

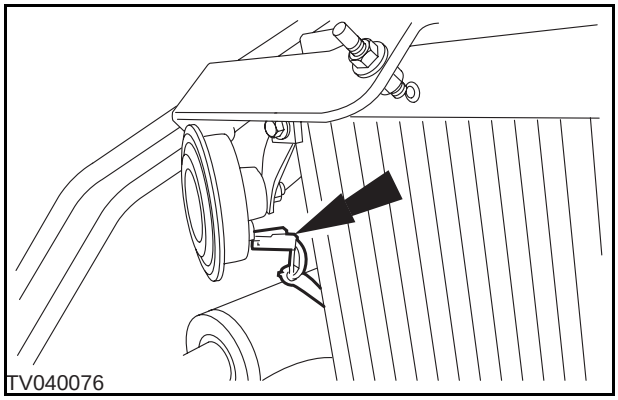
Vehicles with Air Conditioning (A/C)

2. Remove the A/C condensor lower retaining bolts and position to one side.

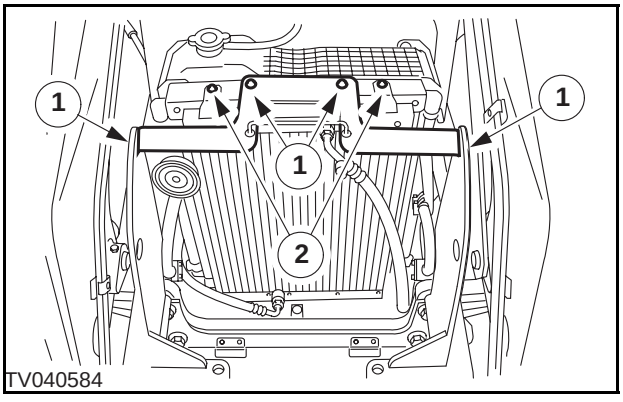

TV040078

All Vehicles

3. Disconnect the horn electrical connectors.

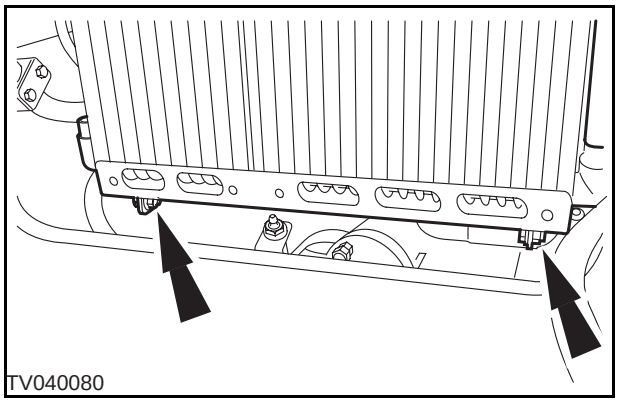

TV040076

4. Remove the radiator support bracket (1).
5. Detach the A/C condensor (2) (if equipped).

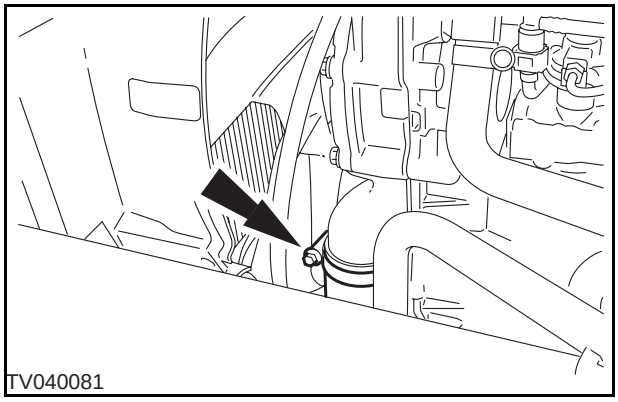


TV040584

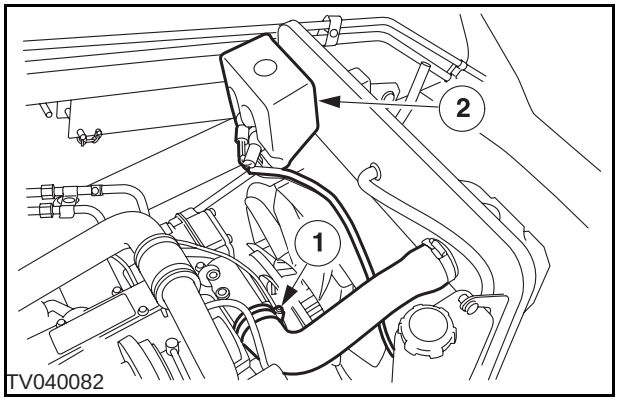
6. Detach the oil cooler.


TV040080

7. Disconnect the radiator lower coolant hose from the water pump.

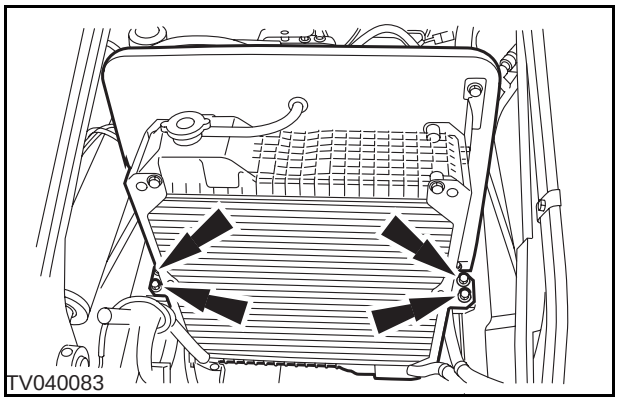

TV040081

8. Disconnect the radiator upper coolant hose from the water pump (1).
9. Detach the windshield washer bottle from the cooling fan shroud and position it to one side (2).



TV040082

10. Remove the radiator.

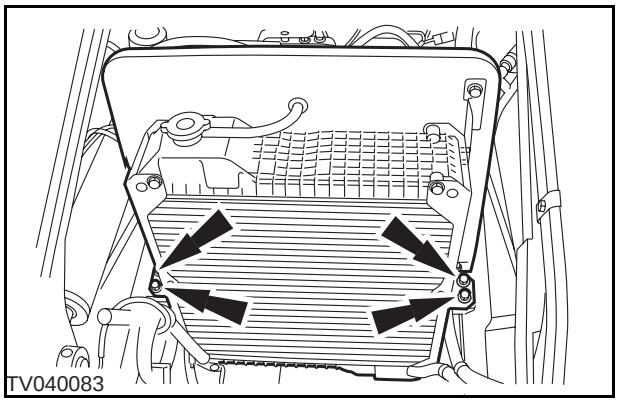

TV040083

11. Remove the cooling fan shroud from the radiator.

Installation

1. To install, reverse the removal procedure.

2. Tighten to 98Nm (72 lb.ft).



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REMOVAL AND INSTALLATION — FUEL TANK

BHP1401RC

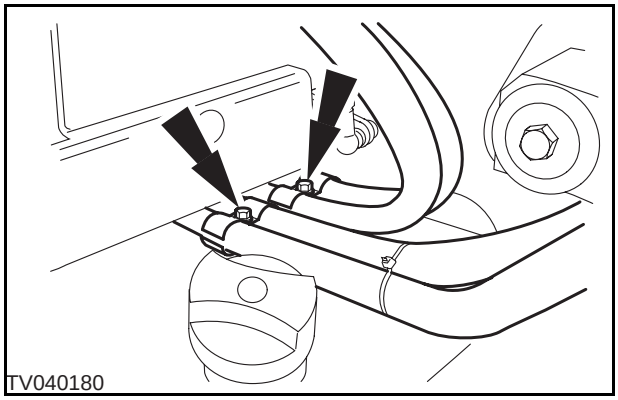
Operation: **Removing and Installing the Fuel Tank**	*Job Code:* **14 28 13 xx**		
Suitable trolley jack	Standard tools, Suitable container		

Removal

⚠ **Warning:**
- **Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.**

⚠ **Warning:**
- **This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.**

1. Isolate the battery ground cable. For additional information, refer to Section J09-01 BATTERY ISOLATION, PAGE J09–01–33 .
2. Drain the fuel tank into a suitable container.
3. Detach the hydraulic hoses from the fuel tank.

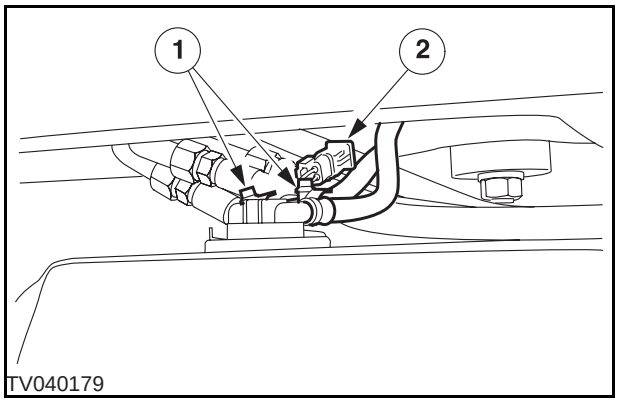

TV040180

Note:
- Make a note of the position of the fuel lines prior to disconnection to aid installation.

  Install blanking plugs to avoid contamination.

4. Disconnect the fuel supply and fuel return lines (1) from the fuel tank sender unit.

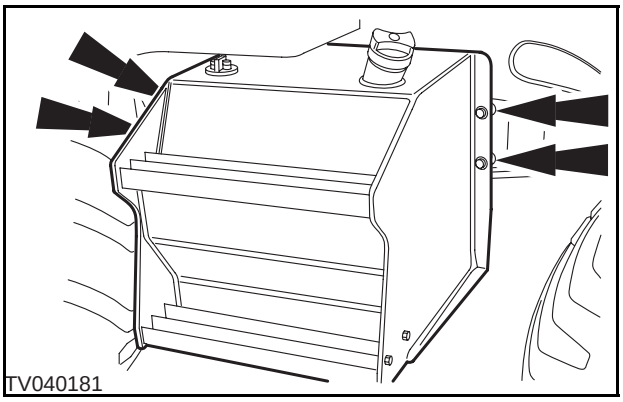
5. Disconnect the fuel tank sender unit electrical connector (2).



⚠ **Warning:**

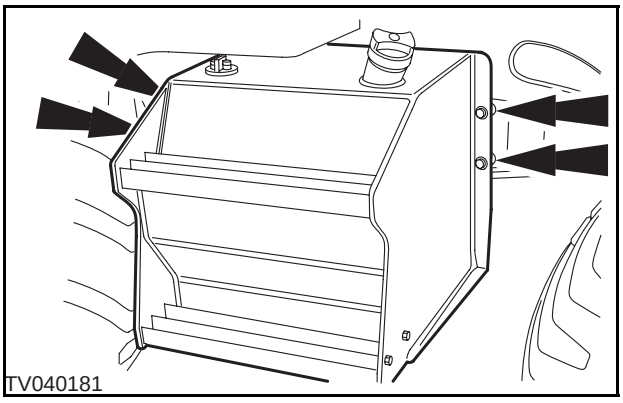
- **This component is very heavy. Ensure the lifting equipment is adequate. Failure to follow this instruction may result in personal injury.**

6. Using a suitable trolley jack, support the fuel tank.
7. Remove the fuel tank.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 98Nm (72 lb.ft).



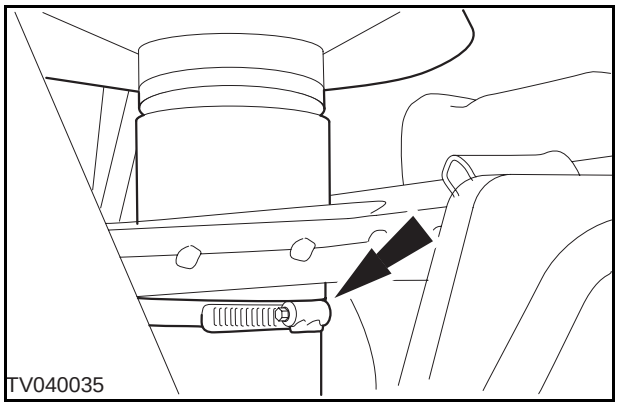
REMOVAL AND INSTALLATION — AIR CLEANER

BHP1401RD

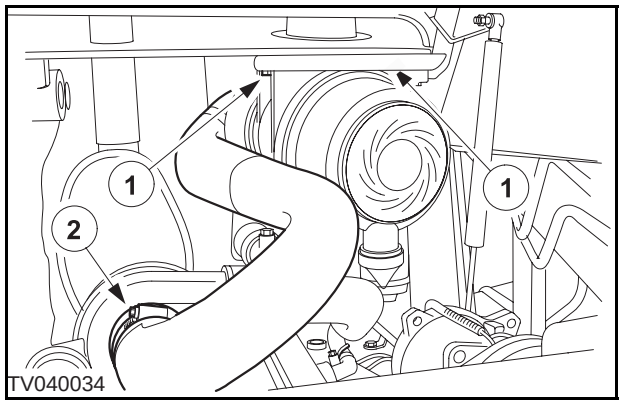
Operation: **Removing and Installing the Air Cleaner**	*Job Code:* **14 33 13 xx**		
None	Standard tools		

Removal

1. Open the hood.
2. Remove the air cleaner pre cleaner.

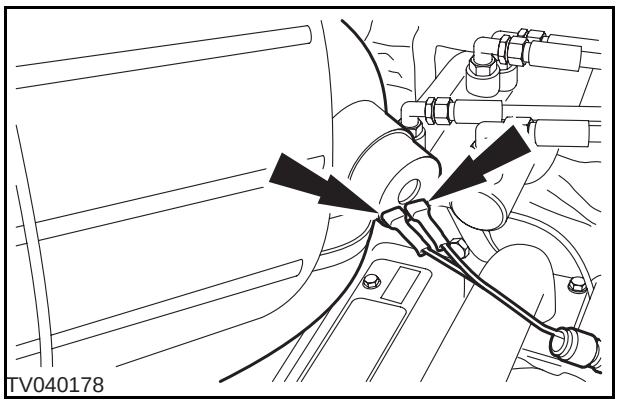

TV040035

3. Remove the air cleaner assembly retaining bolts (1).
4. Detach the turbocharger inlet tube (2) and reposition the air cleaner.



TV040034

5. Disconnect the air cleaner vacuum electrical connectors and remove the air cleaner.


TV040178

Installation

1. To install, reverse the removal procedure.

Note: This page intentionally left blank.

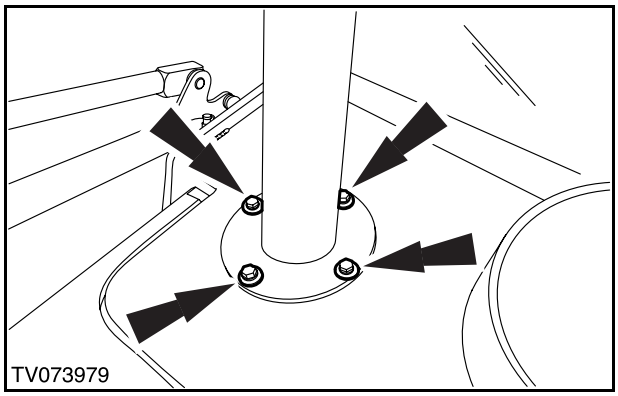
REMOVAL AND INSTALLATION — EXHAUST PIPE

BHP1401RF

Operation: **Removing and Installing the Exhaust Pipe**	*Job Code:* **XX XX XXxx**		
None	Standard tools		

Removal

1. Open the hood.
2. Remove the exhaust pipe retaining bolts.



3. Remove the exhaust pipe.

Installation

1. To install, reverse the removal procedure.

Note: This page intentionally left blank.

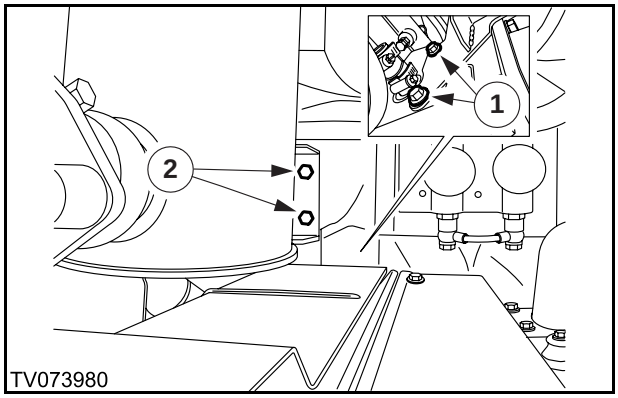
REMOVAL AND INSTALLATION — EXHAUST SILENCER

BHP1401RG

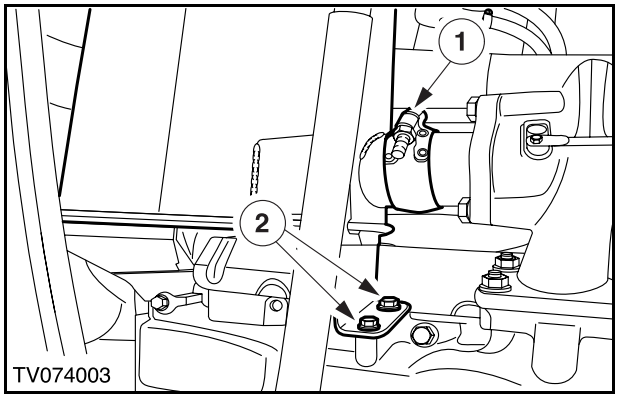
Operation: **Removing and Installing the Exhaust Silencer**	*Job Code:* **XX XX XXxx**		
None	Standard tools		

Removal

1. Remove the exhaust pipe. For additional information, refer to EXHAUST PIPE REMOVAL AND INSTALLATION, PAGE P14–01–35 in this section.
2. loosen the silence r rear mounting bracket retaining bolts (1).
3. Remove the silencer rear retaining bolts (2).



4. Loosen the exhaust silencer clamp (1).
5. Remove the silencer front retaining bolts (2).



6. Remove the silencer.

Installation

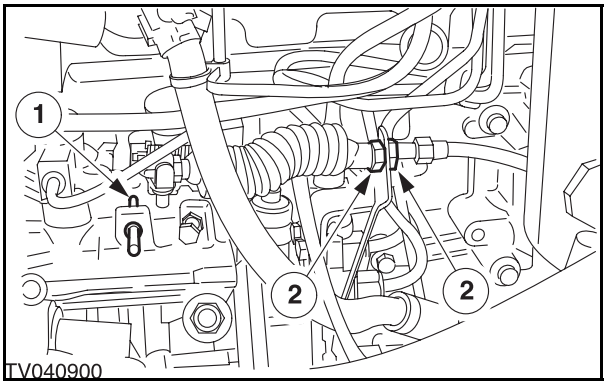
1. To install, reverse the removal procedure.

Note: This page intentionally left blank.

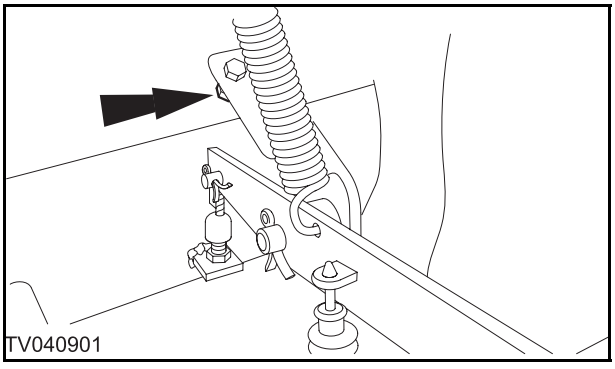
GENERAL PROCEDURE — THROTTLE ADJUSTMENT

BHP1401GA

1. Park the machine on firm level ground.
2. Switch off the engine.
3. Move the hand throttle lever to the max. rpm position
4. Check that the throttle linkage on the fuel injection pump is in contact with the stop screw (1).
5. If the throttle linkage is not in contact with the stop screw (1), adjust the length of the cable using the locknuts at the throttle bracket (2).



6. Set the throttle pedal to the max. rpm position and hold it there.
7. Check the gap between the throttle pedal and the stop bolt on the mounting bracket is less than 0 to 0.5mm.
8. If the gap between the throttle pedal and the stop bolt is greater than 0 to 0.5mm adjust the length of the stop bolt to bring the gap within limits.
9. Move the hand throttle lever to the min rpm position.
10. Start the engine.
11. Check that the engine idle RPM is between 700 — 900rpm. Maximum engine rpm is 2350rpm.
12. If the engine rpm is incorrect, adjust the stop screw on the fuel injection pump to bring the rpm within limits.
13. Make sure that the hand throttle lever is in contact with the stop on the hand throttle assembly.



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GENERAL PROCEDURE — DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM

BHP1401GB

Operation: **General Procedure — Draining, Filling and Bleeding the Cooling System**	*Job Code:* **14 04 09 xx**		
None	Standard tools, Suitable container		

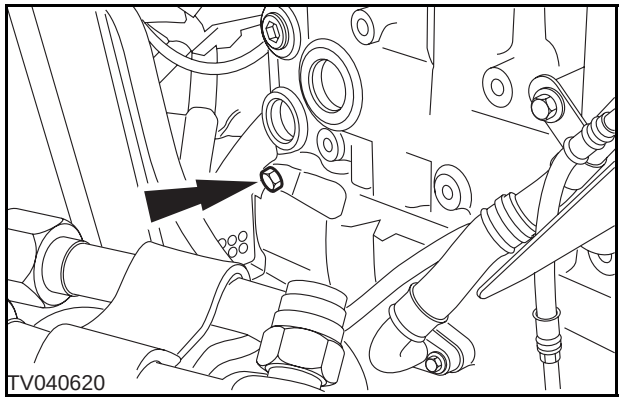
Draining

⚠ Warning:
- **When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.**

⚠ Warning:
- **Do not allow anti-freeze to contact skin. Adhere to instructions detailed on the antifreeze container. Failure to follow this instruction may result in personal injury.**

1. Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn.
2. Remove the coolant drain plug from the right-hand side of the cylinder block and drain the cooling system.

Note:
- Drain the coolant into a suitable container.


TV040620

3. Install the cylinder block drain plug.

Filling and Bleeding

1. Make sure the correct grade, and quality of antifreeze is added to the water. Recommended content mixture is 50% water, with 50% antifreeze.
2. Refill the cooling system through the radiator cap until completely full. Re-install the radiator cap and refill the coolant expansion tank to the full mark.
3. Start the engine and run until the normal engine operating temperature is achieved. Check for leaks, allow to cool then recheck the coolant level.

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SPECIFICATIONS — ENGINE

BHP1401SA

General Information

Engine	Low Power (820)	High Power (860 – 970)
Make	Perkins	
Model	1104C–44T	
Bore and Stroke	105x127mm	
Capacity	4400 cc	
Compression Ratio	16.5:1	
Firing Order	1 3 4 2	
Type	2164/2200	2166/2200
Build List (With Air Con)	RG38043	RG38044
Build List (Without Air Con)	RG38100	RG38099
Power @ 2200rpm	68.5kW (92 HP)	74.5kW (100 HP)
Torque @ 1400rpm	395Nm	415Nm
Turbocharger	Garrett GT 25, with wastegate	
Perkins P/N	2674A226	
Wastegate beginning to operate pressure	1.0 +/- 0.05bar	
Injection Pump	Delphi	
Model	DP210	
Type	1398/2644H013	1405/2644H023
Setting Code	XR/2/2350	DT/2/2350
Perkins Type	9320A212G	9320A342G
Perkins P/N	2644H002	2644H003
Injection Advance	0.5° BTDC	
Timing	Pin Timed 0° ATDC	
Speed at which cut off starts under full load	2200 +/- 25rpm	
Maximum No Load Speed	2350 +/- 25rpm	
Idle Speed	700 – 1200rpm	
Injectors	Delphi	
Type	LJBX6921101	
Perkins P/N (Nozzle)	2645K611	
Opening Pressure	290 +/- 8bar	
Colour Code	Yellow	
Fuel Feed Pump Pressure	0.1 – 0.7bar	
Valve Lash (Cold) – Inlet	0.20mm	
Valve Lash (Cold) – Exhaust	0.45mm	

Valve Arrangement	IE IE IE IE
Cold Start System	Glow Plugs (4)
Make	Beru
Perkins P/N	2666A016
Initial Current	30A Immediately Reduced to 21A
After 8 sec	14A
After 20 sec	10A
After 60 sec	9A
Cold Start Sensor	Normally Open
Perkins P/N	2848A127
Closes at	50 +/- 3°C
Re–opens at	40 +/- 3°C
Radiator Cap Pressure	110kPa
Thermostat	Wax Element By-pass Blanking
Perkins P/N	2485C041P
Nominal Temperature Stamped on Thermostat	82°C
Start to Open Temperature	79 – 84°C
Fully Open Temperature	93°C
Minimum Valve Lift Fully Open	10mm
Lubrication	Rotor Pump
Minimum Oil Pressure at Max rpm	3.0bar

Capacity

System	Tempera-tures		Viscosity	Specifications	Capacities (Litres)	Notes
	From	To				
Engine Turbocharged – 1100 Series 820/860/970	-40°C	+40°C	0W – 40	EMA DHD-1 or CH-4 API CH-4 ACEA E3 or E5	7.3	If sulphur content in fuel is above 0.2% of mass (2000ppm), change oil and filter every 250 hours)
	-30°C	+40°C	5W – 40			
	-10°C	+50°C	15W – 40			

For additional information, refer to the Perkins Engine Manual.