

KOBELCO

Hydraulic Excavator

Dynamic Acera

SERVICEMAN HANDBOOK

SK450-VI	LS06 – 01001 ~
SK450LC-VI	YS06 – 00901 ~
SK480-VI	LS06 – 01001 ~
SK480LC-VI	YS06 – 00901 ~

KOBELCO CONSTRUCTION MACHINERY CO., LTD.

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1. GENERAL DIMENSIONS

SHIPPING DIMENSIONS

A. SK450-VI & SK450 LC-VI

a. Machine with standard attachments

Refer to Figure 5.12 & 5.13 for reference in regards to the machine basic dimensions, as manufactured by KOBELCO, with standard attachments:

- a.1. Standard boom ... 7.0 m (23'-0")
- a.2. Standard arm 3.45 m (11'-4")
- a.3. Bucket 1.80 m³ (2.35 cu yd)

Unit : mm (ft-in)

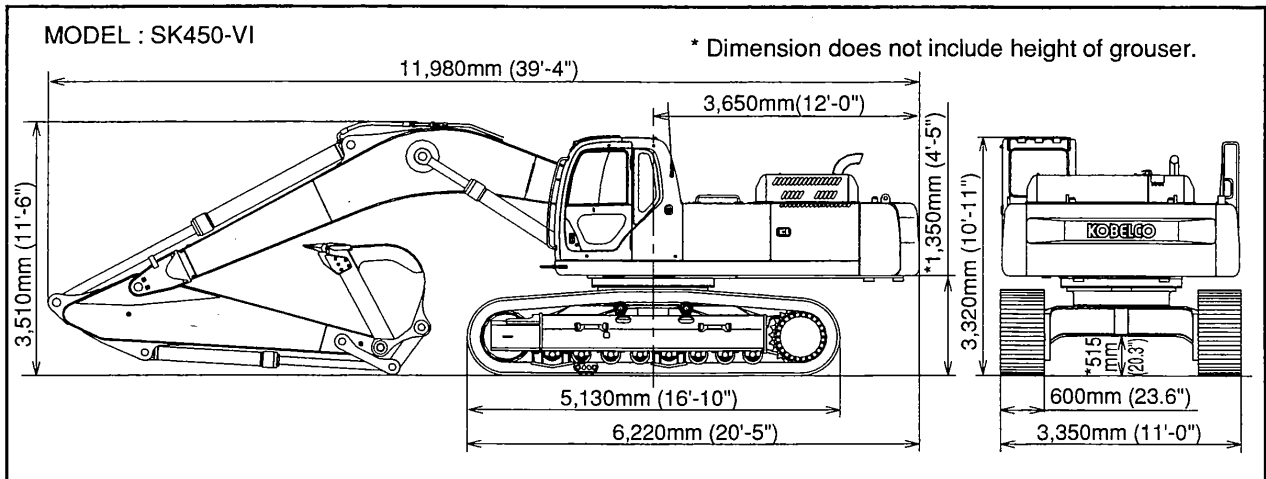


FIGURE 5.12

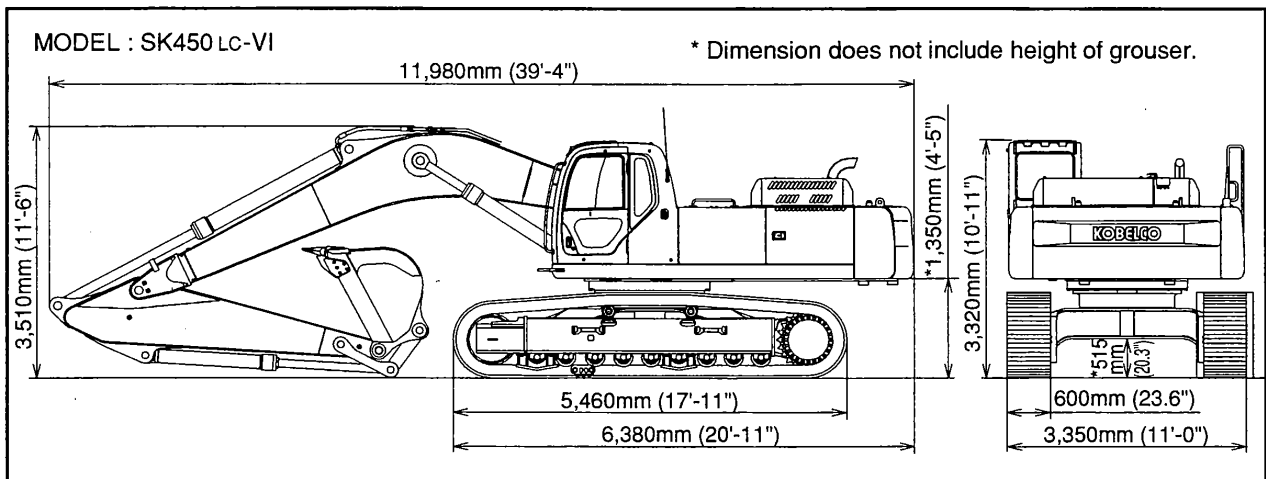


FIGURE 5.13

B. SK480-VI, SK480LC-VI

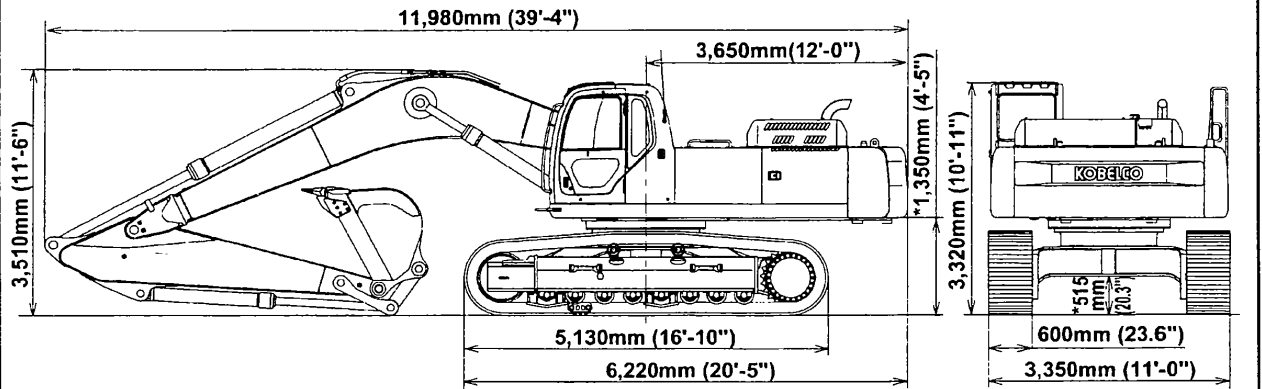
Unit : mm (ft-in)

MODEL : SK480-VI

7.00m(23' 0") Boom+3.45m(11' 4") Standard Arm+1.80m³(2.35cu·yd) Buckt+600mm(23.6") Shoe

NOTE :

Dimensions marked ※ do not include the height of the shoe lug.

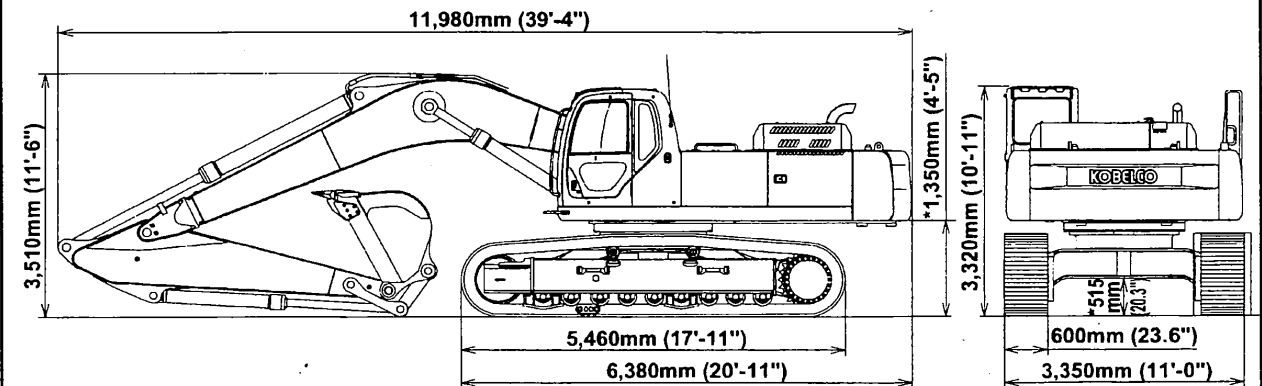


MODEL : SK480LC-VI

7.00m(23' 0") Boom+3.45m(11' 4") Standard Arm+1.80m³(2.35cu·yd) Buckt+600mm(23.6") Shoe

NOTE :

Dimensions marked ※ do not include the height of the shoe lug.



2. SPECIFICATIONS AND PERFORMANCE

■ SPEED AND CLIMBING CAPABILITY

Item	Area & Model	EU	ASIA
		SK480LCVI	SK450(LC)VI
Swing speed		9 rpm	←
Travel speed (1-speed/2-speed)	km/h (mile/h)	3.5 / 5.6 (2.2 / 3.5)	←
Gradeability	%(degree)	70 (35)	←

■ ENGINE

Engine model	MMC (Mitsubishi) 6D24-TLU2C	MMC 6D24-TLE2A
Type	Water-cooled, 4-cycle direct injection type engine with turbo charger and inter cooler	←
Number of cylinders—Bore×Stroke	6—130mm×150mm (5.12in×5.91in)	←
Total displacement	11,950cc (729cu·in)	←
Rated output / Rotation speed	235kW (320PS) / 2,000rpm	←
Maximum torque / Rotation speed	127kgf·m (918 lbf·ft) / 1,200rpm	←
Starter	24V / 5.5kW	←
Alternator	24V / 35A	←

■ HYDRAULIC COMPONENTS

Hydraulic pump	Variable displacement axial piston + gear pump	←
Hydraulic motor (swing)	Axial piston motor	←
Hydraulic motor (travel)	2-speed axial piston motor	←
Control valve	6-spool control valve	←
Cylinder (Boom, Arm, Bucket)	Double action cylinder	←
Oil cooler	Air-cooled type	←

■ WEIGHT

Unit : kg (lb)

	SK480LCVI	SK450LCVI	SK450VI
Fully equipped weight	45,900 (101,190)	←	45,200 (99,670)
Upper structure	20,800 (45,860)	←	←
Lower machinery	17,000 (37,490)	←	16,300 (35,930)
Attachment (7.00m (23ft-0in) Boom+3.45m (11ft-4in) Arm +1.80m³ (2.35cu·yd) Bucket)	8,100 (17,860)	←	←

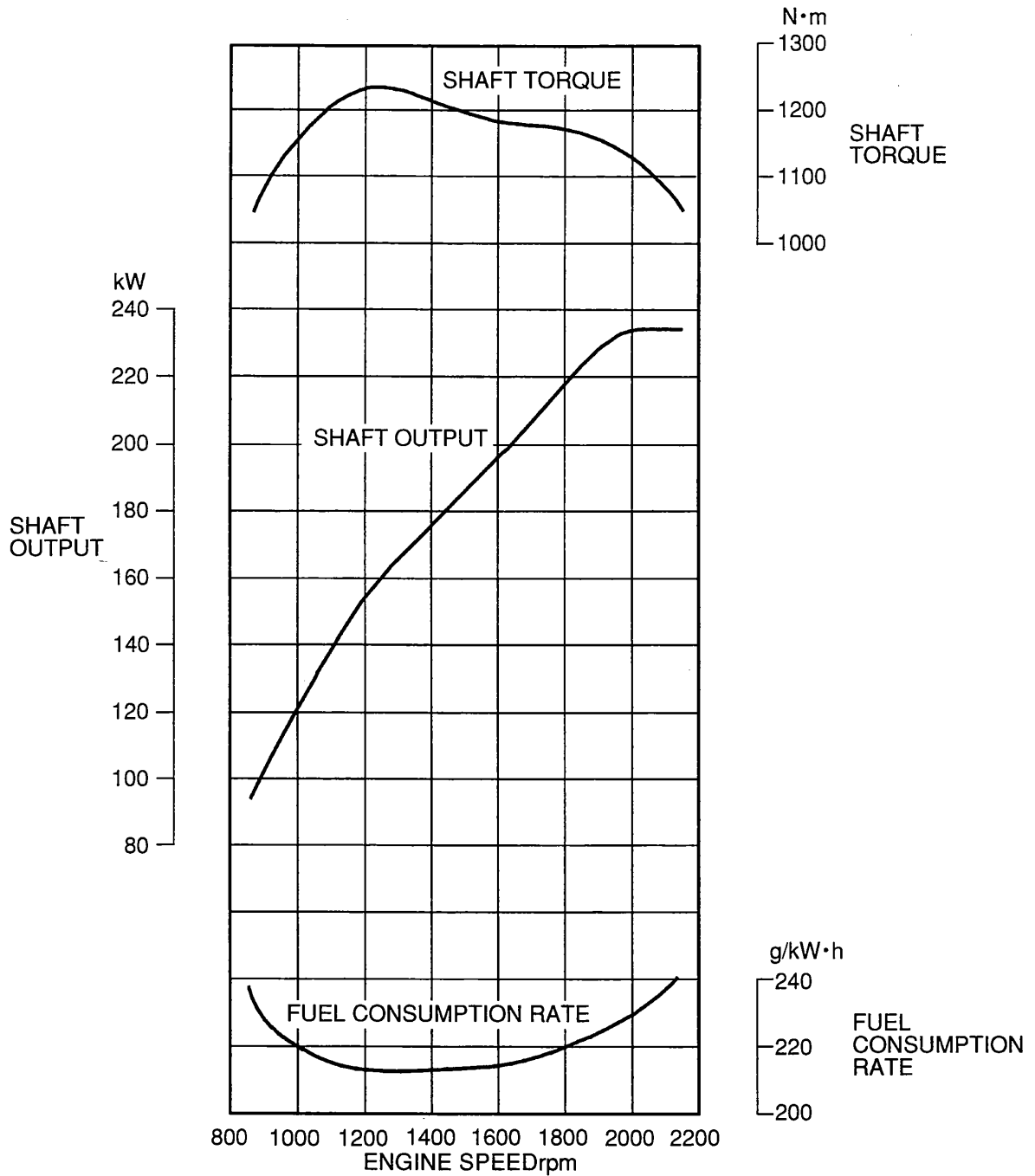
3. ENGINE SPECIFICATIONS

■ SPECIFICATIONS

Applicable machine		SK450(LC)VI, SK480LCVI		
Engine model		MITSUBISHI 6D24-TLE2A, 6D24-TLU2C		
Type		Diesel, 4-cycle water-cooled, in-line, direct injection, turbo charged and with inter cooler		
Number of cylinder× Bore×Stroke	mm (in)	6×130×150 (5.12×5.91)		
Total displacement	cc (cu·in)	11,950 (729)		
Compression ratio		17.5		
Rated output	PS (kW) at rpm	320 (235) at 2,000		
Maximum torque	kgf·m (lbf·ft) at rpm	127 (918) at 1,200		
High idling	rpm	2,200±20		
Low idling	rpm	1,000±30		
Injection valve opening pressure	kgf/cm ² (psi)	181 (2,570)		
Thermostat action Start/Full open	°C (F°)	76.5 / 90 (170 / 194)		
Firing order		1—5—3—6—2—4		
Compression pressure	kgf/cm ² (psi) at min ⁻¹	27.5 (390) at 200		
Lubrication oil pressure	kgf/cm ² (psi) at rpm	—		
Fuel injection timing		2° before top dead point		
Valve clearance		Valve clearance	Open	Close
	Intake valve	0.4mm (0.016) at cool	18° before top dead point	50° after bottom dead point
	Exhaust valve	0.6mm (0.024) at cool	50° before bottom dead point	18° after top dead point
Starter capacity	V×kW	24×5.5		
Generator capacity (Alternator)	V×A	24×35		
Cooling fan drive method		φ 720 (28.3) suction type 10 fans, V-belt drive, pulley ratio Crank / Fan= 0.9 (EU,ASIA)		
Engine oil quantity		Full level 45 (11.9) Low level sensor actuation 32.5 (8.6) Oil filter, etc. 4 (1.1)		
Dry weight	kg (lb)	1,020 (2,250)		
Fuel consumption ratio	g / PS·h	167		
Allowable inclination	(Limited by E/G lubrication)	Front / Rear and Right / Left : 35°		
Dimension (L×W×H)	mm (in)	1,688×900×1,266 (66.5×35.4×49.8)		
Rotating direction		Counterclockwise seeing from flywheel side		

ENGINE CHARACTERISTIC CURVE (MITSUBISHI 6D24-TL)

Condition to be measured : With fan, alternator and air cleaner and muffler



$$\begin{aligned}
 &\text{Fuel consumption volume} \\
 &= \frac{\text{Fuel consumption rate}}{0.835 \times 1000} \times \text{kW} \times \text{Load factor } (\alpha) \\
 &= \frac{228 \text{ g / kW} \cdot \text{h}}{0.835 \times 1000} \times 235 \text{ kW} \times \alpha \\
 &= 64.2 \alpha \cdot \text{h} / \text{h}
 \end{aligned}$$

$$\begin{aligned}
 &\text{Fuel consumption volume} \\
 &= \frac{\text{Fuel consumption rate}}{0.835 \times 1000} \times \text{PS} \times \text{Load factor } (\alpha) \\
 &= \frac{167 \text{ g / PS} \cdot \text{h}}{0.835 \times 1000} \times 320 \text{ PS} \times \alpha \\
 &= 64.2 \alpha \cdot \text{h} / \text{h}
 \end{aligned}$$

α : Standard load factor
(0.70~0.80)

Fuel consumption in regular operation
(load factor: 0.70~0.80)
44.9~51.4 h / h

4. HYDRAULIC COMPONENTS SPECIFICATIONS & PERFORMANCE

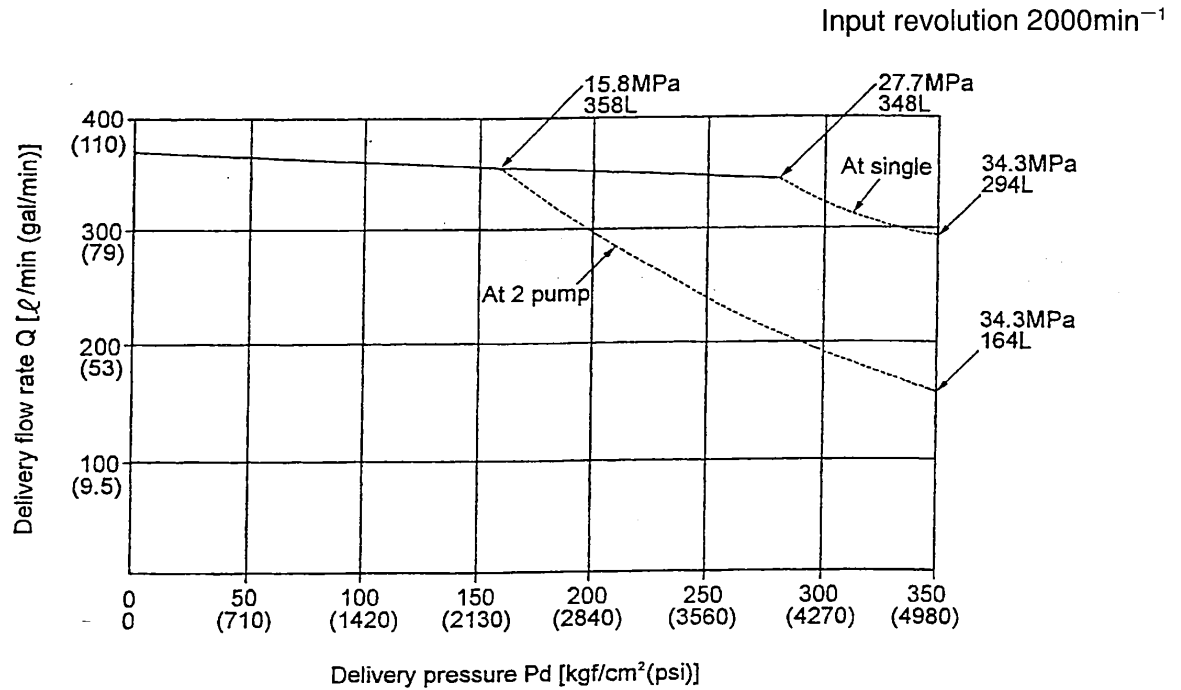
Item				Main pump	Gear pump for pilot	
Pump model				K3V180DTH-1M0R-9T0V	ZX15LHRZ2-06G	
HYDRAULIC PUMP	Max.displacement capacity		cm ³	185×2	15	
	Speed	Rated	min ⁻¹ (Clockwise seeing from shaft end)	2000	←	
		Hi idle		2220 or less	←	
	Pressure	Rated	kgf/cm ² (psi)	320(4,550)	50(710)	
		ATT boost pressure		350(4,980)		
	Max.flow		ℓ /min(gal/min)	364(96)×2 at 80 kgf/cm ² (1140psi)	30(7.9)	
	Max.input horse power		kW{PS}	235.4{320}	3.4{4.6}	
	Max.input torque		kgf·m(lbf·ft)	115(830)	1.5(11)	
	Regulator		Model	KR3H-9T0V		
			Control function	Electric flow control,total power control at back-up,power shift control at back-up and negative flow control		
Others			With solenoid proportional reducing valve (KDRDE5K-31/30C40-111)			
Weight		kg(lb)	187(412)			
CONTROL VALVE	Model			UY36-105		
	Rated flow		ℓ /min(gal/min)	370×2(98×2)		
	Main relief valve set pressure When power boost pressure		kgf/cm ² (psi)	320(4550) at 320 ℓ /min(84gal/min)		
				350(4980) at 320 ℓ /min(84gal/min)		
	Over load relief valve set pressure Boom H,Bucket H,Arm R Boom R,Bucket R,Arm H Swing		kgf/cm ² (psi)	370(5260) at 30 ℓ /min(7.9gal/min)		
				355(5050) at 30 ℓ /min(7.9gal/min)		
270(3840) at 30 ℓ /min(7.9gal/min)						
Foot relief valve set pressure				kgf/cm ² (psi)	32(460) at 50 ℓ /min(13gal/min)	
SWING MOTOR	Hydraulic motor assy	Hydraulic motor	Type	MX500B0-10A-03		
			Displacement	cm ³ (cu·yd)	485(630)	
			Working pressure	kgf/cm ² (psi)	320(4550)	
			Max.flow	ℓ /min(gal/min)	370(98)	
			Braking torque	kgf·m(lbf·ft)	229(1660)	
			Release pressure (Stroke end)	kgf/cm ² (psi)	22.4/14.3(320/200)	
			Weight	kg(lb)	163(359)	
		Relief valve block	Type	VBV-155C		
			Main relief valve set pressure	kgf/cm ² (psi)	260(3700)	
			Weight	kg(lb)	25(55)	
	Hydraulic motor assy weight		kg(lb)	188(414)		
	Reduction unit	Speed reduction type		Planetary 2-stage		
		Reduction ratio		13.623		
		Lubricate oil		Gear oil SAE90(API class GL-4 grade)		
		Lubricate oil volume		ℓ (gal)	38.5(10)	
Grease		Extreme pressur multipurpose grease				
Grease volume		A small amount				
Weight		kg(lb)	519(1140)			
Total weight		kg(lb)	683(1510)			

Note:The max.input power and the max.input torque of the main pump include those of the gear pump.

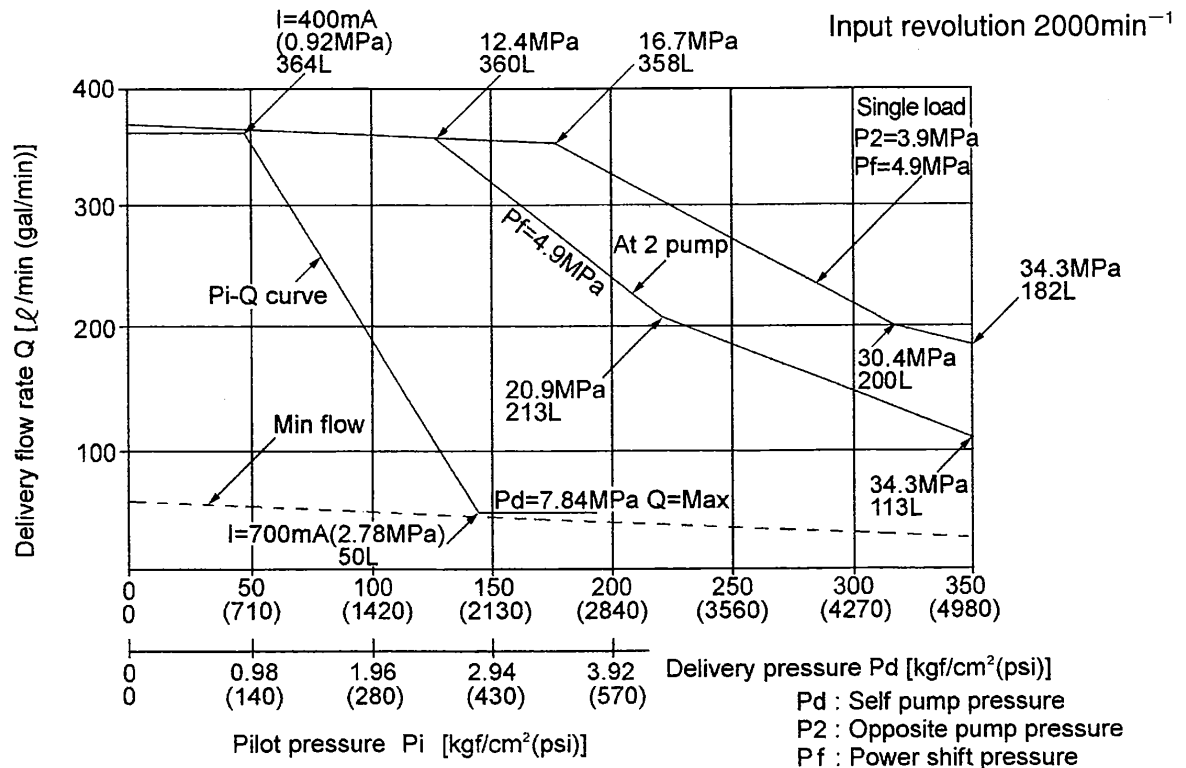
TRAVEL MOTOR		• Motor	Type	M3V260/160B	
		• Reduction		RG9.5	
	Hydraulic motor	Max.displacement	cc/rev(cu·in/rev)	262.6(16.02)	
		Min.displacement	cc/rev(cu·in/rev)	160.6(9.8)	
		Overload valve cracking pressure	kgf/cm ² (psi)	365~385(5,190~5,480)	
		Tilting control pilot pressure	kgf/cm ² (psi)	50(710)	
		Allowable drain pressure	kgf/cm ² (psi)	Working	2.0(14)
				Surge	10.0(72)
		Parking brake torque	kgf·m(lbf·ft)	More than 92(670)	
		Parking brake release pressure	kgf/cm ² (psi)	15.7(220)	
		Auto speed select set pressure	kgf/cm ² (psi)	About 280(3,980)	
				Pilot pressure 50(710)	
	Reduction unit	Reduction ratio		65.316	
		Number of reduction stages		2	
		Lube oil capacity	ℓ (gal)	15(4)	
		Lube oil capacity specification		Gear oil SAE90API GL-4	
	Machine specification	Flow	L/min(gal/min)	370(98)	
		Working pressure (Relief valve set pressure)	kgf/cm ² (psi)	350(4,980)	
		Weight	kg(lb)	About 645(1,420)	

■ CONTROL CURVE OF PUMP

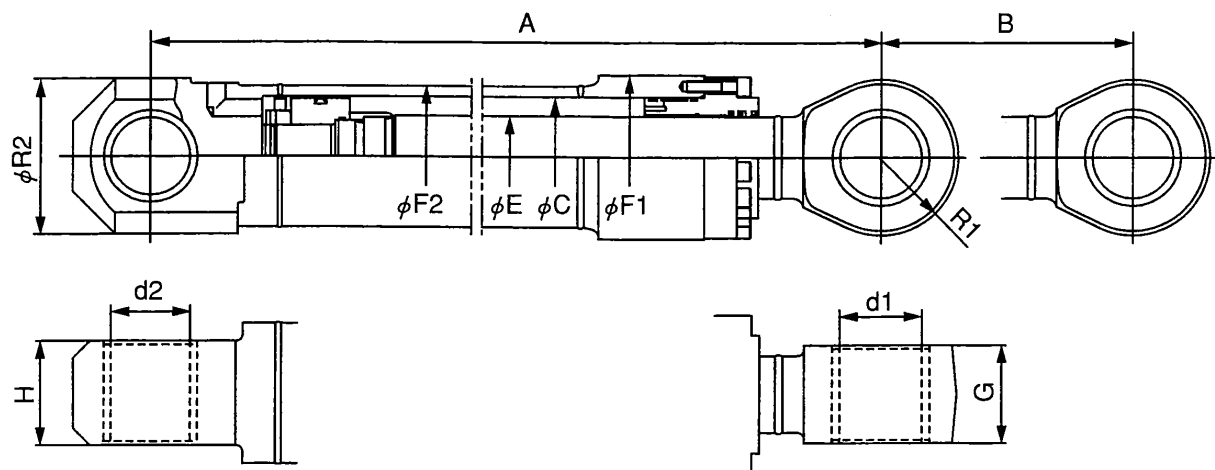
(1) At electric power control



(2) At back-up mode



■ HYDRAULIC CYLINDER



Unit : mm (ft·in)

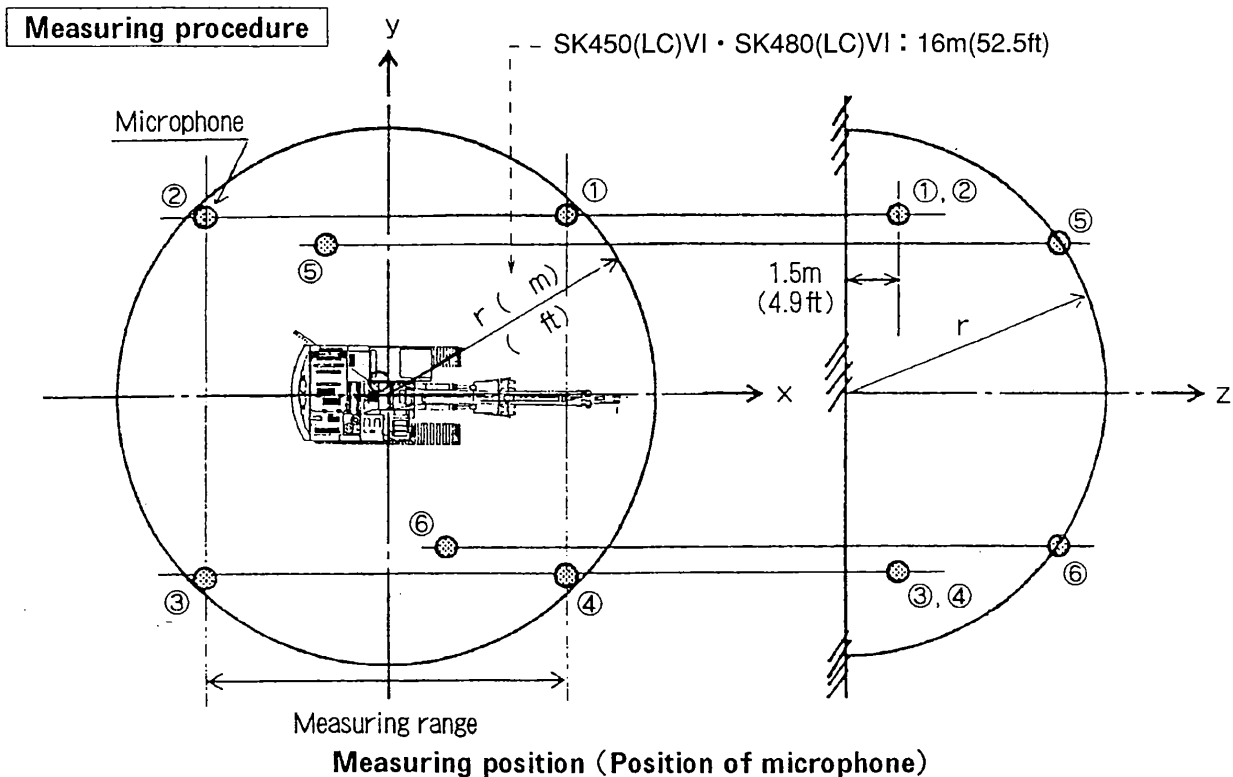
Model	Part No.		Applicable No.	A	B	φC	φE	φF1	φF2	G	H	R1
Boom	RH	LS01V00002F1	LS06-01001~ YS06-00901~	2,200	1,590	170	115	232	199	140	150	110
	LH	LS01V00001F1		{72.61}	{52.59}	{6.69}	{4.52}	{9.13}	{7.83}	{5.51}	{5.91}	{4.33}
Arm		LS01V00003F1		2,630	1,970	190	130	270	222	160	160	110
				{87.54}	{65.55}	{7.48}	{5.12}	{10.63}	{8.74}	{6.30}	{6.30}	{4.33}
Bucket		LS01V00004F1		2,020	1,410	160	110	222	188	160	160	110
				{67.52}	{47.51}	{6.29}	{4.33}	{8.74}	{7.40}	{6.30}	{6.30}	{4.33}

Model	Part No.		Applicable No.	R2	φd1	φd2	Weight kg (lb)	Cushion mechanism		Remarks
								Rod side	Head side	
Boom	RH	LS01V00002F1	LS06-01001~ YS06-00901~	220	120	110	396	○		Cushion stroke R:60 {2.36}
	LH	LS01V00001F1		{8.66}	{4.72}	{4.33}	{15.59}			
Arm		LS01V00003F1		240	120	120	586	○	○	Cushion stroke HR:60 {2.36}
				{9.45}	{4.72}	{4.72}	{23.07}			
Bucket		LS01V00004F1		210	100	100	364	○		Cushion stroke R:60 {2.36}
				{8.27}	{3.94}	{3.94}	{14.33}			

5. PERFORMANCE TABLE

MODEL	SWING SPEED min ⁻¹	TRAVEL SPEED km/h	DRAW BAR PULL kN	GRADE ABILITY %	ATT DIGGING FORCE kN {kgf}		FUEL CONSUMPTION l/h		WORK LOAD m ³ /h		CYCLE TIME 90° SWING	
					ARM	BUCKET	A	M	A	M	A	M
SK450VI SK480VI	9	5.6/3.5	403 {41.1}	70(35)	3.45m(11.4) 202/221 {20,600/22,500}	1.8m ³ (1.6) 264/289 {26,900/29,500}	53.9	55.7	498	520	20.4	19.5
					3.0m(9.1) 222/242 {22,600/24,700}	2.1m ³ (1.8) 264/289 {26,900/29,500}						
					4.04m(13.3) 181 {18,400}	1.6m ³ (1.4) 264 {26,900}						
					4.9m(16.1) 157 {16,000}	1.4m ³ (1.2) 264 {26,900}						

6. NOISE LEVEL



Unit : dB

Model	Circumference noise value (Dynamic)		Close to operator's ear in the cab (At no load, Hi)
	Average noise value	Sound power level	Close cab door
SK450(LC)VI • SK480(LC)VI	74	106	72

7. WEIGHT OF COMPONENTS

Unit : kg (lb)

Item	Model	SK480LCVI	SK480VI
Machine complete		45,900 (101,190)	45,200 (99,650)
1. Upper frame assy (including the following :)		20,800 (45,860)	←
1.1 Upper frame		4,650 (10,250)	←
1.2 Counterweight		9,230 (20,350)	←
1.3 Cab		260 (570)	←
1.4 Engine		※ 1,020 (2,250)	←
1.5 Hydraulic oil tank		※ 360 (790)	←
1.6 Fuel tank		※ 230 (510)	←
1.7 Slewing motor (including reduction unit)		※ 720 (1,590)	←
1.8 Control valve		※ 380 (840)	←
1.9 Boom cylinder		※ 400 (880)×2	←
1.10 Pin (for mounting boom)		115 (250)	←
1.11 Pump		※ 190 (420)	←
1.12 Radiator		190 (420)	←
2. Lower frame assy (including the following :)		17,000 (37,490)	16,300 (35,930)
2.1 Lower frame		5,900 (13,000)	5,700 (12,570)
2.2 Slewing bearing		700 (1,540)	←
2.3 Travel motor (including reduction unit)		※ 650 (1,430)×2	←
2.4 Upper roller		30 (66)×4	←
2.5 Lower roller		98 (220)×18	98 (220)×16
2.6 Front idler		270 (600)×2	←
2.7 Idler adjuster		325 (720)×2	←
2.8 Sprocket		100 (220)×2	←
2.9 Swivel joint		58 (130)	←
2.10 Track guide		50 (110)×4	←
2.11 Track link with 600mm (23.6in) shoes assy		2,700 (5,990)×2	2,540 (5,600)×2
2.11.1 Track link assy		1,160 (2,560)×2	1,090 (2,400)×2
3. Attachment (including the following / STD :)		8,100 (17,860)	←
[7.0m (23ft) Boom+3.45m (11ft-4in) Arm +1.8m ³ (2.35cu·yd) Bucket]			
3.1 Bucket assy (STD)		1,440 (3,170)	←
3.2 STD Arm assy (including the following :)		2,380 (5,250)	←
3.2.1 STD Arm		1,450 (3,200)	←
3.2.2 Bucket cylinder		※ 360 (790)	←
3.2.3 Idler link		56 (120)×2	←
3.2.4 Bucket link		150 (330)	←
3.2.5 Pin (2pcs. for mounting bucket cylinder / 2pcs. for mounting bucket)		155 (340)	←
3.3 Boom assy		4,240 (9,350)	←
3.3.1 Boom		3,330 (7,280)	←
3.3.2 Arm cylinder		※ 590 (1,300)	←
3.3.3 Pin (Mounting arm•Mounting arm cylinder)		124 (270)	←
4. Lubricant and water (including the following :)		1,200 (2,650)	←
4.1 Hydraulic oil		570 (1,260)	←
4.2 Engine oil		42 (90)	←
4.3 Fuel		540 (1,190)	←
4.4 Water		48 (105)	←

NOTE : Numerical values marked※ indicate the dry weight.

8. SPECIFIED OIL AND GREASE, AND FILTER ELEMENT LST

SK450-6

LUBRICANT SPECIFICATIONS

The following information is designed to allow usage of the proper oils, greases, fuels and coolants in various climates and certain working conditions.

LUBRICANT	CLIMATE ZONE				
HYDRAULIC OIL (ANTI-WEAR, ANTIOXIDANT AND NON-FOAMING) *Note: Machines are shipped from factory with SHELL TELLUS 32S hydraulic oil	FRIGID -30°C~-15°C (-22°F~-59°F) ISOVG22	FRIGID -20°C~-30°C (-4°F~-86°F) ISOVG32	FRIGID~WARM -25°C~-40°C (-13°F~-104°F) ISOVG32S*	WARM -5°C~-40°C (23°F~-104°F) ISOVG46	VERY HOT 5°C~55°C (41°F~131°F) ISOVG68

LUBRICANT	CLIMATE ZONE		
ENGINE OIL* A.P.I. CLASSIFICATION FOR "SERVICE CD" *ALL ENGINES SHIPPED FROM FACTORY WITH SAE30 OR SAE15W40 OIL ACCORDING TO AMBIENT TEMPERATURE IN ENGINE OIL PAN.	FRIGID -30°C~-30°C (-22°F~-86°F) SAE10W30	WARM -5°C~-40°C (23°F~-104°F) SAE15W40	VERY HOT 30°C and Above (86°F and Above) SAE15W50

LUBRICANT	CLIMATE ZONE		
FUEL	FRIGID -15°C~-25°C (5°F~-13°F) WINTERIZED ASTM D975 No.1	WARM -5°C~-15°C (23°F~-5°F) ASTM D975 No.2	VERY HOT -5°C and Above (23°F and Above) ASTM D975 No.2

LUBRICANT	FOR ROLLERS AND IDLERS ON ALL MODELS. A.P.I. Classification for "Service CD"-SAE30
ENGINE OIL (FOR GENERAL PURPOSE LUBRICATION)	

LUBRICANT	FOR SWING MOTOR REDUCTION UNIT AND TRAVEL MOTOR REDUCTION UNITS ON THE FOLLOWING MODELS : SK450-VI, SK450LC-VI EXTREME PRESSURE GEAR OIL #90 GRADE GL-4 BY A.P.I. CLASSIFICATION
GEAR OIL	

LUBRICANT	GENERAL LUBRICATION	SWING GEAR SUMP (BATH)
GREASE	EXTREME PRESSURE MULTIPURPOSE GREASE No.2 EP TYPE GREASE	N.L.G.I. No.2 LITHIUM BASE WITH MoS₂ GREASE

LUBRICANT	ANTIFREEZE (LLC) -34°C (-29.2°F) MIXTURE RATIO SHOULD PROSPECT TO 5°C (9°F) LOWER THAN THE COLDEST TEMPERATURE THE MACHINE WILL EXPERIENCE. TAKE INTO CONSIDERATION WIND CHILL FACTORS.
ENGINE COOLANT (50% MIXTURE)	

NOTE: USE OF BIO-DEGRADABLE OILS

When you use Bio-degradable Oil (BIO OIL), refer to the following information.

1. There are two types of BIO OIL available; vegetable-based and synthetic-based. You are recommended to use the synthetic-based type, because the vegetable-based oil has a maximum usage temperature of 80°C (176°F). Because of this, the degradation of vegetable-based oil occurs more rapidly, and caused reduced service life.
2. Do not mix either type of BIO OIL with the original factory-filled mineral oil. In the case that you do use BIO OIL. It is required to flush the hydraulic system that was filled with mineral oil two times.
3. If you use BIO OIL, swing and propel parking brake performance will be reduced, because of the lower friction factor of BIO OIL compared to that of mineral oil.
4. For further information about recommended Bio-degradable oil, please contact KOBELCO distributor

SK450-6

FLUIDS & FILTERS

The following charts list all the necessary lubricants, oils, greases, fuels, coolants and filters required for the KOBELCO SK450-VI and SK450LC-VI hydraulic excavator. Also a chart is provided giving specific information for the proper lubricants, oils, greases, fuels and coolants to be used in certain climates. Contact KOBELCO distributor to order the required filters, fluids and lubricants.

A. REQUIRED FLUIDS & QUANTITIES

TYPE OF FLUID	LOCATION OF USE	QUANTITIES REQUIRED
HYDRAULIC	HYDRAULIC TANK	405 Liters (107 GAL)
	HYDRAULIC SYSTEM	660 Liters (174 GAL)
ENGINE OIL	ENGINE OIL PAN (H LEVEL)	45 Liters (12 GAL)
	ENGINE OIL PAN (L LEVEL)	32.5 Liters (8.6 GAL)
	UPPER ROLLER	100cc X 4 (6.1cu.in X 4)
	LOWER ROLLER	500cc X 16 (31cu.in) X 16 500cc X 18...LC (31cu.in) X 18...LC
	IDLER	400cc X 2 (24.4cu.in X 2)
GEAR OIL	SWING MOTOR REDUCTION UNIT	39 Liter (10 GAL)
	TRAVEL MOTOR REDUCTION UNIT	15 Liter X 2 (4.0 GAL X 2)
EP GREASE	OPERATING LEVER JOINT	"U" JOINT EACH SIDE
	ATTACHMENT PINS	16 PLACES
	SLEWING RING GEAR	1 PLACE 90° X 4
	TRACK TENSION ADJUSTMENT	2 PLACES AS REQ'D
WITH LITHIUM BASE MoS ₂ GREASE	SWING GEAR SUMP (BATH)	22 kg (48.5 lbs)
ENGINE COOLANT	RADIATOR	2.1 Liters (5.5 GAL)
	COOLING SYSTEM TOTAL VOLUME	48 Liters (13 GAL)
DIESEL FUEL	FUEL TANK	650 Liters (172 GAL)

B. REQUIRED FILTERS

SYSTEM	LOCATION OF FILTER USE	PART NUMBER SK450(LC)-VI
HYDRAULIC	RETURN FILTER ELEMENT KIT	LS30T00004F1
	RETURN FILTER ELEMENT KIT (BREAKER)	LS30T00004F2
	TANK SUCTION STRAINER	LS50V00001F1
	TANK BREATHER FILTER ELEMENT	2446U228S8
	PILOT LINE FILTER ELEMENT	YN50V01001S005
ENGINE	ENGINE OIL FILTER CARTRIDGE (BYPASS & FULL FLOW)	*ME180514
	AIR CLEANER INNER ELEMENT	2446U250S2
	AIR CLEANER OUTER ELEMENT	2446U250S3
FUEL	FUEL PRE-FILTER	2446U287S4
	ENGINE FUEL FILTER CARTRIDGE	*ME150631
	ENGINE FEED PUMP GAUZE FILTER	_____
OPERATOR CAB	AIR-CON FILTER (OUTER)	YN50V01006P1
	AIR-CON FILTER (INNER)	YT20M00004S050

* AVAILABLE FROM MMC DEALER ONLY.

C.

PART NUMBER	DESCRIPTION
KSP1000-1001	ENGINE OIL-SAE 15W/40 (1 GALLON)
KSP1000-1005	ENGINE OIL-SAE 15W/40 (5 GALLON)
KSP1000-1055	ENGINE OIL-SAE 15W/40 (55 GALLON)
KSP1000-2005	HYDRAULIC OIL-AW 46 (5 GALLON)
KSP1000-2055	HYDRAULIC OIL-AW 46 (55 GALLON)
KSP1000-4014	GREASE EP/2-14 OUNCE
KSP1000-4035	GREASE EP/2-35 POUNDS
KSP1000-120	GREASE EP/2-120 POUNDS
KSP1000-3035	GEAR OIL 80W90-5 GALLONS

SK480-6

LUBRICANT SPECIFICATIONS

The following information is designed to allow usage of the proper oils, greases, fuels and coolants in various climates and certain working conditions.

LUBRICANT	CLIMATE ZONE				
HYDRAULIC OIL (ANTI-WEAR, ANTIOXIDANT AND NON-FOAMING) *Note: Machines are shipped from factory with SHELL TELLUS 32S hydraulic oil	FRIGID -30°C~-15°C (-22°F~59°F) ISOVG22	FRIGID -20°C~-30°C (-4°F~86°F) ISOVG32	FRIGID~WARM -25°C~-40°C (-13°F~104°F) ISOVG32S*	WARM -5°C~-40°C (23°F~104°F) ISOVG46	VERY HOT 5°C~55°C (41°F~131°F) ISOVG68

LUBRICANT	CLIMATE ZONE		
ENGINE OIL* A.P.I. CLASSIFICATION FOR "SERVICE CD" *ALL ENGINES SHIPPED FROM FACTORY WITH SAE30 OR SAE15W40 OIL ACCORDING TO AMBIENT TEMPERATURE IN ENGINE OIL PAN.	FRIGID -30°C~-30°C (-22°F~86°F) SAE10W30	WARM -5°C~-40°C (23°F~104°F) SAE15W40	VERY HOT 30°C and Above (86°F and Above) SAE15W50

LUBRICANT	CLIMATE ZONE		
FUEL	FRIGID -15°C~-25°C (5°F~-13°F) WINTERIZED ASTM D975 No.1	WARM -5°C~-15°C (23°F~5°F) ASTM D975 No.2	VERY HOT -5°C and Above (23°F and Above) ASTM D975 No.2

LUBRICANT	FOR ROLLERS AND IDLERS ON ALL MODELS. A.P.I. Classification for "Service CD" -SAE30
ENGINE OIL (FOR GENERAL PURPOSE LUBRICATION)	

LUBRICANT	FOR SWING MOTOR REDUCTION UNIT AND TRAVEL MOTOR REDUCTION UNITS ON THE FOLLOWING MODELS : SK480-VI, SK480LC-VI EXTREME PRESSURE GEAR OIL #90 GRADE GL-4 BY A.P.I. CLASSIFICATION
GEAR OIL	

LUBRICANT	GENERAL LUBRICATION	SWING GEAR SUMP (BATH)
GREASE	EXTREME PRESSURE MULTIPURPOSE GREASE No.2 EP TYPE GREASE	N.L.G.I. No.2 LITHIUM BASE WITH MoS₂ GREASE

LUBRICANT	ANTIFREEZE (LLC) -34°C (-29.2°F) MIXTURE RATIO SHOULD PROSPECT TO 5°C (9°F) LOWER THAN THE COLDEST TEMPERATURE THE MACHINE WILL EXPERIENCE. TAKE INTO CONSIDERATION WIND CHILL FACTORS.
ENGINE COOLANT (50% MIXTURE)	

NOTE: USE OF BIO-DEGRADABLE OILS

When you use Bio-degradable Oil (BIO OIL), refer to the following information.

1. There are two types of BIO OIL available; vegetable-based and synthetic-based. You are recommended to use the synthetic-based type, because the vegetable-based oil has a maximum usage temperature of 80°C (176°F). Because of this, the degradation of vegetable-based oil occurs more rapidly, and caused reduced service life.
2. Do not mix either type of BIO OIL with the original factory-filled mineral oil. In the case that you do use BIO OIL. It is required to flush the hydraulic system that was filled with mineral oil two times.
3. If you use BIO OIL, swing and propel parking brake performance will be reduced, because of the lower friction factor of BIO OIL compared to that of mineral oil.
4. For further information about recommended Bio-degradable oil, please contact KOBELCO distributor

SK480-6

FLUIDS & FILTERS

The following charts list all the necessary lubricants, oils, greases, fuels, coolants and filters required for the KOBELCO SK480-VI and SK480LC-VI hydraulic excavator. Also a chart is provided giving specific information for the proper lubricants, oils, greases, fuels and coolants to be used in certain climates. Contact KOBELCO distributor to order the required filters, fluids and lubricants.

A. REQUIRED FLUIDS & QUANTITIES

TYPE OF FLUID	LOCATION OF USE	QUANTITIES REQUIRED
HYDRAULIC	HYDRAULIC TANK	405 Liters (107 GAL)
	HYDRAULIC SYSTEM	660 Liters (174 GAL)
ENGINE OIL	ENGINE OIL PAN (H LEVEL)	45 Liters (12 GAL)
	ENGINE OIL PAN (L LEVEL)	32.5 Liters (8.6 GAL)
	UPPER ROLLER	100cc X 4 (6.1cu.in X 4)
	LOWER ROLLER	500cc X 16 (31cu.in) X 16 500cc X 18...LC (31cu.in) X 18...LC
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	TRAVEL MOTOR REDUCTION UNIT	15 Liter X 2 (4.0 GAL X 2)
EP GREASE	OPERATING LEVER JOINT	"U" JOINT EACH SIDE
	ATTACHMENT PINS	16 PLACES
	SLEWING RING GEAR	1 PLACE 90° X 4
	TRACK TENSION ADJUSTMENT	2 PLACES AS REQ'D
WITH LITHIUM BASE MoS ₂ GREASE	SWING GEAR SUMP (BATH)	22 kg (48.5 lbs)
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	COOLING SYSTEM TOTAL VOLUME	48 Liters (13 GAL)
DIESEL FUEL	FUEL TANK	650 Liters (172 GAL)

B. REQUIRED FILTERS

SYSTEM	LOCATION OF FILTER USE	PART NUMBER SK480(LC)-VI
HYDRAULIC	RETURN FILTER ELEMENT KIT	LS30T00004F1
	RETURN FILTER ELEMENT KIT (BREAKER)	LS30T00004F2
	TANK SUCTION STRAINER	LS50V00001F1
	TANK BREATHER FILTER ELEMENT	2446U228S8
ENGINE	PILOT LINE FILTER ELEMENT	YN50V01001S005
	ENGINE OIL FILTER CARTRIDGE (BYPASS & FULL FLOW)	*ME180514
	AIR CLEANER INNER ELEMENT	2446U250S2
	AIR CLEANER OUTER ELEMENT	2446U250S3
FUEL	ENGINE FUEL FILTER CARTRIDGE	*ME150631
	ENGINE FEED PUMP GAUZE FILTER	_____
OPERATOR CAB	AIR-CON FILTER (OUTER)	YN50V01006P1
	AIR-CON FILTER (INNER)	YT20M00004S050

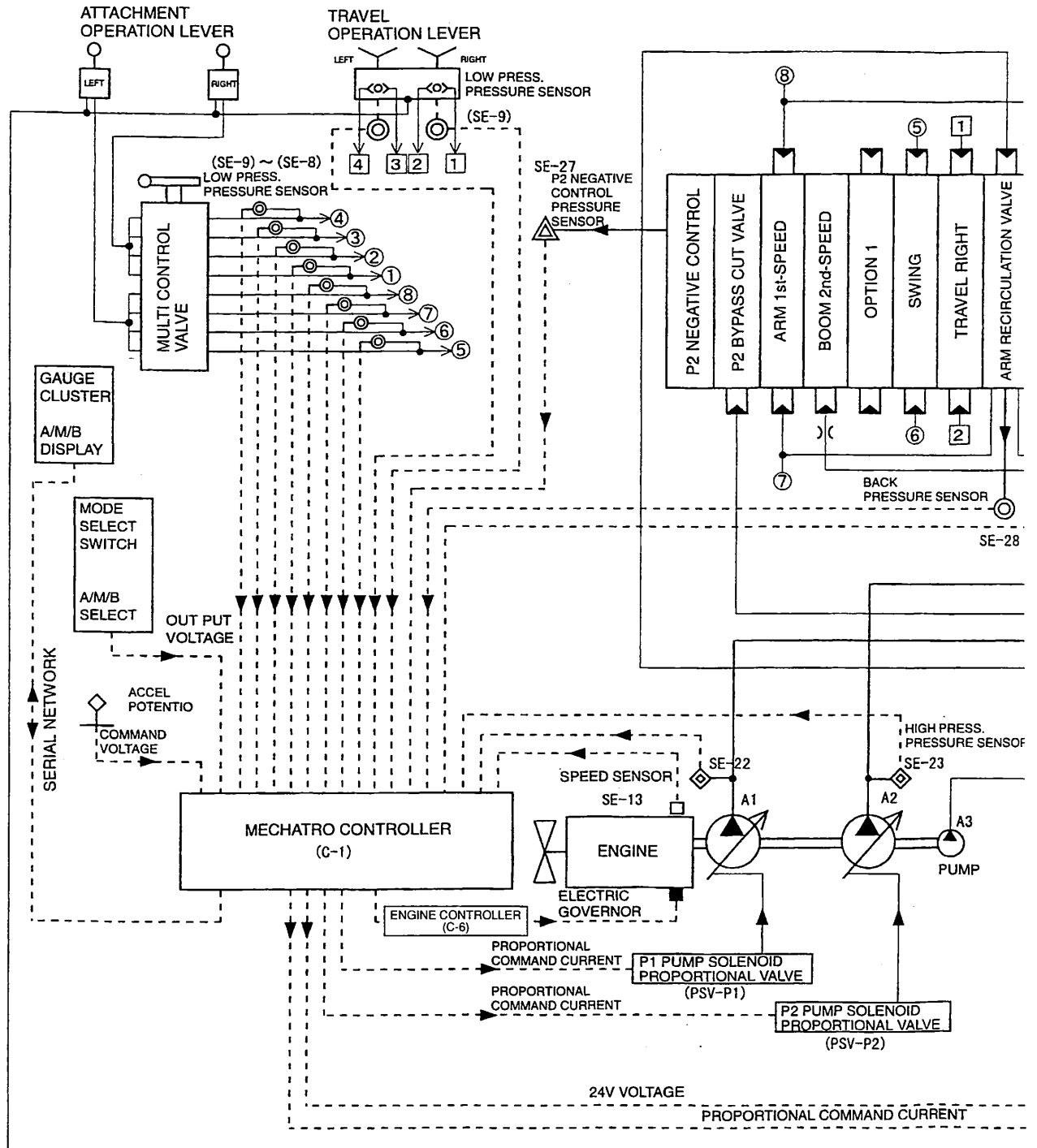
* AVAILABLE FROM MMC DEALER ONLY.

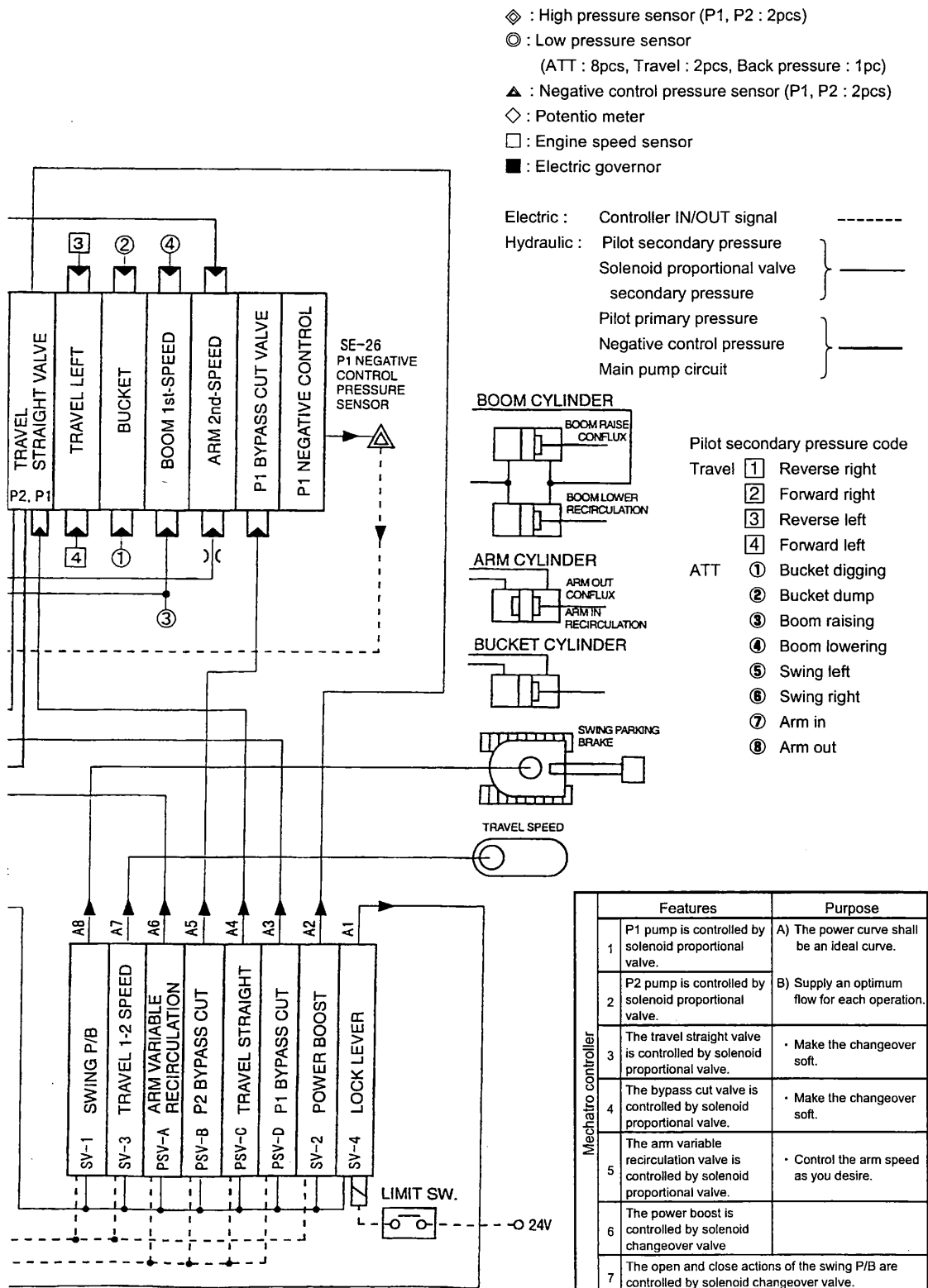
C.

PART NUMBER	DESCRIPTION
KSP1000-1001	ENGINE OIL-SAE 15W/40 (1 GALLON)
KSP1000-1005	ENGINE OIL-SAE 15W/40 (5 GALLON)
KSP1000-1055	ENGINE OIL-SAE 15W/40 (55 GALLON)
KSP1000-2005	HYDRAULIC OIL-AW 46 (5 GALLON)
KSP1000-2055	HYDRAULIC OIL-AW 46 (55 GALLON)
KSP1000-4014	GREASE EP/2-14 OUNCE
KSP1000-4035	GREASE EP/2-35 POUNDS
KSP1000-120	GREASE EP/2-120 POUNDS
KSP1000-3035	GEAR OIL 80W90-5 GALLONS

9. SUMMARY OF MECHATRO CONTROL SYSTEM

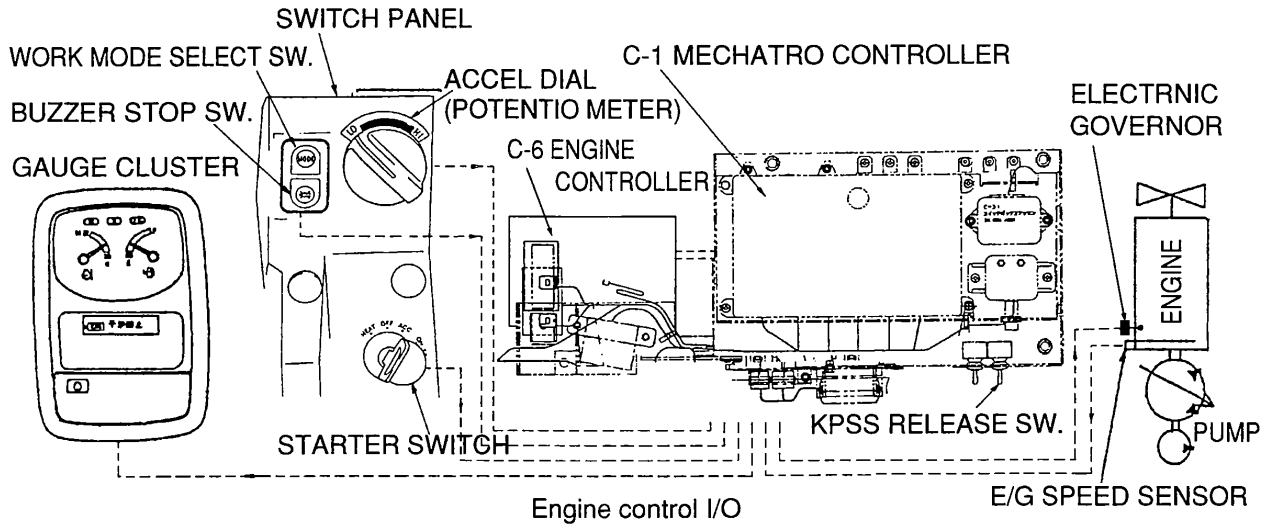
MECHATRO CONTROL SYSTEM IN GENERAL





10. MECHATRO CONTROLLER ADJUSTMENT

■ ENGINE CONTROL INPUT/OUTPUT



■ ADJUSTING THE ENGINE REVOLUTION

Since the engine revolution is adjusted with the electronic governor controller, the adjustment of the engine speed (conventional "A" adjustment) is not necessary.

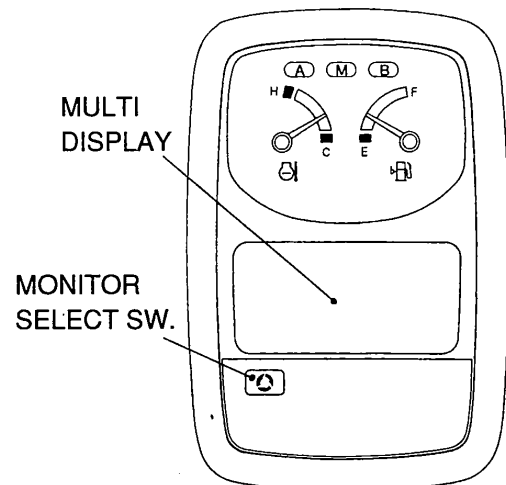
■ MECHATRONIC CONTROL DEVICES

1) Variable displacement hydraulic pumps

In case [P1 or P2 pump proportional valve error] is indicated on the multi-display of the gauge cluster, turn the KPSS release switch to "Release".

The P1, P2 proportional pump valves are performing mechatronic total power control. Therefore, the total power control is shifted to the power shift(reduced power) if the KPSS release switch is turned to "Release".

Furthermore, the P1, P2 proportional pump valves are also performing mechatro / negative flow control. Therefore, if the rods(642) of both pumps are loosened completely, hydraulic negative control is enabled. In that case, however, troubleshoot and correct the fault immediately.



2) Work mode select switch

If the work mode select switch is pressed, a signal is transmitted to the C-1 controller and changes the work modes in the order of

$M \rightarrow A \rightarrow B$.

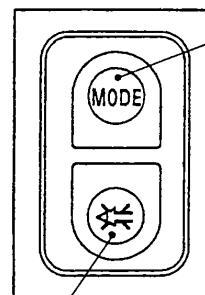
4) Buzzer stop switch

When the error is detected by self-diagnosis, the C — 1 controller sends alarm by sounding buzzer. And press buzzer stop switch to stop buzzer sounding. Also, when engine coolant temperature has risen or the engine oil pressure has lowered, buzzer sounds. But in this case the buzzer sounding does not stop.

4) Engine emergency stop knob

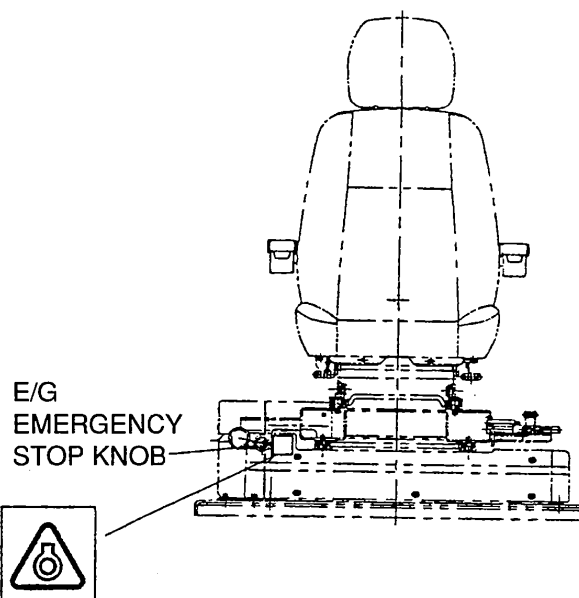
When the engine does not stop after the starter switch is turned off, pull the emergency stop knob located on the lower right side of the seat fully, and the engine stops.

SWITCH PANEL



MODE SELECT SWITCH

BUZZER STOP SWITCH



E/G emergency stop knob

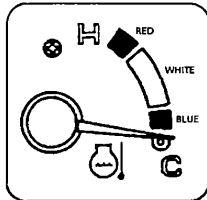
11. MEASUREMENT OF ENGINE SPEED

■ MEASUREMENT OF ENGINE SPEED

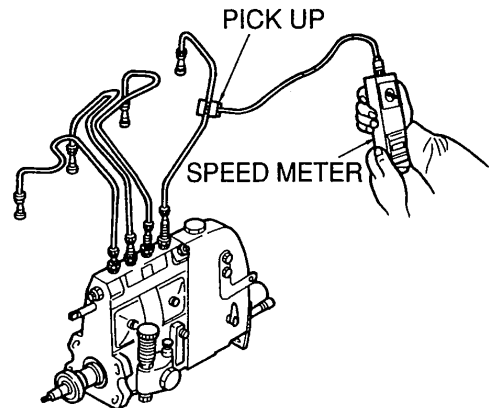
(1) Warming up of engine

Start engine to raise the coolant temperature of engine to 40° to 80°C. (104° to 176° F)

Engine water temperature gauge



The E/G coolant temperature gauge is used to measure. The range in white color shows the temperature of approx. 40° to 100°C (104° to 212° F), so confirm that the pointer indicates the temperature within the range of white color.



Measurement of E/G speed

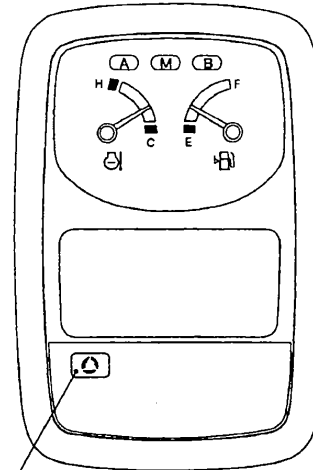
(2) Measuring with diesel engine speed meter

- 1) Install diesel engine speed meter pickup on and of injection pipes on which the pickup can be easily installed.
- 2) Check E/G speed shown in Table 1 in idling speed.

(3) Engine speed measured value through service diagnosis

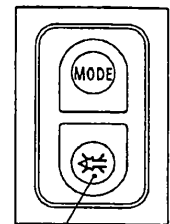
- 1) Turn "ON" the starter switch with the buzzer stop switch pressed.
- 2) A program No. and an actual engine revolution are displayed as the No.2 Item.
- 3) The screen advances like No.2, No.3....each time the "Screen change" switch on the gauge cluster is pushed.
- 4) The screen returns like No.25, No.24....each time the buzzer stop switch is pressed.
- 5) The display does not disappear unless the starter switch is turned to "OFF" .

GAUGE CLUSTER



SCREEN CHANGE SWITCH

SWITCH PANEL



BUZZER STOP SWITCH

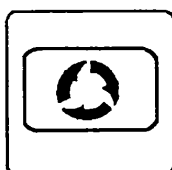
Switches related with E/G speed displays

No.2		
E/G SET	<u>2200</u>	No load set rpm
MEAS	<u>2201</u>	Actual rpm
E/G PRS.	<u>LIVE</u>	LIVE/DEAD indication
KPSS SW	<u>M</u>	A/M/B indication

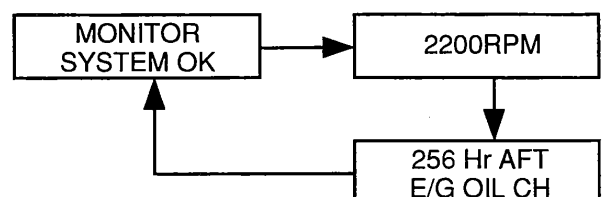
Engine speed measuring service diagnosis

(4) Actual measurement of engine revolution by the screen change switch

After the engine starts, the following items are displayed in that order each time the screen change switch is pressed.



- Engine speed
- Hours after the engine oil was replaced



Example of screen change

12. MEASUREMENT OF HYDRAULIC PRESSURE

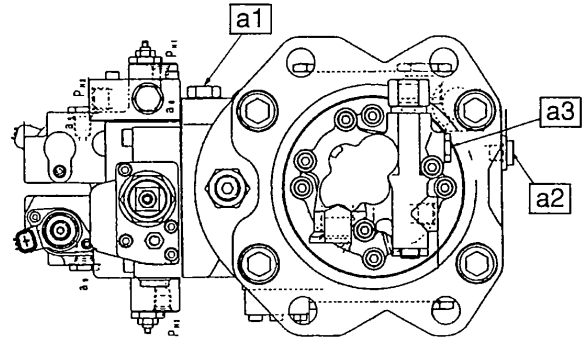
■ PREPARING TO MEASURE HYDRAULIC PRESSURE

(1) Hydraulic equipment

70kgf/cm² (1000psi) pressure gauge 1 unit
 400 ~ 500kgf/cm² (5700 ~ 7100psi)
 Pressure gauge 2 unit
 Pressure measuring equipment and instrument
 for analysis 1 set

(2) Measuring cleanliness of hydraulic oil

! After releasing air in the hydraulic oil tank, open the cover and sample oil in the hydraulic tank, and measure with the instrument for analysis. If the measured value is higher than the reference value, replace the return filter or change the hydraulic oil.



Gauge port on main pump

■ PLACE TO INSTALL PRESSURE GAUGE

(1) Main circuit

Replace plugs PF1/4 of main pump gauge ports **a1**, **a2** with plugs for pressure measurement, and attach pressure gauge 500kgf/cm² (7100psi).

(2) Pilot circuit

Replace pilot gauge plug **a3** with plug PF1/4 for pressure measurement, and attach pressure gauge 70kgf/cm² (1000psi).

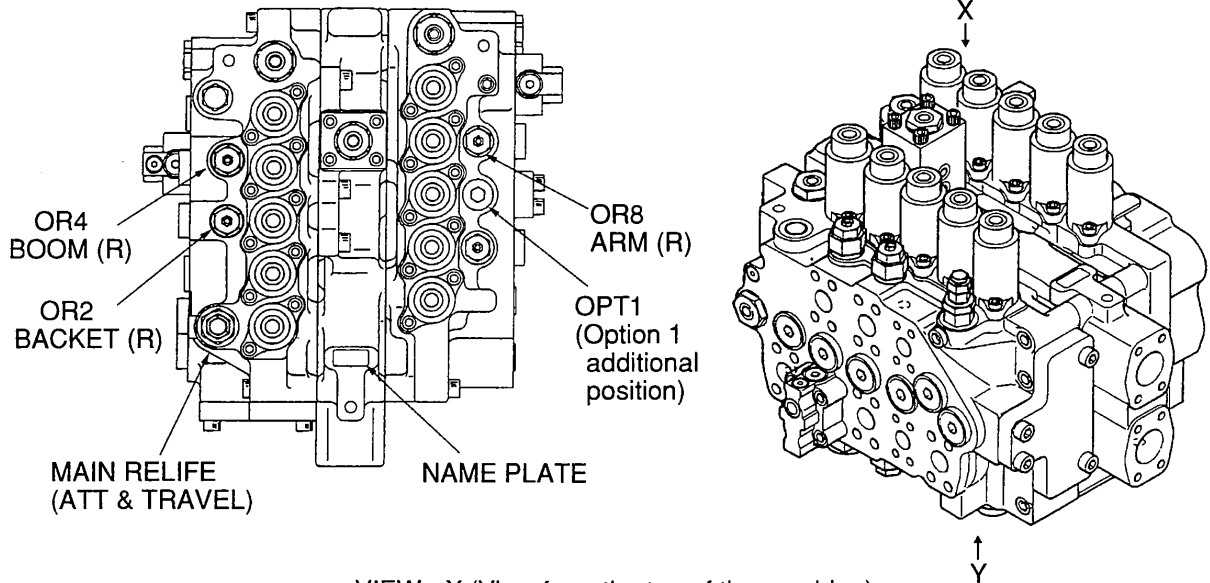
Note :

In normal condition, pressure may be measured by the below service diagnosis numbers. However, in faulty condition, the above pressure gauge must be installed and pressure adjustment is required.

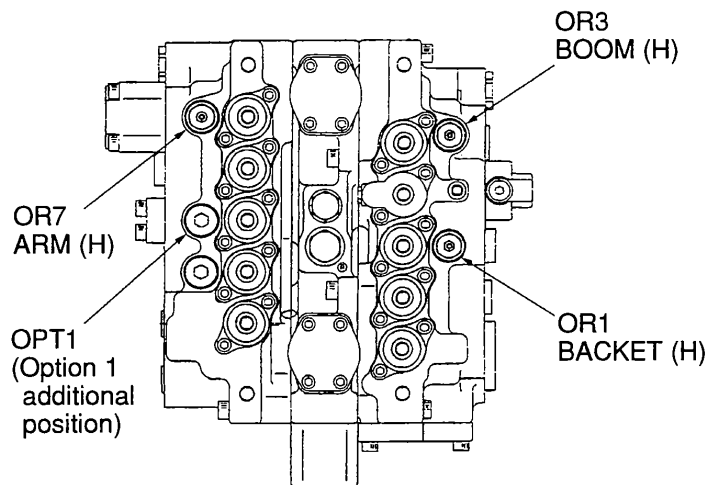
Main circuit	No. 14
Pilot secondary pressure	No. 9 ~ 13

■ PRESSURE ADJUSTMENT POSITION AND ADJUSTING

(1) Main control valve



VIEW X (View from the top of the machine)



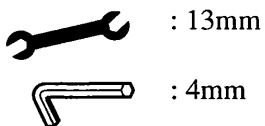
VIEW Y (View from the bottom of the machine)

Main control valve

(2) Over load relief valve

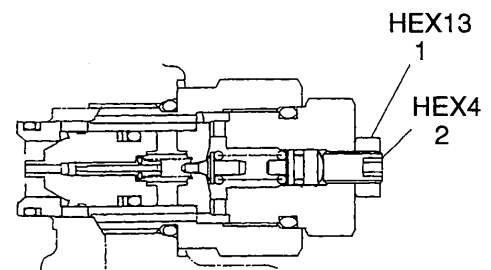
(Boom, bucket, arm sections)

Loosen lock nut (1) and adjust it with adjust screw (2).



Tightening torque :
 $0.31 \text{ kgf} \cdot \text{m}$ ($2.2 \text{ lbf} \cdot \text{ft}$)

No. of turns of adjust screw	Pressure change kgf/cm ² (psi)
1 turn	Approx. 306 (4350)



Over load relief valve
 (Boom, bucket, arm sections)

(3) Boost pressure main relief(common to travel and ATT)

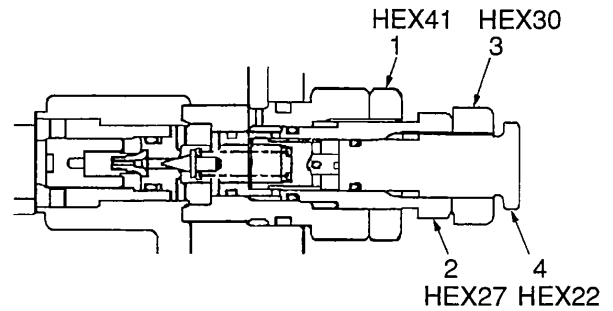
Begin with boost pressure setting. Loosen nut (1) and adjust pressure with adjust screw(2). After adjustment, tighten up nut(1).

Low pressure setting:

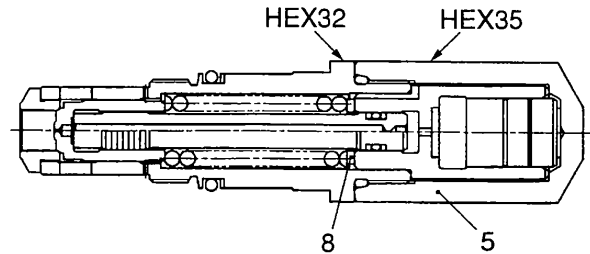
Loosen nut(3) and adjust pressure with adjust screw(4). Tighten up nut(3) after adjustment.

	: 41mm	Tightening torque :
	: 30mm	Tightening torque :
	: 22,27mm	adjust screw

No. of turns of adjust screw	Pressure change kgf/cm ² (psi)
At boost• low press. 1/4 turn	Approx. 46 (650)



Main relief valve
(Travel part, ATT part)



Travel over load relief valve

(4) Travel overload relief valve

Loosen cap (5) and adjust it with shim (8). Increasing the shim thickness increases the pressure.

	: 32mm	Tightening torque :
	: 35mm	Tightening torque :
		10 ~ 12kgf · m (72 ~ 86 lbf · ft)
		15 ~ 17kgf · m (110 ~ 120 lbf · ft)

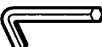
O.D, I.D. and thickness of shims (mm)	Pressure change kgf/cm ² (psi)
φ17× φ10.2×2	Approx. 200 (2840)
φ17× φ10.2×0.1	Approx. 10 (140)

(5) Pilot relief valve

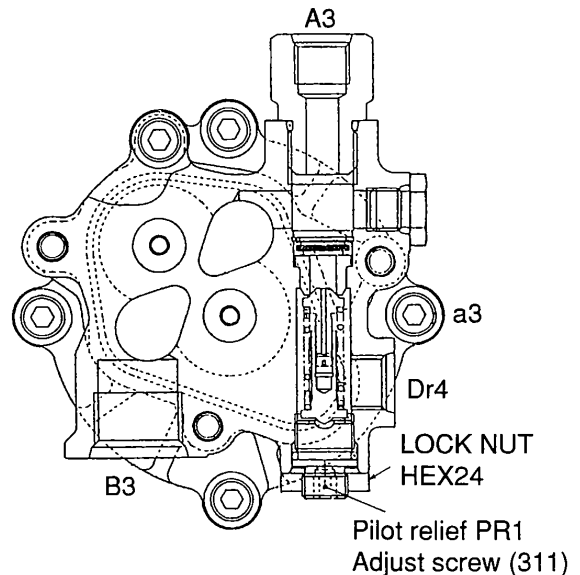
The pilot relief valve PR1 is located on the gear pump that is attached to the main pump.

1) Procedure for adjusting relief valve

Adjust it with pilot relief valve adjust screw (311).

	: 24mm	Tightening torque :
	: 6mm	3.0kgf · m (22 lbf · ft)

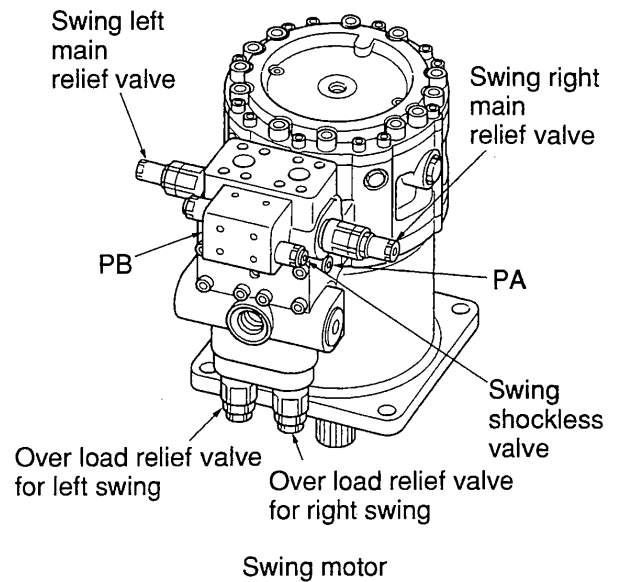
No. of turns of adjust screw	Pressure change kgf/cm ² (psi)
1 turn	Approx. 21 (300)



Pilot relief valve position

(6) Swing motor

The swing motor is equipped with plugs PA,PB for pressure measurement, but the measurement is carried out using gauge ports **a1** and **a2** .



1) Swing main relief valve

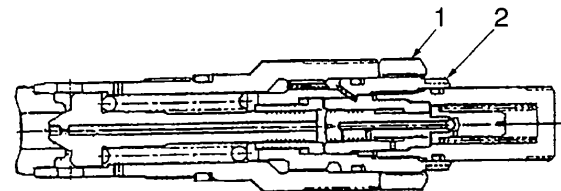
When the adjustment of pressure is required, loosen lock nut (1) and adjust the pressure with cap (2).



: 27,41mm Tightening torque :
16kgf·m (120 lbf · ft)

No. of turns of adjust screw	Pressure change kgf/cm ² (psi)
1 turn	Approx.102 (1450) ²

When the pressure adjusted value is over 10kgf/cm² (142psi), replace the relief valve assy.



Swing main relief valve

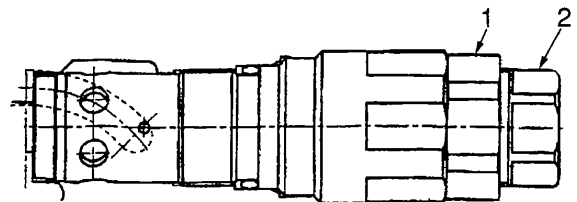
2) Over load relief valve (Swing)

When the adjustment of pressure is required, loosen lock nut (1) and adjust the pressure with cap (2).



: 30,38mm Tightening torque :
12kgf · m (87 lbf · ft)

No. of turns of adjust screw	Pressure change kgf/cm ² (psi)
1 turn	Approx. 69.4 (990)



Swing over load relief valve

13. MEASURING TRAVEL PERFORMANCES

■ TRAVEL SPEED

(1) Purposes

Measure the track link revolution and confirm the performances between the hydraulic pump and the travel motor of the travel drive system.

(2) Conditions

Hydraulic oil temperature ; 45 ~ 55°C
(113 ~ 131°F)

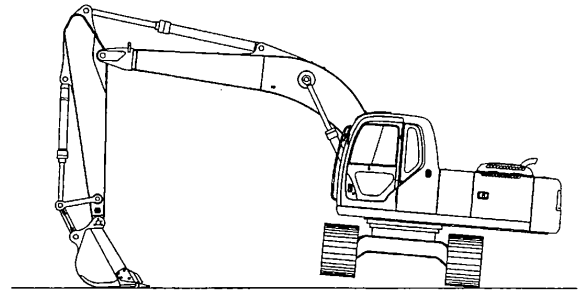
Crawler on the right and left sides are tensioned evenly.

(3) Preparation

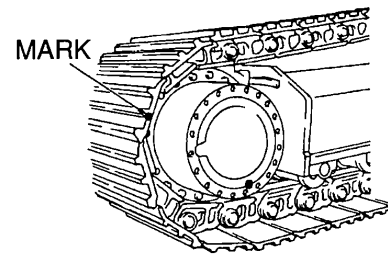
Paint the mark on the travel shoe plate.
Swing the swing frame through 90° as shown in Fig.13 and make the crawler on one side take off the ground, using the attachment.

(4) Measurement

Engine revolution ; Hi idle
2-speed travel switch ; 1-speed and 2-speed
Measuring points ; Right and left
Method ; sec/3 revolutions



One side lifted position



Marking position

Track link revolution		Unit : sec / 3 revolutions		
Measurement item		Standard value	Repairable level	Service limit
STD	M1	32.6~35.8	41.7~45.8	51.3~
	M2	20.2~22.2	25.9~28.4	31.8~
LC	M1	34.8~38.0	44.5~48.6	54.6~
	M2	21.5~23.5	27.5~30.1	33.8~

■ DEVIATION OF TRAVEL

(1) Purpose

Measure the amount of deviation at 20m (22yard) travel and confirm the horizontal balance between the hydraulic pump and the travel motor of the travel drive system.

(2) Condition

Hydraulic oil temperature ; 45 ~ 55° C
(113 ~ 131° F)

RH and LH crawler are tensioned evenly.

Plain, level and solid ground

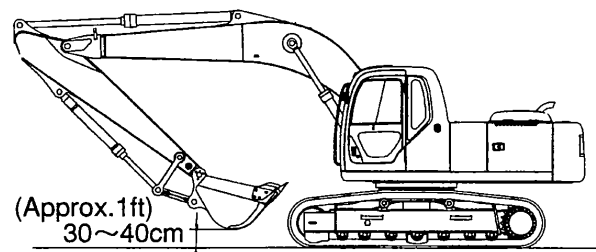
Engine revolution ; Hi idle

(3) Preparation

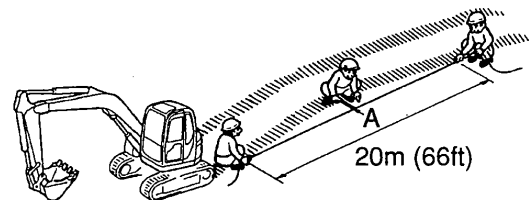
- 1) Straight course more than 30m (33yard)
- 2) Travel position in which the bottom of the bucket is lifted by about 30cm (1ft).

(4) Measurement

- 1) Measure the max. deviation distance of the circular arc in the 20m (22yard) length, excluding the preliminary run of 3 ~ 5m (10 ~ 16ft).
- 2) Operate the travel lever at the same time.



Travel position



Measuring method

Travel deviation		Unit : m(ft-in)/20m (66ft)		
Measuring position		Standard value	Repairable level	Service limit
A		1.2 (3'9") or less	2.0 (6'7")	3.0 (9'10")

■ PERFORMANCES OF PARKING BRAKE

(1) Purpose

Confirm that the parking brake holds a stopped condition of the machine in a no-load travel position and on a 1/5 gradient slope.

(2) Condition

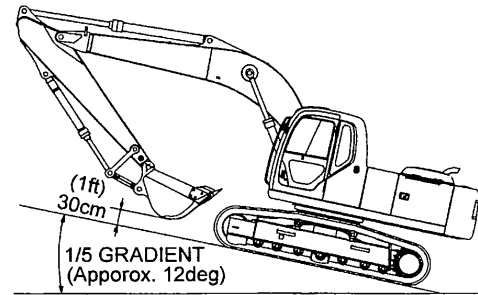
A slope with 1/5 (Approx. 12deg) gradient and a stopped condition in a no-load travel position

(3) Preparation

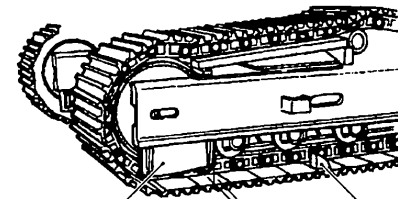
Place an angle meter on the shoe plate and confirm that it makes an angle more than 12° . Hang a perpendicular in parallel with the guide frame rib on the track frame and put a mark (matching mark) on the shoe plate.

(4) Measurement

Five minutes after the engine stops, measure the movement distance of the matching mark.



Parking brake operating position



GUIDE FRAME C ANGLE METER
Method of measurement

Parking brake		Unit : mm/5 min.	
Measuring position	Standard value	Repairable level	Service limit
C	0	1 (0.04in)	2 (0.08in)

■ DRAIN RATE OF TRAVEL MOTOR

(1) Purpose

To measure the drain rate of the travel motor and to confirm the performances of the travel motor.

(2) Conditions

Hydraulic oil temperature : 45 ~ 55° C
(113 ~ 131° F)
Engine revolution : Hi idle

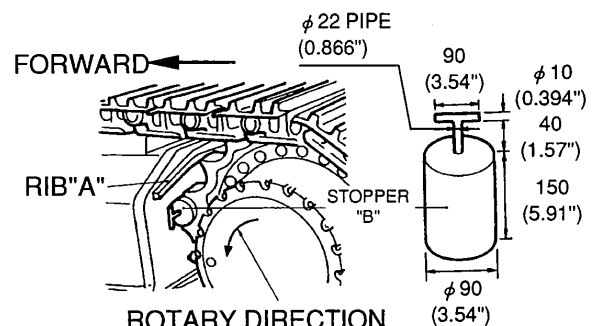
(3) Preparation

- 1) Place a stopper under the RH and LH travel sprockets.
- 2) Stop the engine and vent pressure from the hydraulic circuit.
- 3) Connect a hose with the drain port of the travel motor and take drain in a container.

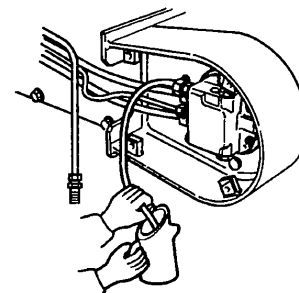
(4) Measurement ; at Travel Lock

! Unless you observe the rotary force direction at travel lock, rib "A" may be broken by stopper "B" in some cases.

- 1) Start the engine and relieve pressure at the full stroke of the travel lever.
- 2) Measure the drain rate for 30 seconds of relieving.



Location of stopper applied to travel sprocket



Method of measuring the drain rate of travel motor

Drain rate of travel motor		Unit : 0/30sec	
Measuring position	Standard value	Repairable level	Service limit
Drain rate	6.5 (1.7gal)	13 (3.4gal)	19.5 (5.1gal)

14. MEASURING SWING PERFORMANCES

■ SWING SPEED

(1) Purpose

Measure the swing time and confirm the performances between the hydraulic pump and the swing motor of the swing drive system.

(2) Conditions

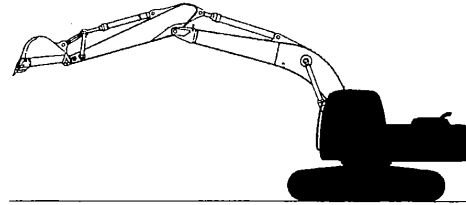
Hydraulic oil temperature ;45 ~ 55°C
(113 ~ 131 ° F)
Plain, level, and solid ground
Engine ;Hi idle

(3) Preparation

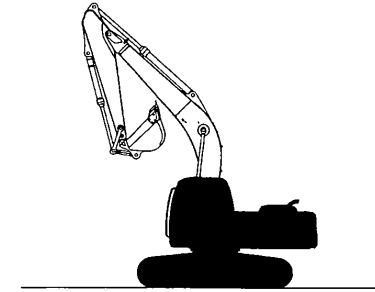
Bucket empty, arm cylinder fully retracted (Max. reach), or arm cylinder fully extended (Min. reach)

(4) Measurement

Operate the swing lever to full strokes to swivel the machine. Measure the time needed to make the machine three turns.



Swing speed measuring position
(at the max. reach)



Swing speed measuring position
(at the min. reach)

■ PERFORMANCE OF SWING BRAKE

(1) Purpose

Confirm the braking torque performances by the swing relief valve.

(2) Conditions

Hydraulic oil temperature ;45 ~ 55°C
(113 ~ 131 ° F)
Plain, level and solid ground
Engine ;Hi idle

(3) Preparation

- 1) A height of 1.5m (5ft) at which the bottom of the bucket matches the tip of the tooth on condition that the bucket is empty, the arm cylinder is most retracted and the bucket is used for digging.
- 2) Put a matching mark on the outer circumference of the swing bearing of the upper frame side and of the track frame side. Erect two poles (flags) at the front and back of the extended line of the matching mark.

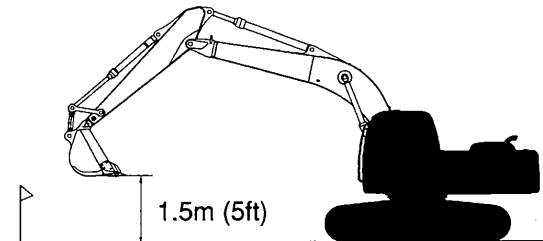
(4) Measurement

- 1) When operating in regular swing speed, by shifting lever to neutral position at pole position the swing operation stops.
- 2) Calculate the swing drift angle by the following equation, after the upper swing body stops, using the amount of deflection (m) of the matching marks on the swing race and the length (m) of the circumference of the swing race :

$$\text{Swing drift angle} (^{\circ}) = \frac{\text{Amount of deflection of matching marks [m(ft-in)]}}{\text{Circumferential length of swing race [m(ft-in)]}} \times 360^{\circ}$$

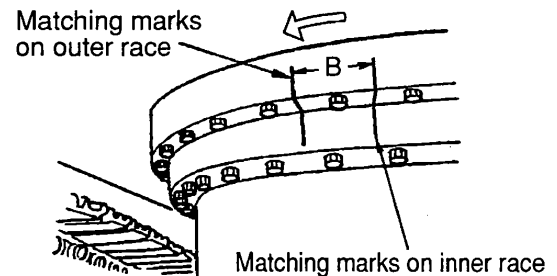
Swing speed Unit : sec / 3 revolutions

Measuring position	Standard value	Repairable level	Service limit
Swing speed max. reach	20.3~22.3	26.0~28.5	32.0~
min. reach	20.3~22.3	26.0~28.5	32.0~



Swing brake performance measuring position

Measuring the length of the arc over the outer circumference of outer race



Measuring position of swing brake performances

performance Unit : degree

Measuring position	Standard value	Repairable level	Service limit
Swing 180°	With in 105°	With in 110°	With in 115°

■ PERFORMANCE OF SWING PARKING BRAKE

(1) Purpose

To confirm the mechanical performances of the swing parking brake that is fitted to the inside of the swing motor.

(2) Conditions

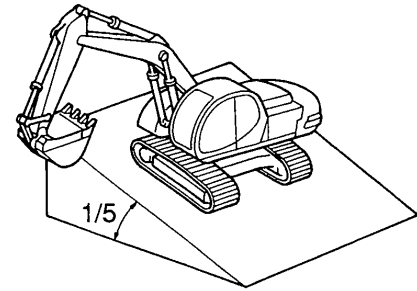
On a slope with 1/5 (Approx. 12deg.) gradient. Stop the machine at right angles with the slope at the height of 1.5m (5ft) at which the bottom of the bucket matches the tip of the tooth on condition that the bucket is empty, the arm cylinder is most retracted and the bucket is operated for digging.

(3) Preparation

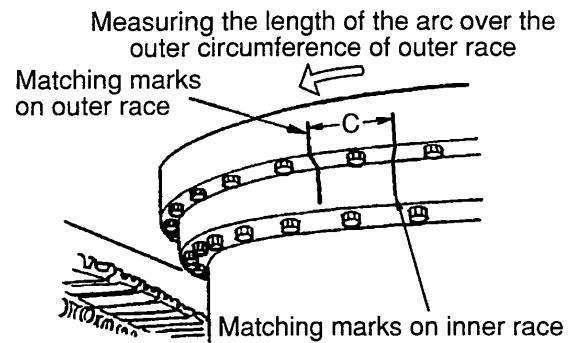
Put the angle meter on the shoe plate and make sure that the angle is more than 12°. Put a matching mark on the outer race side and on the inner race side.

(4) Measurement

When five minutes has passed after the engine stops, measure the length of the movement of the matching marks.



Swing parking brake performance measuring position



Measuring position of swing brake performances

■ DRAIN RATE OF SWING MOTOR

(1) Purpose

Measure the drain rate of the swing motor and confirm the performances of the swing motor.

(2) Conditions

Hydraulic oil temperature ;45 ~ 55° C
(113 ~ 131° F)
Engine revolution ;Hi idle

(3) Preparation

- 1) Stop the engine.
- 2) Release pressure from inside the hydraulic circuit.
- 3) Disconnect the swing motor drain hose from its end returning to the hydraulic oil tank and take oil in a container.
- 4) Put a plug to the tank side.

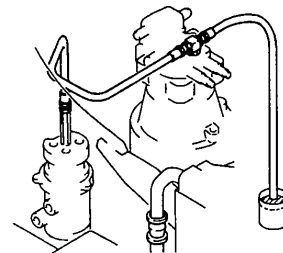
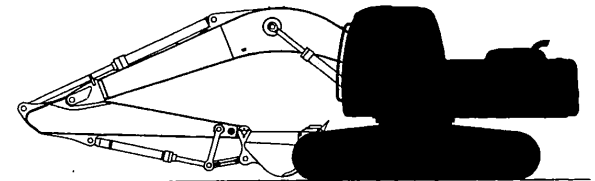
(4) Measurement ; at Swing Lock

- 1) Start the engine and put the side faces of bucket against the inside of the right or left shoe plates.
- 2) Relieve the swing motor at full stroke of the swing motion.
- 3) Receive in a container the amount of drain accumulated in 30 seconds of relieving.

Performance of swing parking brake

Unit : mm/5 min

Measuring position	Standard value	Repairable level	Service limit
C	0	1 (0.04in)	2 (0.08in)



Drain rate of swing motor

Unit : ℓ/30sec

Measuring item	Standard value	Repairable level	Service limit
Drain rate	9 (2.4gal)	18 (4.8gal)	27 (7.1gal)

15. MEASURING ATTACHMENT OPERATING PERFORMANCES

■ OPERATING TIME OF CYLINDERS

(1) Purpose

Measure the operating time of the boom, arm and bucket and confirm the performances between the hydraulic pump and the cylinder of the attachment drive system.

(2) Condition

Hydraulic oil temperature ;45 ~ 55° C
(113 ~ 131° F)

Engine ;Hi idle

Operating time excluding the cushion stroke

(3) Preparation

Plain ground with the bucket empty

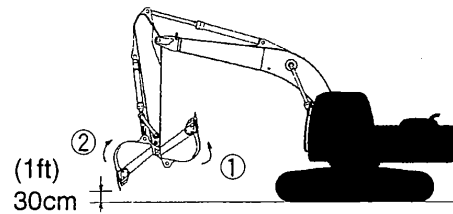
(4) Measurement 1 ; Boom up and down

With the boom operating lever at full stroke, measure the required operating time of the bucket between the ground surface and its highest position.

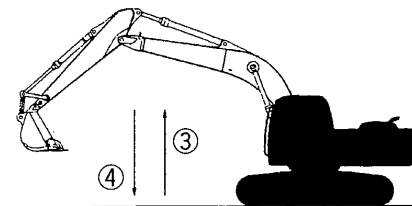
! When lowering the boom, allow the bucket onto a soft ground or cushioning such as rubber tires ; never put the bucket against concrete or other solid material.

Measurement 2 ; Arm in and out, bucket digging and dump

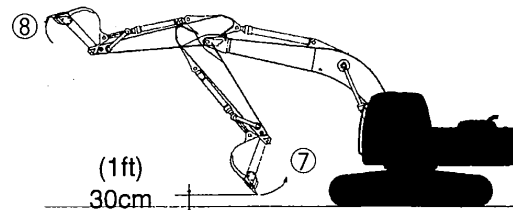
In a position in which the tooth of the bucket rises to a level of about 30cm (1ft) above ground, measure the full stroke operating time required with the arm and bucket operating levers at full stroke.



Measuring position for bucket digging and dump



Measuring position for boom up and down motions



Measuring position for arm in and out motions

■ OIL TIGHTNESS OF CYLINDERS

(1) Purpose

Confirm that the cylinder oil tight by checking the moving length of the cylinder rods.

(2) Condition

Hydraulic oil temperature ;45 ~ 55° C
(113 ~ 131° F)

Plain, level and solid ground

Immediately after cylinders are replaced, bleed off air from the cylinders, before checking for oil tightness.

! Avoid the range of cushion stroke.
Extend the cylinder approx. 50mm (2in) from stroke end.

(3) Preparation

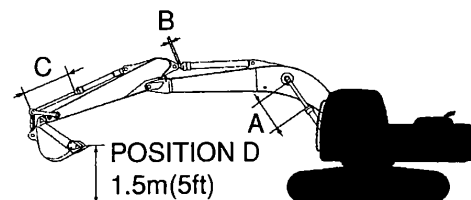
Keep the tip of the bucket at 1.5m (5ft) height, with the bucket empty and the arm cylinder is most retracted.

(4) Measurement

Measure the items five minutes after the engine is turned off.

Cylinder Operating time Unit : sec

Measuring position	Standard value	Repairable level	Service limit
①	2.8~3.4	3.6~4.4	4.7~
②	2.2~2.8	2.9~3.6	3.8~
③	3.5~4.1	4.5~5.2	5.7~
④	2.9~3.5	3.7~4.5	4.8~
⑦	4.5~5.3	5.8~6.8	7.4~
⑧	3.0~3.6	3.8~4.6	5.0~



Oil tightness of cylinder Unit : mm/5min

Measuring position	Standard value	Repairable level	Service limit
A	6 (0.24in)	8 (0.32in)	10 (0.39in)
B	6 (0.24in)	8 (0.32in)	10 (0.39in)
C	—	—	—
D	180 (7.1in)	230 (9.1in)	300 (12in)

16. MEASURING PERFORMANCES OF SWING BEARING

(1) Purpose

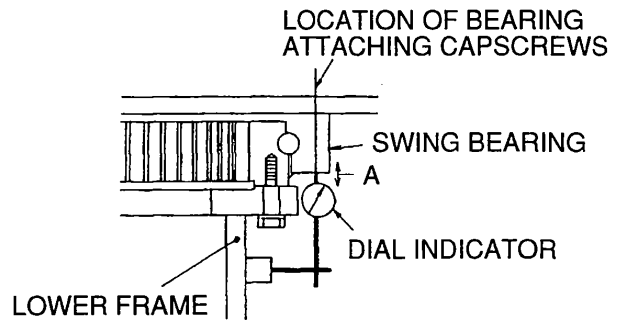
Measure the gap between the lower frame and the bottom face of the swing bearing and estimate the degree of wear of the swing bearing.

(2) Condition

Plain, level and solid ground

The swing bearing mounting bolts are not loosened.

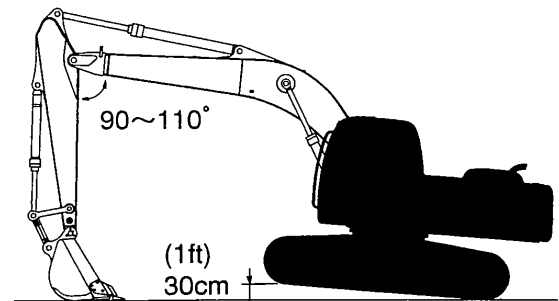
The swing bearing is lubricated well, not making abnormal sound during turning.



How to measure the axial play of swing bearing

(3) Preparation

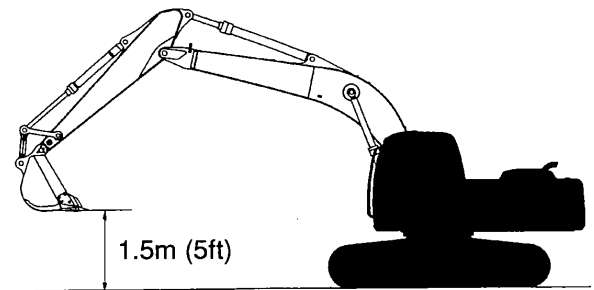
- 1) Install a dial indicator to the magnetic base and fix it to the lower frame.
- 2) Direct the upper swing body and the lower frame toward the travel direction, bring the probe of the dial indicator in contact with the bottom surface of the outer race on the swing body side and set the reading at zero.



Measuring position I

(4) Measurement 1 (Measuring position I and II)

- 1) Measure the travel of the outer race in the axial direction in position I [The arm at $90^{\circ} \sim 110^{\circ}$ and the crawler front lifted about 30cm (1ft)] and in position II, using a dial indicator.
- 2) Take measurement three times on the right and the left respectively, and make the mean value a measured value.



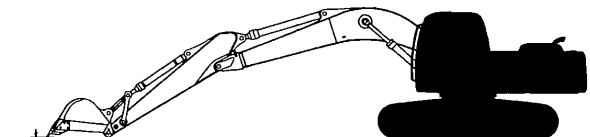
Measuring position II

Axial play of swing bearing Unit : mm (in)

Measuring position	Standard value	Repairable level	Service limit
A	0.8~1.8 (0.03~0.07)	2.3~3.3 (0.09~0.13)	3.6 (0.14)

(5) Measurement 2 (Measuring position III)

- 1) With the arm cylinder most retracted and the bucket dump, lift the tip of the tooth of the bucket about 10mm (0.4in) and swing the tip of the bucket to the right and the left by man power.
But in this case, the gap of the attachment is included.



10mm
(0.4in)

Measuring position III

Right and left movement of the tip of bucket Unit : mm (in)

Measuring position	Standard value	Repairable level	Service limit
Bucket tiptoe	60 (2.36)	100 (3.94)	120 (4.72)

17. PERFORMANCE INSPECTION STANDARD TABLE

Table 1 (1/2)

Note ; The mode is already "M" mode when power is thrown.
(But "A" mode is provided in EU.)

Unless otherwise specified, measure it on "M" mode.

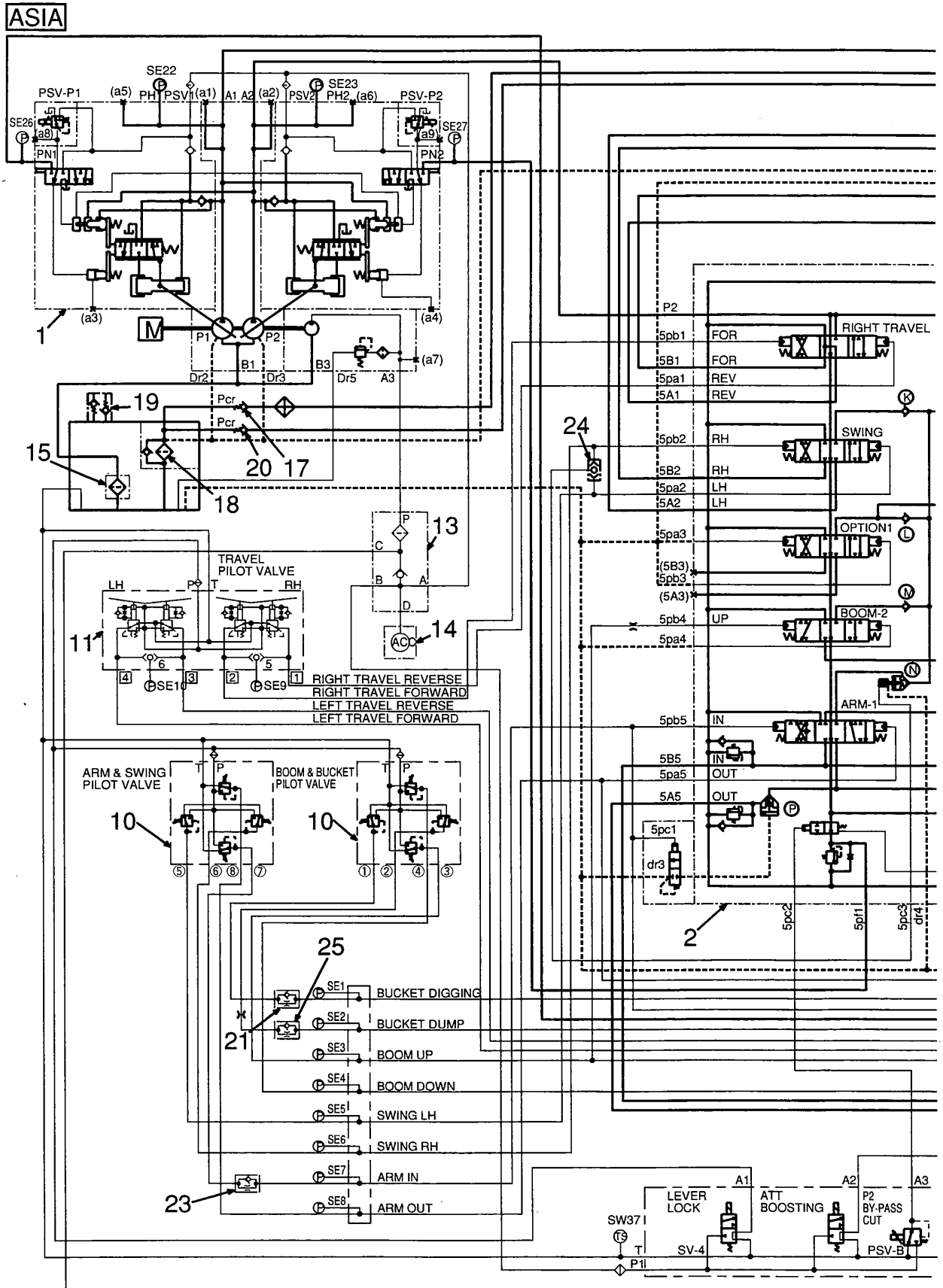
Inspection Item				Measuring Position		Standard value	Hi	Lo	Unit	Adjusting Point	Measuring condition			
				Position	Port									
Standard Measuring condition	Cleanliness of hydraulic oil			Hydraulic oil in tank		NAS 8	+1	−1	Class	—	Sampling			
	Hydraulic oil temperature			Tank surface		50 (122)	+5 (41)	−5 (23)	°C	—	Ambient temp. 50°C~−10°C (122°F~14°F)			
	Water temperature			Radiator surface		75 (167)	+15 (59)	−15 (5)	(F°)	—				
	Engine speed	Mmode	Lo idle	Multi display on the gauge cluster (Injection pipe)		1000	+30	−30	rpm	Adjustment not required	LOW throttle			
			Hi idle			2200	+20	−30			FULL throttle (M mode)			
		A mode Hi				1900	+30	−30			Perform all measurement with the air-conditioner "OFF".			
		B mode Hi				2200	+20	−30						
		Decel				1050	+30	−30						
	Pilot primary pressure circuit				G pump	a4	50 (710)	+3 (43)	0	kgf/cm ² (psi)	PR1	M mode Hi idle		
	High pressure circuit	Main relief valve pressure	ATT & Travel	P1	Main pump	a1	320 (4550)	+5 (71)	0		MR1	Simultaneous Operation of travel RH and LH or Boom up		
P2				a2		350 (4980)	+10 (140)	−5 (71)	MR1		ATT boost SW. ON Boom up			
Boost			P1	a1		375 (5330)	0	−55 (780)	OR3		Boom up			
			P2	a2		355 (5050)	0	−35 (500)			OR4	Boom down		
—		—	—	—	—	—	—	—	—					
Over load relief valve pressure		Boom	H		Main pump	a1	375 (5330)	0	−55 (780)		OR3	Boom up		
							355 (5050)	0	−35 (500)			OR4	Boom down	
			Bucket	H		a1	375 (5330)	0	−55 (780)		OR1	Bucket digging		
							355 (5050)	0	−35 (500)			OR2	Bucket dump	
		Travel		RH		Forward	a2	335 (4760)	0		−15 (210)	OT1	Simultaneous Operation of travel RH and LH	
						Reverse		a1	335 (4760)		0			−15 (210)
			LH	Forward		a2			355 (5050)		0			−35 (500)
				Reverse				375 (5330)	0		−55 (780)			OT4
		Swing	LH			a2	260 (3700)	+60 (850)	0		OR5	Swing LH		
							355 (5050)	0	−35 (500)		OR6	Swing RH		
		Arm	H			a2	375 (5330)	0	−55 (780)		OR7	Arm in		
	375 (5330)						0	−55 (780)	OR8	Arm out				
Nega-con relief valve			Pn1	a1	32 (460)	+15 (210)	0	NR1	M mode					
			Pn2	a2				NR2	E/G Hi idle					
Secondary pilot Pressure circuit	Proportional Valve block	P2 bypass cut	A3	Gauge cluster Service diagnosis screen No.	21	4 (57)	+1.5 (21)	−0.5 (7)	→ mA ← kgf/cm ² (psi)	300	With the solenoid valve at neutral (The current reading in the table on the left has the same meaning as the standard pressure.)			
		Travel straight	A4		22	6 (85)				350				
		P1 bypass cut	A5		20	4 (57)				300				
		Arm variable recirculation	A6		23	6 (35)				350				
		P2 bypass cut	A3		21	25 (360)	+2 (28)	−1.5 (21)		647	With the solenoid valve at work (The max. value is indicated.)			
		Travel straight	A4		22	25 (360)				647				
		P1 bypass cut	A5		20	25 (360)				647				
		Arm variable recirculation	A6		23	25 (360)				647				

Table 1 (2/2)

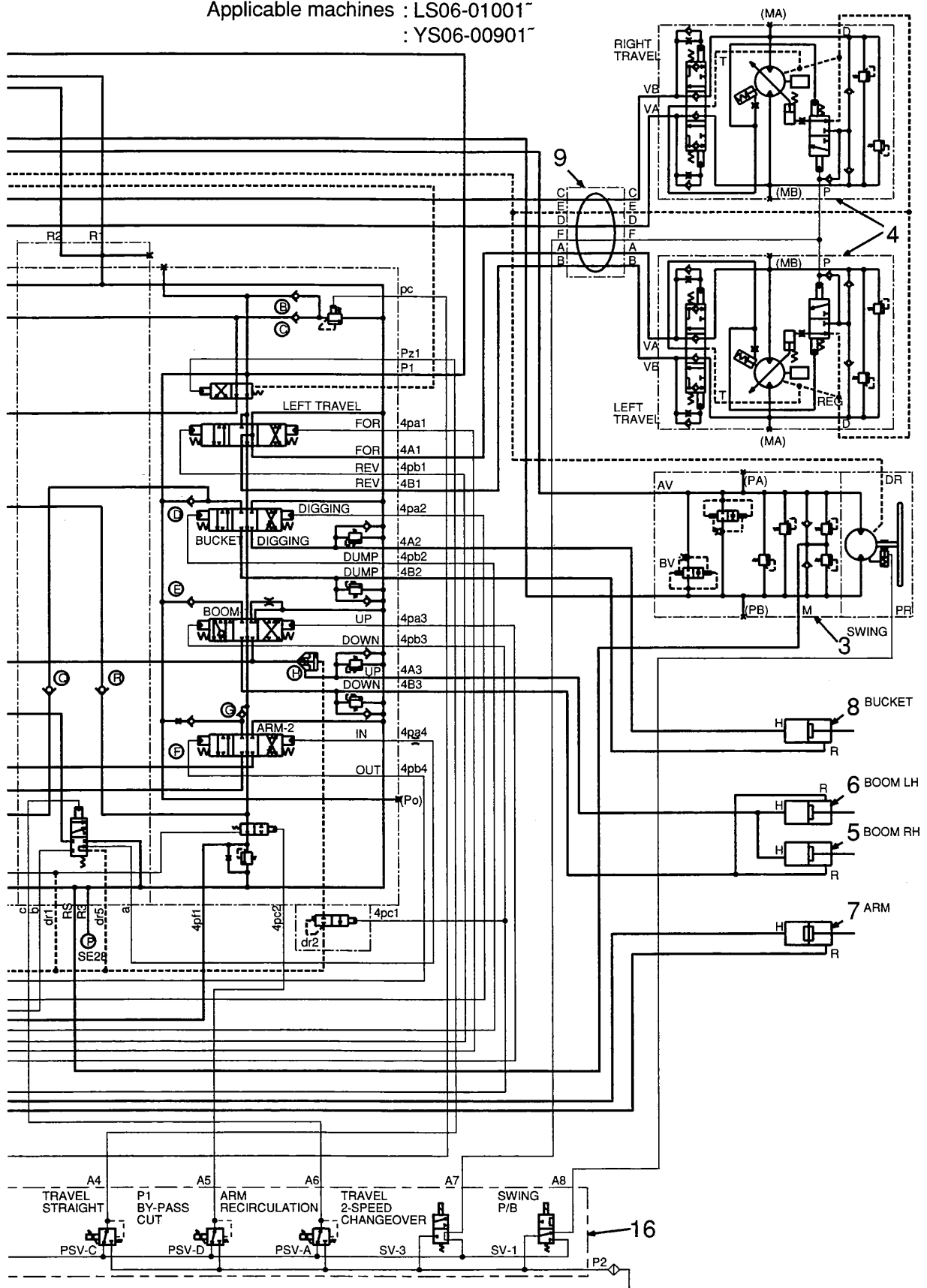
Inspection Item		Measuring Position		Stand- ard value	Hi	Lo	Unit	Adjusting Point	Measuring condition
		Position	Screen code						
Secondary pilot pressure circuit	P1 pump proportional valve & P2 pump proportional valve	Gauge cluster Service diagnosis screen No. C-2	24	6 (85)	+0.5 (7)	-0.5 (7)	kgf/cm ² (psi)	Indicated Current value (mA) MIN 350	E/G Hi Lever on full When power shifting
			25						
			24	32 (460)	+1.5 (20)	-1.5 (20)		MAX 770	Lever on neutral position
			25						

Inspection item					Standard value	Unit	
Operating speed	Track link revolution (RH,LH)	M mode	STD	1st speed	32.6~35.8	sec / 3 rev	M mode E/G HI idle
				2nd speed	20.2~22.2		
			LC	1st speed	34.8~38.0		
				2nd speed	21.5~23.5		
	Operating time of cylinder (At no load) (Not include cushion stroke)	Boom	Raise	3.5~4.1	sec		
			Lower	2.9~3.5			
		Arm	In	4.5~5.3			
			Out	3.0~3.6			
		Bucket	Digging	2.8~3.4			
			Dumping	2.2~2.8			
		—	—	—			
			—	—		—	
	Swing speed (M mode STD)	—		—	sec / 3 rev		
		Full speed		20.3~22.3			
	Travel speed	1st speed	Rubber	—	sec / 20m		
			Iron	19.0~24.0			
		2nd speed	Rubber	—			
			Iron	12.6~14.6			
Amount of travel deviation	2nd speed		0~1.20	m / 20m			
Parking brake drift	1 / 5 Gradient		0	mm / 5min			
Performance of Swing brake	Neutral position after 180°full speed swing		65~105	degree			
Performance of Swing parking brake	1 / 5 Gradient		0	mm / 5min			
Attachment cylinder dirt	Tip of the bucket tooth		180	mm / 5min	(At no load)		
	Boom cylinder		6				
	Arm cylinder		6				
	Dozer cylinder		—				
Amount of horizontal play at the bucket tooth			50~70	mm			

18. HYDRAULIC CIRCUIT AND COMPONENTS

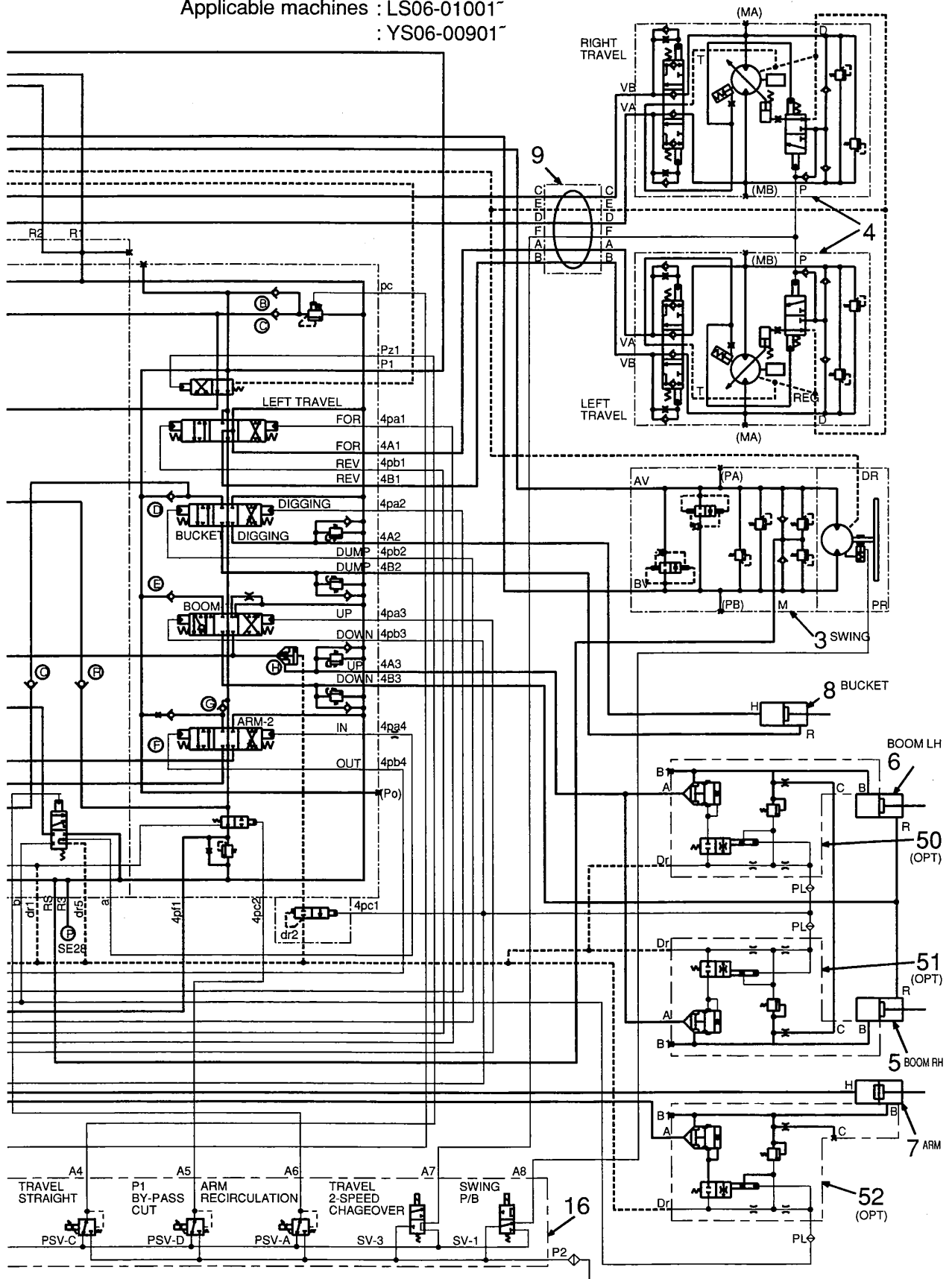


Applicable machines : LS06-01001~
: YS06-00901~





Applicable machines : LS06-01001~
: YS06-00901~

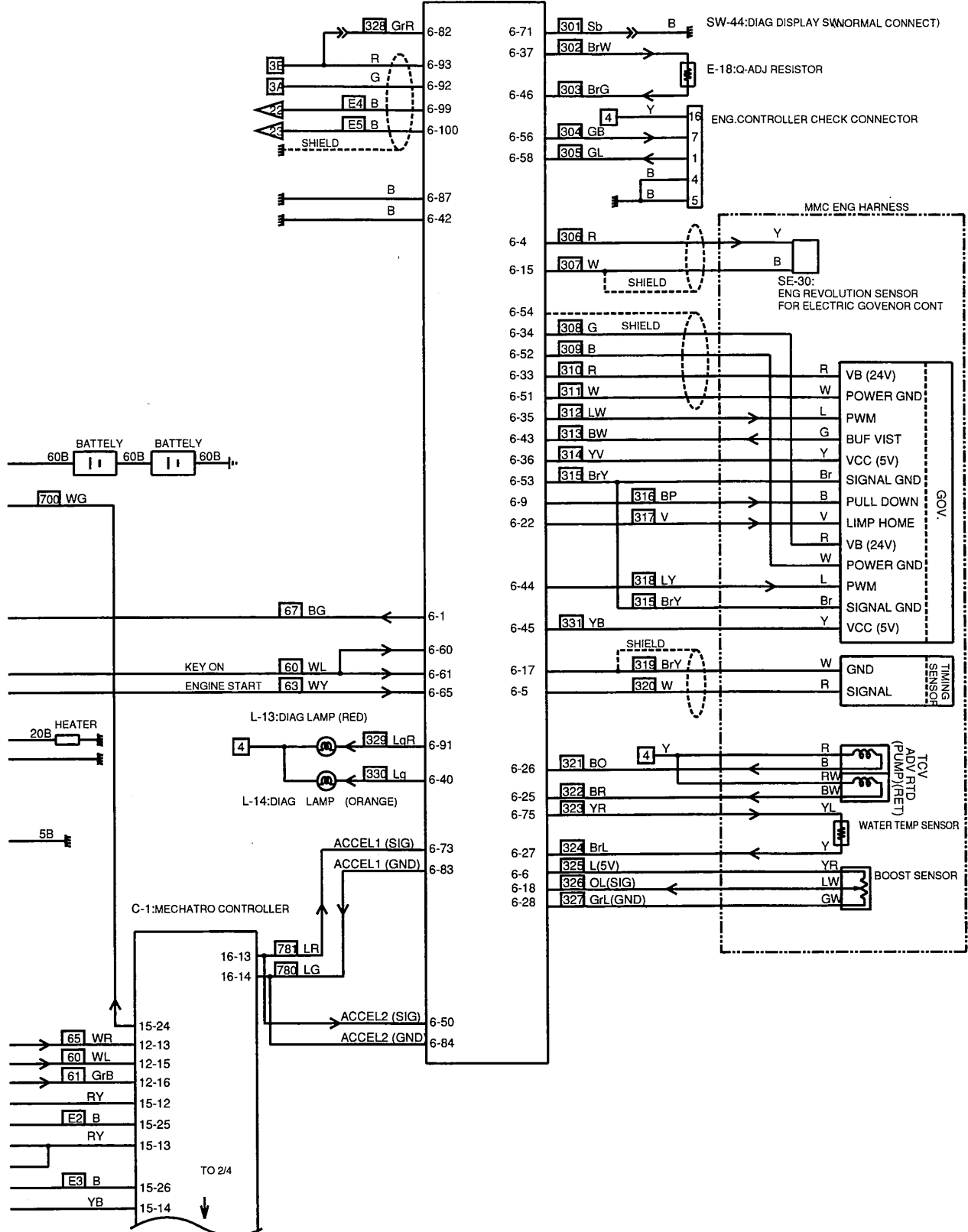


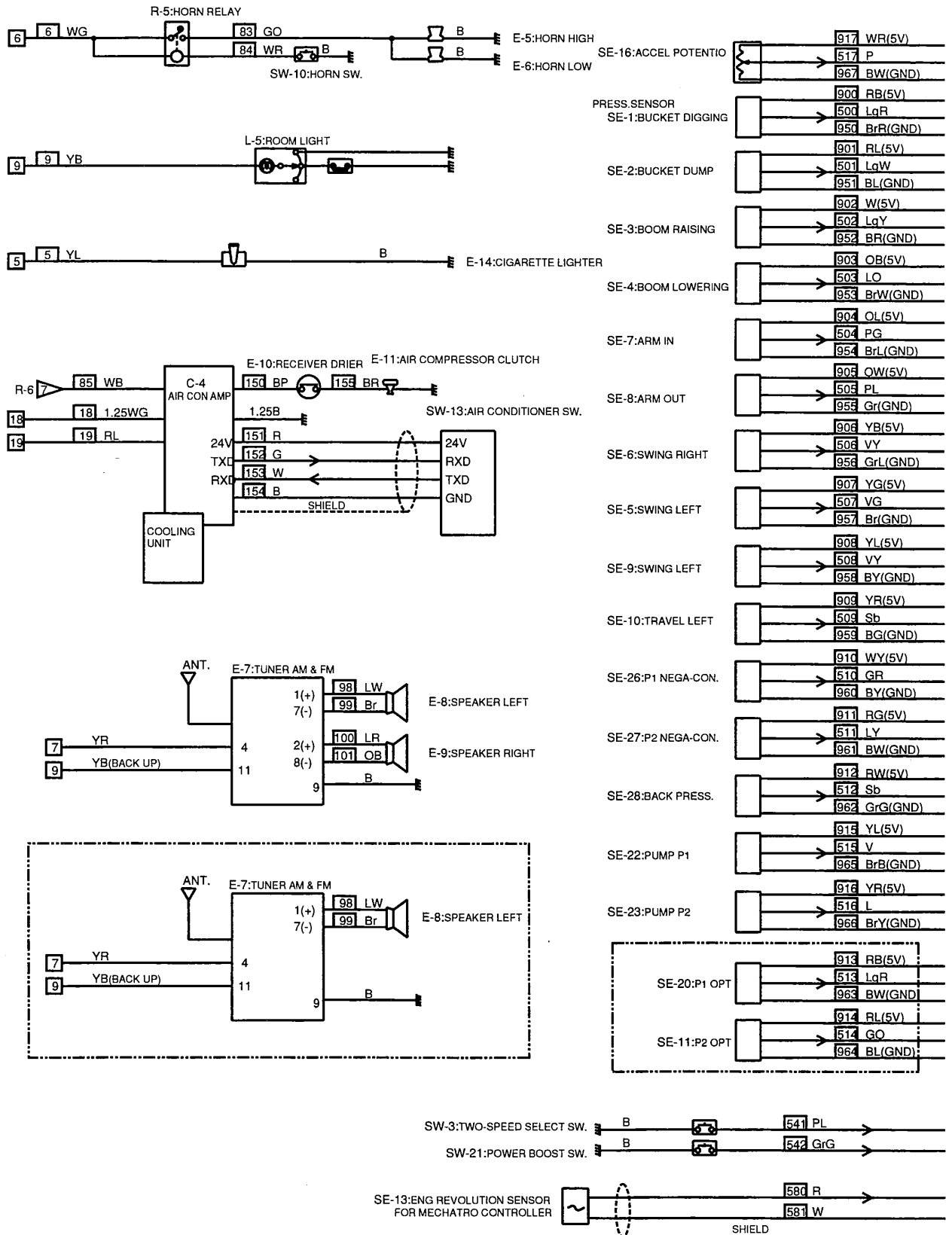
The diagram illustrates the electrical system for a vehicle, featuring a battery (B1) and a battery relay (R-1). The battery is connected to a fuse box (E-1) and a series of fuses (50, 51, 52, 53, 54, 55) that protect various circuits. These circuits include the starter motor (M-1) and starter relay (R-2), the alternator (E-2) and its relay (R-3), the heater relay (R-21), the heater relay (R-3), the safety relay (R-4), the hour meter (E-3), the cigarette lighter (5), the horn (6), the tuner (7), the power window (8), the room light (9), the back up (10), the key switch (11), the wiper washer (12), the cluster gauge (13), the work light (14), the solenoid (15), the work light (16), the opt work light (17), the air con (18), the air con (19), the reserve (20), the converter (21), the flasher (22), the work light alarm (23), the wiper washer (24), the cluster gauge (25), the work light (26), the solenoid (27), the work light (28), the opt work light (29), the air con (30), the air con (31), the reserve (32), the converter (33), the flasher (34), the work light alarm (35), the wiper washer (36), the cluster gauge (37), the work light (38), the solenoid (39), the work light (40), the opt work light (41), the air con (42), 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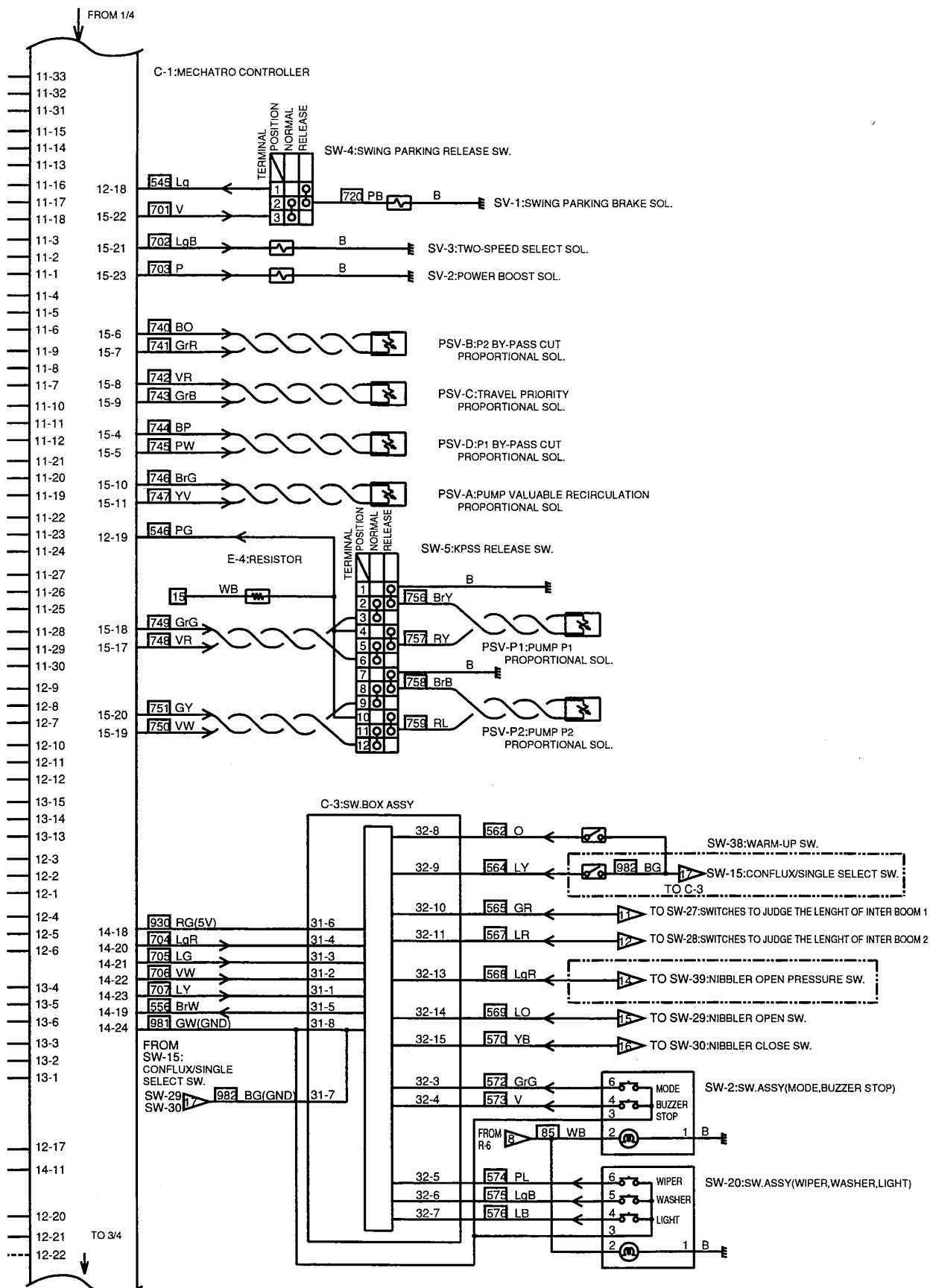
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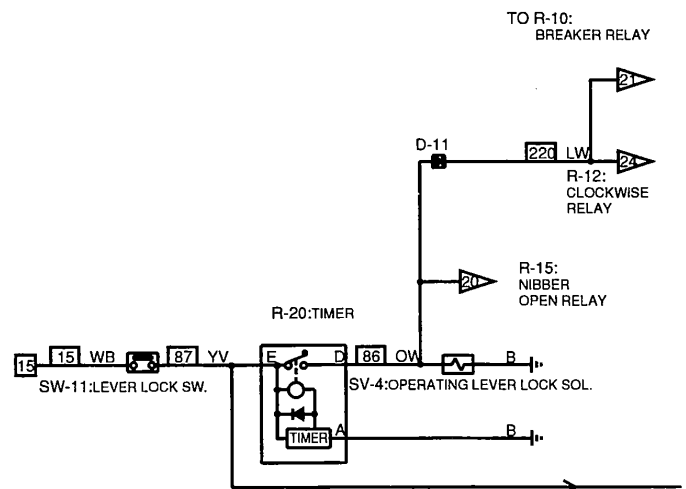
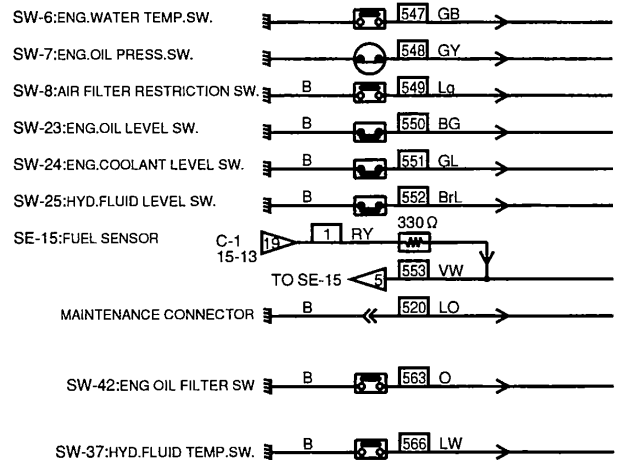
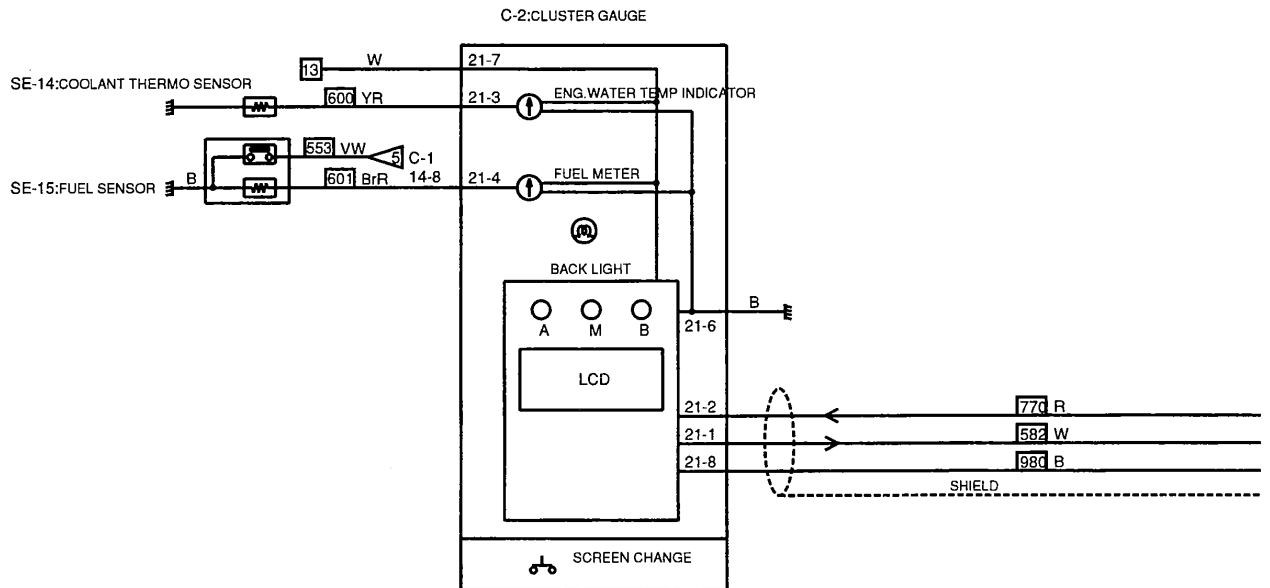
C-6:ENG CONTROLLER

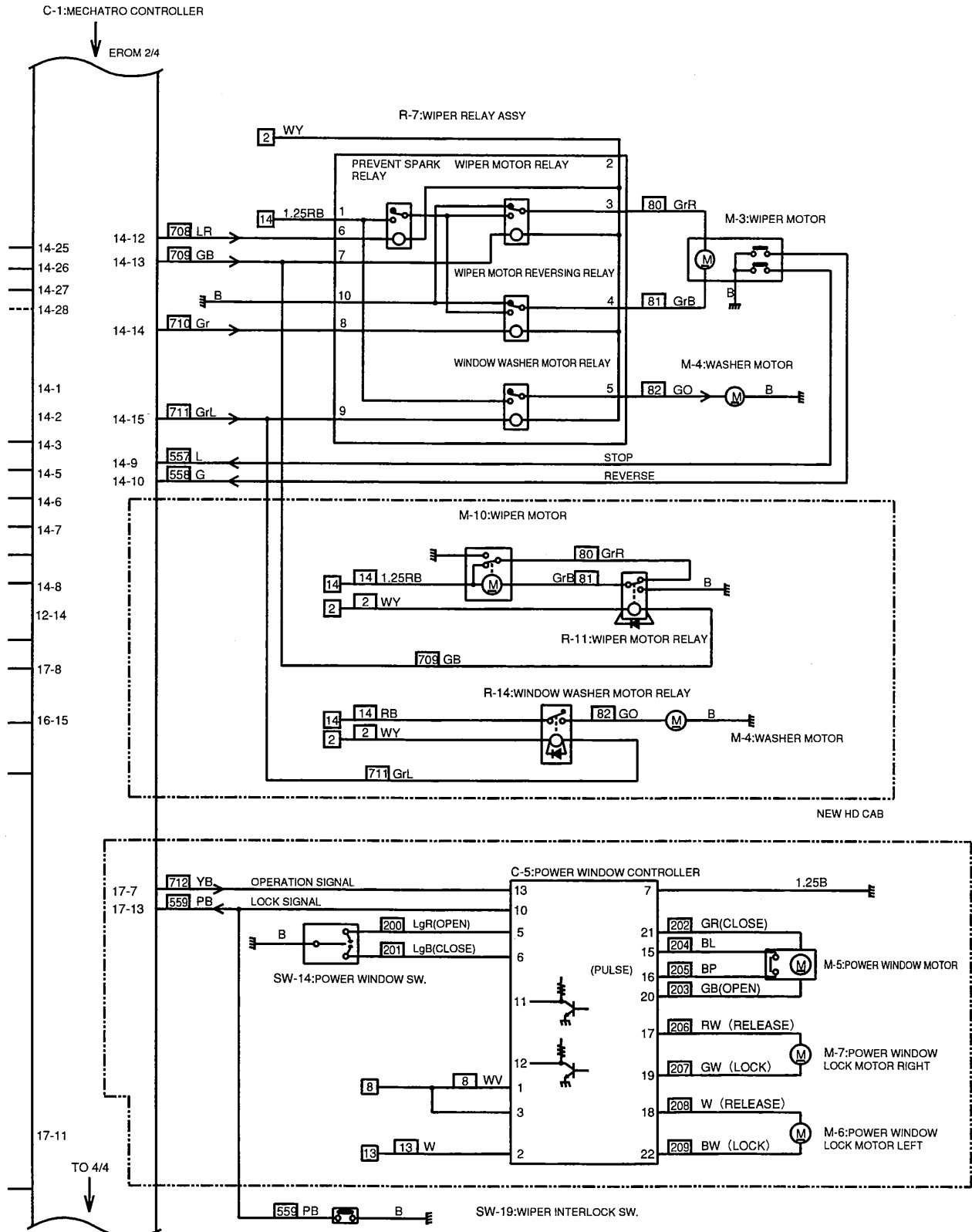
SW-45:MEMORY RESET SW. (NORMAL CONNECT)

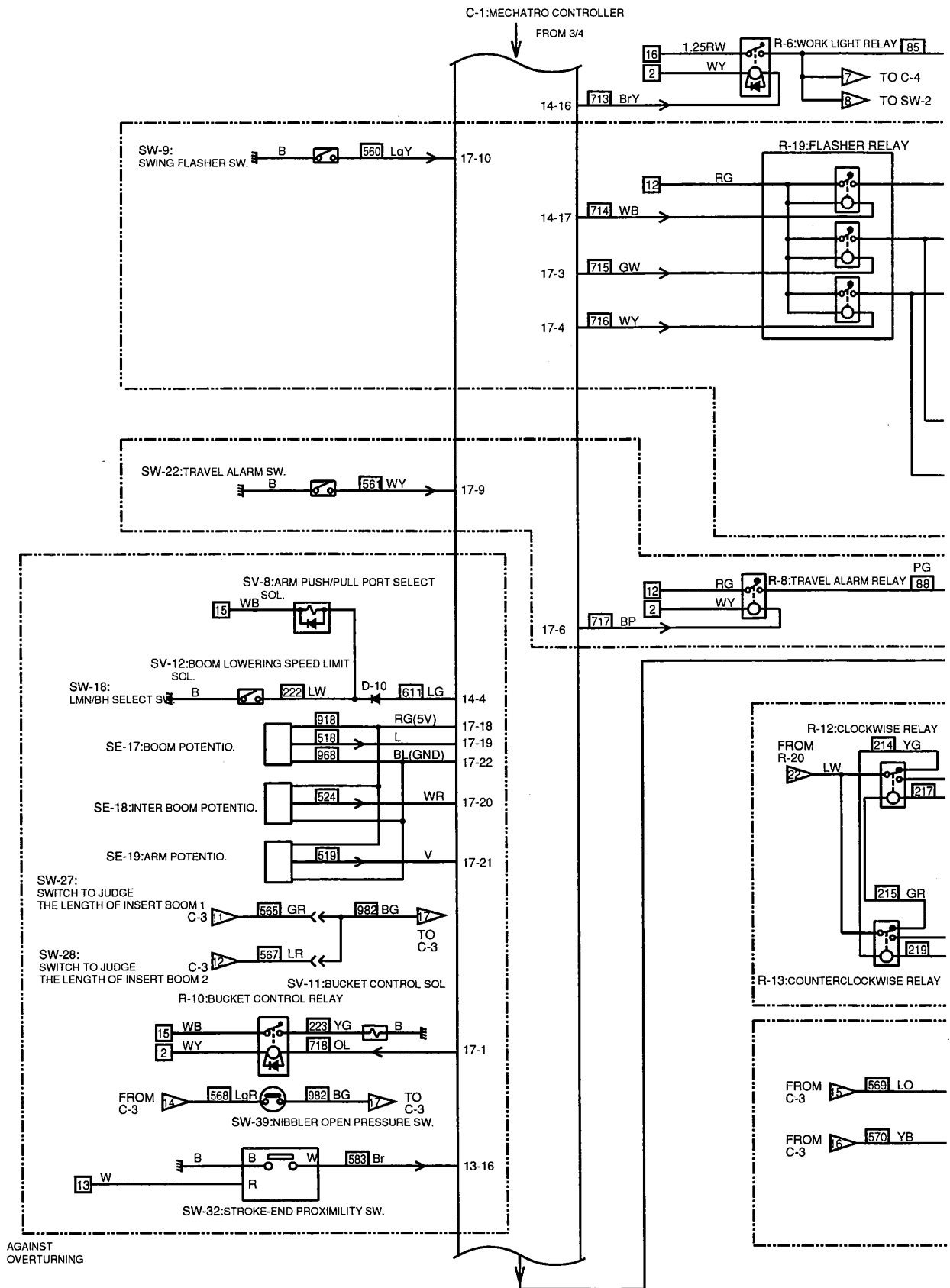


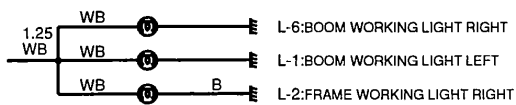




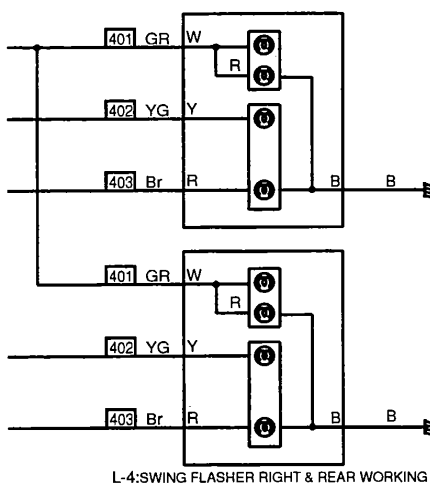






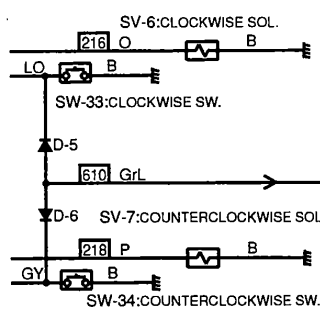
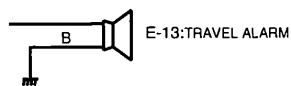


L-3: SWING FLASHER LEFT & REAR WORKING LIGHT

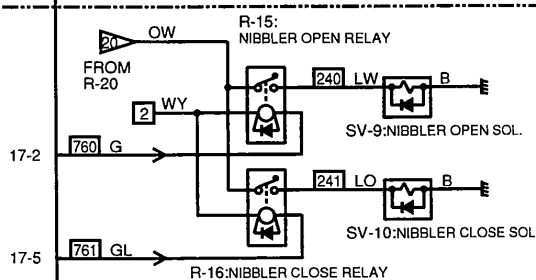
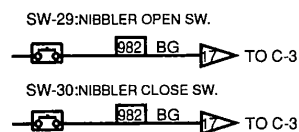


L-4: SWING FLASHER RIGHT & REAR WORKING LIGHT

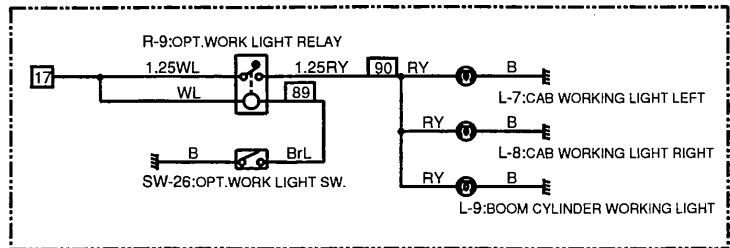
SWING FLASHER & WORKING LIGHT



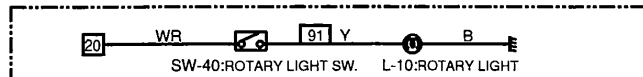
HAND CONTROL FOR ROTATION



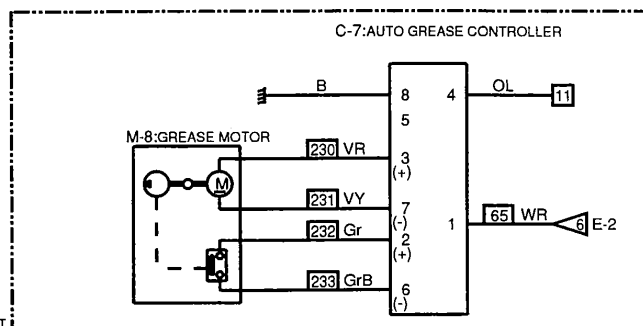
HAND CONTROL FOR NIBBLER OPEN/CLOSE



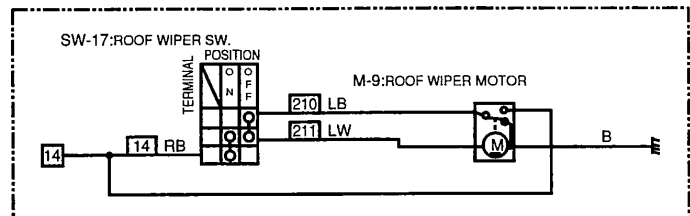
OPT WORK LIGHT



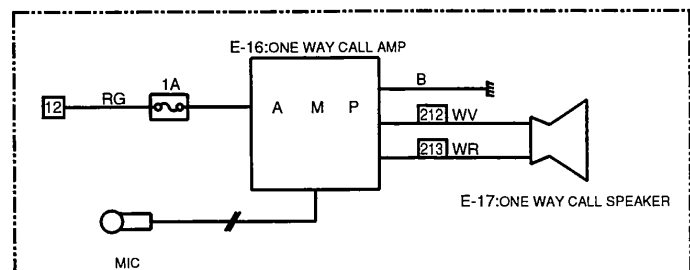
ROTARY LIGHT



AUTO GREASE

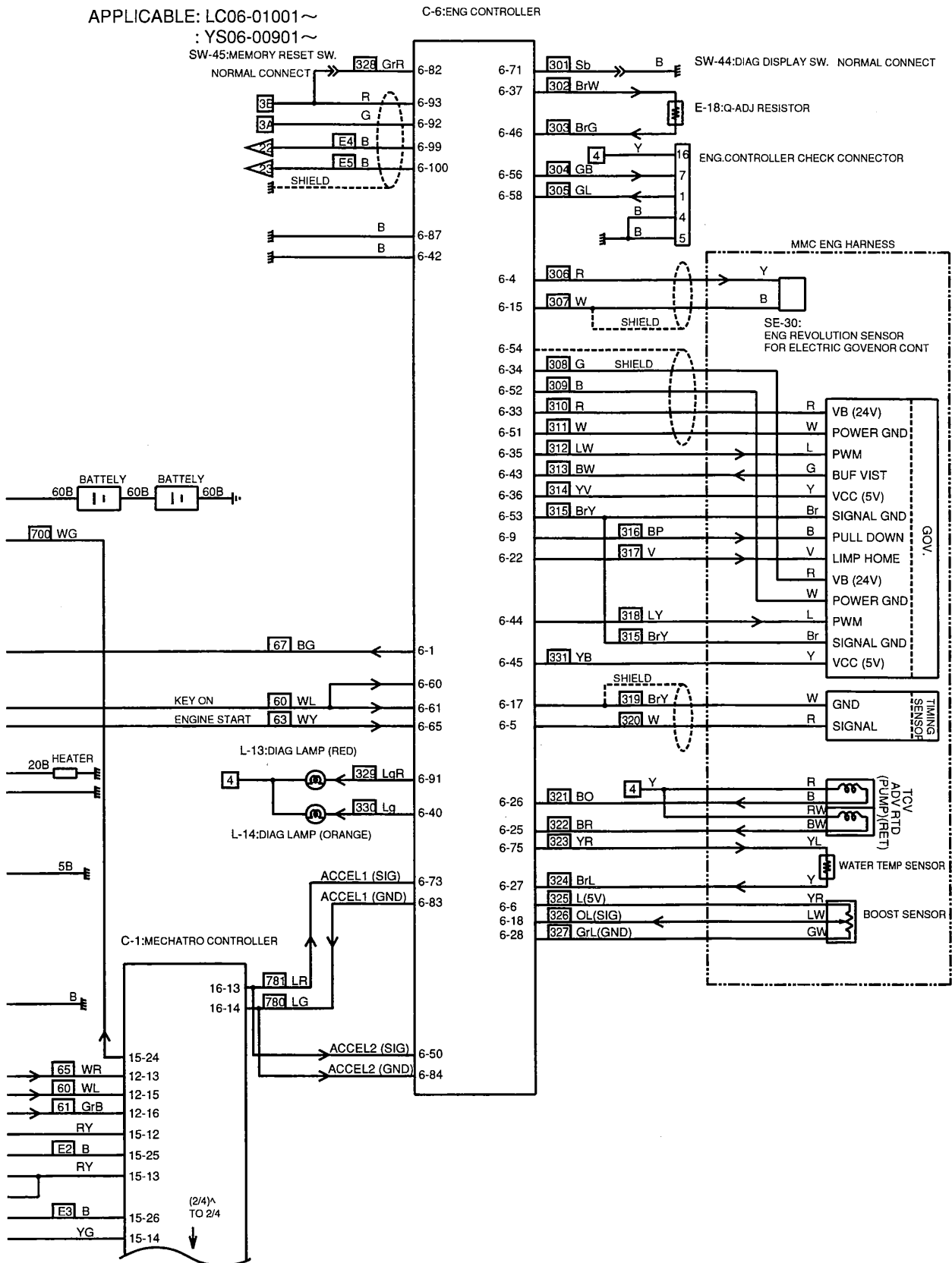


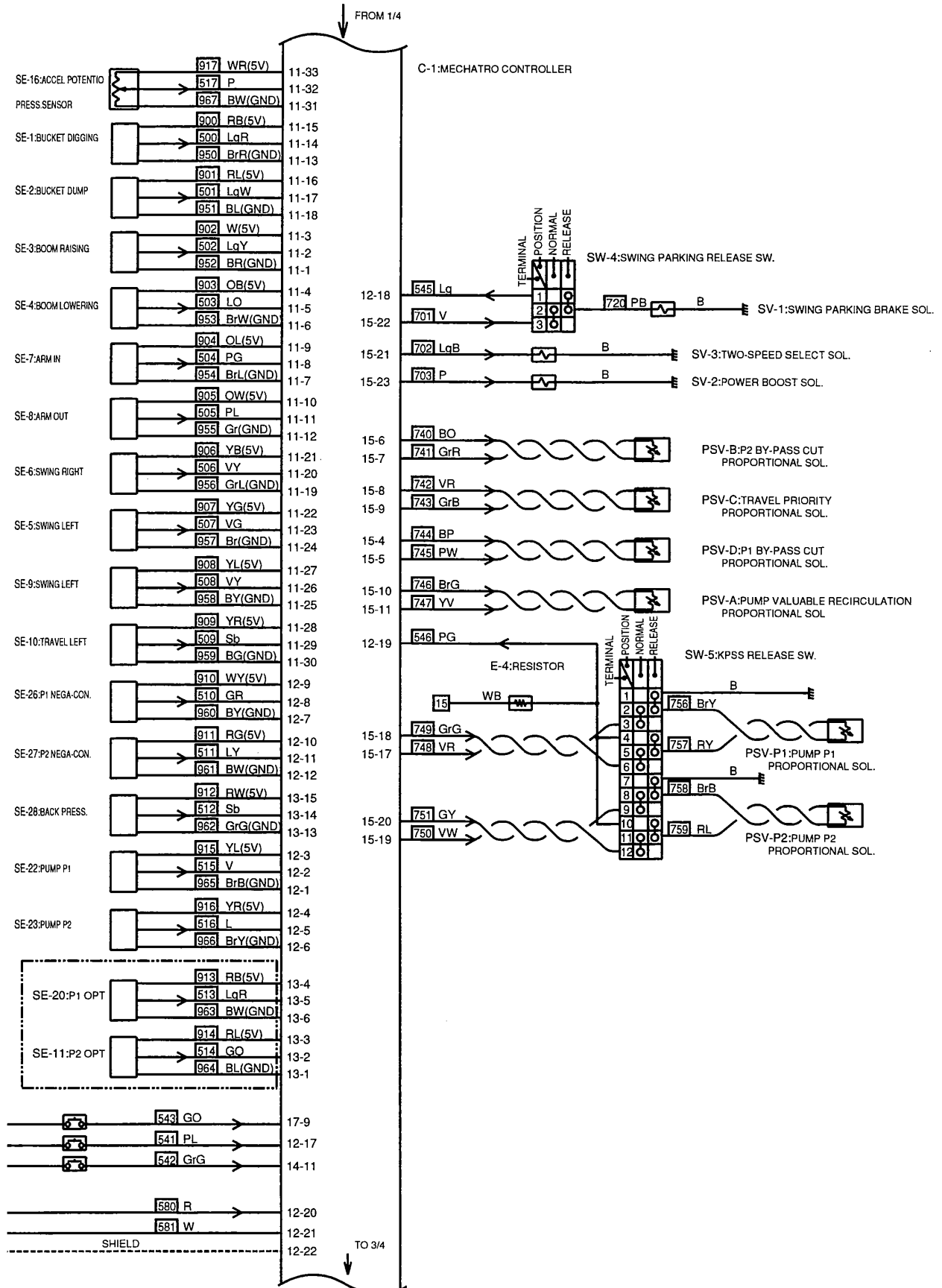
ROOF WIPER

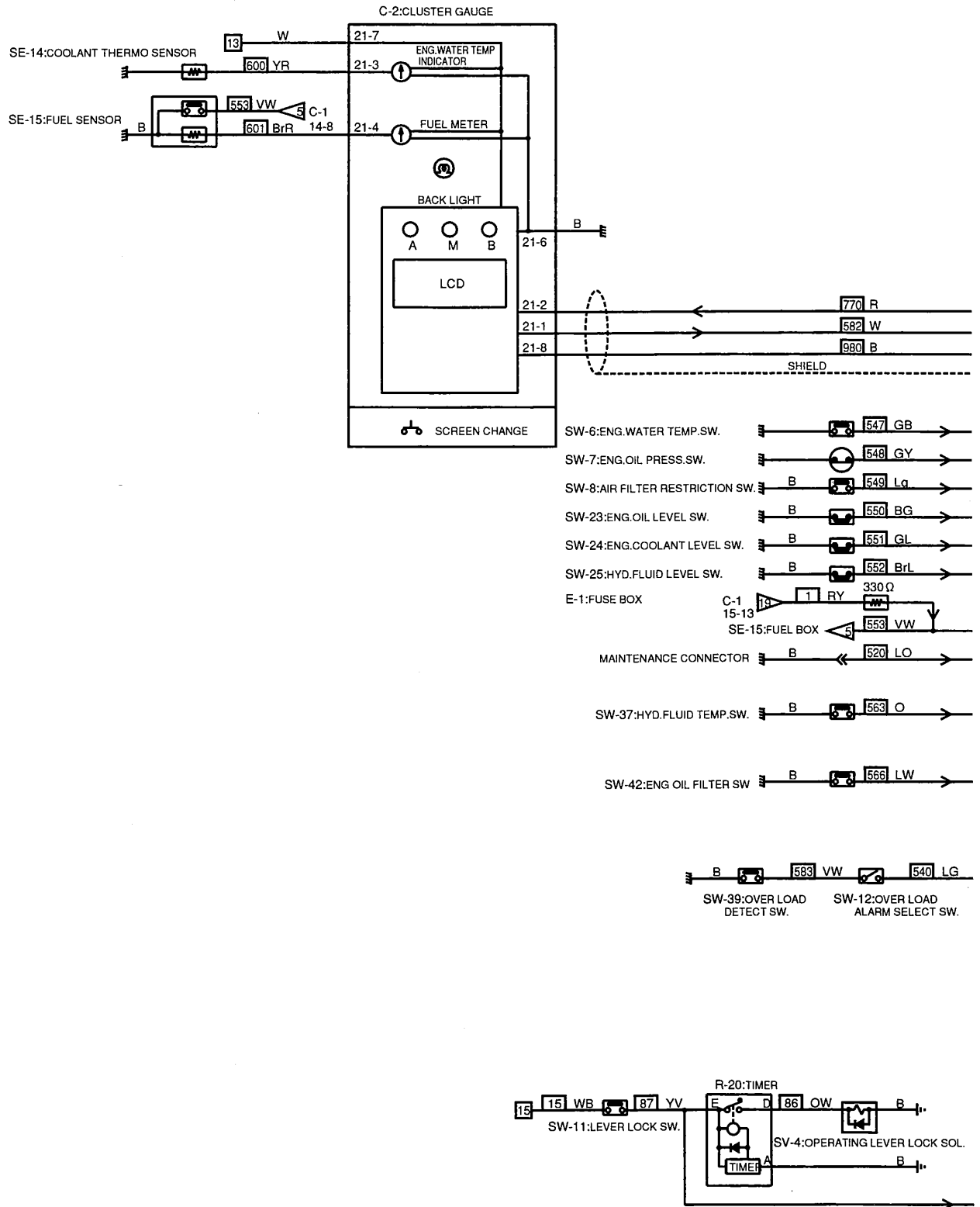


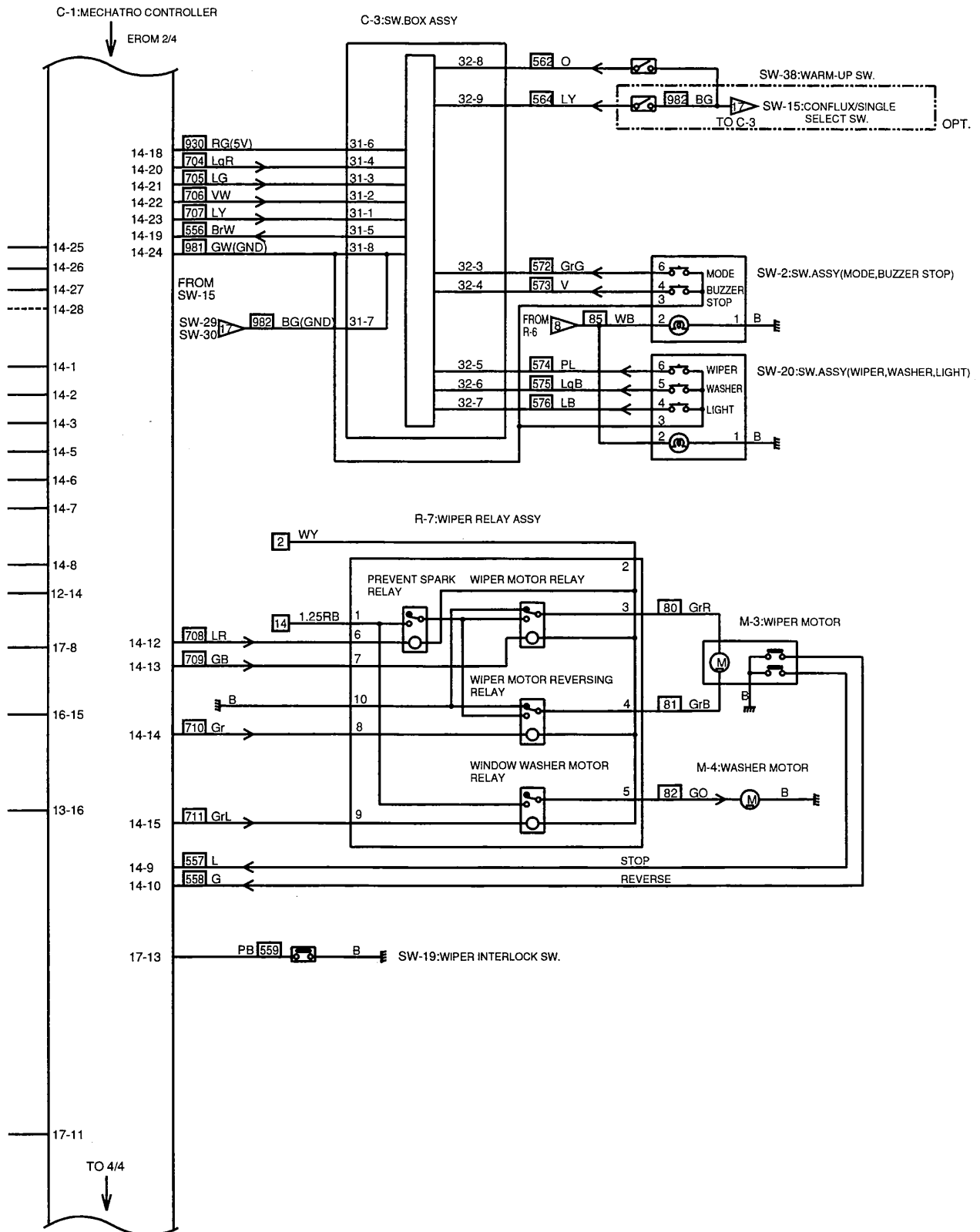
ONE WAY CALL

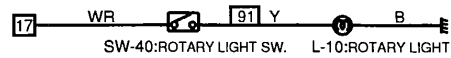
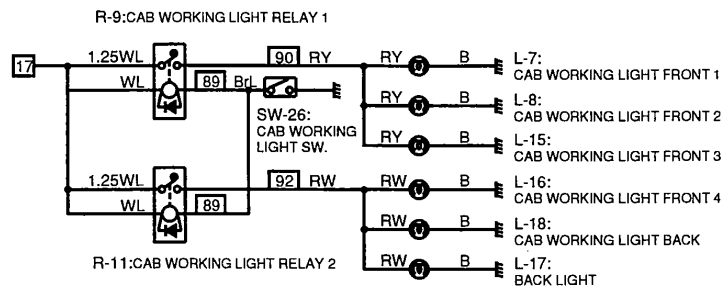
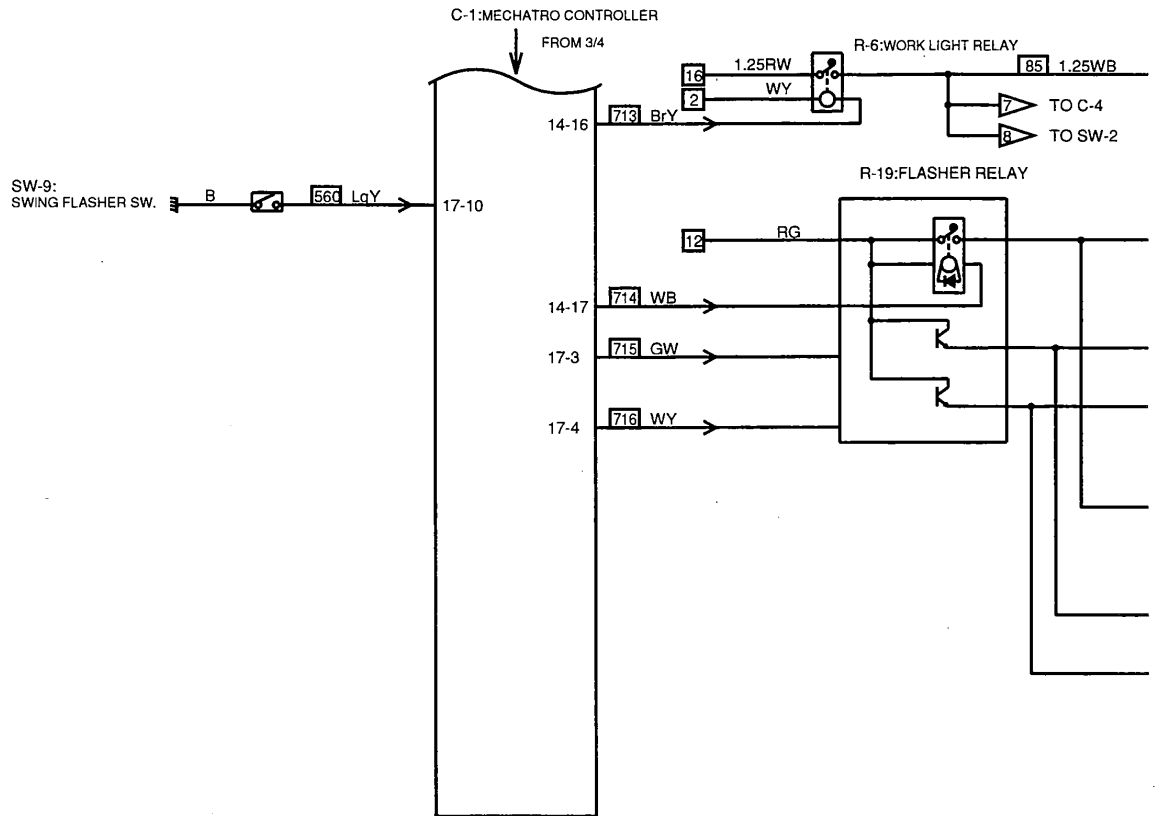


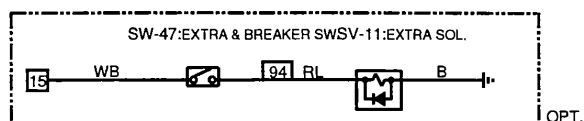
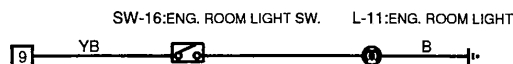
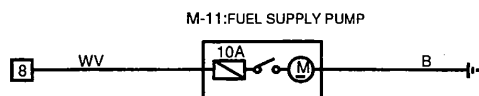
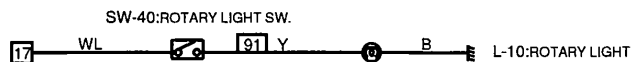
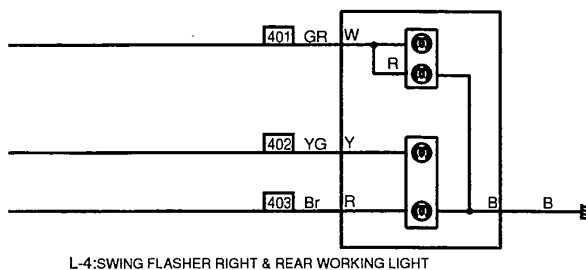
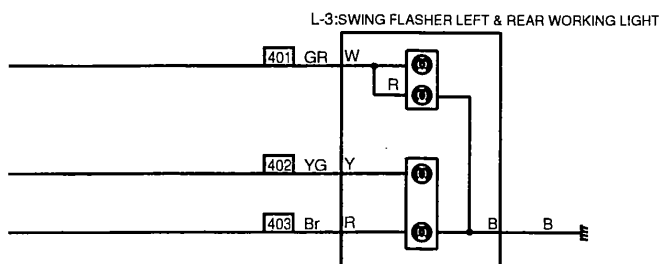
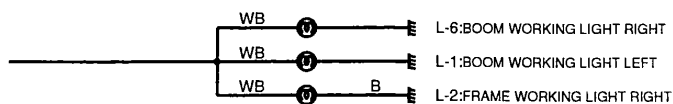












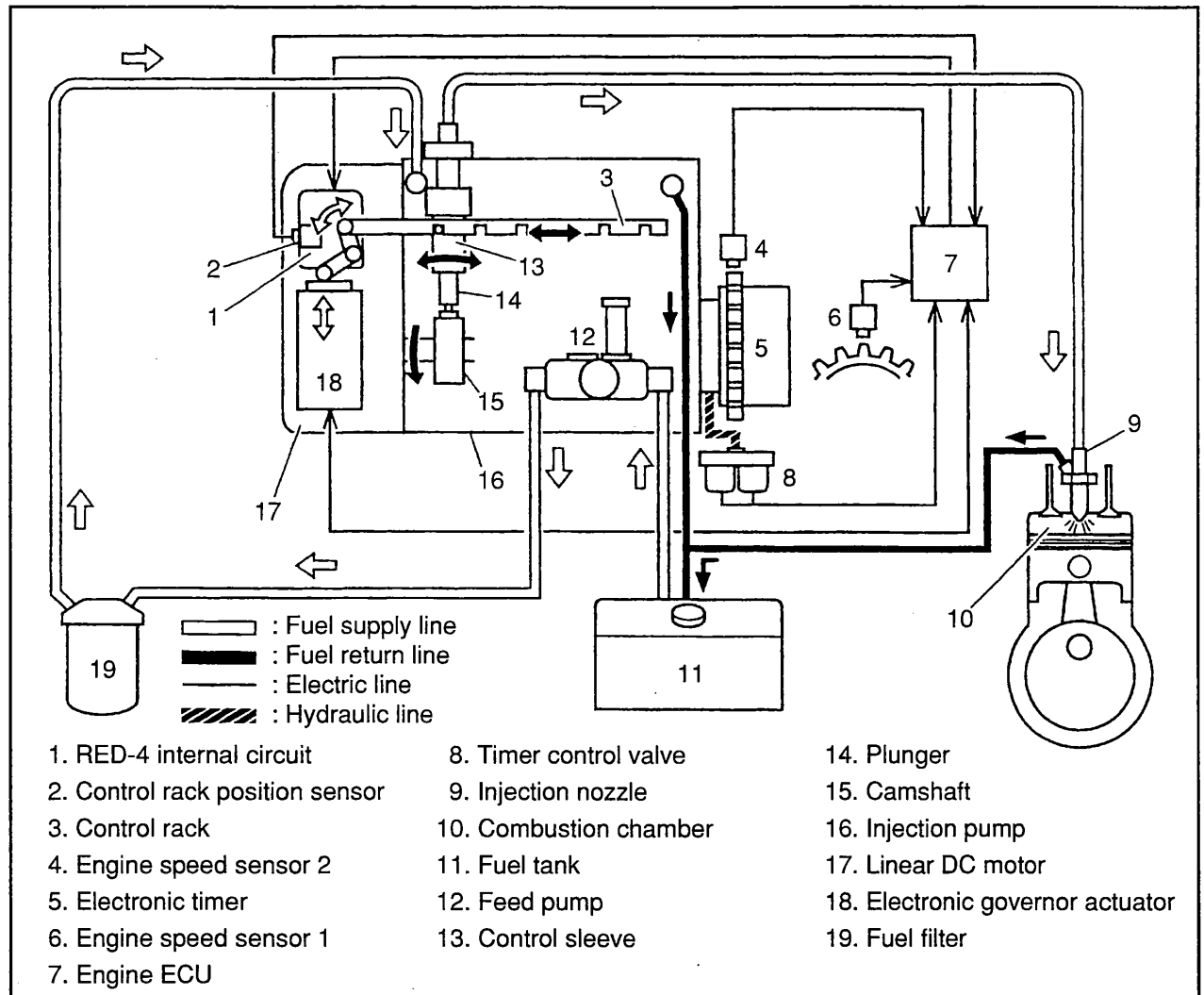
20. ELECTRONICALLY CONTROLLED FUEL SYSTEM

■ GENERAL

With the electronically controlled injection pump system, electronic control is applied to the governor and timer (the components of the injection pump assembly) to realize the optimum fuel injection timing and fuel injection rate.

The electronic governor ECU optionally controls the governor and timer in accordance with data signals from sensors mounted on the engine and other parts of the vehicle.

■ Principle of Operation



The extent of operation of the linear motor 17 and timer control valve 8 are determined by signals from the engine ECU 7.

The linear motor 17 moves the control rack 3, thereby changing the fuel injection quantity.

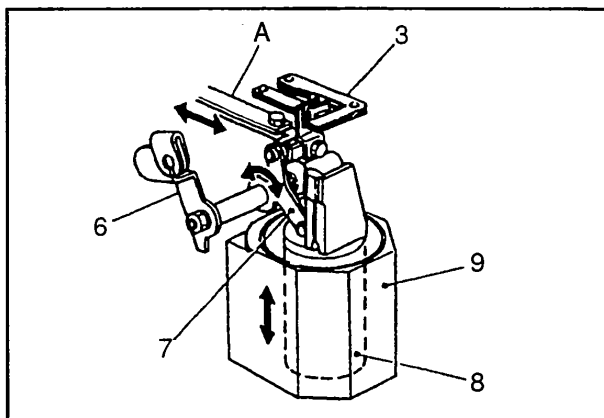
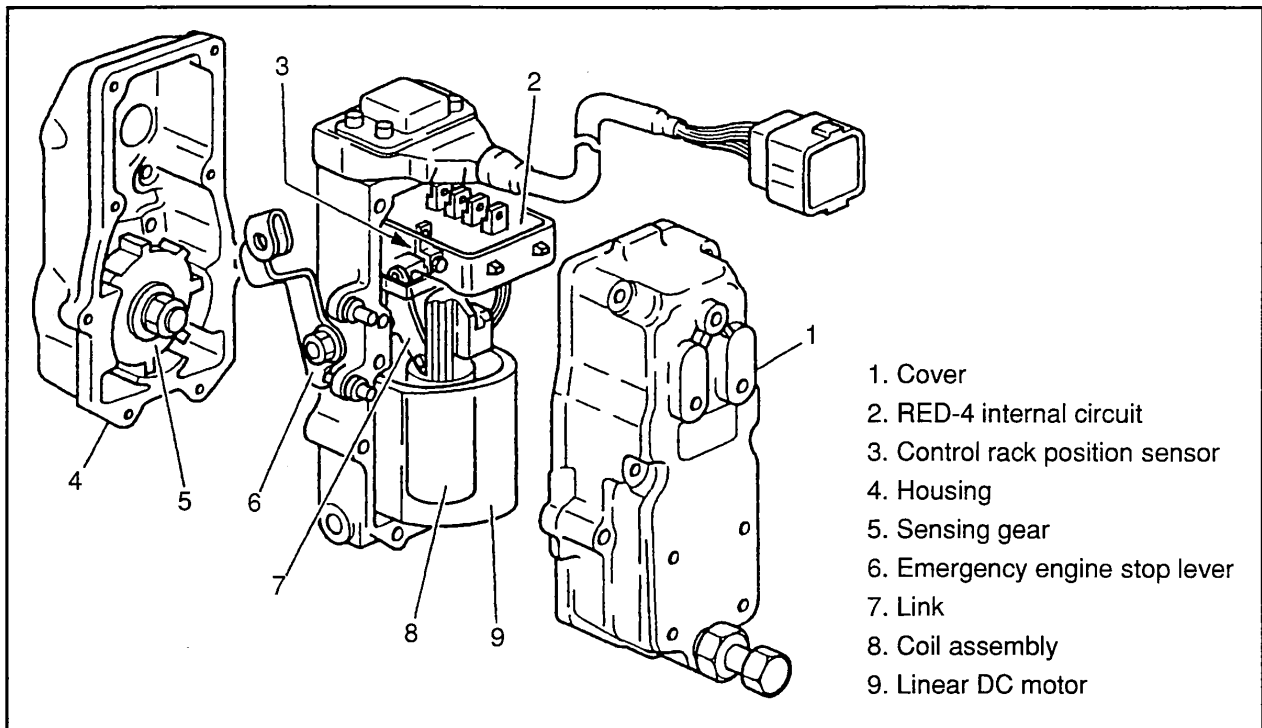
The timer control valve 8 controls the hydraulic pressure applied to the electronic timer 5, thus adjusting the fuel injection timing.

The RED-4 internal circuit 1 is incorporated into the electronic governor actuator 18. It contains a control

rack position sensor processing circuit and a linear DC motor drive circuit, which are conventionally incorporated into the engine ECU. This arrangement eliminates noise in the harness and thus prevents erroneous ECU operation. More accurate electronic control is possible as a result.

The engine speed is sensed by engine speed sensor 1 6 and engine speed sensor 2 4. Each of these sensors acts as a backup if the other fails.

Electronic Governor



(1) Linear DC motor

The linear DC motor 9 moves the coil assembly 8 vertically in accordance with signals from the engine ECU and RED-4 internal circuit. Via the link 7, this movement is transmitted to the control rack A, which moves longitudinally to increase and decrease the fuel quantity.

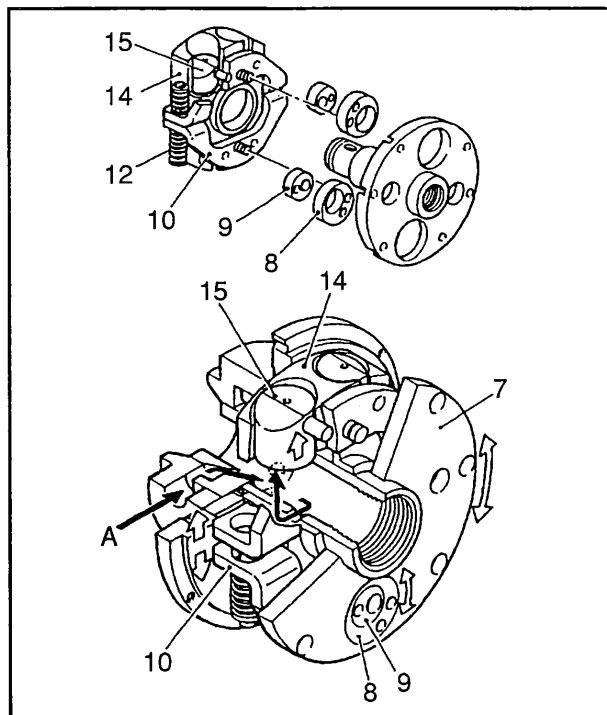
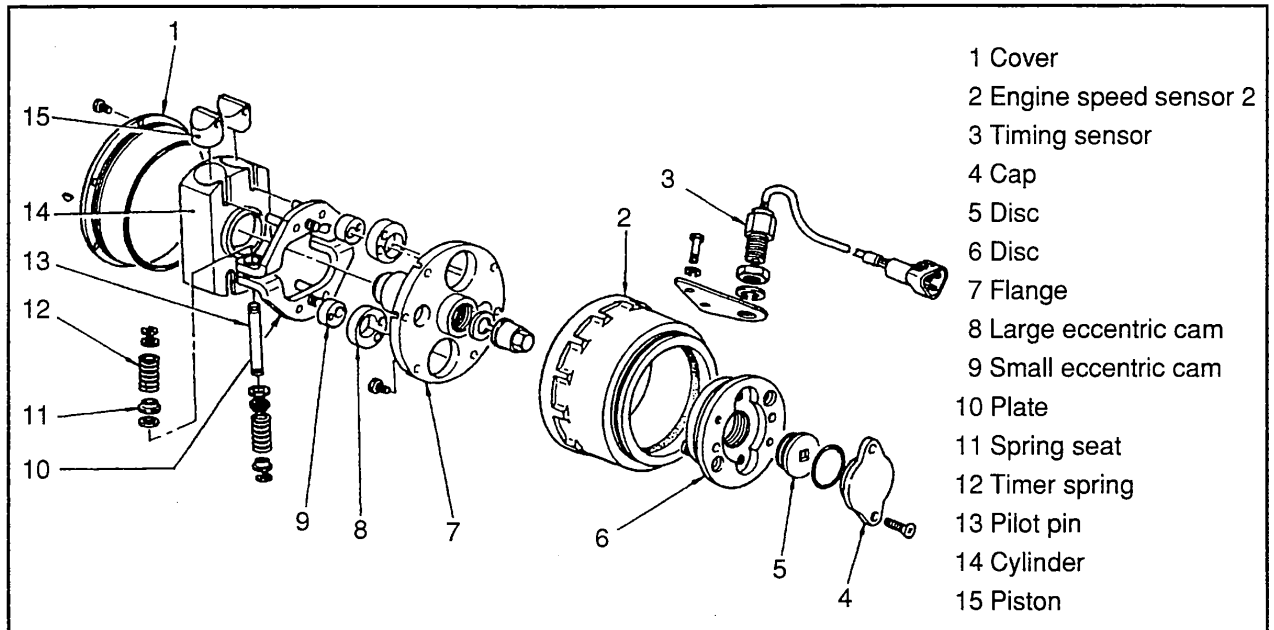
(2) Control rack position sensor

The control rack position sensor 3 senses whether the control rack A is moved to the correct position by the linear DC motor 9. In the event of a discrepancy between the actual control rack position and the target control rack position (this is determined by the engine ECU and RED-4 internal circuit 2), the engine ECU causes the linear DC motor 9 to perform a corrective movement.

(3) Emergency engine stop lever

The emergency engine stop lever 6 is connected to the link 7. Via a wire, it enables the link to be moved from the driver's seat. In the event of a system fault that prevents the engine from being stopped normally, operation of the emergency engine stop lever forces the control rack A to move to the position at which fuel injection is terminated. This operation takes place irrespective of the position of the linear DC motor 9.

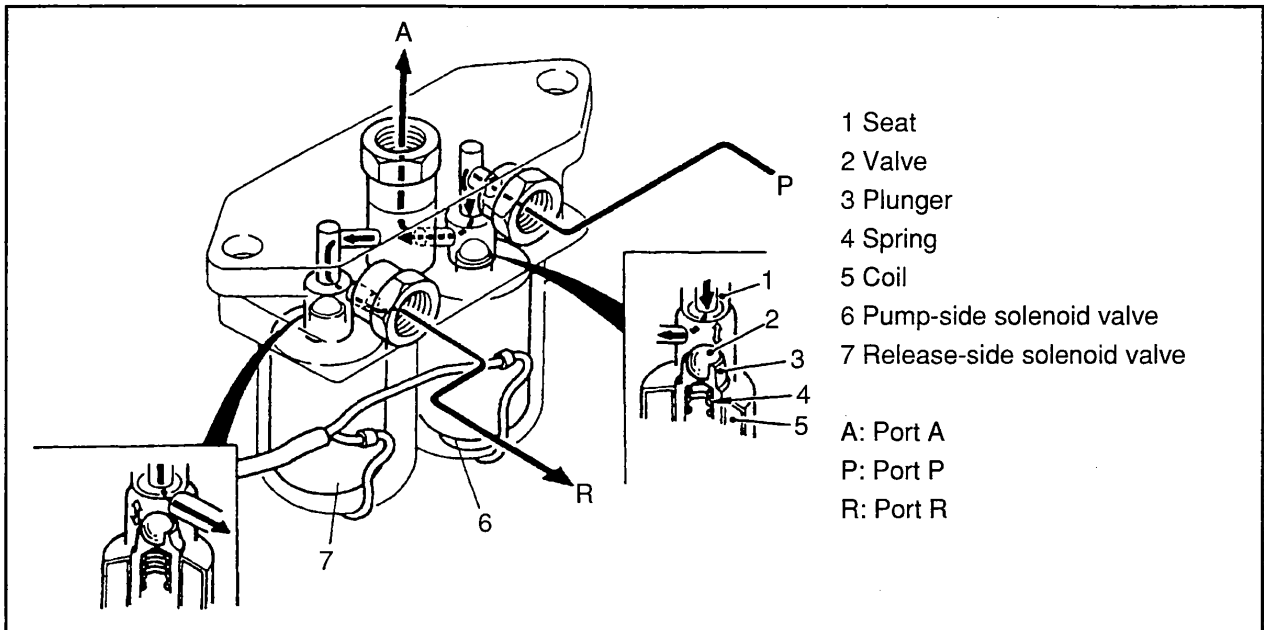
■ Electronic Timer



The electronic timer uses an eccentric cam arrangement to adjust the injection timing. The eccentric cams 8,9 in the electronic timer are moved by hydraulic pressure supplied from the timer control valve assembly.

- (1) The timer incorporates four pistons 15, which are activated by hydraulic pressure A. The pistons are arranged as two pairs, and each piston slides vertically in a cylinder 14.
- (2) Each pair of pistons 15 is linked to a plate 10. The two plates are pressed against each other by timer springs 12.
- (3) When hydraulic pressure A acts upon the pistons 15, the pistons move toward the outside of the timer flange 7.
- (4) As the pistons 15 move outward, the plates 10 (thus far pressed together by the timer springs 12) also move outward.
- (5) The eccentric cams 8,9 move in conjunction with the plates 10, thereby altering the fuel injection timing.

■ Timer Control Valve

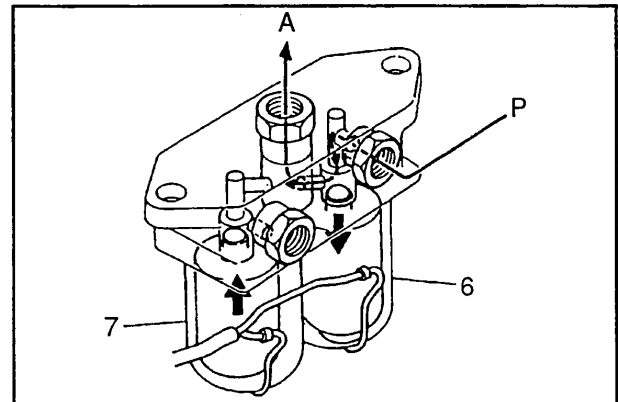


The timer control valve controls the hydraulic pressure (engine oil) that activates the electronic timer assembly.

Internal oil passages emerge at port P (where engine oil enters the assembly), port A (which supplies engine oil to the timer), and port R (which returns engine oil to the oil pan).

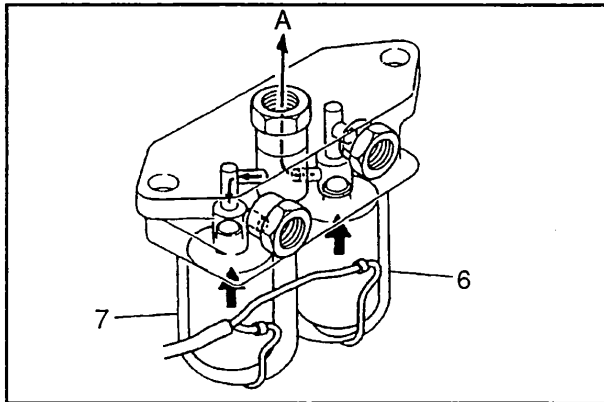
The oil passages are interrupted by two solenoid valves 6,7, one on the pump side and the other on the release side. The solenoid valves control the hydraulic pressure reaching the timer. Each solenoid valve incorporates a plunger 3 and coil 5. When the solenoid valve is activated, the coil 5 attracts the plunger 3, which moves the valve 2 away from the seat 1, thereby opening the oil passage. Opening and closing timing of the solenoid valves is controlled by the electronic timer control unit.

(1) Advancement of fuel injection timing



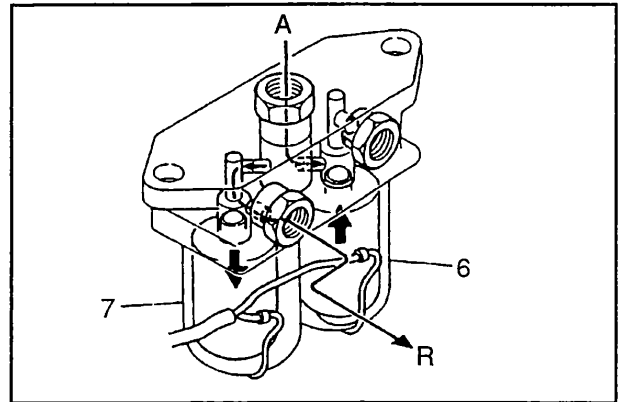
The pump-side solenoid valve 6 is activated. The release-side solenoid valve 7 is not activated. With the solenoid valves in these conditions, ports P and A are connected, allowing the supply of hydraulic pressure to the timer. Thus, the fuel injection timing is advanced.

(2) Maintenance of advanced (or retarded) fuel injection timing



The pump-side solenoid valve 6 is not activated. The release-side solenoid valve 7 is not activated. With the solenoid valves in these conditions, the ports are isolated from each other. Thus, the hydraulic pressure in the timer stays constant and the timer remains in its current condition.

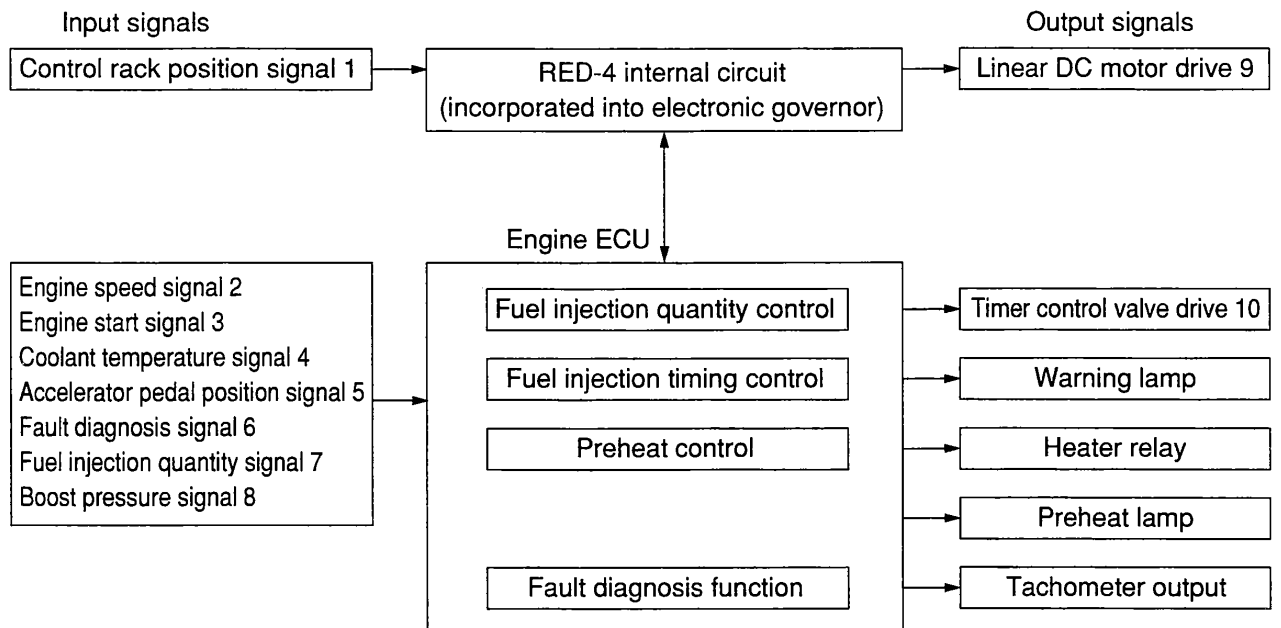
(3) Retardation of fuel injection timing



The pump-side solenoid valve 6 is not activated. The release-side solenoid valve 7 is activated. With the solenoid valves in these conditions, ports A and R are connected, allowing oil in the timer to return to the oil pan. Thus, the fuel injection timing is retarded.

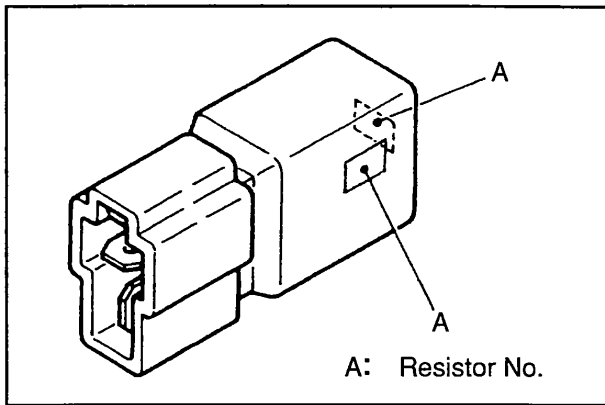
■ Electronic Control System

(1) System block diagram



	Signal	Part	Main function/operation
1	Control rack position signal	Control rack position sensor	Sensing of control rack position
2	Engine speed signal	Engine speed sensors 1,2	Sensing of engine speed Use of two sensors allows for backup if one sensor fails.
3	Engine start signal	Starter switch	Recognition of engine startup with starter switch in START position
4	Coolant temperature signal	Coolant temperature sensor	Sensing of coolant temperature
5	Accelerator pedal position signal	Accelerator pedal position sensor	Sensing of extent of depression of accelerator pedal
		Accelerator pedal switch (ON with pedal released)	Detection of pedal depressed/released condition
6	Fault diagnosis signal	Diagnosis switch	Call-up of diagnosis codes
		Memory clear switch	Deletion of diagnosis codes; call-up of past diagnosis codes
7	Fuel injection quantity signal	Fuel injection quantity adjusting resistor	Correction of fuel injection quantity
8	Boost pressure signal	Boost pressure sensor	Detection of boost pressure
9	—	Linear DC motor	Moving of control rack
10	—	Timer control valve	Control of hydraulic pressure applied to electronic timer

Injection quantity adjusting resistor

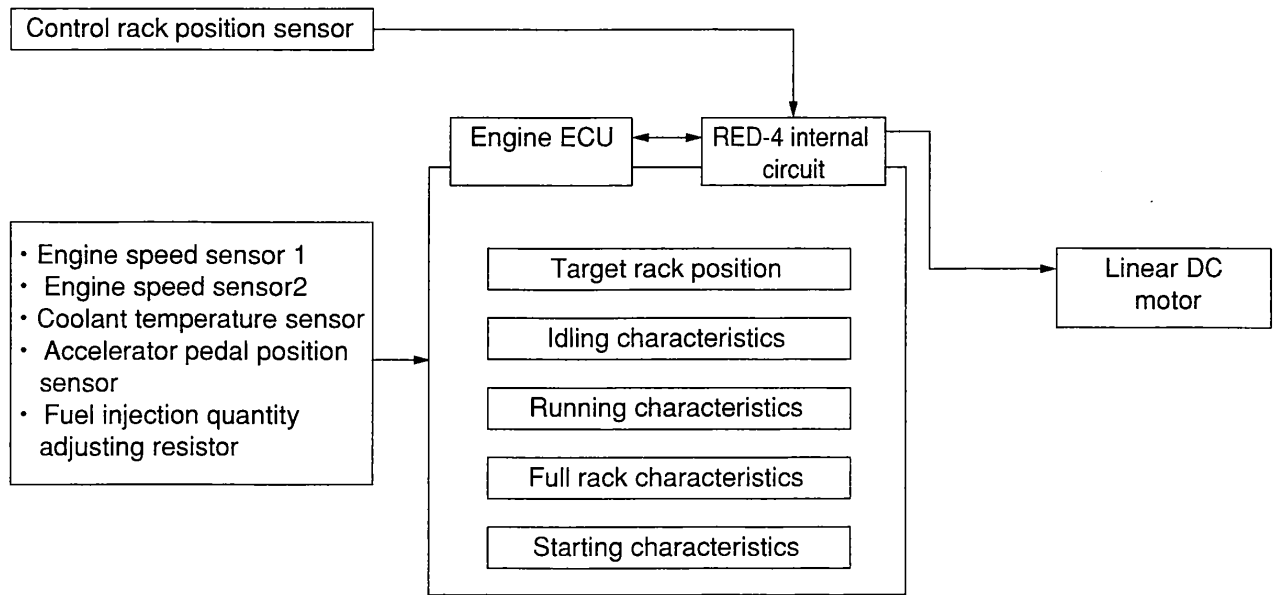


The injection quantity adjusting resistor makes fine adjustments to achieve optimal commensuration of injected fuel quantity with fuel feed from the common rail.

NOTE

This resistor, selected as the best from among several types, determines the final injection quantity. DO NOT change it for any other type.

(2) Control of fuel injection quantity



(a) Control effected by engine ECU and RED-4 internal circuit

The RED-4 internal circuit processes control rack position signals and transmits the results to the engine ECU.

The engine ECU effects control during engine operation using the stored idling characteristics or running characteristics, and it determines the target control rack position in accordance with signals issued by the RED-4 internal circuit.

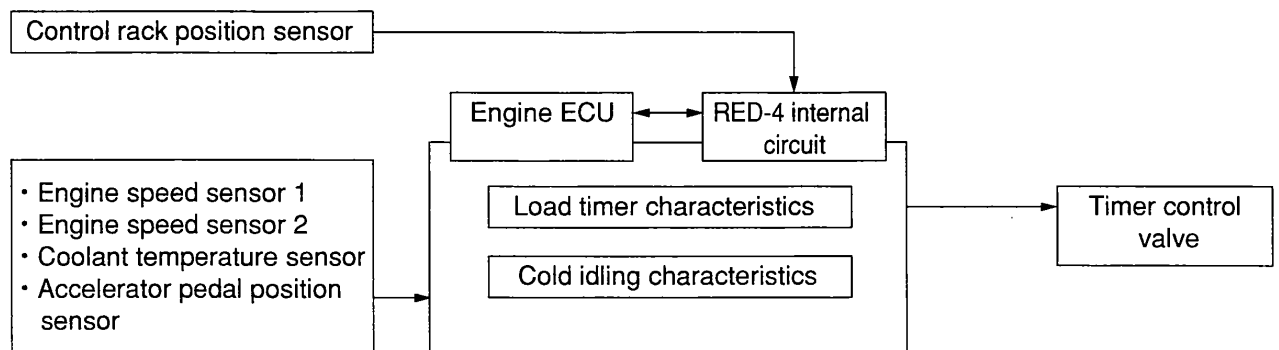
The control rack position signal issued by the engine ECU is returned to the RED-4 internal circuit. Via the servo circuit and drive circuit, it causes activation of the linear DC motor such that the control rack is moved.

(b) Feedback control effected using control rack position sensor

The control rack position sensor enables the RED-4 internal circuit to calculate whether the linear DC motor has moved the control rack to the target position. This arrangement enables the RED-4 to ensure that the control rack position always corresponds to the target value.

The engine ECU receives signals indicating the control rack's actual position from the RED-4 internal circuit and uses them to evaluate control rack position errors.

(3) Control of fuel injection timing



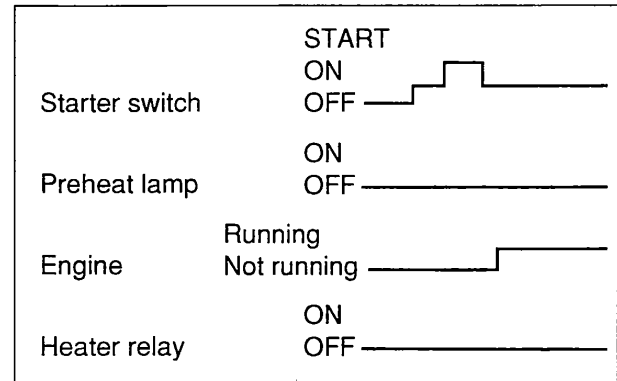
- (a) The engine ECU controls the fuel injection timing by controlling the activation of the timer control valve, which applies hydraulic pressure to the electronic timer.
- (b) The engine ECU controls the timer control valve by determining the target and actual advance angles, comparing them with each other and with characteristics stored in its memory, and issuing drive signals to the timer control valve in accordance with the results.
- 1) Target advance angle: calculated by comparison of data signals from sensors with characteristics stored in engine ECU's memory.
- 2) Actual advance angle: determined in accordance with signals from engine speed sensor 1 and engine speed sensor 2.
- (c) When the engine is cold, startability and post-start warm-up are optionized by the use of cold idling characteristics in determination of the fuel injection timing.

(4) Preheat control

Preheat control improves startability when the engine's coolant temperature is low.

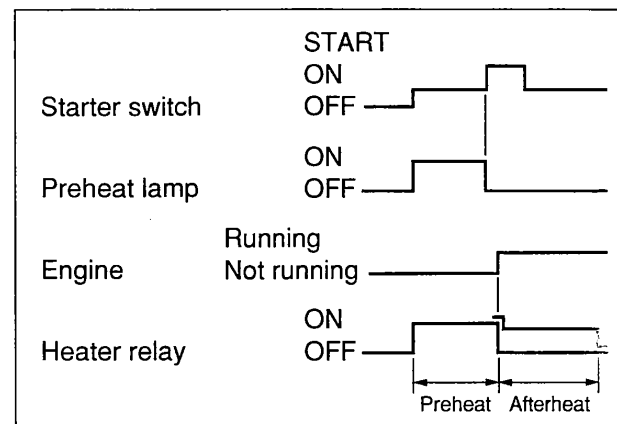
(a) Operating modes

- 1) Engine coolant temperature higher than 0 °C



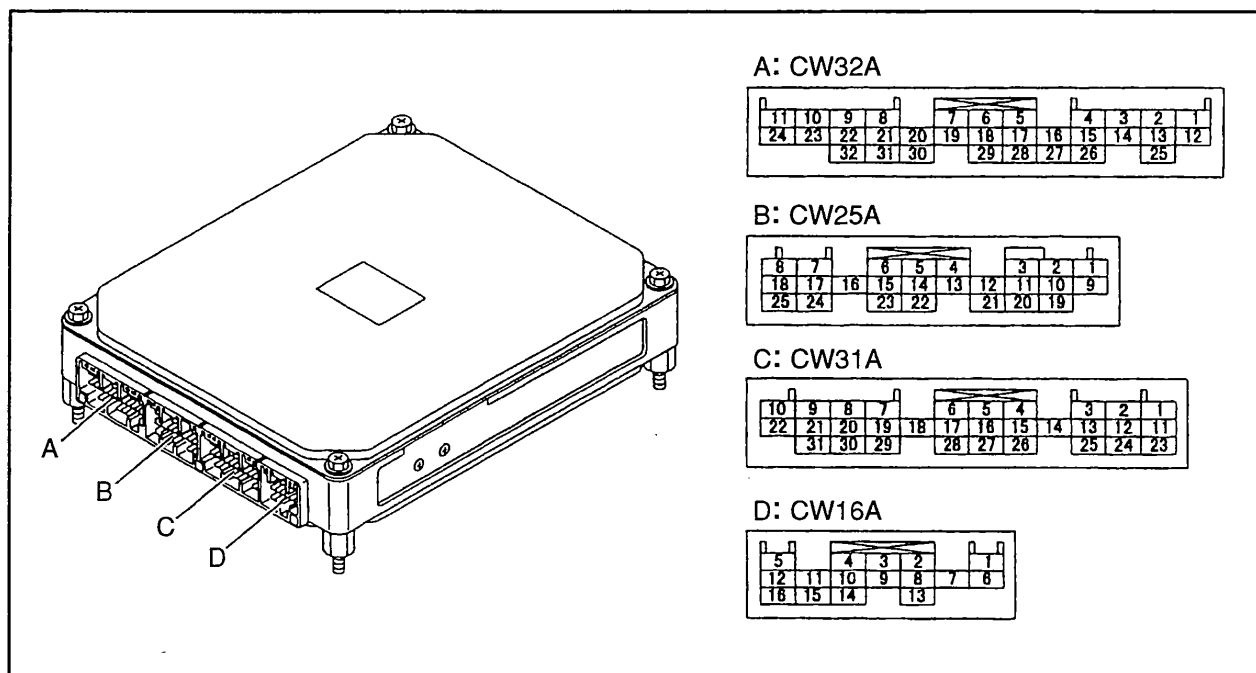
No preheating is necessary at the time of engine startup, so the heater relay is kept OFF.

- 2) Engine coolant temperature 0 °C or lower



"ts" seconds after the starter switch is turned ON, the heater relay is turned ON, causing preheating to begin. The preheat lamp illuminates simultaneously. When preheating finishes, the preheat lamp goes off to indicate that the engine can be started. The heater relay remains ON until the engine is started. When the engine is started, the engine ECU determines whether after-heating is necessary in accordance with the engine coolant temperature. If the engine ECU determines that after-heating is not necessary, pre-heat control is terminated. If it deems that after-heating is necessary, the heater relay remains ON for a certain period after engine startup to cause after-heating.

■ ECU Terminal Configuration



A: CW32A			
Terminal No.	Item(s) to which terminal is connected	Terminal No.	Item(s) to which terminal is connected
1	—	17	—
2	—	18	Boost pressure sensor (SIG)
3	RED-4 ECU (PULL DOWN)	19	Engine speed sensor 2 (GND), RED-4 ECU (SIGNAL GND-2)
4	—	20	—
5	—	21	Engine speed sensor 1 (GND)
6	Boost pressure sensor (+5V)	22	—
7	Engine speed sensor 2 (SIG)	23	—
8	Engine speed sensor1 (SIG)	24	—
9	—	25	—
10	—	26	—
11	Heater relay	27	—
12	—	28	—
13	—	29	Boost pressure sensor (GND)
14	RED-4 ECU (LIMP HOME)	30	Coolant temperature sensor (GND)
15	—	31	Timer control valve (ADV)
16	—	32	Timer control valve (RTD)

B:CW25A

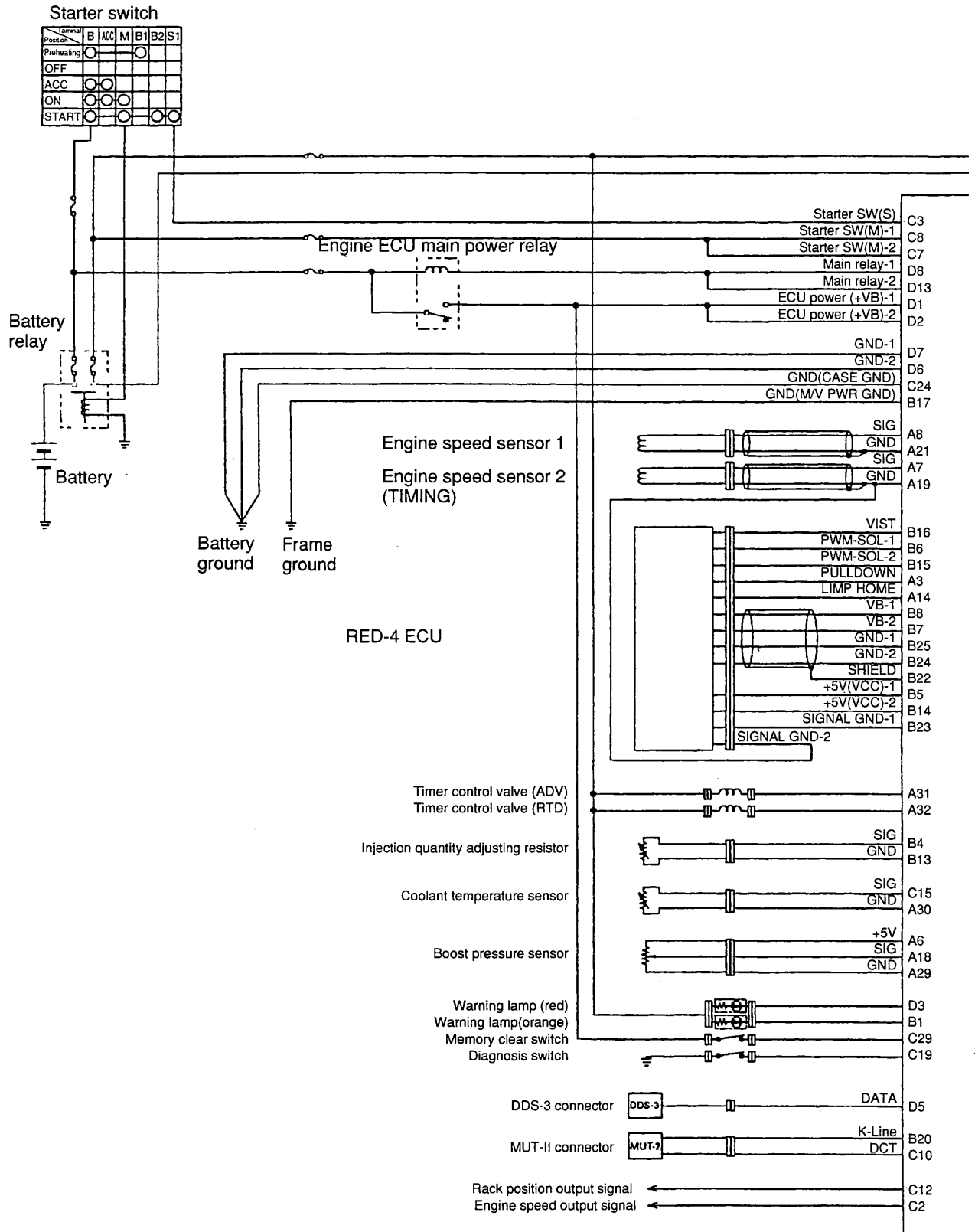
Terminal No.	Item(s) to which terminal is connected	Terminal No.	Item(s) to which terminal is connected
1	Warning lamp (orange)	14	RED-4 ECU (+5 VCC-2)
2	Accelerator pedal switch	15	RED-4 ECU (PWM SOL-2)
3	—	16	RED-4 ECU (V-IST)
4	Injection quantity adjusting resistor (SIG)	17	Frame ground (M/V POWER GND)
5	RED-4 ECU (+5 VCC-1)	18	—
6	RED-4 ECU (PWN SOL-1)	19	—
7	RED-4 ECU (VB2)	20	MUT-II connector (K-LINE)
8	RED-4 ECU (VB1)	21	—
9	Accelerator pedal position sensor 2 (SIG)	22	Shield (SHIELD) of VB-1, VB-2, GND-1 and GND-2
10	—	23	RED-4 ECU (SIGNAL GND-1)
11	—	24	RED-4 ECU (GND-2)
12	—	25	RED-4 ECU (GND-1)
13	Injection quantity adjusting resistor (GND)		

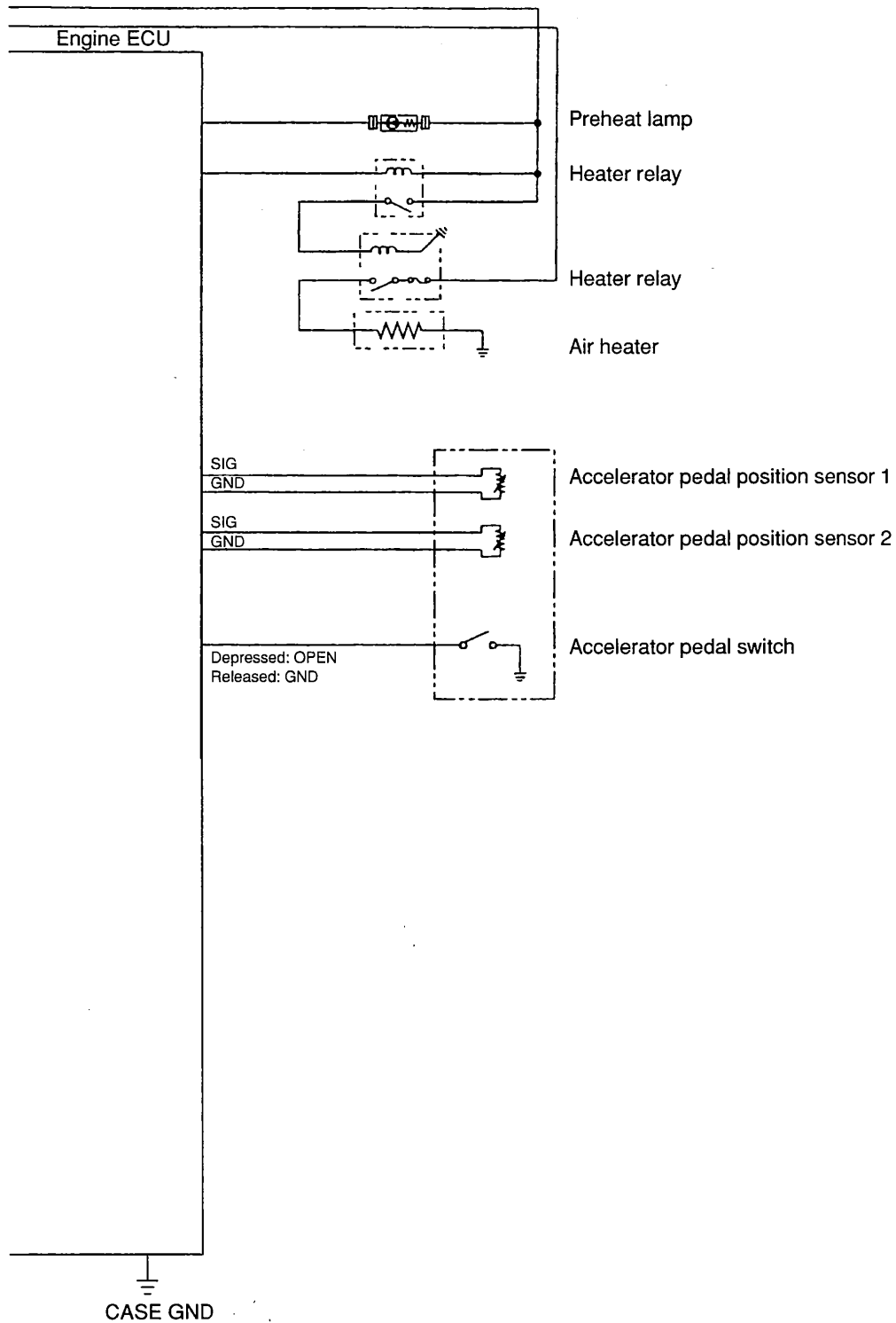
C:CW31A

Terminal No.	Item(s) to which terminal is connected	Terminal No.	Item(s) to which terminal is connected
1	—	17	Accelerator pedal position sensor1 (SIG)
2	Engine speed output signal (NE OUT SIG)	18	—
3	Starter switch S terminal (STARTER SW S)	19	Diagnosis switch
4	—	20	—
5	—	21	—
6	—	22	—
7	Battery relay (STARTER SW M-2)	23	—
8	Battery relay (STARTER SW M-1)	24	Battery ground (CASE GND)
9	—	25	—
10	MUT-II connector (DCT)	26	Preheat lamp (PREHEAT LAMP)
11	—	27	Accelerator pedal position sensor 2 (GND)
12	Control rack position output signal (RAC OUT SIG)	28	Accelerator pedal position sensor 1 (GND)
13	—	29	Memory clear switch
14	—	30	—
15	Coolant temperature sensor (SIG)	31	—
16	—		

D:CW16A

Terminal No.	Item(s) to which terminal is connected	Terminal No.	Item(s) to which terminal is connected
1	Engine ECU main power relay (+VB-2)	9	—
2	Engine ECU main power relay (+VB-1)	10	—
3	Warning lamp (red)	11	—
4	—	12	—
5	DDS-3 connector (DDS3)	13	Engine ECU main power relay (MAIN RELAY-2)
6	Battery ground (GND-2)	14	—
7	Battery ground (GND-1)	15	—
8	Engine ECU main power relay (MAIN RELAY-1)	16	—





■ SPECIFICATIONS

ITEM		Specification
Injection pump assembly	Manufacturer	BOSCH AUTOMOTIVE SYSTEMS
	Model	Electronically controlled in-line pump
	Injection pump model	NP-PE6P120
	Governor model	NP-4 (RED-4 with internal circuit)
	Timer model	SPGH
	Feed pump model	KD
Timer control valve	Manufacturer	BOSCH AUTOMOTIVE SYSTEMS
	Rated voltage V	24
	Pressure range kPa {kgf/cm ² }	49 to 980 (0.5 to 10)
ECU	Manufacturer	BOSCH AUTOMOTIVE SYSTEMS
	Rated voltage V	24

■ TROUBLESHOOTING

■ Inspection Procedures

■ Diagnostic function

Whenever the starting switch is placed at ON, the diagnostic function is activated to check all the sensors, etc. If any of them is found faulty, the warning lamp in the meter cluster is lit to alert the driver. At the same time, the fault location is stored in memory, and the system enters the back-up mode.

The stored fault location can be read as a diagnostic trouble code by the Multi-Use Tester-II or the diagnostic switch.

Warning lamp indications

	Warning lamp
Safety-critical error (Vehicle must not be driven.)	Red
Non-safety-critical error (Vehicle can be driven despite poor control feeling)	Orange

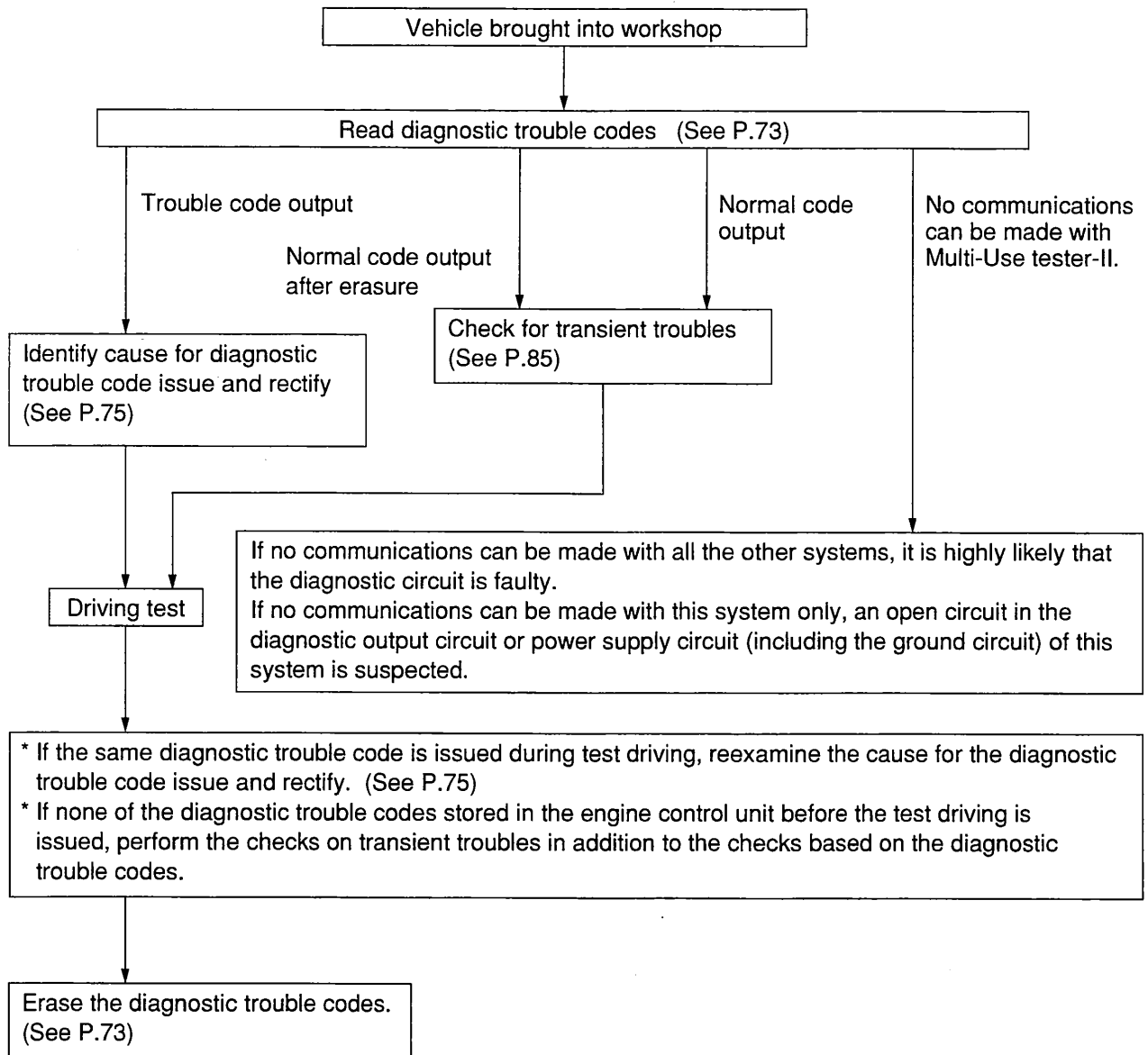
Notes:

- Check to ensure that the battery voltage is within the specified range.
- Check all the harness and device connectors for looseness. Always remove a connector at least 20 seconds after placing the starting switch at LOCK position.
- Do not forget to clear the diagnostic trouble code by the Multi-Use tester II or memory clear switch after a fault has been rectified.
- As a rule, inspection operations should be performed with the starting switch at the LOCK position. Some checks, however, may have to be made with the starting switch at the ON position. In such a case, use care to make sure that no short circuit develops between pins of the connectors or with the body.
- The resistance value of each component is affected by the temperature and the accuracy of the tester. The reading, therefore, does not always fall within the standard limits. Note that the check values shown in the text are the values obtained at normal temperature (10 to 35°C).
- Whether or not the system automatically returns to normal from the back-up mode after a fault has been removed depends on the diagnostic trouble code (fault location).
- Even when the fault has been removed and the system has been automatically returned to the normal mode, the diagnostic trouble code of the fault remains stored in the engine control unit.
- When a fault occurs at a point where the system is not automatically reset, perform the memory clear procedure to let the system exit from the back-up mode. (See P.73)

■ Inspection flowchart

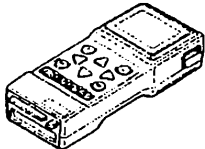
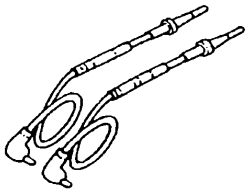
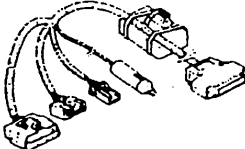
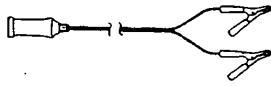
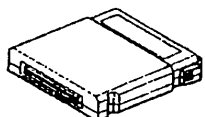
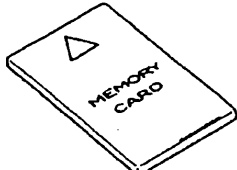
The system inspection can be performed effectively by use of the Multi-Use Tester II. The types of system inspections may be broadly divided as shown below in accordance with the trouble symptoms and diagnostic trouble code outputs.

- (1) Inspections based on diagnostic trouble codes stored in the engine control unit.
- (2) Inspections of transient troubles



■ Connection of Multi-Use Tester-II

■ Special tools

Tool name	Shape	Tool name	Shape
Multi-Use Tester-II MB991496 Inspection of system		Multi-use Tester-II harness MB991499 To use Multi-Use Tester-II as a circuit tester	
Multi-Use Tester-II harness (for communications) MC887252 To supply power to Multi-Use Tester-II proper and communicate with vehicle side electrical devices		Battery clamp harness harness MK320193 Power supply to Multi- Use tester-II in vehicle without cigarette lighter; detection of start signal in vehicle without cigarette lighter	
Read-only memory pack (MRI-E1) MK369392 Data for inspection and control of engine control unit			
Memory card (set in Multi-Use Tester-II proper) MB991500 To write date			

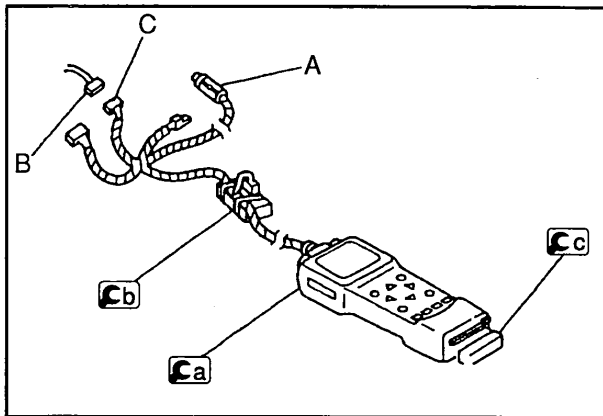
The Multi-Use Tester II typically draws power from the cigarette lighter. In a vehicle without a cigarette lighter, the power connection of the Multi-Use Tester II is different depending on the type of the starter switch as follows:

Multi-Use Tester II power supply connection	With cigarette lighter socket		Without cigarette lighter socket
	Starter switch type A*a	Starter switch type A*b	
Cigarette lighter socket	○	—	—
Battery	—	○	○

*a With starter switch type A, power supply to cigarette lighter continues while engine is being cranked.

*b With starter switch type B, power supply to cigarette lighter is suspended while engine is being cranked.

(1) Power supplied to Multi-Use Tester II from cigarette lighter

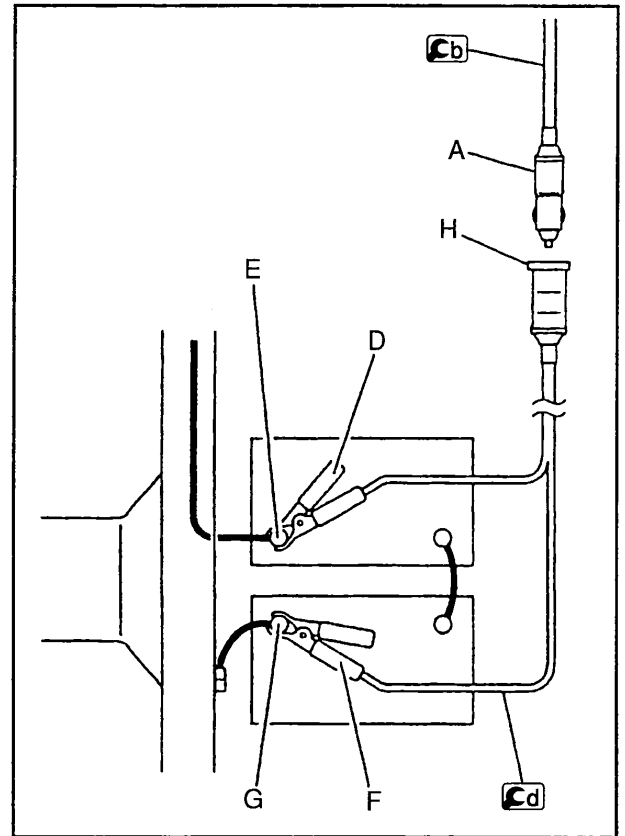


- Place the starting switch at the LOCK position.
- Connect the **[Ca]** Multi-Use Tester II harness to **[Cb]** Multi-Use Tester II and insert the **[Cc]** read-only memory in the tester.
- Connect the connector A to the cigar lighter socket.
- Connect the Multi-Use Tester II connector C (16 pins) to the data link connector B (16 pins)

Note:

For the operating procedures for the Multi-Use Tester II, refer to the instruction manual for the Multi-Use tester II.

(2) Power supplied to Multi-Use Tester II from battery



- Place the starter switch in the LOCK position.
- Connect the **[Cb]** Multi-Use Tester II harness (for communication) to the **[Ca]** Multi-Use Tester II, then insert the **[Cc]** ROM pack.
- Connect the $\oplus$ clamp D (red) of the **[Cd]** battery clamp harness to the $\oplus$ terminal E of the battery and the $\ominus$ clamp F (black) to the $\ominus$ terminal G of the battery.
- Fit the connector A into the socket H of the **[Cd]** battery clamp harness.
- Fit together the Multi-Use Tester II connector B (16 pins) and connector C (16 pins).

Note:

Connect the $\oplus$ clamp D (red) of the **[Cd]** battery clamp harness before connecting the $\ominus$ clamp F (black).

■ Reading and Erasing Diagnostic Trouble Codes

Two types of methods are available for reading or erasing a diagnostic trouble code; one using the Multi-Use Tester-II and one using the vehicle side diagnostic functions.

(1) Method using Multi-Use tester-II

(a) Current diagnostic trouble code

- 1) Check to see that the memory clear switch 1 is connected.
- 2) Set the starting switch to ON.
- 3) Operate the Multi-Use Tester-II to read the current diagnostic trouble code and determine the fault location.

(b) Past diagnostic trouble code

- 1) Set the starting switch to ON.
- 2) Disconnect the memory clear switch 1.
- 3) Operate the Multi-Use Tester-II to read the past registered diagnostic trouble codes and determine the fault location.

(c) Erasing diagnostic trouble codes

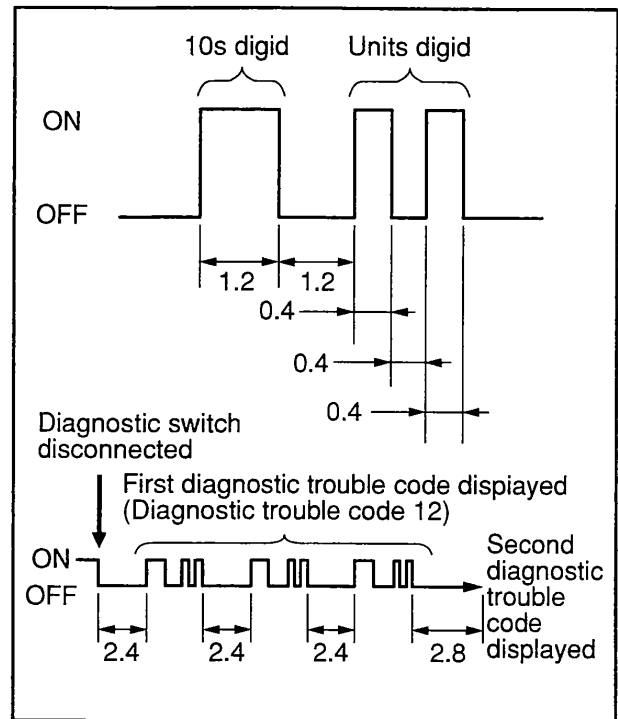
- 1) Set the starting switch to ON.
- 2) Operate the Multi-Use Tester-II to erase all of the diagnostic trouble codes stored in the engine control unit.

(2) Method Not Using Multi-Use Tester-II (Method Using Diagnostic Switch and Memory Clear Switch)

(a) Current diagnostic trouble code

- 1) Set the starting switch to ON.
- 2) Disconnect the diagnostic switch 2.
- 3) The diagnostic trouble code is displayed by flashes of the warning lamp 3.

(b) Reading diagnostic trouble code

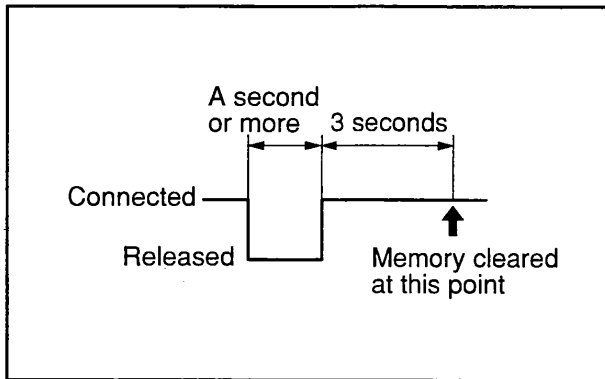


- 1) Diagnostic trouble codes are indicated by the number of times the warning lamp 3 flashes and their duration.
 - The flashing intervals also differ between the 10s digit and units digit.
 - 10s digit: 1.2 second interval
 - Units digit: 0.4 second interval
 - Each diagnostic trouble code is displayed from the 10s digit followed by the units digit. As for a code which has no 10s digit, units digit only is displayed.
- 2) Each diagnostic trouble code is displayed three times in succession.
- 3) If there is no more code stored, the sequence is then repeated from the beginning with each code indicated three times.
- 4) When the diagnosis switch 2 is connected, the engine control unit will immediately stop displaying codes.

(c) Past diagnostic trouble codes

- 1) After reading the current diagnostic trouble codes (with the diagnosis switch 2 disconnected), disconnect the memory clear switch 1. Then the  warning lamp³ will restart flashing.
- 2) This time, the warning lamp displays the past diagnostic trouble codes. Determine the fault locations based on the indicated codes.

(d) Erasing diagnostic trouble codes



Disconnect the memory clear switch 1 and the diagnostic switch 2 then reconnect them. Then all the diagnostic trouble codes stored in the engine control unit will be cleared.

Note:

- If the contents of memory are not to be cleared after display of the stored codes, set the starting switch to OFF with the memory clear switch 1 disconnected. Thereafter, connect the memory clear switch.
- When you change the combination of the injection pump and engine control unit, you must rewrite the pump data stored in the engine control unit. For this purpose, be sure to perform the diagnostic trouble code erasing procedure
- Whenever the engine control unit has been replaced with a new one, be sure to erase the diagnostic trouble codes by disconnecting the memory clear switch 1 and diagnostic switch 2 after connecting all the connectors. Upon completing the procedure, confirm that no diagnostic trouble codes is stored.

■ Causes of Diagnostic Trouble Code Issue and Inspection Items

■ Diagnostic Trouble Codes

Multi-Use Tester-II display		Page of reference
Diagnostic trouble code	Message	
07	OVER REV.	P.75
11	GOV. SERVO	
14	SUB NE SNSR	
15	NE SNSR	P.76
16	ACCEL. SNSR-2	
17	TCV FEEDBACK	
19	AIR PRES SNSR	P.77
21	WTR TEMP SNSR	
22	RACK SNSR	

Multi-Use Tester-II display		Page of reference
Diagnostic trouble code	Message	
23	TCV	P.78
24	ACCEL. SNSR-1	P.79
32	BST PRES SNSR	
33	ECU SYSTEM	
34	Q RESISTOR	P.80
45	ENG. REVERSE	
65	ACCEL SW	
78	HEATER RELAY	

■ Diagnostic trouble code issue conditions, and check items

Perform service operations with reference to the diagnostic trouble code issue conditions and probable causes shown below.

07 OVER REV.		
Code issue condition (Reset condition)	Diagnostic trouble code 07 indicates that the engine speed is too high. (The code is reset when the engine speed returns to a specified range.)	
Action taken by ECU	Governor operation is stopped.	
Probable cause and check item	Injection pump assembly's control sleeve faulty • Over-revving of engine (for example, on downhill road) • ECU faulty	Inspection of injection pump assembly (Have inspection performed by BOSCH AUTOMOTIVE SYSTEMS service station.)

11. GOV. SERVO		
Code issue condition (Reset condition)	Diagnostic trouble code 11 indicates that the difference between the target control rack position and actual control rack position is too large. (No reset condition)	
Action taken by ECU	Governor operation is stopped.	
Probable cause and check item	• Control rack position sensor faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 - No.09: Measurement of target rack position - No.0A: Measurement of actual rack position • Inspection of control rack position sensor (Have inspection performed by BOSCH AUTOMOTIVE SYSTEMS service station.)

14 SUB NE SNSR (injection pump side)		
Code issue condition (Reset condition)	Diagnostic trouble code 14 indicates that the number of pulses from engine speed sensor 2 (on the injection pump) is smaller than the number of pulses from engine speed sensor 1 (on the flywheel housing). [The code is reset when engine speed sensor 1 is normal and the number of pulses from engine speed sensor 2 returns to normal.]	
Action taken by ECU	• Normal control is effected using only engine speed sensor 1. • If engine speed sensor 1 is also faulty, governor operation is stopped.	
Probable cause and check item	• Open circuit or short circuit in harness between ECU and engine speed sensor 2. • Engine speed sensor 2 faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 • No.02: Measurement of engine speed • Inspection using ECU connector See P.83 • 01 : Measurement of resistance of engine speed sensor-2 • Inspection of engine speed sensor 2 • See P.86: Inspection of Electronic Equipment 263 • Check of circuit between ECU and engine speed sensor 2
14 SUB NE SNSR (injection pump side) 15 NE SNSR (flywheel housing side)		
Code issue condition (Reset condition)	Diagnostic trouble codes 14 and 15 are both issued if engine speed sensor 1 (on the flywheel housing) and engine speed sensor 2 (on the injection pump) fail at the same time. [The code is reset when pulses are applied from engine speed sensor 1 or engine speed sensor 2 following engine startup.]	
Action taken by ECU	Fuel injection timing control is stopped, and governor operation is stopped.	
Probable cause and check item	• Open circuit or short circuit in harness between ECU and engine speed sensors 1 and 2. • Engine speed sensors 1 and 2 faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 • No.02: Measurement of engine speed • Inspection using ECU connector See P.83 • 01 : Measurement of resistance of engine speed sensor-2 • 02 : Measurement of resistance of engine speed sensor-1 • Inspection of engine speed sensor 1 and 2 • See P.86: Inspection of Electrical Equipment 263 • Check of circuit between ECU and engine speed sensors 1 and 2
15 NE SNSR (flywheel housing side)		
Code issue condition (Reset condition)	Diagnostic trouble code 15 indicates that the number of pulses from engine speed sensor 1 (on the flywheel housing) is smaller than the number of pulses from engine speed sensor 2 (on the injection pump). [The code is reset when engine speed sensor 2 is normal and the number of pulses from engine speed sensor 1 returns to normal.]	
Action taken by ECU	• Normal control is effected using only engine speed sensor 2. • If engine speed sensor 2 is also faulty, governor operation is stopped.	
Probable cause and check item	• Open circuit or short circuit in harness between ECU and engine speed sensor 1. • Engine speed sensor 1 faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 • No.02: Measurement of engine speed • Inspection using ECU connector See P.83 • 02 : Measurement of resistance of engine speed sensor-1 • Inspection of engine speed sensor 1 • See P.86: Inspection of Electrical Equipment 263 • Check of circuit between ECU and engine speed sensor 1

16 ACCEL. SNSR-2		
Code issue condition (Reset condition)	Diagnostic trouble code 16 indicates short or open circuit in accelerator position sensor 2 harness and faulty sensor proper. (If diagnostic trouble code 16 is issued, inspections for diagnostic trouble code 24 must also be performed.) The code is issued when accelerator position sensor 2 voltage is out of specified limits. [When accelerator position sensor 2 voltage is back within specified limits, a reset is made.]	
Action taken by ECU	• Normal control is effected using only non-faulty accelerator pedal position sensor 1. • If accelerator pedal position 1 is also faulty, control is effected using assumptions of 100% with the pedal depressed and 0% with the pedal released.	
Probable cause and check item	• Open or short circuit in harness between ECU and accelerator position sensors 2. • Accelerator position sensor 2 faulty or poorly adjusted • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 No.03,04: Measurement of throttle opening indicated by accelerator pedal position sensor No.5: Measurement of accelerator pedal position sensor's output voltage • Inspection of accelerator pedal position sensor • Check of circuit between ECU and accelerator pedal position sensor 2
17 TCV FEEDBACK		
Code issue condition (Reset condition)	Diagnostic trouble code 11 indicates that the difference between the target and actual timer positions exceeds a specified limit. [After a return to a normal condition, the code is reset when the starter switch is turned from OFF to ON.]	
Action taken by ECU	Fuel injection timing control is stopped.	
Probable cause and check item	• Timer control valve faulty • Electronic timer faulty • Engine hydraulic system faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 No.12: Measurement of timer angle difference • Inspection of timer control valve main body See P.86: Inspection of Electrical Equipment 574 • Inspection of engine hydraulic system • Inspection of electronic timer (Have inspection performed by BOSCH AUTOMOTIVE SYSTEMS service station.)
19 AIR PRES SNSR		
Code issue condition (Reset condition)	Diagnostic trouble code 19 indicates short or open circuit in air pressure sensor harness and faulty air pressure sensor (built in ECU). The code is issued when air pressure sensor voltage is out of specified limits. [When air pressure sensor voltage falls back within specified limits, a reset is made.]	
Action taken by ECU	Air pressure is defaulted to 100kPa (760mmHg).	
Probable cause and check item	• Air pressure sensor (built in ECU) faulty. • ECU faulty	• Perform checks on the basis of Multi-Use Tester-II service data. See P.81 No.18: Air pressure measurement

21 WTR TEMP SNSR		
Code issue condition (Reset condition)	Diagnostic trouble code 21 indicates open circuit in water temperature sensor harness and faulty sensor proper. The code is issued when water temperature sensor voltage is out of specified limits. [When water temperature sensor voltage falls back within specified limits, a reset is made.]	
Action taken by ECU	Controls are continued assuming that coolant temperature is -20 °C when engine is started and 80 °C when engine is running.	
Probable cause and check item	• Open or short circuit in harness between ECU and water temperature sensor. • Water temperature sensor faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 No.16: Measurement of engine coolant temperature • Inspection using ECU connector See P.83 03 : Measurement of resistance of coolant temperature sensor • Inspection of coolant temperature sensor See P.86: Inspection of Electrical Equipment 262 • Check of circuit between ECU and coolant temperature sensor

22 RACK SNSR		
Code issue condition (Reset condition)	Diagnostic trouble code 22 indicates that the control rack position sensor's output voltage is outside specified limits. [No reset condition]	
Action taken by ECU	Governor is temporarily stopped. (Feedback control is resumed after the engine is restarted.)	
Probable cause and check item	• Control rack position sensor faulty • Control rack not moving smoothly • Governor actuator's link faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 No.0A: Measurement of actual rack position • Inspection of control rack position sensor and control rack (Have inspection performed by BOSCH AUTOMOTIVE SYSTEMS service station.)

23 TCV		
Code issue condition (Reset condition)	Diagnostic trouble code 23 is issued in the following circumstances: (1) The ECU issues a command to turn the timer control valve OFF following a short circuit in the timer control valve. [The code is reset when the timer control valve returns to normal.] (2) The ECU issues a command to turn the timer control valve ON following an open circuit in the timer control valve. [After the open circuit is rectified, the code is reset when the starter switch is turned from OFF to ON.]	
Action taken by ECU	Fuel injection timing control is stopped.	
Probable cause and check item	• Open circuit and short circuit in harness between ECU and timer control valve • Timer control valve faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester II service data. See P.81 No.12: Measurement of timer angle difference • Inspection of timer control valve See P.86: Inspection of Electrical Equipment 574 • Check of circuit between ECU and timer control valve

24 ACCEL. SNSR-1		
Code issue condition (Reset condition)	Diagnostic trouble code 24 indicates short or open circuit in accelerator position sensor 1 harness and faulty sensor proper. (If diagnostic trouble code 24 is issued, inspections for diagnostic trouble code 16 must also be performed.) The code is issued when accelerator position sensor 1 voltage is out of specified limits. [When accelerator position sensor 1 voltage falls back within specified limits, a reset is made.]	
Action taken by ECU	• Normal control is effected using only non-faulty accelerator pedal position sensor 2. • If accelerator pedal position 2 is also faulty, control is effected using assumptions of 100% with the pedal depressed and 0% with the pedal released.	
Probable cause and check item	• Open or short circuit in harness between ECU and accelerator position sensor 1. • Accelerator position sensor 1 faulty or poorly adjusted • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 - No.03,04: Measurement of throttle opening indicated by accelerator pedal position sensor - No.5: Measurement of accelerator pedal position sensor's output voltage • Inspection of accelerator pedal position sensor • Check of circuit between ECU and accelerator pedal position sensor 1
32 BST PRES SNSR		
Code issue condition (Reset condition)	Diagnostic trouble code 32 indicates short or open circuit in boost pressure sensor harness and faulty sensor proper. The code is issued when boost pressure sensor voltage is out of specified limits. [When boost pressure sensor voltage falls back within specified limits, a reset is made.]	
Action taken by ECU	Control is effected with the boost pressure assumed to be fixed at 0kPa (0mmHg).	
Probable cause and check item	• Open or short circuit in harness between ECU and boost pressure sensor. • Boost pressure sensor faulty. • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 - No.2D: Measurement of boost pressure • Inspection of boost pressure sensor main body - See P.86: Inspection of Electrical Equipment 318 • Check of circuit between ECU and boost pressure sensor
33 ECU SYSTEM		
Code issue condition (Reset condition)	Diagnostic trouble code 33 indicates a processing error or memory error in the ECU. [No reset condition]	
Action taken by ECU	Governor operation is stopped.	
Probable cause and check item	ECU faulty	—
34 Q RESISTOR		
Code issue condition (Reset condition)	Diagnostic trouble code 34 indicates short or open circuit in injection quantity adjusting resistor harness and faulty adjusting resistor. The code is issued when injection quantity adjusting resistor voltage is out of specified limits. [When injection quantity adjusting resistor voltage falls back within specified limits, a reset is made.]	
Action taken by ECU	Injection quantity correction value is fixed at No.1 value.	
Probable cause and check item	• Open or short circuit in harness between ECU and injection quantity adjusting resistor. • Injection quantity adjusting resistor faulty. • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 - No.14: Check of resistor number of fuel injection quantity adjusting resistor • Inspection using ECU connector See P.83 ●04● : Measurement of resistance of fuel injection quantity adjusting resistor • Inspection of fuel injection quantity adjusting resistor - See P.86: Inspection of Electrical Equipment 328 • Check of circuit between ECU and fuel injection quantity adjusting resistor

45 ENG. REVERSE		
Code issue condition (Reset condition)	Diagnostic trouble code 45 indicates that an extremely low engine speed (a speed lower than that resulting from cranking with the starter) has been detected with the starter switch in the OFF position. [The code is reset when the engine speed is no longer detected with the starter switch in the OFF position or when the starter switch is turned to the ON position.]	
Action taken by ECU	Governor operation is stopped.	
Probable cause and check item	• Operating error at time of engine startup • Poor matching of connected devices • ECU faulty	—
65 ACCEL SW		
Code issue condition (Reset condition)	Diagnostic trouble code 65 indicates short or open circuit in accelerator pedal switch harness and faulty accelerator switch. The code is issued when accelerator pedal is released (accelerator switch ON) and accelerator pedal opening signal is input. [When accelerator pedal opening signal returns to normal, a reset is made.]	
Action taken by ECU	Normal control is effected.	
Probable cause and check item	• Open or short circuit in harness between ECU and accelerator pedal switch • Accelerator pedal switch faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 No.03,04: Measurement of throttle opening indicated by accelerator pedal position sensor - No.69: Check of operation of accelerator pedal switch • Inspection using ECU connector See P.83 05 : Check of continuity of accelerator pedal switch • Inspection of accelerator pedal switch • Check of circuit between ECU and accelerator pedal switch
78 HEATER RELAY		
Code issue condition (Reset condition)	Diagnostic trouble code 78 is issued in the following circumstances. (1) The ECU issues a command to turn the heater relay OFF following a short circuit in the heater relay. [The code is reset when the heater relay returns to normal.] (2) The ECU issues a command to turn the heater relay ON following an open circuit in the heater relay. [No reset condition]	
Action taken by ECU	Pre-heat control is stopped.	
Probable cause and check item	• Open circuit or short circuit in harness between ECU and heater relay • Heater relay faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester-II service data. See P.81 No.92: Check of operation of heater relay • Actuator test using Multi-Use Tester-II See P.82 No. BC: Check of operation of heater relay • Inspection of heater relay • Check of circuit between ECU and heater relay

Multi-Use Tester-II Service Data

Multi-Use Tester II display			Condition at time of inspection	Normal condition
No.	Item	Data		
01	BATT VOLTAGE	■■■.■■■V	Idling	20 to 30 V
02	ENGINE SPEED	■■ ■■■.rpm	Racing (with engine running)	Same as tachometer indication
03	ACCEL(%)	■■■■.■%	Accelerator pedal released	0%
			Accelerator pedal gradually depressed	Gradually increases
			Accelerator pedal fully depressed	100%
04	ACCEL(%) REAL	■■■■.■%	Accelerator pedal released	0%
			Accelerator pedal gradually depressed	Gradually increases
			Accelerator pedal fully depressed	100%
05	ACCEL(V)	■.■■■■V	Accelerator pedal gradually depressed from released position	Depends on vehicle specifications
09	TARGET RACK	■■■.■■■mm	Starter switch ON	3mm
0A	REAL RACK	■■■.■■■mm	Starter switch ON	3mm
12	TCV ANG. DIFF.	■■■.■■■°CA ■■■.■■■deg	Depends on vehicle specifications	
14	Q RESISTOR	■.■■■■	—	Same as number marked on fuel injection quantity adjusting resistor
16	WATER TEMP	■■■■.■°C ■■■■.■°F	Engine cold	Approximately same as ambient temperature
			During engine warm-up	Gradually increases
			Engine stopped after warm-up	Gradually increases
18	AIR PRESS	■■■■.kpa ■■■■.mmHg	Altitude 0m	101 kPa
			Altitude 600m	95 kPa
			Altitude 1,200m	88 kPa
2D	BOOST PRESS	■■■■.kpa ■■■■.mmHg	Running at high idle speed	Depends on vehicle specifications
4F	DIAGNOSIS SW	ON/OFF	Diagnosis switch ON (connected to connector)	ON
			Diagnosis switch OFF (disconnected from connector)	OFF
51	DIAG LAMP(U)	ON/OFF	Starter switch in ON position (engine not started)	ON
			Starter switch in OFF position	OFF
52	DIAG LAMP(R)	ON/OFF	Starter switch in ON position (engine not started)	ON
			Starter switch in OFF position	OFF
56	KEY SW	ON/OFF	Starter switch in ON position	ON
			Starter switch in any position except ON	OFF
62	DIAG RESET SW	ON/OFF	Memory clear switch ON (connected to connector)	ON
			Memory clear switch OFF (disconnected from connector)	OFF
67	PULL DOWN	ON/OFF	Normal condition	OFF
			Abnormal condition (during pull-down control)	ON

Multi-Use Tester-II display			Condition at time of inspection		Normal condition
No.	Item	Data			
69	ACCEL SW	ON/OFF	Accelerator pedal depressed		ON
			Accelerator pedal released		OFF
73	START SW	ON/OFF	Engine cranked with starter switch in START position		ON
			Starter switch in any position except START		OFF
91	PRE-HEAT LAMP	ON/OFF	Starter switch ON	Coolant temperature low	ON
				Coolant temperature high	OFF
92	HEATER RELAY	ON/OFF	Starter switch ON	Coolant temperature low	ON
				Coolant temperature high	OFF

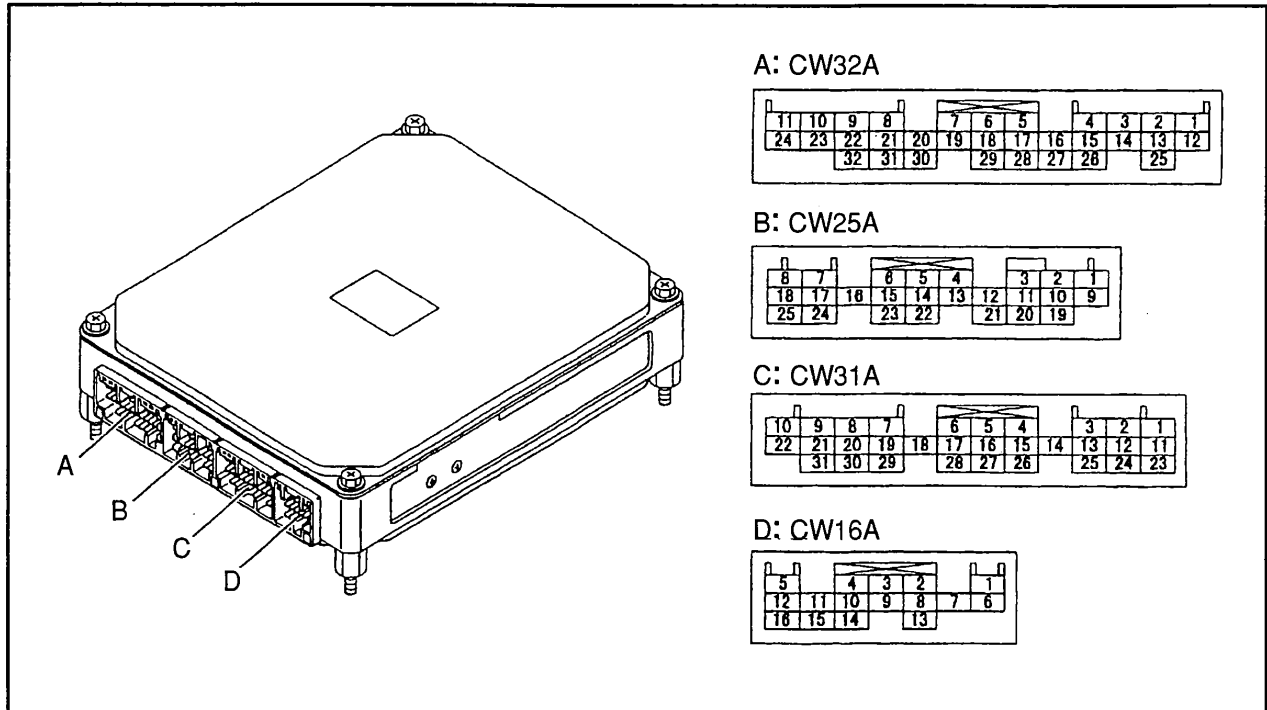
■ Actuator Tests Using Multi-Use Tester-II

Multi-Use Tester-II display		Method of checking operation
No.	Item	
AC	DIAG LAMP(U)	* Create warning lamp illumination conditions. * Perform test with engine speed of zero and vehicle speed of zero. * Cause warning lamp five times to be on for one second then off for one second.
AD	DIAG LAMP(R)	* Create warning lamp illumination conditions. * Perform test with engine speed of zero and vehicle speed of zero. * Cause warning lamp five times to be on for one second then off for one second.
BB	PRE-HEAT LAMP	* Create indicator lamp illumination conditions. * Perform test with engine speed of zero and vehicle speed of zero. * Cause indicator lamp five times to be on for one second then off for one second.
BC	HEATER RELAY	* Create air heater operating conditions. * Perform test with engine speed of zero and vehicle speed of zero. * Cause air heater five times to be on for one second then off for one second.

■ Inspection Using ECU Connector

These checks allow correct transmission of ECU signals via vehicle harnesses and connectors to be verified. They are intended to assist in troubleshooting. The numbers (**01** **02**, etc.) in the tables correspond to reference numbers in section 3.4 "Causes of Diagnostic Trouble Code Issue, and Inspection Items".

■ ECU terminal pin configuration



No.	Item	Page of reference
01	Resistance of engine speed sensor 2	See P-84
02	Resistance of engine speed sensor 1	
03	Resistance of coolant temperature sensor	
04	Resistance of fuel injection quantity adjusting resistor	
05	Continuity of accelerator pedal switch	

■ Inspection instructions

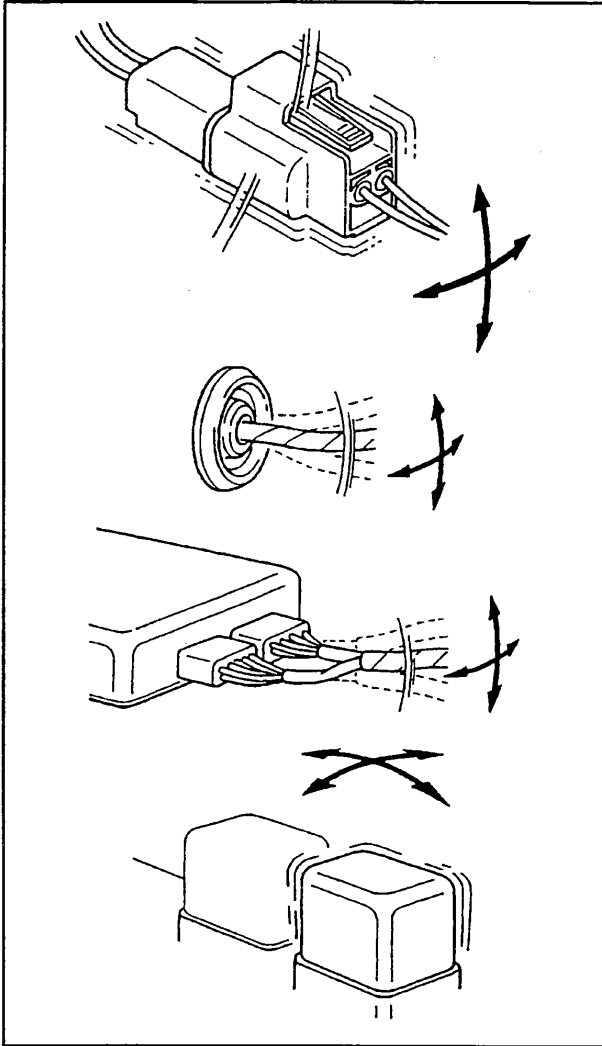
NOTE:

Some inspections are performed with the connector removed, and others are performed with the connector fitted. Note the following instructions:

- Do not touch any terminal other than the ones specified for the inspections. Be particularly careful not to cause short circuits between terminals using the tester probes.
- Terminal numbers shown in the tables are the numbers of terminals on the ECU. Be careful not to select the wrong terminals for inspections.

Check item	Method																								
01 Resistance of engine speed sensor 2	[Check conditions] • Starter switch OFF • Connector removed. Check performed on vehicle-side harness. [Normal condition] * Between terminals A⁷ and A¹⁹:2.1 to 2.5 Ω																								
02 Resistance of engine speed sensor 1	[Check conditions] • Starter switch OFF • Connector removed. Check performed on vehicle-side harness. [Normal condition] * Between terminals A⁸ and A²¹:2.1 to 2.5k Ω																								
03 Resistance of coolant temperature sensor	[Check conditions] • Starter switch OFF • Connector removed. Check performed on vehicle-side harness. [Normal conditions] • Between terminals C¹⁵ and A³⁰: 2.3 to 2.6 kΩ (at 20℃) 0.3 to 0.34 kΩ (at 80℃)																								
04 Resistance of fuel injection quantity adjusting resistor	[Check conditions] • Starter switch OFF • Connector removed. Check performed on vehicle-side harness. [Normal conditions] • Between terminals B⁴ and B¹³: <table><tr><td>No.</td><td>Resistance</td><td>No.</td><td>Resistance</td><td>No.</td><td>Resistance</td></tr><tr><td>1</td><td>270 Ω</td><td>4</td><td>1300 Ω</td><td>7</td><td>5600 Ω</td></tr><tr><td>2</td><td>510 Ω</td><td>5</td><td>2000 Ω</td><td>8</td><td>15000 Ω</td></tr><tr><td>3</td><td>820 Ω</td><td>6</td><td>3300 Ω</td><td></td><td></td></tr></table>	No.	Resistance	No.	Resistance	No.	Resistance	1	270 Ω	4	1300 Ω	7	5600 Ω	2	510 Ω	5	2000 Ω	8	15000 Ω	3	820 Ω	6	3300 Ω		
No.	Resistance	No.	Resistance	No.	Resistance																				
1	270 Ω	4	1300 Ω	7	5600 Ω																				
2	510 Ω	5	2000 Ω	8	15000 Ω																				
3	820 Ω	6	3300 Ω																						
05 Continuity of accelerator pedal switch	[Check conditions] • Starter switch OFF • Connector removed. Check performed on vehicle-side harness. [Normal conditions] Between terminals ((+) and (-)) B² and D⁶: • Accelerator pedal depressed: Continuity does not exist. • Accelerator pedal released: Continuity exists.																								

■ Checks on Transient Troubles



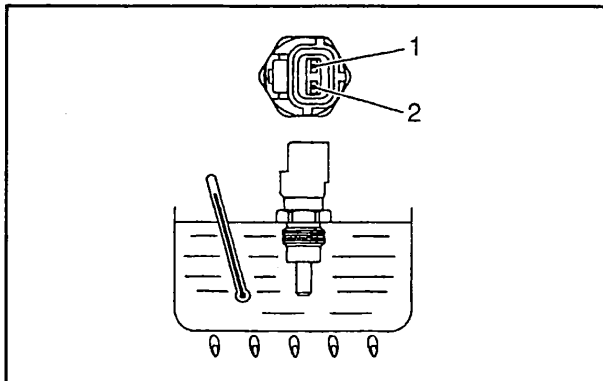
- Lightly move the connector up and down and to the right and left.
- Lightly move the harness up and down and to the right and left.
- Lightly shake the sensors and other devices by hand.
- Lightly shake the wiring harness located in the moving components such as the suspension.

The connectors and other parts to be checked are identifiable from the descriptions in the Probable Causes or the Checking Procedures for the displayed diagnostic trouble code.

A transient trouble often occurs in a specific condition. Therefore, pinpointing the condition will make it easy to estimate the cause. To pinpoint the condition for a transient trouble, ask the customer in detail about the driving condition when the trouble occurs, weather, occurrence frequency and symptoms, and reproduce the symptoms of the trouble. Depending on the condition where the trouble occurs, determine whether the cause of the trouble is vibration, temperature or any other factor. If the probable cause is vibration, perform the following checks on the relevant connectors harnesses, etc. and check whether the symptoms of the trouble are reproduced.

INSPECTION OF ELECTRICAL EQUIPMENT

262 Checking Water Temperature Sensor



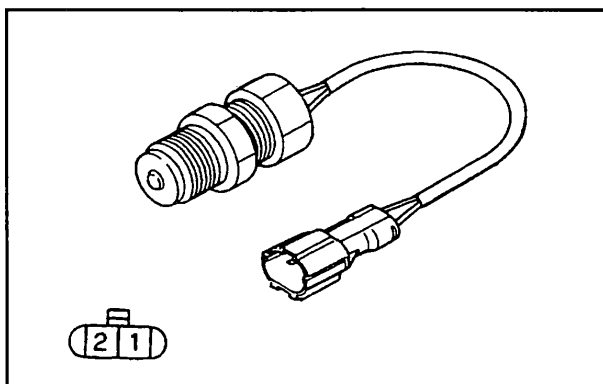
- (1) Put the water temperature sensor in a container filled with engine oil.
- (2) Heat the engine oil to various specified temperatures while stirring the engine oil.
- (3) Measure the resistance value between pins 1 and 2 (body).

Standard value	20°C	2.3 to 2.6kΩ
	80°C	0.30 to 0.34kΩ

- (4) If the reading is out of the standard value, replace the water temperature sensor.

263 Checking Engine Speed Sensor

<Engine speed sensor 1>



- (1) Measure the resistance value between pins 1 and 2.

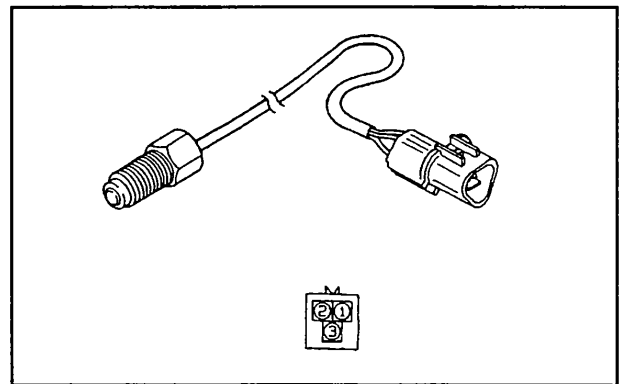
Standard value (at 20 °C)	2.3 ± 0.2kΩ
------------------------------	-------------

- (2) If the reading is out of the standard value range, replace the engine speed sensor.

NOTE:

If the sensor is not tightened sufficiently, it may not issue signals. Make sure the sensor's tightening torque is correct.

<Engine speed sensor 2>
[Inspection]



- (1) Measure the resistance between terminals (1) and (3).

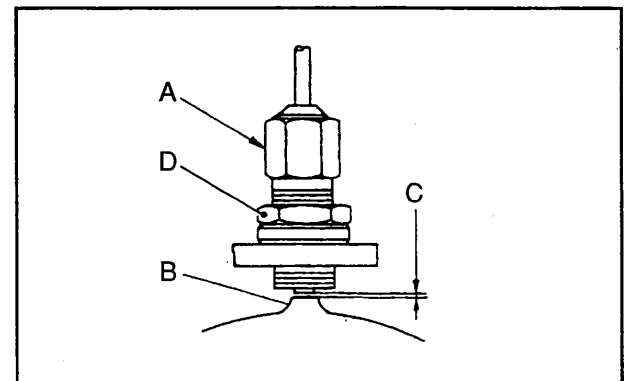
Standard value	2.1 to 2.5kΩ
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- (2) Check for continuity between terminals (1) and (2) between terminals (2) and (3).

Standard value	Continuity exists
----------------	-------------------

- (3) If either result is out of specification, replace the sensor.

[Installation]



- (1) Screw in engine speed sensor 2 A until it touches the protrusion on the timer flange B.
- (2) Back off engine speed sensor 2 A by 0.8 to 1.0 turn to create a clearance C(1.2 to 1.5mm) between the sensor and the protrusion B.
- (3) Tighten the lock nut D on engine speed sensor 2 A.

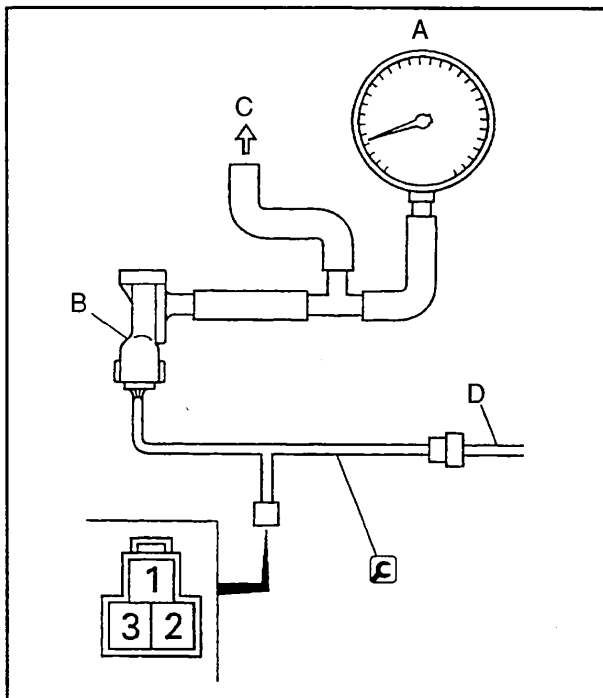
318 Checking Boost Pressure Sensor

<Checking by use of Multi-Use Tester II> See P.81

NOTE:

The boost pressure checking conditions differ between when the boost pressure is checked by use of the Multi-Use Tester II and when it is checked without use of the Multi-Use Tester-II. So the standard values also differ.

<Checking without use of Multi-Use Tester II>



- (1) Disconnect the chassis side harness D and connect the (E) inspection harness between them.

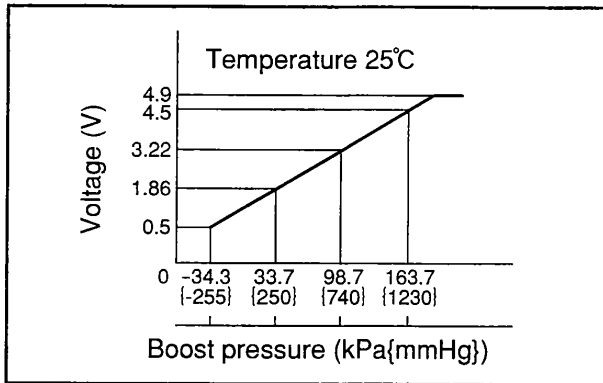
Tool name	shape
Inspection harness MC854336	

- (2) Mount pressure gauge A for measurement of the boost pressure.
C: To inlet manifold.
- (3) Set the starting switch to ON.
- (3) Measure the output voltage of the boost pressure sensor B according to the following table.

Item	Connector pin		
	1 Power(+)	2 GND(-)	3 Output(+)
Power voltage			
* Output voltage (Refer to the output characteristics shown at left.)			

*: Start the engine before measurement.

Output Characteristics

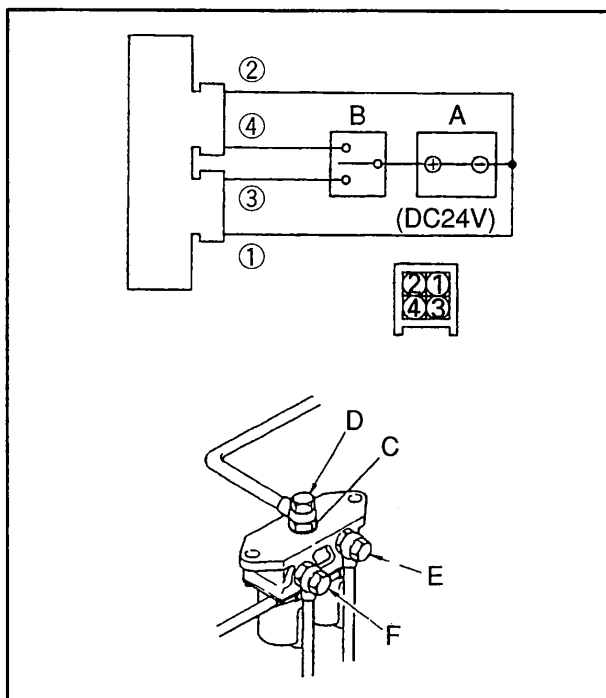


Standard value	2-3	5V
	1-2	0.5V/-34.3kPa {-255mmHg}
		1.86V/33.7kPa {250mmHg}
		3.22V/98.7kPa {740mmHg}
		4.5V/163.7kPa {1230mmHg}

- (5) If the results of the above mentioned checks show any deviation from the standard values, replace the boost pressure sensor B.

574 Inspection of timer control valve

< Checking valve operation >



- (1) Remove the connector from the timer control valve then connect a 24V DC power supply A and selector switch B.
- (2) Slightly loosen the eyebolt D on port C.
- (3) Run the engine at idling speed.
- (4) Turn the selector switch B to the port E setting and check that oil leaks from the eyebolt D of port C.
- (5) Turn the selector switch B to the port F setting and check that oil stops leaking.
- (6) After confirming that oil stops leaking, tighten the eyebolt D to the specified torque.

Tightening torque	20 to 25 Nm {2 to 2.5kgfm}
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C: Engine oil outlet

(Hydraulic pressure supply to electronic timer)

E: Engine oil inlet

F: Engine oil return outlet

- (7) If this inspection reveals any abnormality, replace the timer control valve.

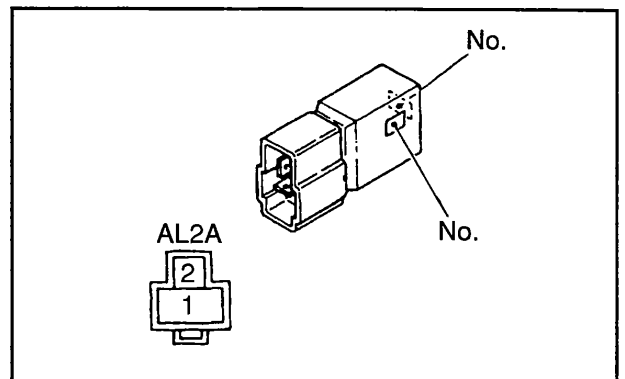
< Checking valve resistances >

- (1) Take resistance measurements between terminals (1) and (3) and between terminals (2) and (4). Determine whether the measurements comply with the standard value.

Standard value	21.9 to 24.1 Ω
----------------	-----------------------

- (2) Make sure that there is no continuity between terminals (3) and (4), between terminal (3) and the body and between terminal (4) and the body.
- (3) If these checks reveal any abnormality, replace the timer control valve.

828 Inspection of fuel injection quantity adjusting resistor



- (1) Measure the resistance of the fuel injection quantity adjusting resistor.
The standard value corresponds to the resistor number marked on the case.

Standard value (at 20°C)	Resistor No.	1	270 Ω
		2	510 Ω
		3	820 Ω
		4	1300 Ω
		5	2000 Ω
		6	3300 Ω
		7	5600 Ω
		8	15000 Ω

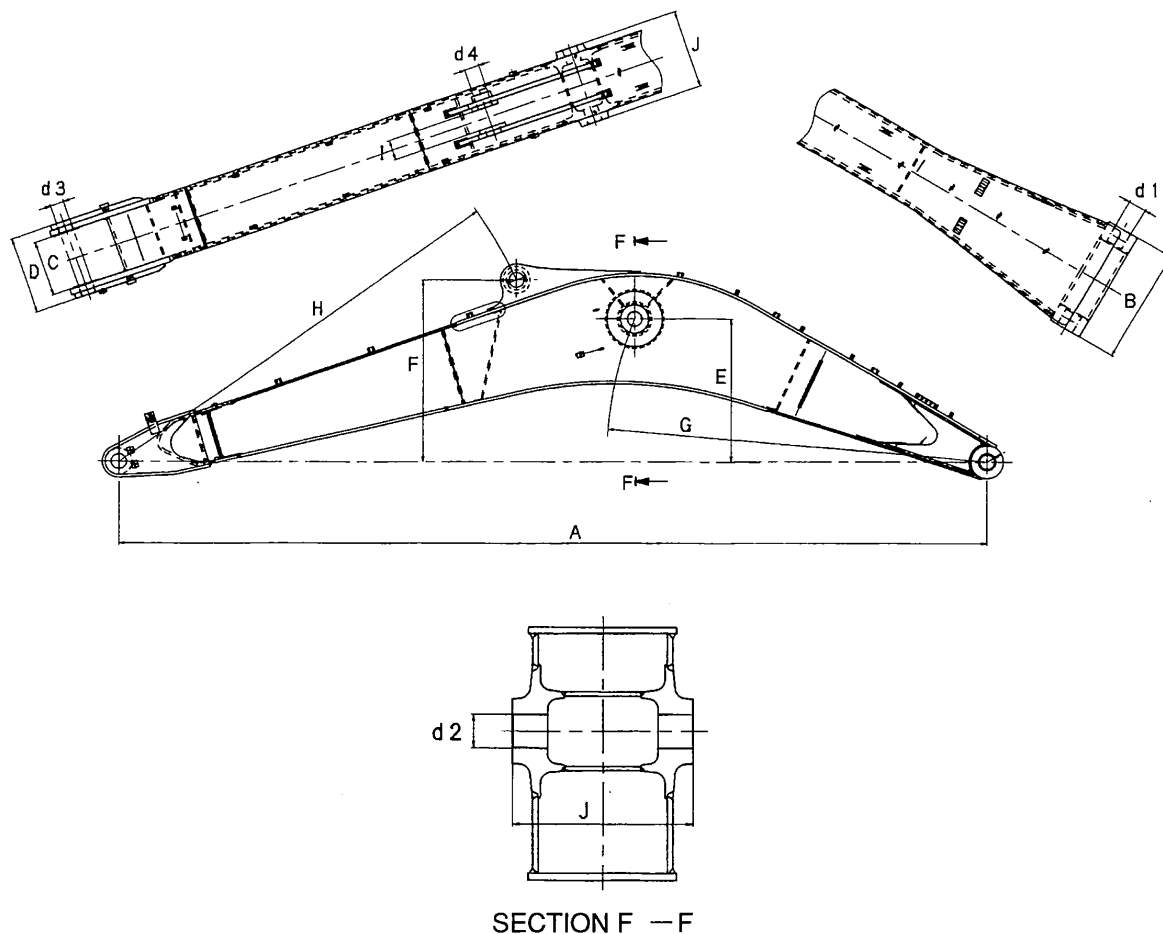
- (2) If the measurement is out of specification, replace the fuel injection quantity adjusting resistor.

Note :

The fuel injection quantity adjusting resistor is matched to the injection pump. Replace it only with one that has the same resistor number.

21. DIMENSIONS OF ATTACHMENT

■ BOOM DIMENSIONAL DRAWING



SECTION F — F

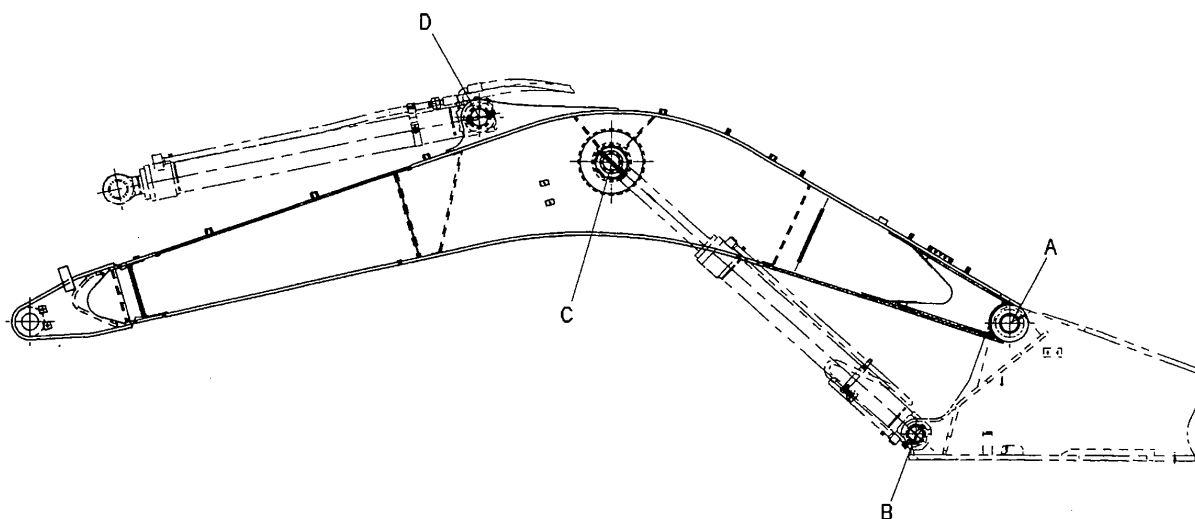
Boom dimensional drawing

Unit : mm (ft-in)

7.0M (23ft) STD BOOM		DIMENSION
No	NAME	
A	Boom length	7,000 (23')
B	Boom foot width	930 (36.6")
C	Boom end inner width	449.8 (17.7")
D	Boom end outer width	627 (24.7")
E	Height of boom cylinder rod pin	1,162 (3'10")
F	Height of arm cylinder (head side) pin	1,477 (4'10")
G	Distance between pins of boss	R3,069 (10'1")
H	Distance between pins of bracket	R3,530 (11'7")
I	Arm cylinder (head side) inner width	162 (6.38")
J	External width of boom cylinder (rod side) mounting section	638 (25.1")
d1	Boom foot pin dia. (inner dia. of bushing)	φ120 (4.72")
d2	Boom cylinder (rod side) pin dia.	φ120 (4.72")
d3	Pin dia. of arm end. (inner dia. of bushing)	φ120 (4.72")
d4	Arm cylinder (head side) pin dia.	φ120 (4.72")
	Weight	kg (lb)
		3,330 (7,340)

■ BOOM MAINTENANCE STANDARD

(1) Clearance of pin and bushing

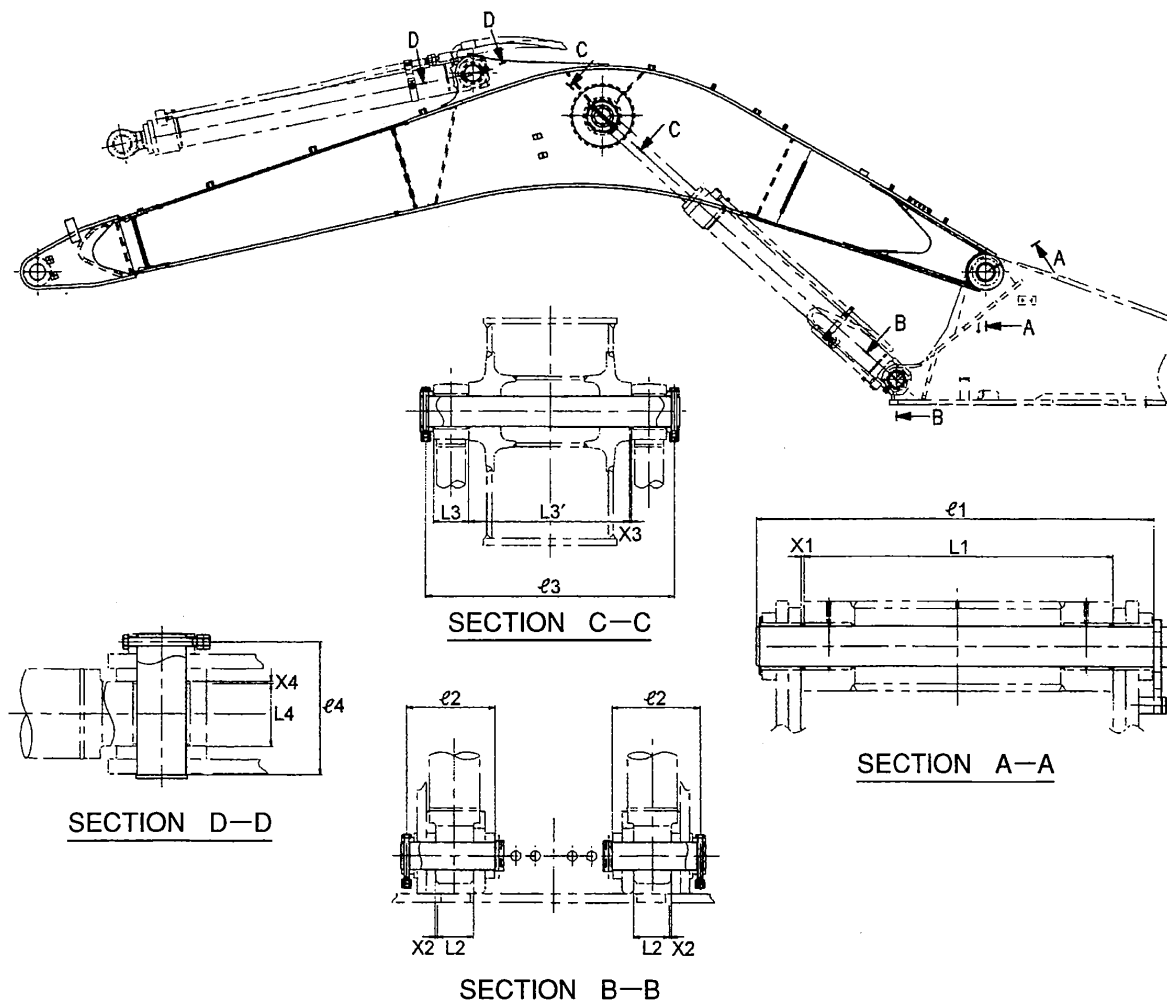


Clearance of pin and bushing on boom section

Unit : mm (in)

No.	Item	Pin part No.	Standard value			Clearance			Remedy
			Pin dia.	Pin dia. tolerance	Bushing i.d. tolerance	Standard value	Repairable level	Service limit	
A	Boom foot	LS02B01017P1	$\phi 120$ (4.7244)	+0.020 (+0.0008) -0.020 (-0.0008)	+0.197 (+0.0078) +0.104 (+0.0041)	+0.217 (+0.0085) +0.084 (+0.0033)	More than 2.0 (0.079)	3.0 (0.098)	Replace bushing or pin
B	Boom cylinder (Head side)	LS02B01014P1	$\phi 110$ (4.3307)		+0.250 (+0.0098) +0.050 (+0.0020)	+0.270 (+0.0106) +0.030 (+0.0012)			
C	Boom cylinder (Rod side)	2419P3526	$\phi 120$ (4.7244)			+0.380 (+0.0150) +0.120 (+0.0047)			
D	Arm cylinder (Head side)	2419P3525		+0.070 (+0.0028) -0.130 (-0.0051)					

(2) Clearance in thrust direction.

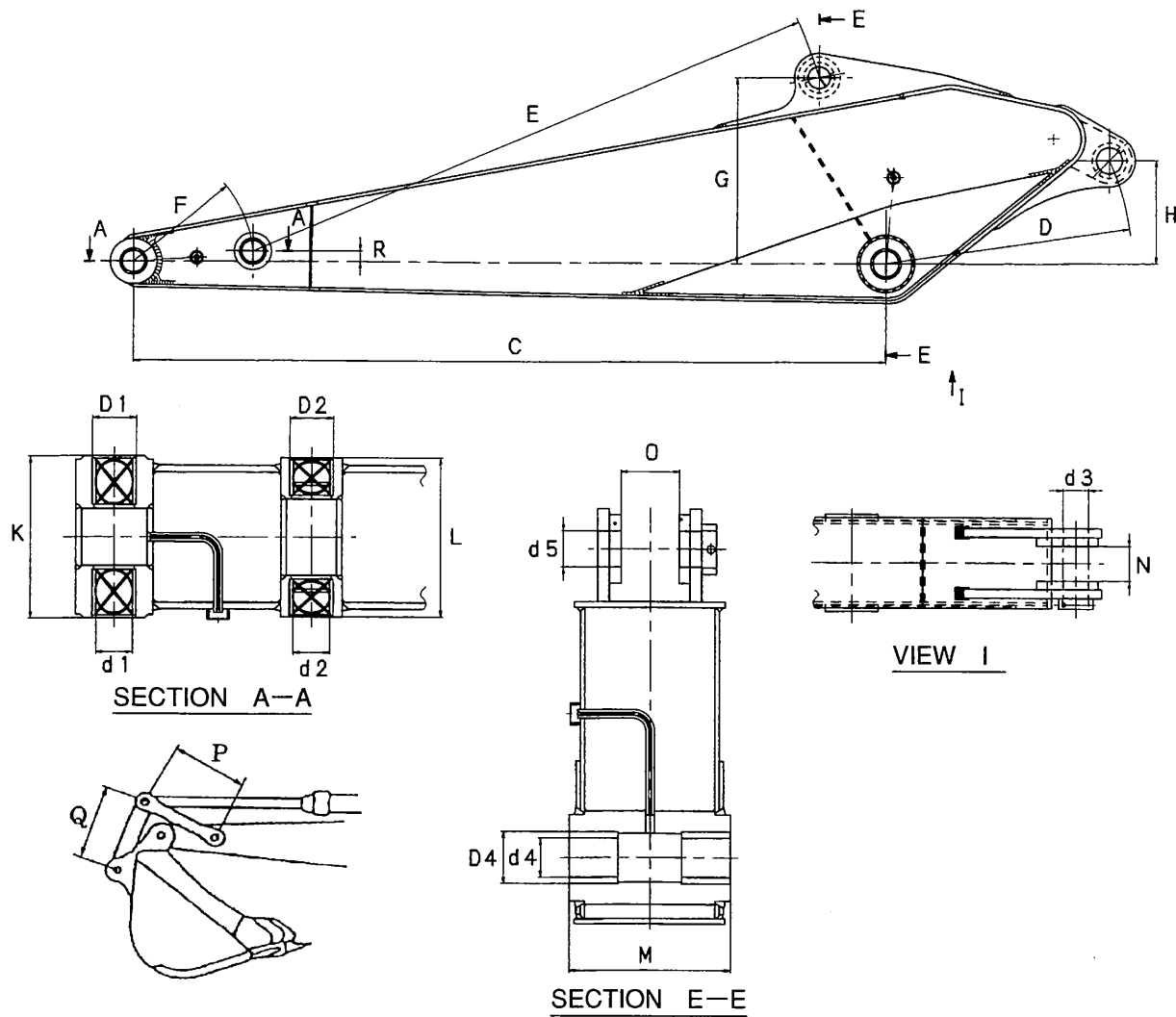


Clearance in thrust direction.

Unit : mm (in)

Section	Item		Basic size		Shim adjusting clearance (Total of both sides)			Length under pin neck		Remedy
			No.	Size	Standard value	Repairable level	Service limit	No.	Length	
A-A	Boom foot	Boom	L1	930(36.6)	0.5 (0.02) or less	2.0 (0.08)	2.5 (0.10)	Q1	1,179 (46.1)	Shim adjustment
		Upper frame		$932^{+2}_{-0}(36.69^{+0.08}_{-0})$						
B-B	Boom cylinder (Head side)	Boom cylinder	L2	150(5.91)	0.6~1.0 (0.02~0.04)			Q2	350 (13.8)	
		Upper frame		$152\pm1(5.98\pm0.04)$						
C-C	Boom cylinder (Rod side)	Boom cylinder	L3	140(5.51)	0.6~2.0 (0.02~0.08)	3.0 (0.12)	4.0 (0.16)	Q3	982 (38.7)	
		Boom	L3'	638(25.1)						
D-D	Arm cylinder (Head side)	Arm cylinder	L4	160(6.3)	0.6~1.0 (0.02~0.04)	2.0 (0.08)	2.5 (0.10)	Q4	331 (13.0)	
		Arm		162(6.38)						

ARM DIMENSIONAL DRAWING

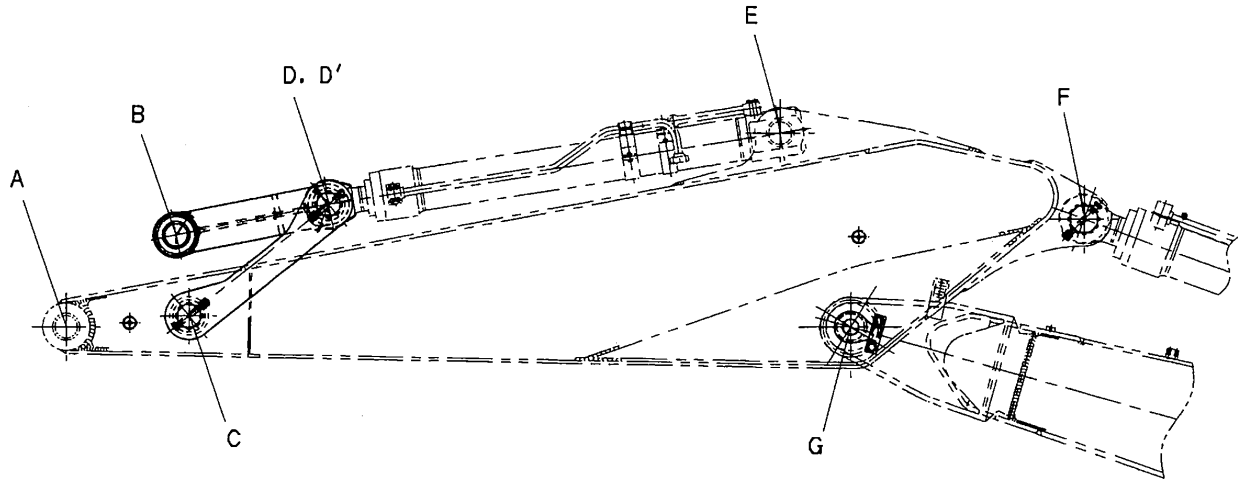


Arm dimensional drawing

3.45M(11'4'')STD ARM.			Unit : mm (ft-in)		
No.	NAME	DIMENSION	No.	NAME	DIMENSION
C	Arm length	3,450 (11'4")	N	Bracket inner width	162 (6.38")
D	Distance between pins of boss and bracket	R1,140 (3'9")	O	Bracket inner width	162 (6.38")
D1	I.D of boss	φ120 (4.72")	P	Idler link dimension	785 (30.9")
D2	I.D of boss	φ120 (4.72")	Q	Bucket link dimension	680 (26.8")
D4	I.D of boss	φ145 (5.71")	R	Distance between pin of boss and center of arm point	48 (1.89")
E	Distance between pins of boss and bracket	R2,728 (8'11")	d1	Pin dia.	φ100 (3.94")
F	Distance between pins of boss and boss	R540 (21.3")	d2	Pin dia.	φ100 (3.94")
G	Height between pins of boss and bracket	858 (33.8")	d3	Pin dia.	φ120 (4.72")
H	Height between pins of boss and bracket	479 (18.9")	d4	Pin dia.	φ120 (4.72")
K	Arm top end boss width	450 (17.7")	d5	Pin dia.	φ100 (3.94")
L	Arm link section boss width	442 (17.4")		Weight	kg (lb)
M	Boss width	448 (17.6")			1,470 (3,240)

■ ARM MAINTENANCE STANDARD

(1) Clearance of pin and bushing

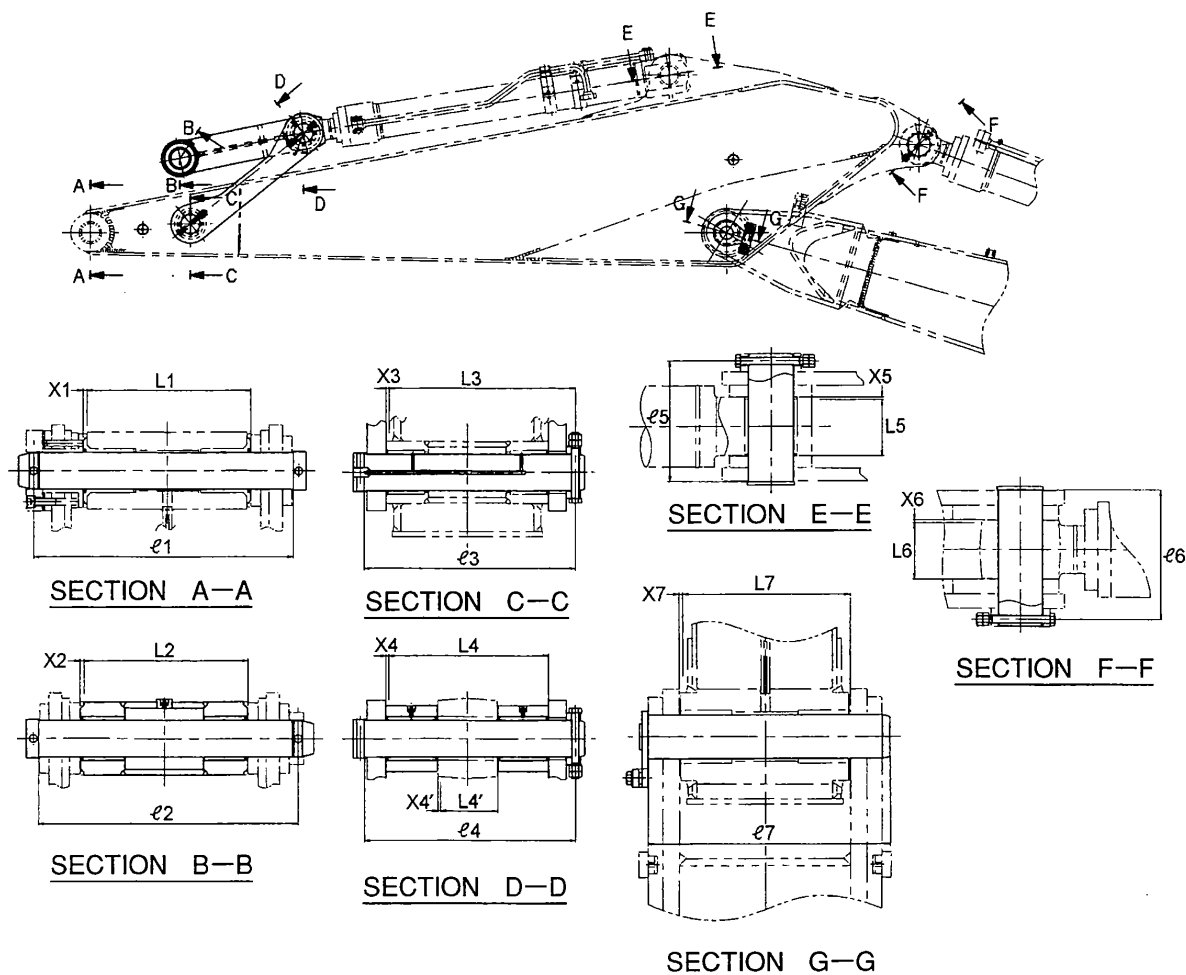


Clearance of pin and bushing

Unit : mm (in)

No.	Item	Pin part No.	Standard value				Clearance		Remedy
			Pin dia.	Pin dia. tolerance	Bushing i.d. tolerance	Standard value	Repairable level	Service limit	
A	Arm point	2419P3582	φ100 (3.9370)	-0.070 (-0.0028) -0.130 (-0.0051)	+0.289 (+0.0114) +0.191 (+0.0075)	+0.419 (+0.0165) +0.261 (+0.0103)	2.0 (0.0787)	2.5 (0.0984)	Replace bushing or pin
B	Bucket link (Bucket connection)				+0.292 (+0.0115) +0.195 (+0.0077)	+0.422 (+0.0166) +0.265 (+0.0104)			
C	Idler link (Arm connection)	LS12B01033P1			+0.298 (+0.0117) +0.204 (+0.0080)	+0.426 (+0.0168) +0.274 (+0.0108)			
D	Bucket link (Idler link connection)	LS12B01034P1			+0.294 (+0.0116) +0.198 (+0.0078)	+0.424 (+0.0167) +0.268 (+0.0106)			
D'	Bucket cylinder (Rod side)								
E	Bucket cylinder (Head side)	2419P3756				+0.250 (+0.0098) +0.050 (+0.0020)			
F	Arm cylinder (Rod side)	LS12B01011P1	φ120 (4.7244)						
G	Arm foot	2419P3840		+0.020 (+0.0008) -0.020 (-0.0008)	+0.288 (+0.0113) +0.181 (+0.0071)	+0.308 (+0.0121) +0.161 (+0.0063)			

(2) Clearance in thrust direction



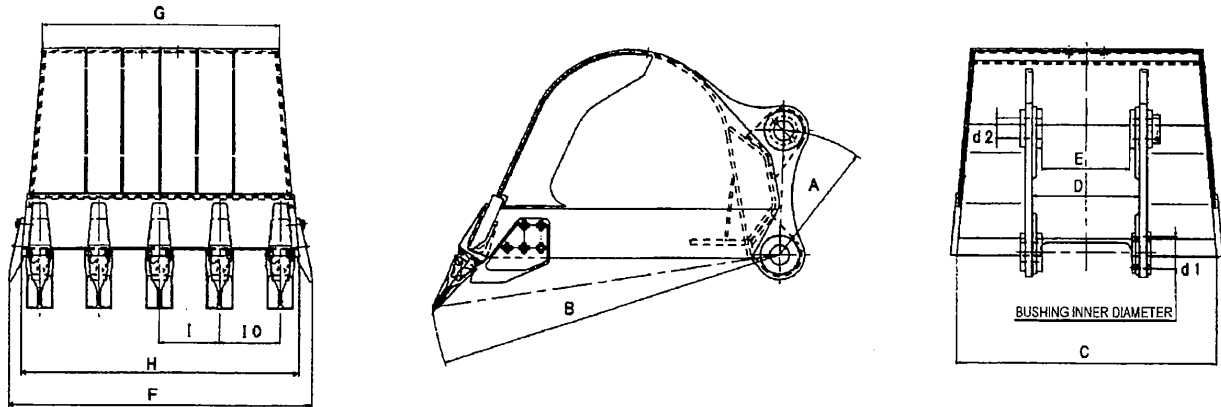
Clearance in thrust direction

Unit : mm (in)

Section	Item		Basic size		Shim adjusting clearance (Total of both sides)			Length under pin neck		Remedy	
			No.	Size	Standard value	Repairable level	Service limit	No.	Length		
A	Arm point	Arm	L1	450(17.71)	(0.02)	2.0		Q1	702 (27.64)	Shim Adjust- ment	
		Bucket		452(17.80)							
B	Bucket link	Link side	L2	450(17.71)							Q2
		Bucket		452(17.80)							
C	Idler link (Arm connection)	Arm	L3	442(17.40)	(0.02)	1.0		Q3	570 (22.44)		
		Link side		—							
D	Bucket link (Idler link connection)	Rod side	L4	—	0.6~1.0	2.0		Q4	570 (22.44)		
		Link side		442(17.40)							
D'	Bucket link (Rod side)	Rod side	L4'	160(6.30)							
		Link side		164(6.46)							
E	Bucket cylinder (Head side)	Head side	L5	160(6.30)	0.6~2.0	3.0		Q5	331 (13.03)		
		Arm		162(6.38)							
F	Arm cylinder (Rod side)	Rod side	L6	160(6.30)				Q6	355 (13.98)		
		Arm		162(6.38)							
G	Arm foot	Arm	L7	448(17.64)	(0.02)	1.0		Q7	649 (25.55)		
		Boom		449.8(17.71)							

■ BUCKET DIMENSIONAL DRAWING

(1) STD bucket



Hoe bucket dimensional drawing

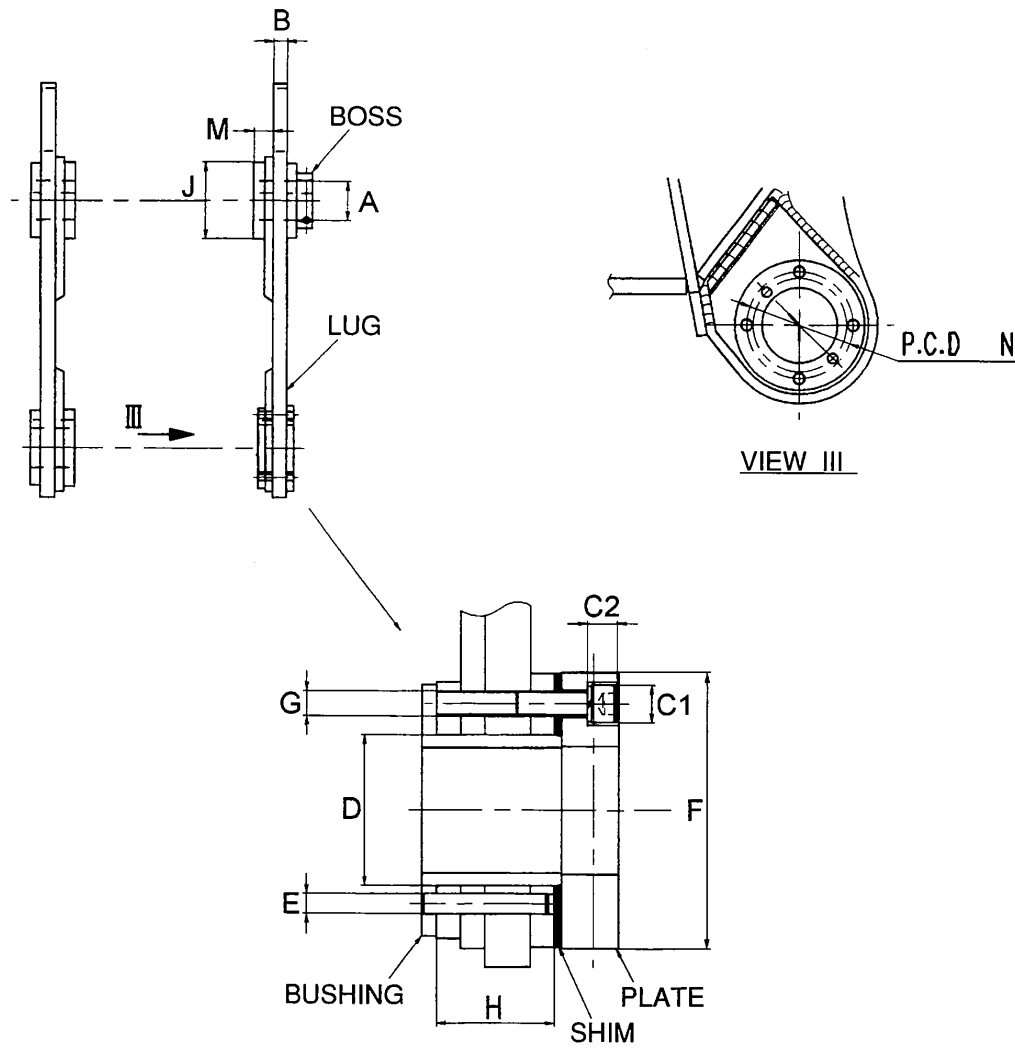
No.	NAME	No.	NAME
A	Distance between pin and bracket	G	Outer width of bucket bottom
B	Distance between bucket pin and tooth end	H	Bucket outer width of teeth
C	Inner width of bucket end	I	Pitch between teeth
D	Inner width of lug	IO	Pitch between teeth
E	Inner width of bracket	d1	Outer dia. of bushing
F	Outer width of side cutter	d2	Pin dia.

■ BUCKET DIMENSIONAL TABLE

Unit : mm (ft-in)

Type	STD Spec.
Capacity	[STD] 1.80m ³ (2.35cu·yd)
A	R630 (24.8")
B	R1,780 (5'10")
C	1,330 (4'4")
D	552 (21'7")
E	452 (17.8")
F	1,522 (5')
G	1,187 (3'11")
H	1,393.5 (4'7")
I	301.5 (11.9")
IO	301.5 (11.9")
d1	φ 100 (3.94")
d2	φ 100 (3.94")

■ DIMENSIONAL DRAWING OF LUG SECTION

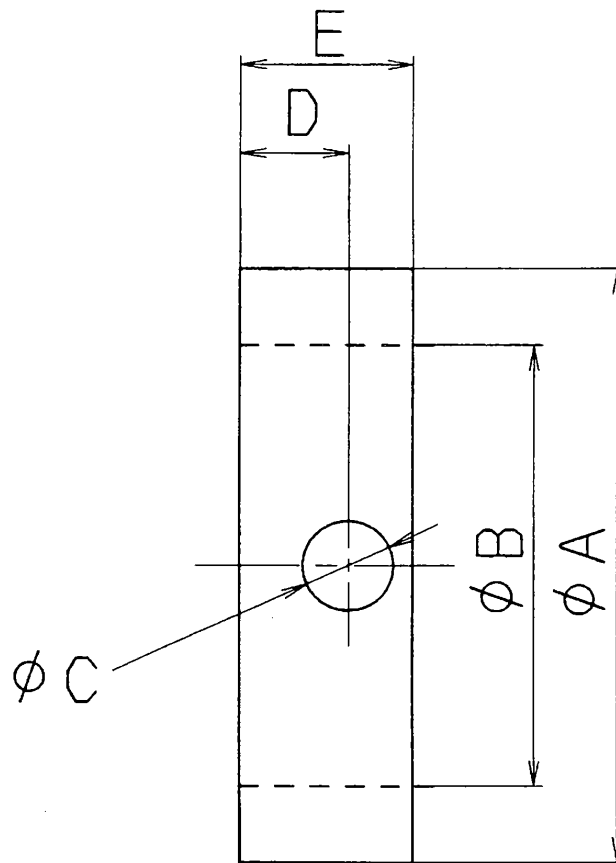


Dimension of lug section

Unit : mm (in)

Type of bucket	Capacity of bucket m ³ (cu·yd)	Pin hole dia.	Lug plate thickness	Spot facing Hole dia./Hole depth	Hole dia.	Spring pin dia.	Boss outer dia.	Screw dia.	Boss width.	Boss outer dia.	Boss width.	Screw hole P.C.D
		A	B	C1/C2	D	E	F	G	H	J	M	N
STD Spec.	[STD] 1.80 (2.35)	φ100 (3.94")	36 (1.42")	φ34/25 (1.34"/0.984")	φ120 (4.72")	φ16 (0.63")	φ220 (8.66")	M20	93 (3.66")	φ195 (7.68")	50 (1.97")	170 (6.69")

■ DIMENSIONAL DRAWING OF BOSS SECTION

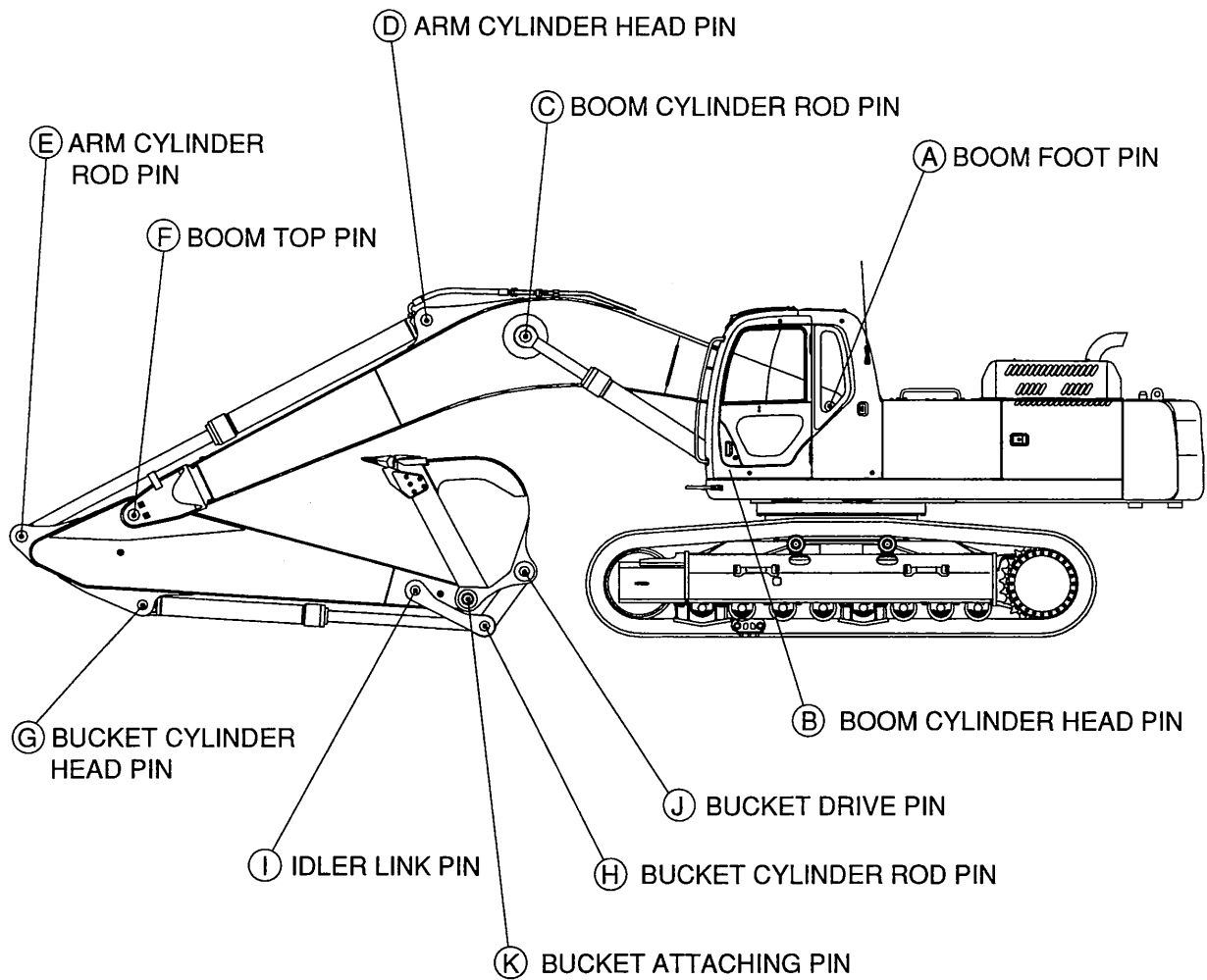


Dimension of boss section

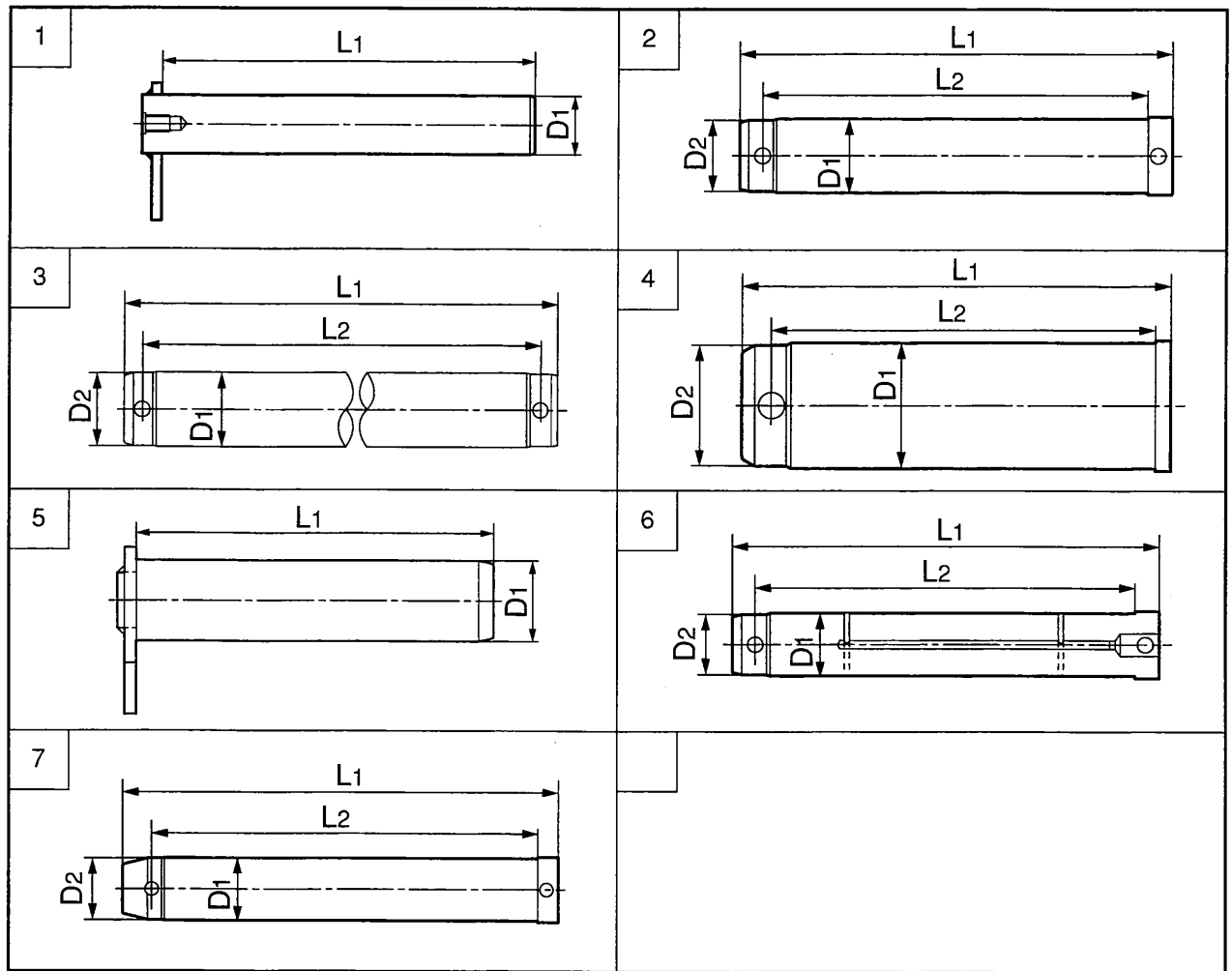
Unit : mm (in)						
Type of bucket	Capacity of bucket m ³ (cu·yd)	φ A	φ B	φ C	D	E
STD Spec.	[STD] 1.80 (2.35)	139.8 (5.50")	103.8 (4.09")	21 (0.827")	25 (0.984")	40 (1.57")

22. PIN AND BUSHING TABLE OF ATTACHMENT

■ NAME OF PIN



■ TYPES OF PIN

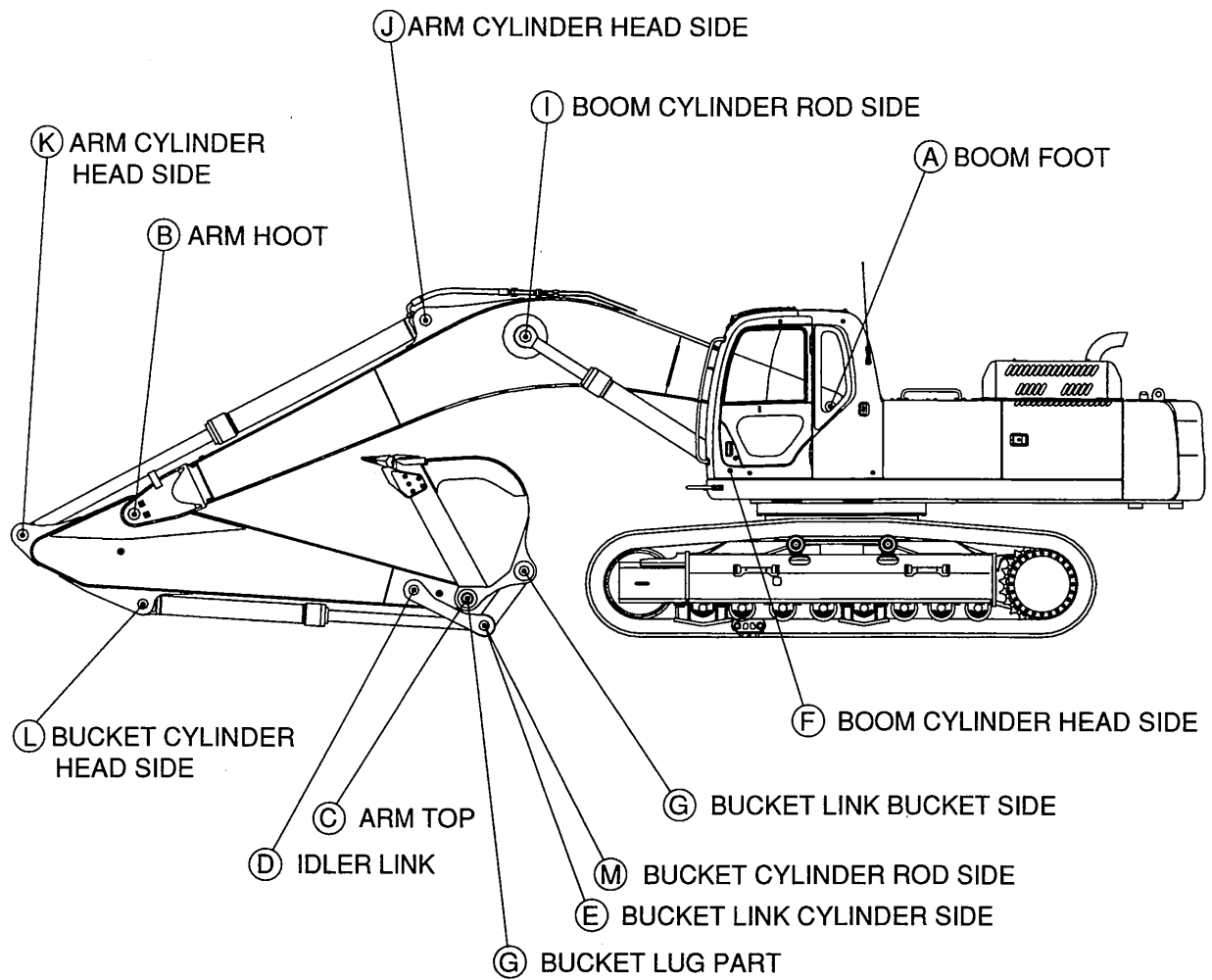


■ DIMENSIONS OF PIN

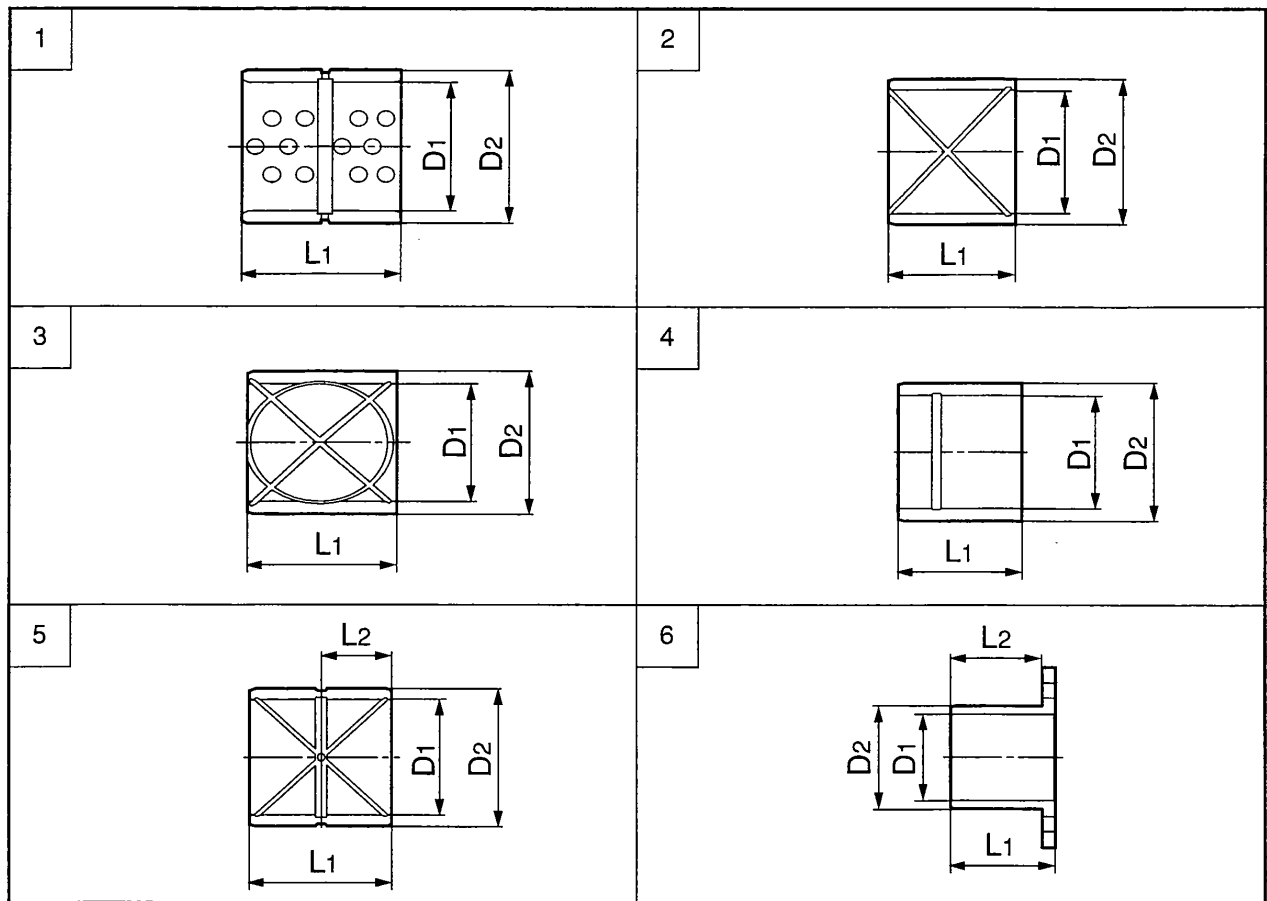
Unit : mm (ft-in)

Pin name \ Type		Pin type	L1	L2	φD1	φD2
A	Boom foot pin	1	1,179 {3'10.42"}	—	120 {3.94"}	—
B	Boom cyl.Head pin	2	406 {15.98"}	350 {13.78"}	110 {4.33"}	108 {4.25"}
C	Boom cyl.Rod pin	3	1,026 {3'4.39"}	982 {38.66"}	120 {3.94"}	118 {4.65"}
D	Arm cyl.Head pin	4	359 {14.134"}	331 {13.03"}	120 {3.94"}	118 {4.65"}
E	Arm cyl.Rod pin	4	381 {15"}	355 {13.98"}	120 {3.94"}	118 {4.65"}
F	Boom top pin	5	649 {25.55"}	—	120 {3.94"}	—
G	Bucket cyl.Head pin	4	345 {13.58"}	318 {12.52"}	100 {3.94"}	98 {3.86"}
H	Bucket cyl.Rod pin	2	630 {24.8"}	570 {22.44"}	100 {3.94"}	98 {3.86"}
I	Idler link pin	6	630 {24.8"}	570 {22.44"}	100 {3.94"}	98 {3.86"}
J	Bucket drive pin	7	779 {30.67"}	702 {27.64"}	100 {3.94"}	98 {3.86"}
K	Bucket installing pin	7	779 {30.67"}	702 {27.64"}	100 {3.94"}	98 {3.86"}

■ NAME OF BUSHING



■ TYPES OF BUSHING



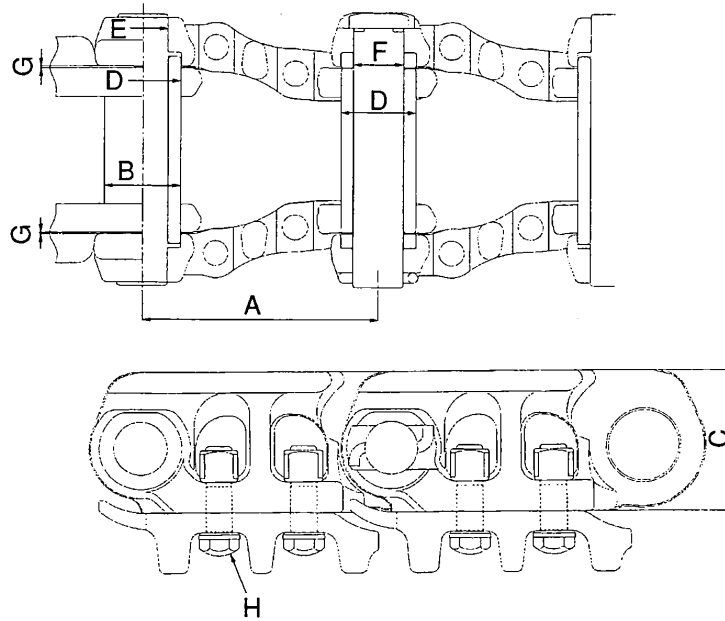
■ DIMENSIONS OF BUSHING

Unit : mm (in)

Bush name \ Type		Bush type	L1	L2	φd1	φd2
A	Boom foot	1	135 {5.82"}	—	120 {4.72"}	140 {5.51"}
B	Arm foot	2	130 {5.12"}	—	120 {4.72"}	145 {5.71"}
C	Arm top	3	128 {5.04"}	—	100 {3.94"}	120 {4.72"}
D	Idler link	4	100 {3.94"}	—	100 {3.94"}	120 {4.72"}
E	Bucket link cylinder side	5	129 {5.08"}	64.5 {2.54"}	100 {3.94"}	120 {4.72"}
F	Bucket link bucket side	2	110 {4.33"}	—	100 {3.94"}	120 {4.72"}
G	Bucket lug part	6	111 {4.37"}	99 {3.90"}	100 {3.94"}	120 {4.72"}
H	Boom cyl.Head side					
I	Boom cyl.Rod side					
J	Arm cyl.Head side					
K	Arm cyl.Rod side					
L	Bucket cyl.Head side					
M	Bucket cyl.Rod side					

23. MAINTENANCE STANDARD

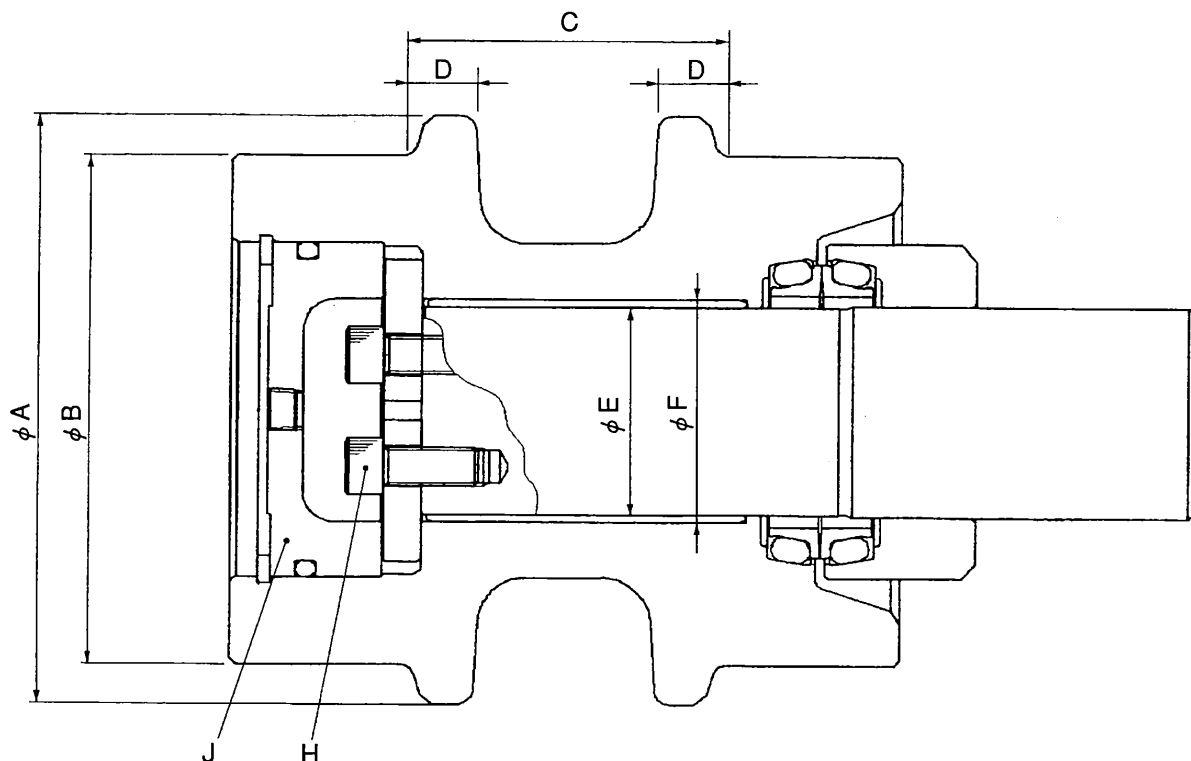
■ TRACK LINK



Unit : mm(in)

No.	ITEM	STANDARD VALUE			REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY
A	Link pitch	228.6 (9)			232 (9.13)	234 (9.21)	Replace the link assy if the service limit is exceeded
B	O.D. of bushing	ϕ73.33 (2.887)			ϕ69 (2.72)	ϕ68 (2.68)	
C	Height of link	129 (5.0787)			123 (4.84)	121 (4.76)	
D	Interference between bushing and link	Basic dimension	Tolerance		Fit	Fit	Replace
		ϕ73.33 (2.8870)	Shaft	+0.1 0 (+0.0039) 0	Interference 0.30 (0.0012)	Interference 0.26 (0.0102)	
E	Interference between track pin and link	ϕ48.83 (1.9224)	Shaft	+0.1 0 (+0.0039) 0	Interference 0.30 (0.0012)	Interference 0.26 (0.0102)	
F	Interference between master pin and link	ϕ48.58 (1.9126)	Shaft	+0.03 0 (+0.0012) 0	Interference 0.05 (0.0020)	Interference 0.03 (0.0012)	
G	Clearance between links	1.5 (0.06) (one side)			8 (0.32) (both side)	10 (0.39) (both side)	Replace
H	Tightening torque of shoe bolt	140kgf • m (1,000ft • lbs)					Reassembly

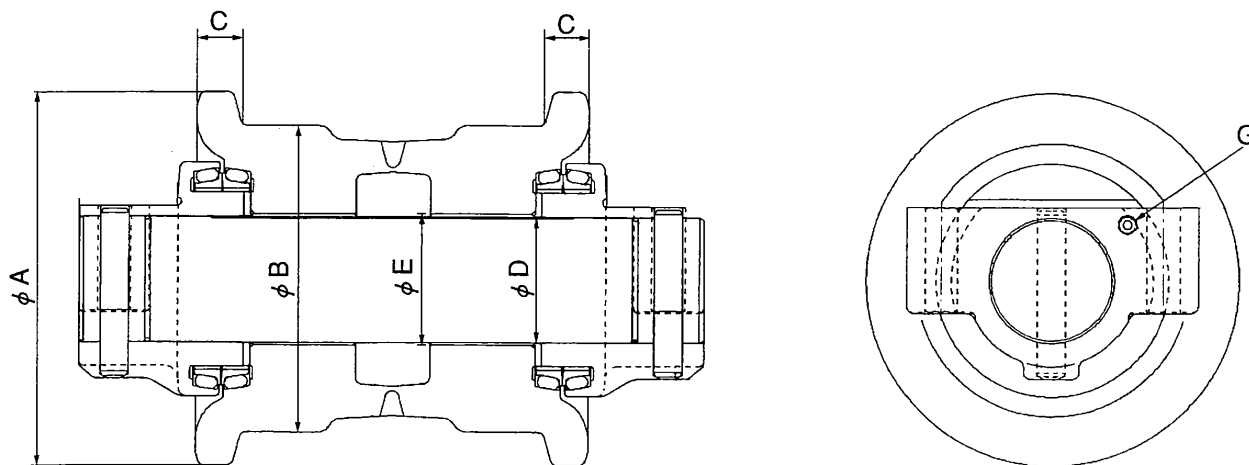
■ UPPER ROLLER



Unit : mm (in)

No.	ITEM	STANDARD VALUE		REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY
A	Dia.	$\phi 185$ (7.28)		$\phi 177$ (6.97)	$\phi 174$ (6.85)	Reinforcement weld, repair or replace
B	Tread dia.	$\phi 160$ (6.30)		$\phi 152$ (5.98)	$\phi 149$ (5.87)	
C	Width	95 (3.74)		90 (3.54)	85 (3.35)	
D	Flange width	19 (0.748)		17 (0.669)	15 (0.591)	
E	Clearance between shaft and bushing	Basic dimension	Tolerance		Standard	Limit
		$\phi 65$ (2.5591)	Shaft	-0.025 -0.040 (-0.0010) -0.0016	Clearance —	Clearance 0.8 (0.0315)
F	Interference between roller and bushing	$\phi 70$ (2.7559)	Hole	$+0.030$ 0 $(+0.0012)$ 0	Interference —	Interference 0
H	Tightening torque of socket bolt	11.7kgf · m(85 lbf · ft)				Apply locktite #262
J	Oil	Engine oil API grade CD #30, 100cc (6.1cu · in)				Refill or replace
	Roller rotation	Roller rotates smoothly by hand.				

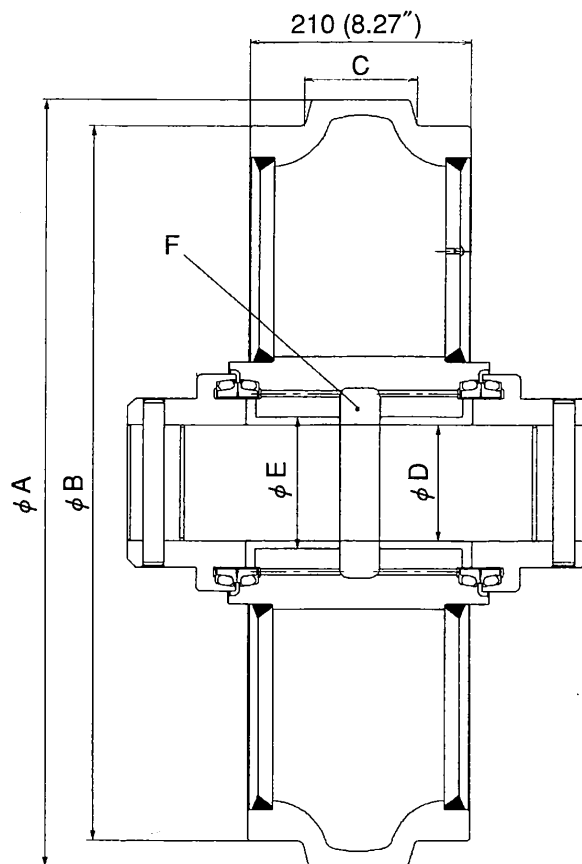
■ LOWER ROLLER



Unit : mm (in)

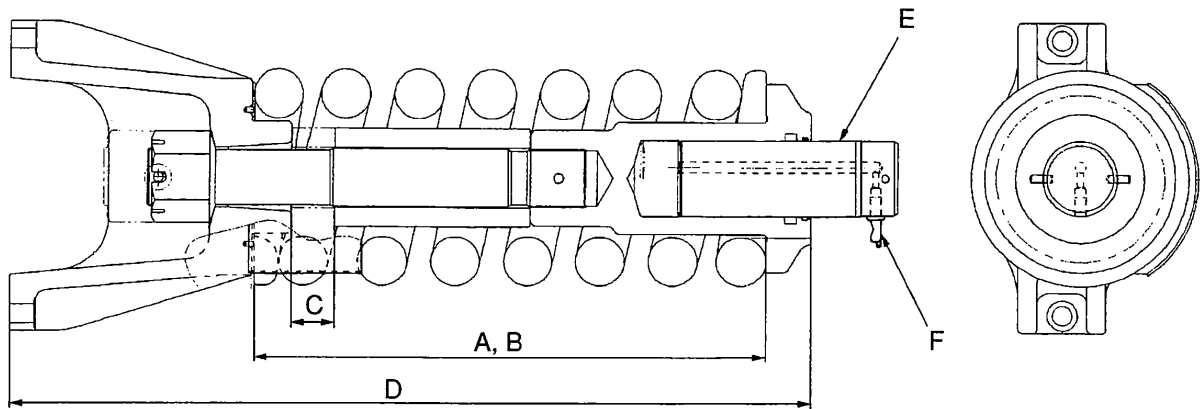
No.	ITEM	STANDARD VALUE		REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY
A	O.D. of flange	$\phi 268$ (10.6)		—	—	Reinforcement weld, repair or replace
B	Tread dia.	$\phi 220$ (8.66)		$\phi 205$ (8.07)	$\phi 204$ (8.03)	
C	Flange width	32 (1.26)				
D	Clearance between shaft and bushing (Wrapped bushing)	Basic dimension	Tolerance	Fit	Fit	Replace bushing.
		$\phi 89.94$ (3.5409)	Shaft -0.060 -0.090 (-0.0024) -0.0035	Clearance 0.7 (0.0276)	Clearance 1.0 (0.0394)	
E	Interference between roller and bushing	$\phi 93.94$ (3.6984)	Hole $+0.035$ 0 (-0.0014) 0	Interference 0.18 (0.0071)	Interference 0.16 (0.0063)	
F	Oil	Engine oil API grade CD #30, 500cc (30.5cu · in)				Refill
G	Plug (9)	Execute air leak test at 2.0kgf/cm ² (28psi) before tightening the plug.				
	Roller rotation	Rotates smoothly by hand.				Reassembly

■ FRONT IDLER



Unit : mm (in)							
No.	ITEM	STANDARD VALUE		REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY	
A	Dia. of idler projection	ϕ726 (28.6)		—	—	Replace	
B	Tread dia.	ϕ676 (26.6)		ϕ665 (26.2)	ϕ662 (26.1)		
C	Flange width	107 (4.21)		101 (3.98)	99 (3.90)		
D	Clearance between shaft and bushing	Basic dimension	Tolerance		Fit	Fit	Replace bushing.
		ϕ110 (4.3307)	Shaft	—0.030 —0.060 (—0.0012) (—0.0024)	Clearance 1.5 (0.059)	Clearance 2.0 (0.079)	
E	Interference between idler and bushing	ϕ125 (4.9212)	Hole	+0.035 0 (+0.0014) 0	Interference 0	Clearance 0.01 (0.0004)	
F	Oil	Engine oil API grade CD#30, 400cc (24.4cu • in)					Refill
	Idler rotation	Rotates smoothly by hand.					Reassemble

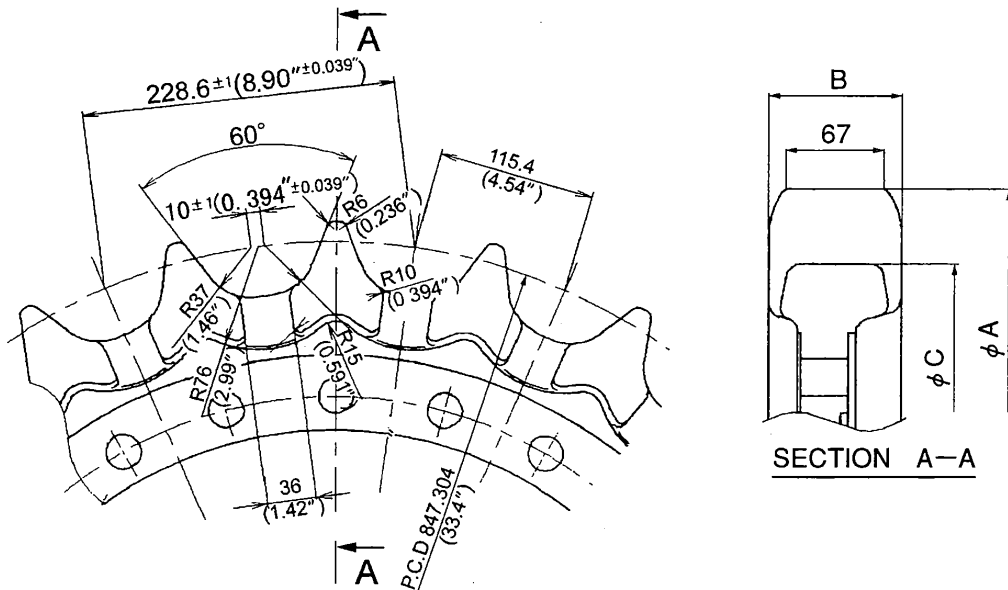
■ TRACKSPRING



No.	ITEM	STANDARD VALUE
A	Installed length of spring	679.8mm (26.8in)
B	Free length of spring	About. 816.1mm (32.1in)
C	Stroke	57mm (2.24in)
D	Set length	1060mm (41.7in)
E	Outside view of piston	Nor scoring and rusting
F	Tightening torque of grease nipple	6kgf · m (43 lbf · ft)

■ SPROCKET

SPECIFICATION	PITCH	115.4mm (4.54in)	NUMBER OF TEETH	23
	ROLLER DIA.	φ73.33 (2.89in)	PITCH DIA.	847.304 (33.4in)

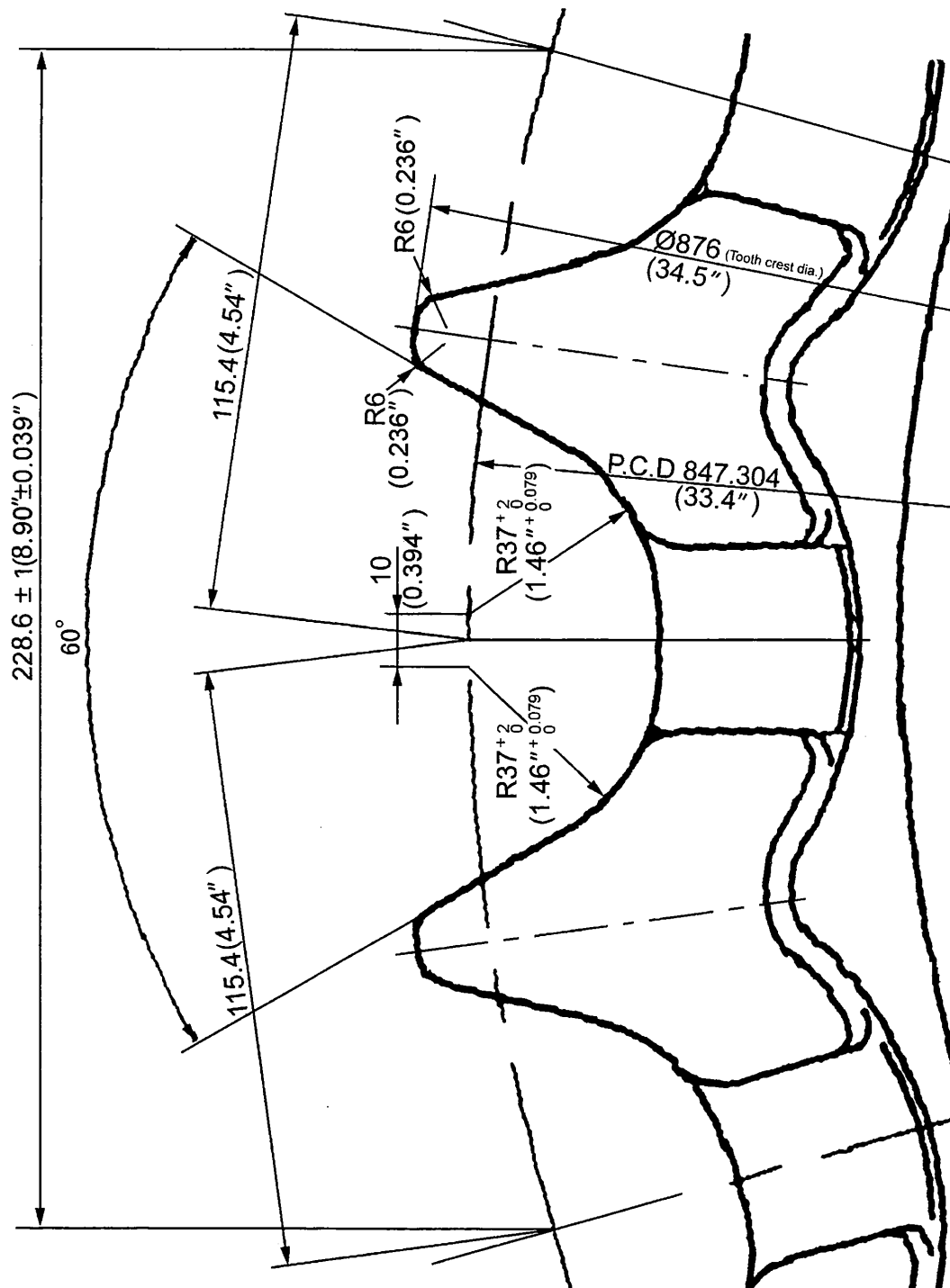


Unit:mm(in)

No.	NAME	STANDARD VALUE	REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY
A	O.D. of sprocket	φ876 (34.5)	φ868 (34.2)	φ866 (34.1)	Reinforcement weld, repair or replace.
B	Width of sprocket teeth	89 ⁰ ₋₃ (3.504 ⁰ _{-0.118})	83 (3.27)	81 (3.19)	Replace.
C	O.D. of sprocket bottom	φ773.3 (30.4)	φ765 (30.1)	φ763 (30.0)	Reinforcement weld, repair or replace.

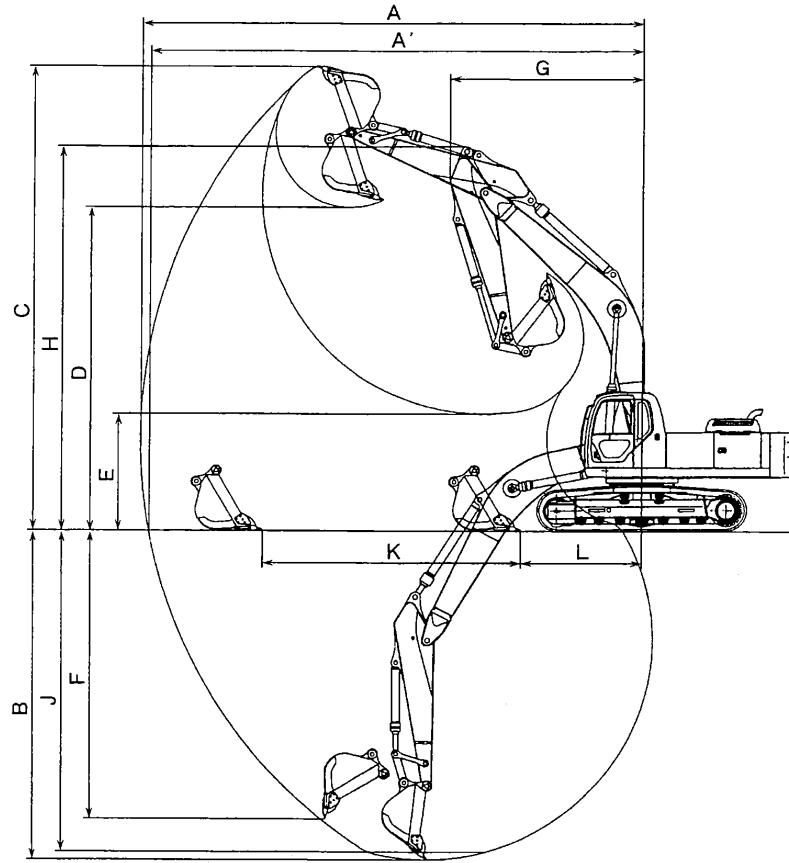
Sprocket tooth profile gauge : W

Unit : mm (in)



24. WORKING RANGE

■ BACK HOE

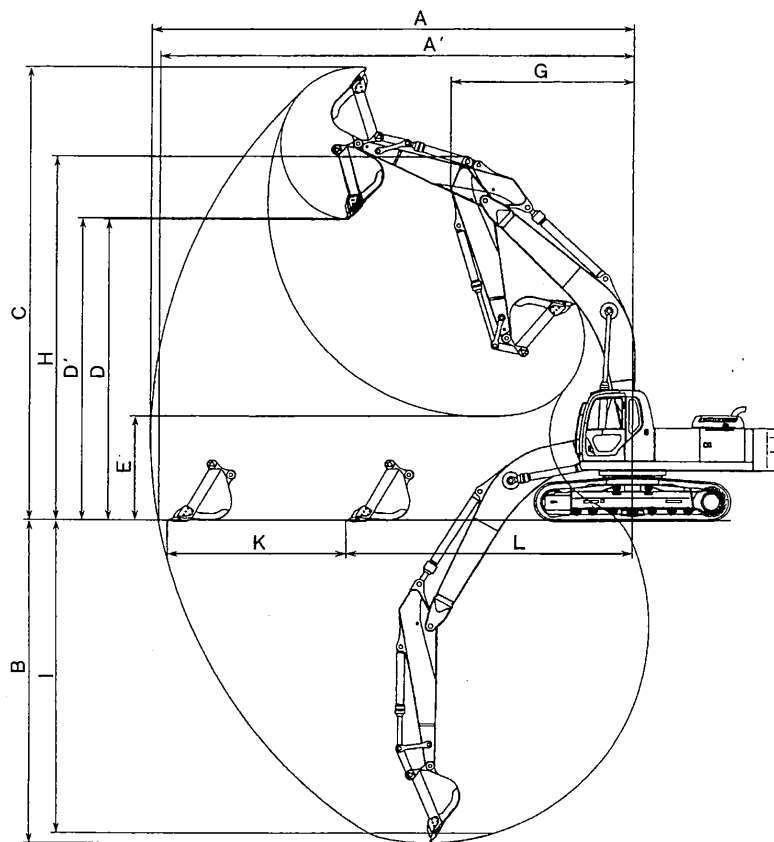


Unit :mm (ft-in)

Attachment Type			3.45m (11ft-4in) Standard Arm with 1.80m ³ (2.35cu·yd) Bucket	3.0m (9ft-10in) Short Arm with 2.05m ³ (2.68cu·yd) Bucket	4.9m (16ft-1in) Long Arm with 1.35m ³ (1.77cu·yd) Bucket
Item					
A	Maximum digging reach		12,070 (39'7")	11,770 (38'7")	13,480 (44'3")
A'	Maximum reach at ground level		11,840 (38'10")	11,540 (38'10")	13,280 (43'7")
※ B	Maximum digging depth		7,800 (25'7")	7,350 (24'1")	9,250 (30'4")
※ C	Maximum digging height		10,950 (35'11")	11,170 (36'8")	11,710 (38'5")
※ D	Maximum dumping height		7,590 (24'11")	7,730 (25'4")	8,310 (27'3")
※ E	Minimum dumping height		2,790 (9'2")	3,240 (10'8")	1,340 (4'5")
※ F	Vertical digging depth		6,950 (22'10")	6,530 (21'5")	8,400 (27'7")
G	Minimum swing radius		5,140 (16'10")	5,280 (17'4")	5,300 (17'5")
※ H	Height at minimum swing		9,050 (29'8")	9,050 (29'8")	9,050 (29'8")
※ J	8-foot level digging depth		7,660 (25'2")	7,190 (23'7")	9,140 (30'0")
K	Horizontal digging	Stroke	6,090 (20'0")	5,200 (17'1")	8,280 (27'2")
L	stroke at ground level	Minimum	3,110 (10'2")	3,690 (12'1")	2,330 (7'8")

NOTE : Dimensions marked ※ do not include the height of the shoe lug.

■ FACE SHOVEL



Unit :mm (ft-in)

Attachment Type			3.45m (11ft-4in) Standard Arm with 1.80m ³ (2.35cu·yd) Bucket	3.0m (9ft-10in) Short Arm with 2.05m ³ (2.68cu·yd) Bucket	4.9m (16ft-1in) Long Arm with 1.35m ³ (1.77cu·yd) Bucket
Item					
A	Maximum digging reach		12,280 (40'3")	11,980 (39'4")	13,690 (44'11")
A'	Maximum reach at ground level		12,060 (39'7")	11,750 (38'7")	13,500 (44'4")
※ B	Maximum digging depth		8,020 (26'4")	7,570 (24'10")	9,470 (31'1")
※ C	Maximum digging height		11,360 (37'3")	11,500 (37'8")	12,080 (39'8")
※ D	Maximum dumping height		7,410 (24'4")	7,610 (25'0")	8,160 (26'9")
D'	Maximum dumping height(45°)		7,310 (24'0")	7,150 (23'6")	7,680 (25'2")
※ E	Minimum dumping height		2,570 (8'5")	3,020 (9'11")	1,120 (3'8")
G	Minimum swing radius		5,140 (16'10")	5,280 (17'4")	5,300 (17'5")
※ H	Height at minimum swing		9,050 (29'8")	9,050 (29'8")	9,050 (29'8")
I	8-feet level digging depth		7,880 (25'10")	7,410 (24'4")	9,360 (30'9")
K	Horizontal digging	Stroke	4,740 (15'7")	4,140 (13'7")	7,370 (24'2")
L	stroke at ground level	Minimum	7,100 (23'4")	7,400 (24'3")	5,890 (19'4")

NOTE : Dimensions marked ※ do not include the height of the shoe lug.

■ LIFTING CAPACITY ASIA OCEANIA

(1) No.1

Unit : kg (lb)

SK450-VI LIFTING CAPACITIES

Based on machine equipped with
 Arm 3450mm (11' 4") arm
 Bucket SAE heaped 1.8m³ (2.35cu. yd) bucket
 Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS						
		 1.5m (4.9')	 3.0m (9.8')	 4.5m (14.8')	 6.0m (19.7')	 7.5m (24.6')	 9.0m (29.5')	
(24.6)	lb						15970	15280
(19.7)	kg						7240	6930
(14.8)	lb						16810	15000
(9.8)	kg						7620	6800
(4.9)	lb						19960	14450
(3.0)	kg						9050	6550
(1.5)	lb						19820	14150
GROUND	kg						8450	6250
LEVEL	lb						11400	9210
(-4.9)	lb	22330	22330	39710	39710	28170	26430	23350
(-9.8)	kg	10130	10130	18010	18010	12770	11980	10790
(-14.8)	lb	10130	10130	46750	37720	32360	24600	20300
(-19.7)	kg	15420	15420	21200	17100	14670	11150	9210
(-24.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-29.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-34.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-39.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-44.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-49.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-54.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-58.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-63.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-68.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-73.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-78.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-83.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-88.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-93.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-98.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-103.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-107.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-112.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-117.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-122.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-127.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-132.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-137.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-142.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-147.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-152.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-156.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-161.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-166.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-171.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-176.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-181.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-186.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-191.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-196.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-201.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-205.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-210.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-215.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-220.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-225.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-230.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-235.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-240.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-245.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-250.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-254.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-259.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-264.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-269.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-274.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-279.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-284.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-289.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-294.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-299.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-303.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-308.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-313.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-318.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-323.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-328.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-333.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-338.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-343.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-348.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-352.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-357.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-362.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-367.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-372.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-377.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-382.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-387.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-392.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-397.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-401.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-406.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-411.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-416.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-421.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-426.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-431.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-436.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-441.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-446.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-450.9)	kg	15420	15420	46750	37720	32360	24600	20300
(-455.8)	lb	15420	15420	46750	37720	32360	24600	20300
(-460.7)	kg	15420	15420	46750	37720	32360	24600	20300
(-465.6)	lb	15420	15420	46750	37720	32360	24600	20300
(-470.5)	kg	15420	15420	46750	37720	32360	24600	20300
(-475.4)	lb	15420	15420	46750	37720	32360	24600	20300
(-480.3)	kg	15420	15420	46750	37720	32360	24600	20300
(-485.2)	lb	15420	15420	46750	37720	32360	24600	20300
(-490.1)	kg	15420	15420	46750	37720	32360	24600	20300
(-495.0)	lb	15420	15420	46750	37720	32360	24600	20300
(-500.0)	kg	15420	15420	46750	37720	32360	24600	20300
(-504.9)	lb	15420	15420	46750	37720	32360	24600	20300
(-509.8)	kg	15420	15420	46750	37720	32360	24600	20300
(-514.7)	lb	15420	15420	46750	37720	32360	24600	20300
(-519.6)	kg	15420	15420	46750	37720	32360	24600	20300
(-524.5)	lb	15420	15420	46750	37720	32360	24600	20300
(-529.4)	kg	15420	15420	46750	37720	32360	24600	20300
(-534.3)	lb	15420	15420	46750	37720	32360	24600	20300
(-539.2)	kg	15420	15420	46750	37720	32360	24600	20300
(-544.1)	lb	15420	15420	46750	37720	32360	24600	20300
(-549.0)	kg	15420	15420	46750	37720	32360	24600	20300
(-553.9)	lb	15420	15420	46750	37720	32360	24600	20300
(-558.8)	kg	15420	15420	46750	37720	32360	24600	20300
(-563.7)	lb	15420	15420	46750	37720	32360	24600	20300
(-568.6)	kg	15420	15420	46750	37720	32360	24600	20300
(-573.5)	lb	15420	15420	46750	37720	32360	24600	20300
(-578.4)	kg	15420	15420	46750	37720	32360	24600	20300
(-583.3)	lb	15420	15420	46750	37720	32360	24600	20300
(-588.2)	kg	15420	15420	46750	37720	32360	24600	20300
(-593.1)	lb	15420	15420	46750	37720	32360	24600	20300
(-598.0)	kg	15420	15420	46750	37720	32360	24600	20300
(-602.9)	lb	15420	15420	46750	37720	32360	24600	20300
(-607.8)	kg	15420	15420	46750	37720	32360	24600	20300
(-612.7)	lb	15420	15420	46750	37720	324		

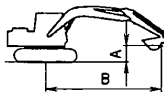
(3) No.3

Unit : kg (lb)

SK450-VI LIFTING CAPACITIES

Based on machine equipped with
Arm 3000mm (9' 10") arm
Bucket SAE heaped 2.05m³ (2.7cu. yd) bucket
Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS				
		3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(19.7)	lb					
(14.8)	kg					
(9.8)	lb					
(4.9)	kg					
(3.0)	kg					
(4.9)	lb					
(1.5)	kg					
GROUND	lb					
LEVEL	kg					
(-4.9)	lb					
(-1.5)	kg					
(-9.8)	lb					
(-3.0)	kg					
(-14.8)	lb					
(-4.5)	kg					
(-19.7)	lb					
(-6.0)	kg					



1. Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
2. Lifting capacities are based on machine standing on level, firm and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
3. Ratios at bucket lift hook.

4. The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load.
5. Operator should be fully acquainted with the operator's and Maintenance instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
6. Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

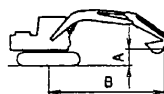
(3) No.3

Unit : kg (lb)

SK450-VI LIFTING CAPACITIES (HEAVY LIFT)

Based on machine equipped with
Arm 3000mm (9' 10") arm
Bucket SAE heaped 2.05m³ (2.7cu. yd) bucket
Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS				
		3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(19.7)	lb					
(14.8)	kg					
(9.8)	lb					
(4.9)	kg					
(3.0)	kg					
(4.9)	lb					
(1.5)	kg					
GROUND	lb					
LEVEL	kg					
(-4.9)	lb					
(-1.5)	kg					
(-9.8)	lb					
(-3.0)	kg					
(-14.8)	lb					
(-4.5)	kg					
(-19.7)	lb					
(-6.0)	kg					



1. Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
2. Lifting capacities are based on machine standing on level, firm and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
3. Ratios at bucket lift hook.

4. The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load.
5. Operator should be fully acquainted with the operator's and Maintenance instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
6. Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

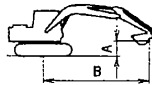
(5) No.5

Unit : kg (lb)

SK450LC-VI LIFTING CAPACITIES

Based on machine equipped with
 Arm 3450mm (11' 4") arm
 Bucket SAE heaped 1.8m³ (2.35cu. yd) bucket
 Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS					
		1.5m (4.9')	3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(24.6)	lb						* 15970
(19.7)	kg						* 7240
(14.8)	lb						* 15810
(9.8)	kg						* 7120
(4.9)	lb						* 17980
(3.0)	kg						* 8150
(1.5)	kg						* 19960
GROUND	lb						* 19960
LEVEL	kg						* 9050
(-4.9)	lb	* 22330	* 22330	* 30340	* 30340	* 49800	* 36520
(-1.5)	kg	* 10130	* 10130	* 13760	* 13760	* 22580	* 16560
(-9.8)	lb	* 34000	* 34000	* 44250	* 44250	* 68800	* 35300
(-3.0)	kg	* 15420	* 15420	* 20060	* 20060	* 31170	* 16010
(-14.8)	lb			* 59790	* 59790	* 42750	* 36100
(-4.5)	kg			* 27110	* 27110	* 19330	* 16370
(-19.7)	lb					* 33810	* 33810
(-6.0)	kg					* 15330	* 15330



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stoppage of loads, hazardous conditions, experience of personnel, etc.
- Ratings at bucket lift hook.
- The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load. Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.
- Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
- Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

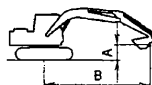
(6) No.6

Unit : kg (lb)

SK450LC-VI LIFTING CAPACITIES (HEAVY LIFT)

Based on machine equipped with
 Arm 3450mm (11' 4") arm
 Bucket SAE heaped 1.8m³ (2.35cu. yd) bucket
 Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS					
		1.5m (4.9')	3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(24.6)	lb						* 17820
(19.7)	kg						* 8080
(14.8)	lb						* 19140
(9.8)	kg						* 8680
(4.9)	lb						* 20470
(3.0)	kg						* 9280
(1.5)	kg						* 22640
GROUND	lb						* 22640
LEVEL	kg						* 10260
(-4.9)	lb	* 24790	* 24790	* 33520	* 33520	* 56120	* 36520
(-1.5)	kg	* 11240	* 11240	* 15200	* 15200	* 25450	* 16560
(-9.8)	lb	* 37530	* 37530	* 48720	* 48720	* 53650	* 36800
(-3.0)	kg	* 17020	* 17020	* 22090	* 22090	* 24330	* 16880
(-14.8)	lb			* 67480	* 67480	* 48320	* 37610
(-4.5)	kg			* 30600	* 30600	* 21910	* 17050
(-19.7)	lb					* 38430	* 38430
(-6.0)	kg					* 17430	* 17430



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stoppage of loads, hazardous conditions, experience of personnel, etc.
- Ratings at bucket lift hook.
- The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load. Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.
- Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
- Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

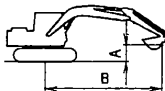
(7) No.7

Unit : kg (lb)

SK450LC-VI LIFTING CAPACITIES

Based on machine equipped with
Arm 3000mm (9' 10") arm
Bucket SAE heaped 2.05m³ (2.7cu. yd) bucket
Shoe 600mm (24") triple grouser shoe

A \ B	LOAD RADIUS				
	3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(19.7)	lb				
(14.8)	kg				
(9.8)	lb				
(4.9)	kg				
(1.5m)	kg				
GROUND	lb				
LEVEL	kg				
(-4.9)	lb				
(-1.5m)	kg				
(-9.8)	lb				
(-3.0m)	kg				
(-14.8)	lb				
(-4.5m)	kg				
(-19.7)	lb				
(-6.0m)	kg				



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
- Ratings at bucket lift hook.

4. The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load.

Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.

5. Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.

6. Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

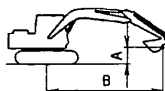
(8) No.8

Unit : kg (lb)

SK450LC-VI LIFTING CAPACITIES (HEAVY LIFT)

Based on machine equipped with
Arm 3000mm (9' 10") arm
Bucket SAE heaped 2.05m³ (2.7cu. yd) bucket
Shoe 600mm (24") triple grouser shoe

A \ B	LOAD RADIUS				
	3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(19.7)	lb				
(14.8)	kg				
(9.8)	lb				
(4.9)	kg				
(1.5m)	kg				
GROUND	lb				
LEVEL	kg				
(-4.9)	lb				
(-1.5m)	kg				
(-9.8)	lb				
(-3.0m)	kg				
(-14.8)	lb				
(-4.5m)	kg				
(-19.7)	lb				
(-6.0m)	kg				



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
- Ratings at bucket lift hook.

4. The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load.

Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.

5. Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.

6. Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

■ LIFTING CAPACITY EU

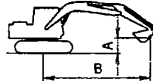
(1) No.11

Unit : kg (lb)

SK480LC-VI LIFTING CAPACITIES

Based on machine equipped with
 Arm 3450mm (11' 4") arm
 Bucket SAE heaped 1.8m³ (2.35cu. yd) bucket
 Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS					
		1.5m (4.9')	3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(24.6)	lb						* 15960
(7.9)	kg						7230
(19.7)	lb						* 16770
(6.0)	kg						7600
(14.8)	lb						* 17940
(4.5)	kg						8130
(9.8)	lb					* 19910	* 19910
(3.0)	kg					9030	9030
(4.9)	lb					* 22570	* 18900
(1.5)	kg					10230	8570
GROUND	lb					* 25080	* 17830
LEVEL	kg					11310	8080
(-4.9)	lb					* 23760	* 17050
(-1.5)	kg					10770	7730
(-9.8)	lb	* 22320	* 22320	* 30330	* 30330	* 36030	* 23220
(-3.0)	kg	* 10120	* 10120	* 13750	* 13750	* 16340	* 10530
(-14.8)	lb	* 33990	* 33990	* 44240	* 44240	* 47480	* 23210
(-4.5)	kg	* 15410	* 15410	* 20060	* 20060	* 21530	* 10520
(-19.7)	lb					* 37530	* 32170
(-6.0)	kg					14580	10740
						* 24890	* 11150
						7700	



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
- Rated at bucket lift hook.
- The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load. Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.
- Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
- Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

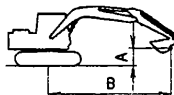
(2) No.12

Unit : kg (lb)

SK450LC-VI LIFTING CAPACITIES (HEAVY LIFT)

Based on machine equipped with
 Arm 3000mm (9' 10") arm
 Bucket SAE heaped 2.05m³ (2.7cu. yd) bucket
 Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS				
		3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(19.7)	lb				* 21430	20850
(6.0)	kg				9720	9450
(14.8)	lb				* 23890	19830
(4.5)	kg				* 10830	8990
(9.8)	lb				* 26350	18710
(3.0)	kg				* 12130	8480
(4.9)	lb				* 29380	17730
(1.5)	kg				* 13320	8040
GROUND	lb				* 30010	17050
LEVEL	kg				13610	7730
(-4.9)	lb	* 31210	* 31210	* 36680	* 40880	* 29550
(-1.5)	kg	* 14150	* 14150	* 16630	* 18540	* 13450
(-9.8)	lb	* 49950	* 49950	* 52230	* 57140	* 29470
(-3.0)	kg	* 22650	* 22650	* 23680	* 25840	* 13490
(-14.8)	lb	* 62230	* 62230	* 45870	* 38120	* 34970
(-4.5)	kg	* 28220	* 28220	* 20800	* 17290	* 15860
(-19.7)	lb					* 34050
(-6.0)	kg					15440



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
- Rated at bucket lift hook.
- The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load. Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.
- Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
- Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

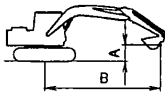
(3) No.13

Unit : kg (lb)

SK480LC-VI LIFTING CAPACITIES

Based on machine equipped with
Arm 3000mm (9' 10") arm
Bucket SAE heaped 2.05m³ (2.7cu. yd) bucket
Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS				
		3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(19.7)	lb					
(14.8)	lb					
(9.8)	lb					
(4.9)	lb					
(1.5)	lb					
GROUND	kg					
LEVEL	kg					
(-4.9)	lb					
(-1.5)	lb					
(-9.8)	lb					
(-3.0)	lb					
(-14.8)	lb					
(-4.5)	lb					
(-19.7)	lb					
(-6.0)	kg					



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
- Retines at bucket lift hook.
- The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load. Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.
- Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
- Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

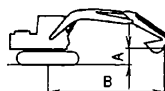
(4) No.14

Unit : kg (lb)

SK480LC-VI LIFTING CAPACITIES (HEAVY LIFT)

Based on machine equipped with
Arm 3000mm (9' 10") arm
Bucket SAE heaped 2.05m³ (2.7cu. yd) bucket
Shoe 600mm (24") triple grouser shoe

A \ B		LOAD RADIUS				
		3.0m (9.8')	4.5m (14.8')	6.0m (19.7')	7.5m (24.6')	9.0m (29.5')
(19.7)	lb					
(14.8)	lb					
(9.8)	lb					
(4.9)	lb					
(1.5)	lb					
GROUND	kg					
LEVEL	kg					
(-4.9)	lb					
(-1.5)	lb					
(-9.8)	lb					
(-3.0)	lb					
(-14.8)	lb					
(-4.5)	lb					
(-19.7)	lb					
(-6.0)	kg					



- Do not attempt to lift or hold any load that is greater than these rated values at their specified load radius and height. Weight of all accessories must be deducted from the above lifting capacities.
- Lifting capacities are based on machine standing on level, firm, and uniform ground. User must make allowance for job conditions such as soft or uneven ground out of level conditions, side loads, sudden stopping of loads, hazardous conditions, experience of personnel, etc.
- Retines at bucket lift hook.
- The above rated loads are in compliance with SAE Hydraulic Excavator Lift Capacity Rating Standard J 1097. They do not exceed 87% of hydraulic lifting capacity or 75% of tipping load. Rated loads marked with an asterisk (*) are limited by hydraulic capacity rather than tipping load.
- Operator should be fully acquainted with the operator's and Maintenance Instructions before operating this machine and rules for safe operation of equipment should be adhered to at all times.
- Capacities apply to only machine as originally manufactured and normally equipped by KOBELCO CONSTRUCTION MACHINERY CO., LTD.

25. TIGHTENING TORQUES FOR CAPSCREWS AND NUTS

Tables 1-1 and 1-2 indicate tightening torques applicable to cases where no special note is given.

Overtightening of bolts may result in a twist-off and a fracture under load.

Insufficient tightening may lead to a loosening or loss of bolts. Always tighten bolts to proper torques.

Table 1-1 Tightening torque for metric coarse threads (not plated)

unit : kgf·m (lbf·ft)

Strength grade	Size	Use	4.8T		7T		10.9T	
			No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M 6	P=1		0.45±0.05 (3.3±0.4)	0.38±0.04 (2.7±0.3)	0.98±0.1 (7.1±0.7)	0.83±0.08 (6.0±0.6)	1.77±0.18 (13±1)	1.5±0.15 (11±1)
M 8	P=1.25		1.09±0.11 (7.9±0.8)	0.92±0.09 (6.7±0.7)	2.4±0.2 (17±1)	2.0±0.2 (14±1)	4.3±0.4 (32±3)	3.6±0.4 (26±3)
M10	P=1.5		2.2±0.2 (16±1)	1.83±0.18 (13±1)	4.7±0.5 (34±4)	4.0±0.4 (29±3)	8.5±0.9 (61±7)	7.2±0.7 (52±5)
M12	P=1.75		3.7±0.4 (27±3)	3.2±0.3 (23±2)	8.1±0.8 (59±6)	6.8±0.7 (49±5)	14.6±1.5 (110±11)	12.3±1.2 (89±9)
M14	P=2		5.9±0.6 (43±4)	5.0±0.5 (36±4)	12.8±1.3 (93±9)	10.8±1.1 (78±8)	23±2 (170±14)	19.5±1.9 (140±14)
M16	P=2		9.0±0.9 (65±7)	7.6±0.7 (55±5)	19.5±2.0 (140±14)	16.4±1.6 (120±12)	35±4 (250±29)	29±3 (210±22)
M18	P=2.5		12.4±1.2 (90±9)	10.5±1.0 (76±7)	27±3 (200±22)	23±2 (170±14)	49±5 (350±36)	41±4 (300±29)
M20	P=2.5		17.5±1.7 (130±12)	14.7±1.4 (110±10)	38±4 (270±29)	32±3 (230±22)	68±7 (490±51)	57±6 (410±43)
M22	P=2.5		23±2 (170±14)	19.6±2.0 (140±14)	51±5 (370±36)	43±4 (310±29)	92±9 (670±65)	77±8 (560±58)
M24	P=3		30±3 (220±22)	24±3 (170±22)	65±7 (470±51)	53±5 (380±36)	118±12 (850±87)	96±10 (690±72)
M27	P=3		44±4 (320±29)	36±4 (260±29)	96±10 (690±72)	78±8 (560±58)	173±17 (1300±120)	140±14 (1000±100)
M30	P=3.5		60±6 (430±43)	50±5 (360±36)	131±13 (950±94)	110±11 (800±80)	235±24 (1700±170)	198±20 (1400±140)
M33	P=3.5		81±8 (590±58)	68±7 (490±51)	176±18 (1300±130)	148±15 (1100±110)	317±32 (2300±230)	266±27 (1900±200)
M36	P=4		105±10 (760±72)	88±9 (640±65)	227±23 (1600±170)	190±19 (1400±140)	409±41 (3000±300)	343±34 (2500±250)

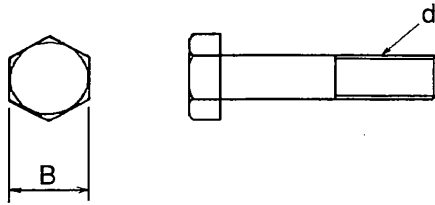
Table 1-2 Tightening torques for metric fine threads (not plated)

unit : kgf·m (lbf·ft)

Strength grade	Size	Use	4.8T		7T		10.9T	
			No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M 8	P=1		1.15±0.11 (8.3±0.8)	0.97±0.1 (7.0±0.7)	2.5±0.2 (18±1)	2.1±0.2 (15±1)	4.5±0.4 (33±3)	3.8±0.4 (27±3)
M10	P=1.25		2.3±0.2 (17±1)	1.91±0.19 (14±1)	4.9±0.5 (35±4)	4.2±0.4 (30±3)	8.9±0.9 (64±7)	7.5±0.7 (54±5)
M12	P=1.25		4.0±0.4 (29±3)	3.4±0.3 (25±2)	8.7±0.9 (63±7)	7.3±0.7 (53±5)	15.7±1.6 (110±12)	13.2±1.3 (95±9)
M16	P=1.5		9.4±0.9 (68±7)	7.9±0.8 (57±6)	20±2 (140±14)	17.2±1.7 (120±12)	37±4 (270±29)	31±3 (220±22)
M20	P=1.5		19±1.9 (140±14)	15.8±1.6 (110±12)	41±4 (300±29)	34±3 (250±22)	74±7 (540±51)	62±6 (450±43)
M24	P=2		32±3 (230±22)	27±3 (200±22)	70±7 (510±51)	58±6 (420±43)	126±12 (910±87)	105±10 (760±72)
M30	P=2		65±6 (470±43)	54±5 (390±36)	142±14 (1000±100)	118±12 (850±87)	255±26 (1800±190)	212±21 (1500±150)
M33	P=2		87±9 (630±65)	72±7 (520±51)	190±19 (1400±140)	158±16 (1100±120)	341±34 (2500±250)	284±28 (2100±200)
M36	P=3		109±11 (790±80)	91±9 (660±65)	238±23 (1700±170)	198±20 (1400±140)	428±43 (3100±310)	357±36 (2600±260)

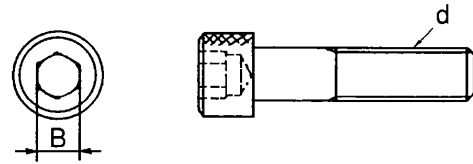
26. SCREW SIZE AND TOOLS NOMINAL SIZE

(1) Capscrew



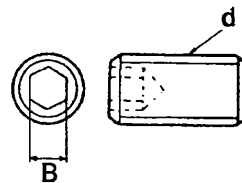
Nominal screw size	B mm
(d)	Tool size
M6	10
M8	13
M10	17
M12	19
(M14)	(22)
M16	24
(M18)	(27)
M20	30
(M22)	32
M24	36
(M27)	(41)
M30	46
M36	55
M42	65
M45	70
M48	75
M56	85
(M60)	90
M64	95
(M68)	100
M72	105
M76	110
M80	115

(2) Socket bolt



Nominal screw size	B mm
(d)	Tool size
(M3)	2.5
(M4)	3
(M5)	4
M6	5
M8	6
M10	8
M12	10
M14	12
M16	14
(M18)	14
M20	17
(M22)	17
M24	19
(M27)	19
M30	22
M36	27
M42	32
(M45)	32
M48	36
M52	36

(3) Set screw



Nominal screw size	B mm
(d)	Tool size
M2.5	1.27
M3	1.5
M4	2
M5	2.5
M6	3
M8	4
M10	5
M12	6
M16	8
M20	10

27. TIGHTENING TORQUES FOR NUTS AND SLEEVES

Table 3 indicates standard tightening torques applicable to cases where no particular note is given. Overtightening or under-tightening of nuts and sleeves in FLARELESS JOINT may develop oil leaks through pipe connections. Always tighten nuts and sleeves to proper torques.

Table 3-1

Manufacturer's name	Working pressure kgf / cm ² (psi)	Tube size OD×thickness mm (in)	Opposing flats (HEX)	Tightening torque kgf·m (lbf·ft)
Nippon A.M.C.	300 (4270)	10×1.5 (0.394×0.059)	19	5.0±1.0 (36±7.2)
		15×2.0 (0.591×0.079)	27	12±1.2 (87±8.7)
		18×2.5 (0.709×0.098)	32	15±1.5 (110±11)
		22×3.0 (0.866×0.118)	36	22±2.2 (160±16)
		28×4.0 (1.10×0.157)	41	28±2.8 (200±20)
		35×5.0 (1.38×0.197)	55	45±4.5 (330±33)

Table 3-2

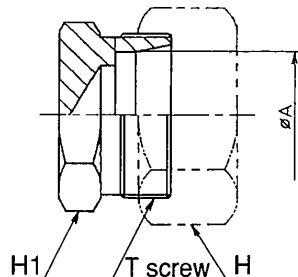
SLEEVE

NUT

Tube size ϕd	Parts No.		Tube size ϕd	Opposing flats (HEX) B	Parts No.	
	Ihara Koatu	Nippon A.M.C.			Ihara Koatu	Nippon A.M.C.
6	ZF93S06000	—	6	14	ZF93N06000	—
8	ZF93S08000	—	8	17	ZF93N08000	—
10	ZF93S10000	ZA93S10000	10	19	ZF93N10000	ZA93N10000
12	ZF93S12000	—	12	22	ZF93N12000	—
15	ZF93S15000	ZA93S15000	15	27	ZF93N15000	ZA93N15000
18	ZF93S18000	ZA93S18000	18	32	ZF93N18000	ZA93N18000
22	ZF93S22000	ZA93S22000	22	36	ZF93N22000	ZA93N22000
28	ZF93S28000	ZA93S28000	28	41	ZF93N28000	ZA93N28000
32	ZF93S32000	—	32	50	ZF93N32000	—
35	ZF93S35000	ZA93S35000	35	55	ZF93N35000	ZA93N35000
38	ZF93S38000	—	38	60	ZF93N38000	—

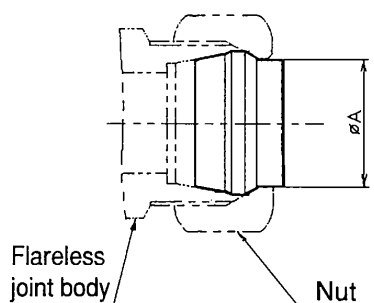
(1) Plug for hydraulic pipe joint

1) Cap nut (Joint plug)



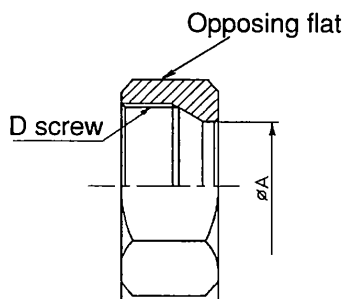
Applicable pipe O. D : A	Cap nut parts No.	T screw	Opposing flat	
			H1	H
6	ZF83H06000	M12×1.5	14	14
8	ZF83H08000	M14×1.5	17	17
10	ZF83H10000	M16×1.5	17	19
12	ZF83H12000	M18×1.5	19	22
15	ZF83H15000	M22×1.5	24	27
18	ZF83H18000	M26×1.5	27	32
22	ZF83H22000	M30×1.5	32	36
28	ZF83H28000	M36×1.5	38	41

2) Plug (Tube plug)



Applicable pipe O. D : A	Plug parts No.
6	ZF83P06000
8	ZF83P08000
10	ZF83P10000
12	ZF83P12000
15	ZF83P15000
18	ZF83P18000
22	ZF83P22000
28	ZF83P28000

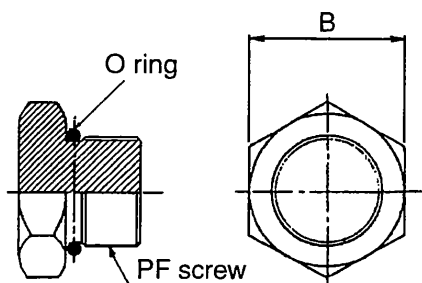
3) Nut



Applicable pipe O. D : A	Nut parts No.	D screw	Opposing flat
6	ZF93N06000	M12×1.5	14
8	ZF93N08000	M14×1.5	17
10	ZF83N10000	M16×1.5	19
12	ZF93N12000	M18×1.5	22
15	ZF93N15000	M22×1.5	27
18	ZF93N18000	M26×1.5	32
22	ZF93N22000	M30×1.5	36
28	ZF93N28000	M36×1.5	41
32	ZF93N32000	M42×1.5	50
35	ZF93N35000	M45×1.5	55
38	ZF93N38000	M48×1.5	60

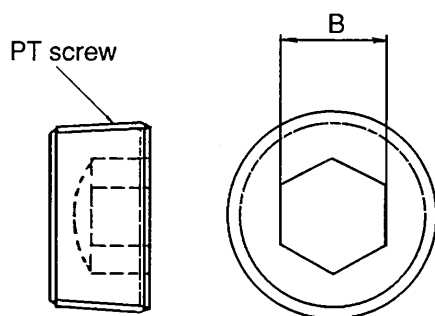
(2) Plug for hydraulic equipment

1) PF screw



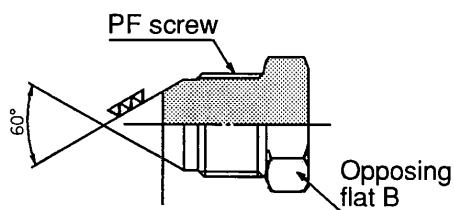
PF screw	Plug parts No.	B mm	O ring parts No.	Nominal O ring
PF 1/4	ZE72X04000	19	ZD12P01100	1B P11
PF 3/8	ZE72X06000	22	ZD12P01400	1B P14
PF 1/2	ZE72X08000	27	ZD12P01800	1B P18
PF 3/4	ZE72X12000	36	ZD12P02400	1B P24
PF 1	ZE72X16000	41	ZD12P02900	1B P29

2) PT screw

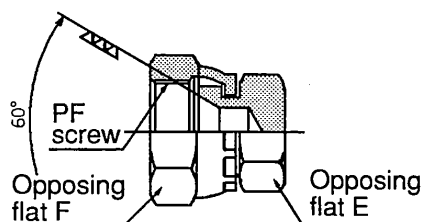


PT screw	Plug parts No.	B mm
PT 1/8	ZE82T02000	5
PT 1/4	ZE82T04000	6
PT 3/8	ZE82T06000	8
PT 1/2	ZE82T08000	10
PT 3/4	ZE82T12000	14
PT 1	ZE82T16000	17
PT 1 1/4	ZE82T20000	22
PT 1 1/2	ZE82T24000	22

(3) Plug for (F) flare hose



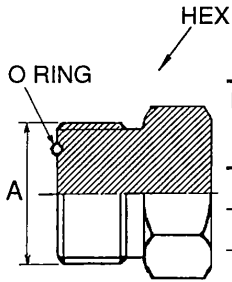
PF screw	Plug parts No.	B mm
PF 1/4	2444Z2728D1	14
PF 3/8	2444Z2728D2	17
PF 1/2	2444Z2728D3	22
PF 3/4	2444Z2728D4	27
PF 1	2444Z2728D5	36



PF screw	Plug parts No.	E mm	F mm
PF 1/4	2444Z2729D1	14	19
PF 3/8	2444Z2729D2	17	22
PF 1/2	2444Z2729D3	23	27
PF 3/4	2444Z2729D4	27	36
PF 1	2444Z2729D5	36	41
PF 1 1/4	2444Z2729D6	40	50

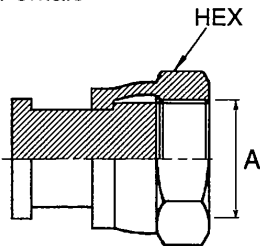
(4) Plug for ORS joints

Male



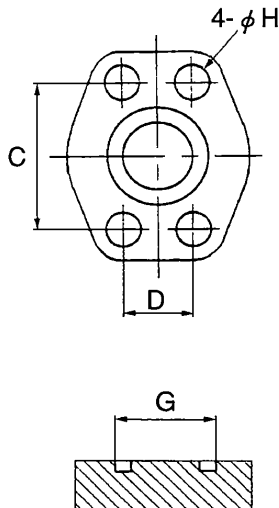
Nominal screw size	Screw size A	Applicable hose O.D	Plug parts No.	Opposing flats(HEX)	O ring parts No.	Nominal Oring
5/8	1-14UNS	ϕ 21.7	YN01H01001P1	27	ZD12A01600	1B A16
3/4	1 3/16-12UN	ϕ 27.2	YN01H01002P1	36	ZD12A01800	1B A18
1	1 7/16-12UN	ϕ 34.0	YN01H01003P1	41	ZD12A02100	1B A21

Female



Nominal screw size	Screw size A	Applicable tube O.D	Plug parts No.	Opposing flats(HEX)
5/8	1-14UNS	ϕ 21.7	YN01H01004P1	32
3/4	1 3/16-12UN	ϕ 27.2	YN01H01005P1	36
1	1 7/16-12UN	ϕ 34.0	YN01H01006P1	41

(5) Plug for half clamp [high pressure : 420kgf/cm² (5970psi)]

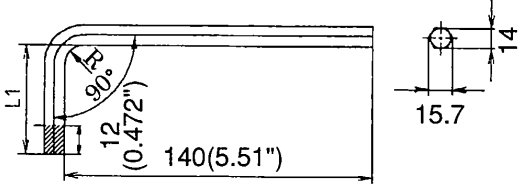
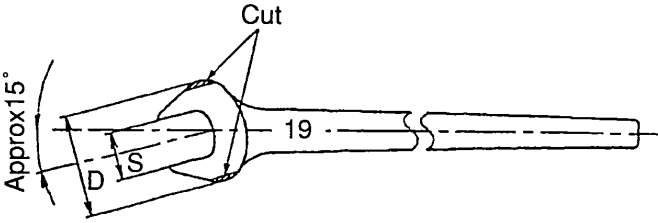
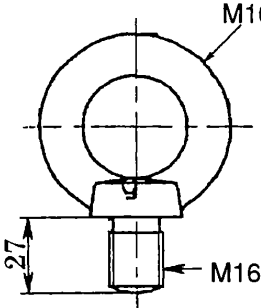
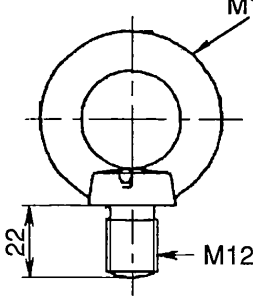


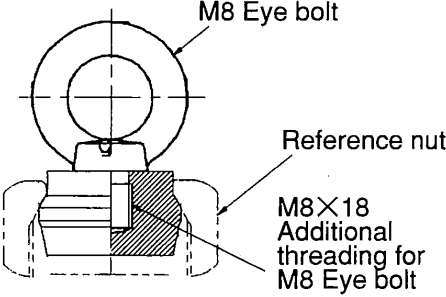
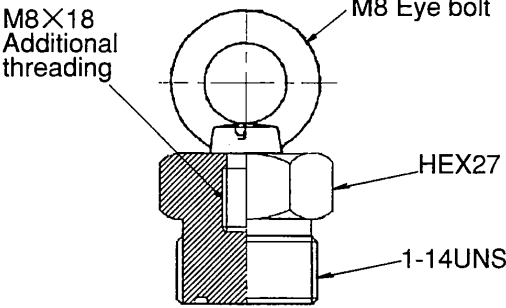
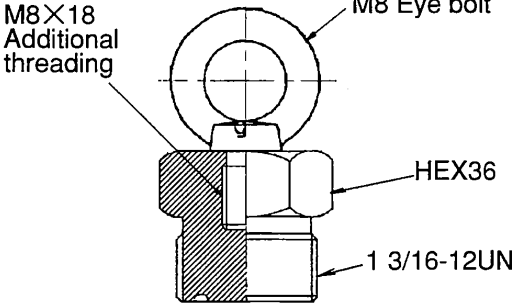
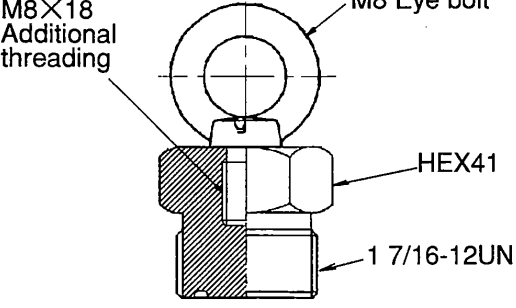
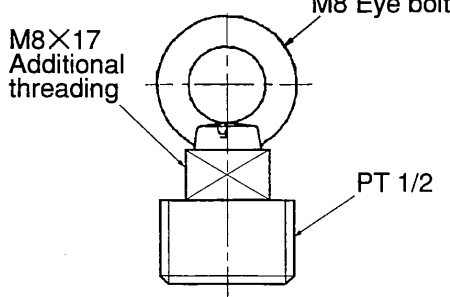
Nominal screw size	Plug parts No.	C mm	D mm	G mm	H mm	Applicable O ring parts No.
1/2	ZE13Q08000	40.49	18.24	25.53 25.40	9	2445Z831D1
3/4	ZE13Q12000	50.80	23.80	31.88 31.75	11	ZD12P02600
1	ZE13Q16000	57.15	27.76	39.75 39.62	13	ZD12P03400
1 1/4	ZE13Q20000	66.68	31.75	44.58 44.45	15	ZD12P03800

28. SPECIAL SPANNER FOR TUBE

Applicable tube diameter mm (in)	Part No.	HEX mm	Drawing of a special spanner mm (in)
15	2421T160	27	
18	2421T138	32	
22	2421T129	30	
22	2421T130	36	
28	2421T115	41	
28	2421T231	46	
32	2421T232	50	

29. SPECIAL TOOLS

No.	Tools name	Tools No.	Shape	Applicable
1	Allen wrench Nominal 14	ZT22A14000	 Commercial tool length(L1) — cut length = Required length $56(2.20") - 12(0.472") = 44(1.73")$	Pump suction
2	Allen wrench Nominal 17	ZT22A17000	General tools	Pump install
3	Spanner Nominal 19	ZT12A19000	 Commercial tool outer width (D) — cut length = Required length $45(1.77") - 8(0.315") = 37(1.46")$	Swing motor A,B port
4	Eye bolt	ZS91C01600 or commercial equivalent	 M16 Eye bolt M16	For slinging the swing motor
5	Eye bolt M12×22	ZS91C01200 or commercial equivalent	 M12 Eye bolt M12	Flare hose

No.	Tools name	Tools No.	Shape	Applicable
6	Plug (Nominal tube dia. 22) Reference Eye bolt Nut	ZF83P22000 ZS91C00800 ZF93N22000		Flare hose
7	Plug Nominal 1-14UNS Eye bolt	YN01H01001P1 ZS91C00800		Flare hose
8	Plug Nominal 1 3/16-12UN Eye bolt	YN01H01002P1 ZS91C00800		Flare hose
9	Plug Nominal 1 7/16-12UN Eye bolt	YN01H01003P1 ZS91C00800		Flare hose
10	Plug PT1/2 Eye bolt	ZE72T08000 ZS91C00800		For slinging the swivel joint

30. APPLICATION OF SCREW LOCKING COMPOUND AND SEALING COMPOUND

(1) For general use

Service	Manufacturer		Features
	Loctite	Three-Bond	
Screw locking compound	#242	1360K	Low strength
	#262	1374	Middle strength
	#271	1305	High strength
Sealing compound	#515	1215	Sealing

(2) For specific location

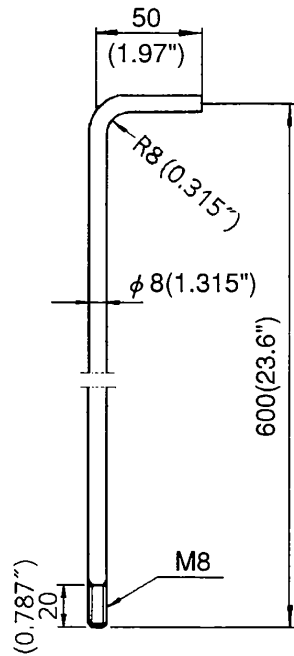
No.	Use	Manufacturer	Name	Equivalent	Applicable
	Sealing compound & adhesive	Three-Bond	#1901	(Manufacturer ; Loctite) Anti-seizure	Cylinder
			#1215 gray	#5699	Swing motor
			#1211 white	#5301J	Swing motor
			#1303B	#211	Main pump
		Loctite	#222	(Manufacturer ; Three-Bond) #1344N	Main pump
			#277	#1307N	Pilot valve
		Loctite Sumitomo Chemical Co., Ltd. Showa-Shell petroleum	Parmatex 98D	(Manufacturer ; Three-Bond) #1121	Hydraulic oil tank : Hose
			Cyano Bond P0—1		For swing bearing : Seal
			Shell Alvania EP2	New Molyknock Grease 2	Swing bearing grease bath

31. SUCTION STOPPER

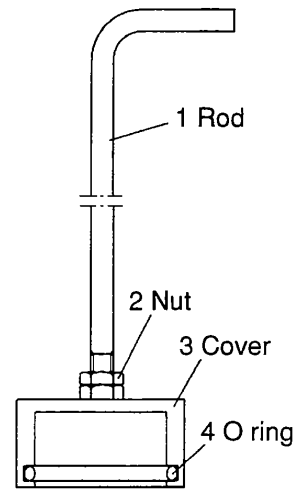
COMPONENTS

No.	NAME	PARTS No.	Q'TY
	SUCTION STOPPER ASSY	24100P978F3	
1	ROD	2420T4660D1	1
2	NUT	ZN16C08007	1
3	COVER	2414T2123D3	1
4	O RING	45Z91D7	1

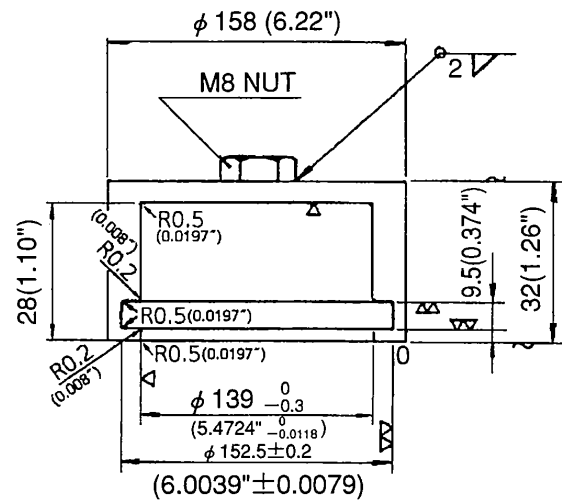
DIMENSION



ROD



Components of suction stopper



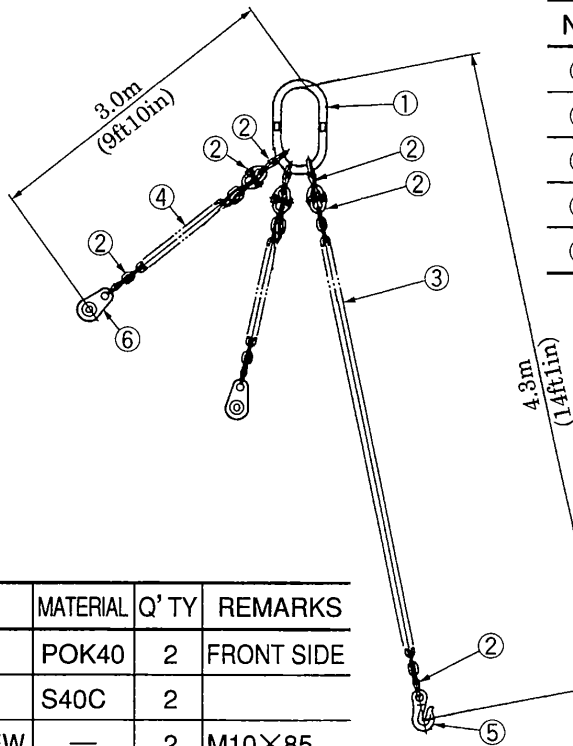
COVER

Dimension of suction stopper

APPLICABLE MODEL

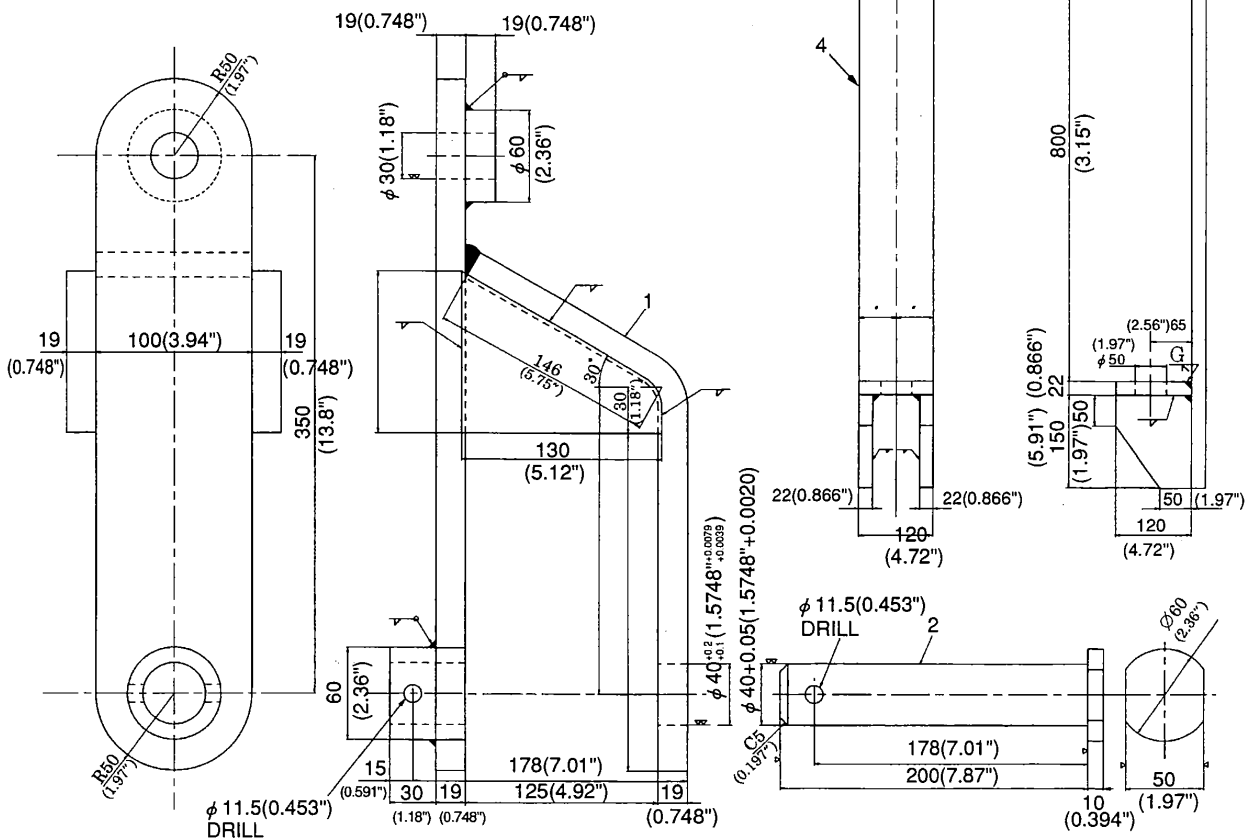
24100P978F3 APPLICABLE MODEL																
MODEL SERIES	TYPE 1	TYPE 2	TYPE 3	TYPE 6												
SK450-VI	⊙	⊙	⊙	⊙												
SK450LC-VI	⊙	⊙	⊙	⊙												
SK480-VI	⊙	⊙	⊙	⊙												
SK480LC-VI	⊙	⊙	⊙	⊙												

32. UPPER FRAME LIFTING JIG

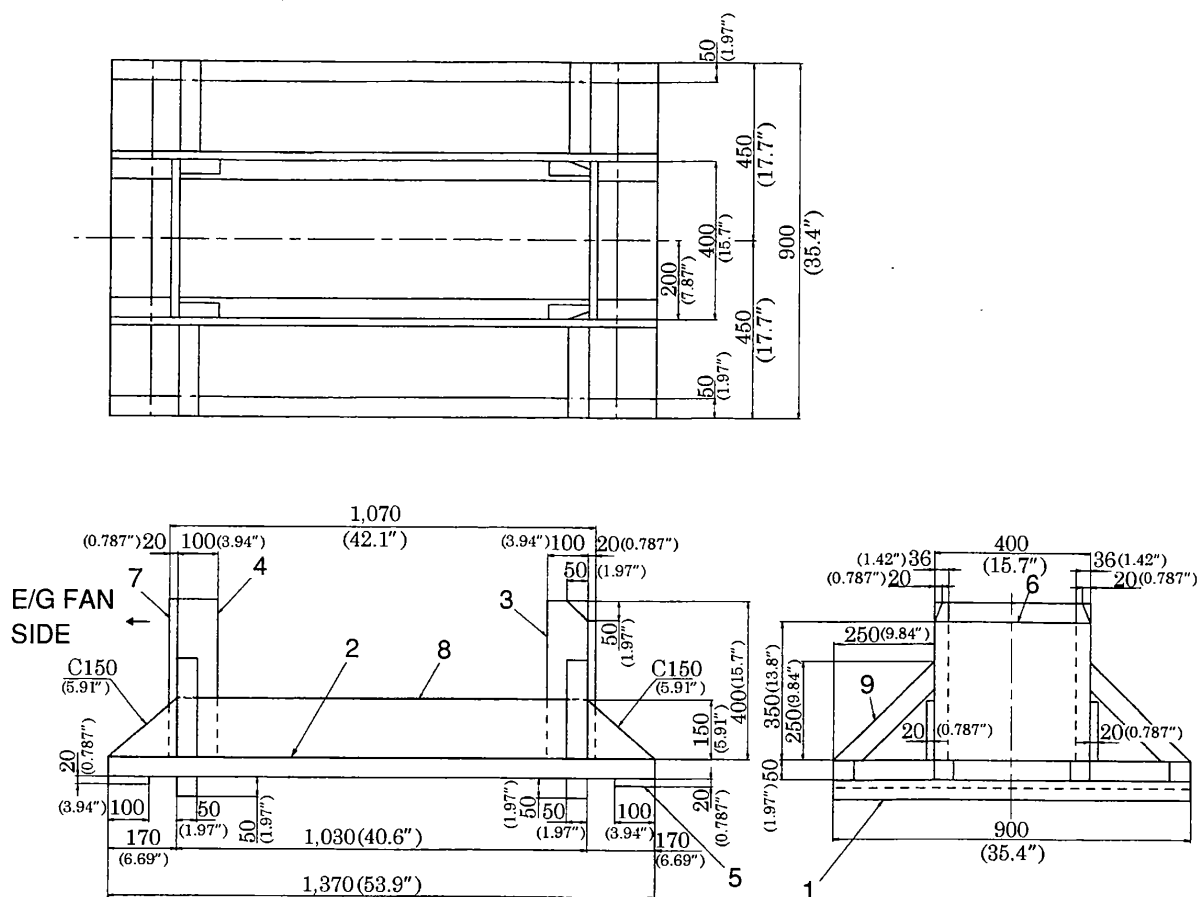


No.	NAME	Q' TY	REMARKS
①	MASTER LINK M	1	
②	HIGH COUPLING HC	12	
③	CHAIN	2	$\phi 10 \times 3.8m$
④	CHAIN	2	$\phi 10 \times 2.5m$
⑤	GRAB HOOK H	2	

No.	NAME	MATERIAL	Q' TY	REMARKS
1	HOLDER	POK40	2	FRONT SIDE
2	PIN	S40C	2	
3	CAPSCREW	—	2	M10×85
4	HOLDER	POK40	2	REAR SIDE



33. ENGINE MOUNTING PEDESTAL



MATERIAL ; WOOD
Unit : mm (in)

No.	NAME	Q' TY	REMARKS
1	FRAME (RAFTER)	2	50×50×900 (1.97×1.97×35.4)
2	FRAME (RAFTER)	4	50×50×1370 (1.97×1.97×53.9)
3	SUPPORT	2	36×100×400 (1.42×3.94×15.7)
4	SUPPORT	2	36×100×400 (1.42×3.94×15.7)
5	PLATE (PLYWOOD)	2	100×900×20 (3.94×35.4×0.787)
6	PLATE (PLYWOOD)	1	350×400×20 (13.8×15.7×0.787)
7	PLATE (PLYWOOD)	1	400×400×20 (15.7×15.7×0.787)
8	PLATE (PLYWOOD)	2	150×1370×20 (5.91×53.9×0.787)
9	SUPPORT (RAFTER)	4	50×50×250 (1.97×1.97×9.84)

