

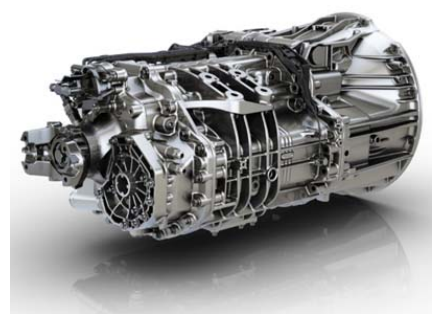
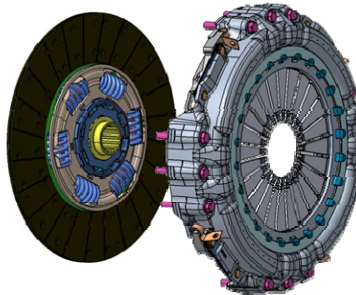


DETROIT
Transmissions

DT12™

CVG12

DETROIT POWERTRAIN DT12 TRANSMISSION



STUDENT GUIDE

Conduct

- Detroit Diesel prohibits the use of jokes, cartoons or pictures that are directly or indirectly derogatory towards race, religion, national origin, gender, age, disability, height, weight or marital status. All employees, visitors, vendors or trainees must be sensitive to the diversity of all participants of this course and those within our workforce, and treat each other with dignity and mutual respect at all times.
- Undermining the dignity of others through inappropriate use of printed material, comments or conduct and utilizing such available communication methods such as email, facsimile and copies will not be tolerated.
- Computers that are used in the classroom are for instructional purposes only. Do not use them for personal use.

Safety Precautions

- Some course activities require running training engines or vehicles. Remember that safety precautions must always be observed when you are in the vicinity of a running engine or vehicle. Additionally, when working on or around engines in the training area, please be aware of the following precautions:
- Observe normal shop safety procedures as stated in Detroit Diesel's service publications. Be alert to prevent accidents by wearing proper clothing, protective equipment including safety glasses. Also use the proper tools for the job.
- The instructor will normally start the training engine or vehicle. Students should never start any training engine or vehicles unless specifically directed to do so by the instructor.
- Students should always stand clear of any running training engine and exhaust system.
- In case of a fire or other emergencies, follow your instructor's directions immediately.
- If you have any questions regarding proper safety procedures, bring them to your instructor's attention.



Customer Support Information

PHONE: 800-445-1980 / FAX: 313-592-5888 (**24/7 coverage**)

Axles: 855-253-0427

Software Support: 855-253-0423

Transmissions 855-253-0428

Virtual Technician: 855-253-0420

PLEASE HAVE THE FOLLOWING AVAILABLE WHEN YOU CALL:

- Dealer/Distributor Location Name and Code
- Contact Name and Email Address
- Phone Number
- Fleet or Owner Name
- Fleet Unit Number
- Engine Serial Number
- Last 6 Digits of the VIN
- Mileage
- Complaint Detail and Codes
- Troubleshooting Completed

THE CUSTOMER SUPPORT CENTER PROVIDES:

- Express Forms
- Backdoor Password Request
- Mainframe Change Request
- DD13 / DD15 Product Report
- General Assistance Request
- Clean Idle Request
- Emission Replacement Label Request / Engine Family Request

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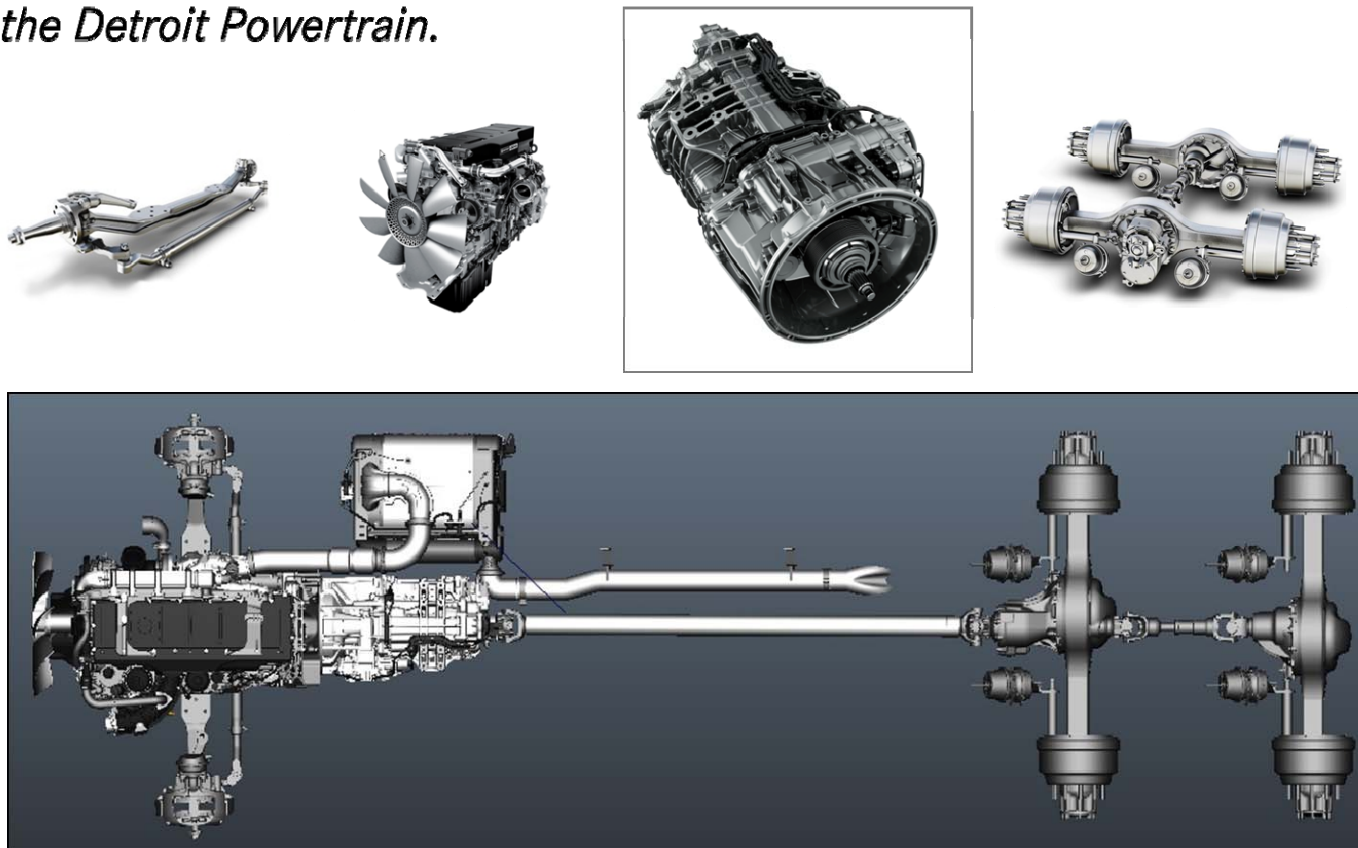
Introduction

In this section we will learn:

- How to read and interpret the transmission model code / data tag
- Transmission specifications including dimensions and gear ratios
- Transmission sizing
- New driver packages

FAMILIARIZATION

The Detroit Transmission is the latest addition to the Detroit Powertrain.



In conjunction with Detroit Engines and Detroit Axles, the Detroit Transmission is the latest addition to Detroit Powertrain components. The DT12 is a pneumatically operated, fully automated transmission. It uses a traditional clutch actuated manual gearbox, with a computer controlled shift actuator. The electronic controls select the right shift pattern for maximum fuel economy and / or power.

**DT12****FAMILIARIZATION CONT'D****DT12-DA-1550****DT** – Detroit Transmission**12** – Gears/Speed**D** – Direct; **O** – Overdrive**A** – large transmission; **B** – small transmission**1550** –Input torque(lb-ft)

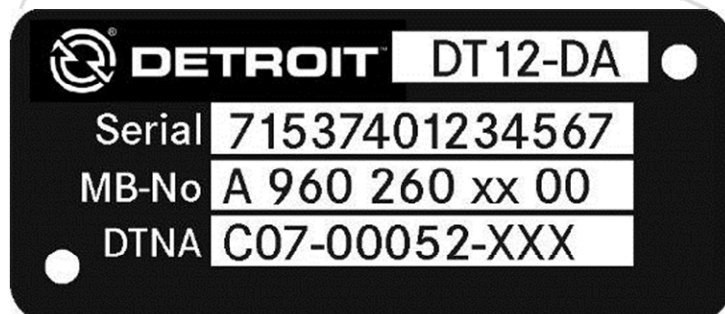
The Detroit Transmission is a 12 speed direct, or overdrive, automated manual transmission. The DT12 naming is derived from the model code. The model code is easily deciphered. The **DT** in the model code stands for Detroit Transmission.

The **12** signifies the number of forward speeds. The next letter indicates whether the transmission is a direct drive or overdrive model. The letter **D** represents direct drive and the letter **O** represents overdrive.

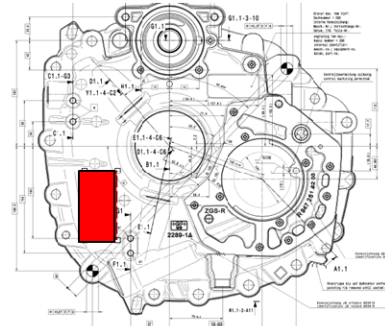
The next letter will either be an A or a B. **A** will denote large transmission (matched with the DD15 / DD16), and **B** will denote small transmission (matched with the DD13).

The final set of numbers specifies the input torque rating of the transmission in foot pounds.

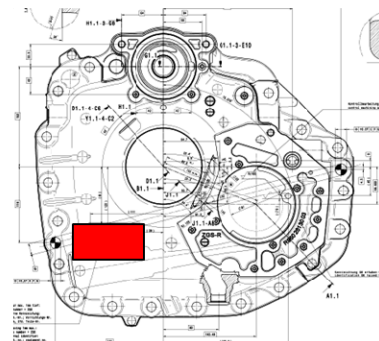
DATA TAG LOCATION



DT12 B Model



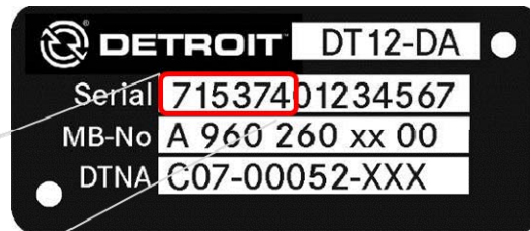
DT12 A Model



The data tag for the DT12 can be found on the range housing section of the transmission.

DATA TAG

TRANSMISSION TYPE IDENTIFICATION

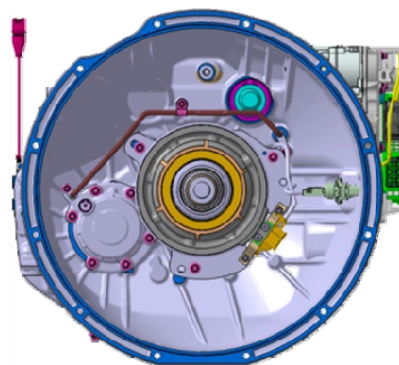
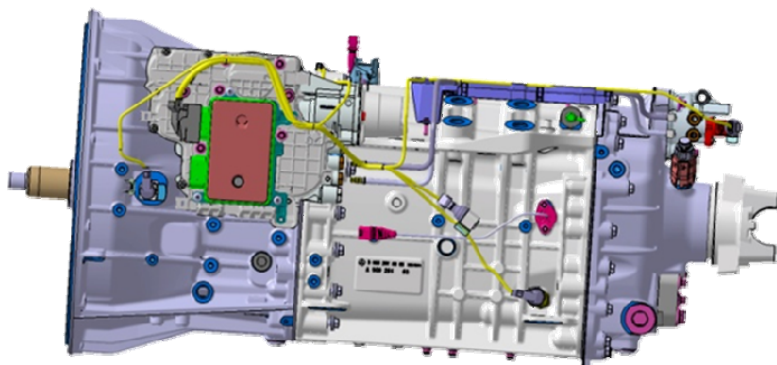


First 6 Digits of Serial Number	NAFTA Naming	European Naming	Max. Input Torque [lb ft]
715 354	DT12- DB	G211	1450
715 364	DT12- OB	G230	1650
715 374	DT12- DA	G281	1750
715 384	DT12- OA	G330	2050

** Information provided by this chart is for reference only and is subject to change*

It is also possible to determine the transmission type by deciphering the first six digits of the transmission serial number as shown in the chart above. The European designation is also shown above.

SIZE: DT12 “A MODEL” DIMENSIONS



Total length: 1200 mm / **3.94 feet**

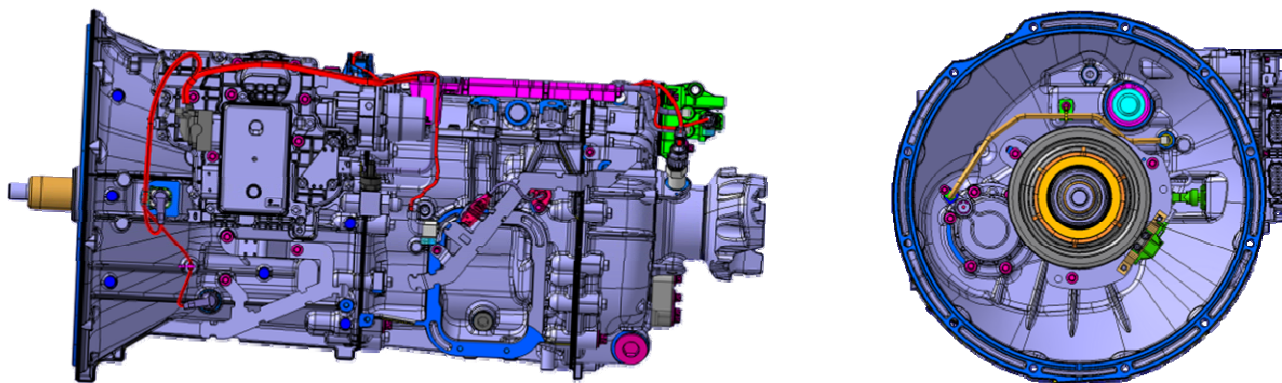
Max. height: 548 mm / **1.8 feet**

Max. width: 609 mm / **2 feet**

Weight: 293kg / **645.95 pounds** + 14liters / **15 quarts of oil**

The dimensions for the larger “A” model transmission are shown above.

SIZE: DT12 “B MODEL” DIMENSIONS



Total length: 1131 mm / **3.7 feet**

Max. height: 556 mm / **1.8 feet**

Max. width: 595 mm / **1.95 feet**

Weight: 237kg / **522 pounds** + 10 liters / **10.5 quarts of oil**

The dimensions for the smaller “B” model are shown above.

DT12 GEAR RATIOS

Direct Drive

	1G	2G	3G	4G	5G	6G	7G	8G	9G	10G	11G	12G	R1	R2	R3	R4
DA	14.93	11.639	9.024	7.035	5.644	4.4	3.393	2.645	2.051	1.599	1.283	1	-16.386	-12.774	-3.724	-2.903
DB	14.93	11.673	9.024	7.056	5.628	4.4	3.393	2.653	2.051	1.604	1.279	1	-14.93	-11.673	-3.393	-2.653

Over Drive

	1G	2G	3G	4G	5G	6G	7G	8G	9G	10G	11G	12G	R1	R2	R3	R4
OA	11.639	9.02	7.035	5.452	4.4	3.41	2.645	2.05	1.599	1.239	1	0.775	-12.774	-9.9	-2.903	-2.25
OB	11.673	9.101	7.056	5.501	4.4	3.431	2.653	2.068	1.604	1.25	1	0.78	-11.673	-9.101	-2.653	-2.068



For reference, the gear ratios for all transmission models are shown above.

DT12 DRIVER PACKAGES

Feature	Economy	Standard	Performance
Skip Shift	✓	✓	✓
Auto-neutral	✓	✓	✓
Economy Mode	✓	✓	✓
Performance Mode			✓
Creep mode	✓	✓	✓
Driveline protection	✓	✓	✓
IPM	✓	✓	✓
Manual shift control		✓	✓
EcoRoll / eCoast	✓	✓	✓
Kick down			✓
Hill start aid	✓	✓	✓



A new package has been released that allows the customer to select what type of driving parameters will best serve his or her needs.

The major changes are:

- The kickdown feature will only be available in the performance package
- Manual shift control will only be available in the standard and performance package
- Performance mode will only be available in the performance package



1. What does the “A” in DT12-DA stand for?

True or False:

2. Kickdown will be available in Economy mode.



DETROIT

Transmissions

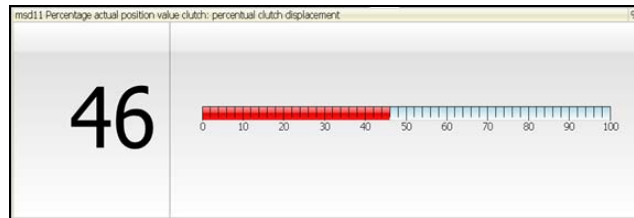
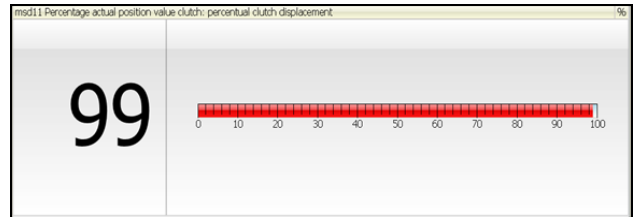
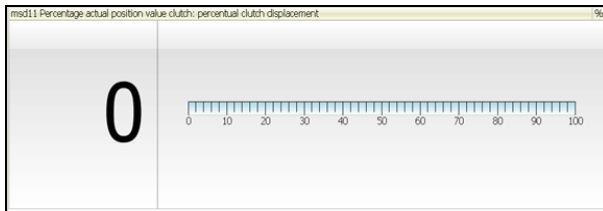
DT12™

Web Review

This section contains important content that was previously covered in the web course.

- Creep Mode and Kisspoint
- Clutch abuse
- A brief review of DT12 features including:
 - eCoast / Creep Mode / Hill Start Aid / Cruise Control / Engine Braking
 - An overview of the transmission control module (TCM) and PTCAN communications

CREEP MODE



Partial Clutch Closing Should NOT Be Confused With Slipping!

- > Just because the clutch is not fully closed does not mean that it is slipping. The partial closing of the clutch is a clamping force.
- > The TCM monitors various shaft speeds to determine if slippage is occurring.
- > If the TCM determines there is slippage, it will close the clutch further.

It is important to mention that while in creep mode, the DT12 clutch control logic is **NOT** slipping the clutch. When a clutch is allowed to slip, a tremendous amount of heat is generated. Damage to the clutch, flywheel, and other components can occur as a result of excessive clutch slipping.

The varying positions, or modulation, of the DT12 clutch is simply a varying of the clamping force needed to sustain torque transfer from the engine to the transmission.

The images shown above are from the user selection in the Diagnostic Service Tool. The top left image shows the actual clutch position as zero percent, indicating a completely closed (engaged) clutch.

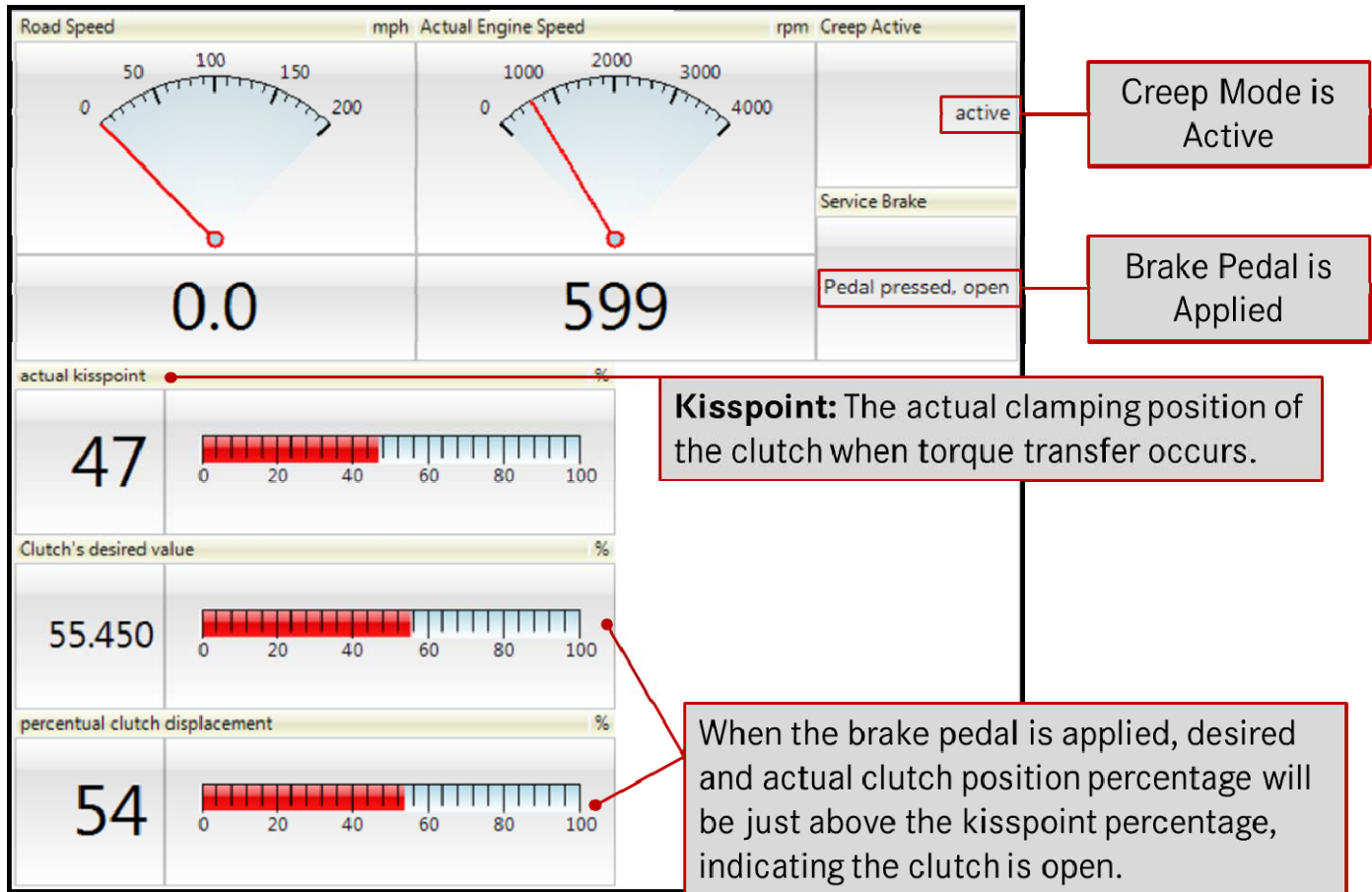
The far right image shows the actual clutch position as being ninety nine percent, indicating a fully open (disengaged) clutch.

The center image indicates the clutch position is at forty six percent. You may recall from the web course, that this position is actually provided by the clutch travel sensor that is attached to the clutch release cylinder. What is being shown here is that the clutch has closed with just enough clamping force to allow sufficient torque transfer without slippage.

Because the clutch clamping force is modulated this way, harsh clutch engagements are eliminated and quicker shifting can occur.



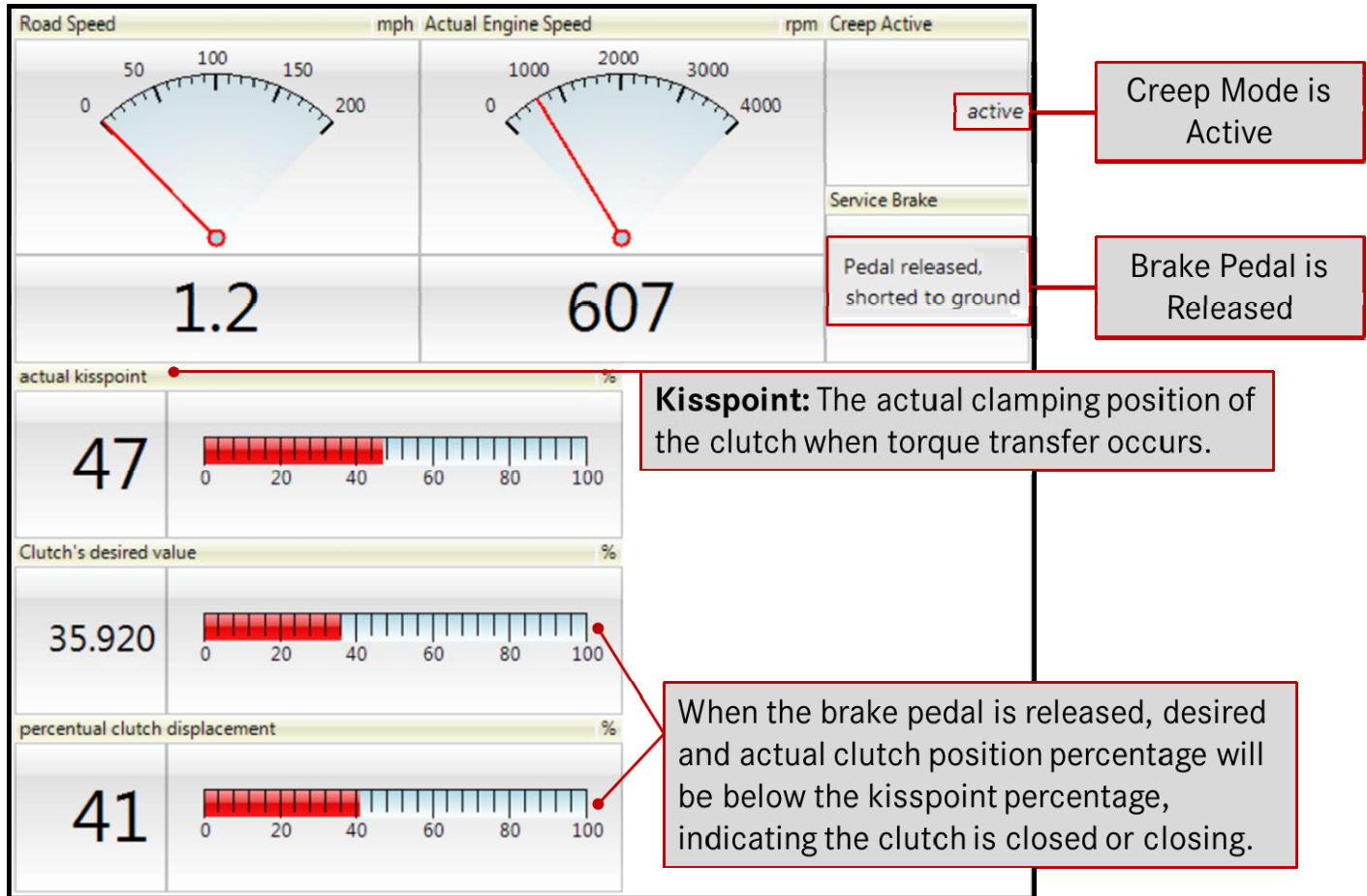
CREEP MODE - KISSPOINT



To fully understand what is occurring with the clutch in creep mode, let's observe various parameters that can be selected in the "user" section of the instrumentation panel. The focus here will be the clutch position relative to the clutch's kisspoint and brake pedal position.

The clutch kisspoint is the actual clamping position of the clutch when torque is transmitted from the engine to the transmission. With the vehicle stopped and the service brake pedal applied, the clutch will open to just **above** the kisspoint. This essentially places the clutch in a ready position. By hovering just above the moment of engagement and torque transfer (kisspoint), a smoother and quicker engagement of the clutch will result. This allows the clutch to act and feel like a vehicle with a torque convertor while driving in creep mode. Remember, the higher the percentage, the more the clutch is open with lower clamping force.

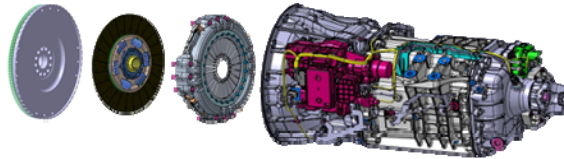
CREEP MODE - KISSPOINT



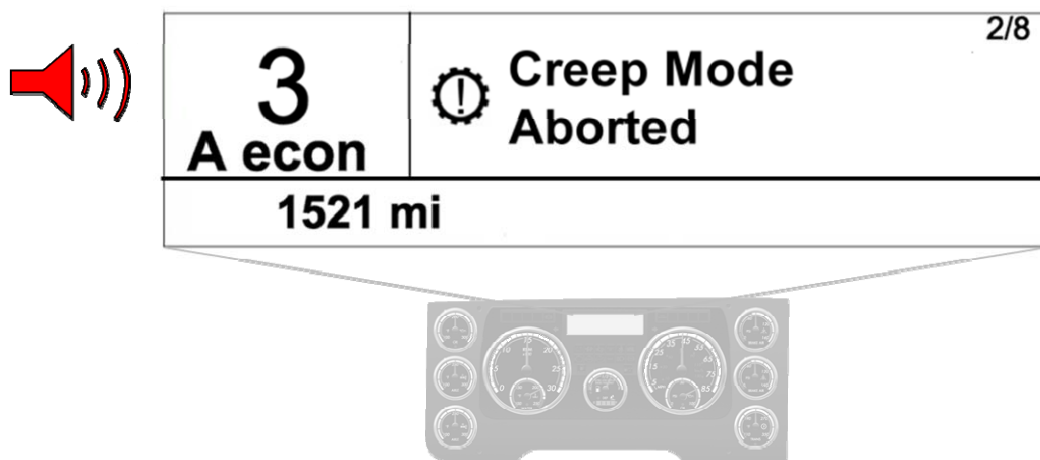
When the pedal is released, the clutch begins to close further **below** the kisspoint, thus increasing the clamp load. While the vehicle is moving in creep mode, this actual clutch position may change depending upon the clamping force required to move the vehicle without clutch slippage; but will always be a value below the kisspoint.

Remember, the lower the percentage, the more the clutch is closing and the greater the clamping force.

CREEP MODE ABORT CONDITIONS



- If creep mode becomes active and cannot move vehicle, Creep Mode will abort after 4 seconds and an audible alert will be sounded
- If wheel slip is detected, Creep Mode will abort and an audible alert will be sounded



In the event ample clamping force cannot be obtained to effectively maneuver the vehicle in creep mode, an abort condition can occur. Both an audible and visual warning will be displayed after 4 seconds of creep attempt.

If wheel slip is detected, creep mode will abort and both the visual and audible warning will be triggered.

CLUTCH ABUSE WARNINGS

CPCx Internal Warning Level	Clutch Temperature State	Instrument Behavior		Transmission Behavior	
		Audible	Visual	Start Gear Limit	Creep Mode
0	no Warning	-	-	5	allowed
1	pre-Warning	-	-	1	allowed
2	Warning	 CONTINUOUS BUZZER *** ***	 CLUTCH OVERLOAD	1	disabled


10



Clutch Heavily Loaded

5555555 mi


10



CRITICAL! Clutch Overloaded

5555555 mi

Although the DT12 does not utilize a clutch pedal, it still has a friction disc clutch that is susceptible to damage from heat and abuse. To protect the clutch, the vehicle has a clutch abuse protection system that alerts the driver and restricts functionality when needed.

Extended periods in creep mode with light brake pedal pressure or slipping the clutch (using the accelerator pedal to hold the vehicle on a hill, for example), can activate the clutch abuse protection system. A display message notifies the operator when the protections are needed.

As you can see, the transmission starting gear will be restricted to first gear when in a pre-warning or warning condition.

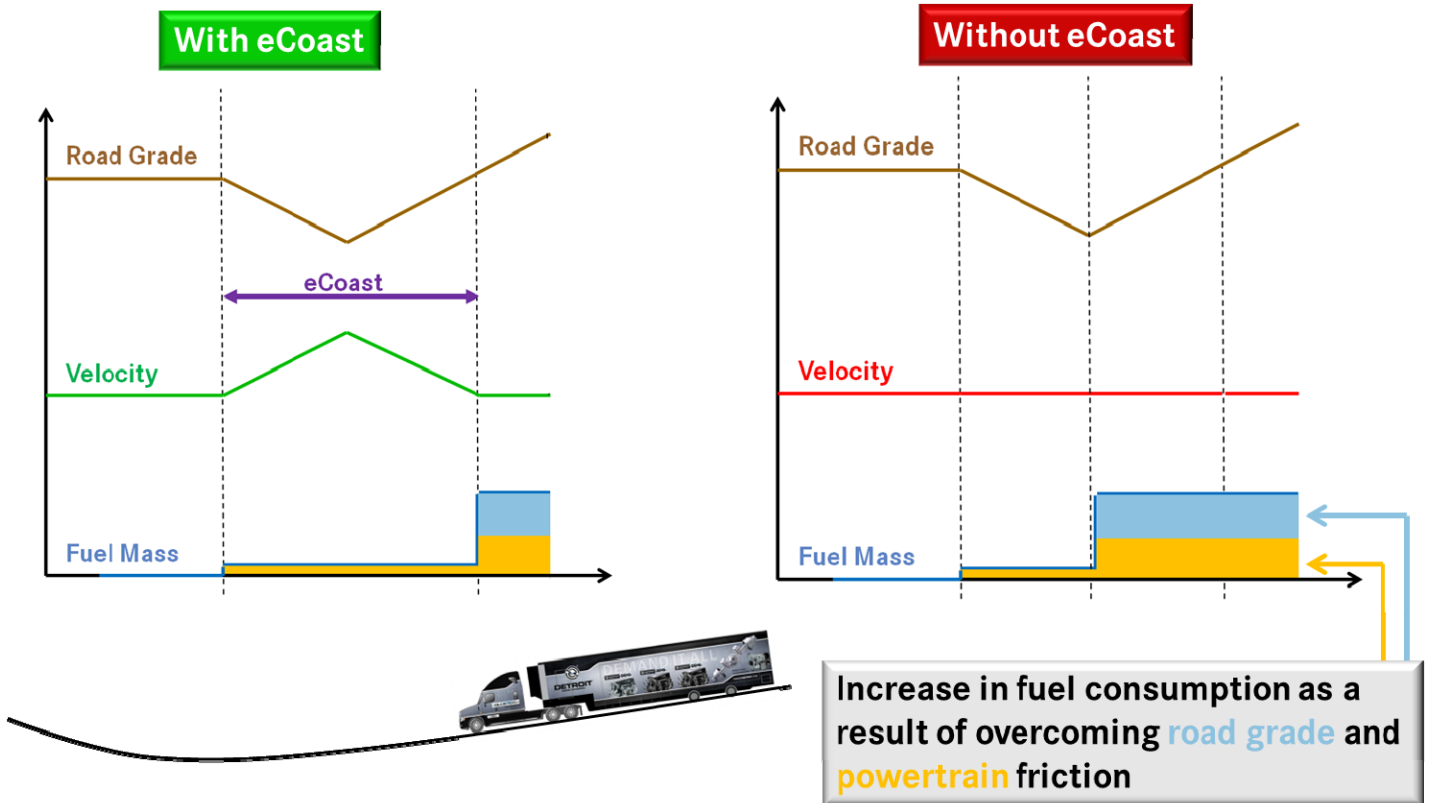
START GEAR SELECTION

			Road Gradient						
			-10	-3.2	0	3.2	5.2	10	15.2
Estimated Vehicle Mass (Weight)	Bobtail	15k	6	6	5	5	5	4	4
		22k			5				
	Less-than Fullload	42k			3				
		60k			2				
	Fullload	77k	4	3	2	2	1	1	1
		105k			2				
	Heavy Haul	125k			2				
		150k			2				

Shown above is a chart that shows typical transmission starting, or launch, gears based on estimated vehicle mass (weight) and road gradient (tilt). The estimated vehicle mass is calculated based on various engine data during operation and the road gradient is calculated based on the tilt sensor data. On somewhat level ground, the vehicle will typically launch in fifth gear when bobtailing, and second gear when fully loaded.

The most obvious way the CPC determines whether the vehicle is bobtail or loaded is when there is a trailer ABS signal.

eCOAST



eCoast preserves the vehicle's velocity, especially in a downward grade, and then uses the momentum gained for the next upwards slope.

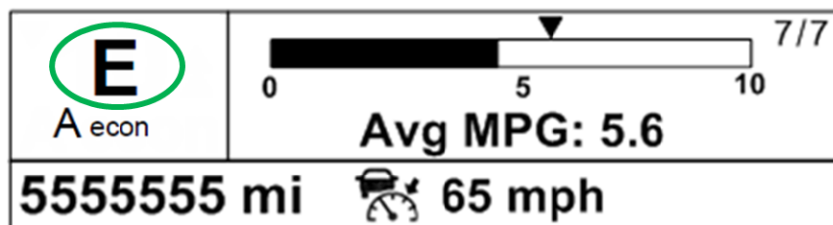
The DT12 is constantly monitoring ways to keep engine RPMs low to save fuel. When coasting down grades, cruising with no accelerator input, or reducing speeds, the DT12 will open the clutch, shift into neutral, and then close (re-apply) the clutch to reduce engine RPMs.

eCoast functions in either accelerator pedal or cruise control mode. The customer can specify whether or not the eCoast feature is desired at the time of vehicle order as well as after the fact via parameterization.

The eCoast feature, if enabled, is only available in Automatic Economy Mode.



eCOAST ENTRY CONDITIONS



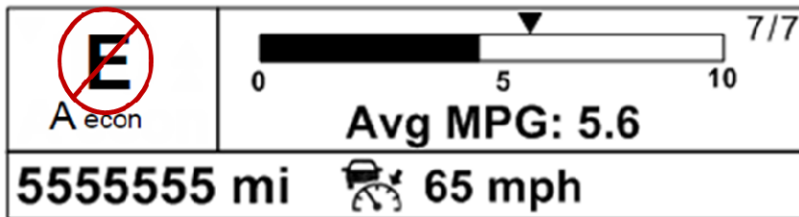
eCoast entry conditions:

- Minimum vehicle speed: 35 km/h or 22mph
- Less than a 3.5% downward slope
- Engine Speed less than 1600 rpm
- No accelerator pedal, brake pedal, or engine retarder actuation
- ***No active regeneration***

Some of the eCoast entry conditions include:

- The vehicle must be traveling at a speed greater than 22 mph
- There is less than a 3.5% downward slope
- Engine speed is less than 1600 rpm
- There is no accelerator pedal, brake pedal or engine retarder actuation
- There is no active regeneration occurring, or about to occur.

eCOAST DE-ACTIVATION CONDITIONS



**** No eCoast if Engine is in DPF Zone 1 or higher!***

eCoast de-activation conditions:

- Cruise control brakes or accelerates
- Vehicle speed exceeds the cruise control set speed by more than approximately 4km/h (approx. 2.5 mph)
- The speed limiter is active and the maximum speed set is exceeded
- Driver intervention: brake pedal, accelerator pedal, engine brake, any shift lever actuation, any cruise control interaction

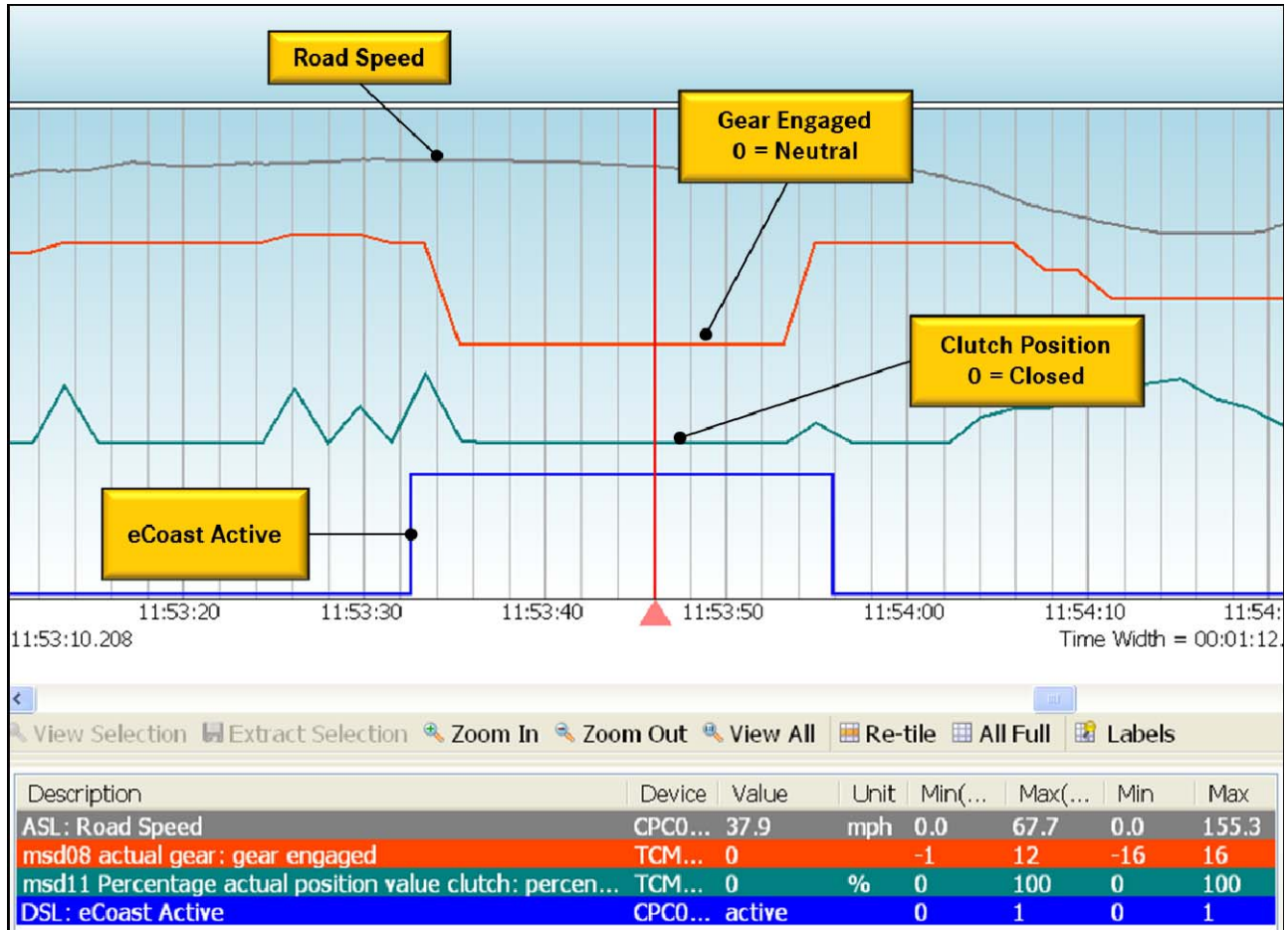
19

Some of the conditions that will cause eCoast to deactivate are as follows:

- If cruise control begins to slow or accelerate the vehicle
- The vehicle exceeds the cruise control set speed by more than approximately 4 km/h (approx. 2.5 mph)
- The speed limiter is active and the maximum set speed is exceeded.
- Also, any driver interaction involving the brake pedal, accelerator pedal, the engine brake, shift lever actuation or any cruise control activation will deactivate eCoast.
- eCoast will de-activate if the engine enters DPF Zone 1 or higher

eCOAST - CLUTCH CLOSED IN NEUTRAL

Clutch is closed during eCoast!

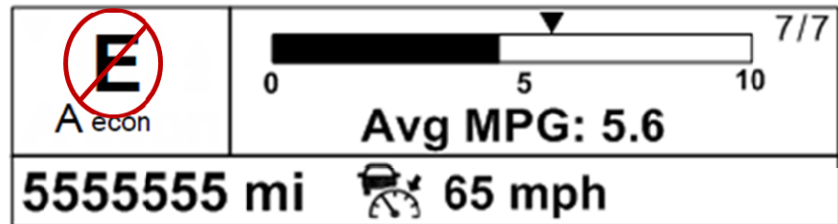


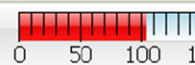
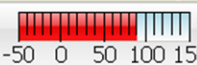
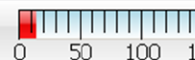
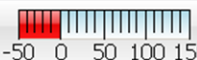
It is important to remember that the clutch is closed while in Neutral during eCoast. Remember, the transmission oil pump is driven by the countershaft and the clutch **must be closed** to rotate the countershaft.

eCOAST - DPF ZONE 1



eCoast unavailable when engine is in DPF Zone 1 or higher !

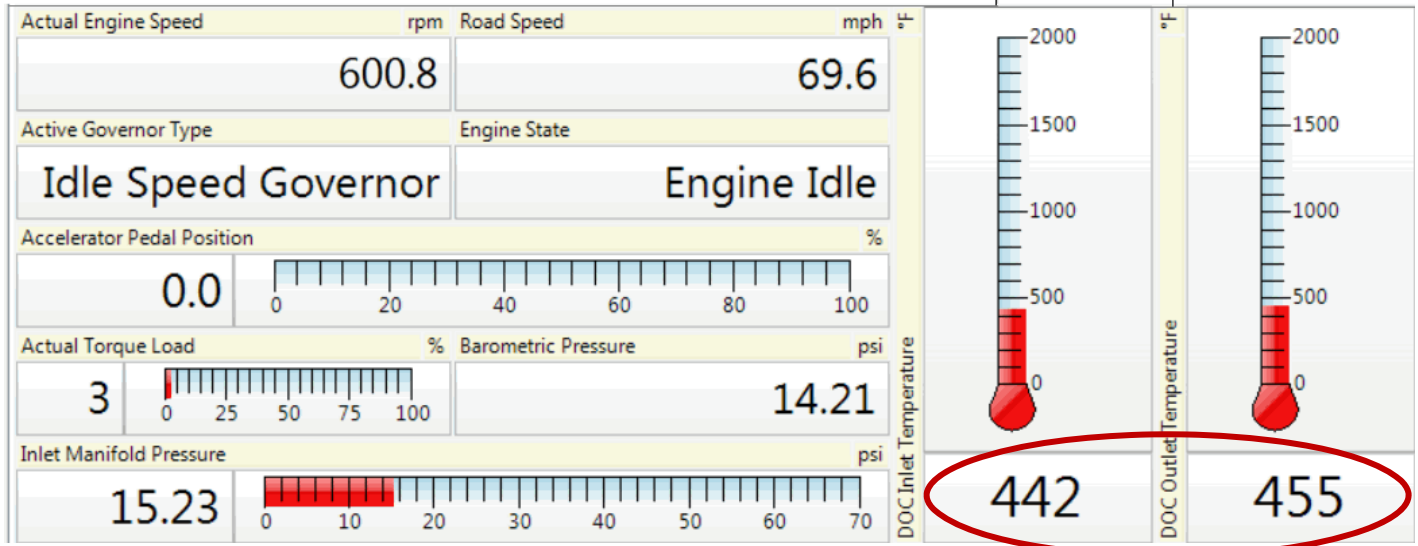


AS077: Fuel Cut Off Valve		%	ASL003: Fuel Compensation Pressure		psi	*Estimated Fuel Compensation Gauge...		psi
100.0			104.06			89.85		
ASL004: Fuel Doser Injection Status		%	ASL003: Doser Fuel Line Pressure		psi	*Estimated Doser Fuel Line Gauge Pres...		psi
8.3				14.72			0.51	
Instrument		Value		Units	Minimum	Maximum	Description	
☐ Regeneration								
AS122: DOC Out Model Delay		692	°F	-40	1832			
AS124: DOC Out Model Delay - Non fueling		541	°F	-40	1832			
AS125: DPF Out Model Delay		706	°F	-40	1832			
AS064: DPF Regen State		Regen Active						
AS065: Actual DPF zone		1		0	255			
AS120: DPF Target Temperature		797	°F	-40	1832			

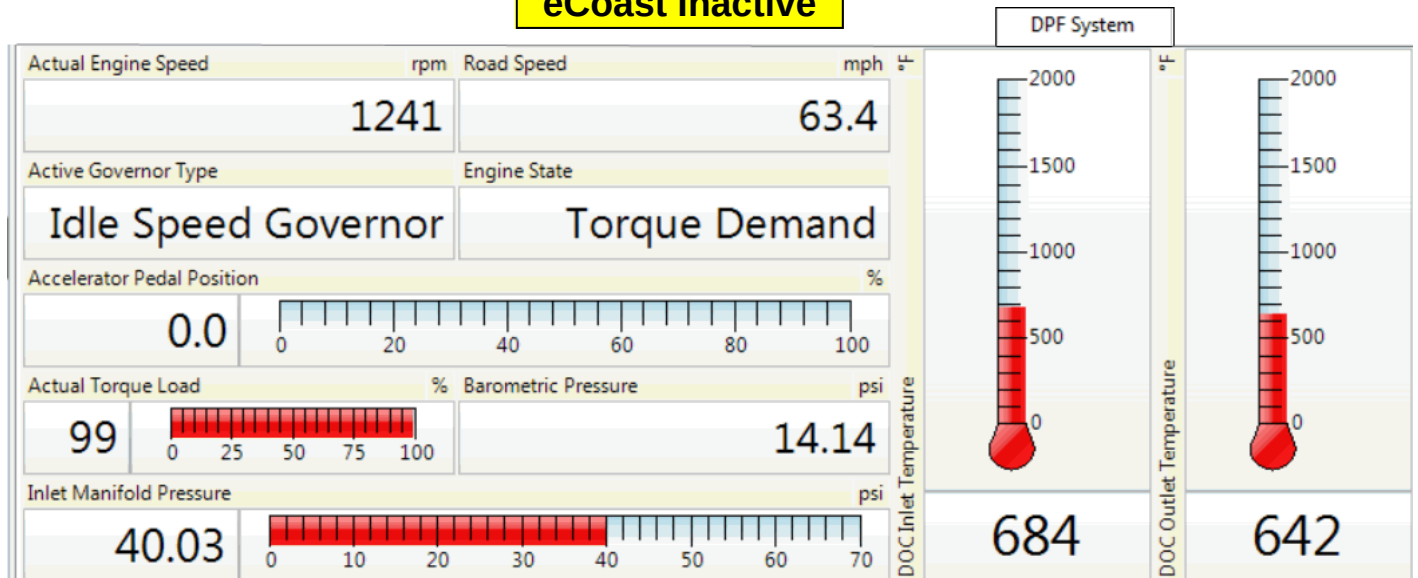
One of the most important things to remember about eCoast is that it will be unavailable when the engine is in DPF Zone 1 or higher. If a customer complains of lack of eCoast, be sure to check what DPF zone he or she is in.

eCOAST - DPF ZONE 1

eCoast Active



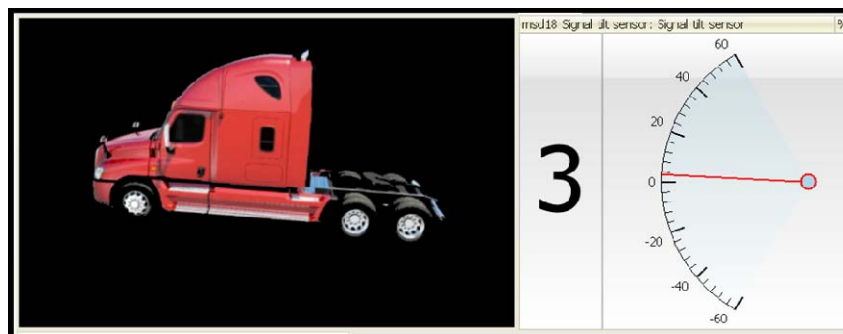
eCoast Inactive



While in eCoast, sustained higher exhaust temperatures are not consistent enough for a driving regeneration, therefore eCoast is inhibited while in zone 1.

HILL START AID

- A key safety feature that holds the vehicle on a grade greater than 3% for up to 3 seconds while the driver transitions from brake to throttle.
- The transmission control module contains an internal “tilt” sensor that monitors the angle of the vehicle to determine road grade.

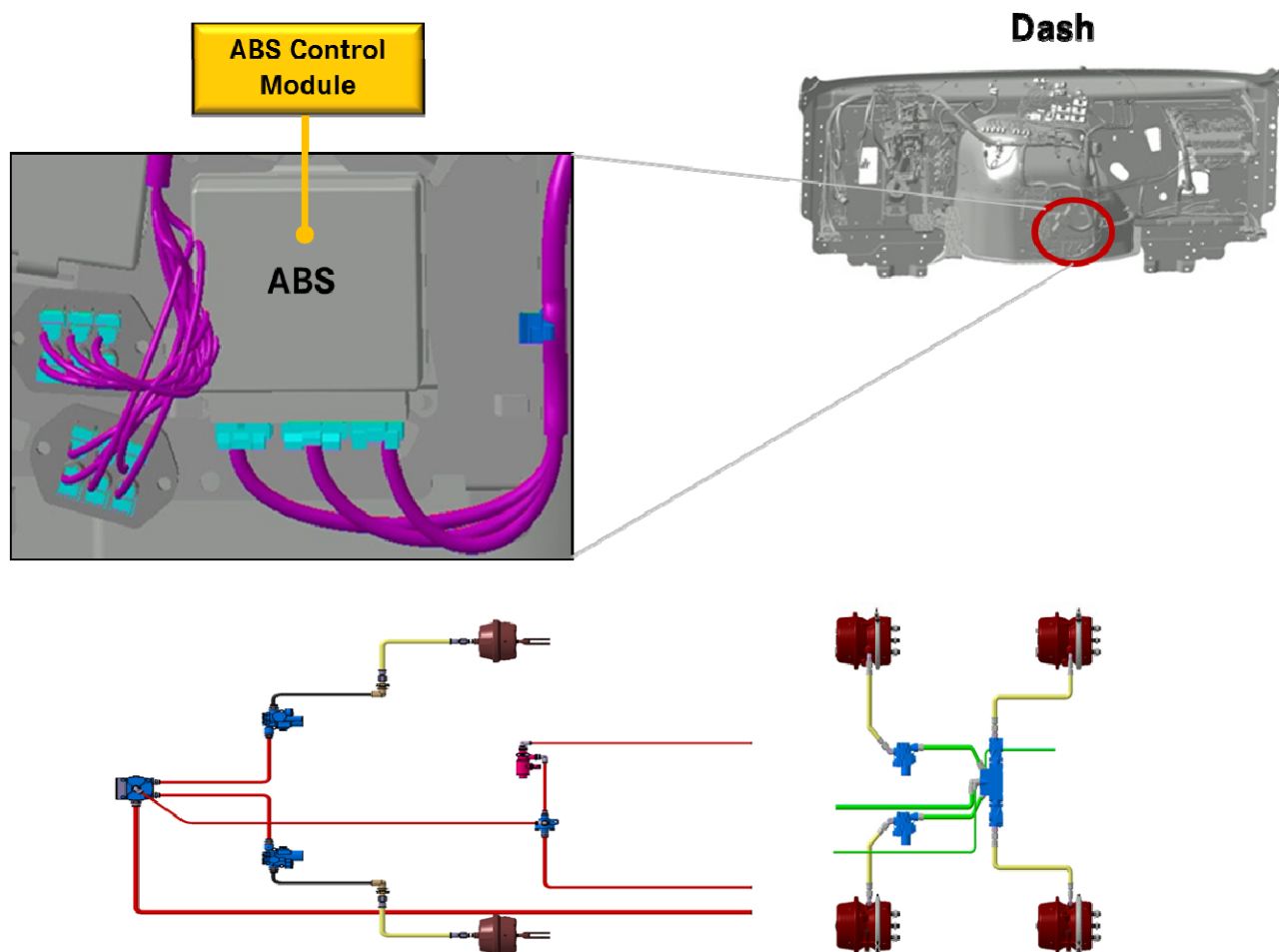


Hill Start Aid is a programmable parameter that acts as a vehicle brake assist feature during transition from vehicle standstill — to vehicle acceleration while on an incline. This reduces, or eliminates, vehicle rollback when the brakes are released.

Creep mode, if enabled, is also used in conjunction with Hill Start Aid.



HILL START AID - ABS MODULE



The Hill Start Aid (HSA) feature resides in the ABS module. HSA holds and modulates brake pressure on both steer and drive axle brakes **after** the driver has released his or her foot from the brake pedal. The ABS module and powertrain modules work together to achieve proper acceleration, torque, and brake modulation to ensure a smooth and safe transition from brake to throttle while on an incline.

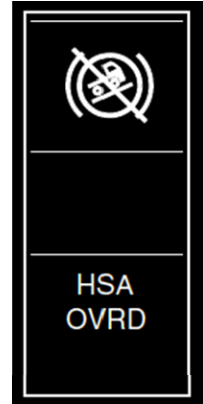
HILL START AID - DASH LAMP



Hill Start Aid Dash
Indicator Lamp

The HSA lamp status is as follows:

- **ON:** HSA fault or other ABS fault and HSA is disabled
- **FLASH:** HSA disabled through the switch
- **OFF:** HSA Enabled



Hill Start Aid
Override Switch



If the vehicle is equipped with HSA, there will be a dash mounted disable switch. The switch is a momentary switch for deactivation below 5 mph and is wired to the Brake System-ECU. Once the vehicle exceeds 5 mph, the HSA feature is re-enabled.

The HSA lamp status is as follows:

On: HSA fault or other ABS fault and HSA is disabled.

Flash: HSA disabled through the Switch

Off: HSA enabled

There is an initial 3 second bulb self test at "Key-On".

HILL START AID - OVERRIDE SWITCH

Situations where the Hill Start Aid override switch can be used:

- Coupling to a trailer at a sloped loading dock
- Backing into a sloped loading dock



There are certain situations where the HSA feature is undesirable and can be overridden. When backing into a sloped loading dock or coupling to a trailer at a sloped loading dock are two examples.

CRUISE CONTROL ENGINE BRAKING

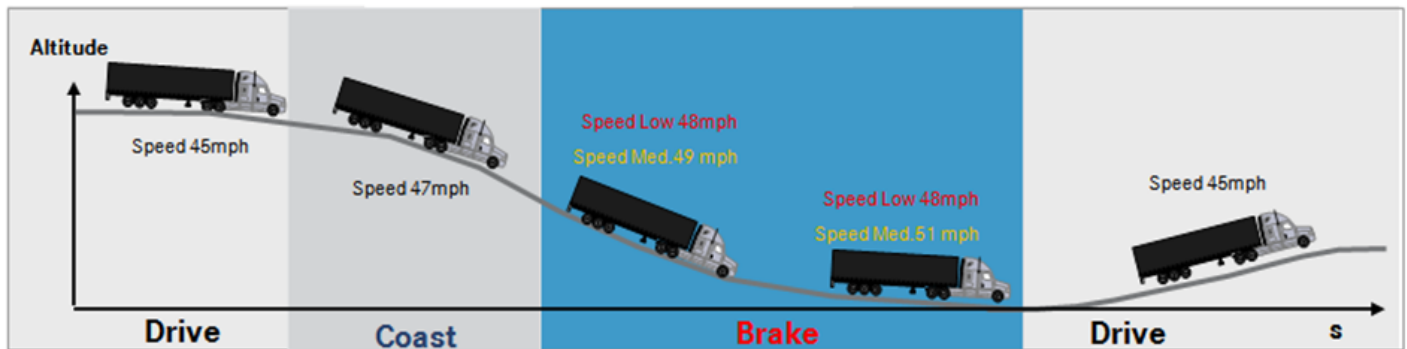
Cruise control band controls when the engine retarder will be engaged above the set cruise speed



Setting	When to Use	Default Speed Range
High	Flat Terrain	Set speed + 155 mph
Medium	Rolling Hills	Set speed +6 mph
Low	Steep Grades	Set speed + 3 mph



Engine Brake Off
"Auto" Position



Another interesting facet of the DT 12 transmission is the way engine braking can be programmed to operate while in cruise control. If this feature is enabled, the engine brake settings will be controlled via a cruise control band , or limit switch, instead of the conventional engine brake switch on the shift stalk. In order for this to function, the stalk will need to be in the full, upright position – or engine brake “off” position. This position is also known as the “auto” position.

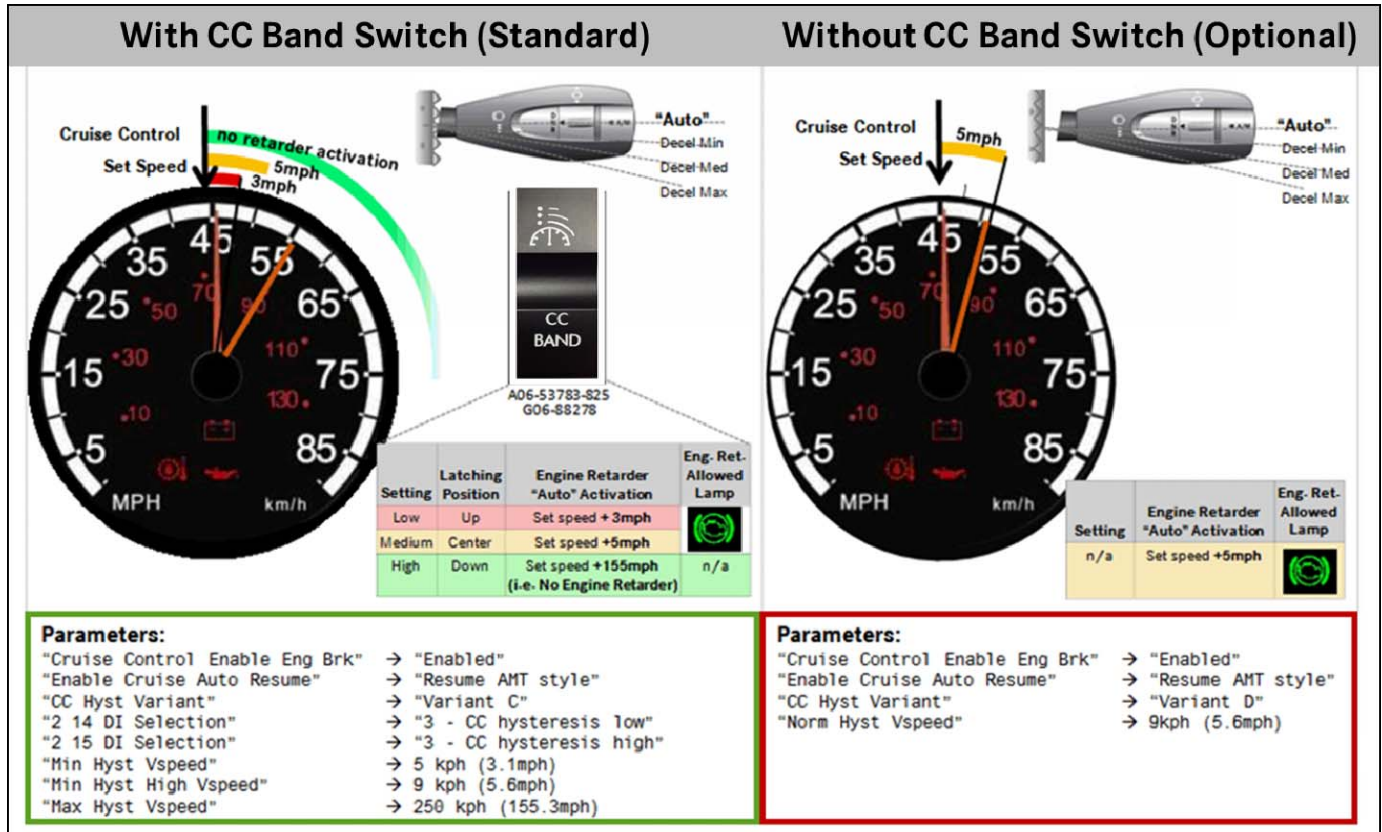
The high, medium, and low settings shown in the graphic are not the conventional high, medium, and low settings of the engine brakes. Instead, they refer to the amount of tolerance, or overspeed, above the cruise control set point that is allowed before the engine brakes will come on.

For example, in the low setting there is a tighter tolerance for overspeed , therefore engine braking will occur sooner to keep the speed closer to the set point. This setting will typically be used in mountainous, steep grade conditions.

Conversely, the high setting is a “no tolerance” setting. Essentially, this is an infinite setting - meaning the engine brakes will not come on. This feature is programmable as well as the overspeed set points.

CRUISE CONTROL ENGINE BRAKING PARAMETERIZATION

CC Engine Braking Parameterization

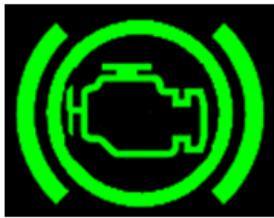


Take a moment to review the different parameter settings between a vehicle with the CC-limit switch and one without.

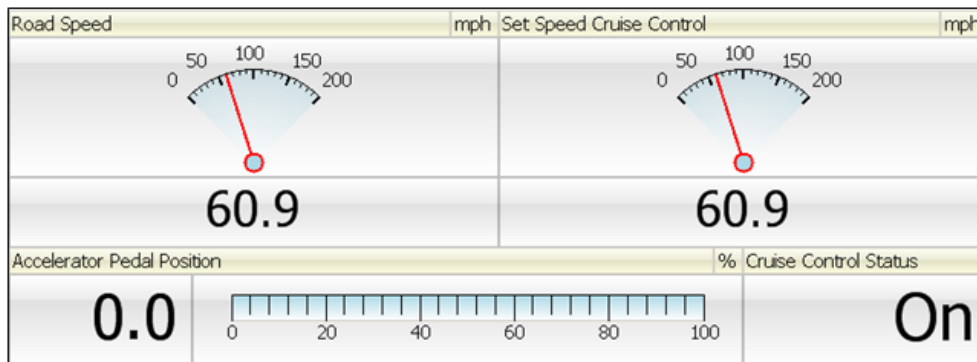
CRUISE CONTROL

ENGINE BRAKE AUTO POSITION

- The engine brake lamp **will** illuminate when cruise control is on and the stalk is fully upright, or in the **engine brake “off” / “auto”** position



Engine Brake Off / Auto



Another point worth mentioning is that the engine brake lamp will illuminate when cruise control is on and the stalk is fully upright, or in the **engine brake “off”** position.

The stalk position for “Engine Brake Off” is also referred to as the **“auto position”** while in cruise control.



CRUISE CONTROL

MANUAL ENGINE BRAKE



Setting	When to Use	Default Speed Range
High	Flat Terrain	Set speed + 155 mph
Medium	Rolling Hills	Set speed + 6 mph
Low	Steep Grades	Set speed + 3 mph



Engine Brake Low

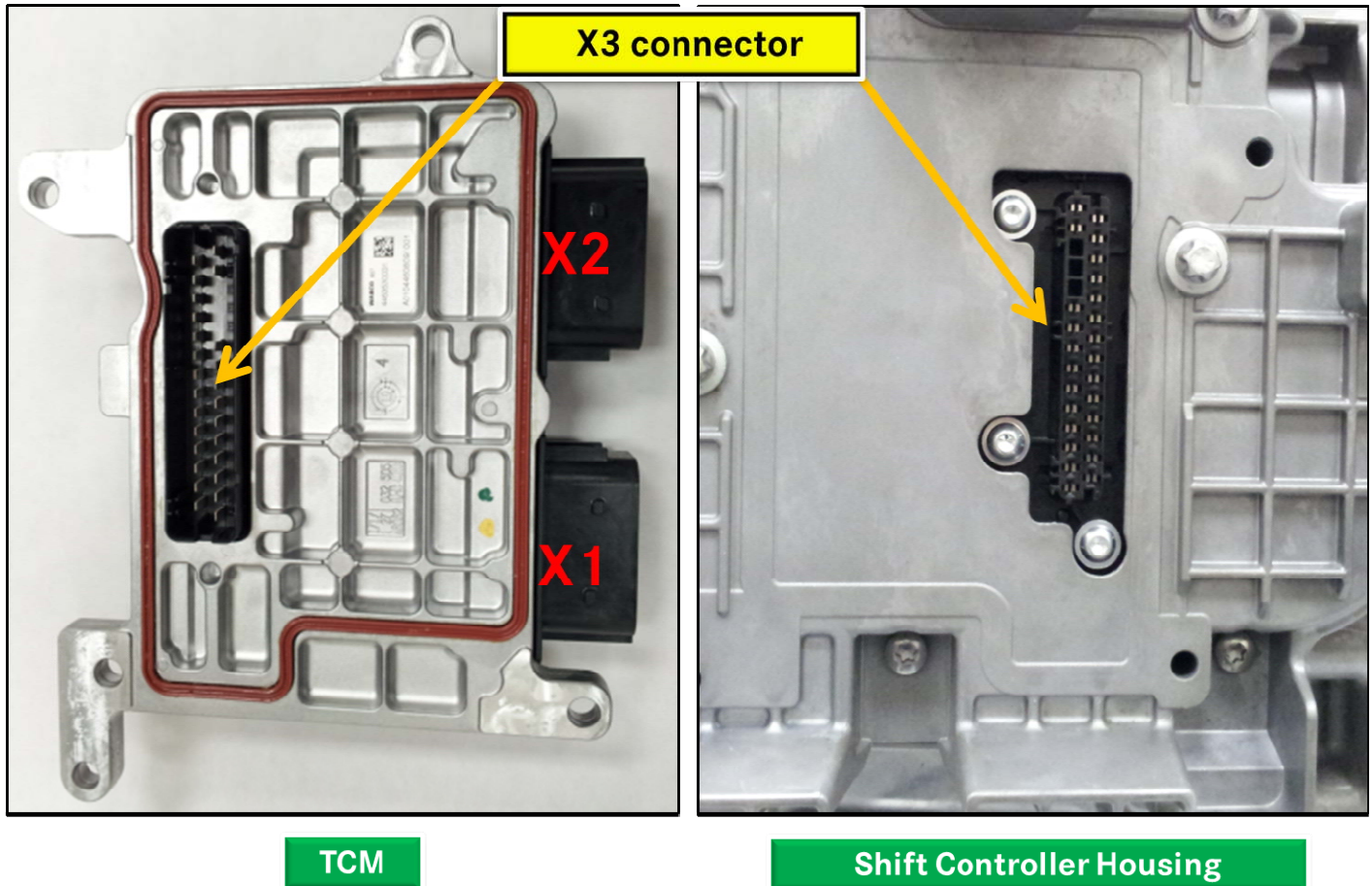
Engine Brake Medium

Engine Brake High

- Manual engine brake activation via the shift stalk will **always** override the cc band switch settings
- Cruise control will ***disable*** when the engine brakes are manually activated via the shift stalk. Cruise control will ***resume*** once the stalk is returned to the full upright, or “off” position provided the settings are parameterized correctly.

It is important to mention that any manual engine brake intervention initiated by the driver ***will always*** override the CC band switch settings.

TRANSMISSION CONTROL MODULE



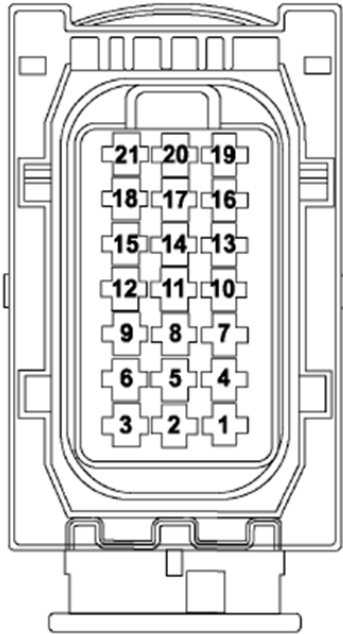
The TCM includes control logic to provide overall transmission management. The TCM monitors various speed, load, and clutch inputs in conjunction with the CPC4, which drive the outputs that are required to shift the transmission. The TCM has a 21-pin connector at X2 and another 21-pin connector at X1.

The TCM also has a third connector that is used for internal solenoid valve operation. The X3 connector can only be accessed once the TCM is removed from the shift controller.

Also, there are 157 different transmission related fault codes.

TRANSMISSION CONTROL MODULE

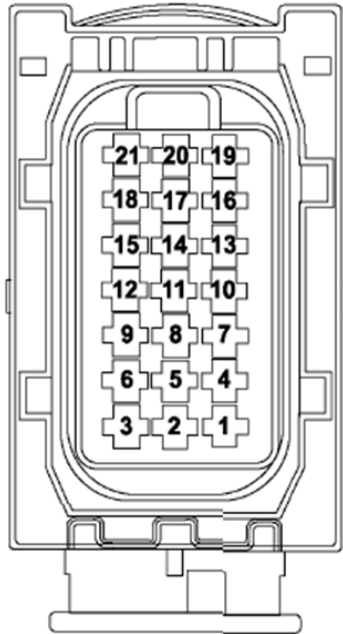
X1 CONNECTOR

TCM Connector #1 Pin Assignments			
Pin	Signal Type	Function	Connector
1/1	KL30A1	Battery (+)	 TCM Harness Connector # 1 Tyco# 1-1355222-1 d260043
1/2	KL30B2	Battery (+)	
1/3	KL30B1	Battery (+)	
1/4	KL15	IGNITION	
1/5	ExtUaBat	Not Used	
1/6	KL30A2	Battery (+)	
1/7	CAN1 GND1	Powertrain CAN Ground	
1/8	CAN1 GND2	Powertrain CAN Ground	
1/9	Not Used	Not Used	
1/10	CAN1 High	Powertrain CAN High	
1/11	CAN1 Low	Powertrain CAN Low	
1/12	Not Used	Not Used	
1/13	Not Used	Not Used	
1/14	Not Used	Not Used	
1/15	Not Used	Not Used	
1/16	KL31B2	Battery (-)	
1/17	Not Used	Not Used	
1/18	Not Used	Not Used	
1/19	KL31A1	Battery (-)	
1/20	KL31A2	Battery (-)	
1/21	KL31B1	Battery (-)	

The X1 connector is used for the chassis interface. It contains all of the powers and grounds as well as the PT CAN circuits.

TRANSMISSION CONTROL MODULE

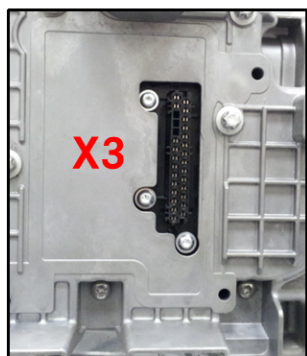
X2 CONNECTOR

TCM Connector #2 Pin Assignments (Supplied with Transmission Harness - Factory Installed)			
Pin	Signal Type	Function	Connector
2/1	DzVgw	Countershaft Speed Sensor	 TCM Harness Connector # 2 Tyco# 2-1355222-1 d260044
2/2	U-DzVgw	Countershaft Speed Sensor	
2/3	U-DzHaw	Main Shaft Speed Sensor	
2/4	GND-Sku	Clutch Position Sensor Ground	
2/5	U-Sku	Clutch Position Sensor Supply	
2/6	DzHaw	Main Shaft Speed Sensor	
2/7	Sku	Clutch Position Signal	
2/8	Sku2	Clutch Position Signal Inverse	
2/9	SSf	Not Used	
2/10	SRa	Range Position Sensor	
2/11	PVERS2	Trans Air Pressure	
2/12	GND-S	Range Position Sensor GND	
2/13	DzSf	Not Used	
2/14	Temp-FSS	Trans Oil Temp	
2/15	DzAw	Output Shaft Speed	
2/16	MSfB	Not Used	
2/17	ExtUBat	Switched - Sensor PWR Battery (+)	
2/18	GND - Sens	GND - Speed, t_oil, press sensors and special function	
2/19	MSfA	Not Used	
2/20	GrS-G2	Not Used	
2/21	GrS-G3	Not Used	

The X2 connector is used for the transmission harness.

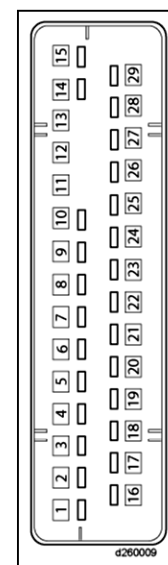
TRANSMISSION CONTROL MODULE

X3 CONNECTOR



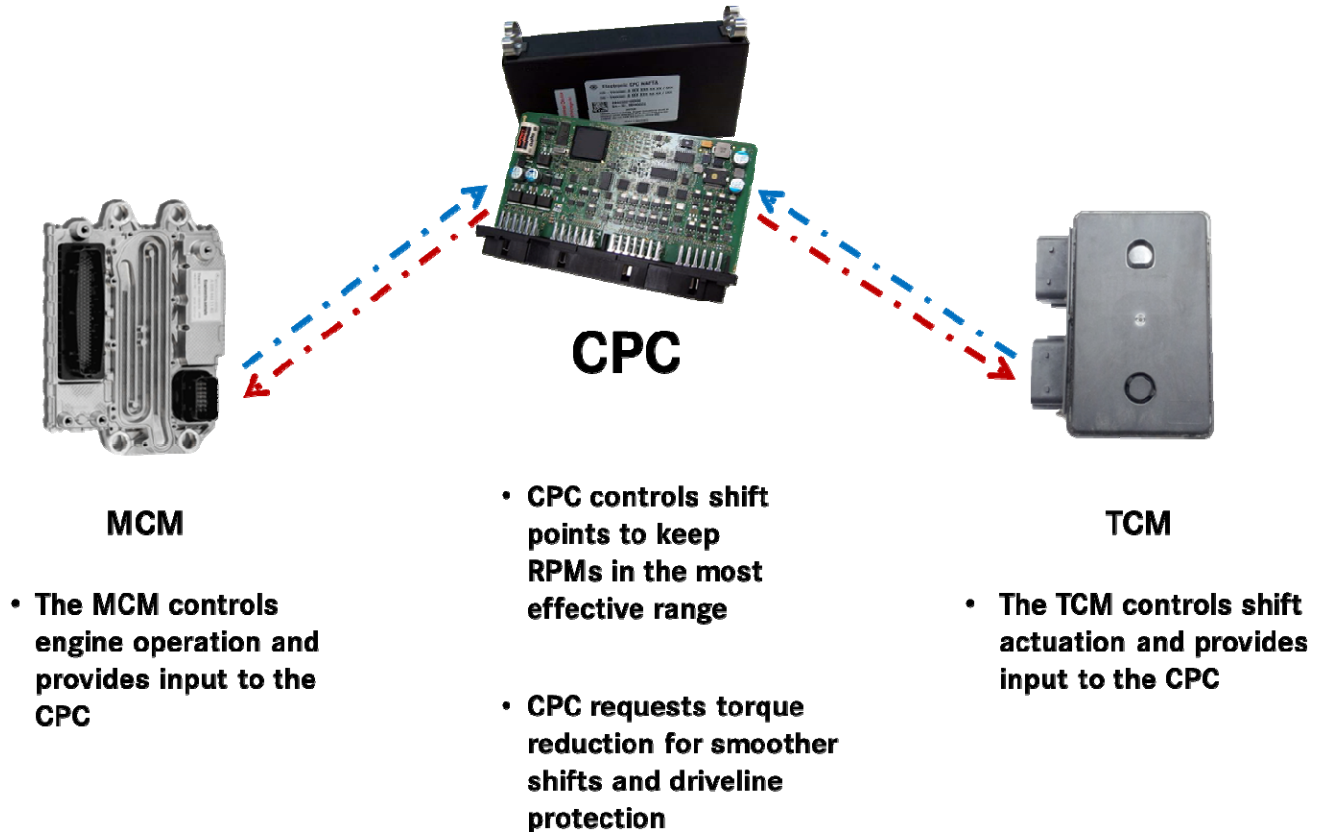
Pin	Description
1	Not Used
2	Not Used
3	Not Used
4	Solenoid Clutch Close Slow
5	Countershaft Solenoid Apply
6	Solenoid Clutch Open Slow
7	Solenoid Split In (High)
8	Solenoid Rail In
9	Solenoid Gear In
10	Solenoid Rail Out
11	Not Used
12	Not Used
13	Not Used
14	Ground
15	Ground

Pin	Description
16	Not Used
17	Not Used
18	Not Used
19	Solenoid Range Out (High)
20	Solenoid Range In (Low)
21	Solenoid Split Out (low)
22	Solenoid Clutch Open Quick
23	Solenoid Clutch Close Quick
24	Solenoid Gear Out
25	Signal - Split Position
26	Signal - Gear Position
27	Signal - Rail Position
28	Not Used
29	Not Used
30	Not Used
31	Not Used



The X3 connector contains the circuits for the shift solenoids located internally of the shift controller.

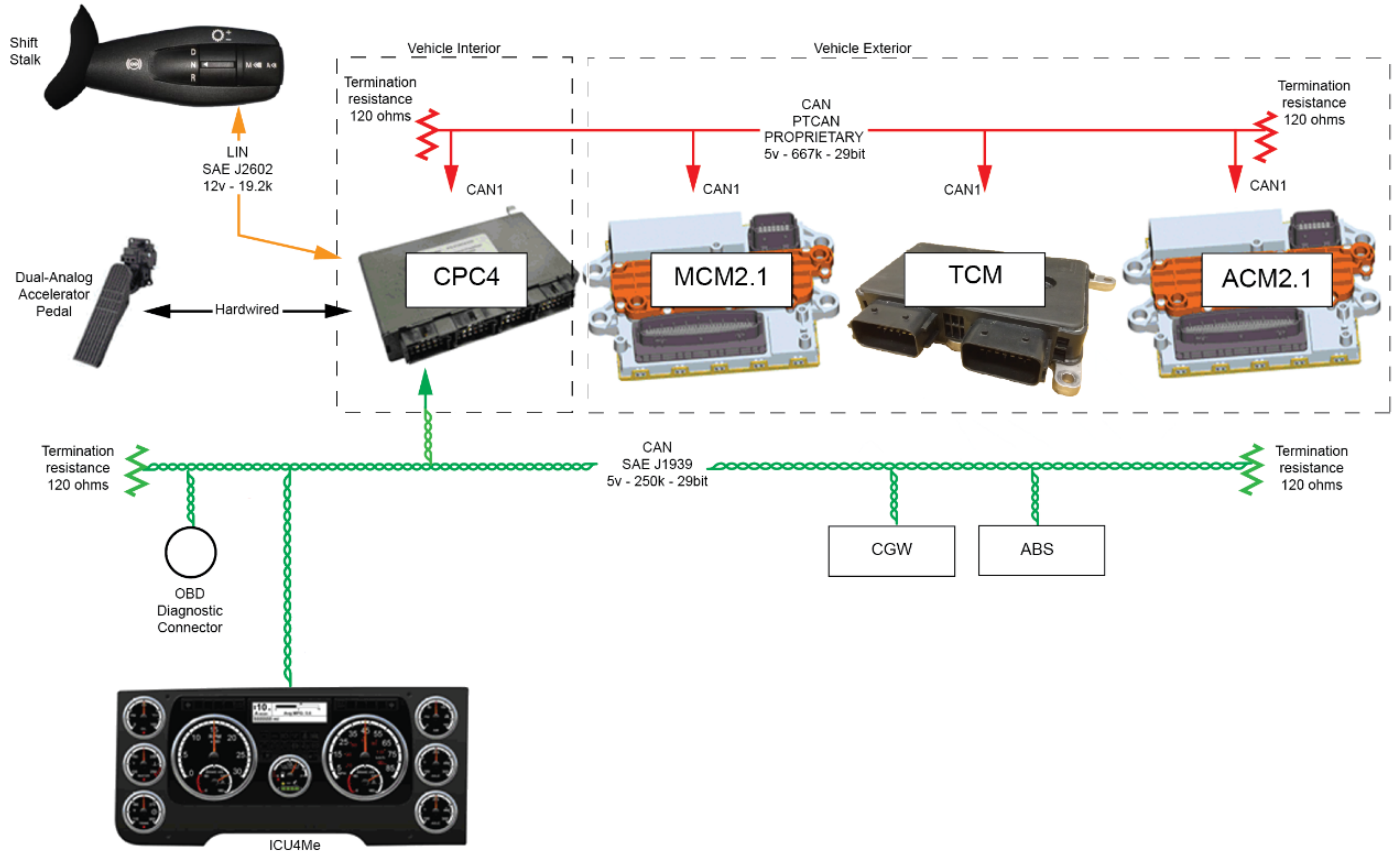
POWERTRAIN COMMUNICATIONS



The DT12 transmission relies on three control modules to function properly. The CPC is the centerpiece of the powertrain communication network. The shift maps for the transmission are stored within the CPC. In a simple explanation of a shift, the CPC will request a torque reduction from the MCM and then commands or “tells” the transmission control module (TCM) when to shift. Shifts are then actuated by the TCM.

If there is a software update available, it is imperative that **all** modules, including the ACM are also updated.

SIMPLE SCHEMATIC FOR THE DT12



In addition to the CPC4, the MCM 2.1, and the ACM 2.1, the PT CAN network now contains the transmission control module. Unlike previous transmissions, the TCM for the DT12 is not directly tied to the SAEJ 1939 public network. The CPC4 is the link between all modules on the PT CAN and the J1939.



1. The engine brake “OFF” position is also known as the _____ position.

2. Which module “tells” the transmission when to shift?



DETROIT

Transmissions

DT12™

Maintenance

In this section we will learn:

- What transmission fluid should be used
- Proper fluid maintenance intervals

DT12 PREVENTATIVE MAINTENANCE

Maintenance Item	Interval	Service Functions
Check Lubricating Oil Level	>60k miles annual travel: inspect at 100k miles	Inspect oil level
Replace Lubricating Oil & Inspect Oil Pump Screen	<80,000 lbs. GCW: 3 years/300k miles >80,000 lbs. GCW: 2 years/200k miles	Drain & replace oil; Inspect oil screen
Bell Housing Vent Hole/Milled Slot	As necessary depending on vehicle operating conditions	Inspect & ensure vent hole/slot free of debris
Pneumatic Air Actuator Vents	As necessary depending on vehicle operating conditions	Inspect & ensure vents are free of debris

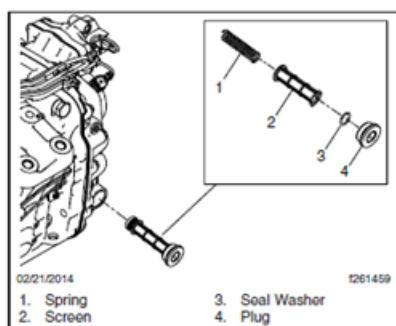
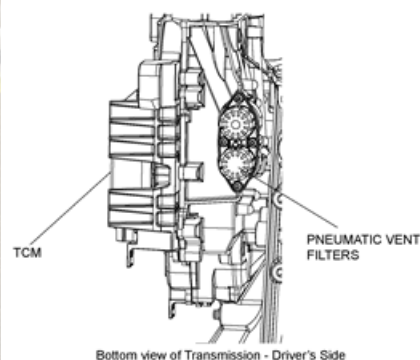


Fig. 2, Oil Pump Screen, Detroit Automated Transmissions

Oil Pump Screen Inspection



Bell Housing Vent/Slot



Pneumatic Air Actuator Vents

Shown above are some basic maintenance procedures that should regularly be performed on the DT12 transmission.

DT12 TRANSMISSION FLUID

The DT12 uses a fully synthetic oil to further increase:

Fuel Efficiency

- Lower viscosity oils that are synthetically engineered for their application reduce friction and pumping inefficiencies, using less fuel to turn the transmission

Reliability

- Synthetic oils are engineered to clean contaminants and dissipate heat more effectively, leading to longer transmission life

ONLY use Detroit Transmission Fluid in the DT12

Low quality oils will:

- Not provide the same fuel efficiency
- Affect reliability by deteriorating gaskets and seals
- Break down further before the maintenance interval



Spec:

75w-90

MB 235.11

The DT12 uses a special proprietary oil and **IS NOT** compatible with *any other manufacturers oils*. The oil is made by Fuchs and is currently the **ONLY** oil to be used in this transmission.



TRANSMISSION OIL CHANGE INTERVAL

Maintenance Operation Number	M3 Maintenance Interval Operations for Service Schedules I and II	Check
00-05	Perform All M1 Operations	
00-06	Perform All M2 Operations	
09-01	Air Cleaner Inspection	
20-02	Radiator Pressure-Flushing and Coolant Change	
25-03	Fluid Change, Hydraulic Clutch Control	
25-04	Clutch Replacement, Detroit™ Automated Transmissions*	
26-01	Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning†	
26-04	Eaton Fuller Transmission Fluid Change and Magnetic Plug Cleaning‡	
35-01	Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning	
42-02	Bendix Air Dryer Desiccant Replacement	
42-09	Bendix E-6 Foot Control Valve Inspection and Lubrication	
42-10	WABCO System Saver Air Dryer Desiccant Cartridge Replacement	
46-02	Power Steering Fluid and Filter Change	
46-07	Bellows Replacement, Rack and Pinion Steering Gear	
49-02	CAT CGI Bellows Replacement	

* Replace the clutch assembly for Detroit automated transmissions at 750,000-mile (1 200 000-km) intervals.

† For Schedule II vehicles with Detroit automated transmissions spec'd to haul more than 80,000 lb (36 000 kg), change the transmission fluid at 200,000-mile (322 000-km) intervals.

‡ For Eaton Fuller transmissions, fluid change intervals are extended to 500,000 miles (800 000 km) on vehicles filled with synthetic transmission fluid.

Current fluid change intervals for schedule II vehicles is 300,000 miles, however, vehicles rated to haul more than 80,000 lbs. GCVW are required to change the fluid at 200,000 miles.

Future DDEC Reports versions will show transmission operating temperatures which may be used to determine oil change intervals.

*** Always refer to the maintenance manual for specific instructions and intervals.**

1. At what interval should vehicles rated to haul more than 80,000 lbs. change the transmission oil at?

2. What two vents should be periodically checked?



DT12™

Notes:



DETROIT

Transmissions

DT12™

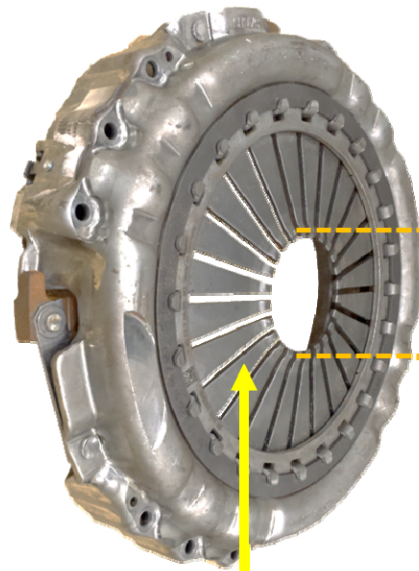
Clutch

In this section we will learn:

- Clutch applications
- Introduction to the dual disc clutch
- The proper procedures to follow for the installation of the clutch
- Damage that may occur from improper installation
- Understanding the self adjustment mechanism of the clutch
- Release cylinder operation
- Clutch and flywheel damage from contamination

PUSH-TYPE CLUTCH

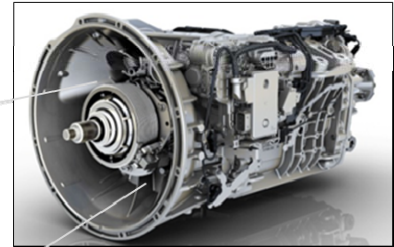
Push-Type Clutch



**Pressure Plate
Release Levers**



Clutch Release Cylinder



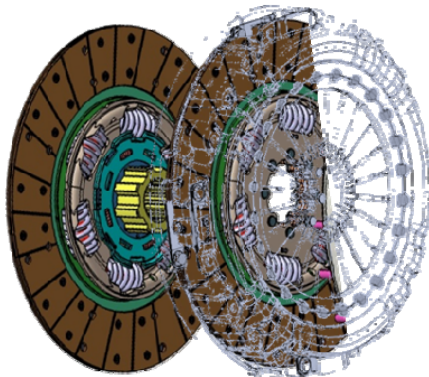
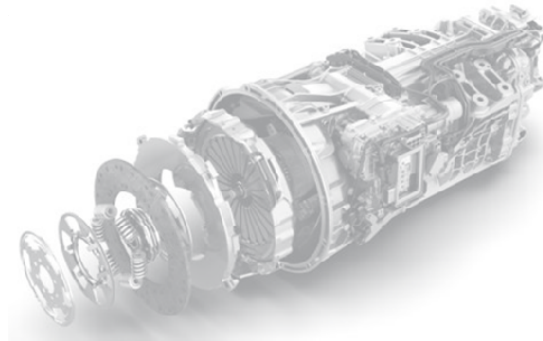
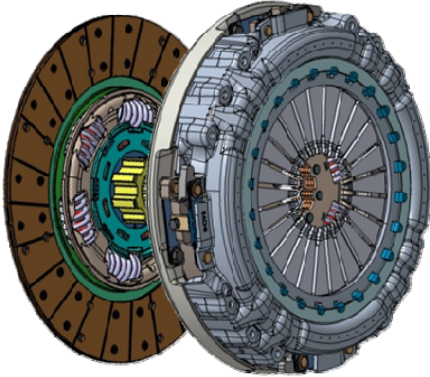
- On vehicles equipped with DT12 transmissions, the release bearing does not need to be lubricated.
- Replace the clutch assembly for Detroit automated transmissions at 750,000 miles (1.2 million km) intervals.

The DT12 utilizes a push-type clutch configuration. In a push-type clutch assembly, the release bearing is not attached to the clutch cover like a pull-type clutch. In the case of the DT12, the release bearing is part of the clutch release cylinder. To disengage the clutch, the pneumatic clutch release cylinder expands allowing an integral release bearing to push against the pressure plate release levers to disengage, or open, the clutch. The levers are compressed to open the clutch and released to close the clutch.

The Clutch Release Cylinder requires no maintenance. It is recommended that the clutch assembly be replaced at 750,000 miles.



CLUTCH APPLICATIONS



Transmission Model	
All DT12	DT12 - OA
≤ 80,000 GCVW	≥ 105,000 GCVW
Single Disc	Dual Disc

- Dual disc optional with DD 15 above 80K
- Dual disc standard with DD 16

** Chart is for information purposes and subject to change*

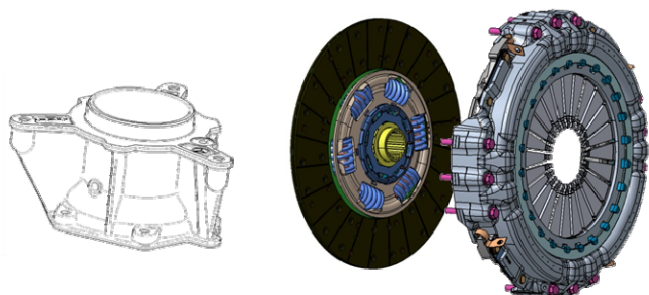
Currently, a single disc clutch is standard on vehicle applications with less than, or equal to 80,000 lbs. gross combined vehicle weight (GCVW).

Applications above 105,000 lbs. GCVW require a dual disc clutch. A dual disc is optional for DD15 applications above 80,000 lbs. GCVW.

A dual disc clutch is standard with the DD16.

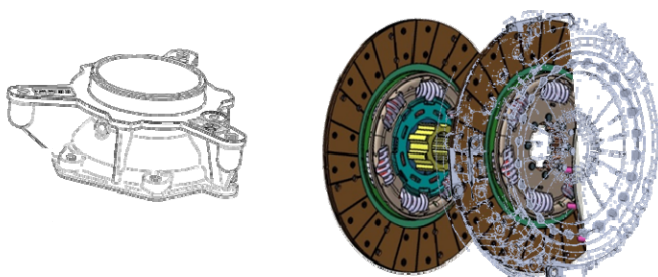
SINGLE VS. DUAL DISC

Single Disc



- Disc measurement: 430 mm / 17 Inches
- 95 mm mounting bolts * *one time use!*
- Input shaft housing part numbers different between A and B box transmission
- Approx. 40.2 kg / **88 lbs.**

Dual Disc



- Disc measurement: 400 mm / 15.7 Inches
- 130 mm mounting bolts
* *one time use!*
- Input shaft housing part number different than that of a single clutch and is physically smaller to accommodate the larger clutch Housing.
- Approx. 73.3 kg / **161 lbs.**

Take a moment to review the differences between the single and dual disc clutch. Currently, a customer **cannot** merely upgrade to a dual disc clutch if so desired. Instead, the transmission must be replaced in that event.



DUAL DISC CLUTCH

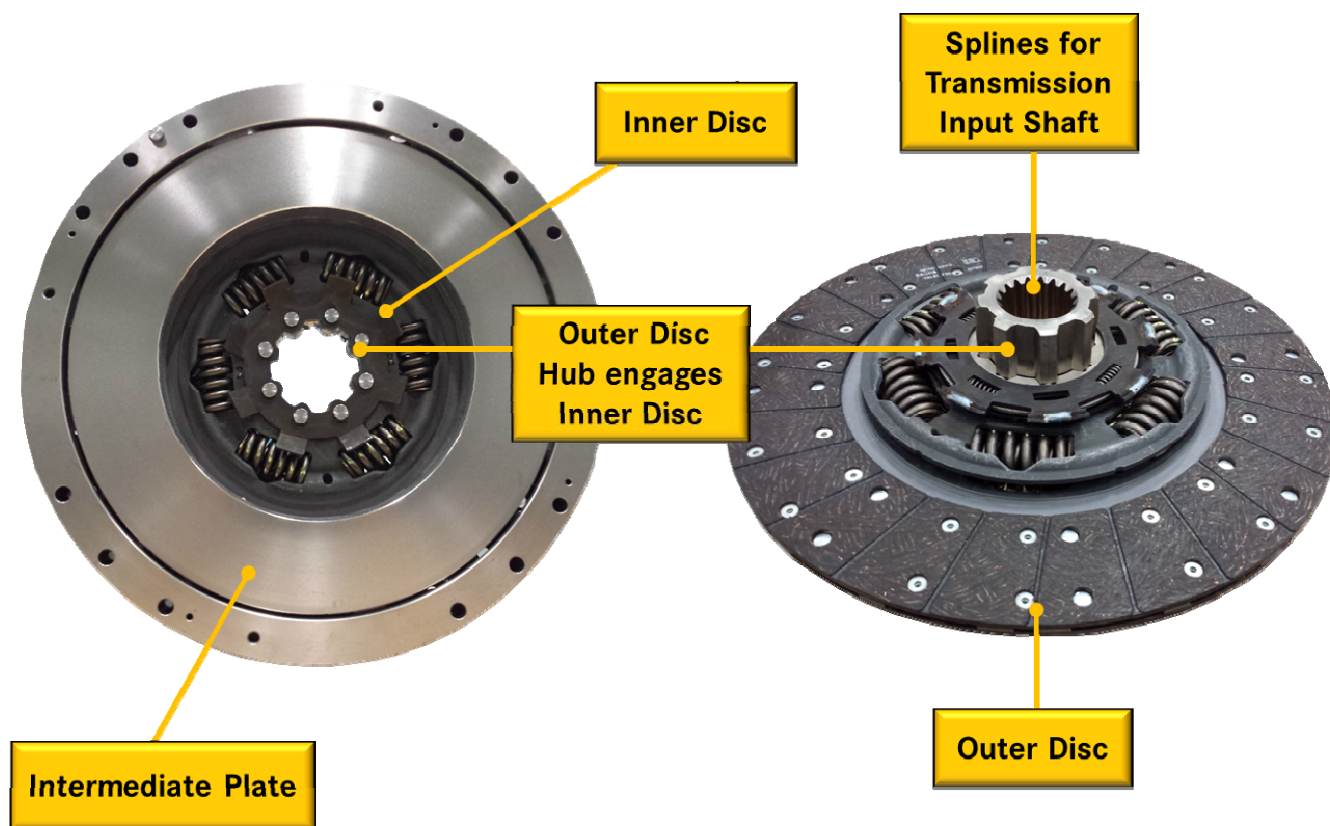


**Inner disc is integral to the
pressure plate / intermediate plate assembly**

The dual disc clutch is a complete assembly, meaning that the inner disc and intermediate plate cannot be removed separately. The only component that is isolated is the outer disc.



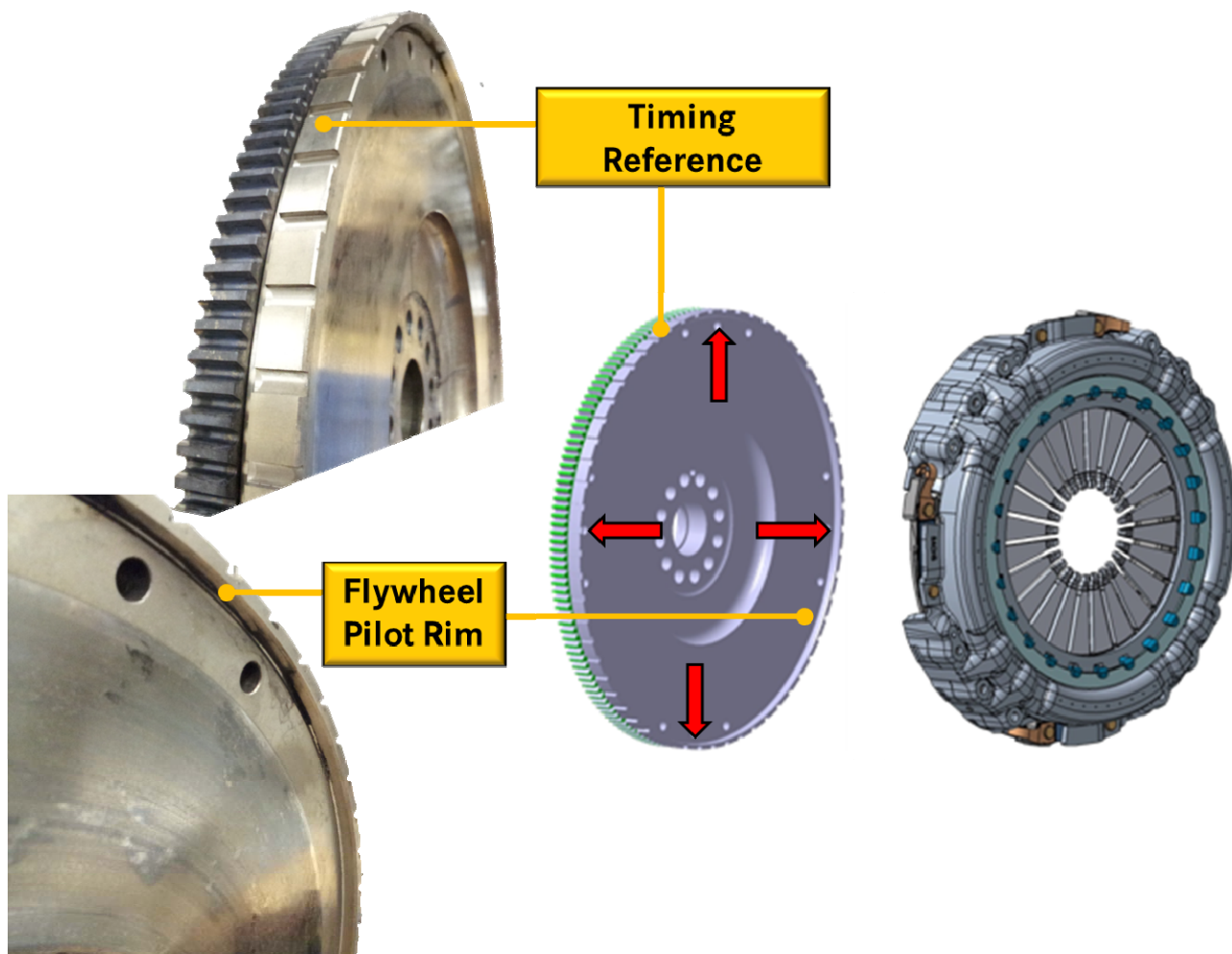
DUAL DISC CLUTCH CONT'D



As you can see, the intermediate plate and inner disc are integral to the clutch assembly. The transmission input shaft splines only engage with the outer disc. The hub of the outer disc then drives the inner disc.

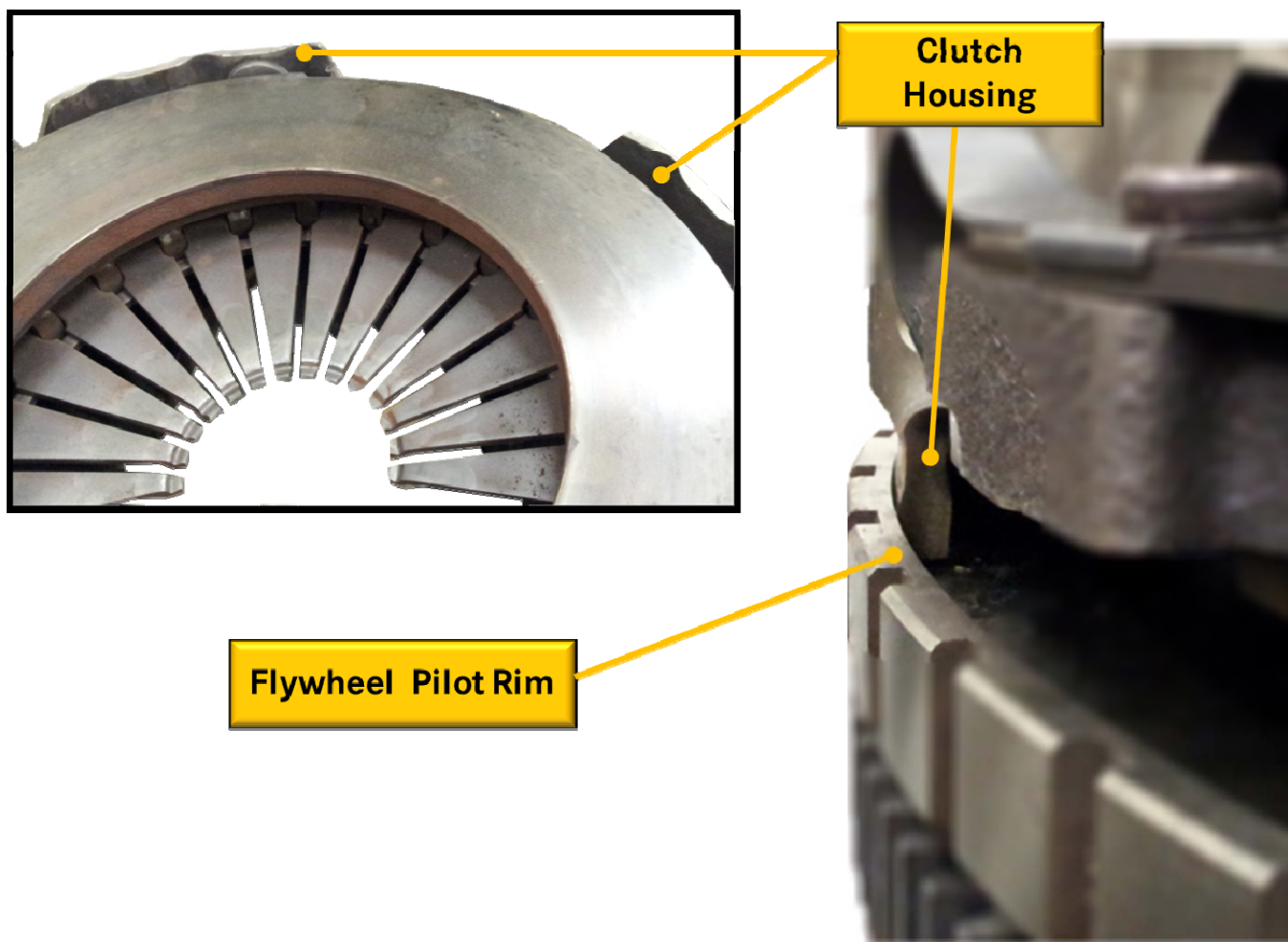


FLYWHEEL PILOT RIM - TIMING REFERENCE



The flywheel contains a machined outer pilot rim that is used for timing reference.

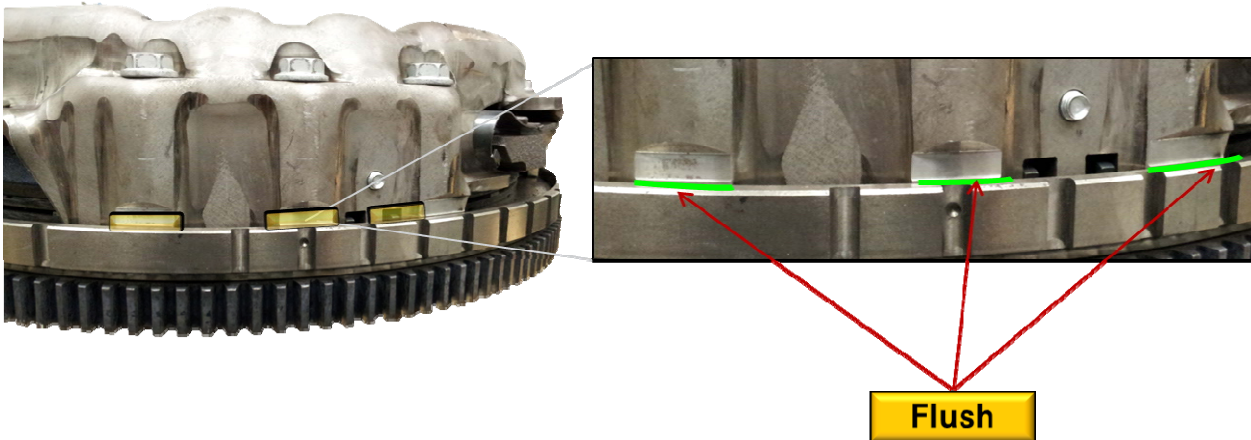
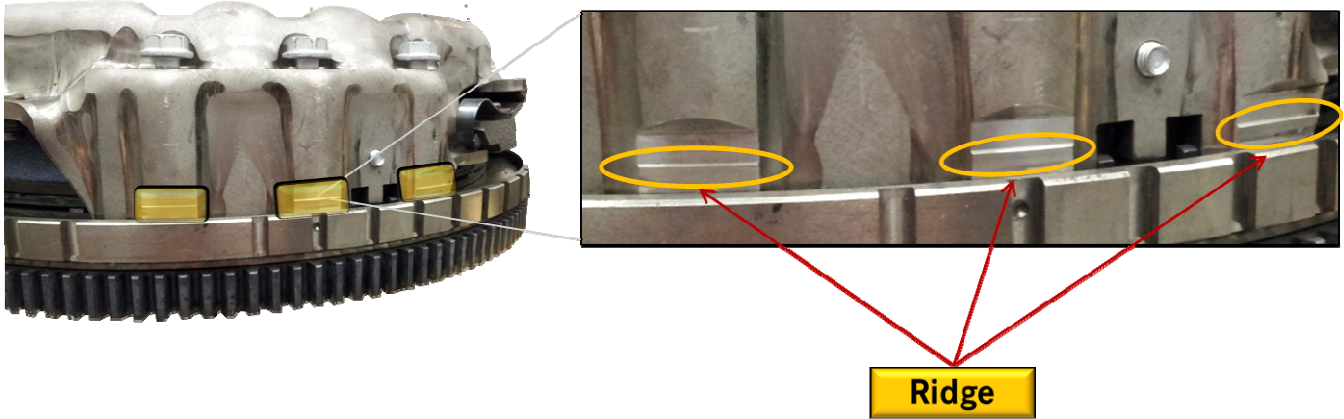
POTENTIAL PILOT RIM DAMAGE



If the clutch assembly is not initially installed correctly, it can damage the pilot rim on the flywheel. Engine timing fault codes and improper clutch operation may arise if this machined area is damaged.

In the image shown, you can see how the clutch housing is seated within the pilot rim.

PROPER CLUTCH INSTALLATION



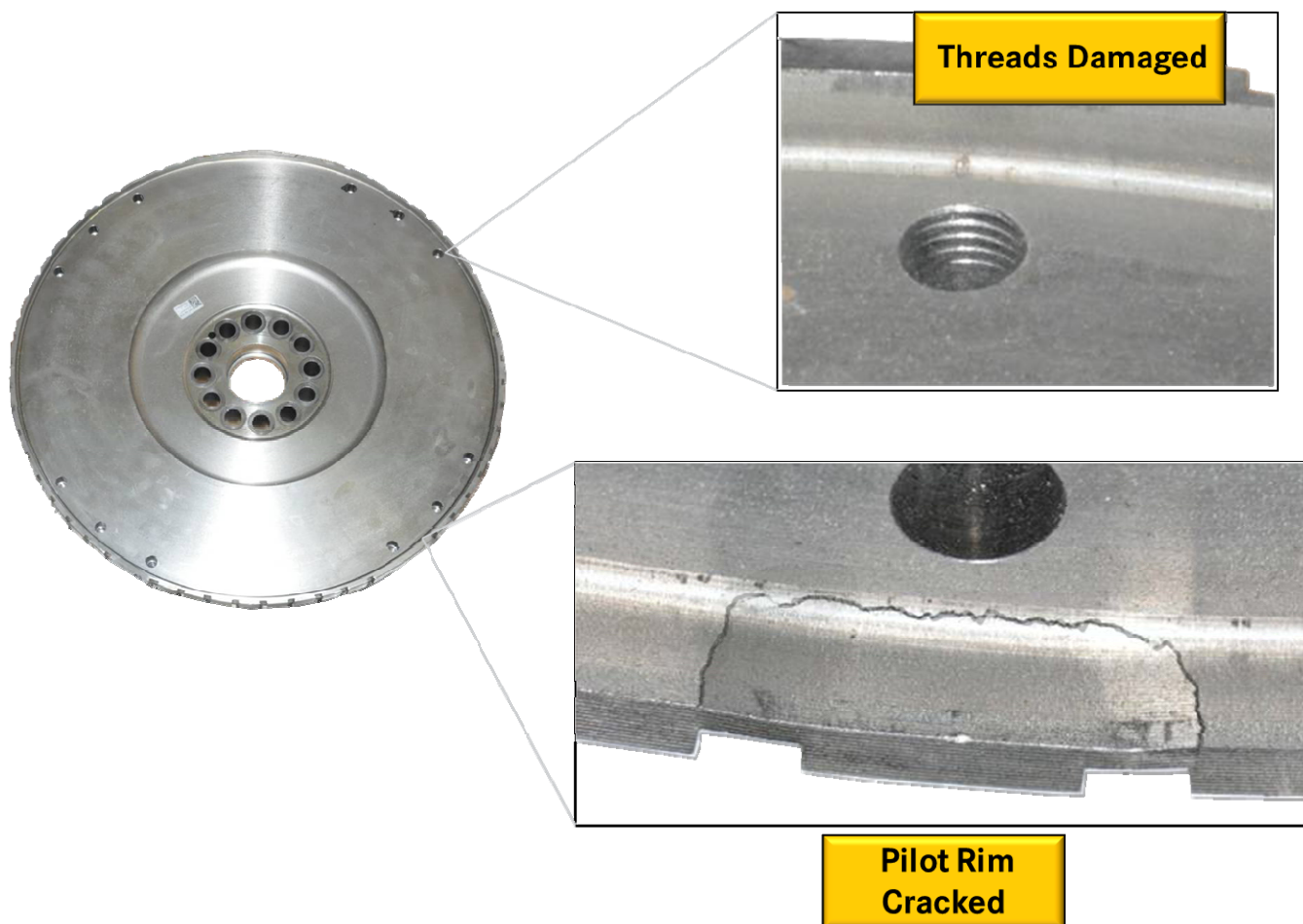
On the four mounting locations of the clutch housing, there are recesses that contain a ridge. It is imperative that these recesses fit completely inside of the flywheel pilot rim.

ALL of the clutch mounting bolts must first be installed hand tight, then tightened and torqued in an alternating pattern to ensure even compression of the clutch release springs and to prevent binding of the clutch assembly within the pilot rim.

Once the clutch assembly is properly torqued, the ridge will be flush with the top of the pilot rim.



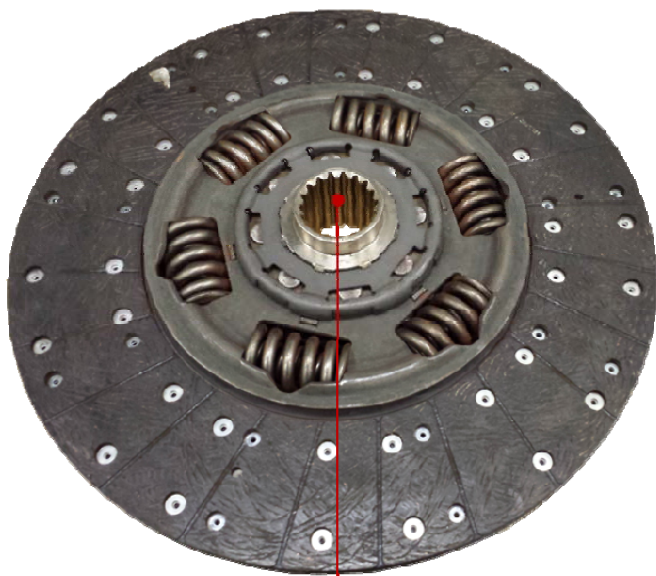
IMPROPER INSTALLATION DAMAGE



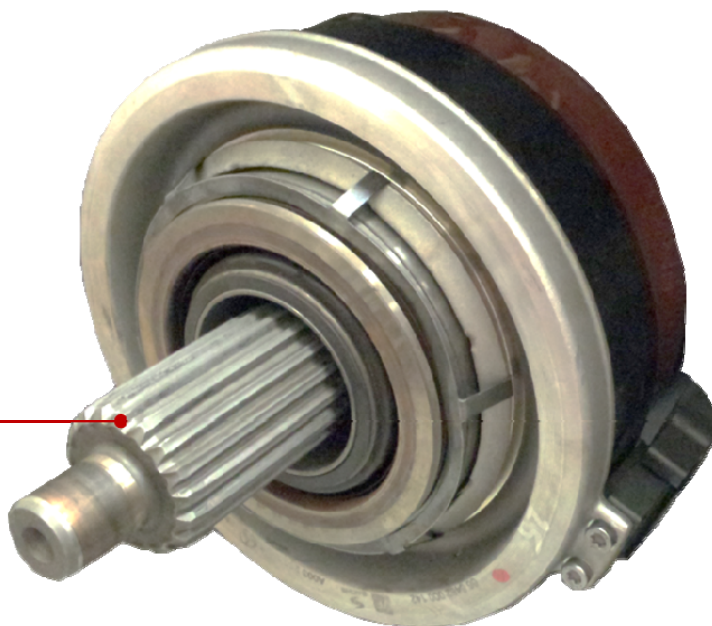
If the clutch assembly is not correctly positioned within the flywheel's pilot rim, the clutch mounting bolt hole threads in the flywheel can be damaged while tightening the bolts.

The pilot rim can also crack, deform, or completely break.

NO LUBRICANT PRECAUTION



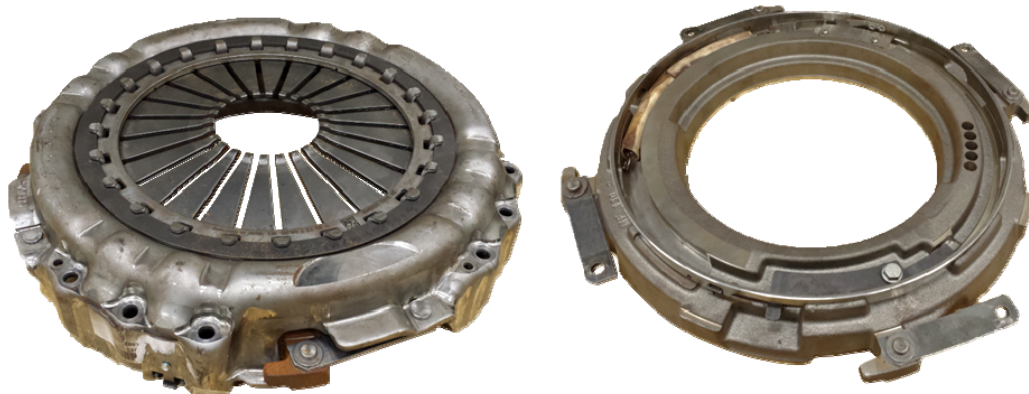
**DO NOT APPLY ANY
TYPE OF LUBRICANT
TO THE INPUT SHAFT
SPLINES OR CLUTCH
DISC SPLINES!**



It is extremely important that **no lubricant of any kind** be installed on the input shaft splines or clutch disc splines prior to installing the transmission. When mating the transmission to the engine, the input shaft splines must be clean and dry. Grease can restrict movement of the clutch disc and cause clutch disengagement issues.



SELF-ADJUST MECHANISM



1. Clutch Pressure Plate
2. Coil Spring
3. Set Collar
4. Coil Spring
5. Slide
6. Leaf Spring

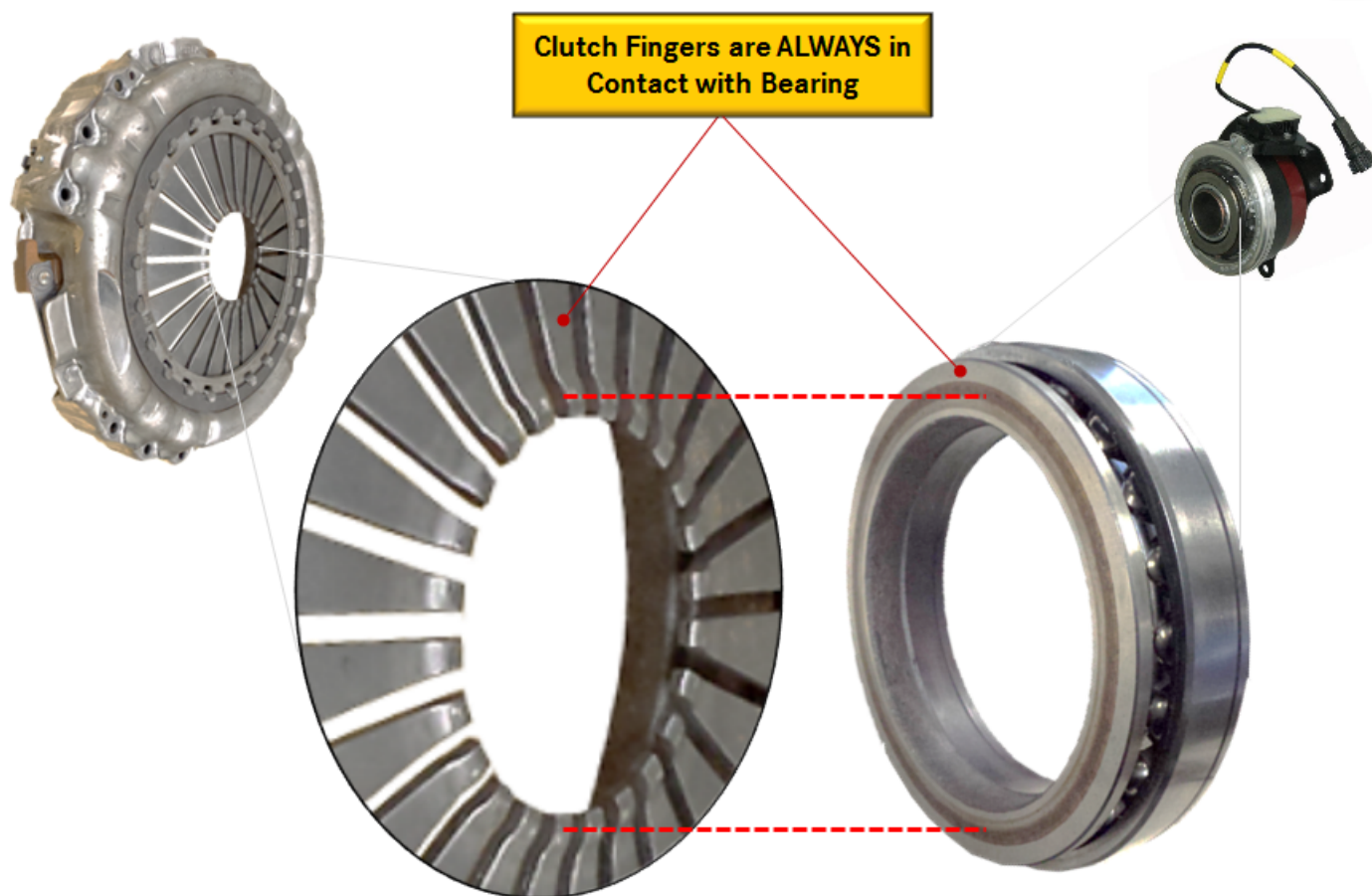
Both single and dual disc clutches contain a self-adjust mechanism that compensates for disc wear. The self-adjust mechanism ***cannot be reset***, therefore the clutch disc cannot be replaced by itself. Any wear or contamination of the disc will require total clutch replacement.

CLUTCH RELEASE CYLINDER EXERCISE

Perform the Clutch Release
Cylinder (CPCA) remove
procedure.



CLUTCH FINGERS



It is important to note that the clutch release bearing is **ALWAYS** in contact with the pressure plate release levers. Different levels of thrust are exerted on the bearing depending on how much or how little the clutch is opened.



CLUTCH RELEASE CYLINDER

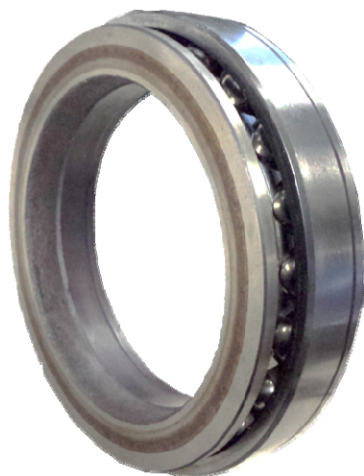


Bearing is sealed and contains grease that requires no additional lubrication or maintenance

Inner Race

Thrust Surface

Outer Race



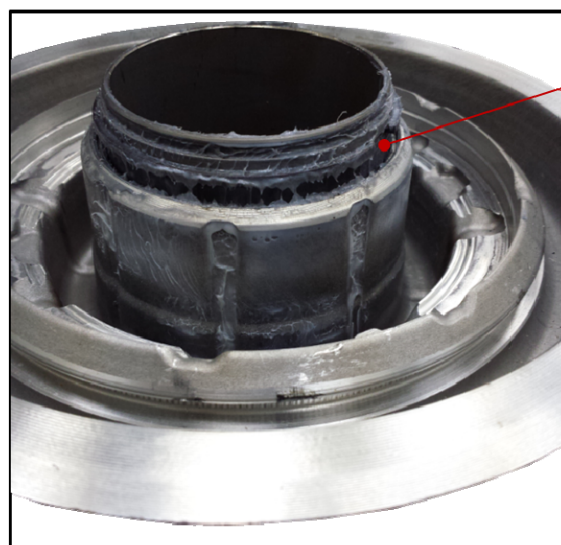
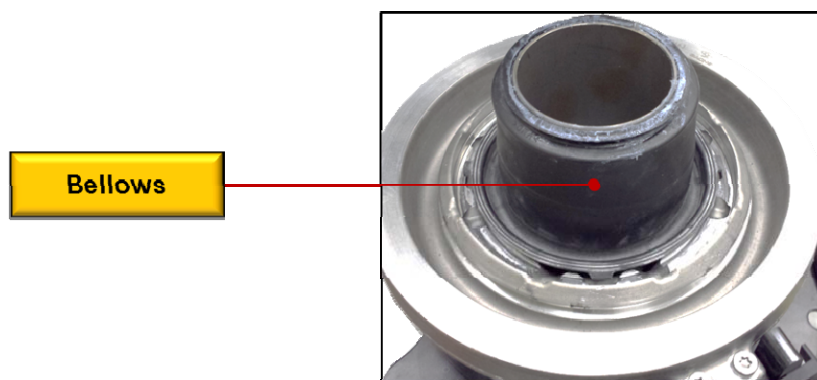
Ball Bearings

The bearing is sealed and lubricated with grease and requires no additional lubrication or maintenance. In the image above, you can clearly see the thrust surface, the inner race, the ball bearings, and finally the outer race.

The release bearing is NOT serviceable by itself.



RELEASE CYLINDER BELLOWS

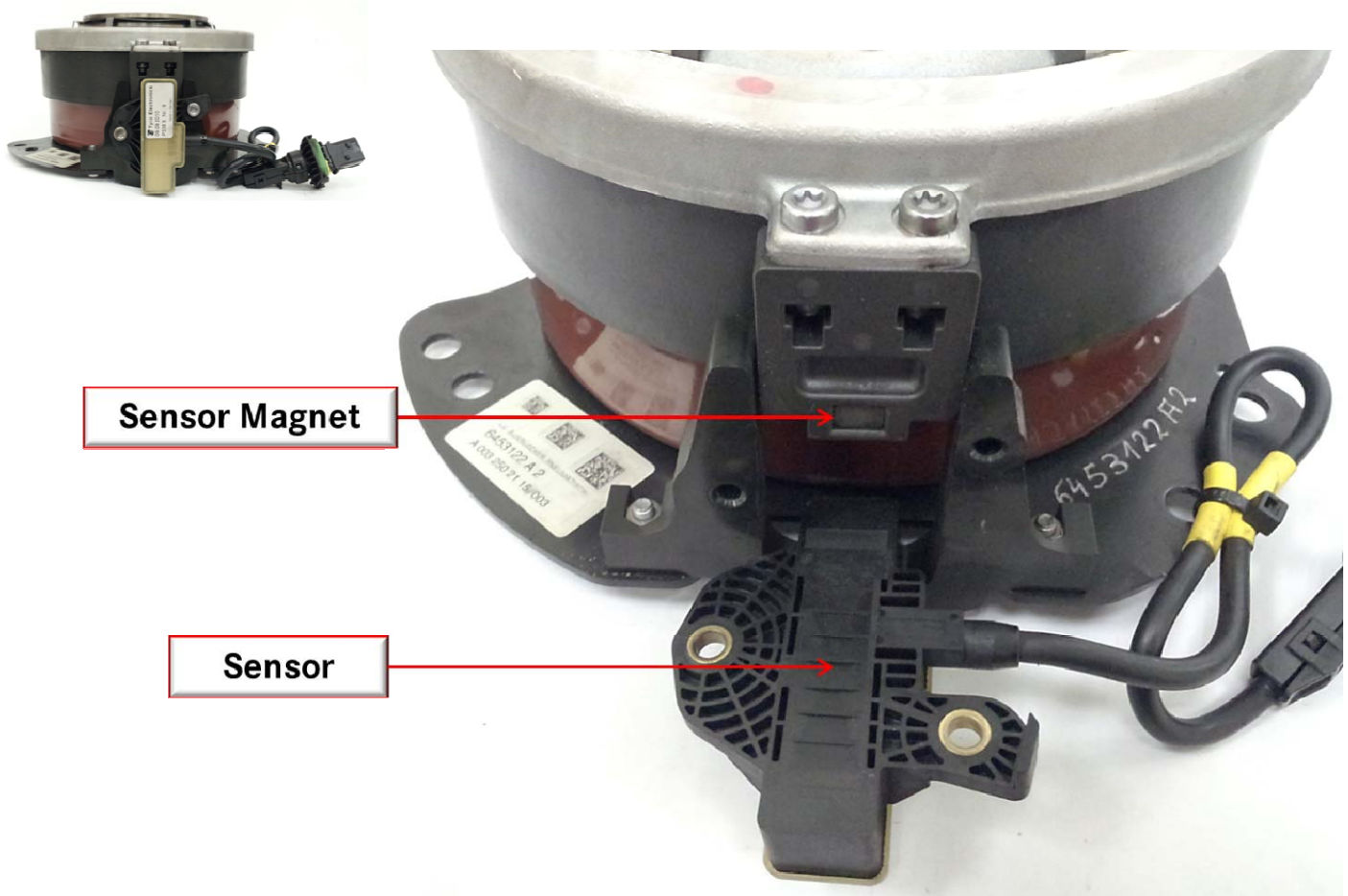


Fixed Shaft



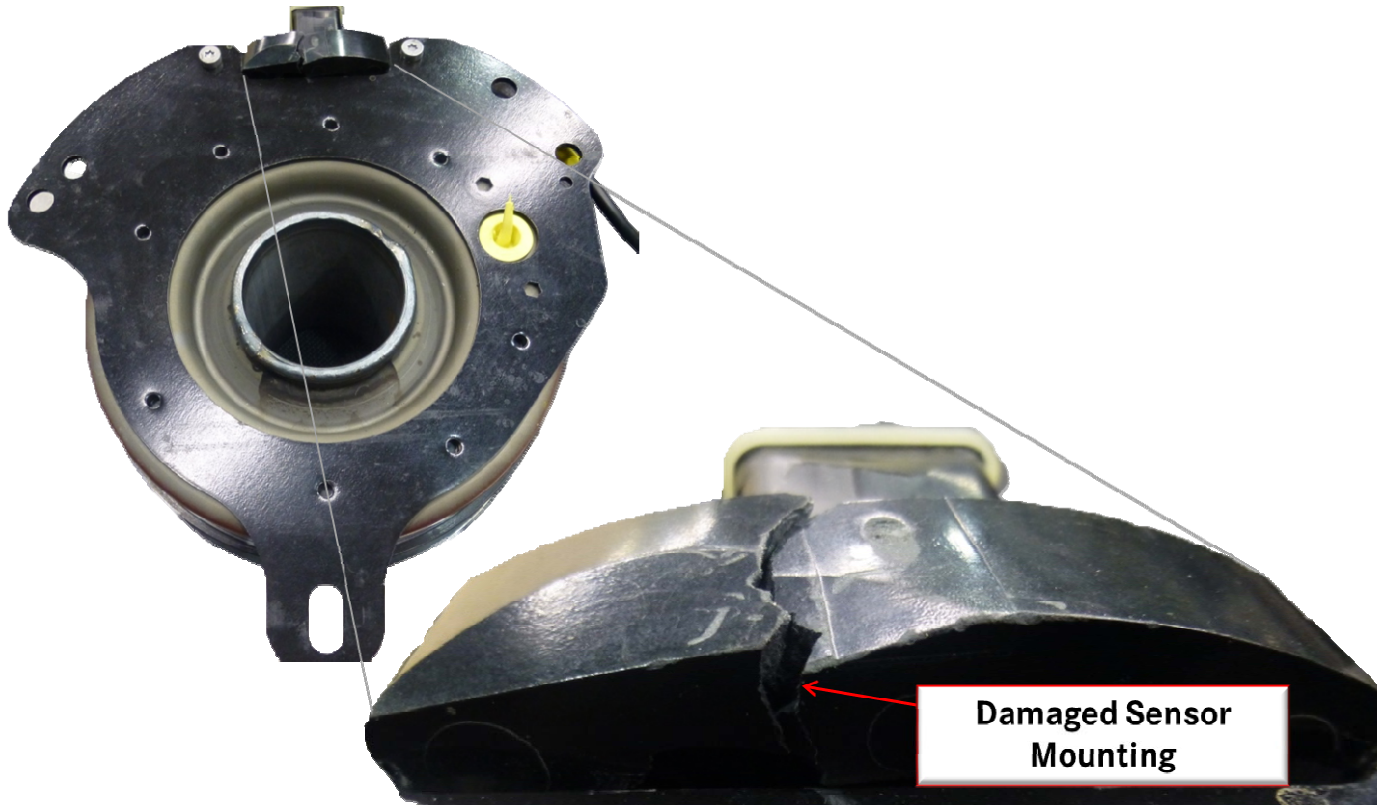
There is an additional component that is lubed within the clutch release cylinder that requires no additional lube or maintenance. You may notice a rubber boot, or bellows, on the cylinder that is easily viewed when the cylinder is compressed. This boot contains grease that lubricates the fixed shaft that the main body of the release cylinder rides fore and aft on. Again, there is no required maintenance on the release cylinder but it is a good practice to visually look for tears in the boot, or evidence of grease leakage.

CLUTCH TRAVEL SENSOR



The only item that is serviceable on the clutch release cylinder is the clutch travel sensor; however, if the magnet or magnet mounting is damaged, the clutch release cylinder will have to be replaced.

CYLINDER OR SENSOR REPLACEMENT



When replacing the sensor, or the release cylinder, always check for any physical damage to those components prior to installation.



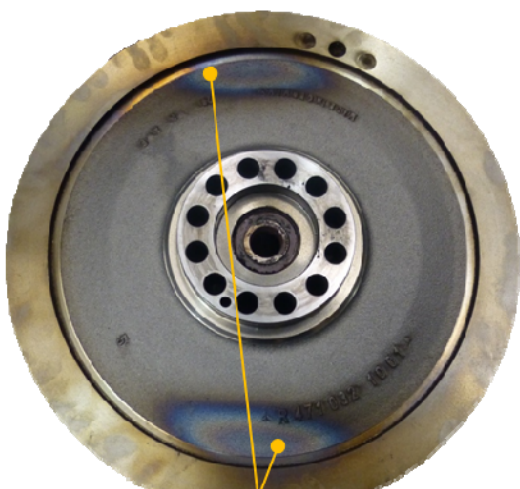
CLUTCH DAMAGE



Pressure Plate Fractured



Clutch Disc Burnt



**Flywheel Hot-Spots
(Back side of flywheel shown)**



**Grease and Disc Material Transfer on
Flywheel Face**

As with any clutch, proper servicing procedures must be followed to prevent damage to the clutch and flywheel assembly. The images above show a burnt clutch disc with a broken pressure plate caused by grease contamination.



CLUTCH DAMAGE CONT'D



The failure occurred from an improperly installed flywheel pilot bearing. The pilot bearing was not fully seated, thus allowing the shoulder of the input shaft to damage the pilot bearing grease seal. The grease was allowed to migrate and contaminate the clutch disc and flywheel face.

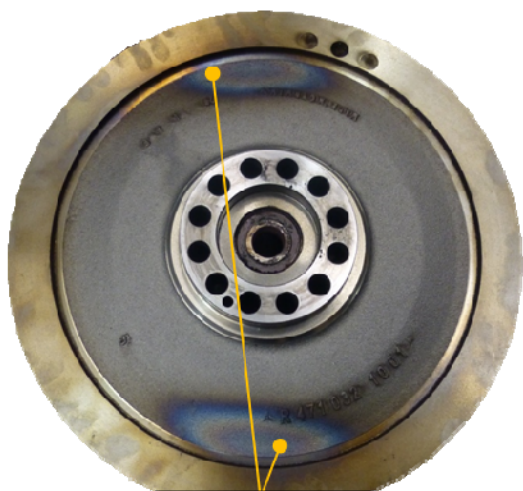
CLUTCH DAMAGE CONT'D



Pressure Plate Fractured



Clutch Disc Burnt



**Flywheel Hot-Spots
(Back side of flywheel shown)**



**Grease and Disc Material Transfer on
Flywheel Face**

The grease contamination allowed the disc to slip and generate a tremendous amount of heat. Localized hot-spots formed on the flywheel causing a ripple, or wave effect that was transferred to the pressure plate. The heat cycling of the pressure plate finally caused the fractures seen above.

It is imperative that the flywheel face and pressure plate are clean and free of debris prior to servicing a clutch. Always inspect the pilot bearing, clutch release cylinder, rear crankshaft seal, and any other seals or components on the engine and transmission that can potentially contaminate the clutch disc.



True or False:

- 1. The clutch release cylinder should be lubricated at every oil change.***

- 2. Always apply anti-seize compound on the transmission input shaft splines prior to installing the transmission.***



DETROIT

Transmissions

DT12TM

Input Shaft Housing

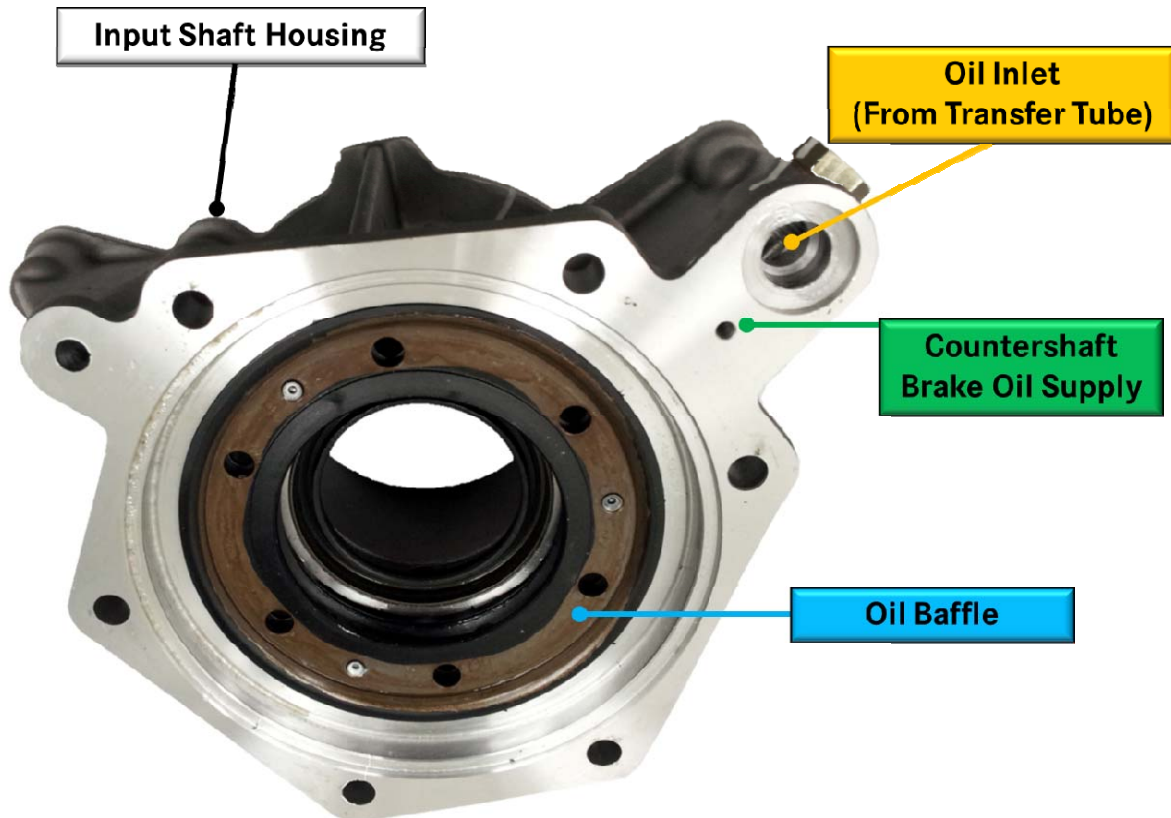
In this section we will learn:

- Input Shaft housing remove and install procedures
- Oil flow through the input shaft housing
- Mainshaft pilot bearing lubrication

INPUT SHAFT HOUSING

Perform the Input Shaft Housing
remove and install procedure.

INPUT SHAFT BEARING LUBRICATION

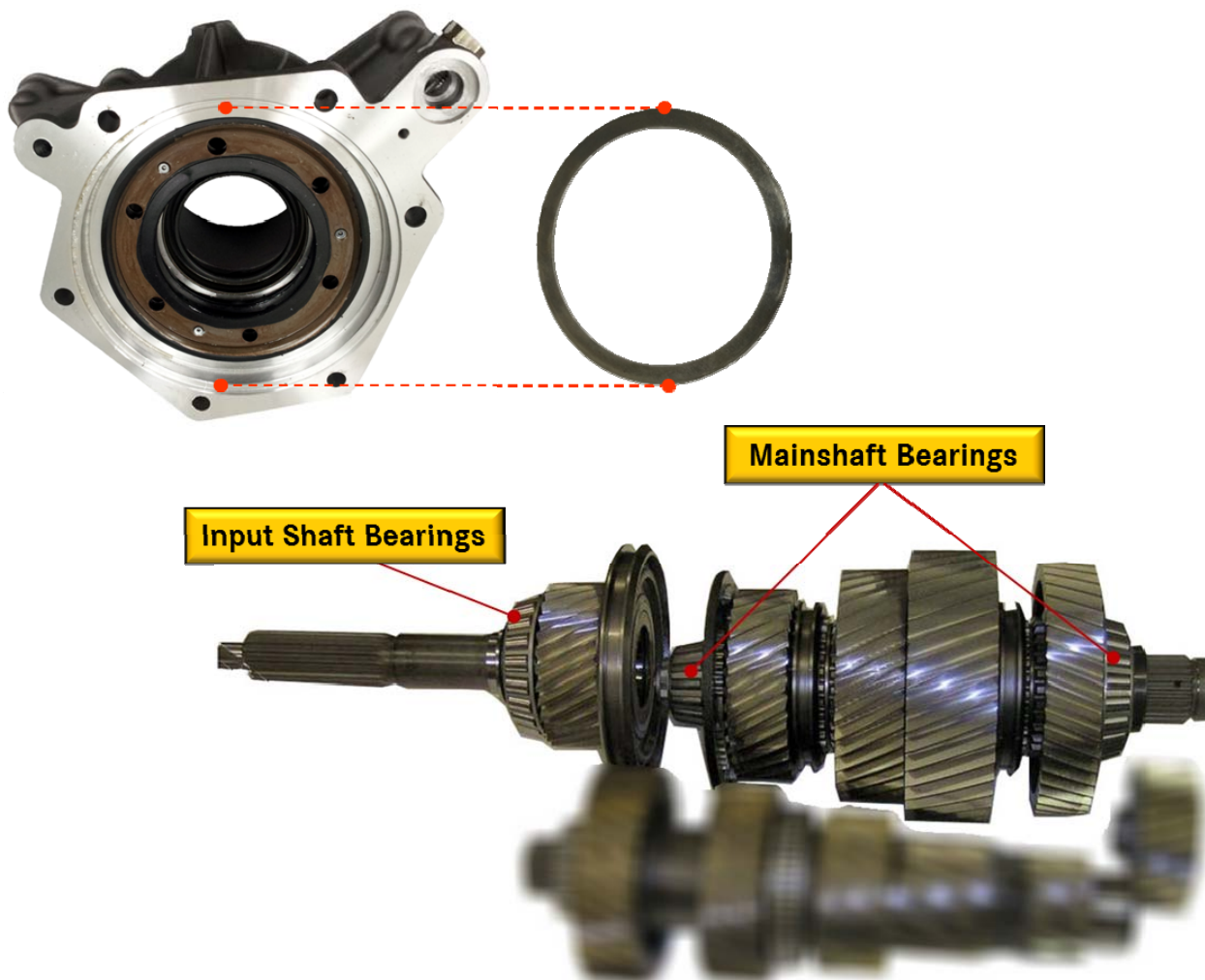


There may be times when the technician will have to remove the input shaft housing to repair a leak. It is important to identify the various passages and components that are involved with lubricating the input shaft bearing.

On the back side of the input shaft housing are two oil ports. One connects to the oil transfer tube that supplies oil to the housing, and the other supplies oil to the countershaft brake.

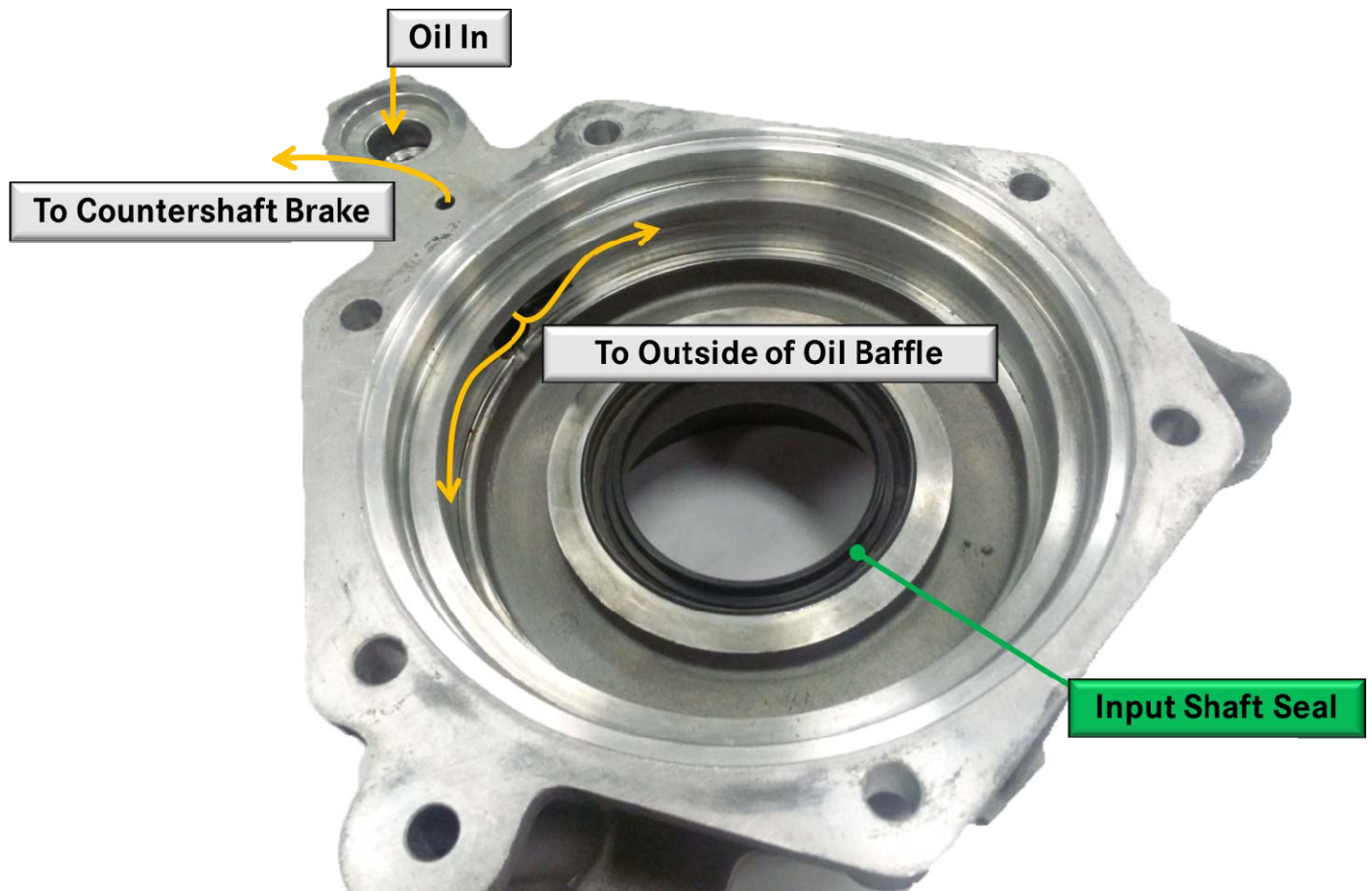
There is also an oil baffle seated within the input shaft housing.

INPUT SHAFT HOUSING SHIM



There is a shim, or shims, on the input shaft housing that are used to set the pre-load on the input shaft and mainshaft bearings. The shims are re-usable. Be sure to re-install the shim, or shims, upon completion of the repair or transmission damage can occur.

OIL FLOW PATH

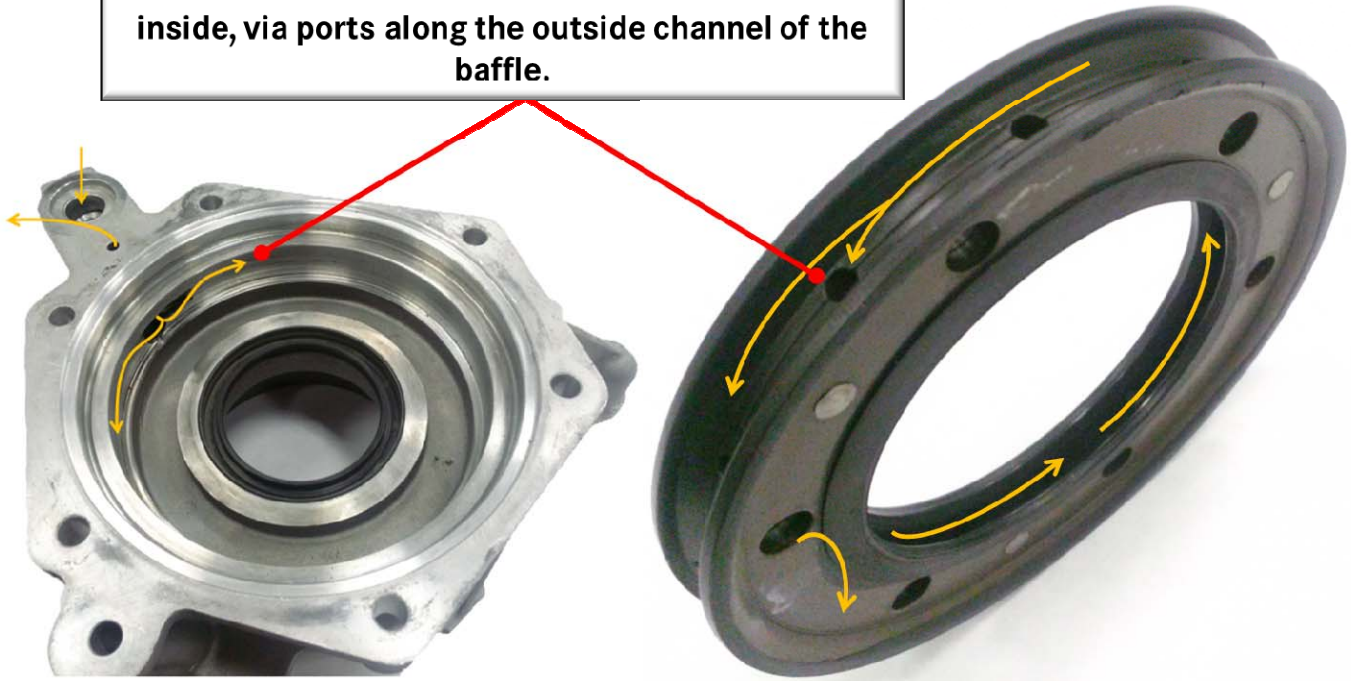


With the oil baffle removed, we will look at the path of oil flow.

The countershaft brake supply port is drilled in such a way that it taps into the main oil supply port. The main oil supply port empties into the oil distributor seat. With the oil baffle removed, you can also see the input shaft seal.

BAFFLE OIL PORTS

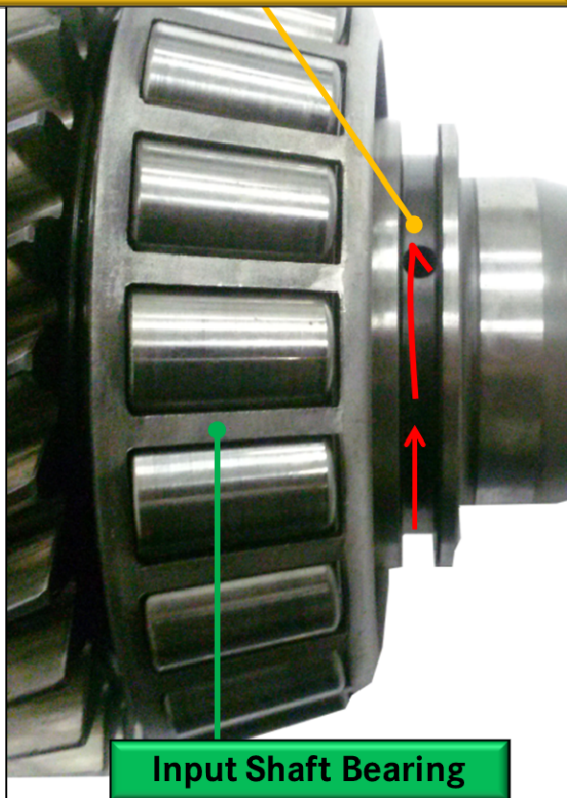
Oil is fed from the outside of the oil baffle to the inside, via ports along the outside channel of the baffle.



Oil is fed from the outside of the baffle to the inside via oil ports along the outside channel of the baffle.

INPUT SHAFT OIL PORTS

**3 Oil Ports Supply the Mainshaft
Pilot Bearing and Mainshaft Gallery**



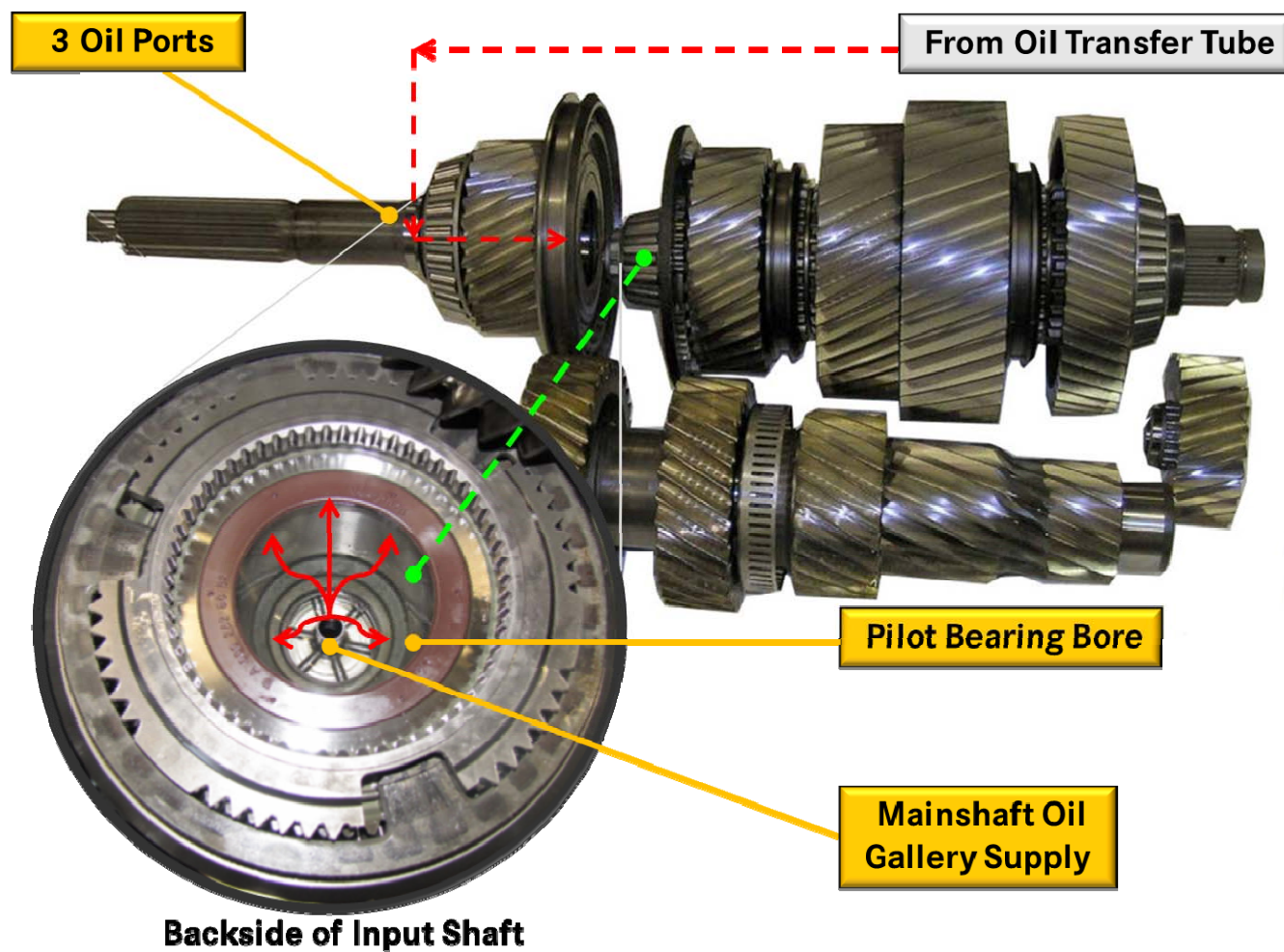
Input Shaft Bearing



**Oil is directed from the outside of the
baffle, to the inside of the baffle to
supply the port.**

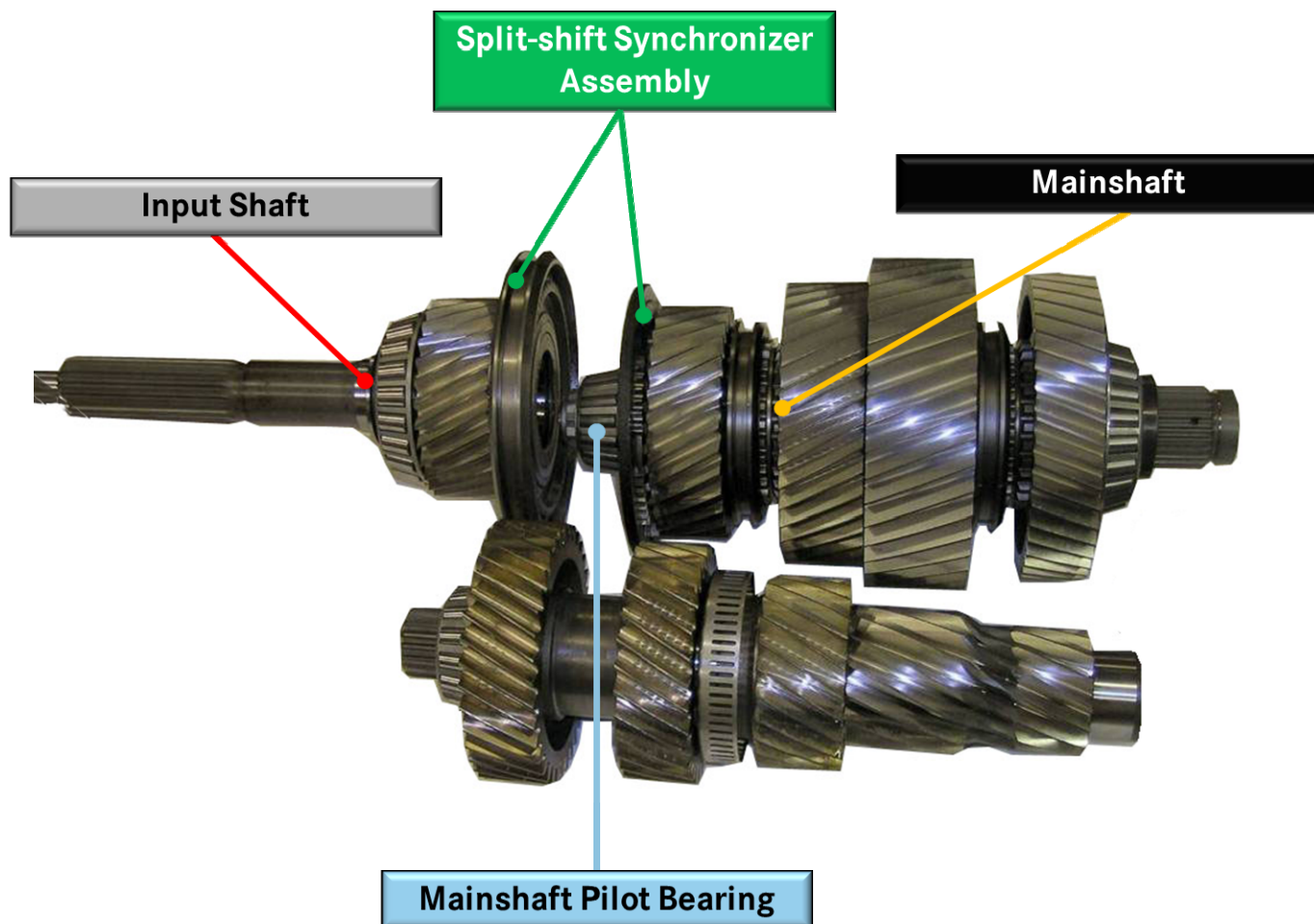
The oil is diverted from the outside channel to the inside channel of the baffle to supply oil the three ports on the input shaft.

MAINSHAFT PILOT BEARING OIL SUPPLY



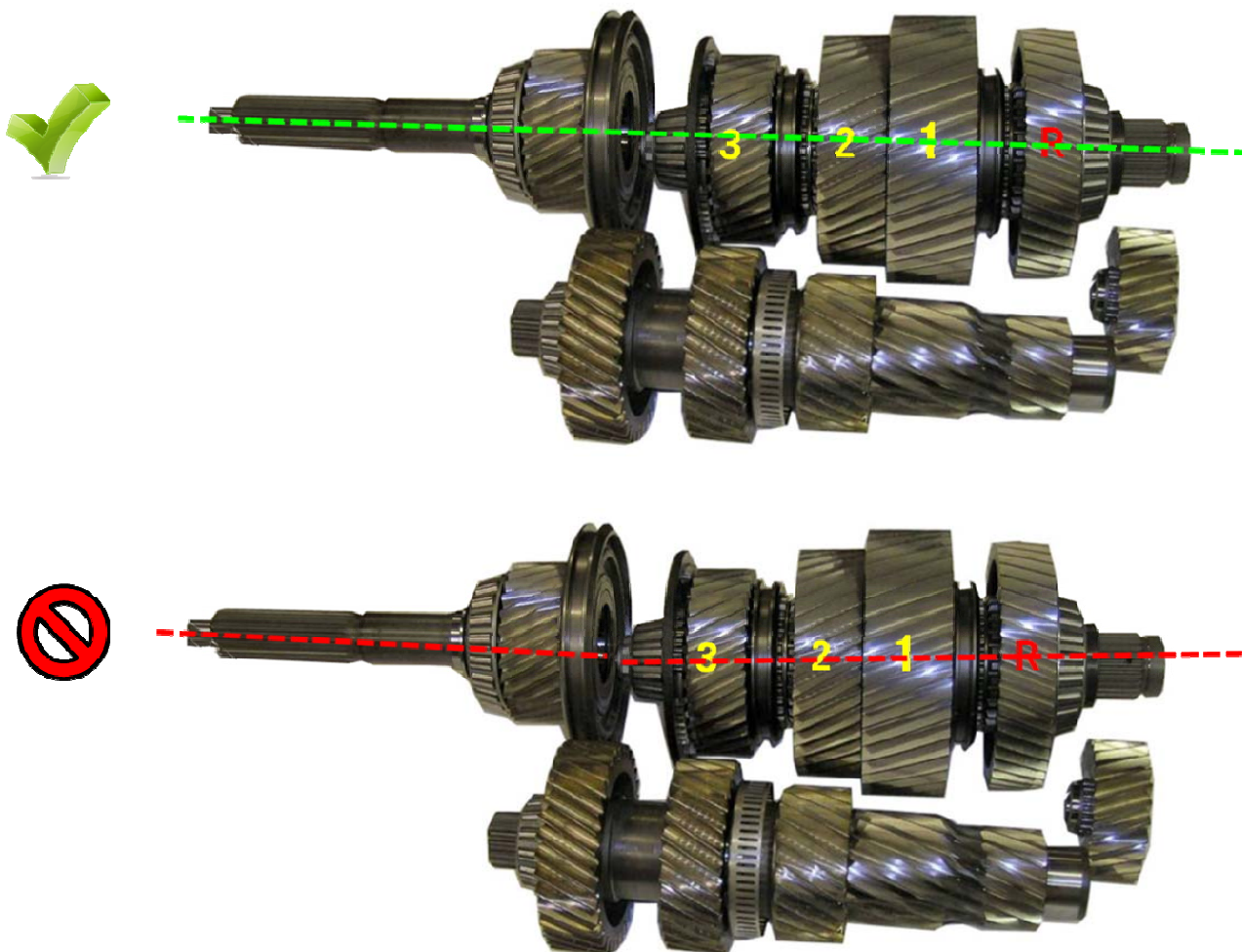
The three input shaft oil ports supply oil to the mainshaft pilot bearing as well as the mainshaft oil gallery.

SPLIT GROUP



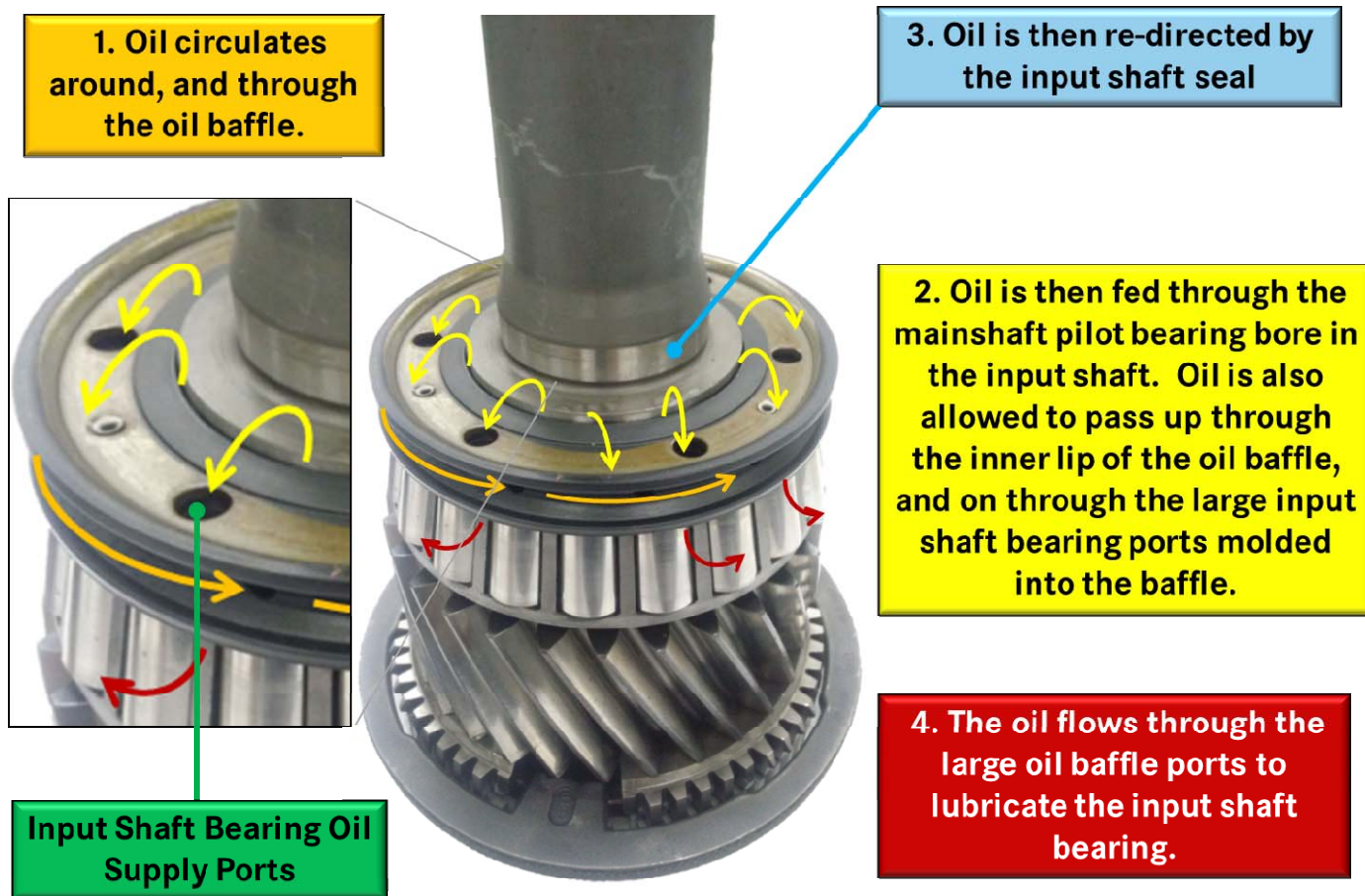
Unrestricted lubrication of the mainshaft pilot bearing is crucial. As you can see, a portion of the split-shift synchronizer resides on both the input shaft and mainshaft.

PRE-LOAD & SHAFT ALIGNMENT



If the mainshaft pilot bearing is compromised, pre-load and shaft alignment are significantly affected. Split shifting failures, such as grinding, and "stuck in gear" conditions, can occur due to the shaft misalignments.

OIL FLOW CIRCULATION



As oil circulates around and through the baffle, it is allowed to flow upwards and through the input shaft where it is then re-directed back down by the input shaft seal. The re-directed oil then flows through the large baffle ports to lubricate the input shaft bearing.



1. What is used to set the bearing pre-load on the input shaft and mainshaft bearings?

2. How many oil ports are located on the input shaft?



DETROIT
Transmissions

DT12™

Countershaft Brake

In this section we will learn:

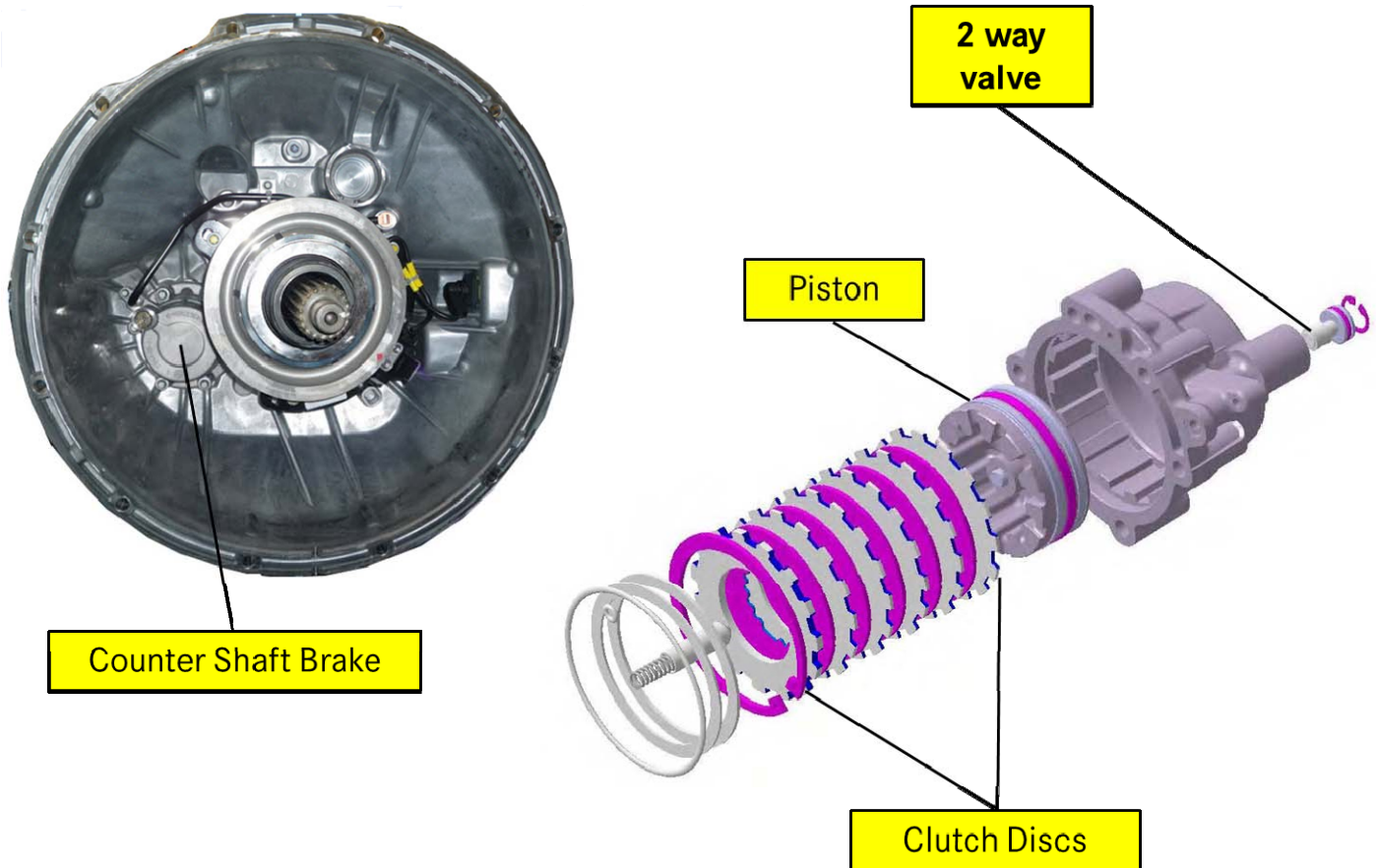
- The countershaft brake remove and install procedure
- Countershaft brake operation
- Importance of the countershaft brake test

COUNTERSHAFT BRAKE

Perform the Countershaft Brake
remove and install procedure.

Re-install the CPCA

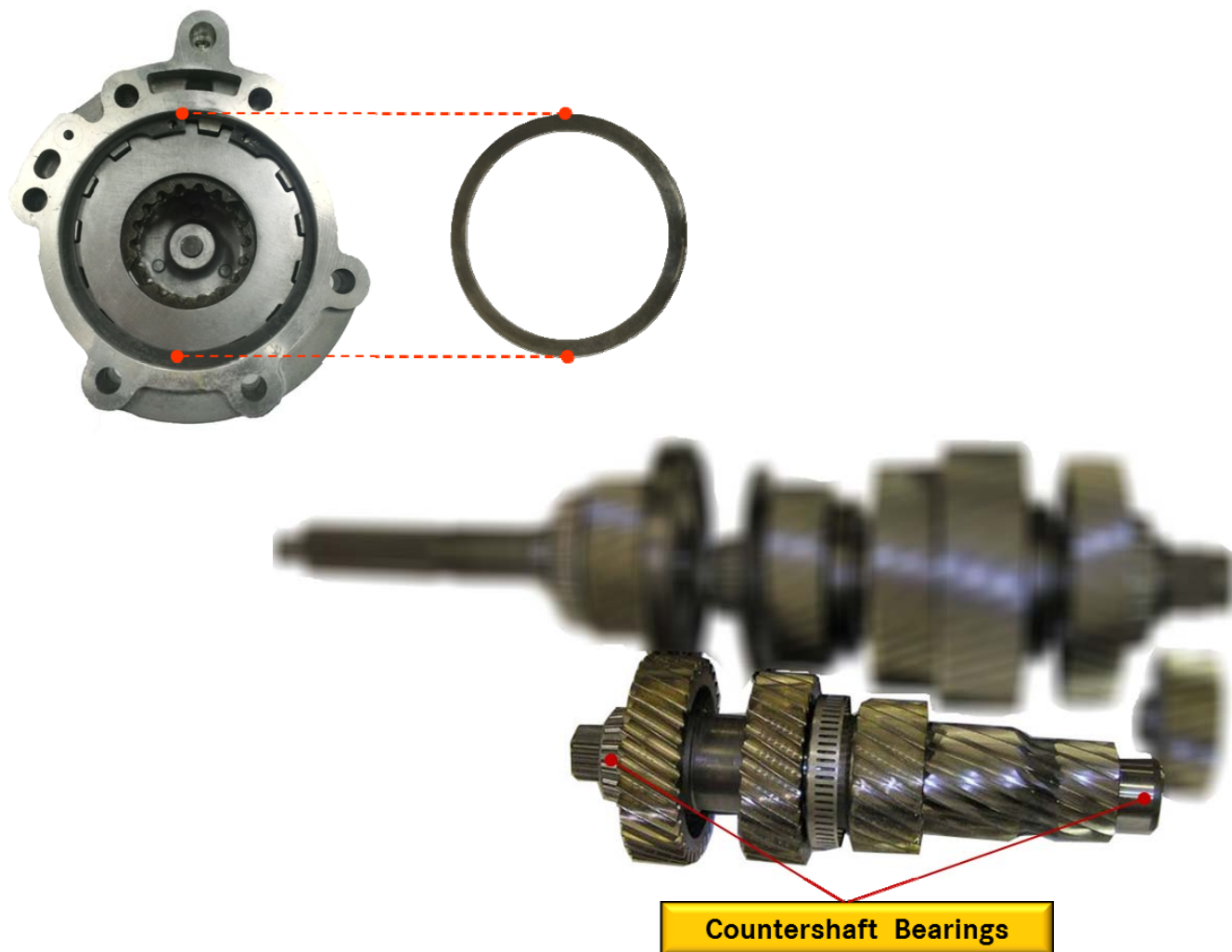
AIR OPERATED COUNTERSHAFT BRAKE



It is critical that the speed of the floating mainshaft gears are closely matched with the speed of the mainshaft during gear shifts to prevent clashing and grinding.

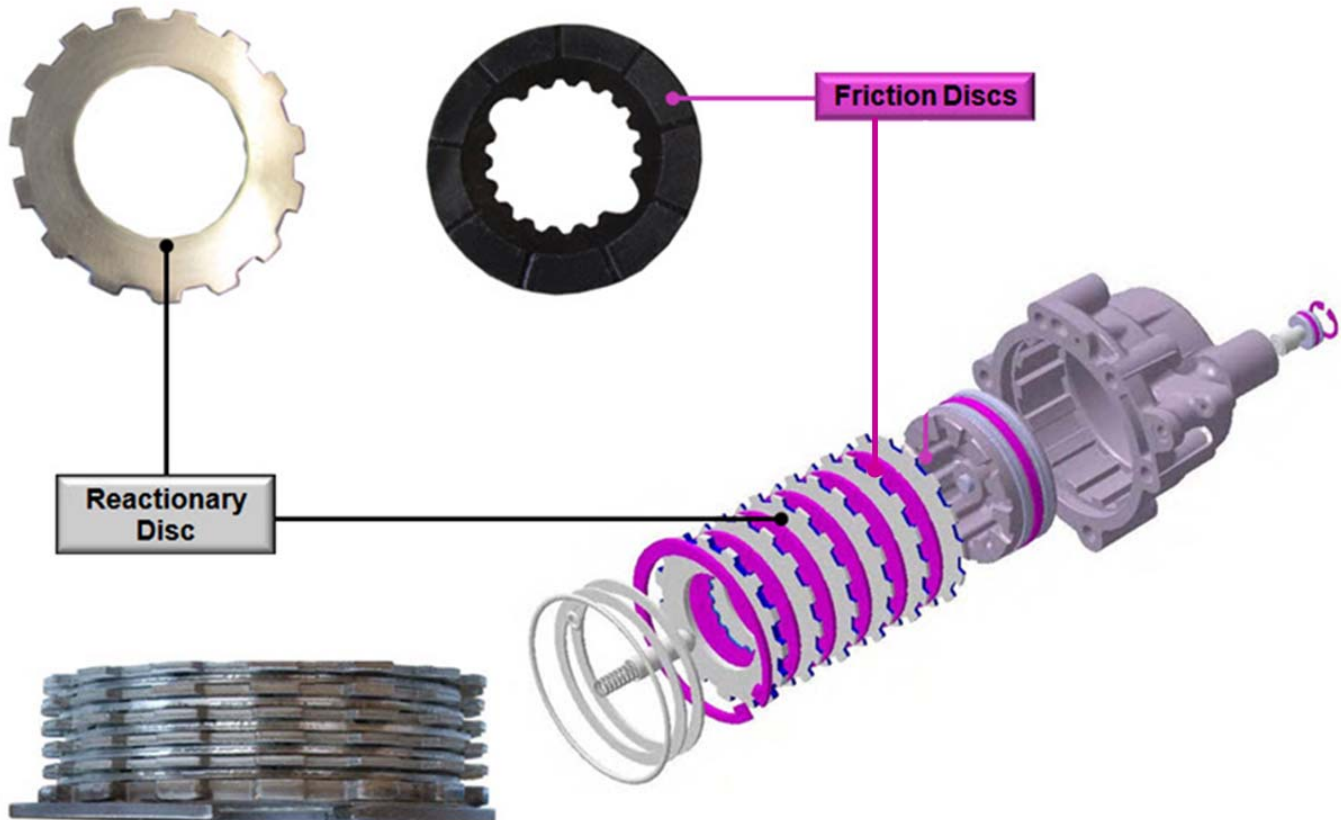
The DT12 uses an air operated countershaft brake to achieve this synchronization of speeds. Because there are different size **fixed** gears (different ratios resulting in different speeds) on the countershaft and **floating** gears on the mainshaft, the TCM needs to slow the countershaft to achieve rpm synchronization between the **next** mainshaft gear selected and the speed of the mainshaft

COUNTERSHAFT BRAKE SHIM



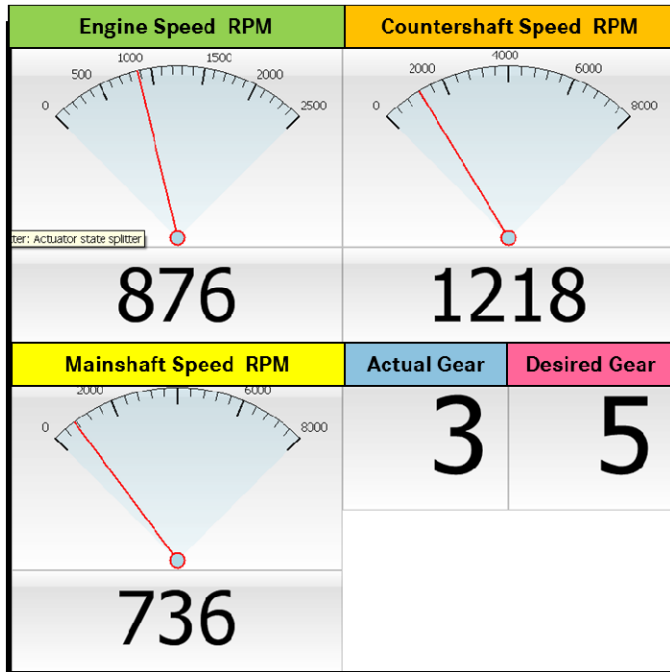
There is a shim, or shims, that is used to set the pre-load on the countershaft bearings. The shims are re-usable. Be sure to re-install the shim, or shims, upon completion of the repair or transmission damage can occur.

COUNTERSHAFT BRAKE COMPONENTS

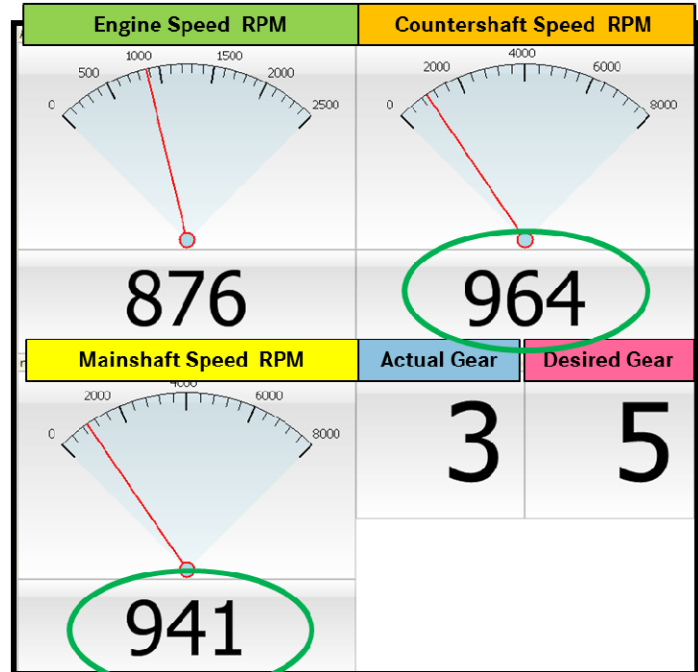


The countershaft brake consists of reactionary discs and friction discs, a piston, a 2 way valve, and a housing. The reactionary discs are splined to the housing and the friction discs are splined to the countershaft. When the discs are compressed, the reactionary discs offer a stationary surface for the friction discs to engage, thus slowing the countershaft.

COUNTERSHAFT & MAINSHAFT SPEED



1. Initial Shift Request



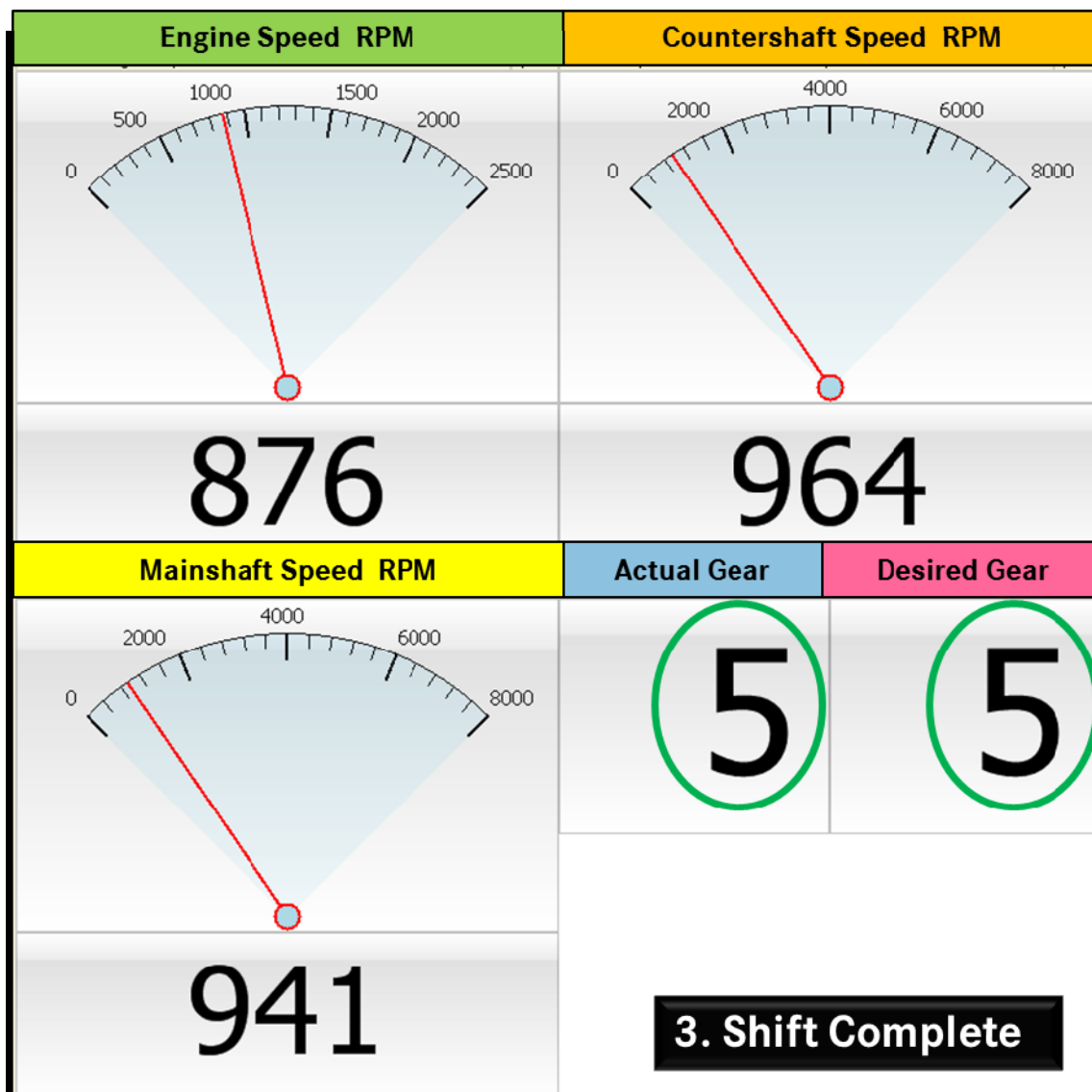
2. Countershaft Brake applied to closely match countershaft and mainshaft speeds

In the example above, the vehicle is in third gear and the CPC is requesting an upshift to 5th gear.

The 5th gear ratio is different than the 3rd gear ratio and the **size** of the gear used for 5th gear (or 5th speed) is more closely matched in size to the corresponding countershaft gear resulting in a decreased offset in speeds. Therefore, the TCM needs to match these speeds by slowing the countershaft **before** and not during the shift. This all occurs almost simultaneously.

The point to remember is that countershaft speed directly effects mainshaft speed. Mainshaft, and the individual mainshaft gear speeds, need to be synchronized to properly shift. The countershaft is slowed to properly match the speed of the mainshaft with the **next** gear to be shifted.

SHIFT COMPLETION



When the speeds are relatively synchronized, the shift will complete.

2.

This diagram illustrates a multi-rail system with 12 wheels and 3 rails. The wheels are arranged in a row, with the first wheel on the left labeled 'R'. The wheels are numbered 1/2, 3/4, 5/6, 7/8, 9/10, and 11/12. The rails are labeled 'Rail 1' and 'Rail 2'. The diagram shows the wheels in contact with the rails, with arrows indicating the direction of movement. A yellow line points to the first wheel, and a black line points to the last wheel. A red dashed line runs horizontally across the diagram, indicating a reference level.

1.

4.

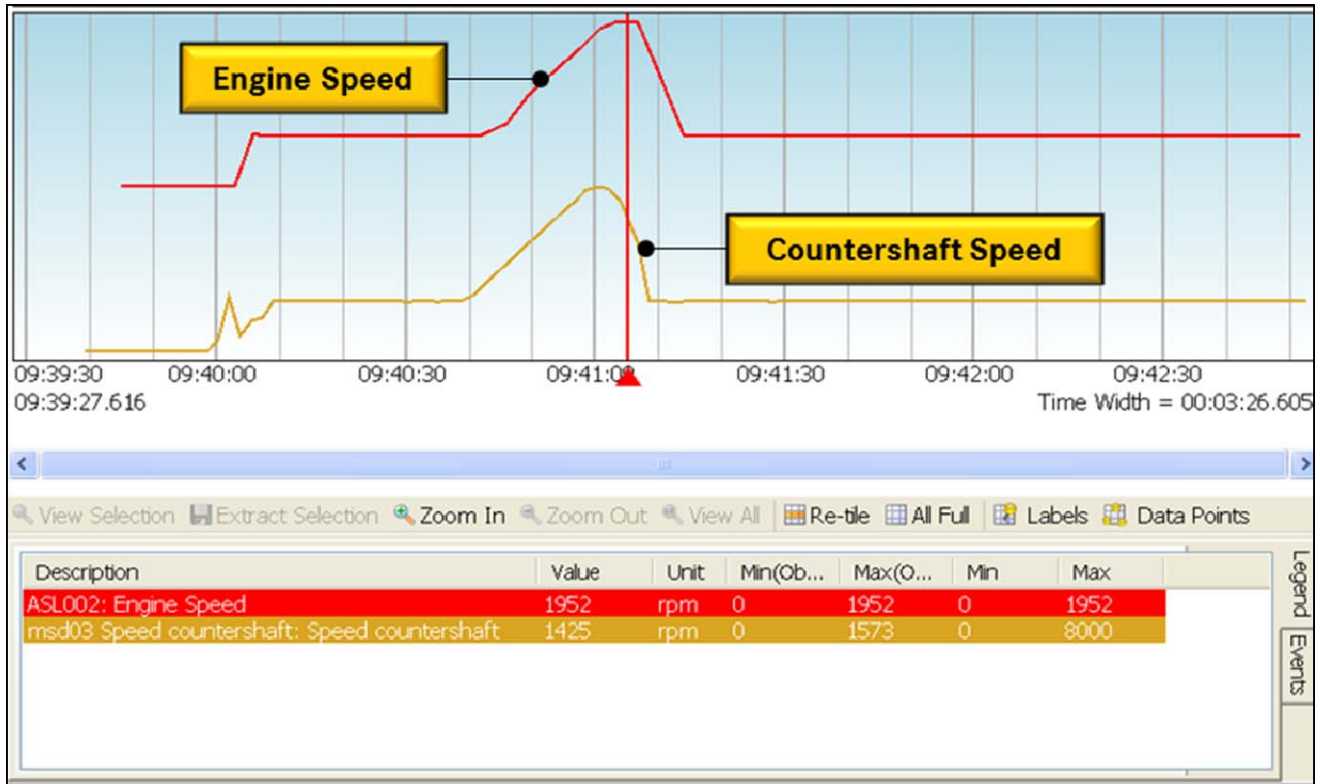
[illegible]

3.

7

COUNTERSHAFT BRAKE TEST

Always perform a countershaft brake test for any grinding or other shifting concerns !



It is extremely important to always perform a countershaft brake test in the diagnostic tool for **any** grinding or shifting complaints.



1. What is used to set the pre-load on the countershaft bearings?

***2. The countershaft brake consists of _____
and _____ discs.***



DETROIT

Transmissions

DT12TM

Range Group

In this section we will learn:

1. The components and functionality of the range group
2. Mainshaft speed sensor replacement
3. Operation of the oil cooler and transmission safety valve
4. Operation of the oil strainer

MAINSHAFT SPEED SENSOR

Perform the Mainshaft Speed Sensor removal procedure and review the main transmission groups.

Demonstrate the range group planetary operations.

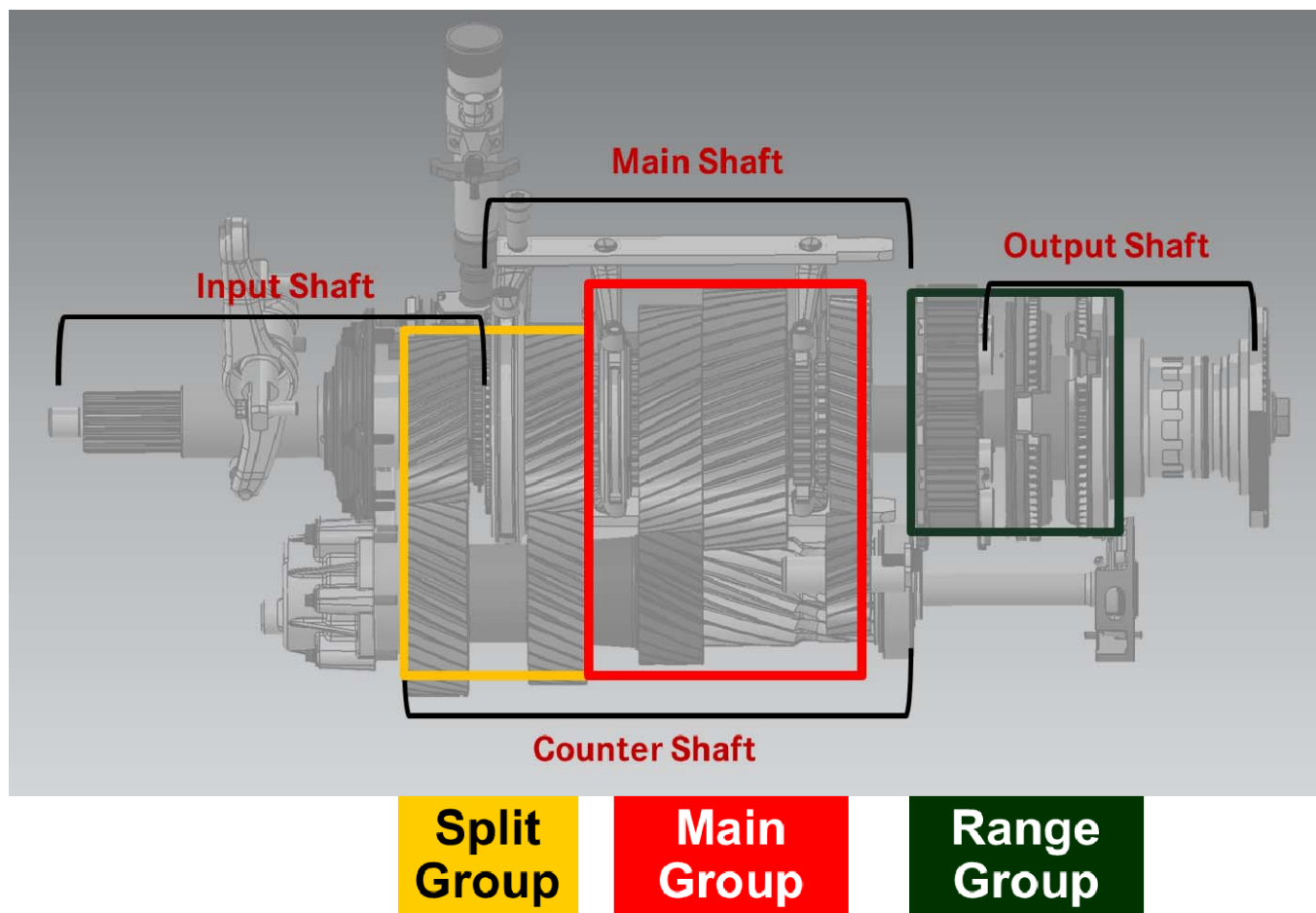


DETROIT
Transmissions

DT12

DT12 TRANSMISSIONS - RANGE GROUP

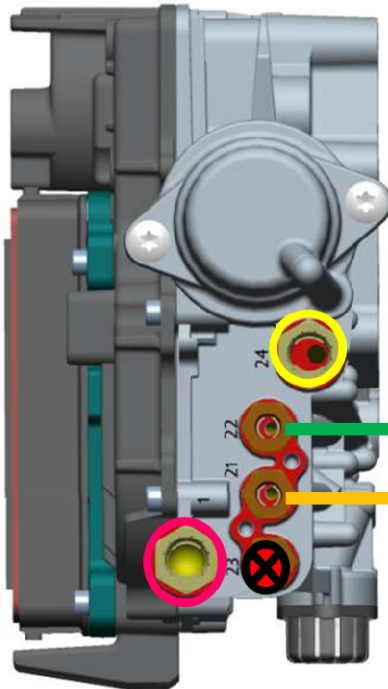
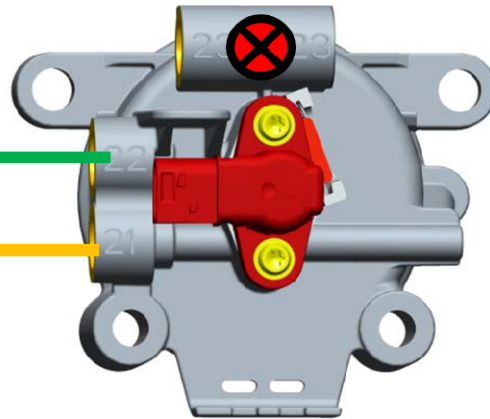
TRANSMISSION GROUPS



The transmission is separated into three distinct groups. They are the split group, the main group, and the range group.

AIR PORTS

SHIFT CONTROLLER & RANGE CYLINDER

Shift Controller**Range Cylinder**

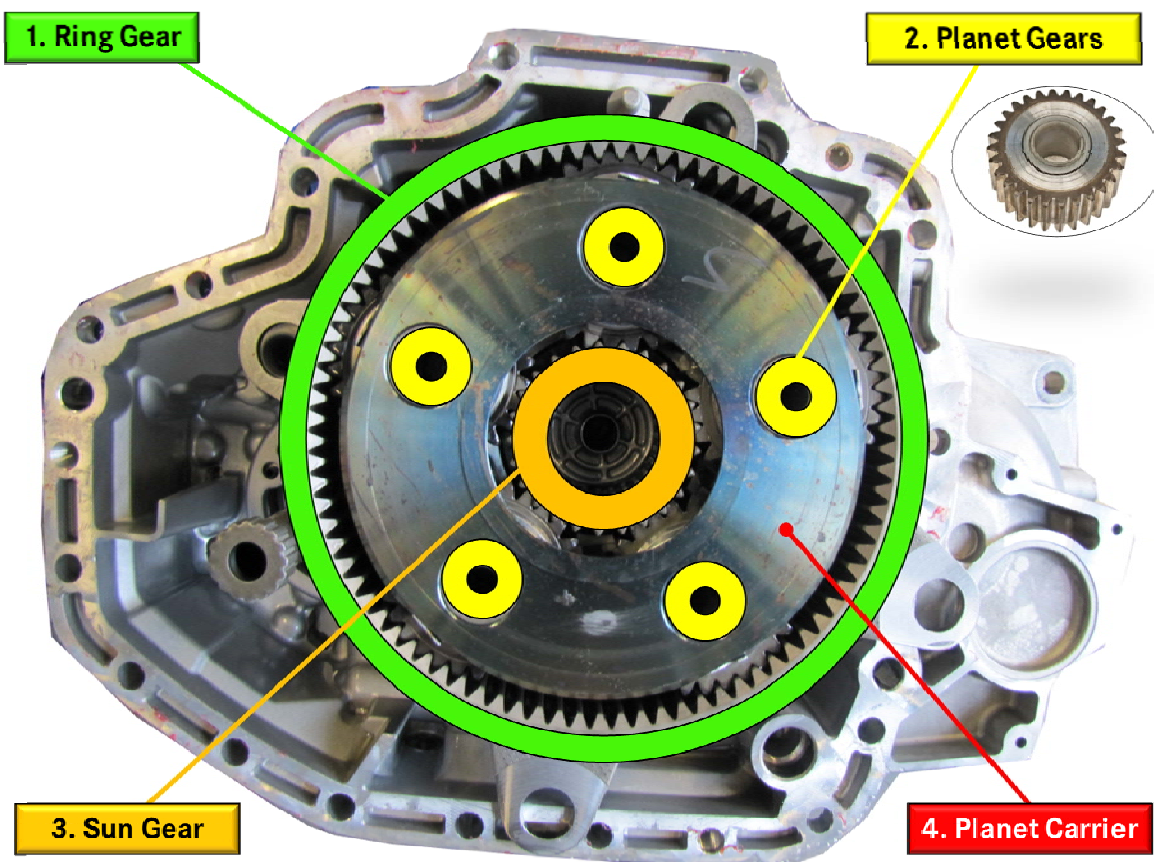
	24	Clutch Exhaust
	22	Range Shift HI
	21	Range Shift LO
	23	PTO = NOT USED
		Trans Air Supply

The air ports are numbered on the shift controller, the lines themselves, and the range cylinder.

Note: Currently, transmissions are not equipped with a PTO, therefore port 23 is not used.



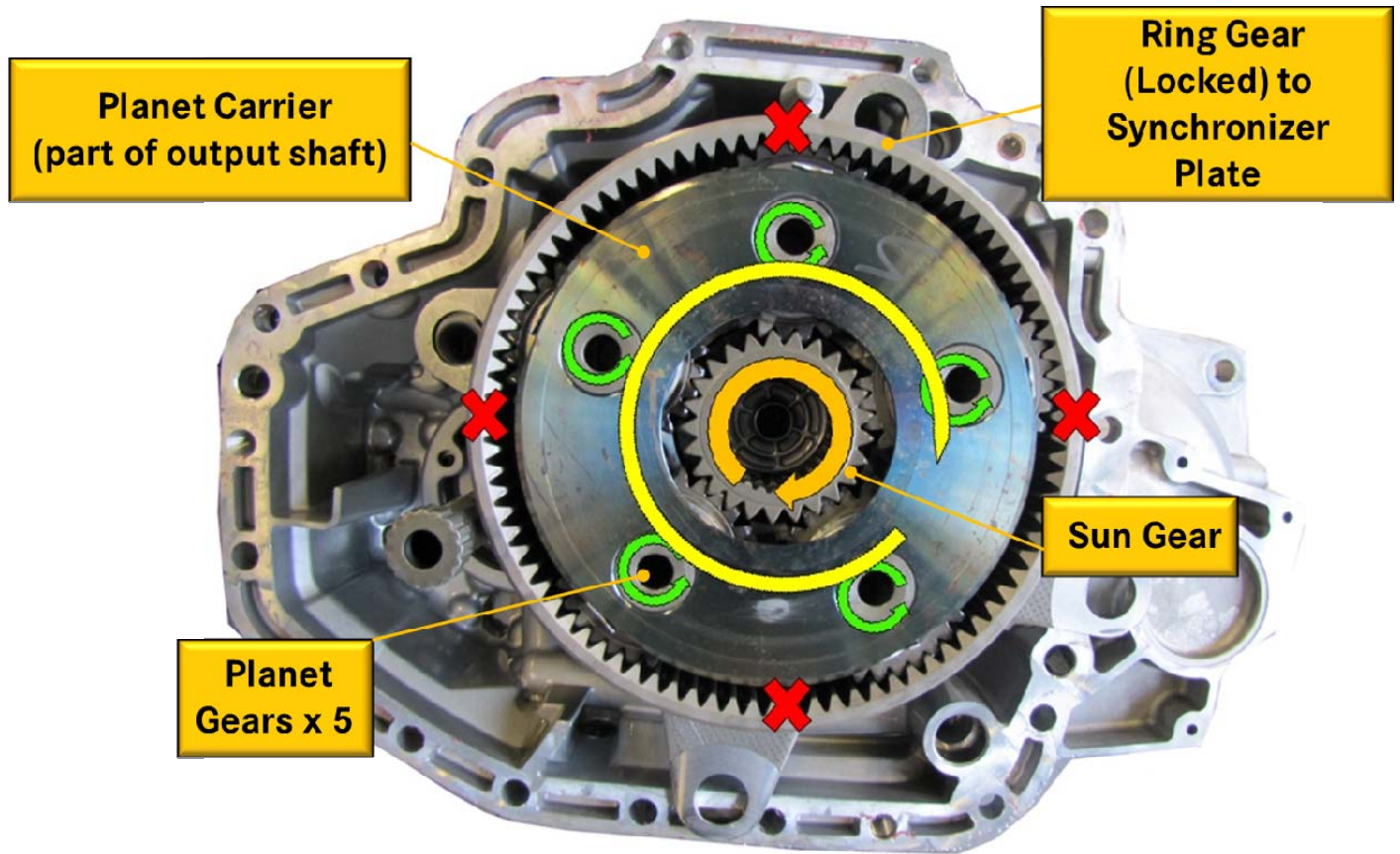
RANGE GROUP



The range group consists of a planetary gear arrangement for the main group gear reduction. The main planetary components consists of the following:

1. The ring gear, assembly.
2. The planet gears
3. The sun gear
4. The planetary carrier

LO RANGE OPERATION



While in low range, the shift fork will lock and hold the ring gear to the synchronizer plate. The sun gear, being driven by the mainshaft, is rotating at a speed that is consistent with whatever gear ratio is selected in the main group.

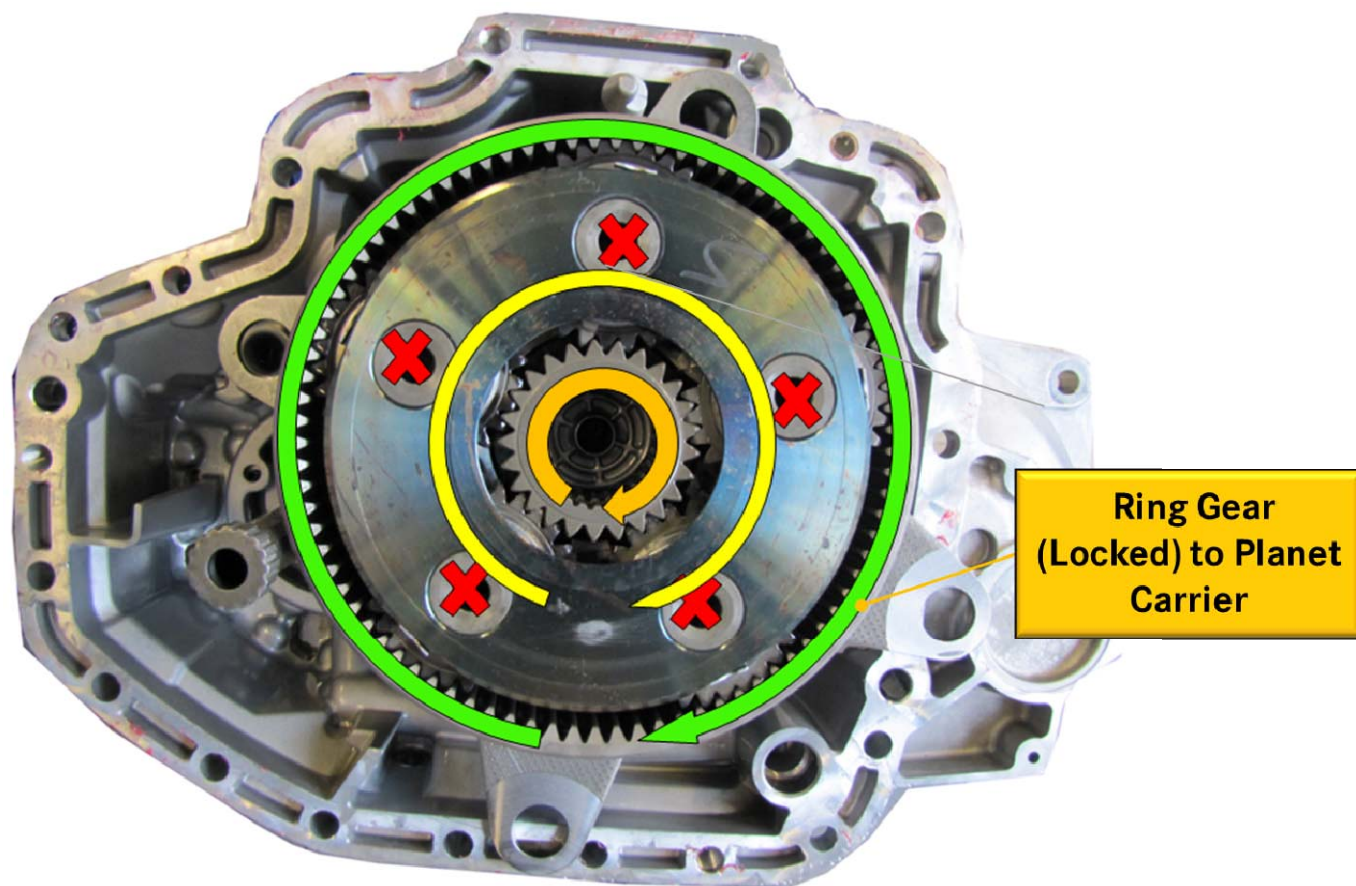
The sun gear is driving the planet gears at this point. Because the ring gear is locked in position, the planet gears are allowed to rotate, or walk, along the stationary ring gear. The planets are connected to the planet carrier via shafts, so when the planets are walking along the ring gear, they are also driving the planet carrier.

The output shaft is actually part of the planet carrier. The planet carrier's rotational speed is actually the final rotational speed of the transmission output shaft.

The gear reduction, or torque multiplication, occurs when the planet gears are allowed to rotate along the ring gear, thus driving the planet carrier at a reduced speed.



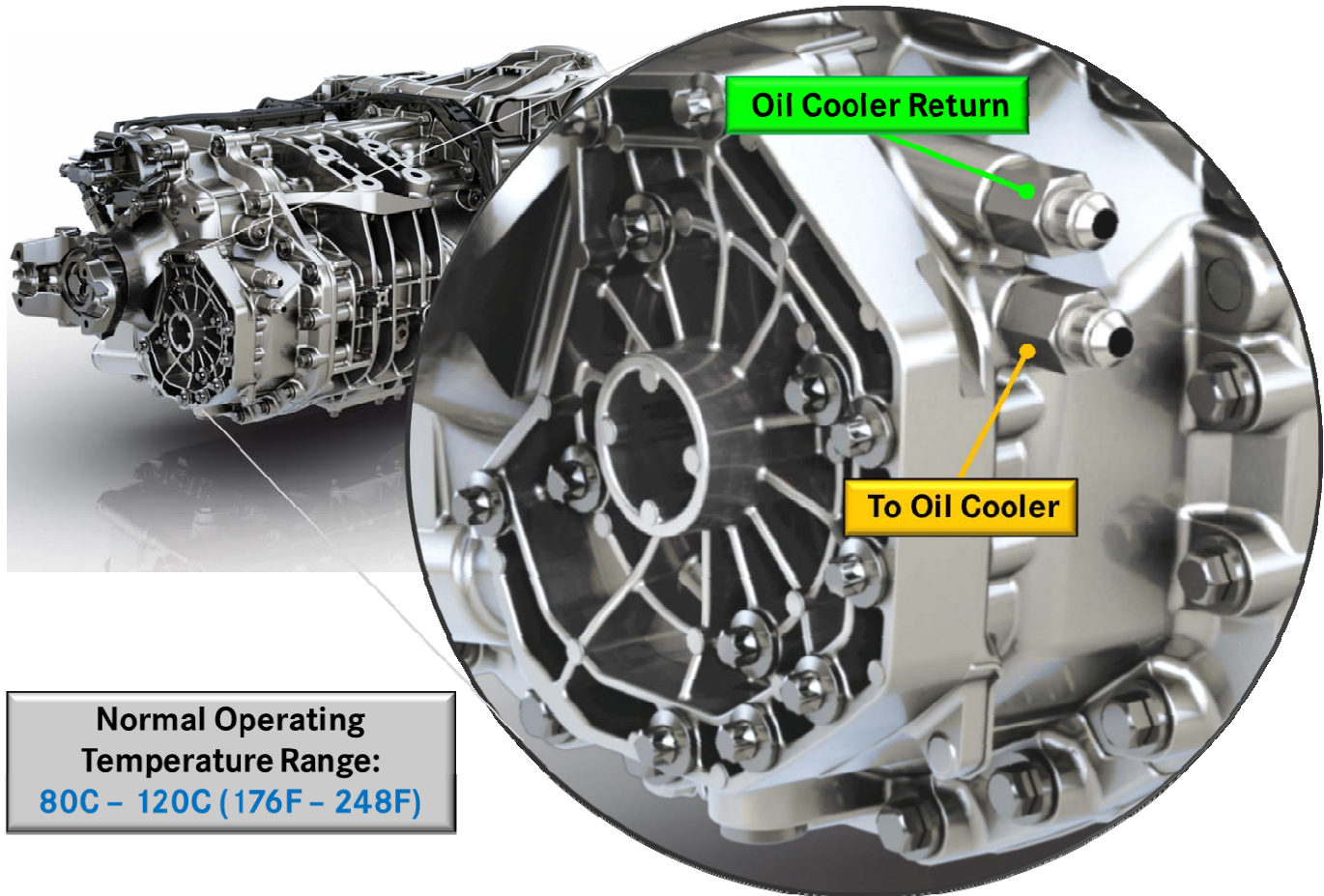
HI RANGE OPERATION



While in the high range position, the shift fork now locks the ring gear to the planetary carrier allowing the ring gear to rotate **with** the planetary carrier. At this point, the planet gears are not rotating, instead, they form a mechanical link between the sun gear and ring gear.

The planet carrier / output shaft is now turning at the same speed as the sun gear, or input. There is no gear reduction or torque multiplication occurring.

OIL COOLER

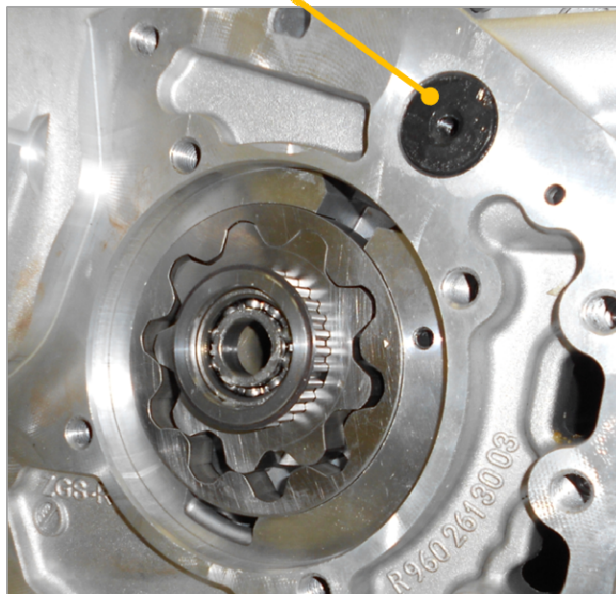


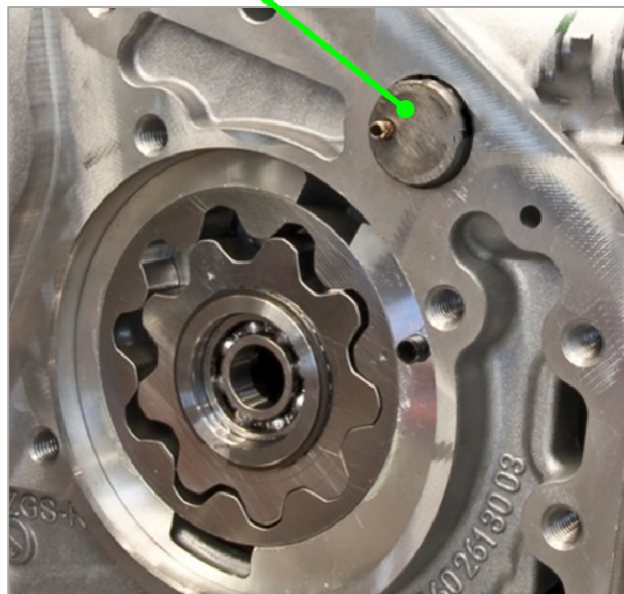
Next we will discuss the differences between a DT12 transmission equipped with, and without an oil cooler.

The normal operating temperature range of the DT12 transmission is between 80°C - 120°C (176°F - 248°F). Transmission component longevity can diminish for every 10°C (18°F) above 120°C (248°F).

Whether or not a DT12 transmission will be equipped with an oil cooler configuration is dependent upon the transmission type, as well as the vehicle application.

OIL COOLER VS. NON-OIL COOLER COMPARISON

Dummy Plug

Non-Oil Cooler Equipped
 DT12 – DA
 DT12 – DB

Valve Element

Oil Cooler Equipped
 DT12 – OA
 DT12 – OB

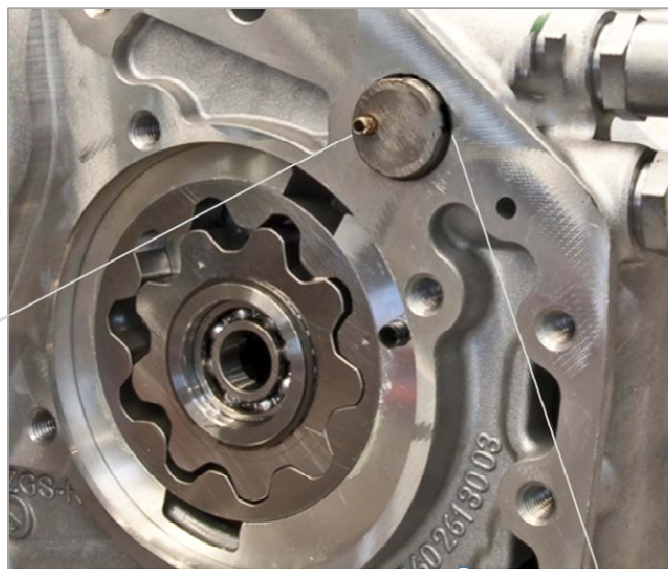
When the oil pump cover is removed, there is a distinct difference in the relief, or safety valve bore. A non-oil cooler equipped transmission will have a dummy plug in place of an outer valve element that is found in an oil cooler equipped transmission.

TRANSMISSION VALVES

Oil Cooler Safety Valve

DT12 - OA

DT12 - OB



Cooler Safety Valve



Transmission Safety Valve

A DT12 transmission equipped for an oil cooler will have two separate safety valves. One valve is for the oil cooler, and the other is for the transmission.

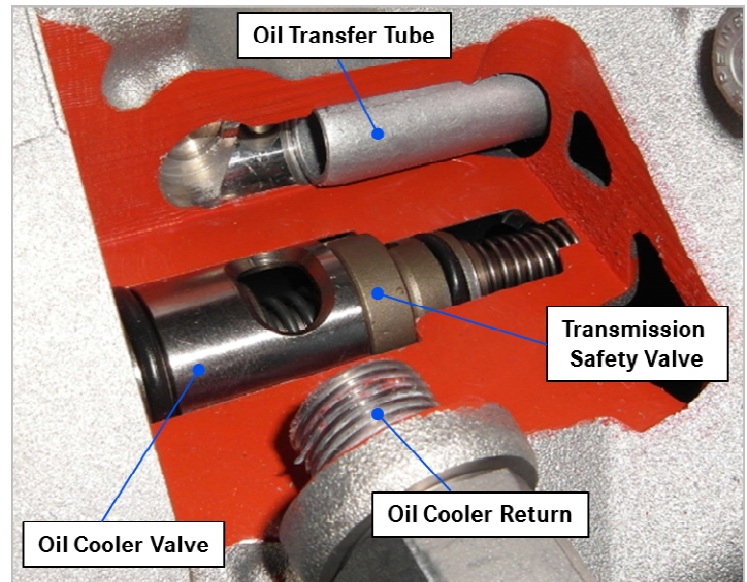
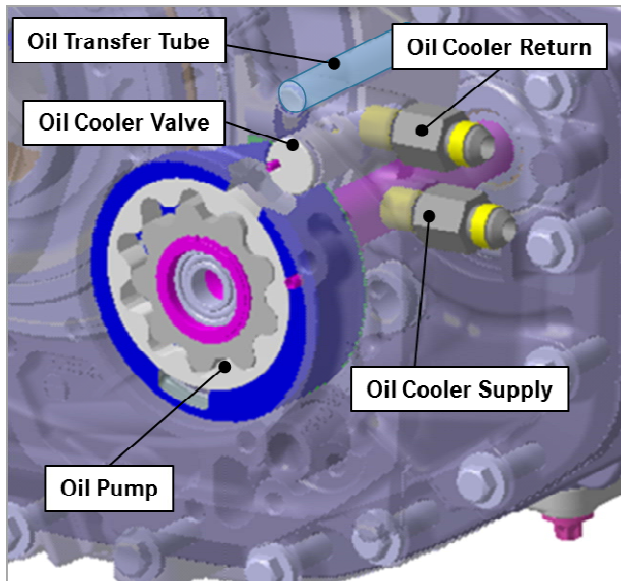


DETROIT
Transmissions

DT12

DT12 TRANSMISSIONS - RANGE GROUP

OIL COOLER EQUIPPED TRANSMISSION COMPONENTS



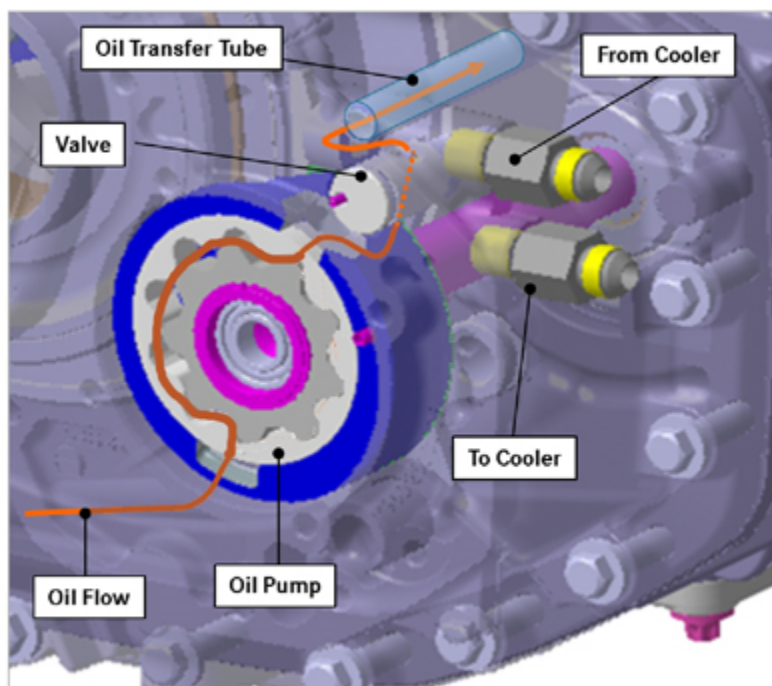
Shown above are the various components that directs and regulates oil flow in an oil cooler equipped transmission.

- **Oil Pump** – pressurizes the transmission oil
- **Oil Cooler Valve** – controls oil flow to the oil cooler
- **Oil Transfer Tube** – directs the oil, either directly from the oil pump or from the oil cooler return, to the front of the transmission to lubricate the input shaft bearing, mainshaft pilot bearing, and mainshaft
- **Transmission Safety Valve** – Protects the transmission from high pressures by diverting some of the oil back into the transmission case



VALVE ACTION - COLD OIL TEMPS

Below 80° C / 176° F



Valve Opened - Direct path to transfer tube

Top View of Valve

Thermostatic
Spring



Direct path to oil transfer tube is exposed.

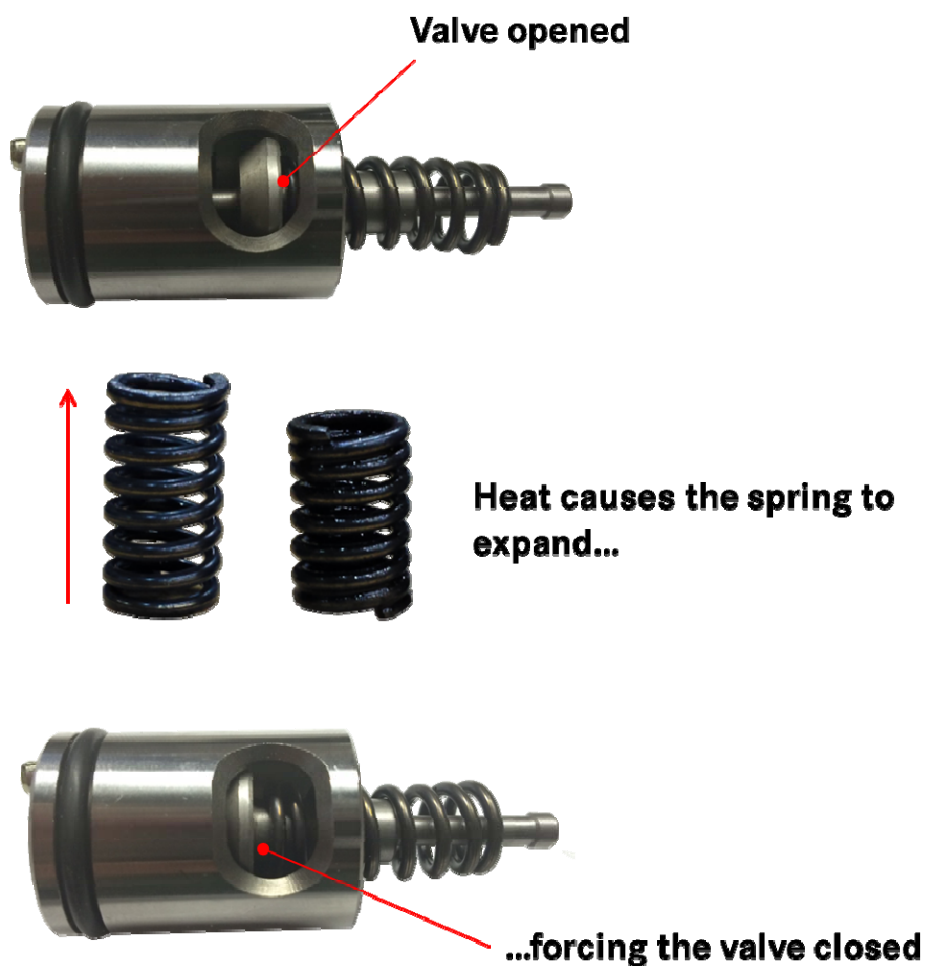
Thermostatic
Spring



Bottom View of Valve

At transmission oil temperatures below 80° Celsius, or 176° Fahrenheit, the oil cooler valve is opened, allowing the oil to bypass the cooler circuit and flow directly to the oil transfer tube.

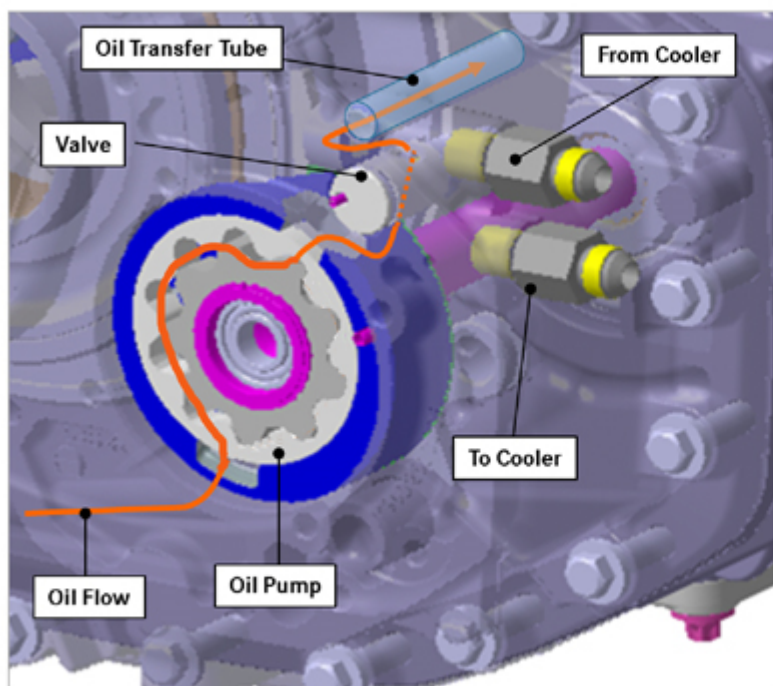
THERMOSTATIC SPRING



As the temperature increases above 80° Celsius / 176° Fahrenheit, the thermostatic spring expands and closes the valve.

VALVE ACTION - HOT OIL TEMPS

Below 80° C / 176° F

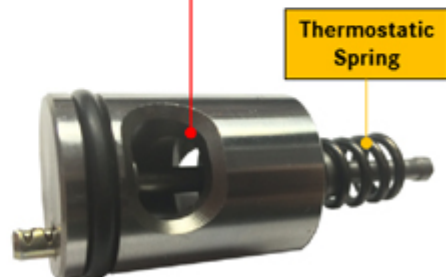


Valve Opened - Direct path to transfer tube

Top View of Valve



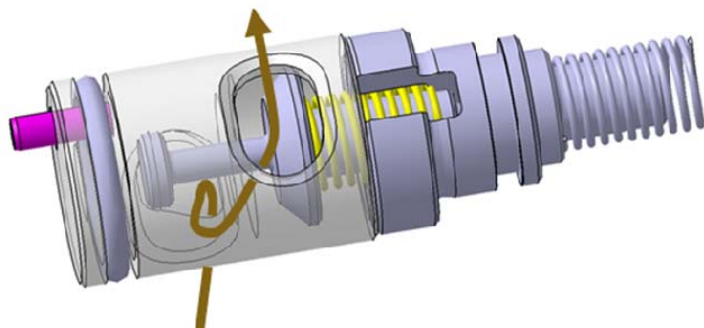
Direct path to oil transfer tube is exposed.



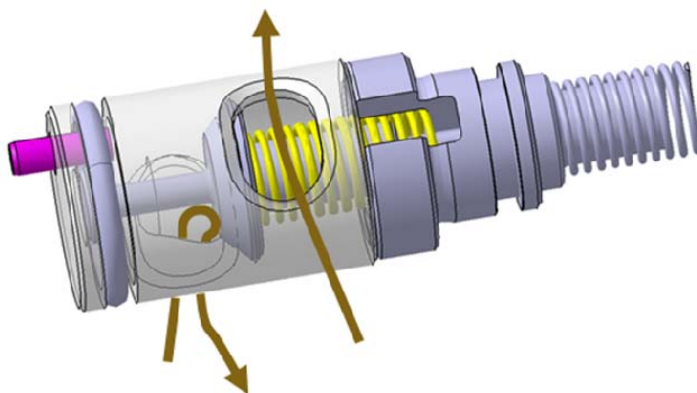
Bottom View of Valve

With the valve closed, there is no longer a direct path to the oil transfer tube and the oil must now flow out to the oil cooler. Cooled oil now flows back to the transmission via the oil cooler return port, and on to the oil transfer tube.

OIL FLOW COMPARISON



Valve Open Below 80° C / 176° F



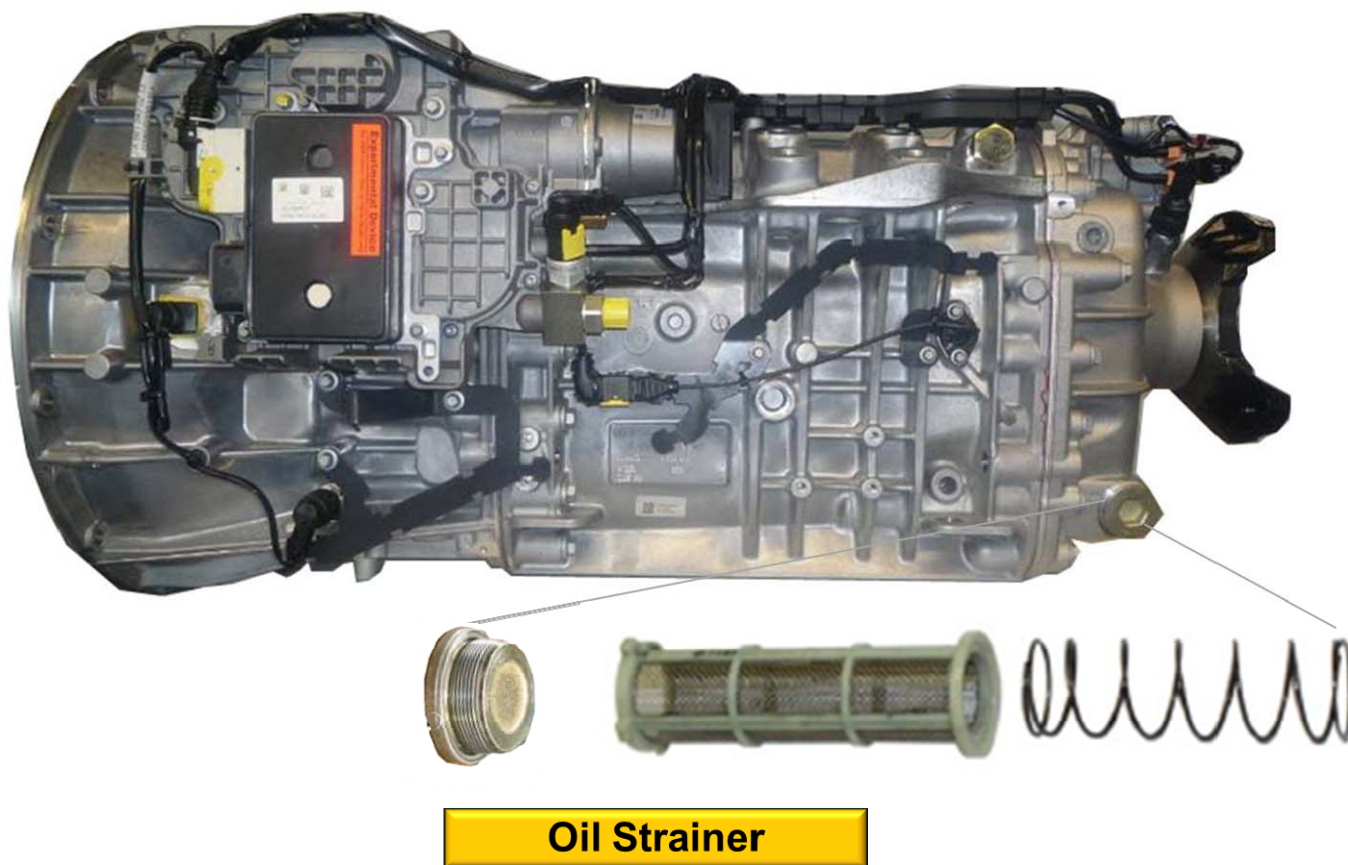
Valve Closed Above 80° C / 176° F

Shown above are the respective oil paths when the valve is opened, and when the valve is closed.



LUBRICATION SYSTEM

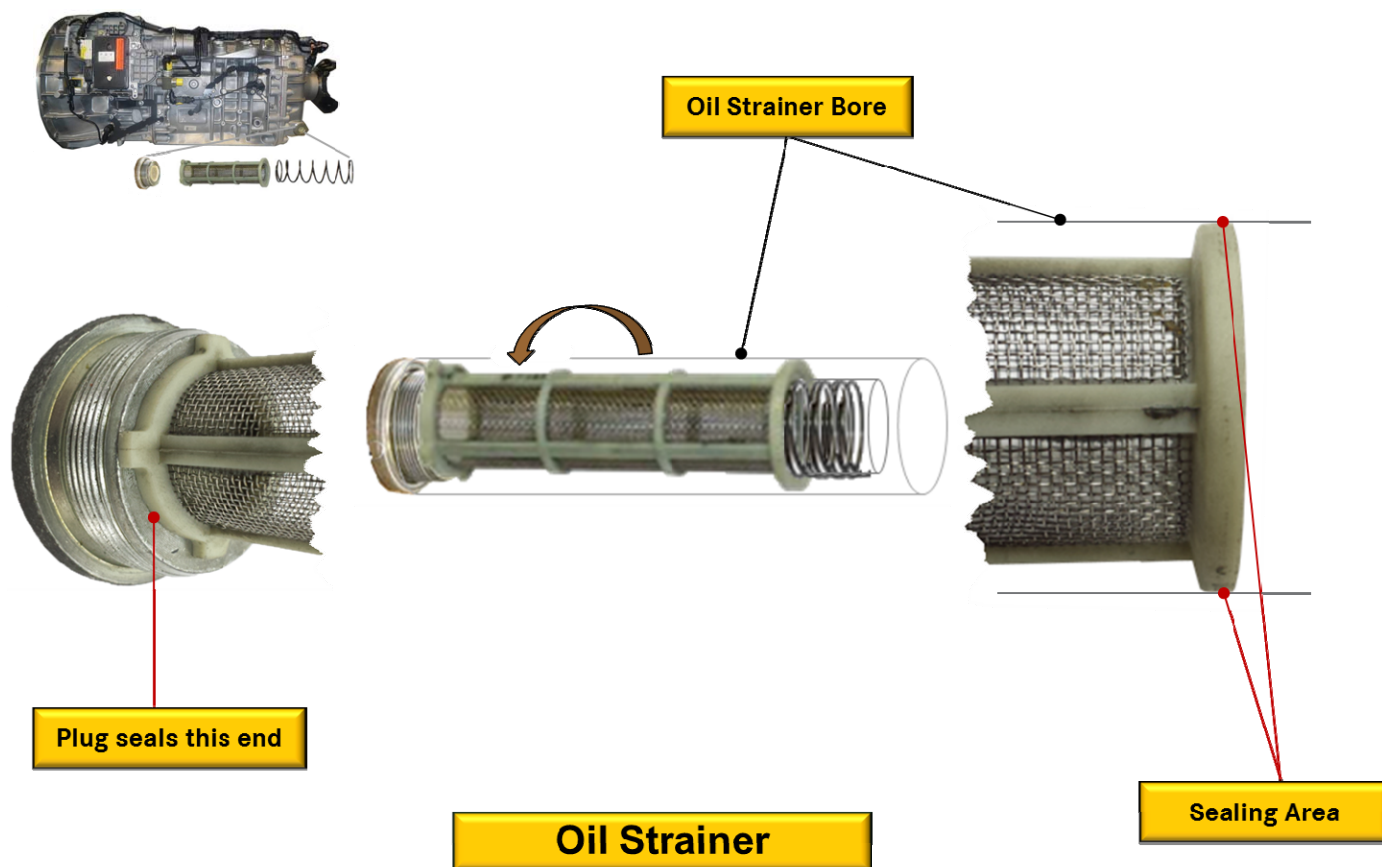
OIL STRAINER LOCATION



The oil strainer is located in the oil pump supply channel of the DT12.

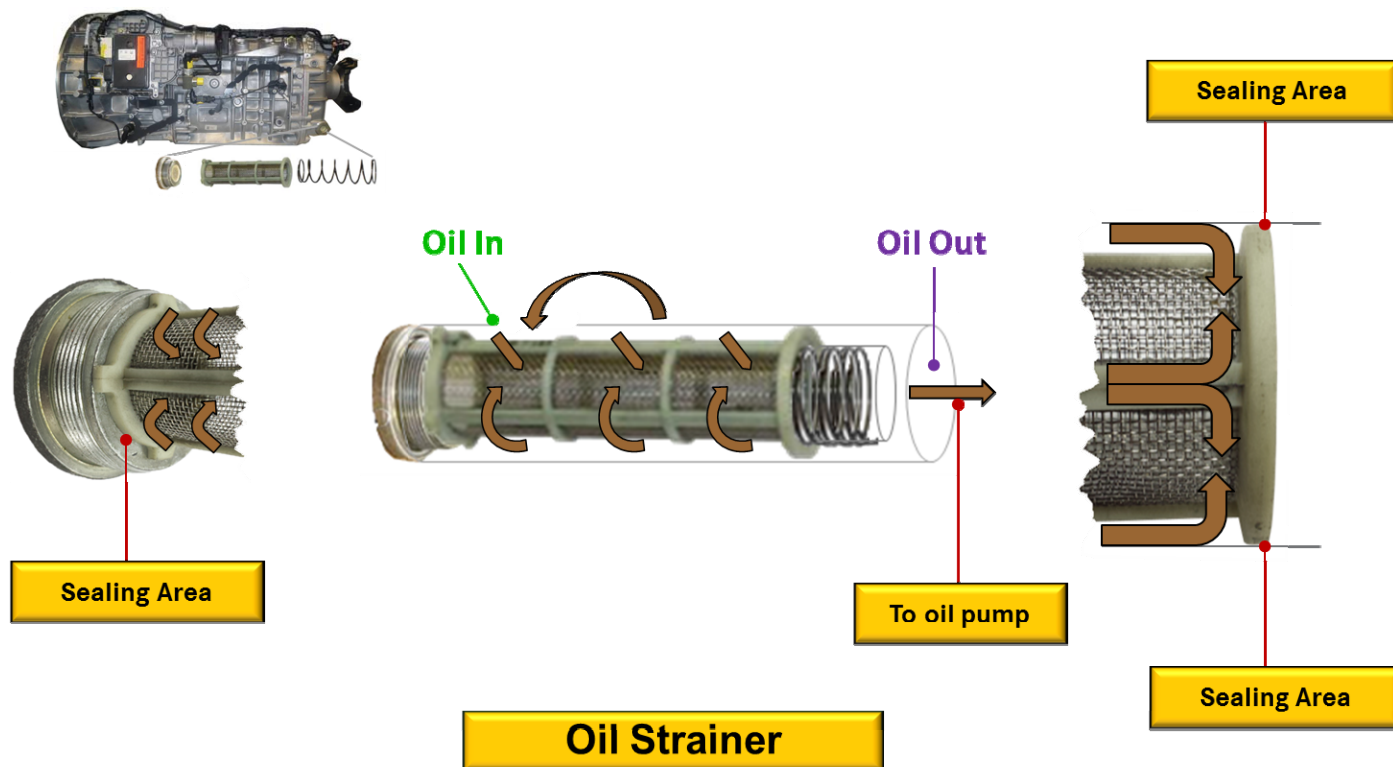
LUBRICATION SYSTEM

OIL STRAINER ORIENTATION



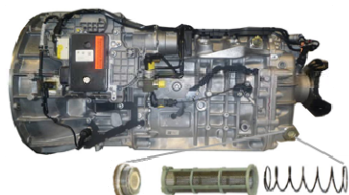
The oil strainer must be oriented correctly to ensure it's proper functionality. Note how on the plug end the strainer seals against the plug face, while on the transmission end, the strainer seals along the oil strainer bore.

OIL FLOW

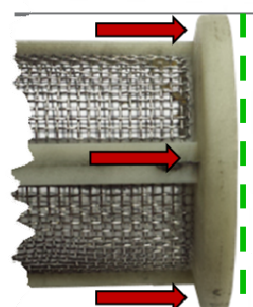
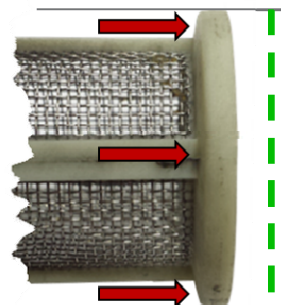
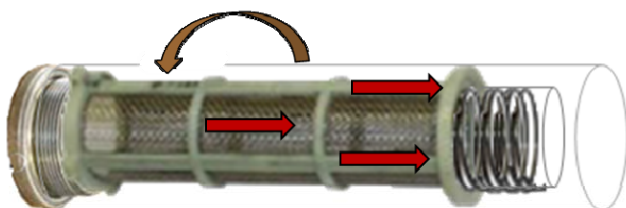


Oil is drawn from the outside of the screen, inwards towards the oil pump.

RESTRICTED STRAINER



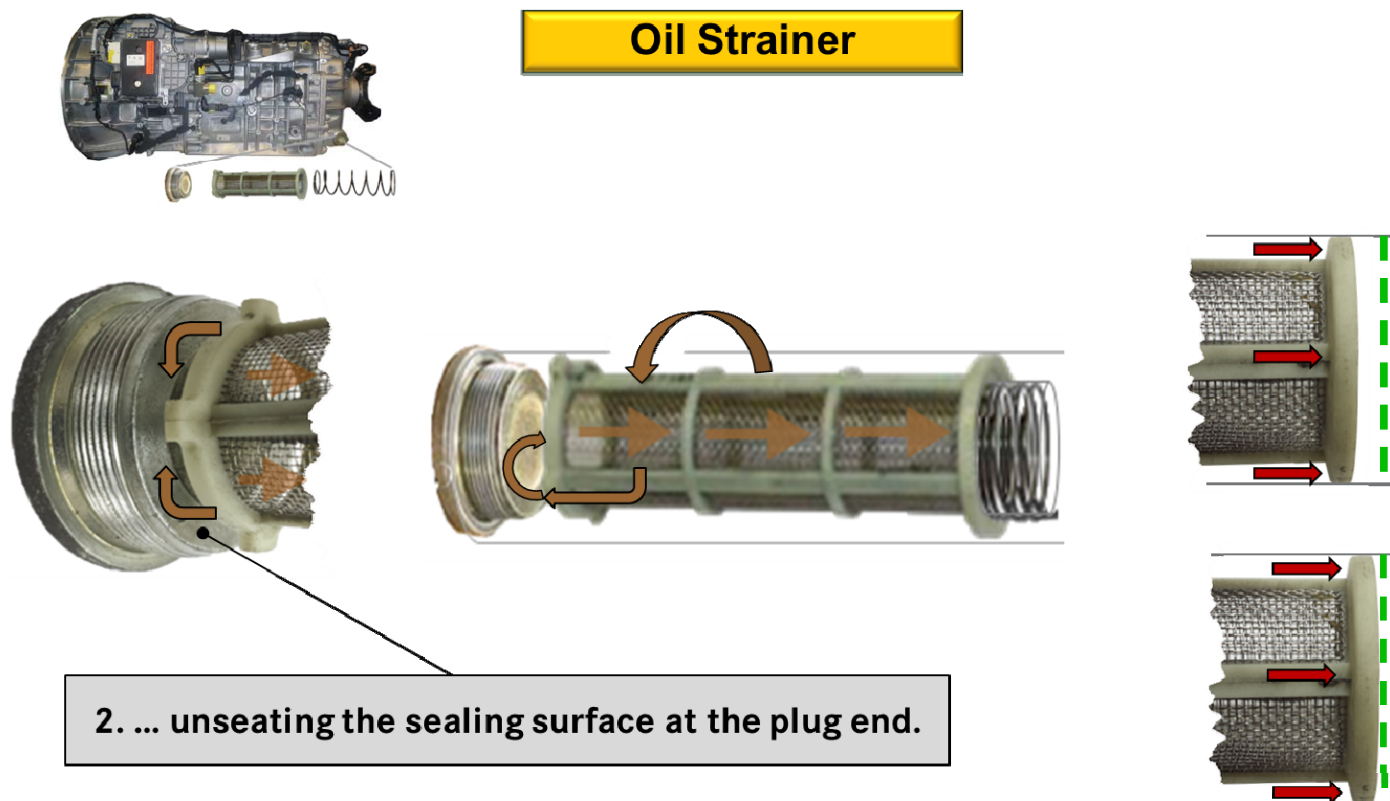
Oil Strainer



1. A restriction will pull the screen against the spring...

In the event the strainer becomes restricted, it will unseat from the plug end.

LUBRICATING OIL PATH



Lubricating oil can now bypass the screen body and flow directly to the inside bore of the strainer.



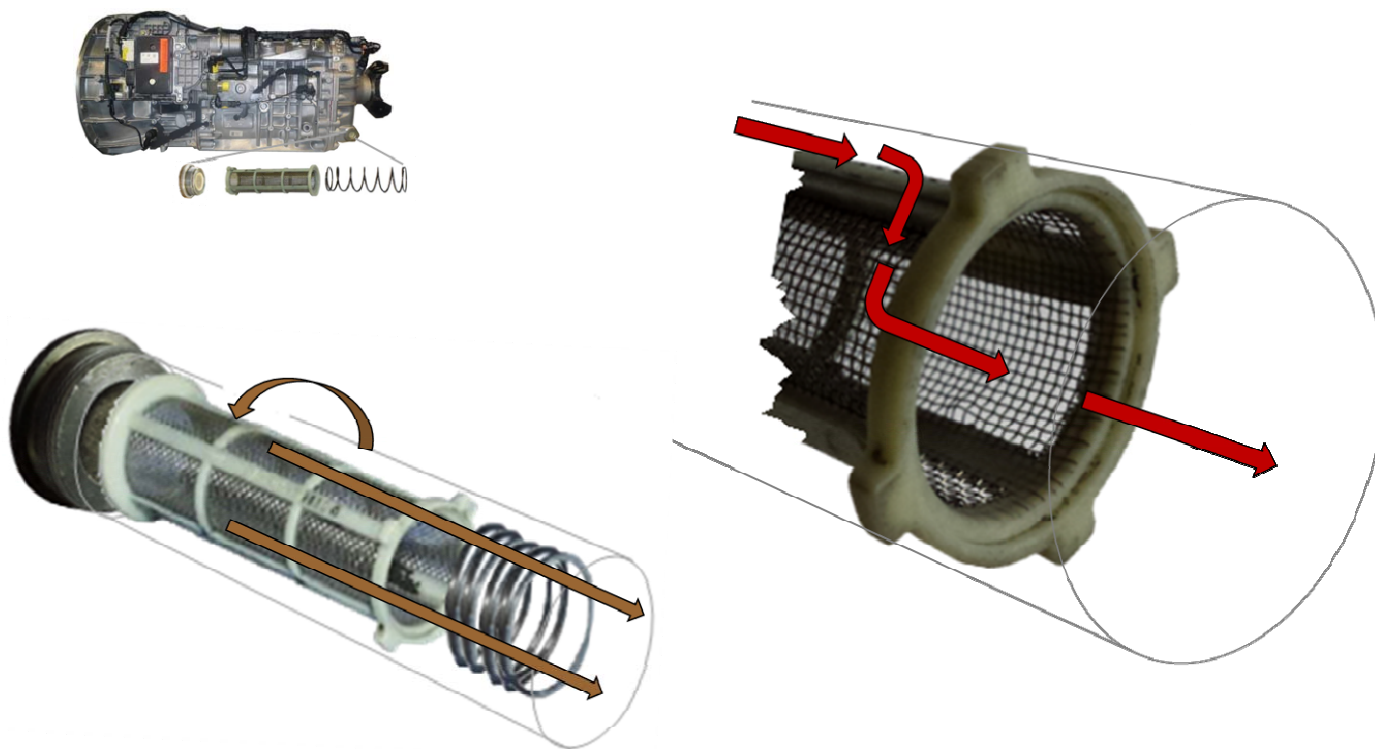
DETROIT
Transmissions

DT12

DT12 TRANSMISSIONS - RANGE GROUP

OIL STRAINER INSTALLATION PRECAUTION

Oil Strainer



In the event the strainer is installed incorrectly, the strainer will **NOT** seal along the inside of the bore and will allow the oil to bypass the screen and enter the pump.

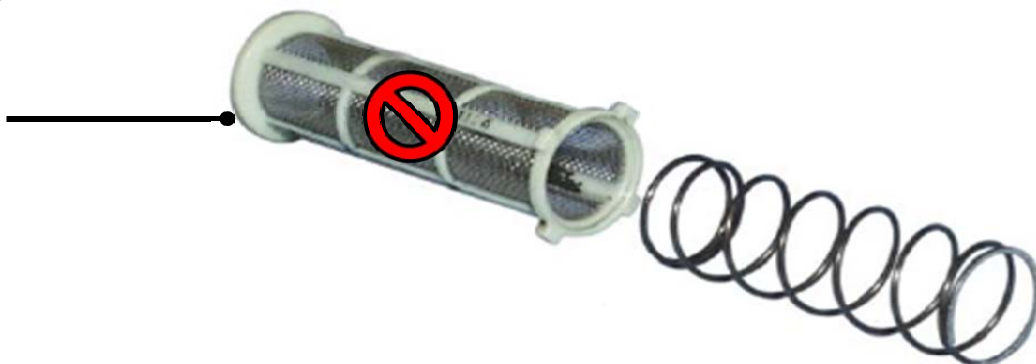
OIL STRAINER

INCORRECT VS. CORRECT INSTALLATION



Oil Strainer

Incorrect



Correct



Shown above are the incorrect, and correct orientation of the oil strainer.

DRAIN PLUG DEBRIS

Fine Metal Shavings On Magnetic Drain Plug

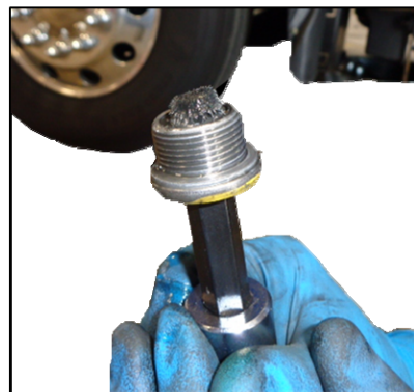
- Small amount of shavings and / or metallic sheen in oil are considered normal.
- Note - drain plug has a magnetic pin.
- Metallic sheen in oil typically due to normal carbon synchronizer material and countershaft brake clutch disc wear.



Metallic Drain Plug



Oil Sheen



Normal Shavings

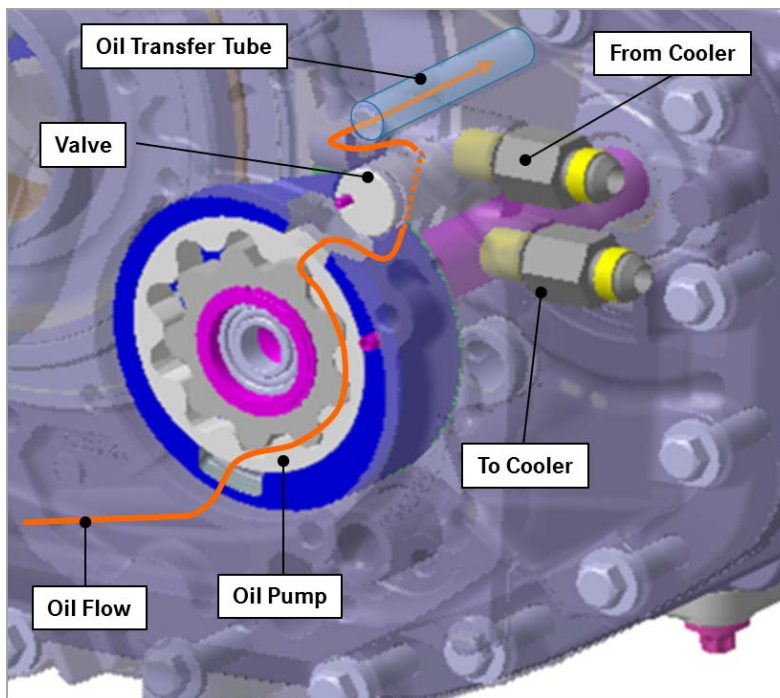
The oil in the DT12 will look unique after use. Don't be alarmed if the oil has somewhat of a silver or dark colored sheen to it. This is considered normal. The oil coloration comes from the carbon synchronizer and clutch brake material use during normal operation.

A small amount of metal shavings on the magnetic drain plug are normal as shown above.

1. Select the correct oil strainer orientation.



2. Looking at the image below, is the transmission oil above or below 176° F / 80° C ?



☒ Above

☐ Below



DETROIT

Transmissions

DT12™

Shift Controller

In this section we will learn:

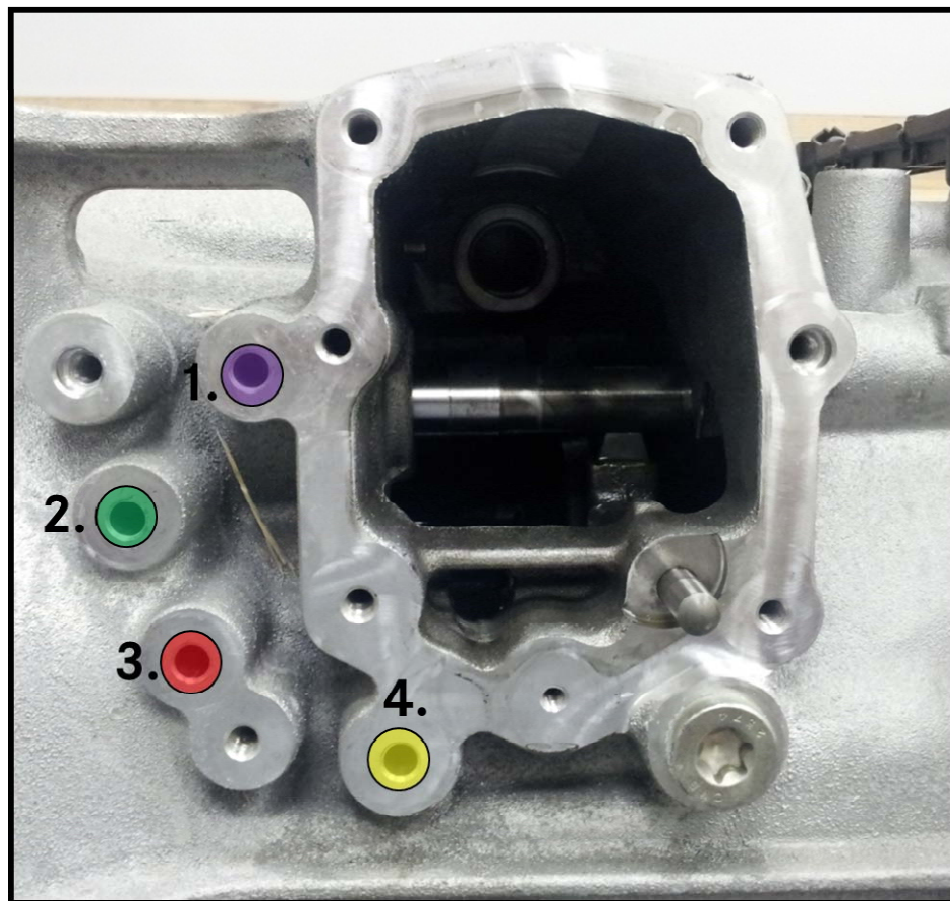
- How to remove and install the shift controller and shift actuator
- The importance of debris prevention
- Identifying correct shift controller installation



Perform the Shift Controller and Shift Actuator remove and install procedure.

AIR PORTS

PREVENTION OF DIRT & DEBRIS INTRUSION



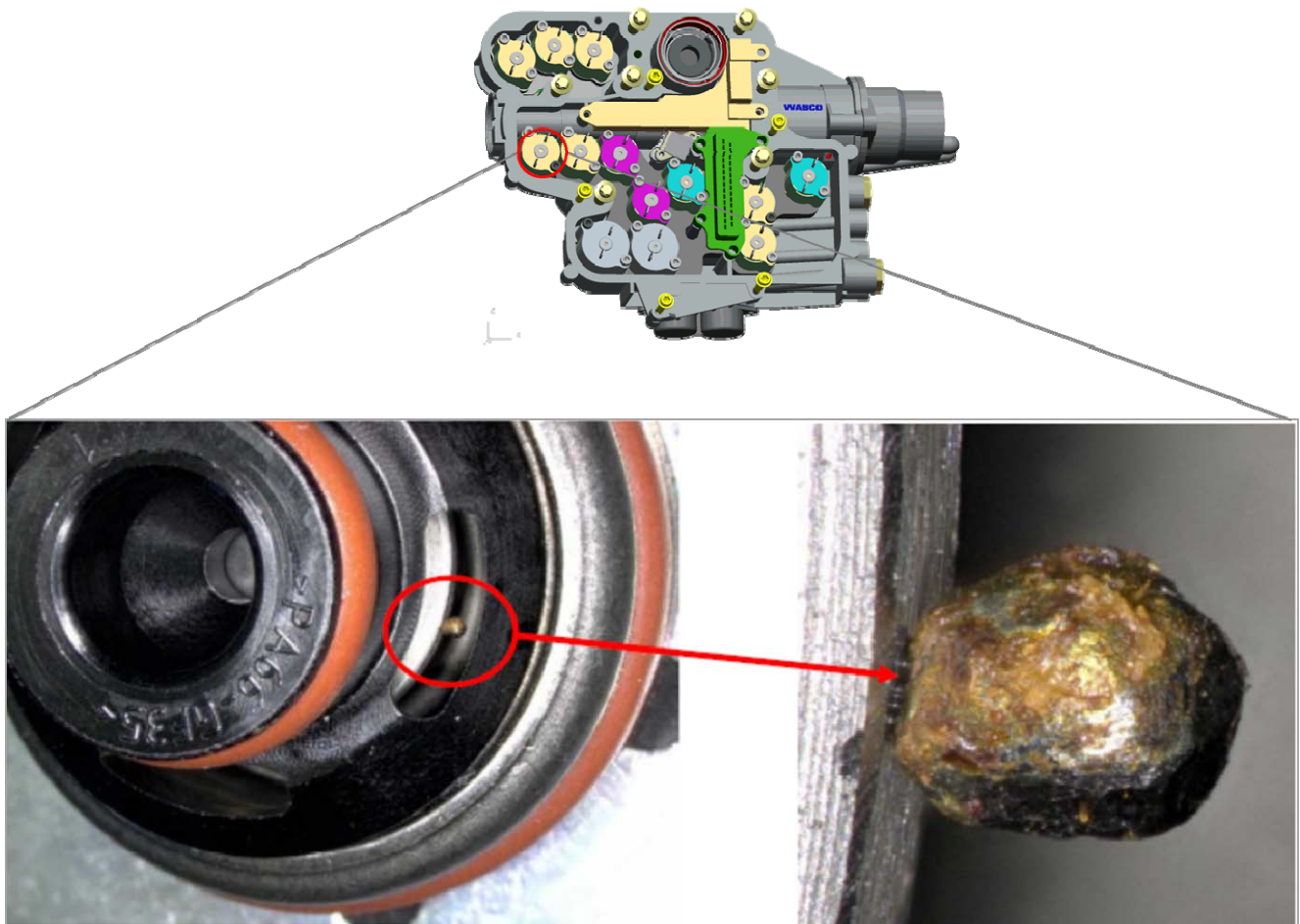
Care must be taken to prevent dirt or debris from entering the exposed ports when the shift controller and shift actuator are removed from the transmission

1.  Split HI
2.  Split LO
3.  Countershaft Brake
4.  Clutch Port

With the shift controller and shift actuator removed, the four main air passages are revealed. Care must be taken to prevent dirt or debris from entering the exposed ports when the shift controller and shift actuator are removed from the transmission.

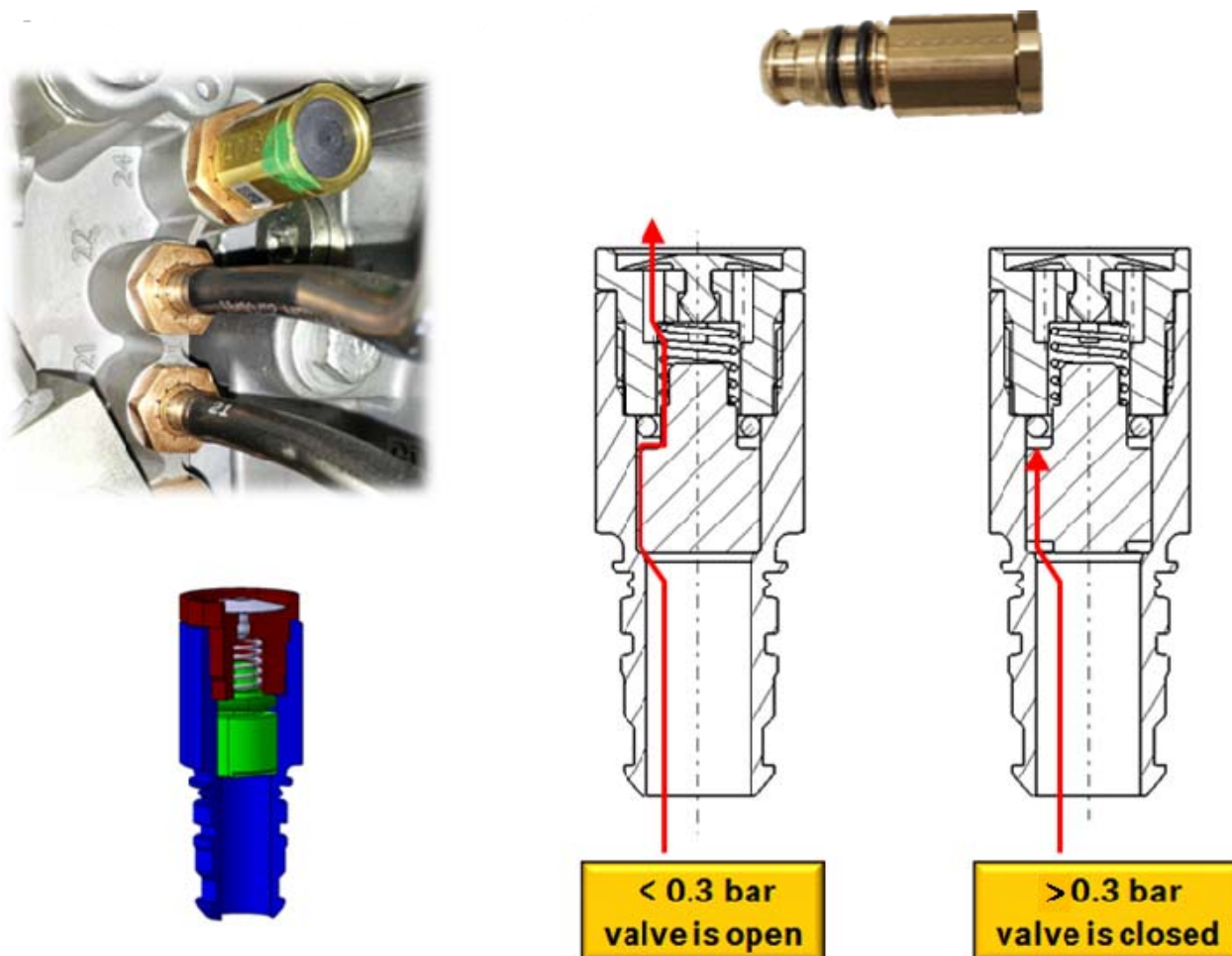
AIR PORTS

PREVENTION OF DIRT & DEBRIS INTRUSION



If care is not taken, dirt and other debris in the air ports can contaminate the shift controller solenoid valves as shown above. This will negatively affect transmission performance.

CLUTCH PROTECTION VALVE



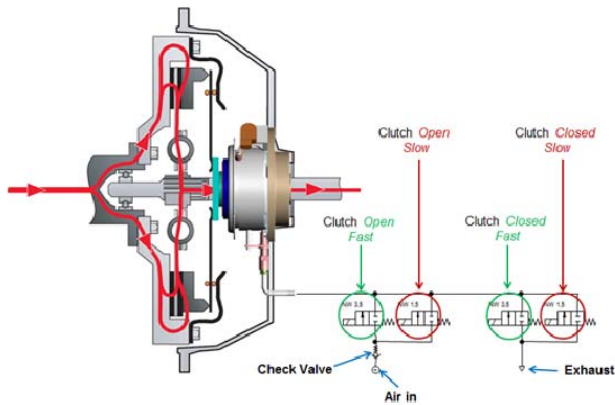
The clutch protection valve prevents the clutch from fully opening due to un-intended leakage of the “clutch open” solenoid valves with the key off, which in turn actually prevents dry-start wear to the crankshaft thrust bearings

The clutch protection valve is placed in the “clutch open” circuit. The valve remains open at pressures under 0.3 bar, or approximately 4.5 psi, allowing any leaking solenoid air to vent to atmosphere. At pressures above 4.5 psi, the valve will close.

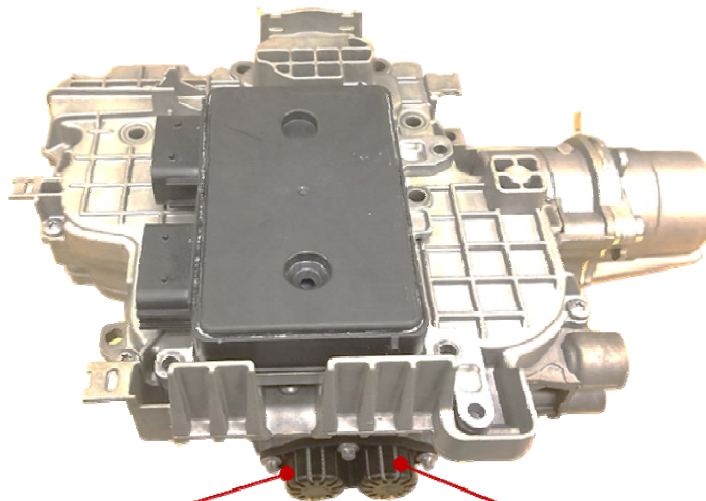
Any leakage of the “clutch open” solenoids during key off state, will bleed through the protection valve to atmosphere.

During normal vehicle operation, the valve will be closed anytime the clutch open solenoids are controlling the clutch at pressures above 4.5 psi.

SHIFT CONTROLLER VENT PORTS



Front of Vehicle



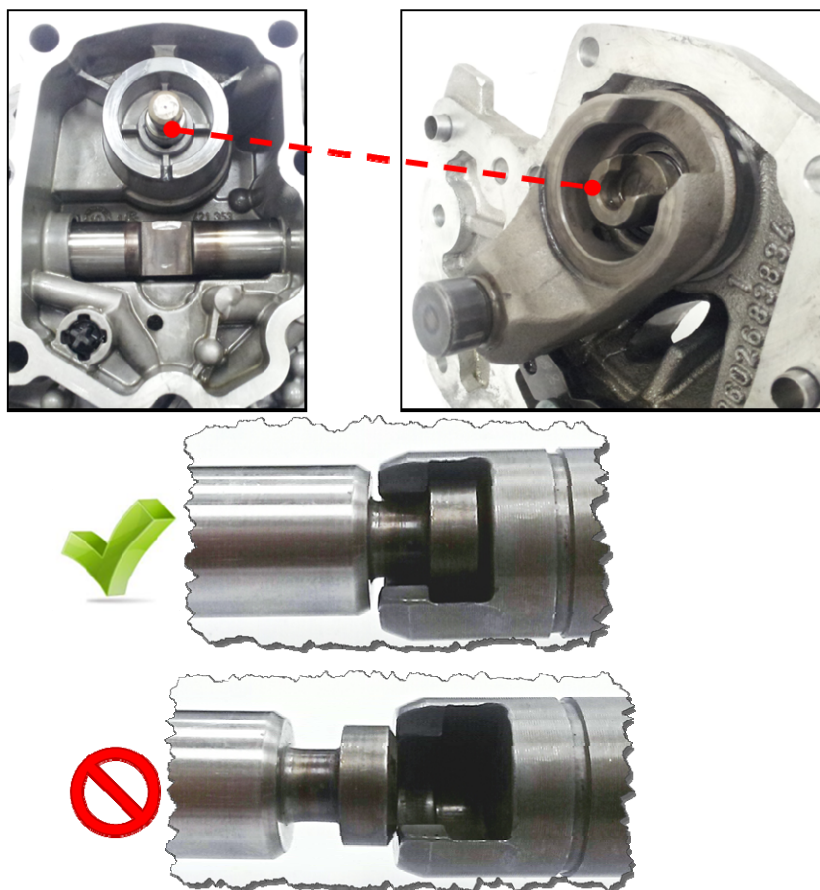
**Clutch solenoids exhausts
through FRONT vent**

**Gear solenoids exhausts
through REAR vent**

All solenoid exhausting is done through the vent ports on the bottom of the shift controller. The clutch solenoids exhaust through the front vent, while the gear solenoids exhaust through the rear vent.

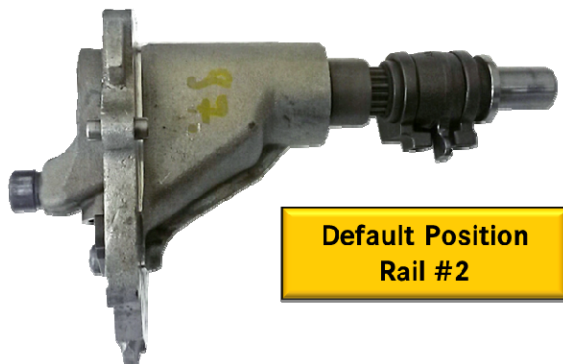
SHIFT CONTROLLER INSTALLATION

Identifying if a Shift Controller is installed incorrectly

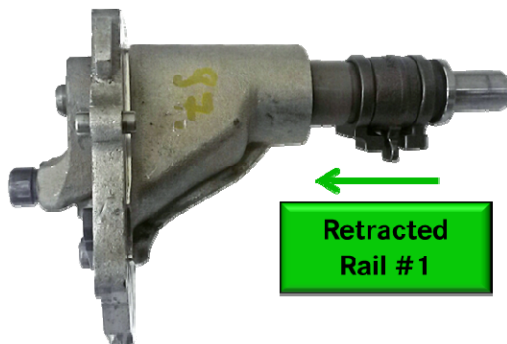
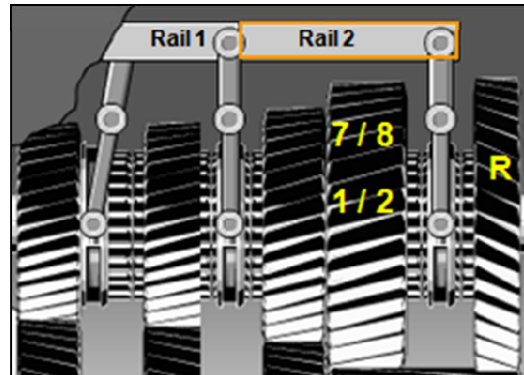


Along with the prevention of dirt intrusion, ensuring that the shift controller is installed correctly is imperative. The rail piston shaft must be inserted into the shift actuator correctly. Lets observe how to identify, via a log file, when a shift controller has been installed incorrectly.

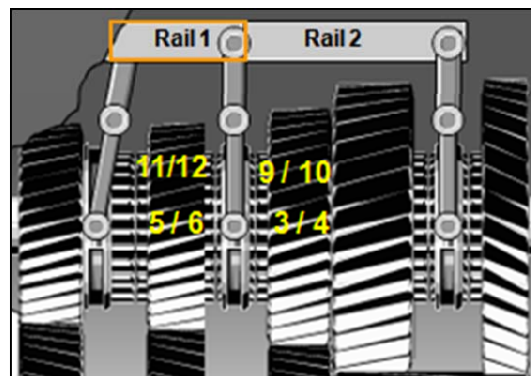
RAIL #1 VS. RAIL #2 POSITIONS



Default Position
Rail #2

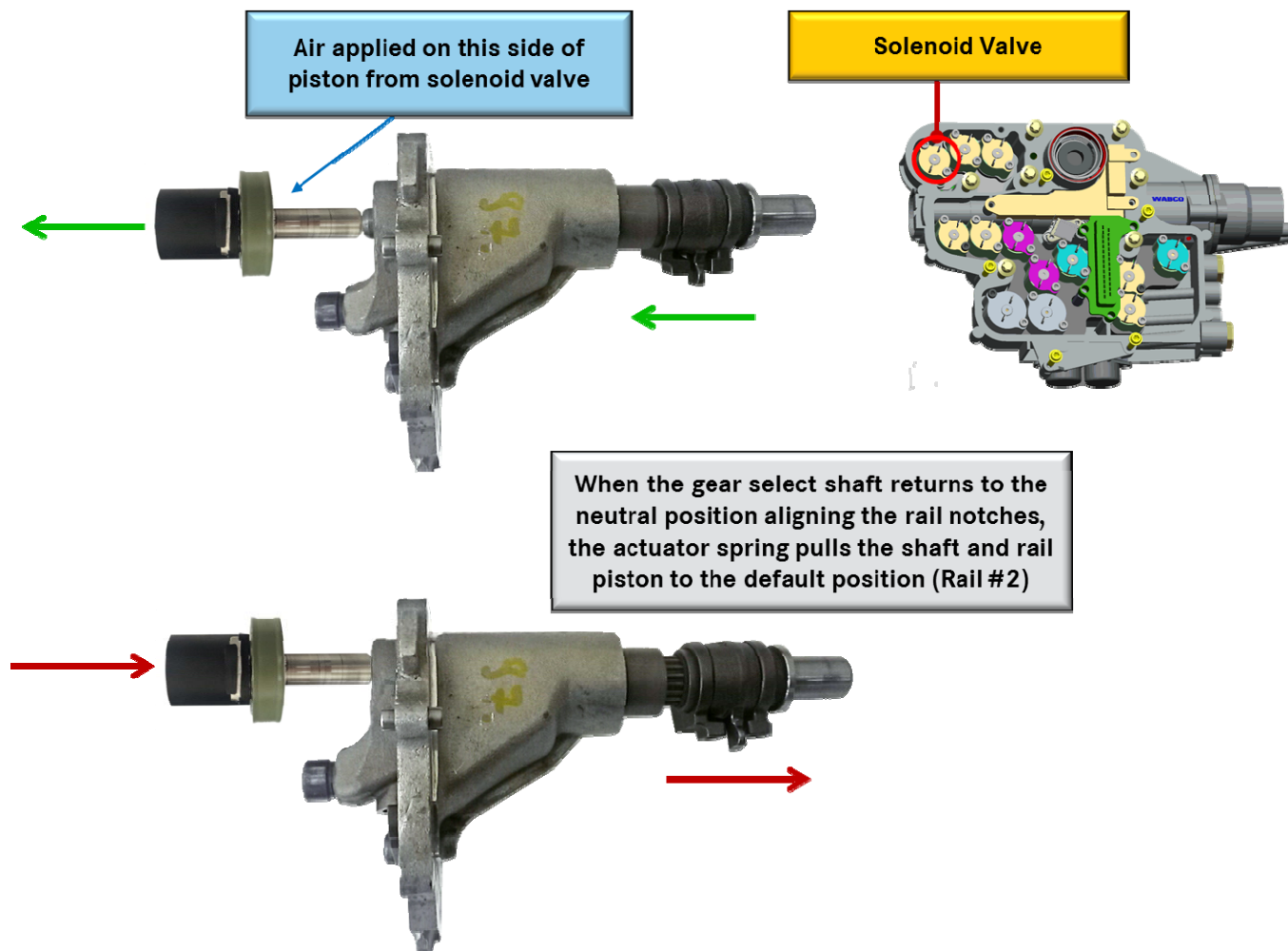


Retracted
Rail #1



When the shift actuator is installed, it's default position is shift rail #2. When retracted, the shift actuator engages rail #1.

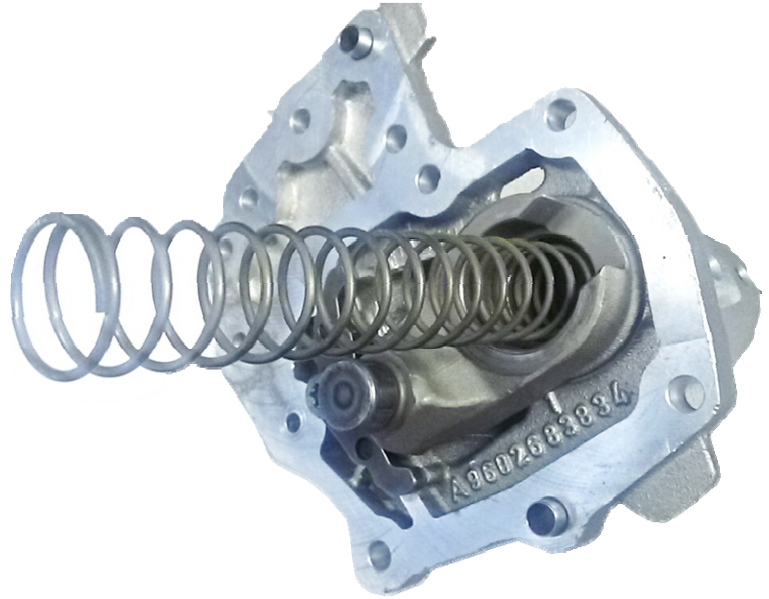
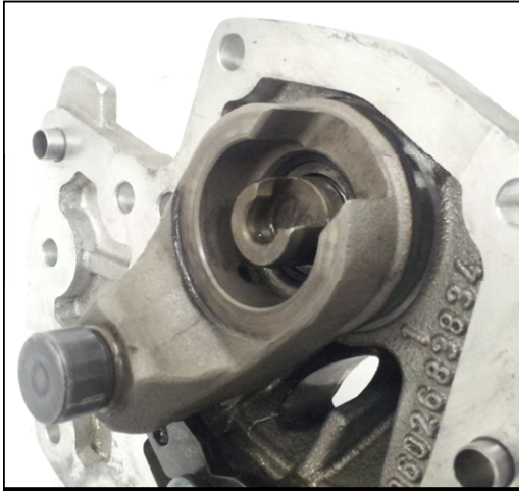
RAIL #1 VS. RAIL #2 POSITIONS CONT'D



When rail #1 is desired, air from the solenoid valve is applied to the back side of the rail select piston, which in turn retracts the shift actuator.

When rail #2 is desired, the gear select shaft returns to the neutral position aligning both shift rail notches. Return spring force pulls the actuator shaft and rail piston back to the default position.

SHIFT ACTUATOR SPRING



Shown above is the rail select return spring.



DETROIT
Transmissions

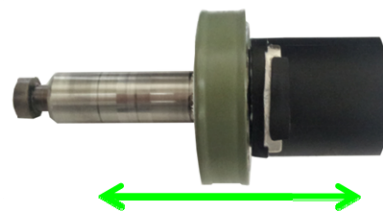
DT12

DT12 TRANSMISSIONS - SHIFT CONTROLLER

RAIL LEARN *GOOD VS. BAD*

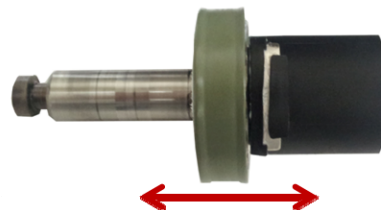


Good



Rail Select Piston is extending and retracting normally

Bad



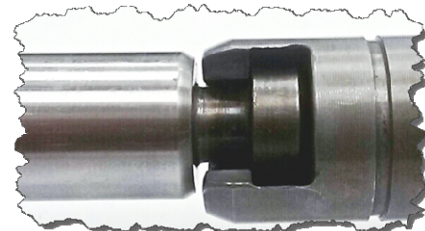
Rail Select Piston extends, but travel distance error is recognized and learn fails

Now let's observe two different log files. Both log files are of a learn procedure - specifically the rail portion.

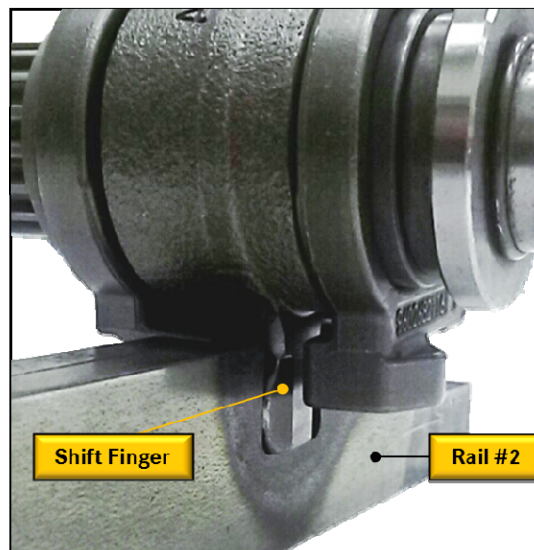
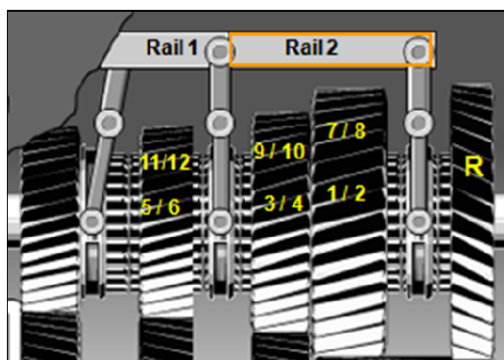
The top represents a shift controller that was installed correctly and had a successful learn procedure.

The bottom log file represents a shift controller that was incorrectly installed and failed the learn procedure.

SHIFT CONTROLLER INSTALLED CORRECTLY

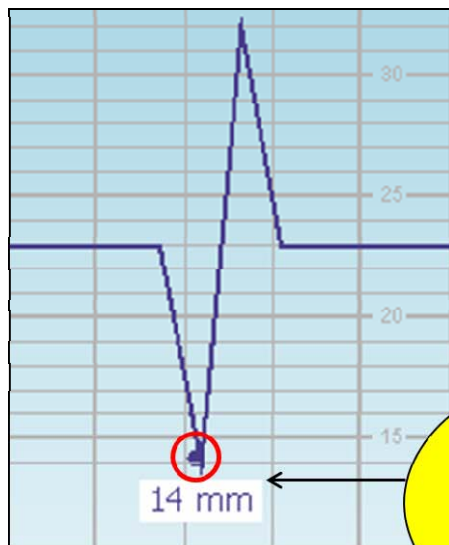


Shift Controller is installed correctly and Rail Select Piston is in it's default position, engaging the shift finger with rail #2.

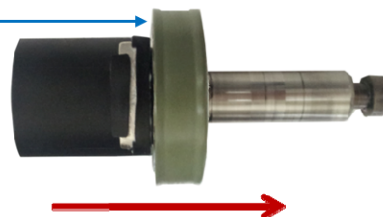


At the beginning of the procedure, the TCM is reading the default position of the rail piston and shift actuator engaged with rail #2.

SHIFT CONTROLLER INSTALLED CORRECTLY *ACTUATOR FULLY EXTENDED*

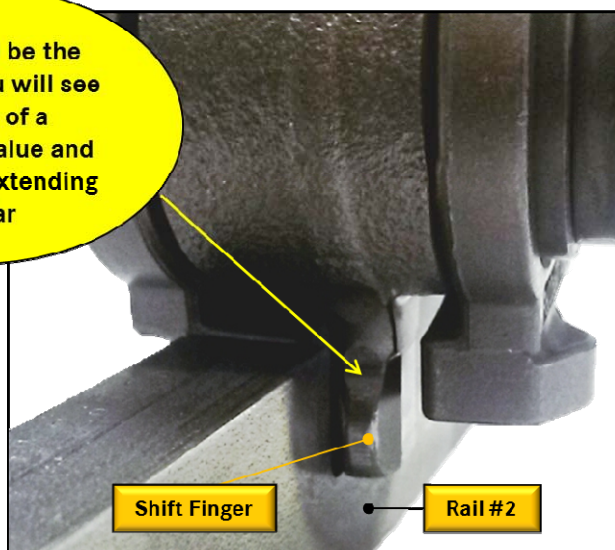
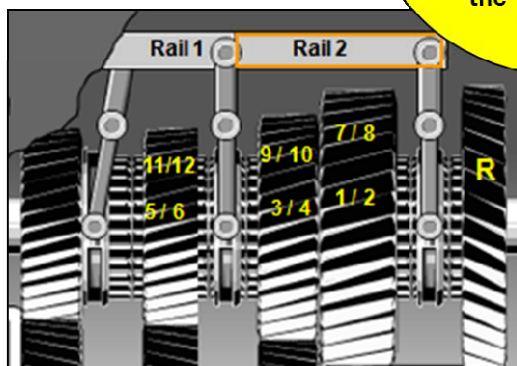


Air applied on this side of piston



Air is applied to front side of piston, fully **extending** actuator and positioning the shift finger PAST rail #2.

This should be the only time you will see this low of a millimeter value and the piston extending this far

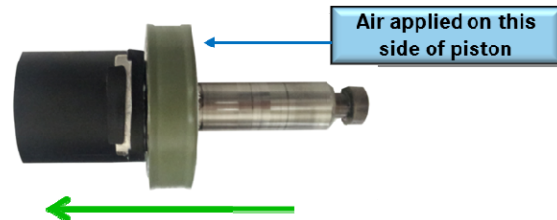
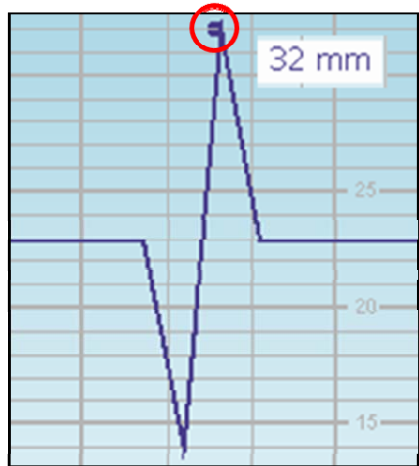


During this phase of the procedure, the rail is fully extended. This actually pushes the shift finger out of Rail #2. Alignment is maintained by the outer guide sleeves.

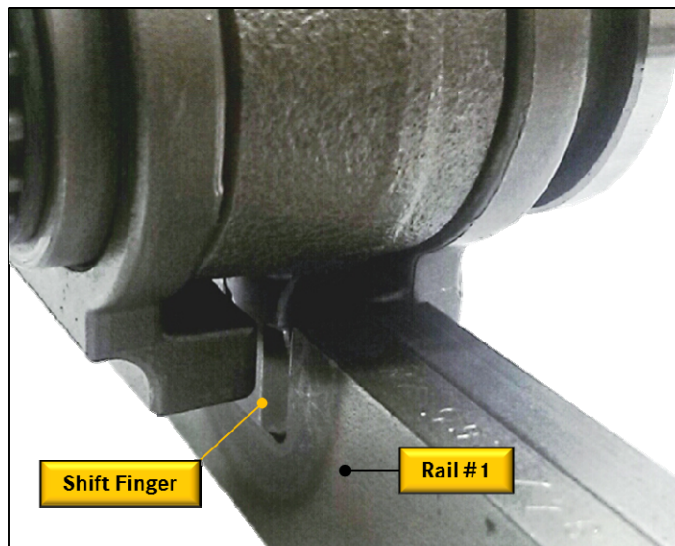
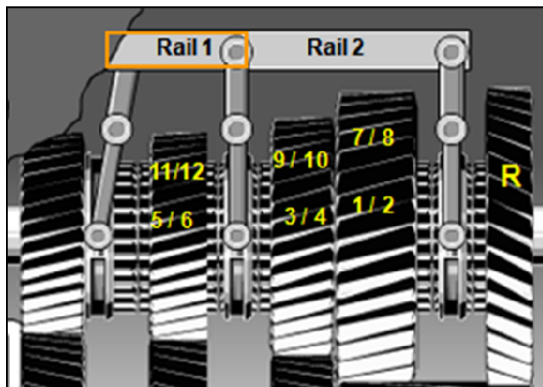
Currently, this is the only time you should see such a low millimeter value and the only time the piston will fully extend this far.

SHIFT CONTROLLER INSTALLED CORRECTLY

RAIL #1 SHIFT FINGER POSITION



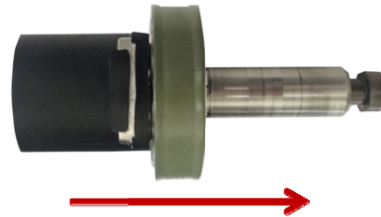
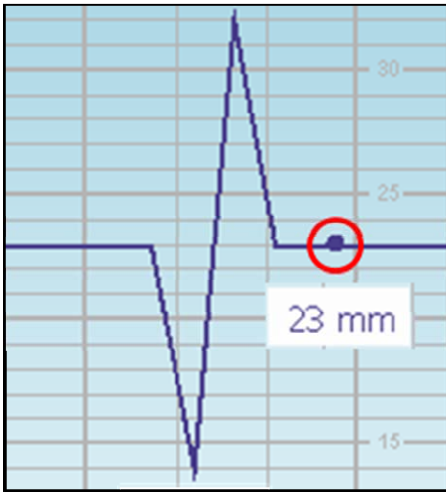
Air is applied to the back side of the piston positioning the actuator shift finger in rail #1.



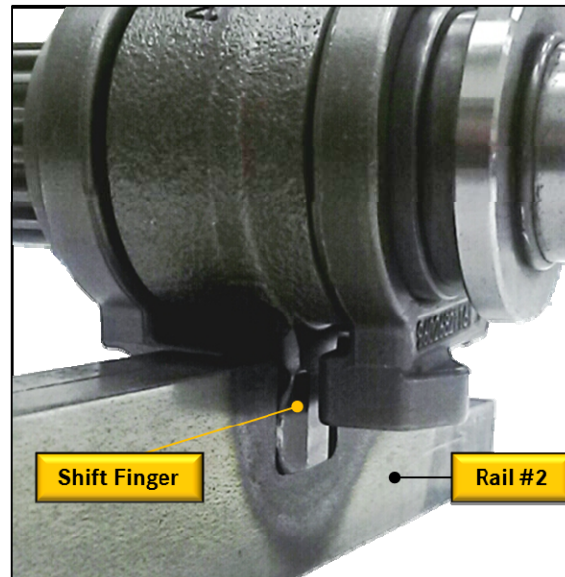
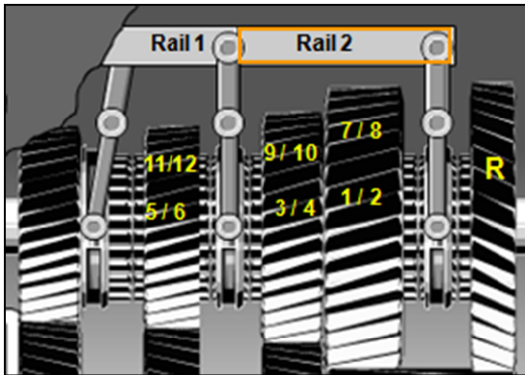
Air is applied to the back side of the piston positioning the actuator shift finger in rail #1.

SHIFT CONTROLLER INSTALLED CORRECTLY

RAIL #2 SHIFT FINGER POSITION (DEFAULT POSITION)

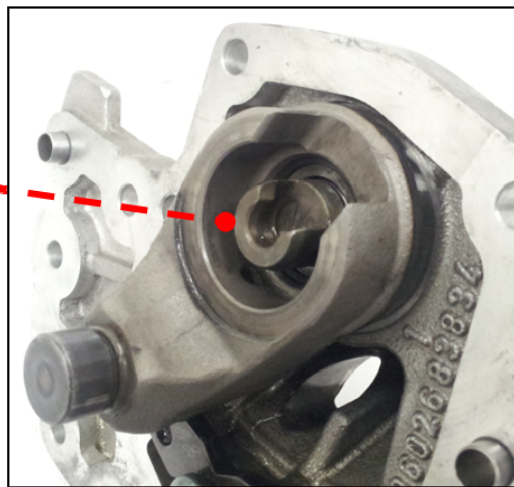
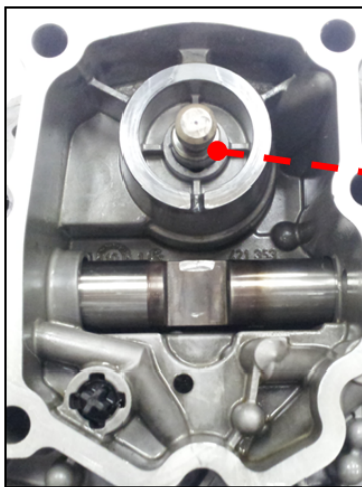
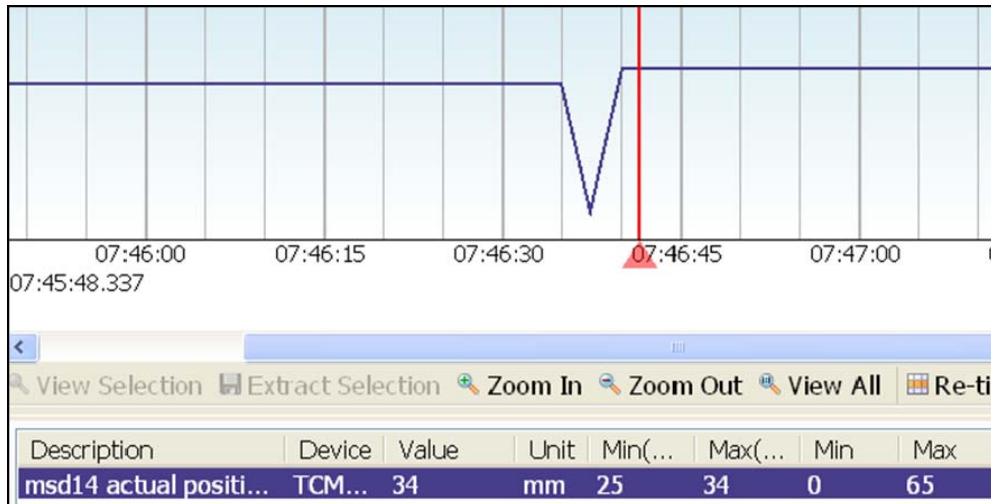


Spring force returns the Rail Select Piston to it's default position, engaging the shift finger with rail #2.



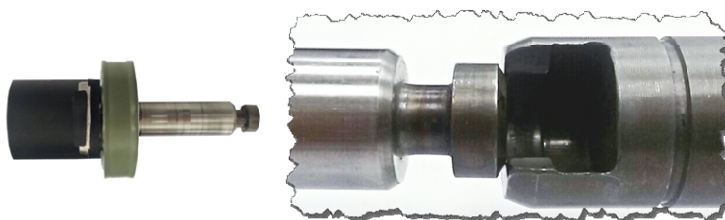
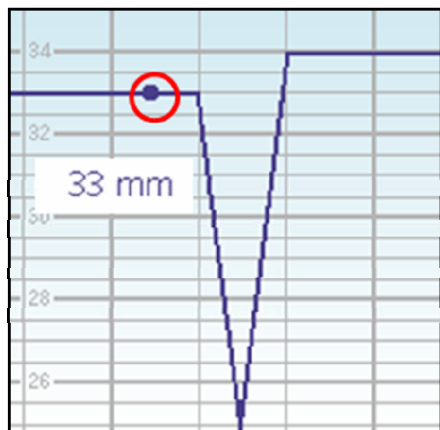
Now, spring force retracts the actuator and positions the shift finger in rail #2.

SHIFT CONTROLLER INSTALLED INCORRECTLY

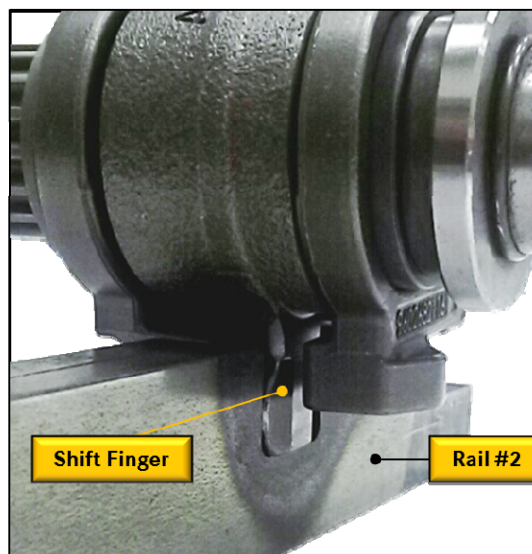
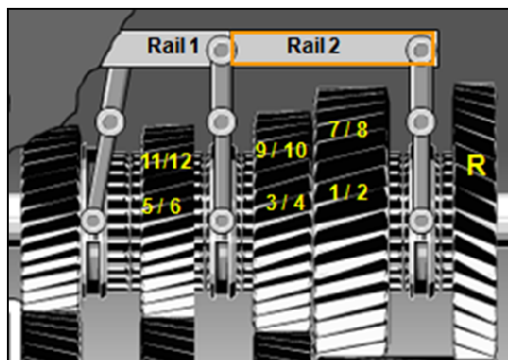


Let's observe the log file readings from a transmission where the shift controller was installed ***incorrectly*** – rail piston shaft not latched.

SHIFT CONTROLLER INSTALLED INCORRECTLY *HIGHER DEFAULT POSITION*

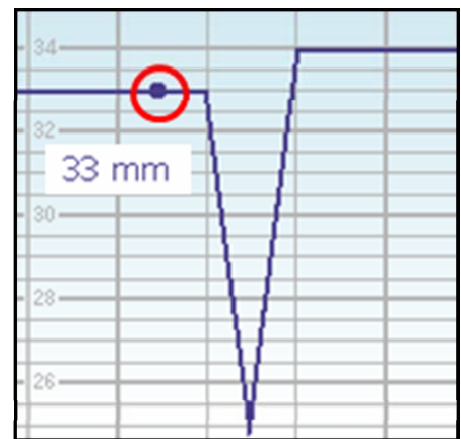
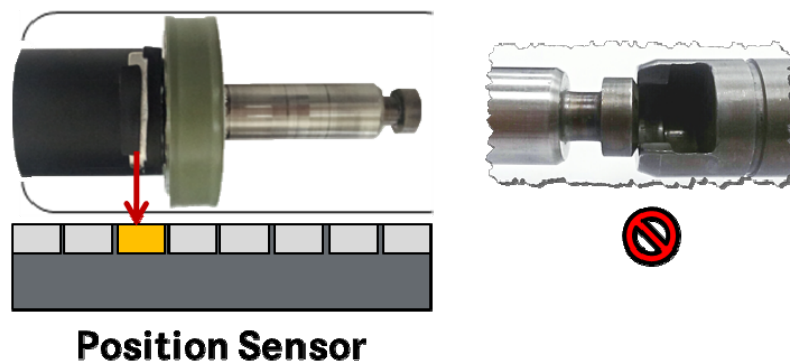
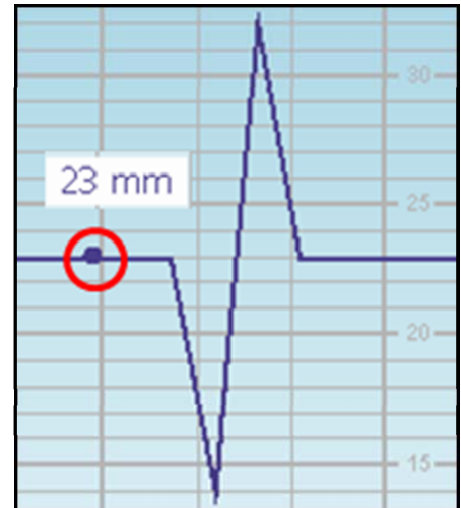
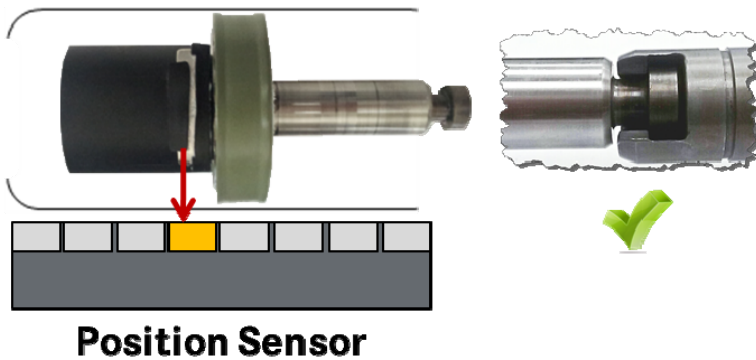


Rail Select Piston is not latched to the actuator shaft. The shift finger is still in it's default position, engaging the shift finger with rail #2.



In the log file of the learn routine, you will notice that the default position is higher - 33 mm as opposed to 23 mm in the previous page.

SHIFT CONTROLLER INSTALLED INCORRECTLY *RAIL PISTON POSITIONING*



This high reading occurs because if the rail shaft isn't latched correctly, the rail piston is forced deeper into its cylinder when the controller is installed.

As you can see, with the piston pushed further back in it's cylinder, the position sensor measures a higher numerical value for the default position.

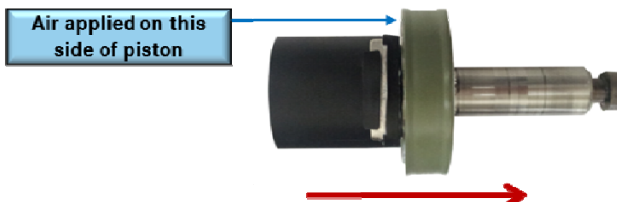
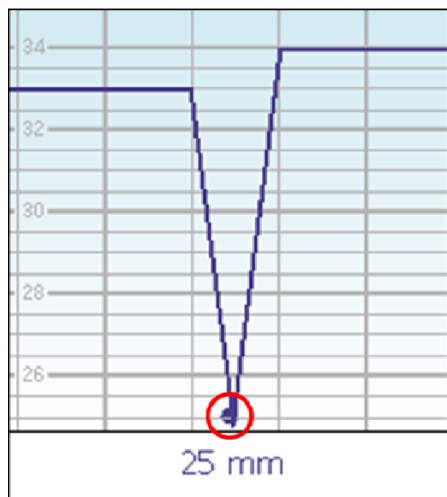


DETROIT
Transmissions

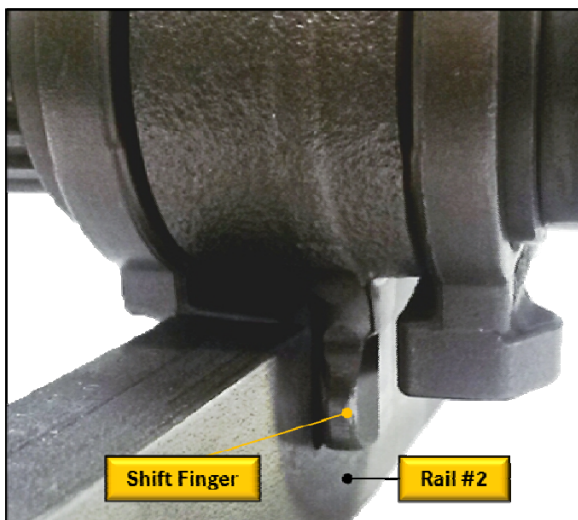
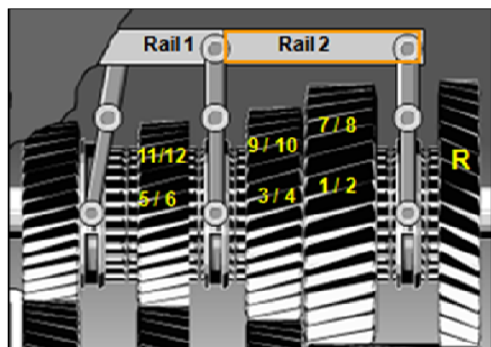
DT12

DT12 TRANSMISSIONS - SHIFT CONTROLLER

SHIFT CONTROLLER INSTALLED **INCORRECTLY** **RAIL PISTON POSITION ABNORMAL**



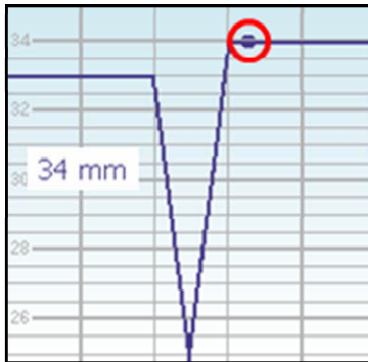
Air is applied to front side of piston to extend the actuator and the TCM recognizes the abnormal value.



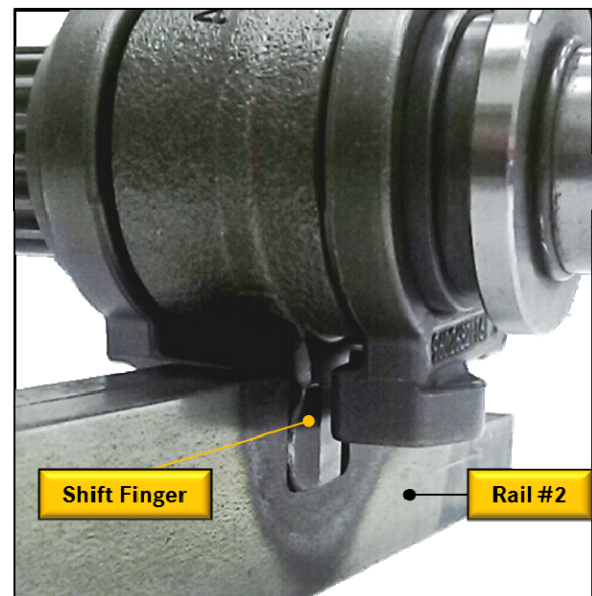
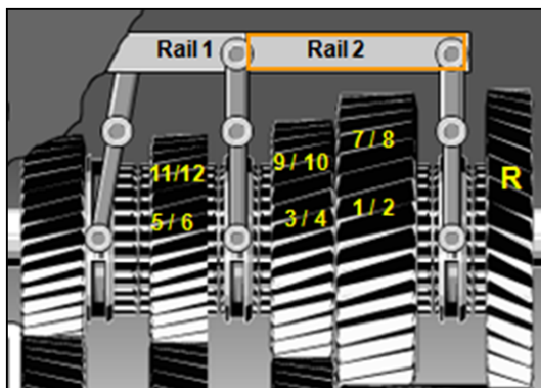
Now, during this portion of the learn procedure, the rail piston position should be in the 14 mm range, however it now only reads 25 mm and the TCM will recognize this as an abnormal value.

SHIFT CONTROLLER INSTALLED INCORRECTLY *TCM FAULT CODE*

TCM01T - Transmission Control Module MY2013				
+	!	TCM Learn - Actuator Distance Error	520978 14	active



The piston retracts, the learn procedure fails and the TCM logs a fault.



At this point, the learn procedure fails and the TCM logs a fault code.



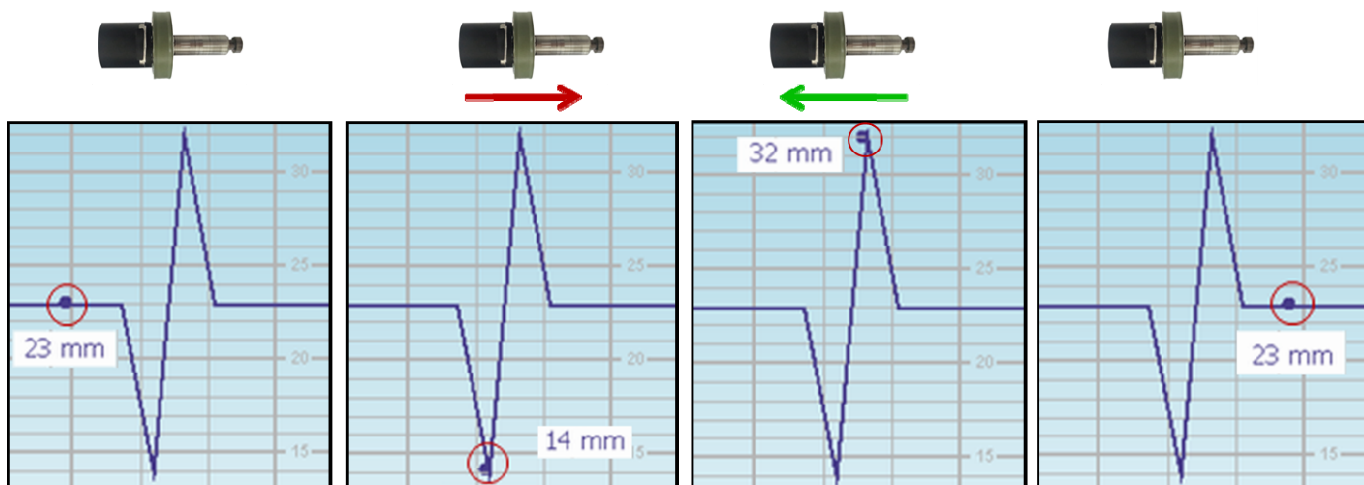
DETROIT
Transmissions

DT12

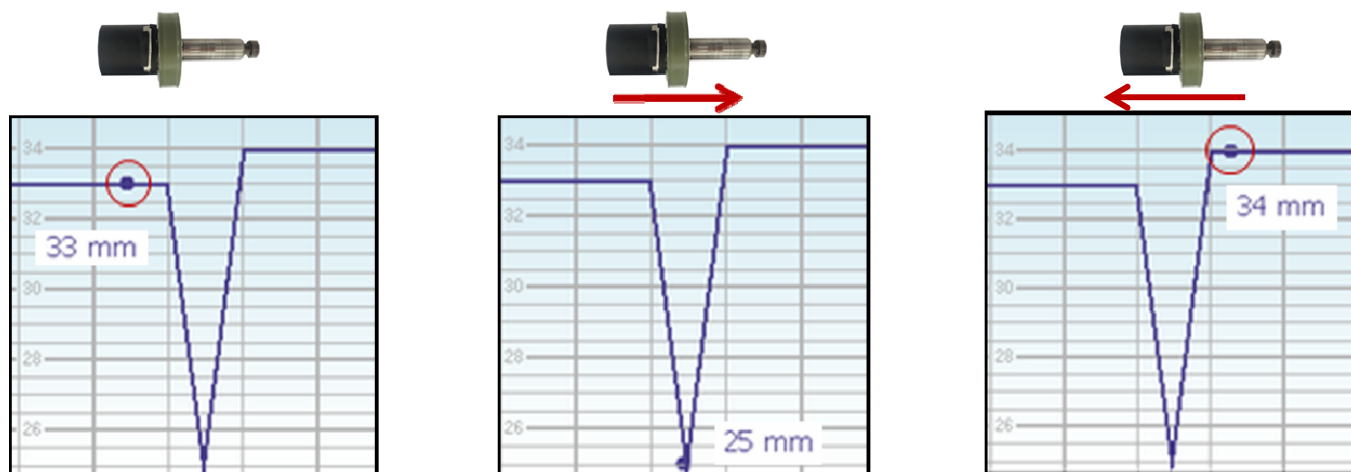
DT12 TRANSMISSIONS - SHIFT CONTROLLER

SUCCESSFUL VS. FAILED LEARN RESULTS

Successful Learn

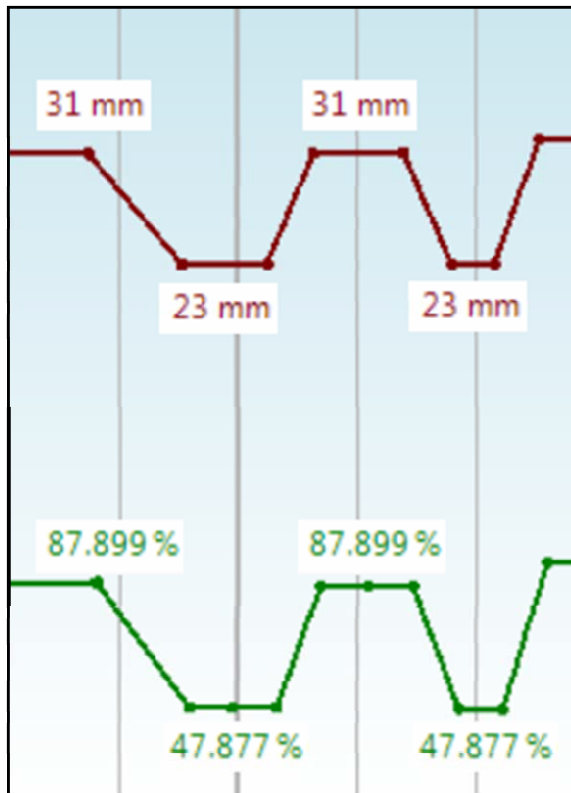


Failed Learn



Here is a comparison of a successful learn with the associated rail position values, and a failed learn.

POINTS OF INTEREST



Whether the rail position is charted as a percentage, or actual measurement, the higher the numerical value – the more the piston is **retracted**.

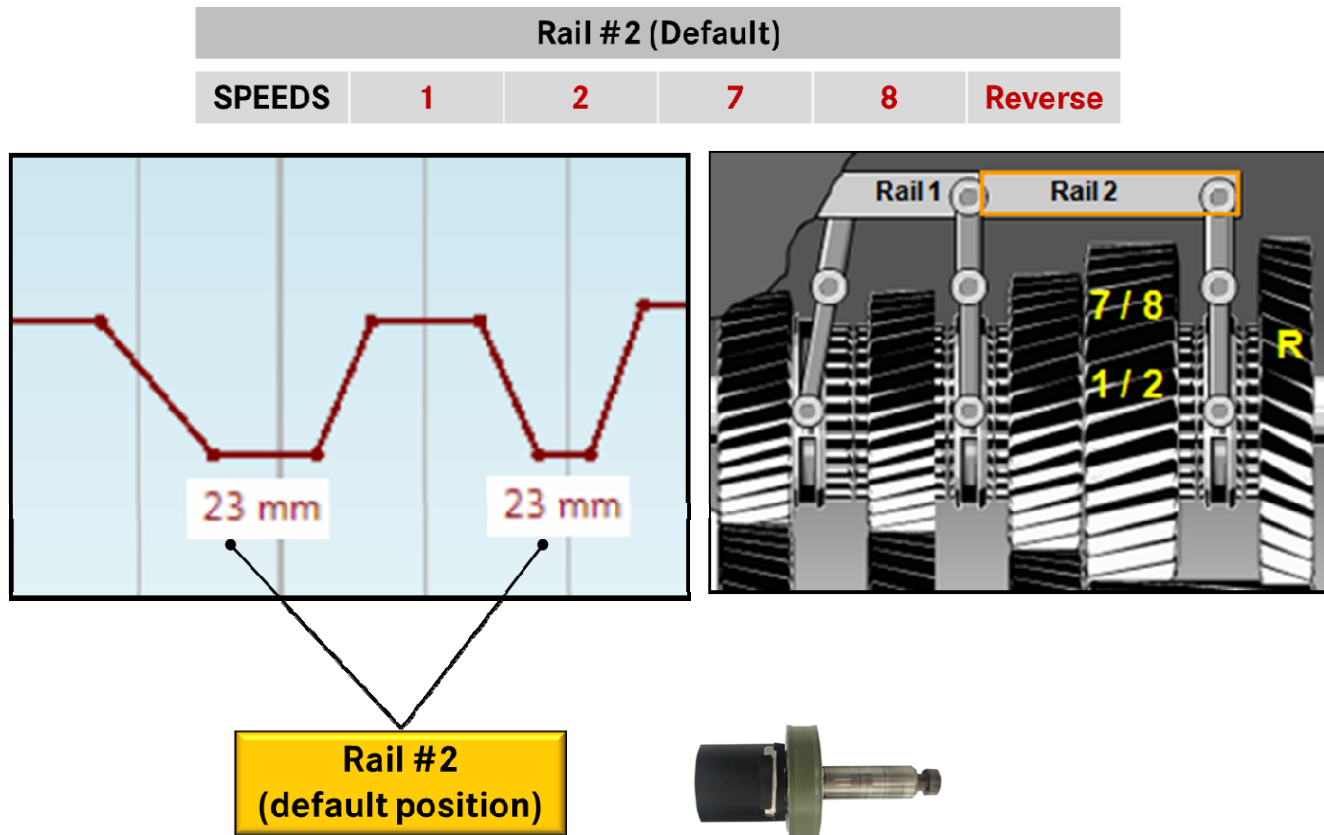


Conversely, the lower the numerical value, the more **extended** the piston is.

Whether the rail position is charted as a percentage, or actual millimeter measurement, the higher the numerical value — the more the piston is ***retracted***.

Conversely, the lower the numerical value, the more ***extended*** the piston is.

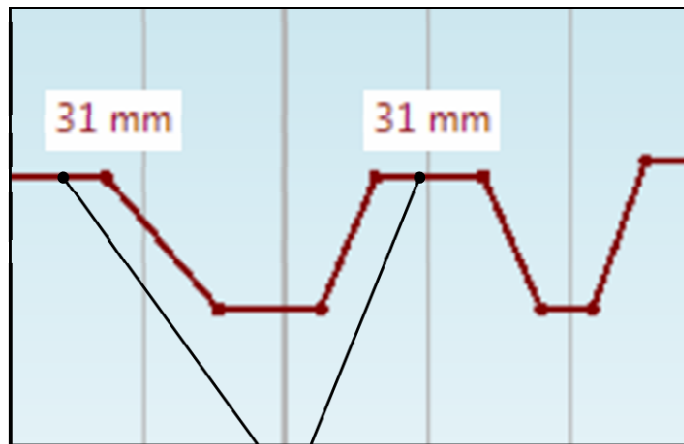
RAIL #2 DEFAULT POSITION



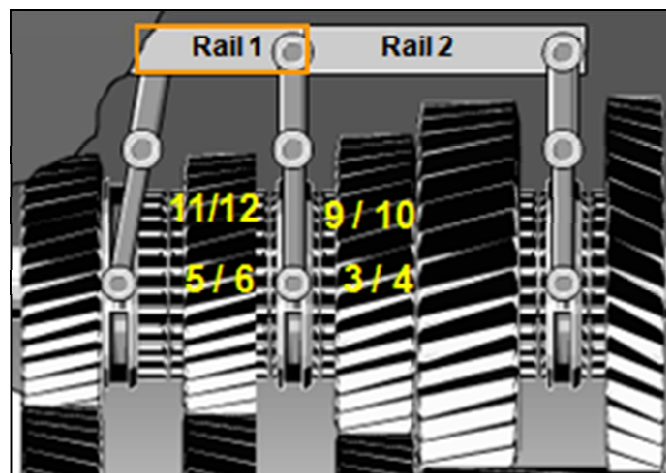
Here are the gears (speeds) that are utilized with the default position – Rail #2.

RAIL #1 - PISTON RETRACTED POSITION

Rail # 1								
SPEEDS	3	4	5	6	9	10	11	12



Rail # 1



piston retracted

Here are the gears (speeds) that are utilized with the piston retracted – Rail #1.

1. On the shift controller, which port vents the clutch?

2. Which rail is the default position?



DT12™

Notes:



DETROIT
Transmissions

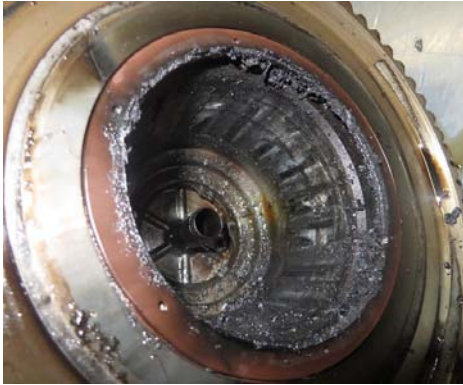
DT12™

Towing Precautions

In this section we will learn:

- The proper methods for towing a DT12 equipped vehicle
- Important consideration regarding towing
- Damage caused by improper towing methods

PROPER TOWING PROCEDURE



**Backside Of Input Shaft
"Bearing Pocket" damaged**



Mainshaft Pilot Bearing Damaged

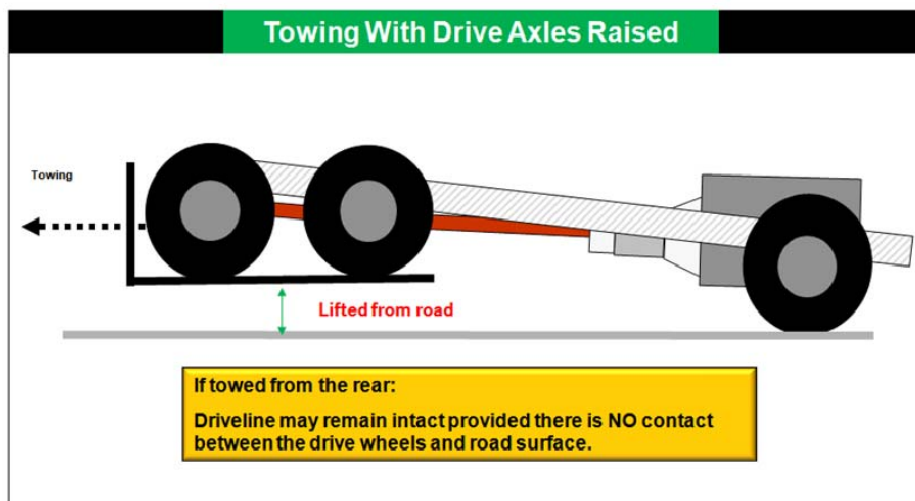
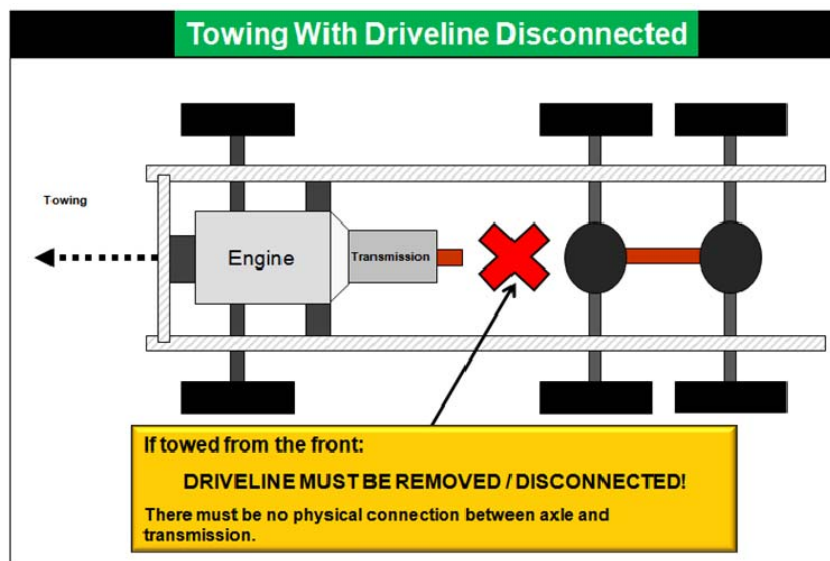
When towing the vehicle with the drive wheels on the ground **AND** the axle shafts left in place, the oil pump will not rotate. Therefore, internal transmission components will not receive adequate lubrication.

This can *quickly* cause severe damage to the transmission

If the axle shafts are not removed, then tow using one of these two methods on the following pages only!

It is critical that a vehicle equipped with a DT12 is towed correctly. If towed from the front with wheels on the ground, either all of the axle shafts or the driveshaft must be removed or damage will occur.

FRONT & REAR TOWING



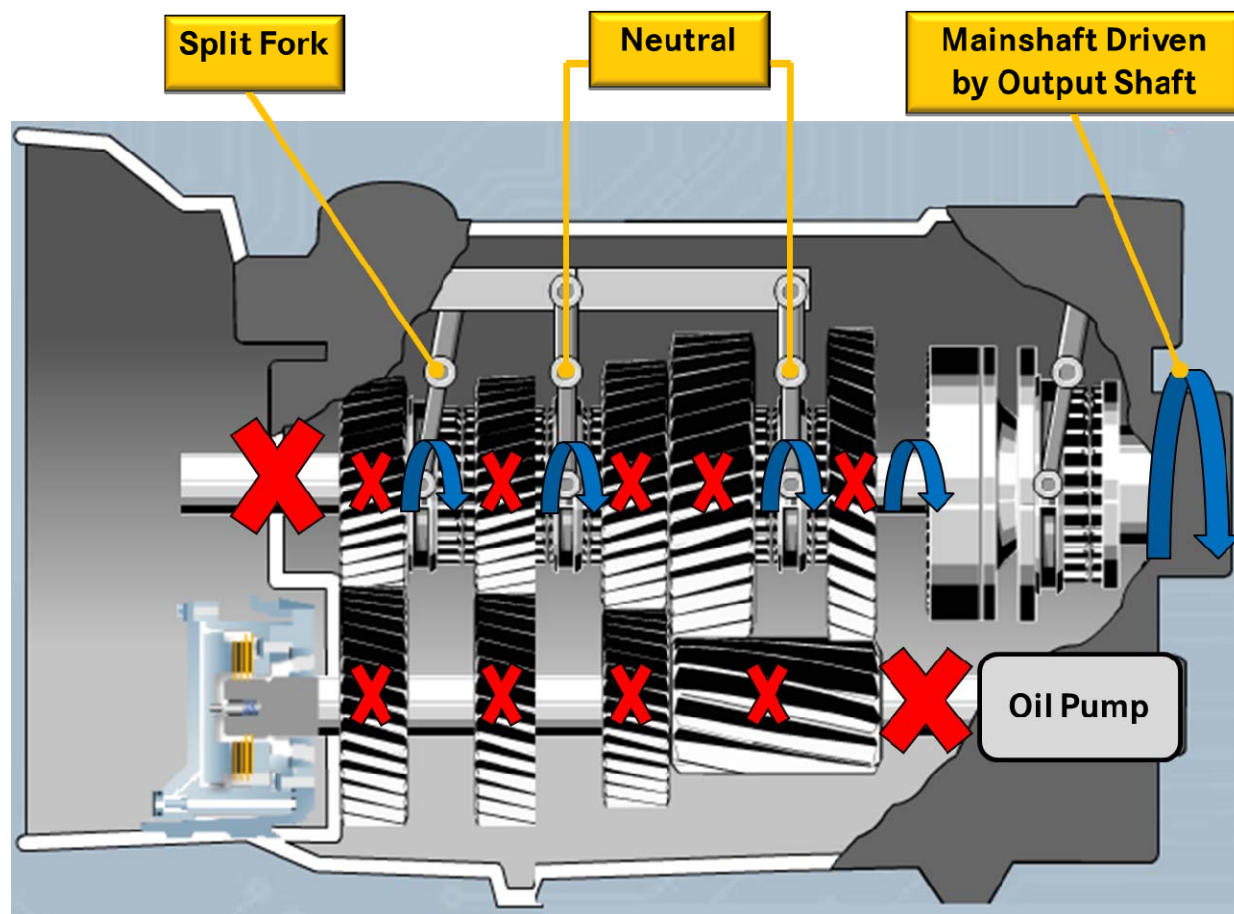
If the axle shafts are to be left in and...

Towed from front: If the vehicle needs to be towed from the front, there must be no physical connection between the drive axles and the transmission; remove the driveshaft.

Towed from rear: If the vehicle is towed from the rear, the driveshaft can be left in place provided both drive axles are raised off of the road surface completely.



TOWING FAILURE EXPLANATION



Here is how damage occurs if the vehicle is towed incorrectly.

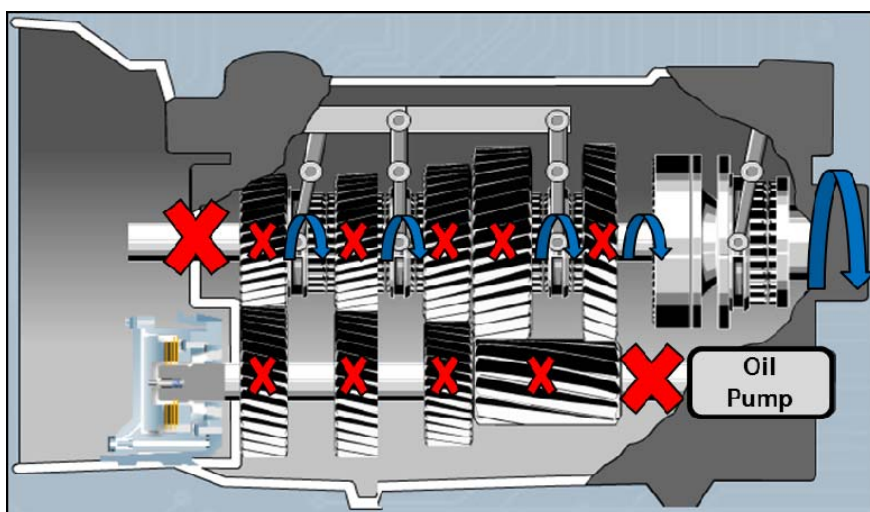
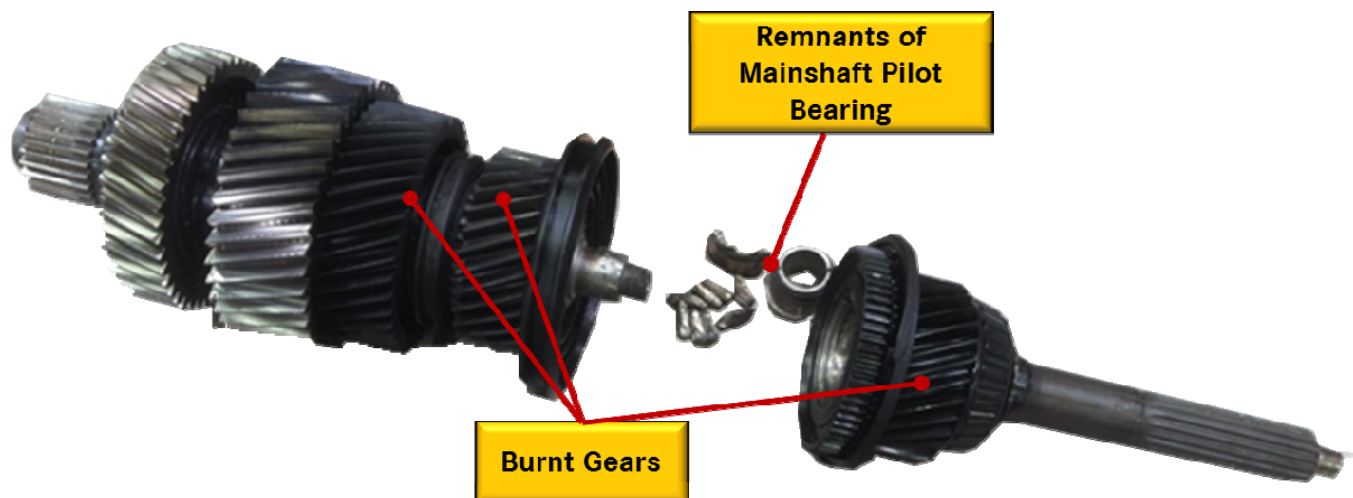
When the TCM is powered down, the transmission will default to neutral. Even though the transmission is in neutral, damage can occur if the vehicle is towed without a means of separating the transmission from the drive wheels.

If you recall the countershaft drives the oil pump. If the driveshaft were left intact, it would drive the output shaft and transmission mainshaft from the rear, but the input shaft would not be rotating. With the gear select forks in the neutral position, no mainshaft gears are locked to the mainshaft. Therefore, no mainshaft gears would be able to drive the countershaft.

Even though the split is engaged, there is no connection between the input shaft and mainshaft to drive the countershaft. Remember the split-shift locks either the input shaft split gear or mainshaft split gear to the input shaft only. Because the countershaft is not rotating, the oil pump will not be providing any lubrication to the mainshaft bearings and mainshaft pilot bearing.



TOWING DAMAGE



When the oil pump is not rotating, no oil is supplied to the input shaft and mainshaft pilot bearing leading to catastrophic failure. Typically, improper towing methods will damage the mainshaft pilot bearing first.

TOWING DAMAGE CONT'D



There should be no input shaft bearing play on a DT12 transmission. Excessive input shaft movement is often times an indication of a damaged mainshaft pilot bearing.

1. What must be done if the vehicle is to be towed from the front with wheels on the ground?

2. What transmission component is most susceptible to damage from improper towing?



DT12™

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DETROIT

Transmissions

DT12™

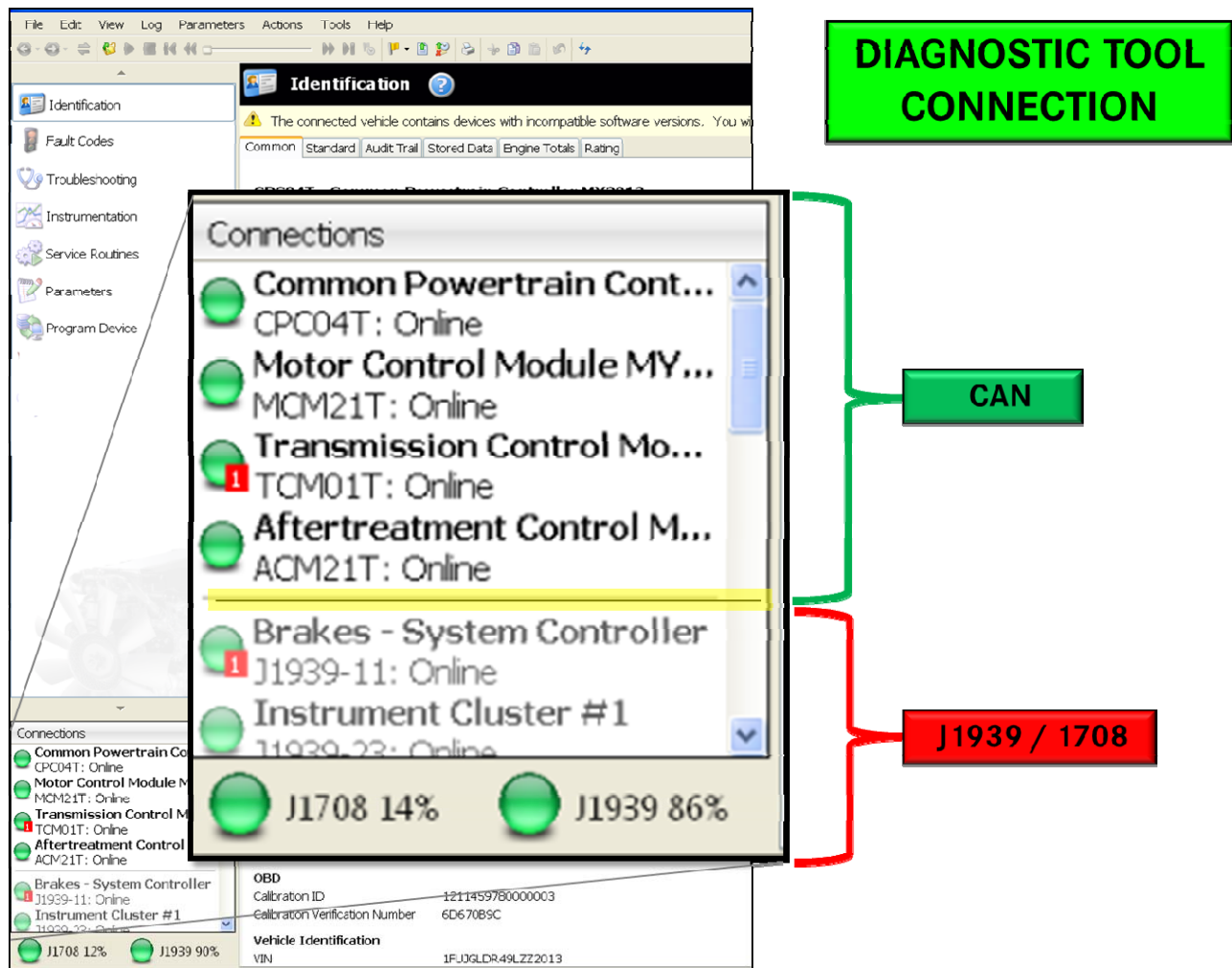
Diagnostic Tool Connection

In this section we will learn:

- How to properly connect the diagnostic tool to the DT12
- How to ensure 1708 / 1939 modules are connected
- Where the DT12 parameters are stored
- The TCM Release Lock feature



POWERTRAIN CAN CONNECTION

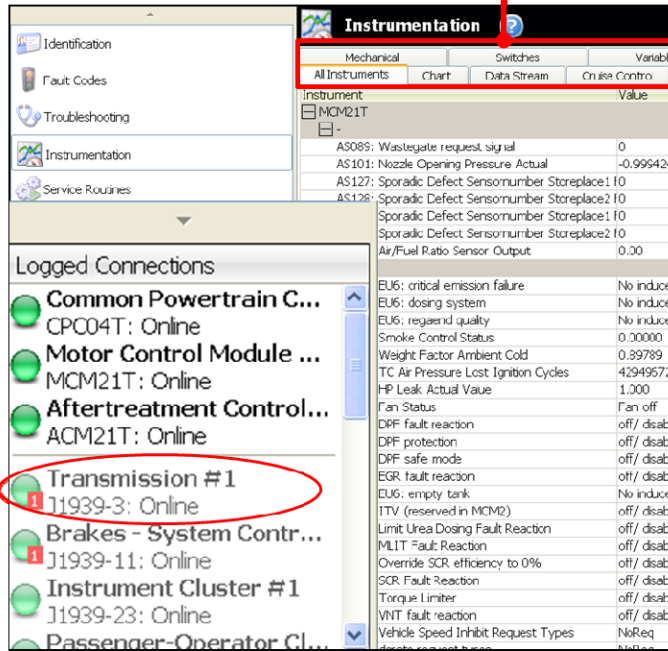


When connected to the powertrain CAN - the CPC, MCM, the TCM, and finally the ACM will be the first four control modules to be displayed in the connection window.

The connection window has a dividing line that separates the powertrain CAN from the 1939 connections.

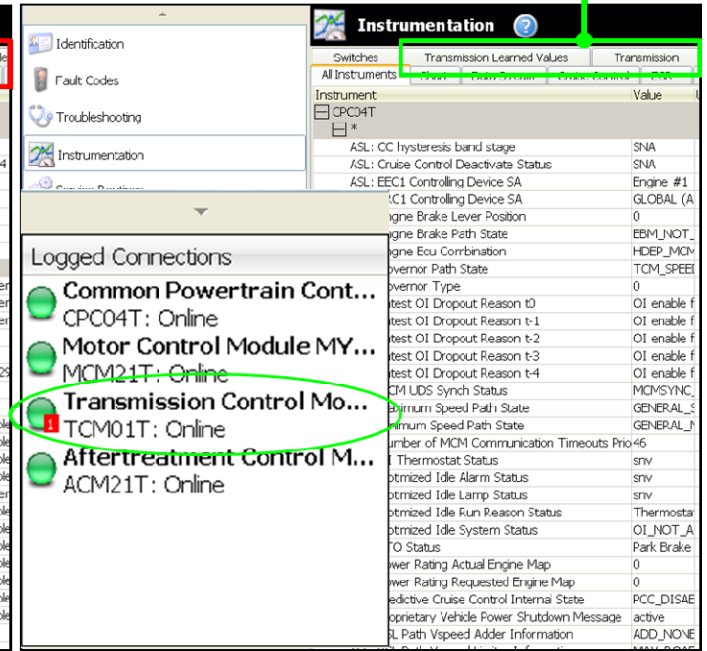
DIAGNOSTIC LINK CONNECTIONS

No Transmission Panels Available



TCM NOT Connected to CAN

Transmission Panels are Available



TCM IS Connected to CAN

When establishing communications with the TCM, the tool **MUST** connect to the TCM via the powertrain CAN to allow proper functionality of DDDL / DDRS service and instrumentation panels.

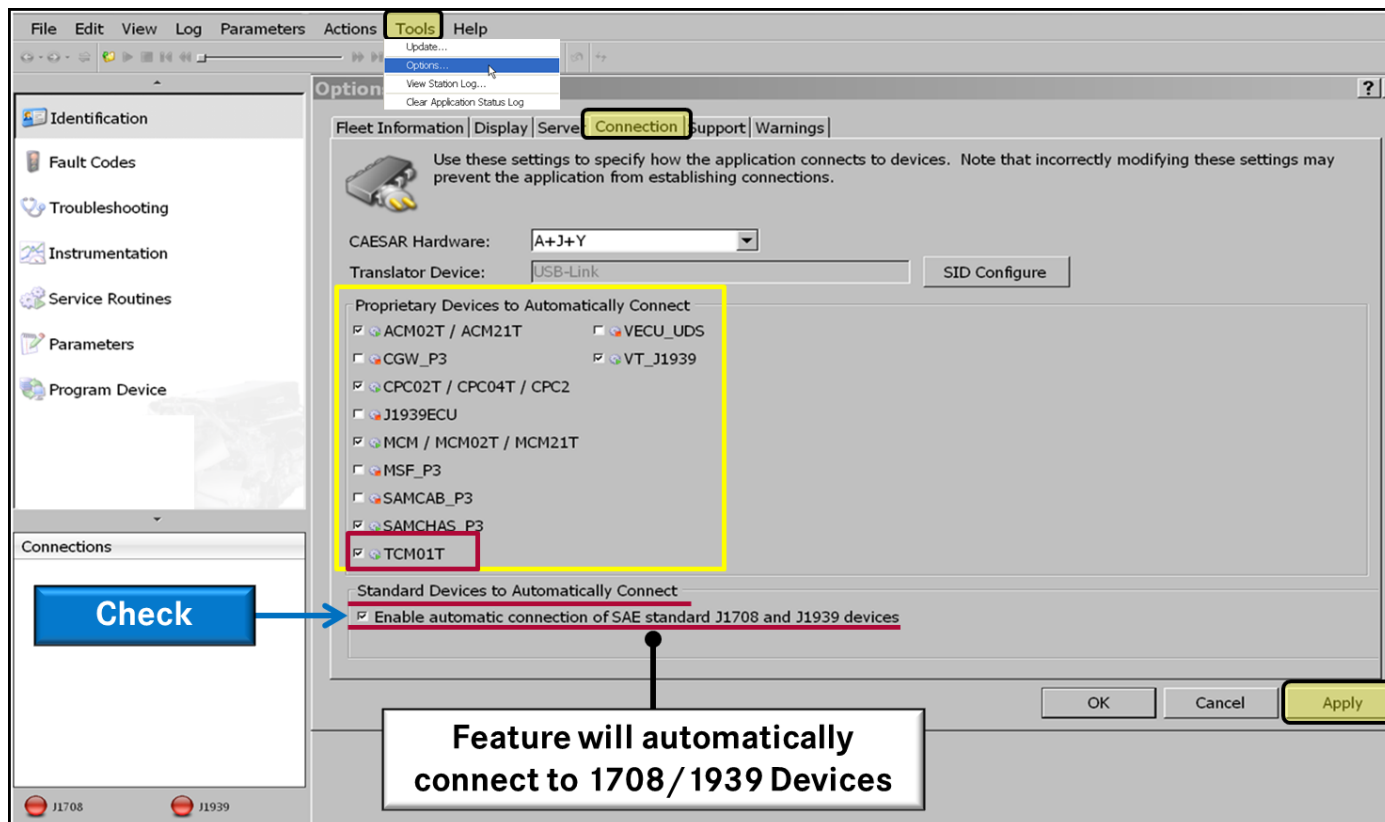
When the connection is made correctly, all four of the control modules will be grouped together. Again, they will be the first four modules displayed in the connection window.

The image on the left shows an improper TCM connection. The TCM is recognized and connected, however this is only occurring via 1939. Again, this will effect the functionality of the tool. The transmission service panels and routines **will not** be displayed with this connection.

The image on the right shows a properly connected TCM via the powertrain CAN. The service panels for the transmission are now available.



ENABLING THE AUTOMATIC CONNECTION



Because ABS related issues can affect transmission performance, it is imperative that “1708/1939 auto connect” box is checked under the Tools/Options/Connections tab. Remember, ABS faults, such as wheel speed sensor issues, can prevent auto-shifting of the transmission. Viewing the 1939 modules and fault codes will help identify root cause much sooner and will save time when sending log files to the call center.

CPC



CPC

Parameters

DETROIT
DEMAND PERFORMANCE

Engine Protection

Fan

Fleet Management I

Green House Gas Emissions

Idle and PTO Shutdown

Inputs and Outputs

Optimized Idle

Progressive Shift

PTC

Speed Limiter

All Parameters

Compare Parameters

Compare Server Data

Fuel Economy

Group Coding Strings

Transfer Accumulators

Cruise Control

Engine Brake Config

Parameter	Value	Units	Minimum	Maximum	Description
CPC04T					
PGR001 Communication					
PGR002 Vehicle Parameters I					
PGR003 Common Limiters					
PGR005 Limiters LIM0 and LIM1					
PGR006 Limiters AC and LIM2					
PGR007 PTO Control on PTO and CC pin					
PGR008 Vehicle Speed Sensor					
PGR009 Analog Outputs					
PGR010 Engine Brake					
PGR011 Accelerator Pedal					
PGR012 Optimized Idle					
PGR013 Inputs					
PGR015 Cruise Control					
PGR017 Idle and PTO Shutdown					
PGR018 Engine Protection Shutdown					
PGR019 Automatic Fan Activation					
PGR020 Remote Accelerator Pedal					
PGR023 Limiters II					
PGR027 Fleet Management					
PGR031 Vehicle Parameters III					
PGR032 Coolant Level Sensor					
PGR035 Digital Outputs					
PGR037 Fault Management					
PGR039 Vehicle Mass					
PGR042 Top2					
PGR043 Acc					
PGR046 Diesel Particulate Filter					
PGR047 Aq					
PGR048 Ptconf					
PGR054 Predictive Cruise Control					
PGR055 Transmission Retarder					

All of the DT12 parameters are found in the CPC.

TRANSMISSION SHIFT MAP



CPC

Identification ?

DETROIT
DEMAND PERFORMANCE

Common | Standard | Audit Trail | Stored Data | Rating | Engine Totals

CPC04T - Common Powertrain Controller MY2013 App_0408

Device Configuration

Software ModeRunning in Application

Device Information

Software VersionR32_00_000A

Diagnostic Version8

Shift Map Part NumberA017 448 77 02 ZGS 001

ECU Serial Number13:5202:00564

Hardware Part NumberA003 446 10 02 ZGS 002

Software Part NumberA017 448 64 02 ZGS 001

Software Date7/29/2013 8:27:00 AM Eastern Standard Time

Real Time Clock1/29/2014 3:44:32 PM Eastern Standard Time

OBD

Calibration ID0W00R0000DT12001

Calibration Verification NumberC297E421

Vehicle Identification

VIN3AKJGED50ESFY5428

Engine Serial Number472906S0219513

Odometer10463.3 miles

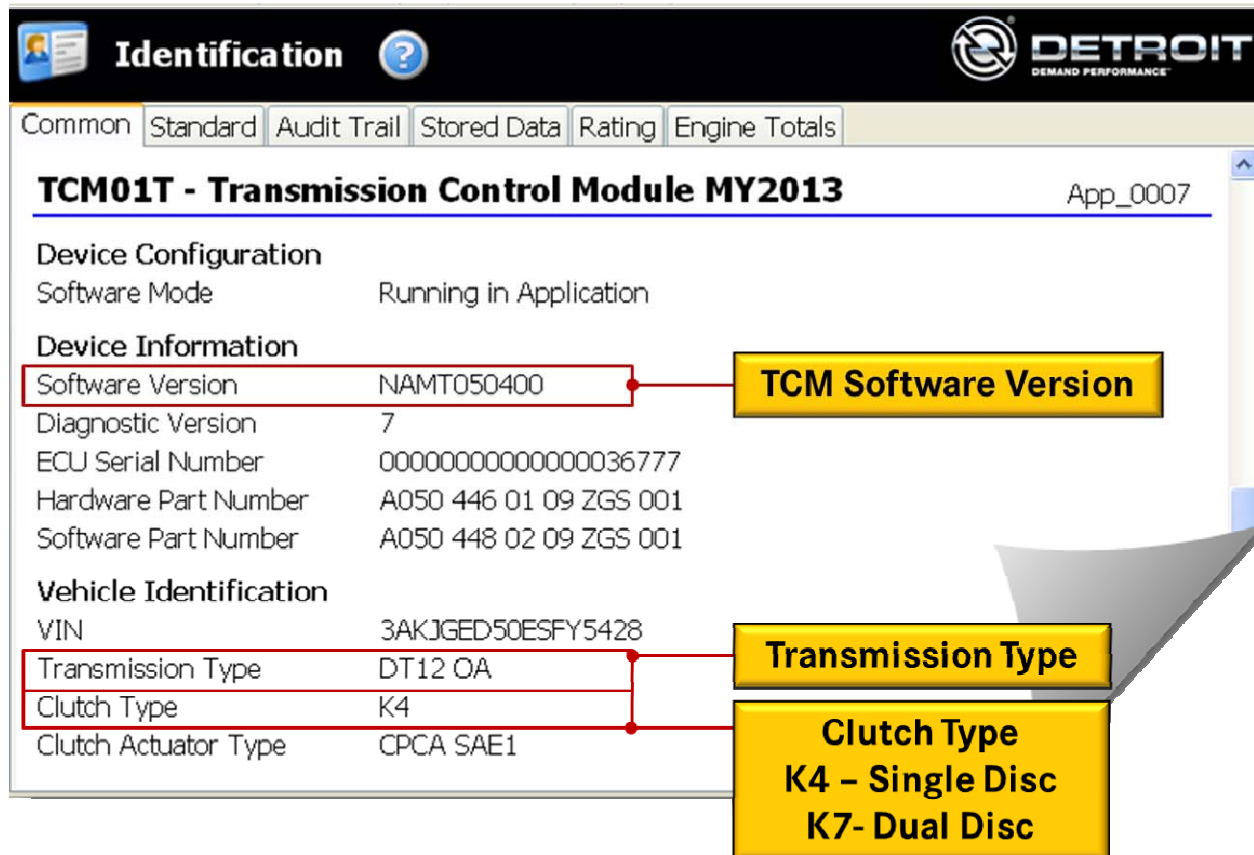
Transmission Shift Map
Resides in CPC

The transmission shift map also resides in the CPC.

TCM SOFTWARE & TRANSMISSION TYPE



TCM



The screenshot shows the 'Identification' tab of the Detroit DT12 diagnostic tool. The main title is 'TCM01T - Transmission Control Module MY2013' with a sub-label 'App_0007'. The interface is divided into sections: 'Device Configuration', 'Device Information', and 'Vehicle Identification'. In the 'Device Information' section, 'Software Version' is highlighted with a red box and labeled 'TCM Software Version'. In the 'Vehicle Identification' section, 'Transmission Type' and 'Clutch Type' are highlighted with red boxes and labeled 'Transmission Type' and 'Clutch Type' respectively. A yellow callout box points to the 'Clutch Type' label, indicating 'K4 - Single Disc' and 'K7- Dual Disc'.

TCM01T - Transmission Control Module MY2013	
App_0007	
Device Configuration	
Software Mode	Running in Application
Device Information	
Software Version	NAMT050400
Diagnostic Version	7
ECU Serial Number	0000000000000036777
Hardware Part Number	A050 446 01 09 ZGS 001
Software Part Number	A050 448 02 09 ZGS 001
Vehicle Identification	
VIN	3AKJGED50ESFY5428
Transmission Type	DT12 OA
Clutch Type	K4
Clutch Actuator Type	CPCA SAE1

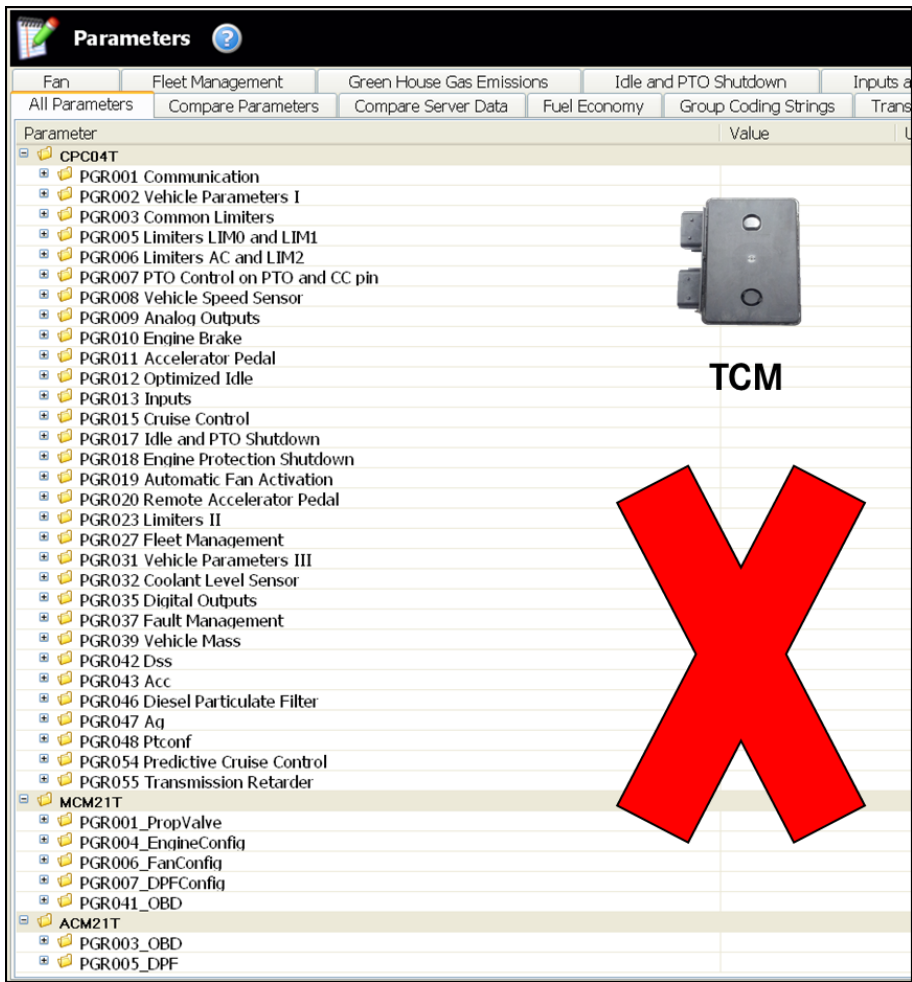
TCM Software Version

Transmission Type

Clutch Type
K4 - Single Disc
K7- Dual Disc

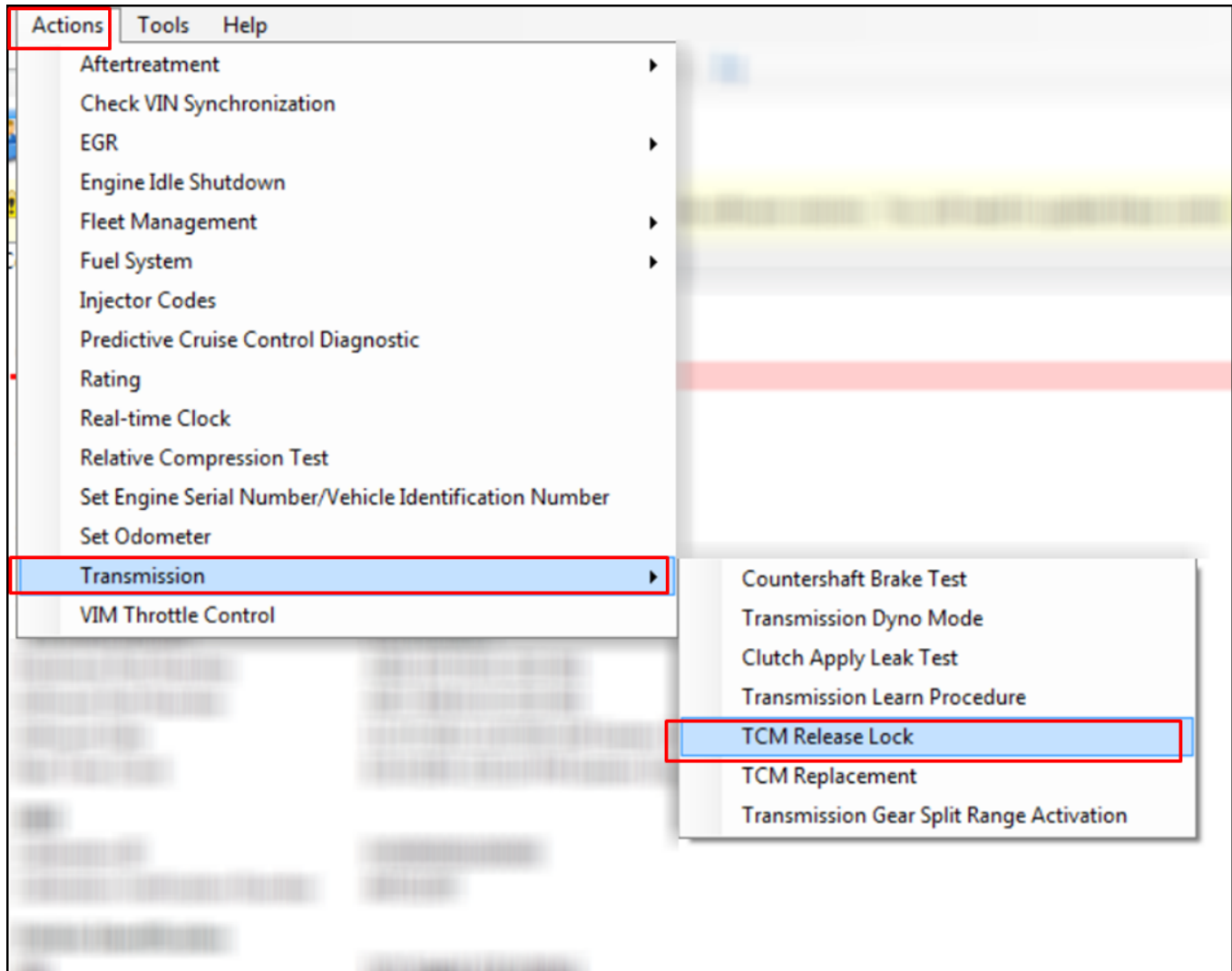
The TCM software version and transmission type reside in the TCM.

TCM PARAMETERS



It is important to note that there are NO adjustable parameters within the TCM. In fact, there is not an option to view TCM parameters.

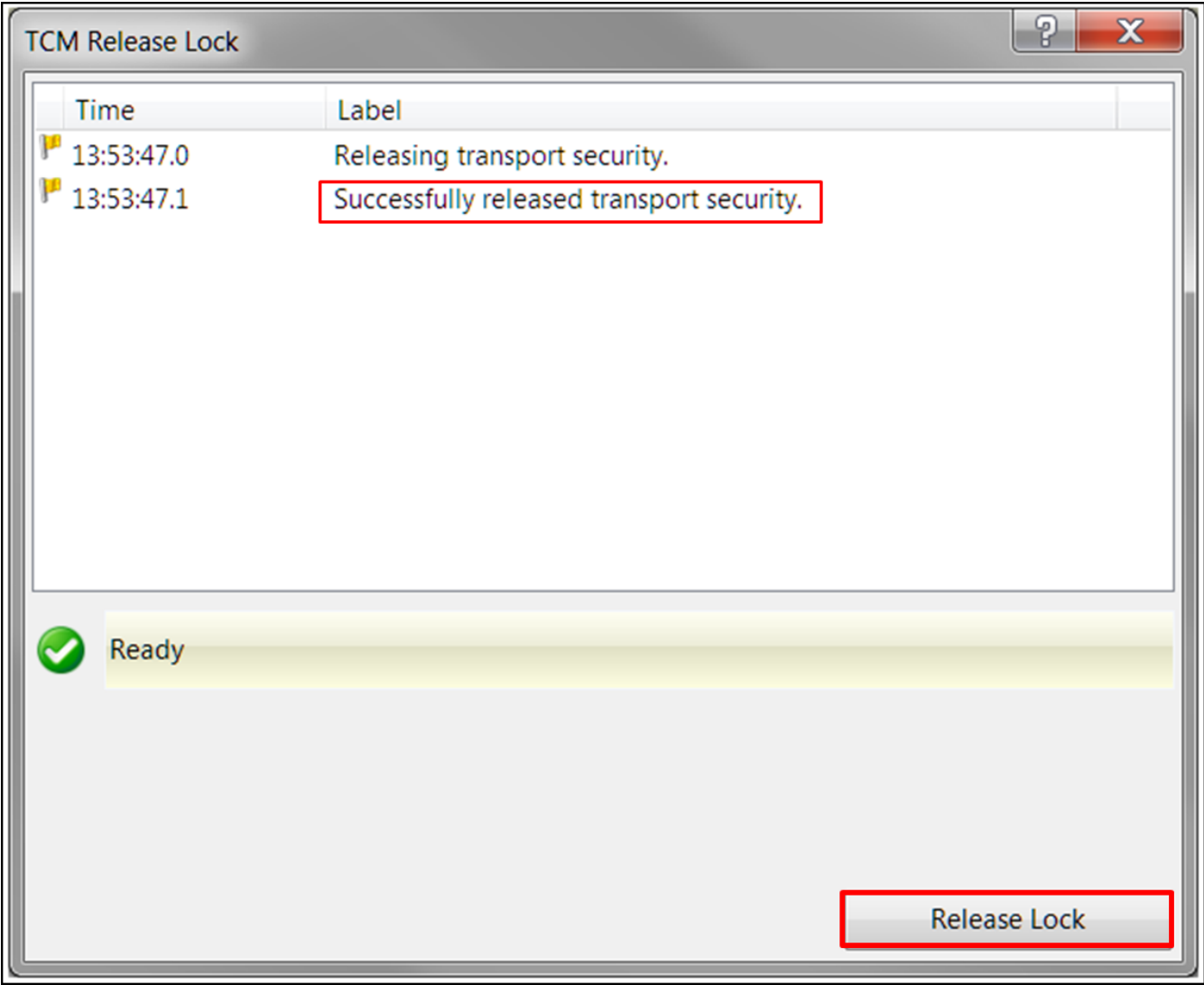
TCM RELEASE LOCK MENU LOCATION



The TCM Release Lock is a new routine that has been added. Previously, anytime a transmission was replaced, a “TCM Replacement” routine was required in order to “unlock” the TCM transport security. In doing so, a full transmission learn procedure was also required. Replacement transmissions already come with the gears learned. All that is required is a “clutch learn”.

The TCM unlock routine saves time in that it unlocks the transport security, and only requires a clutch learn. Shown above is the navigation to the Release Lock feature.

TCM RELEASE LOCK PROCEDURE



Simply click on the “Release Lock” tab to initiate. Once complete, a message will appear indicating a successful release of transport security.

TCM RELEASE LOCK VALUES

Transmission Learn Procedure

Time	Label

Engine Speedrpm
Air Supply pressurepsi

0116.0

Status clutch calibration

no learned values available

Transmission learn status

learned values available

Request Results Fault of learning procedure

1.2.

TCM Learn: Procedure can start

Learn Clutch only

Start

Upon completion of the procedure, clutch learn is all that is required. As you can see above, replacement transmissions already have the gears learned.

Select "Learn Clutch Only" and begin.

TCM RELEASE LOCK VALUES CONT'D

Transmission Learn Procedure

Time	Label
07.31.2014 10:04:26.785	Starting TCM learn - limit stop values of clutch...
07.31.2014 10:04:26.934	Started TCM Learn
07.31.2014 10:04:28.109	Learn procedure continuing.
07.31.2014 10:04:45.493	Checking for faults
07.31.2014 10:04:45.512	Transmission was successfully learned.
07.31.2014 10:04:46.465	Stopping test...

Engine Speedrpm

Air Supply pressurepsi

0

110.2

Status clutch calibration

learned values available

Transmission learn status

learned values available

Request Results Fault of learning procedure

- No fault

TCM Learn: Please turn ignition off, and wait...

Learn Clutch only

Start

Upon completion of the clutch lean, there should be learned values available for both the clutch and the gears, as well as a “No Fault” status registered.

LEARNING ROUTINE MATRIX

	TCM Replacement	Transmission AND Clutch Learn	Clutch Learn ONLY	Tilt Level Learn	VIN Synchronization	TCM Release Lock
Initial Transmission Installation	✗	✗	✓	✓	✓	✓
TCM Replacement	✓	✓	✗	✓	✓	✗
Reprogramming (No DTC's Set)	✗	✗	✓	✓	✗	✗
Reprogramming (DTC's Set)	✓	✓	✗	✓	✓	✗
CPC4 Replacement	✗	✗	✓	✗	✗	✗
CPCA / Clutch Replacement	✓	✓	✗	✓	✗	✗
Engine Removal	✗	✗	✓	✓	✗	✗
Sensor / Actuator Replacement	✗	✓	✗	✗	✗	✗
Transmission Removed and Reinstalled	✗	✗	✓	✓	✗	✗
Chassis Modifications or Repairs and Ride Height Adjustments	✗	✗	✗	✓	✗	✗

Take a moment to review the chart to identify when the various service routines should be performed.

Take note that a TCM replacement routine is no longer required when replacing the transmission. Only a TCM release lock routine is required.



1. What module does the transmission shift map reside in?

Circle the correct answer:

2. A _____ learn procedure must be performed after the TCM unlock feature has been completed.

Clutch

Clutch and Transmission



DETROIT

Transmissions

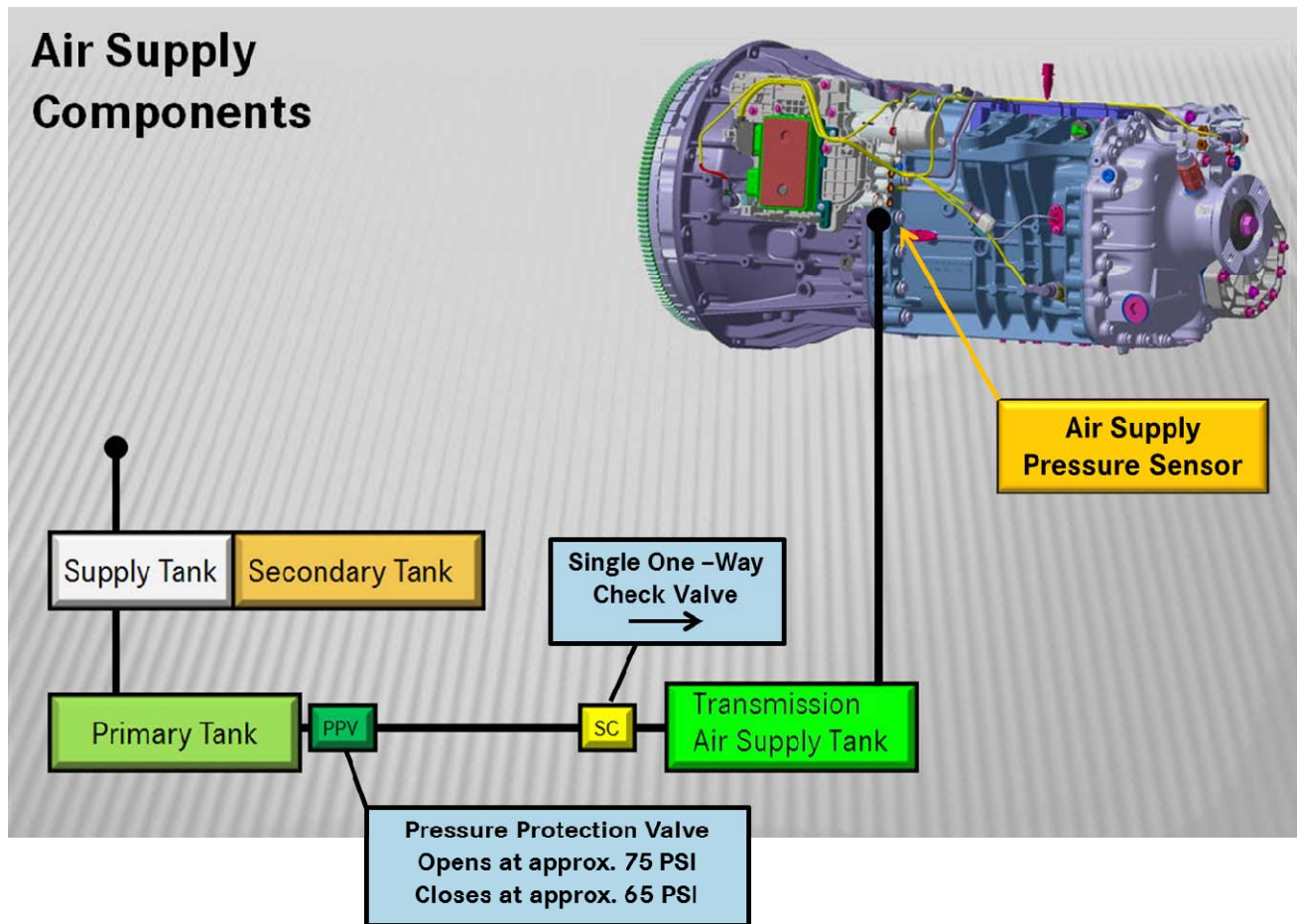
DT12TM

DT12 Air System

In this section we will learn:

- The components associated with the DT12 air system
- FMVSS 121 S5.1.2.1 and 1.2.3 criteria
- Leak locations and the corresponding pressure readings
- DT12 air requirements
- Closed clutch start logic

AIR SUPPLY COMPONENTS



Transmission Air Supply Tank: The transmission air supply tank is a separate, dedicated air tank for the DT12.

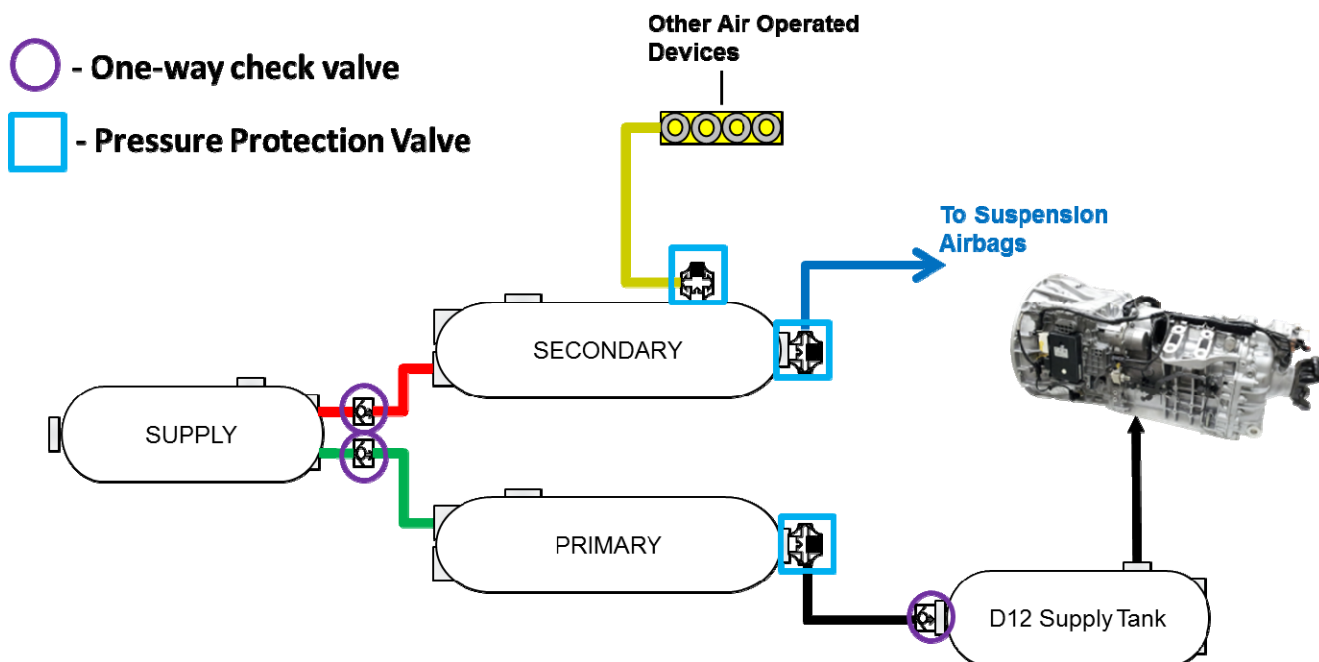
The tank's main purpose is to provide some buffer in the event of a leak or failure of the chassis air system so that the transmission can still perform a limited number of shifts or a neutral shift. The minimum required volume is 10 Liters or 610 cubic inches.

NOTE: The transmission air tank is to be used **solely** for the supply of air to the transmission.

Air Supply Pressure Sensor: The air supply pressure sensor monitors transmission air supply pressure and provides feedback to the TCM. A "**low transmission air warning indicator**" will illuminate on the ICU4Me at pressures below approx. 94 psi.

A minimum of 95 psi is required to perform various diagnostic procedures and pressures below 94 psi can negatively affect transmission performance.

AIR SUPPLY COMPONENTS CONT'D



*** FMVSS 121 S5.1.2.3 requires that each service reservoir system be protected against loss of air pressure due to failure or leakage in the system between the service reservoirs and the source of air pressure by a check valve or equivalent device.**

The primary air tank utilizes a 65 psi Pressure Protection Valve (PPV) to supply the DT12 air tank.

Secondary Tank: The secondary air tank provides pressurized air to the steering axle brakes, trailer brakes, air suspension, and other air powered accessories.

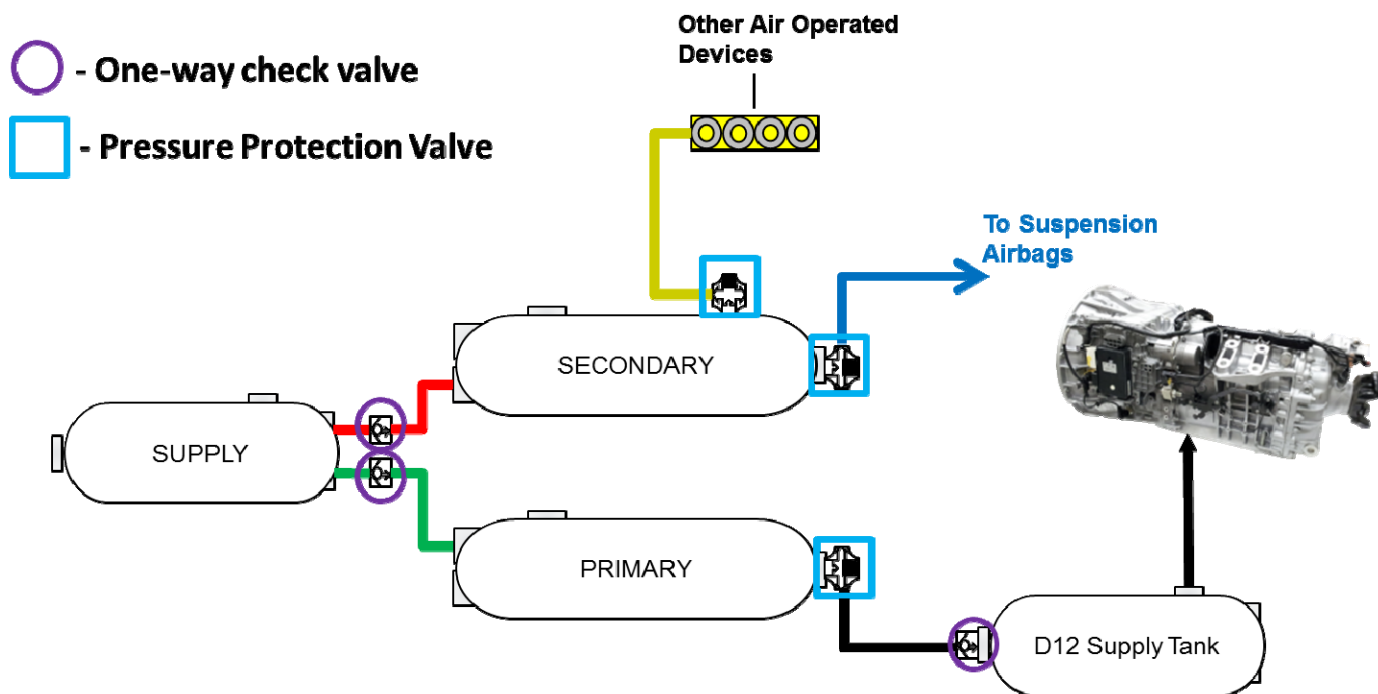
Primary Tank: The primary tank provides pressurized air to the drive axle brakes, trailer brakes, and in this case will also supply pressurized air to the DT12.

Pressure Protection Valve: If a leak develops downstream in the transmission, then the Pressure Protection Valve (PPV) will close to preserve and protect the primary tank air pressure for brake system integrity. The valve opens at approximately 75 psi, and closes at approximately 65 psi.

Single One-Way Check Valve: The single check valve allows air to flow from the primary tank to the transmission tank, *only*. In the event of a leak in the primary system, the valve will immediately close to preserve air pressure in the transmission air supply tank.



AIR SUPPLY COMPONENTS CONT'D



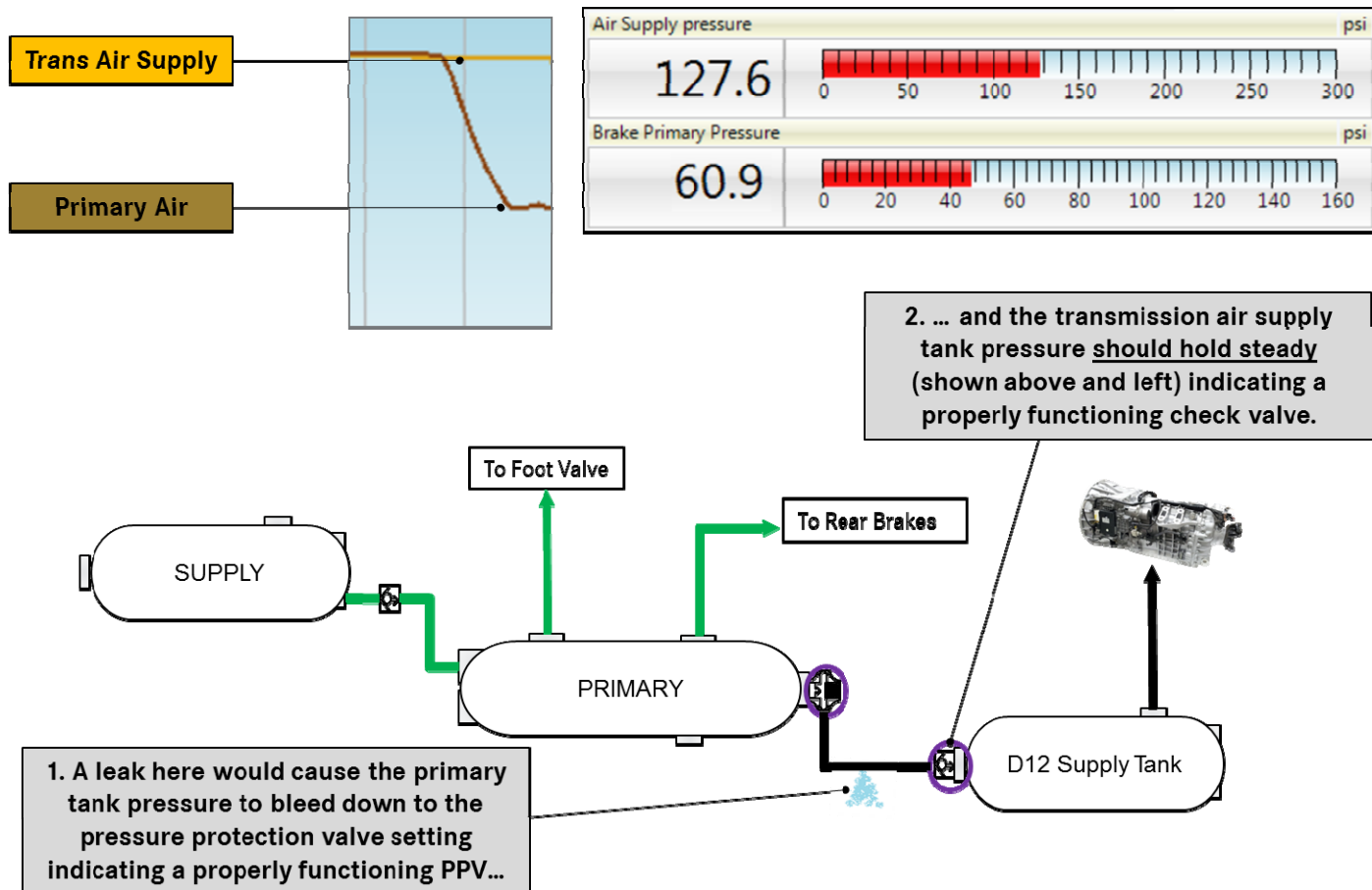
*** FMVSS 121 S5.1.2.1 states that the combined volume of all service reservoirs and supply reservoirs shall be at least 12 times the combined volume of all service brake chambers.**

That criteria is still met with the primary reservoir supplying the DT12 supply tank.

It is worth noting that even though the primary reservoir is supplying the DT12 supply tank, the volume criteria specified in FMVSS 121 S5.1.2.1 is still being met.



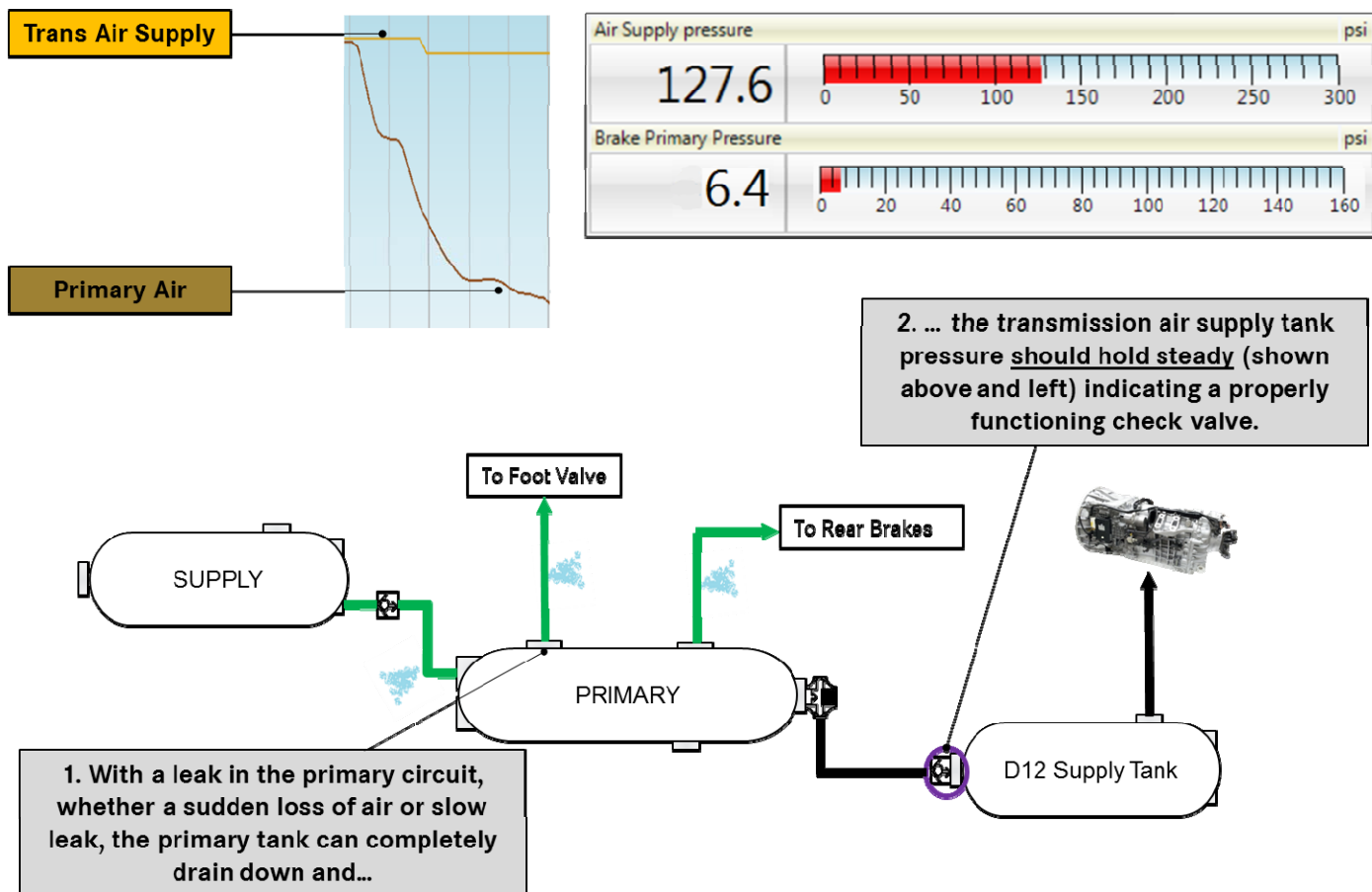
DT12 SUPPLY TANK LINE LEAK



Shown above is an example of what will occur in the event of a leak between the primary reservoir and the DT12 supply tank with the air system fully charged. Primary circuit pressure **should** drop to pressure protection valve pressure (approximately 60 –65 psi), and the transmission tank pressure should hold steady indicating a properly functioning check valve.

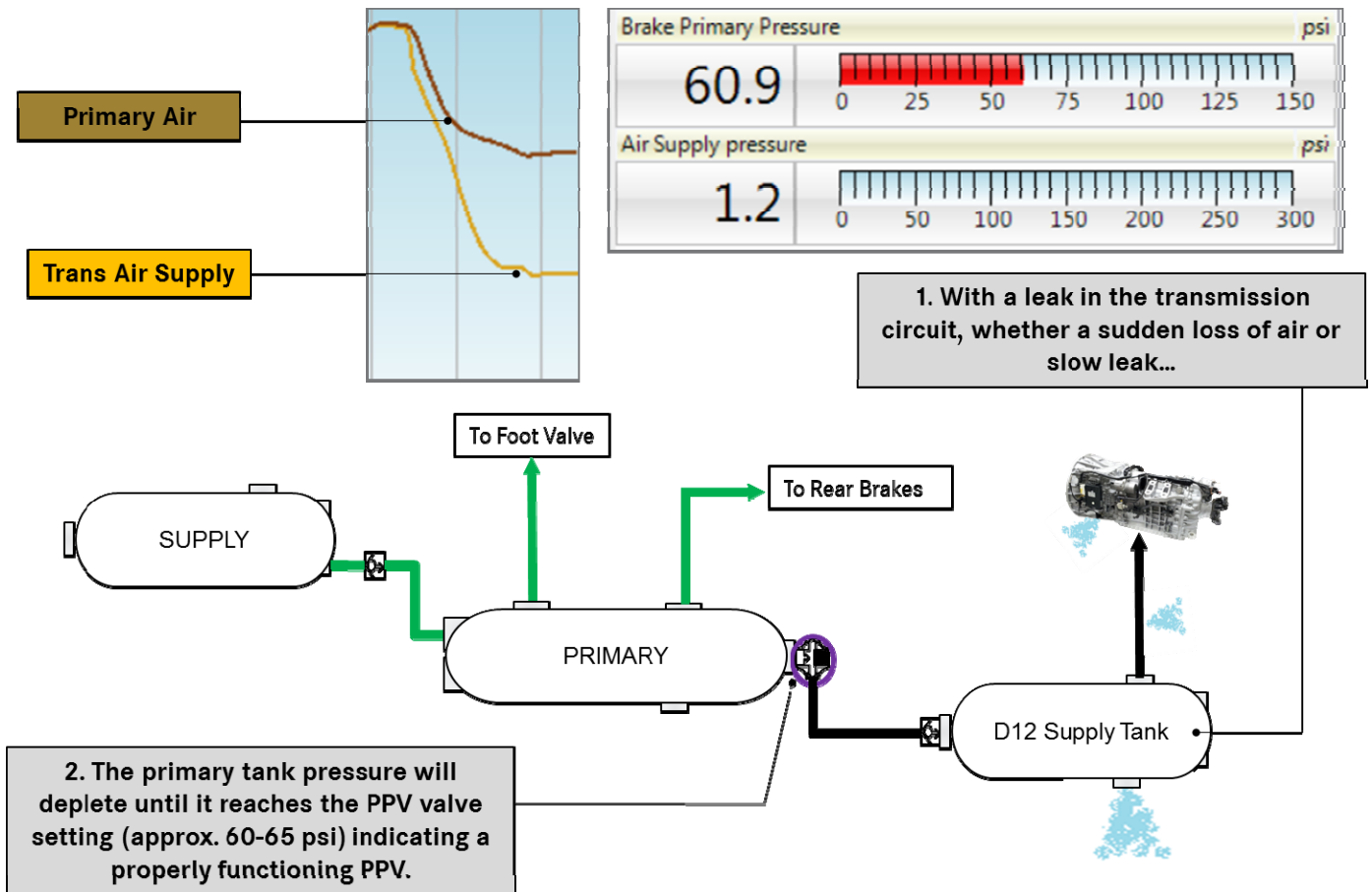


PRIMARY CIRCUIT LEAK



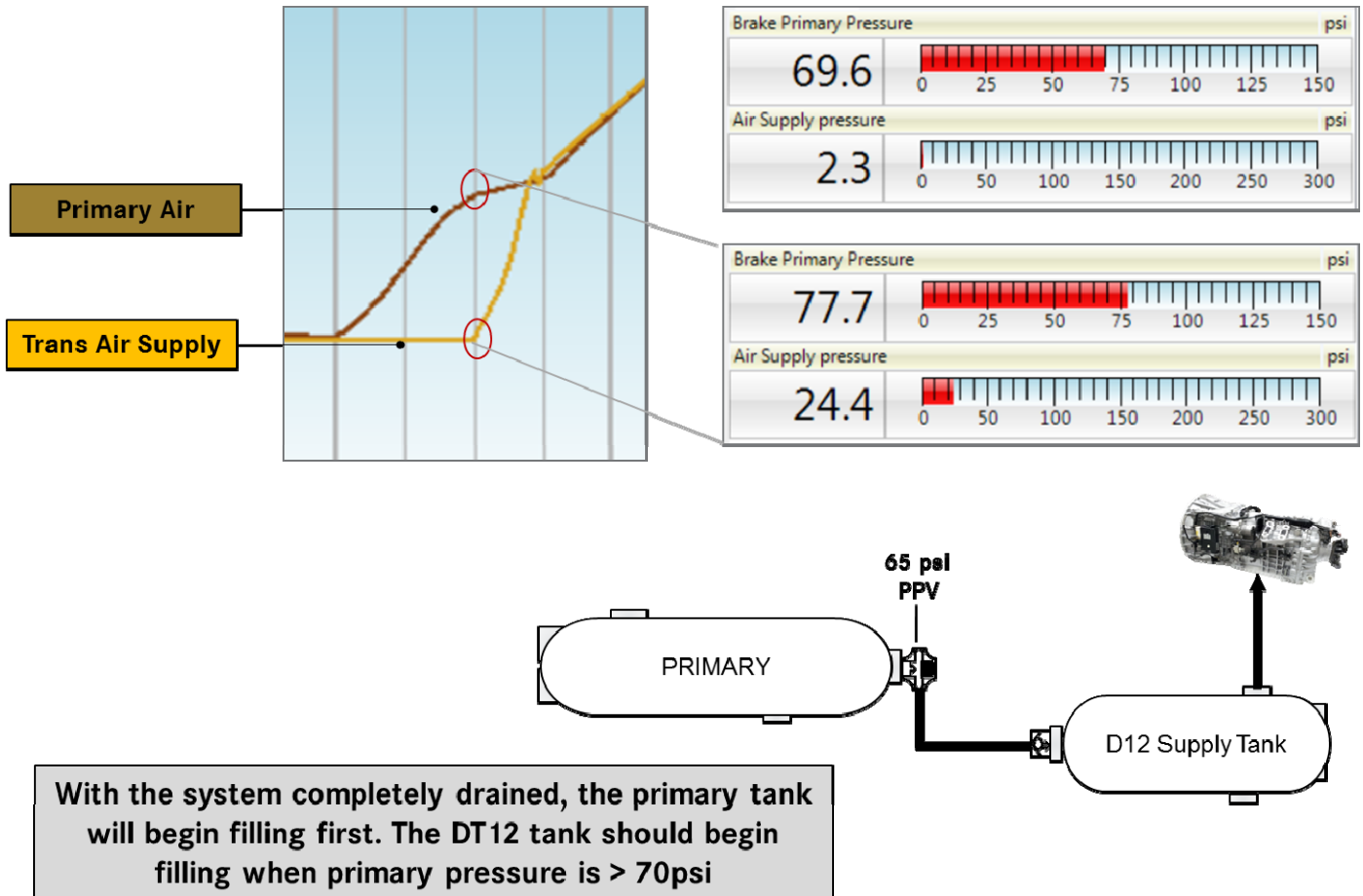
Shown above is an example of what will occur in the event of a leak on the primary circuit with the system fully charged. Primary pressure can leak completely down, while the transmission tank pressure should hold steady indicating a properly functioning check valve.

TRANSMISSION AIR CIRCUIT LEAK



Shown above is an example of what will occur in the event of a leak on the transmission circuit with the system fully charged. The primary reservoir will drain to PPV closing pressure indicating a properly functioning PPV, and the transmission tank will bleed down completely.

SYSTEM FILLING

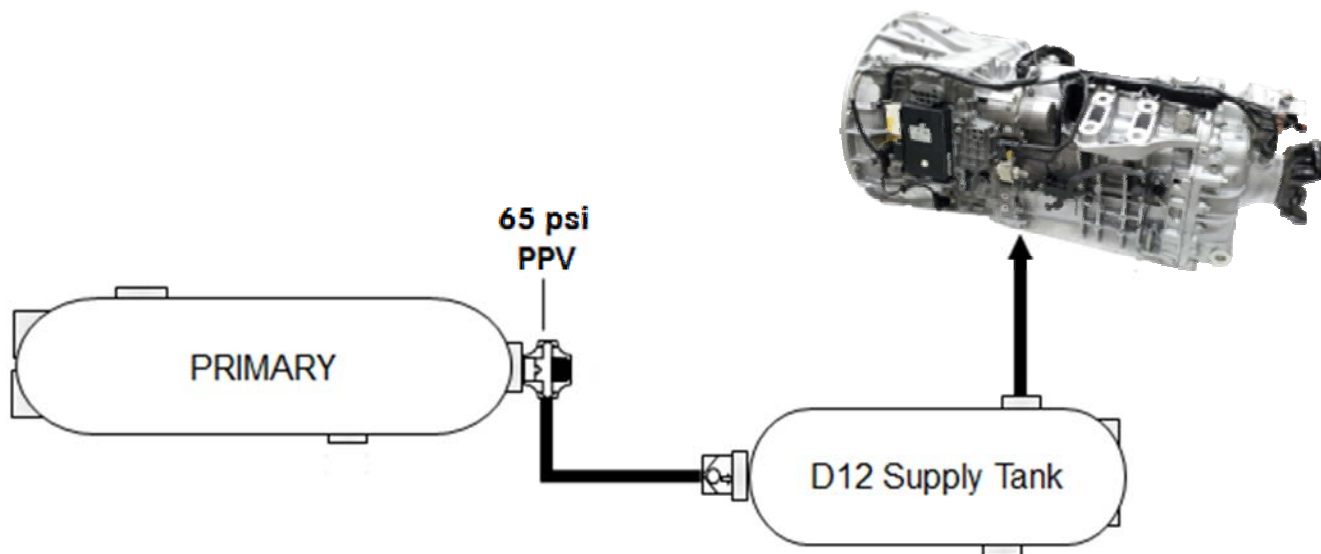


With the system completely drained, the primary tank will begin filling first. The DT12 tank should begin filling when primary pressure reaches PPV opening pressure — approximately 70 –75 psi.



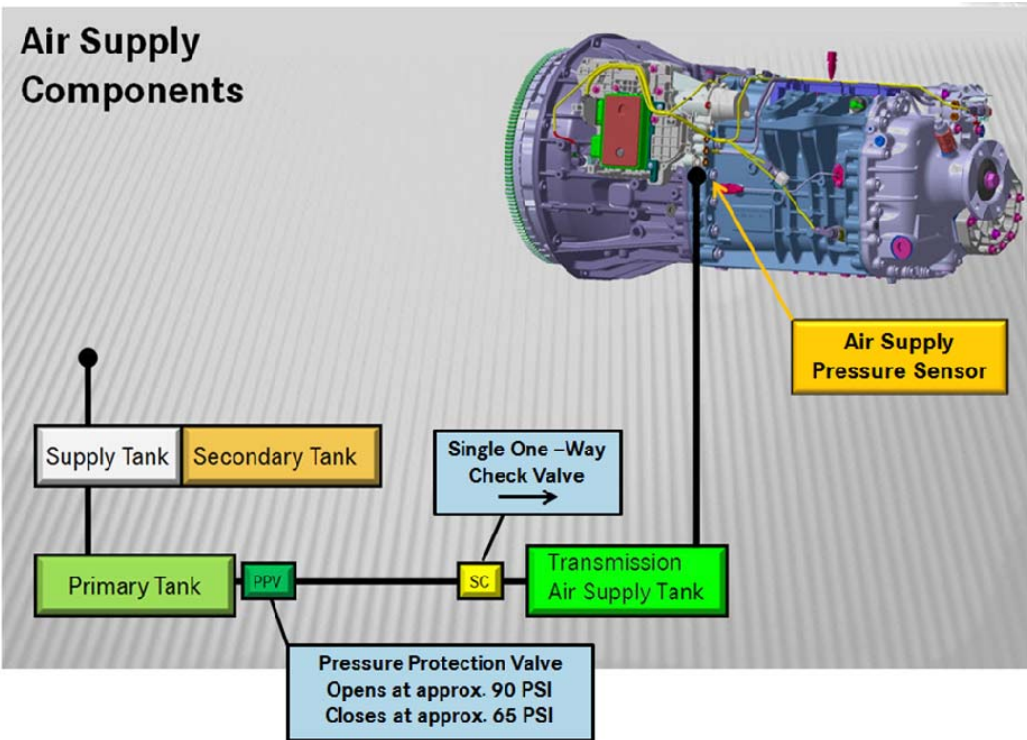
TOP DT12 AIR CONSUMERS

Component Air Consumption	
Most	Clutch
	Gear
	Rail
	Split
	Range
Least	Countershaft Brake



Shown above are the top air consumers of the DT12. Again, even with the primary reservoir supplying the DT12 supply tank, the vehicle still meets the criteria set forth in FMVSS 121 S5.1.2.1.

DT12 AIR PRESSURE REQUIREMENTS



- Nominal pressure for the DT12 is 124 psi.
- Minimum pressure for full function of the DT12 is 94 psi.
- Between 65 and 94 psi there may be a noticeable difference in the comfort of shifts.
- Between 0 and 65 psi there are restrictions in shifting functionality including up to complete break down.

Shown above are the air pressure requirements for proper functionality of the DT12 transmission. Keep in mind, the engine will start with 0 psi of transmission air pressure, however shifting will be inhibited until proper air pressure is obtained.

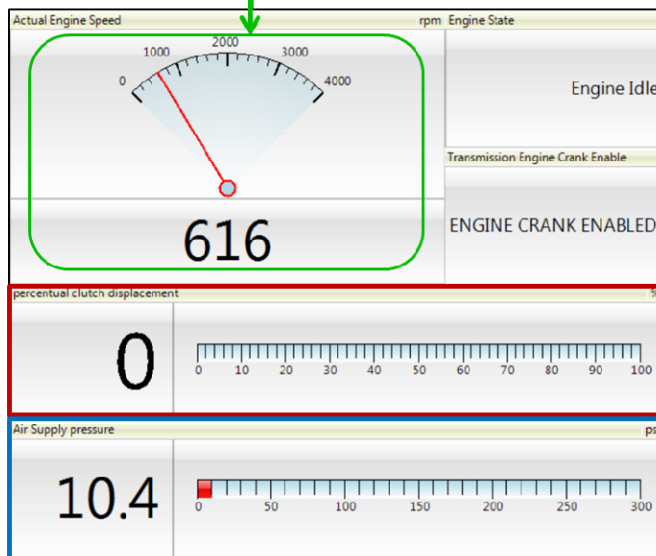
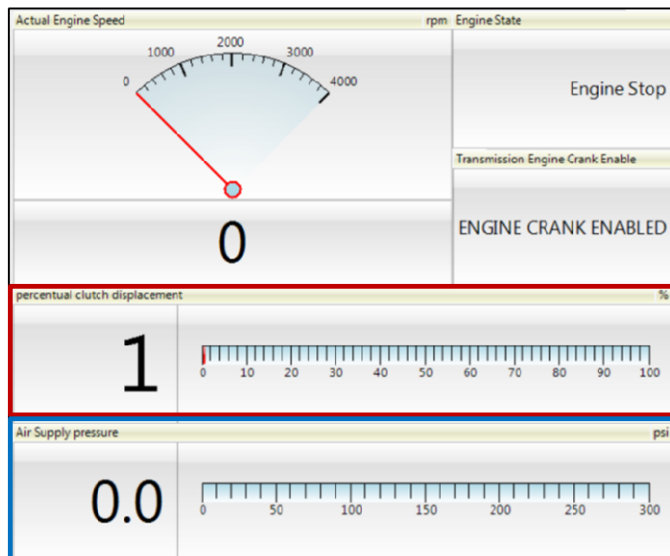
The engine will start with 0 psi transmission air pressure because the DT12 uses “closed clutch” start logic — meaning, the clutch is always closed , or engaged, while starting the engine.

The only time the clutch is opened for starting is extremely cold temperatures (approx. -5°C / 23°F) to reduce parasitic drag for the batteries. The temperature is based off of an internal TCM temperature sensor as well as transmission oil temperature.



ADDITIONAL CLUTCH INFORMATION

Engine started with clutch closed and zero transmission air pressure



Status clutch calibration
learned values available
Transmission learn status
learned values available

The “closed clutch” start logic mentioned earlier, allows the engine to start with very little, or no transmission air pressure, **PROVIDED** there **are** learned values available for both the clutch and transmission **and** the gear position can be read in **NEUTRAL**.



1. At approximately what pressure does the transmission low air warning indicator come on?

2. Can the vehicle start with 0 psi of transmission pressure? If so, why?



DETROIT

Transmissions

DT12™

Diagnostics

In this section we will learn:

- ABS fault reaction to the DT12
- Clutch travel faults
- Log file analysis

ABS DIAGNOSTICS

CPC04T - Common Powertrain Controller MY2013				
Automatic gear selection: Gear shift not plausible 524286 4 active				
Description	Number	Mode	Status	Troubleshooting ...
CPC04T - Common Powertrain Controller MY2013				
J1939 HRW (High Resolution Wheel Speed) W...	1592	19	active	Traditional
VDC1 Message was not received or has stopp...	1814	9	not active	Traditional
J1939 HRW Message (High Resolution Wheel ...	1592	9	not active	Traditional
Coolant Level Very Low	111	1	not active	Traditional
J1939 EBC1 Message is missing	973	9	not active	Traditional
ABS fault restricts automatic gear selection fu...	1243	14	not active	Traditional
J1939 Message is missing from source addres...	2011	9	not active	Refer to PSL
Automatic gear selection: Gear shift not plaus...	524286	4	not active	Traditional
ITPM error: drivetrain speed signal is inconsis...	524286	7	not active	Refer to PSL

- ABS concerns, such as wheel speed sensor faults, can cause shifting issues and prevent certain transmission features (hill start aid, automatic gear shifting, creep mode, etc...) from functioning properly

Bottom line: **DO NOT OVERLOOK OR IGNORE ABS SYSTEM FAULTS!**



It is imperative that ABS faults, such as wheel speed sensor faults, are not ignored when diagnosing transmission performance or functionality. A wheel speed sensor fault can disable automatic shifting of the transmission.

It is important to remember that if automatic shifting is restricted due to a fault, the driver can **still manually shift** the transmission even if Manual Mode is disabled in the parameter settings.

CLUTCH TRAVEL SENSOR FAILURE - #1

Description	Number	Mode	Status	Troubleshooting ...
CPC04T - Common Powertrain Controller MY2013				
Automatic gear selection: automatic mode is ...	524286	1	active	Traditional
TCM01T - Transmission Control Module MY2013				
Clutch Actual Position Unknown	520971	7	active	Refer to PSL
Clutch Position Sensor - Data Erratic	521486	2	active	Refer to PSL
Clutch Position Sensor Signal - Invalid	521491	2	active	Refer to PSL
Clutch - Unable to Open Fully	520970	7	not active	Traditional



Check Trans

All Instruments	Chart	Data Stream	Cruise Control	EGR
Engine Brake	FIS Fuel Quantity	Mechanical	Switches	
Transmission Learned Values	Transmission	Variable Speed Water Pump	User	
Splitter group sensor learned minimum value	mm	Actual position value clutch	mm	
16.800		s.n.a.		
Splitter group sensor learned maximum value	mm	Learned value clutch minimum	mm	
22.720		11.410		
Range group sensor learned minimum value	mm	Clutch limit stop maximum value	mm	
15.710		27.910		
Range group sensor learned maximum value	mm	Status clutch calibration		
44.560		learned values available		
Gear actuator sensor learned minimum value...	mm	Actual position value splitter	mm	
17.660		16		
Gear actuator sensor learned maximum value...	mm	Actual position value rail	mm	
49.190		24		
Gear actuator sensor learned neutral position...	mm	Actual position value range	mm	
33.890		15		
Transmission learn status				
learned values available				

It is also important that a clutch learn, or gear learn procedure is performed **ONLY** when instructed to do so. The learn procedures are not intended to be a “cure-all” when diagnosing transmission performance issues or fault codes.

The initial complaint above was that the transmission shifted into neutral and would not go back into gear. The truck **would** start and learned values were available.

After noticing S.N.A for actual clutch position, a clutch learn procedure was performed. The learn procedure failed and learned values became “unavailable”.

At this point, **with the learned values lost**, the truck would no longer start.

Damaged clutch travel sensor was root cause.

CLUTCH TRAVEL SENSOR FAILURE - #2



Check Trans

Description	Number	Mode	Status	Troubleshooting ...
 CPC04T - Common Powertrain Controller MY2013				
 Automatic gear selection: automatic mode is ...	524286	1	active	Traditional
 TCM01T - Transmission Control Module MY2013				
 Clutch - Unable to Open Fully	520970	7	active	Traditional
 Clutch Position Error - Position Not Plausible	521497	0	active	Refer to PSL
 TCM Learn - Clutch Error	520979	14	not active	Traditional

Damaged Clutch Travel Sensor

Actual position value clutch	mm
9.890	
Learned value clutch minimum	mm
10.420	
Clutch limit stop maximum value	mm
26.920	

Here is another instance when the transmission shifted into neutral and would not go back into gear. Now, notice there is a value for the actual clutch position but the TCM recognizes this position is erroneous.

A clutch learn was performed and just like the previous scenario, the learn procedure failed. Once the learn procedure is initiated, the previous learned values are erased. Without learned values, the engine will not start.

Damaged clutch travel sensor again was the root cause.

DAMAGED SENSOR VS GOOD SENSOR



Check Trans

Description	Number	Mode	Status	Troubleshooting ...
CPC04T - Common Powertrain Controller MY2013				
Automatic gear selection: automatic mode is ...	524286	1	active	Traditional
TCM01T - Transmission Control Module MY2013				
Clutch - Unable to Open Fully	520970	7	active	Traditional
Clutch Position Error - Position Not Plausible	521497	0	active	Refer to PSL
TCM Learn - Clutch Error	520979	14	not active	Traditional

Damaged Clutch Travel Sensor

Actual position value clutch	mm
s.n.a.	
↕ or ↕	
Actual position value clutch	mm
9.890	
Learned value clutch minimum	mm
10.420	
Clutch limit stop maximum value	mm
26.920	

Normal Clutch Travel Sensor

Actual position value clutch	mm
28.630	
Learned value clutch minimum	mm
29.240	
Clutch limit stop maximum value	mm
45.740	

Here is a comparison of clutch values with a damaged sensor, and a known – good sensor.

CLUTCH LEARNED VALUES

ONLY IDLE ALLOWED

Even though the actual clutch position may be erroneous...

Actual position value clutch	mm
9.890	
Learned value clutch minimum	mm
10.420	
Clutch limit stop maximum value	mm
26.920	

...or even unavailable

Actual position value clutch	mm
s.n.a.	
Learned value clutch minimum	mm
11.410	
Clutch limit stop maximum value	mm
27.910	

Gear actuator sensor learned neutral position value	mm
33.240	

The vehicle **WILL** start because there are available “learned values” for the clutch and the “gear neutral” position is known. However, the vehicle will only idle and will not be allowed into gear.

Even though clutch values are erroneous or unavailable, the vehicle will start provided there are learned values for the gears. In this situation the truck will start, however the engine will only idle with a loss of gear functionality.

CLUTCH LEARNED VALUES

CLUTCH CLOSED START LOGIC

Actual position value clutch	mm
9.890	
Learned value clutch minimum	mm
10.420	
Clutch limit stop maximum value	mm
26.920	

Actual position value clutch	mm
s.n.a.	
Learned value clutch minimum	mm
11.410	
Clutch limit stop maximum value	mm
27.910	

Gear actuator sensor learned neutral position value	mm
33.240	

The DT12 uses a “clutch closed” logic for engine starting which means the clutch is **NOT** opened during engine cranking.

* This is why we can start the engine with erroneous - or missing - ACTUAL Clutch Position values.

As long as the neutral gear position is known (part of the learn procedure), the engine will start. The DT12 uses a “clutch closed” logic for engine starting and this is why we can start the engine with erroneous - or missing - ACTUAL Clutch Position values.

CLUTCH LEARNED VALUES

CURRENT VALUES ERASED UPON INITIATION

Actual position value clutch	mm
9.890	
Learned value clutch minimum	mm
420	
Clutch limit stop maximum	mm
2920	

Actual position value clutch	mm
s.n.a.	
Learned value clutch minimum	mm
110	
Clutch limit stop maximum	mm
2710	

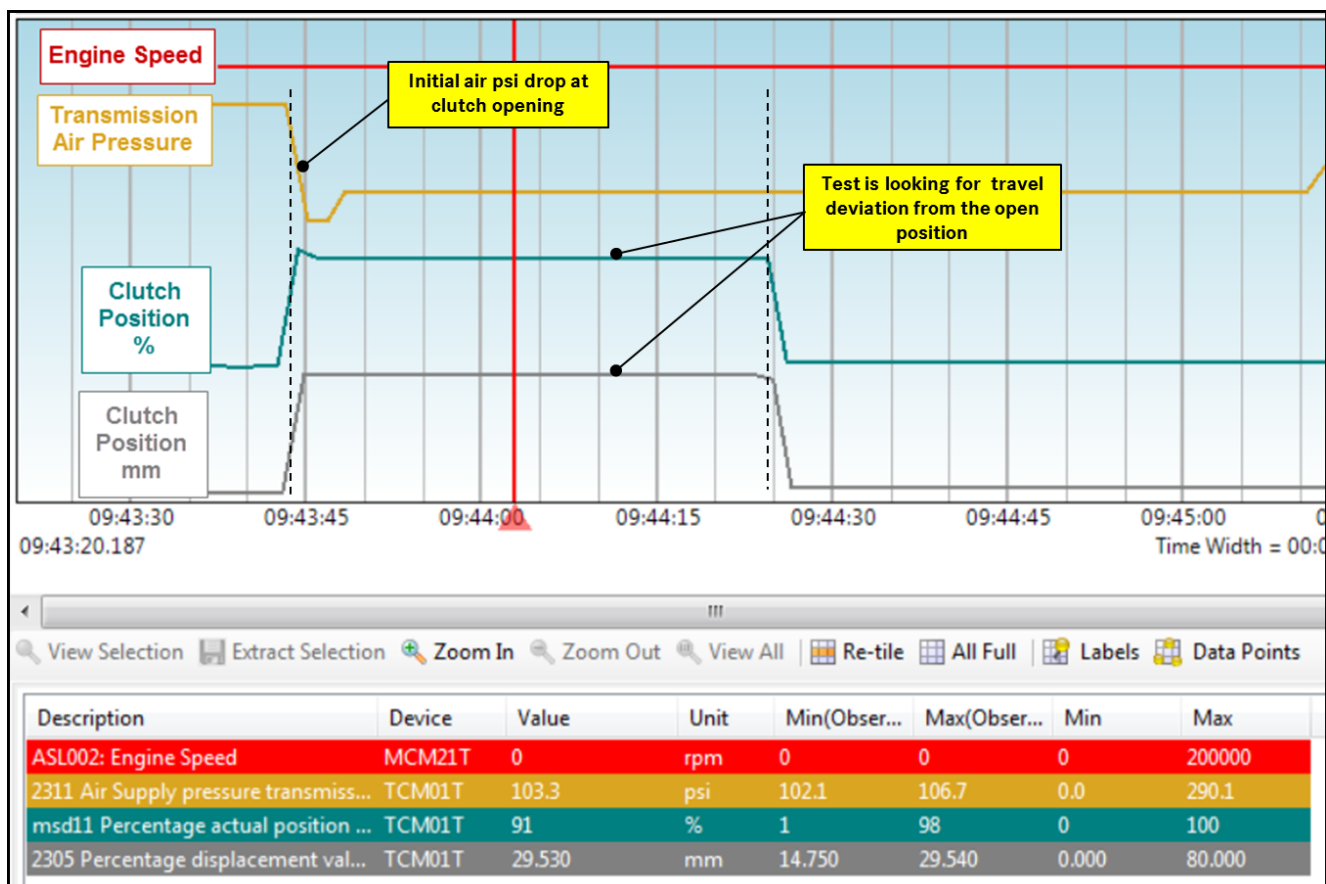
Once a clutch learn procedure is initiated, the current learned values are erased.

If the procedure fails, (for whatever reason) and the clutch cannot “learn”, the vehicle WILL NOT START.

Remember, once a clutch learn procedure is initiated, the current learned values are erased. If the procedure fails, (for whatever reason) and the clutch cannot “learn”, the vehicle ***WILL NOT START***.

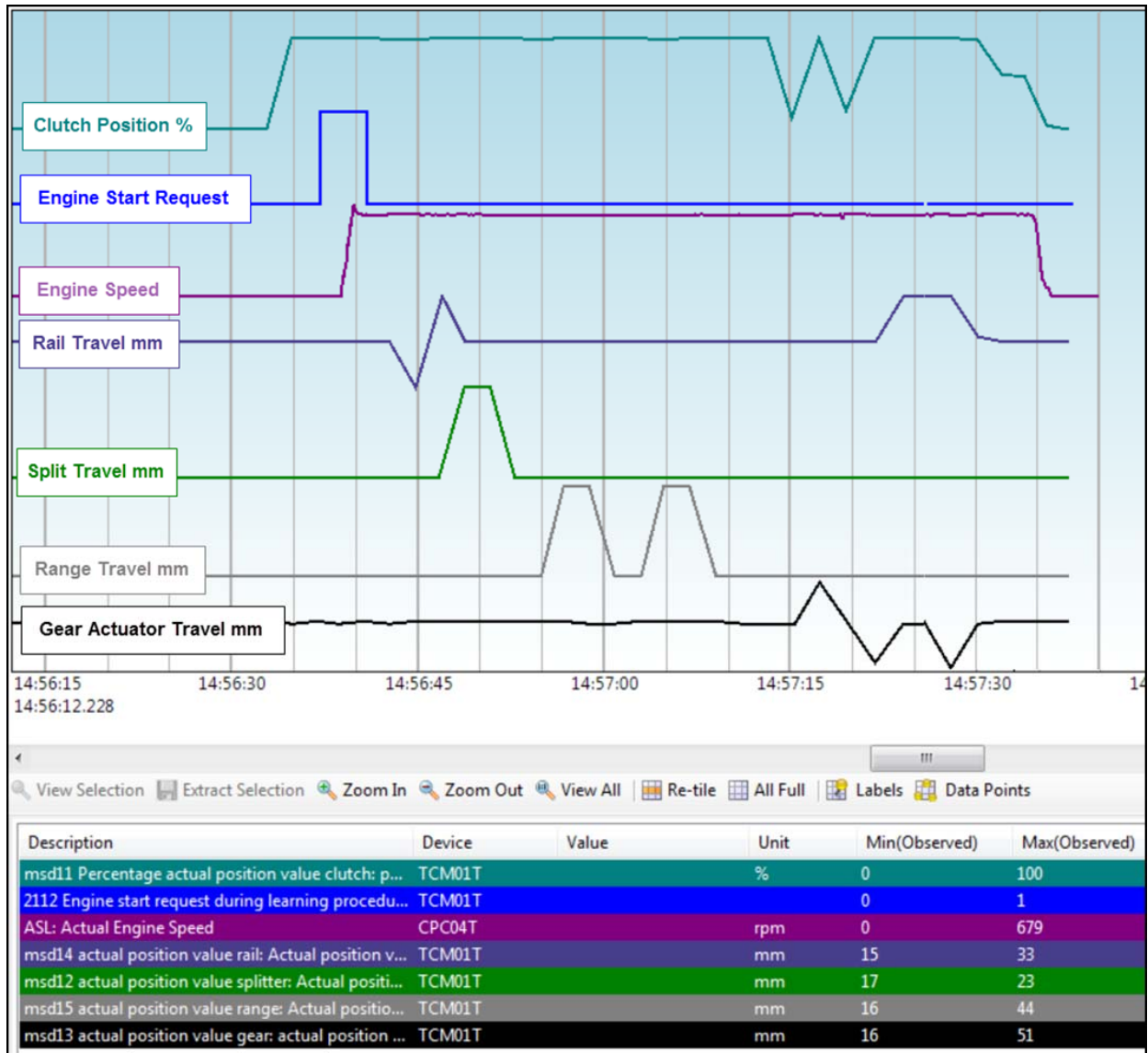


CLUTCH APPLY LEAK TEST



The clutch apply leak test checks the integrity of the clutch circuit. As was previously mentioned in the web course, this is a simple pass/fail test. The test takes approximately 45 seconds to complete. The test completely opens the clutch and holds. It then looks at any travel deviation from the open position indicating an air leak. During the test, a technician should make every opportunity to listen for any air leaks around the shift controller or bell housing to help pinpoint the source of a leak in case the test issues a FAIL result.

CLUTCH & TRANSMISSION LEARN SEQUENCE

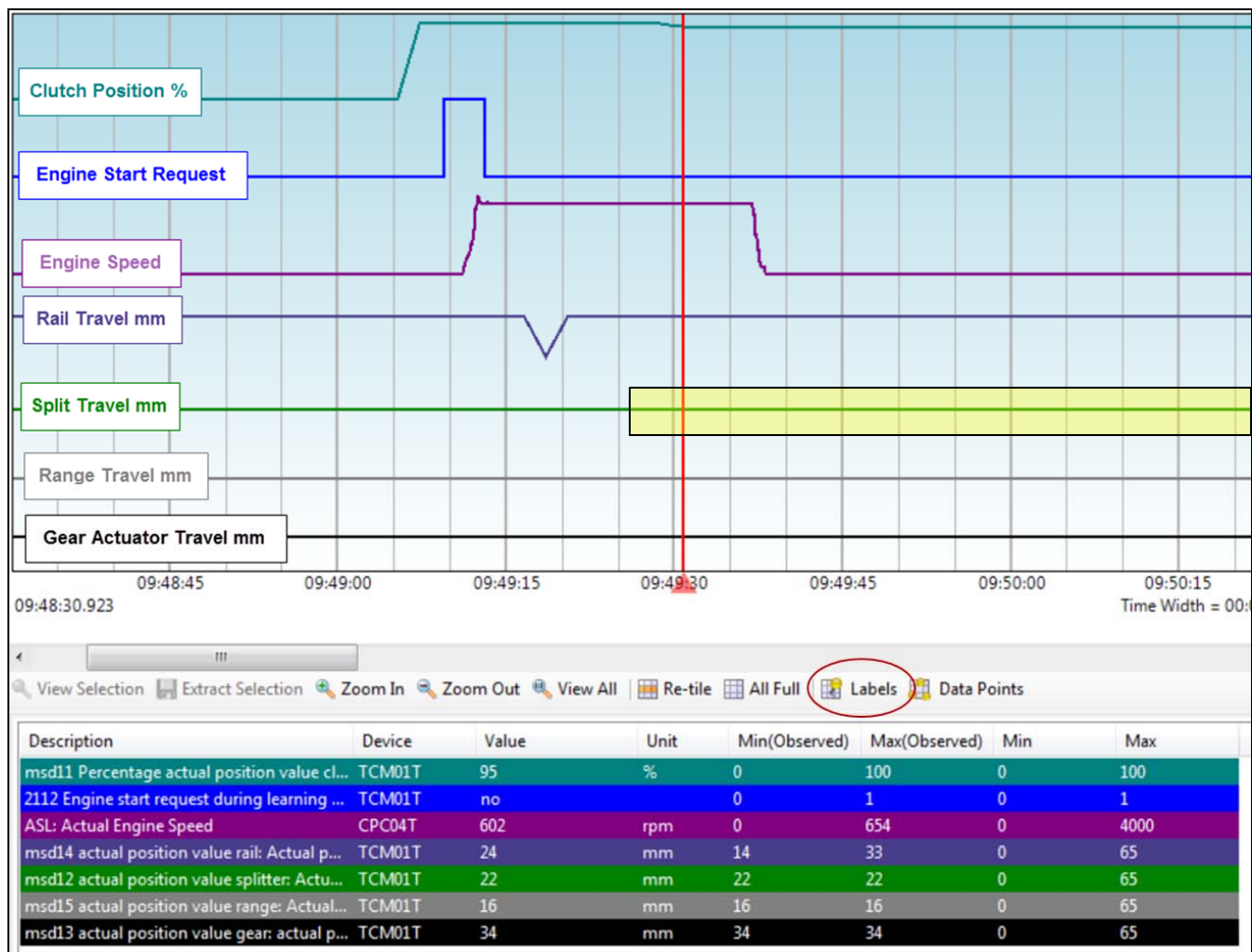


Shown above are the sequence of events during a Clutch and Transmission Learn Procedure and the corresponding patterns that should be seen. This represents a successfully completed learn procedure.



FAILED TRANSMISSION LEARN PROCEDURE

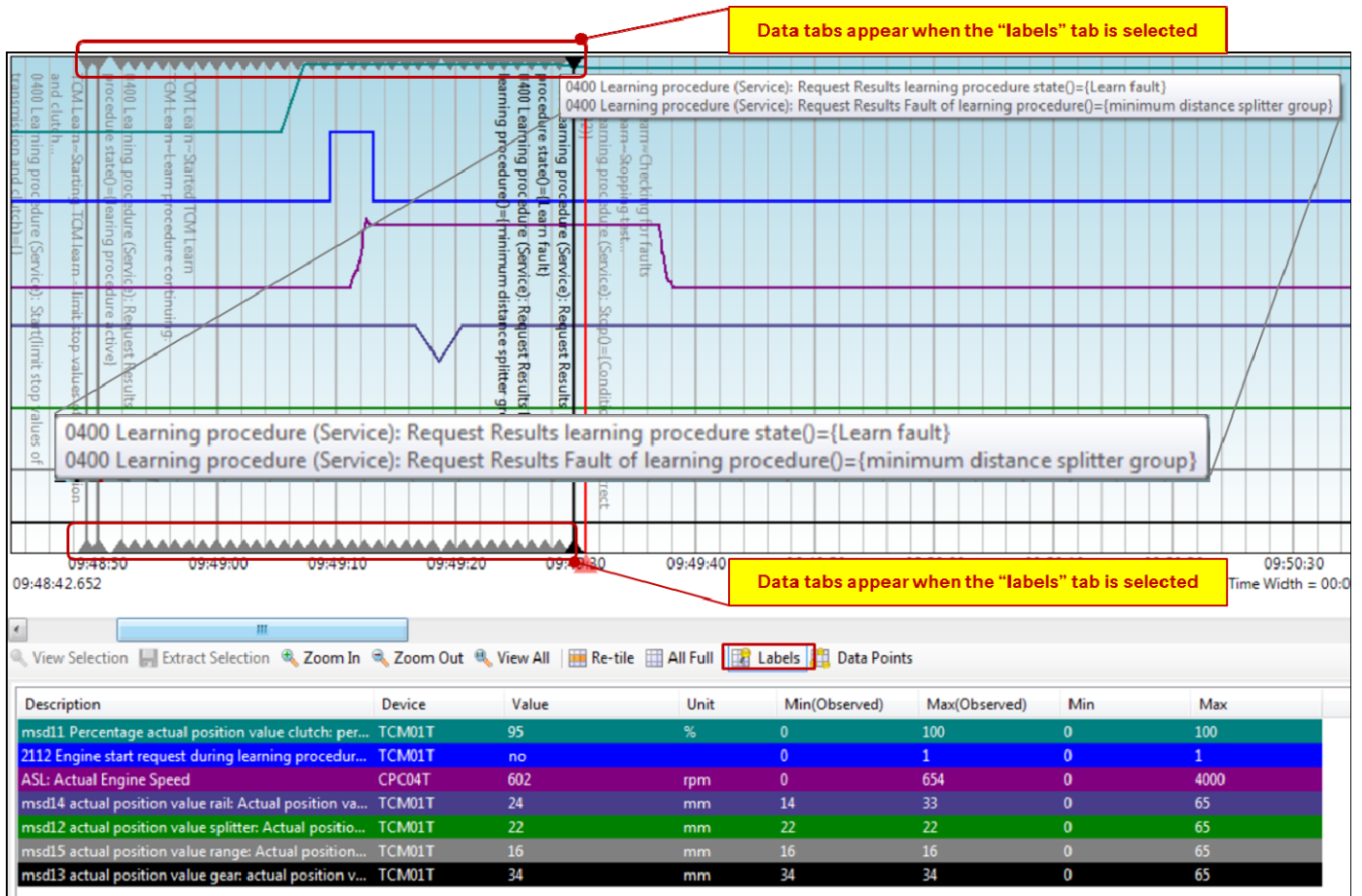
SPLIT GROUP



The above log file shows a failed learn procedure involving the split. The split fork failed to move thus failing the procedure (highlighted line). The next page will show how to use the “labels” feature (circled) to show at what point the learn failed and why.

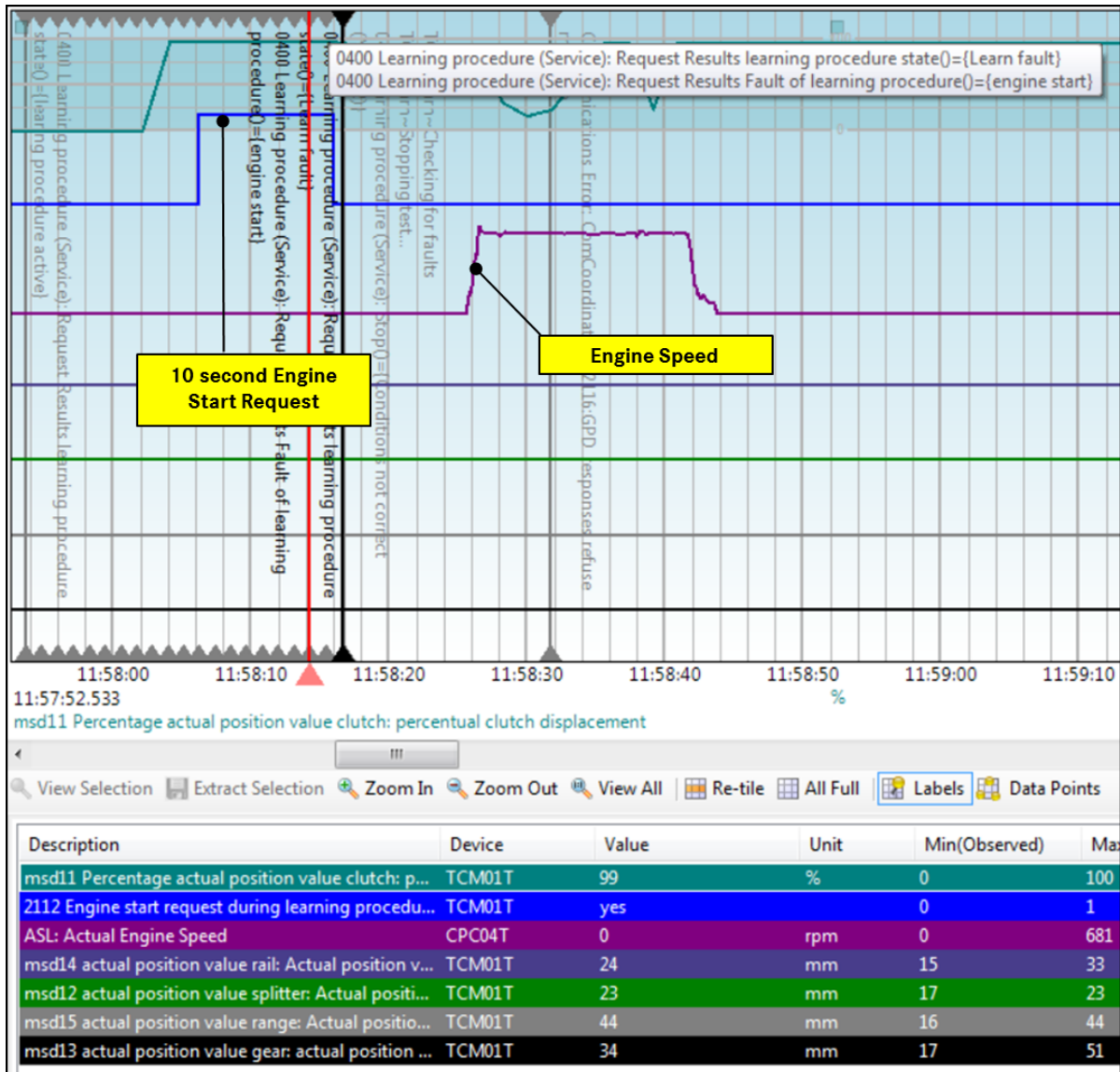
FAILED TRANSMISSION LEARN PROCEDURE

SPLIT GROUP CONT'D



When the "labels" tab is selected, data labels appear on the screen. When you hover the mouse pointer over these labels, information bubbles appear describing different events occurring within the file. This is beneficial when attempting to determine what prevented the learn procedure from successfully completing.

FAILED TRANSMISSION LEARN PROCEDURE *ENGINE START REQUEST*

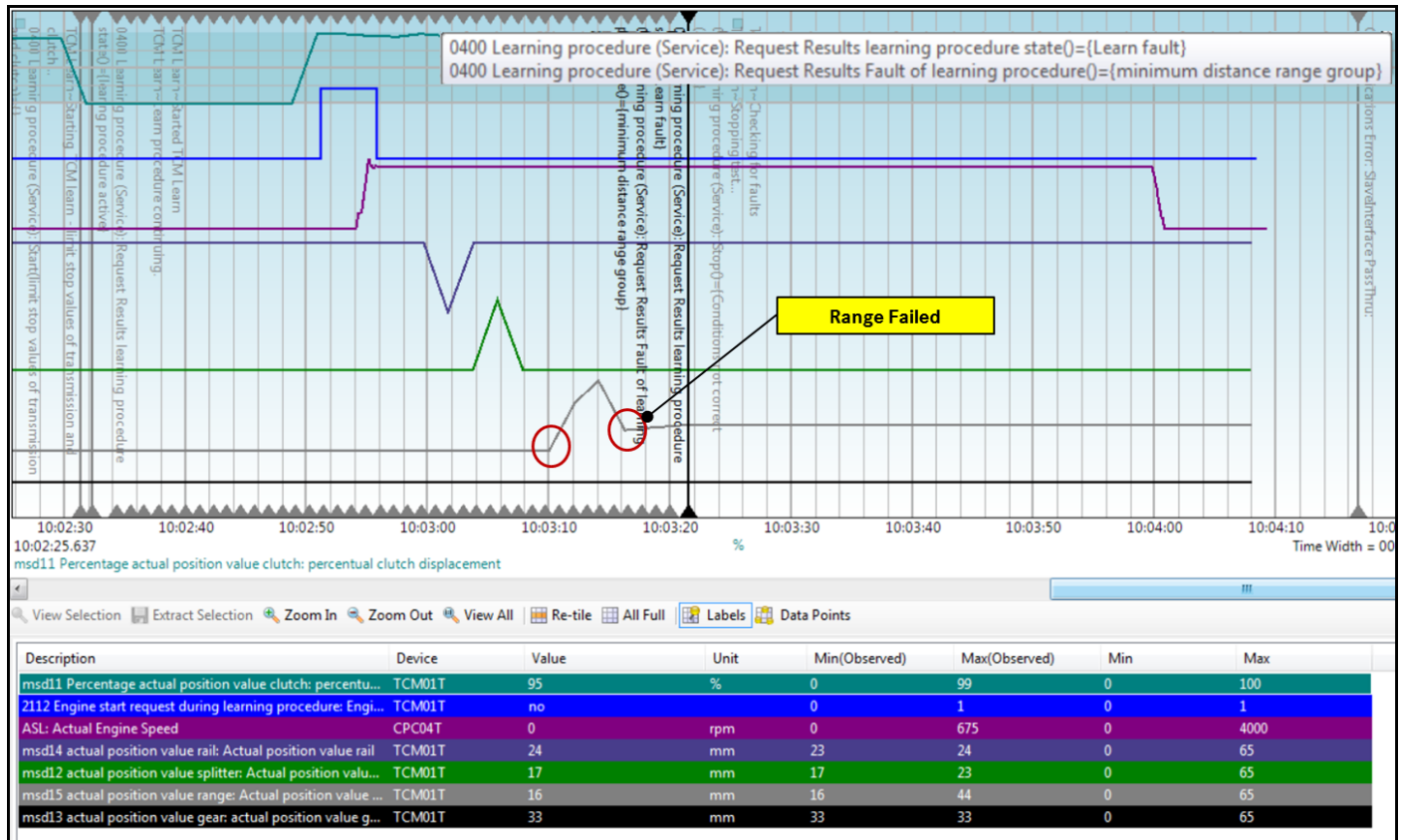


This particular log file is one of the most easiest to identify when troubleshooting why a learn procedure has failed. As is clearly obvious above, the engine was not started within 10 seconds of the **Engine Start Request**. When this occurs, the engine can still start, but no throttle or gear selection will be available. The engine will only idle.

Simply re-run the learn procedure and ensure the engine is started within the 10 sec. window.

FAILED TRANSMISSION LEARN PROCEDURE

RANGE GROUP

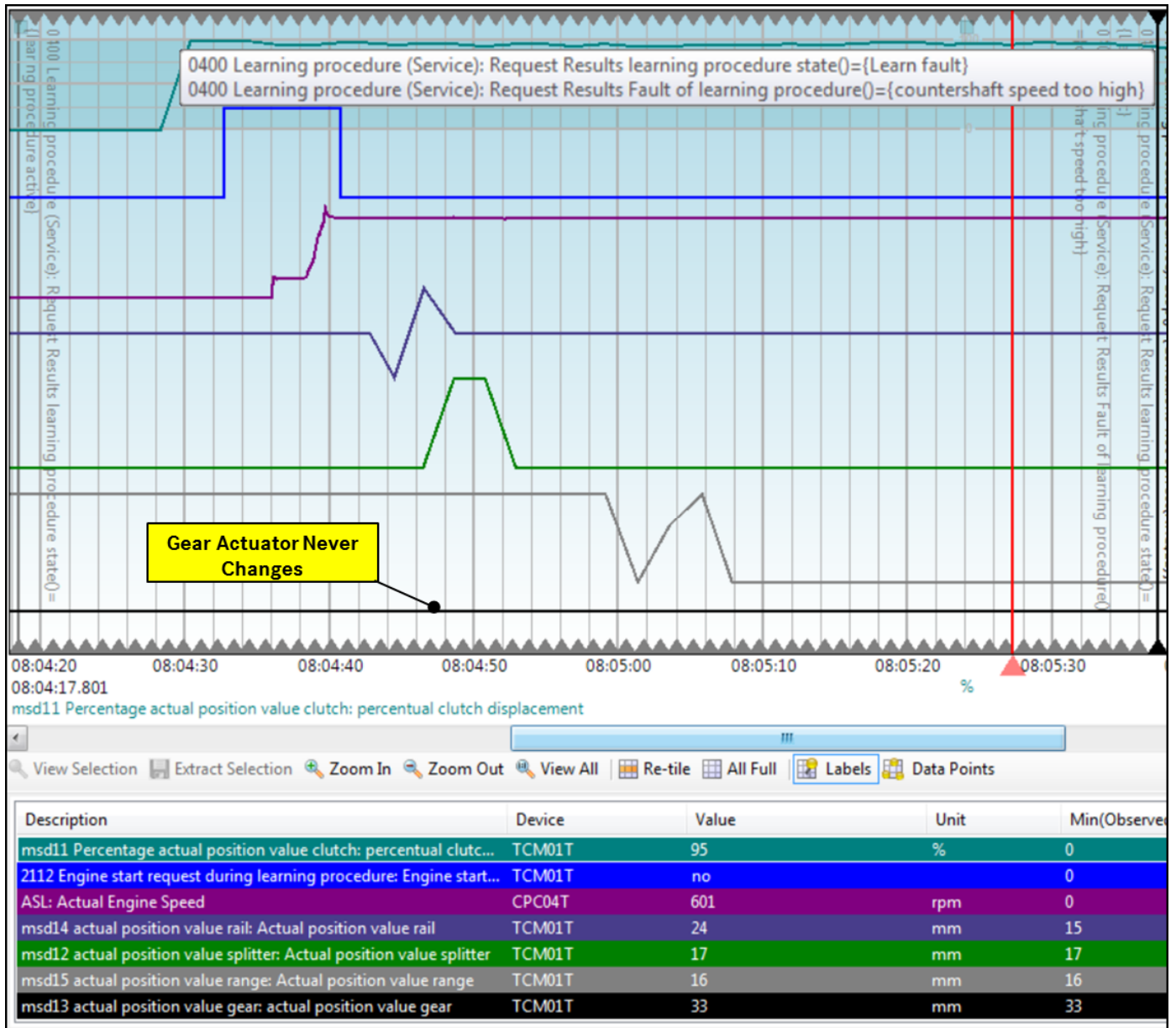


This file shows the range group section failing the learn procedure. Notice the erratic position values of the range group. The range failed to completely return to the LO position.

Root Cause: Nothing, this is an unsynchronized transmission and because shifts can fail, learn procedures may also fail as a result. You may find that performing a second procedure is needed. In this example, the parking brake was released to settle any torque wind up in the driveline and transmission gear meshing. The vehicle was rolled back and forth a very short distance (6-10 inches) and the procedure was successfully performed.

This log file is a prime example of why a learn procedure should never be performed as an attempt to diagnose or repair a complaint unless specifically instructed to do so by the call center, or by specific diagnostics and repair literature.

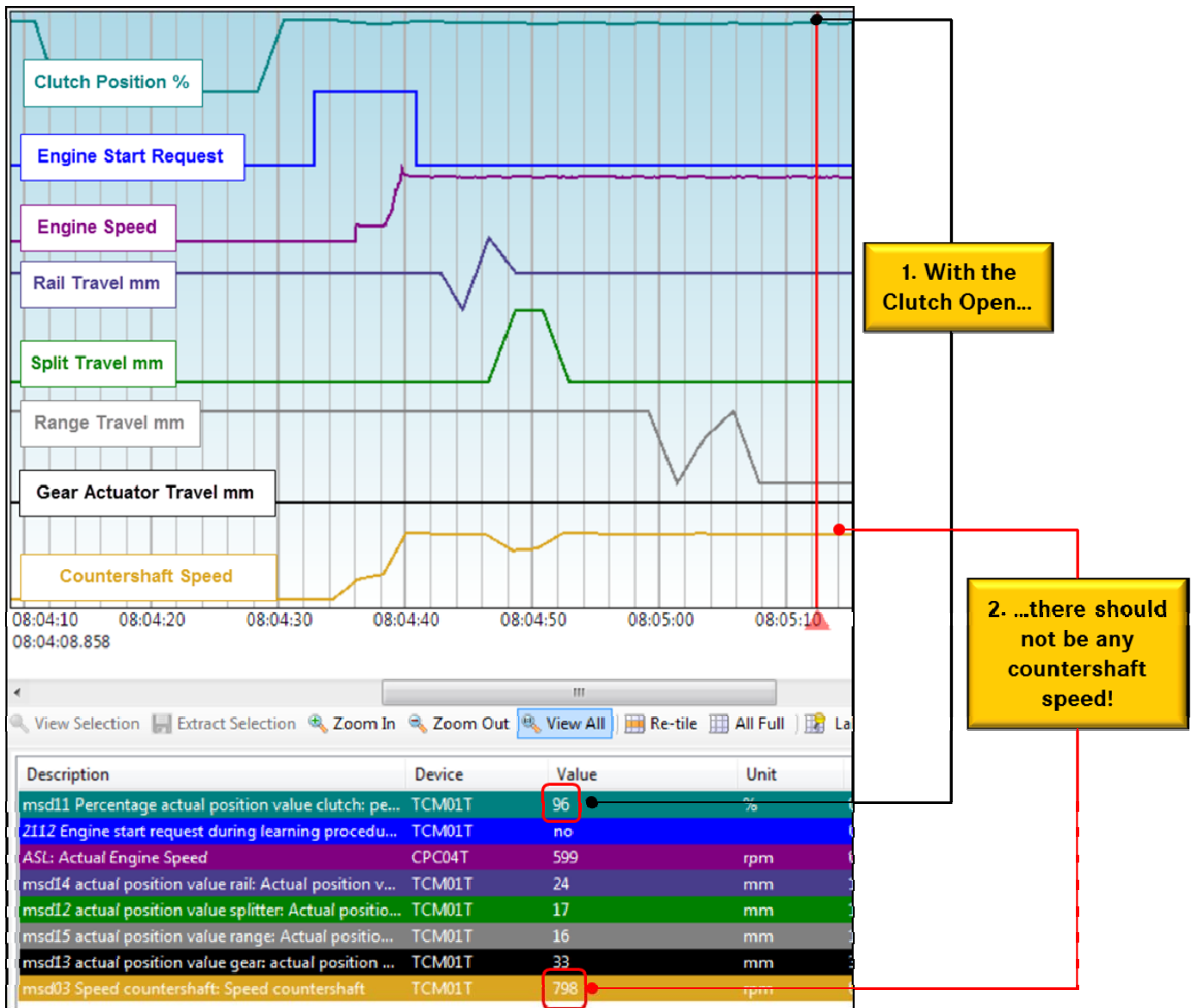
FAILED TRANSMISSION LEARN PROCEDURE *COUNTERSHAFT SPEED TOO HIGH*



This next example shows another log file of a failed learn procedure. If you notice, the gear actuator position never changed. One might think that this is what caused the procedure to fail, however, by looking at the labels, we see that the procedure actually failed because the countershaft speed is too high. We will actually investigate this particular failure in more detail later in the next page.

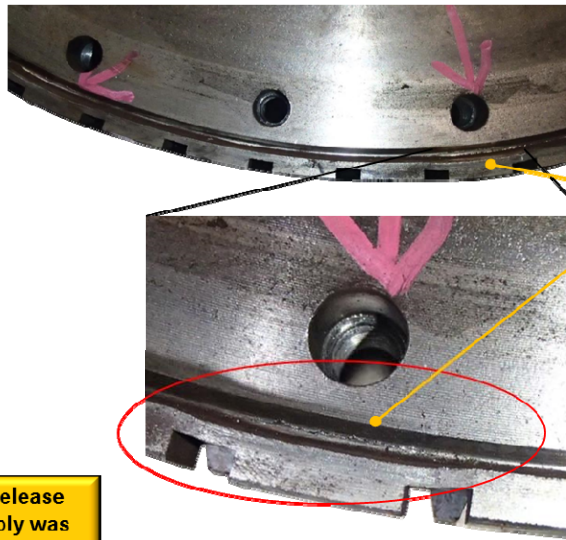
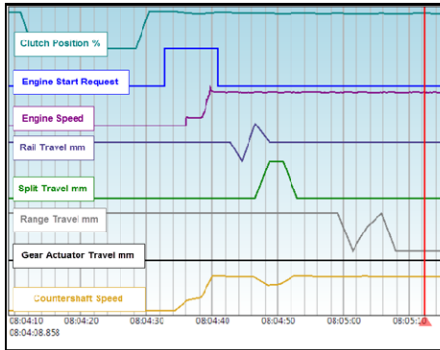
FAILED TRANSMISSION LEARN PROCEDURE

COUNTERSHAFT SPEED TOO HIGH CONT'D



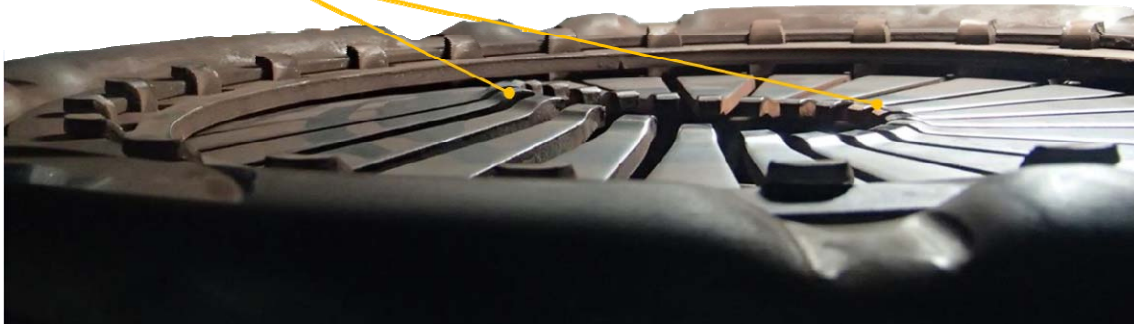
When we look at the countershaft speed parameter in the log file, we can clearly see countershaft speed being registered when the clutch is open. The countershaft should NOT be rotating while the clutch is open.

FAILED TRANSMISSION LEARN PROCEDURE ***COUNTERSHAFT SPEED TOO HIGH CONT'D***



Flywheel pilot rim bulging from improper alignment

Notice the uneven heights in the clutch release fingers. Indication that the clutch assembly was not properly aligned in the flywheel pilot rim.



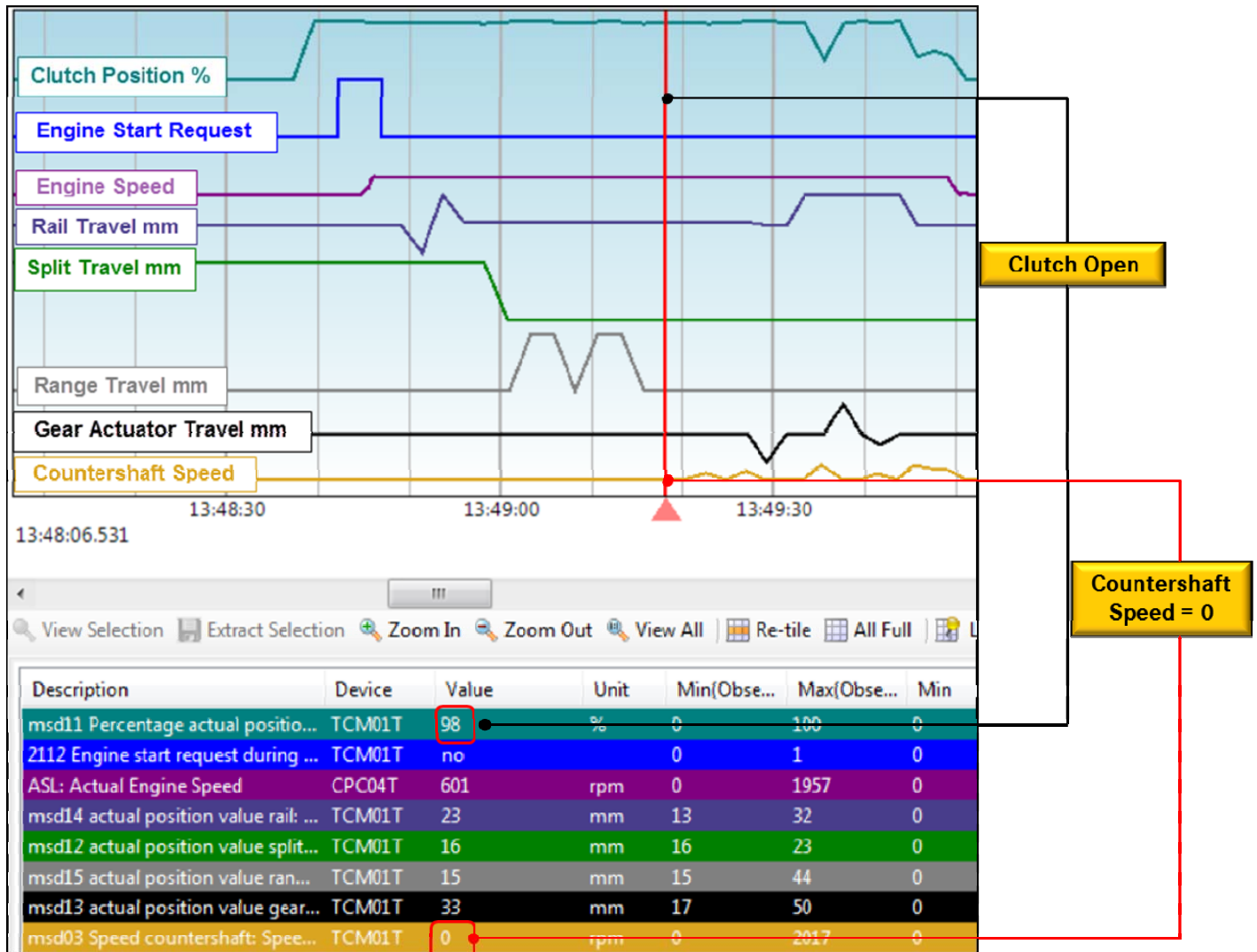
The clutch was removed from this vehicle as part of another repair. After re-installing the clutch and new transmission, the technician was unable to complete the learn procedure due to a high countershaft speed.

Further inspection revealed that the clutch was incorrectly re-installed. It was not properly seated in the flywheel pilot rim. With this improper alignment of the pressure plate housing to the flywheel, the clutch assembly was essentially “cocked” preventing full release of the disc once the clutch was opened. This is the root cause of why there was un-intended countershaft speed.

So as you can see, it is absolutely critical that the clutch is installed correctly following the proper service procedures outlined in PSL.

FAILED TRANSMISSION LEARN PROCEDURE

CORRECT COUNTERSHAFT SPEED

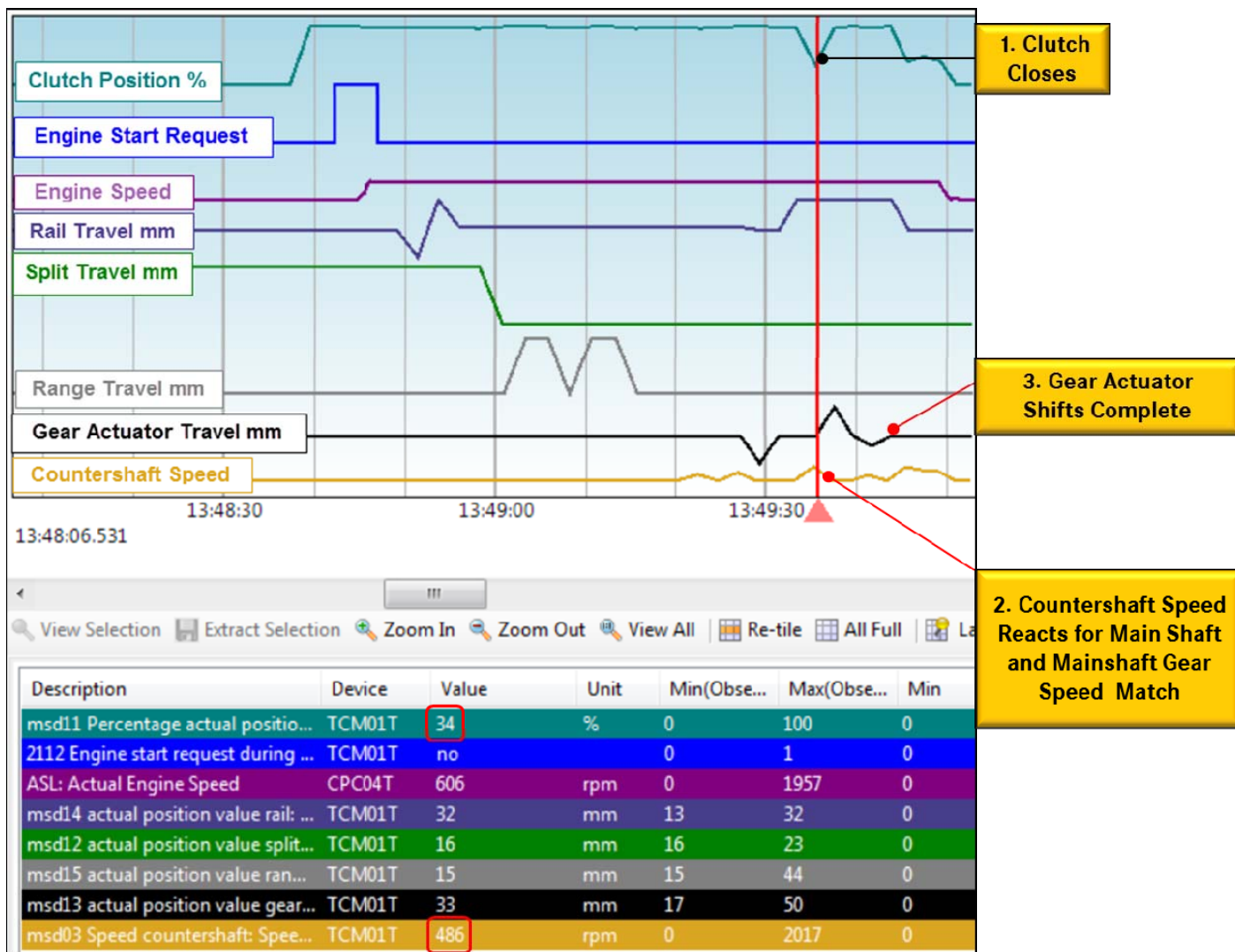


Shown above is a log file showing what the countershaft speed **should** look like. As you can clearly see, with the clutch open, there should not be any countershaft speed registering.



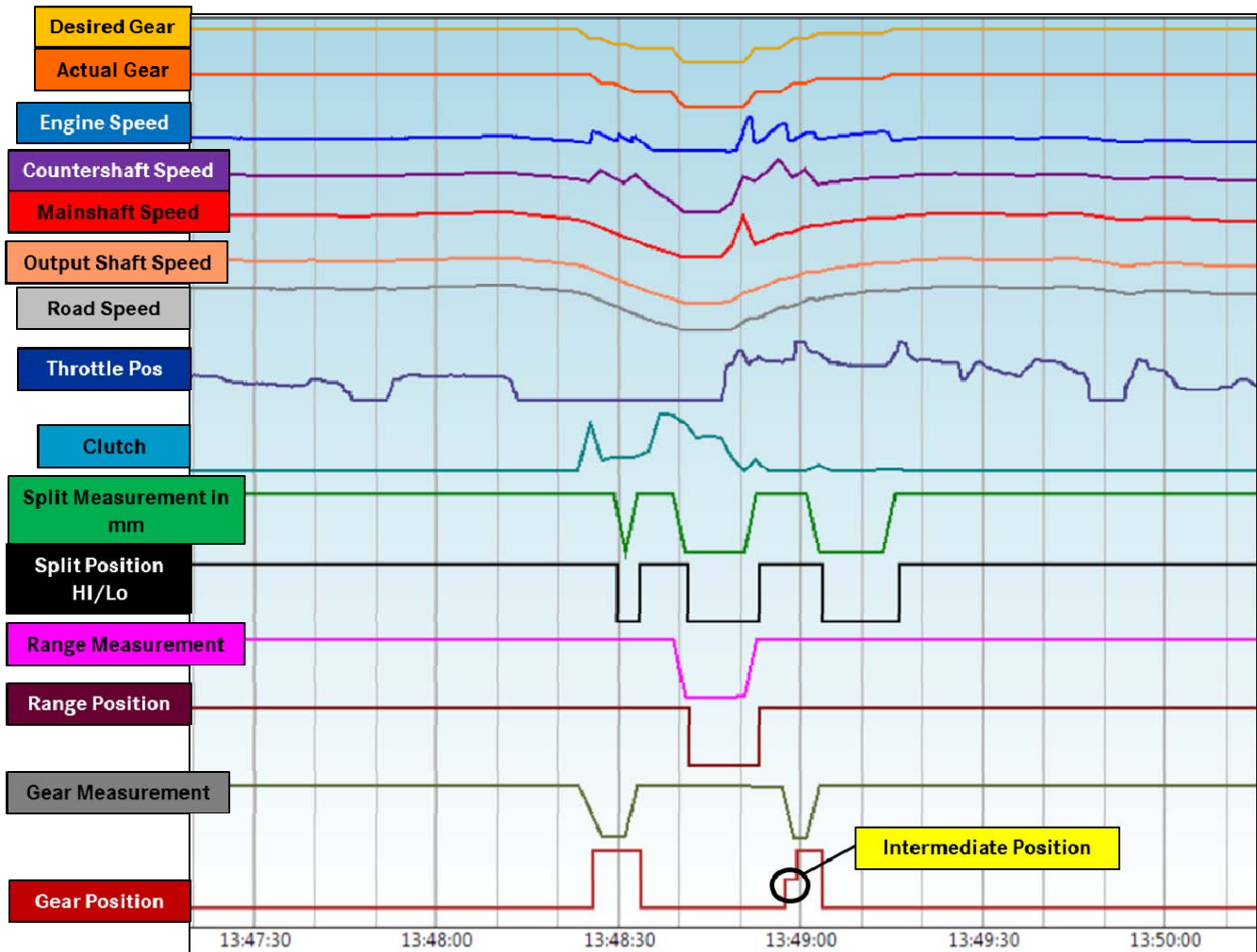
FAILED TRANSMISSION LEARN PROCEDURE

CORRECT COUNTERSHAFT SPEED



Because the gear actuator learn portion requires shifting mainshaft gears, the clutch will close as needed to generate countershaft speed for the purpose of matching the mainshaft speed with the current mainshaft gear / gears speed. Upon completion of the gear actuator shifts, the learn will successfully complete.

COMMON PARAMETERS TO VIEW

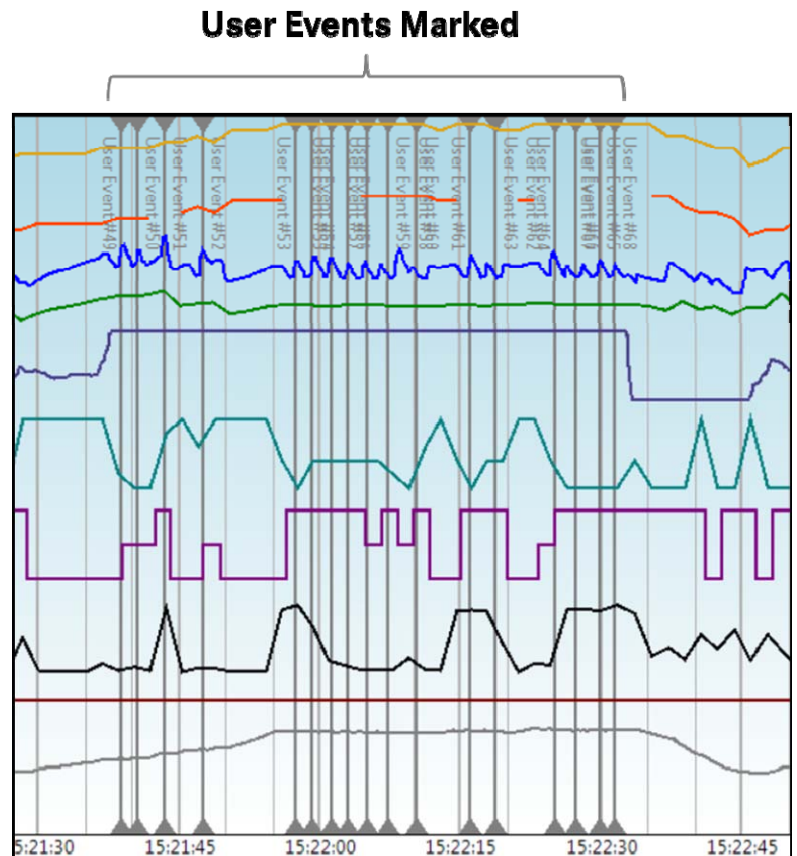
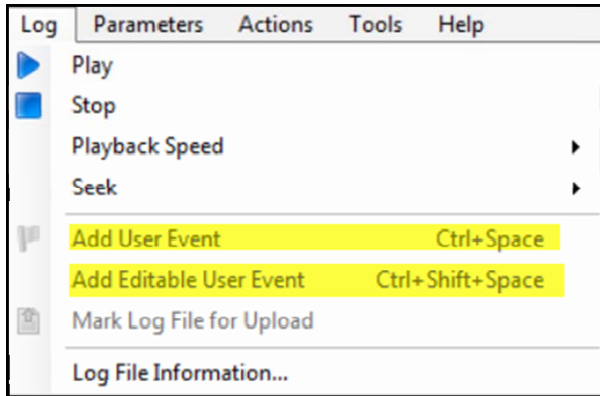


Shown above is an image of some important parameters to view when diagnosing transmission issues. The log file is representative of a “good” drive cycle.

- The desired gear and actual gear match
- The pattern of the engine speed and countershaft speed match
- The pattern of the output shaft speed and road speed match
- Select throttle position to see driver’s intent - i.e. full throttle, steady state, inadvertent kickdown, etc.
- The split, range, and gear measurements are nice, crisp peaks and valleys
- The split, range, and gear positions switch consistently from high to low

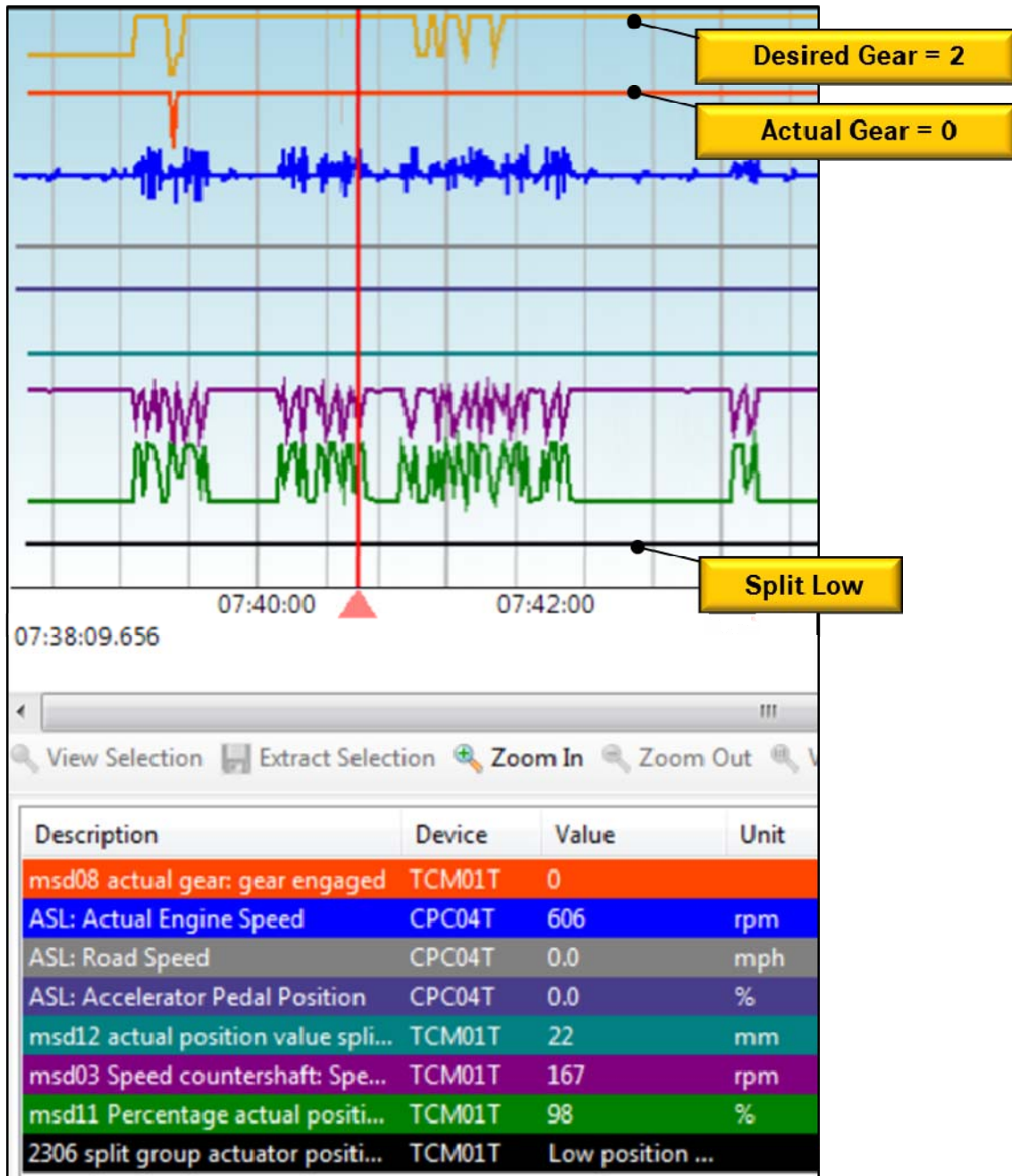
The intermediate position, shown in the gear position parameter, will occur from time to time and is considered to be normal. It is only when there are an abundance of intermediates that correspond with certain measurements or user events, that should be of concern.

USER EVENTS



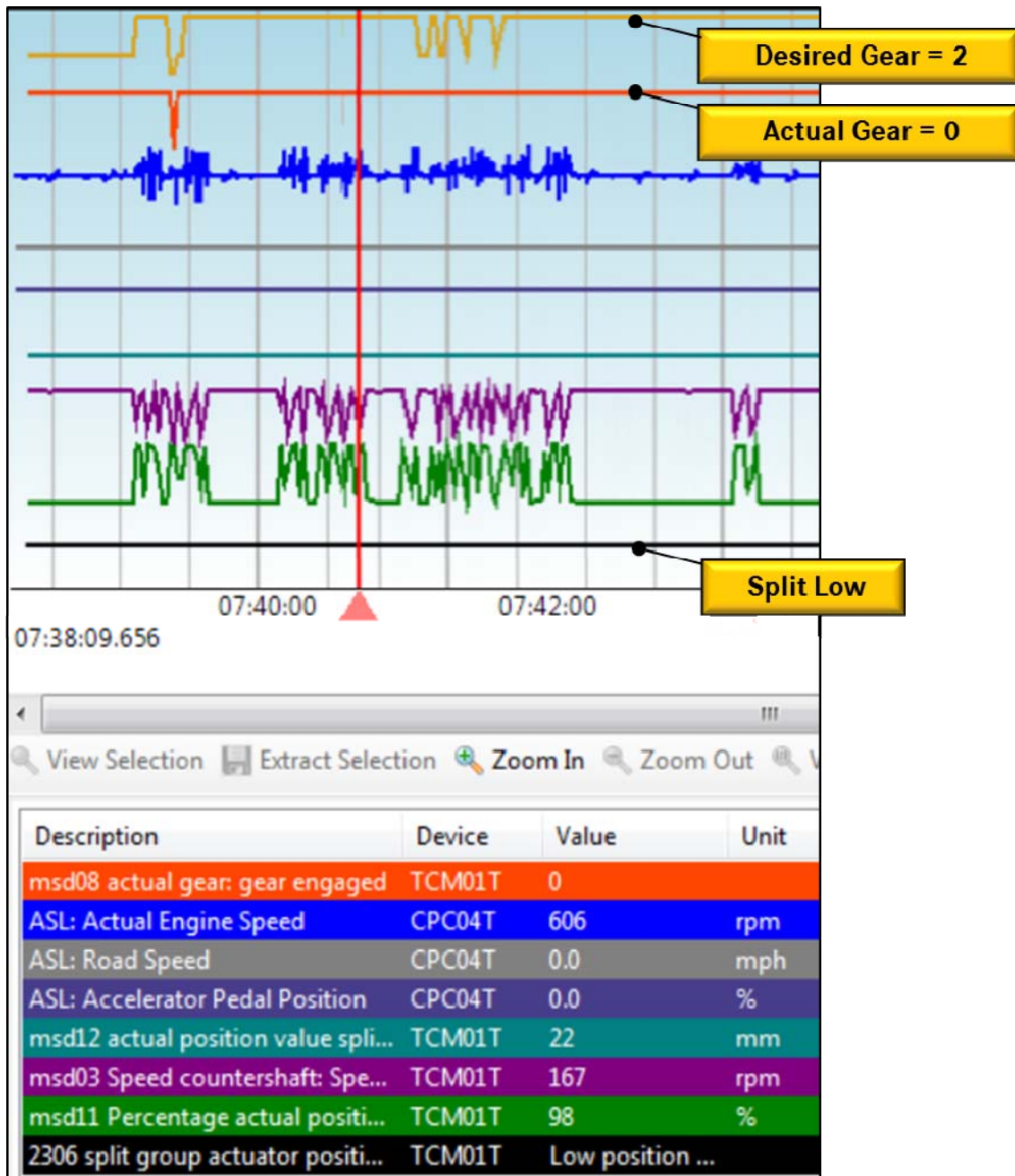
During a road-test, it is helpful to mark user events (if possible) when attempting to diagnose grinding, gear drop-outs, or any other abnormal shifting concerns. Simply hit the Control and Space Bar together during a particular event, such as gear grinding during a shift, to mark the occurrence within the log file.

WILL NOT ENGAGE FORWARD GEAR



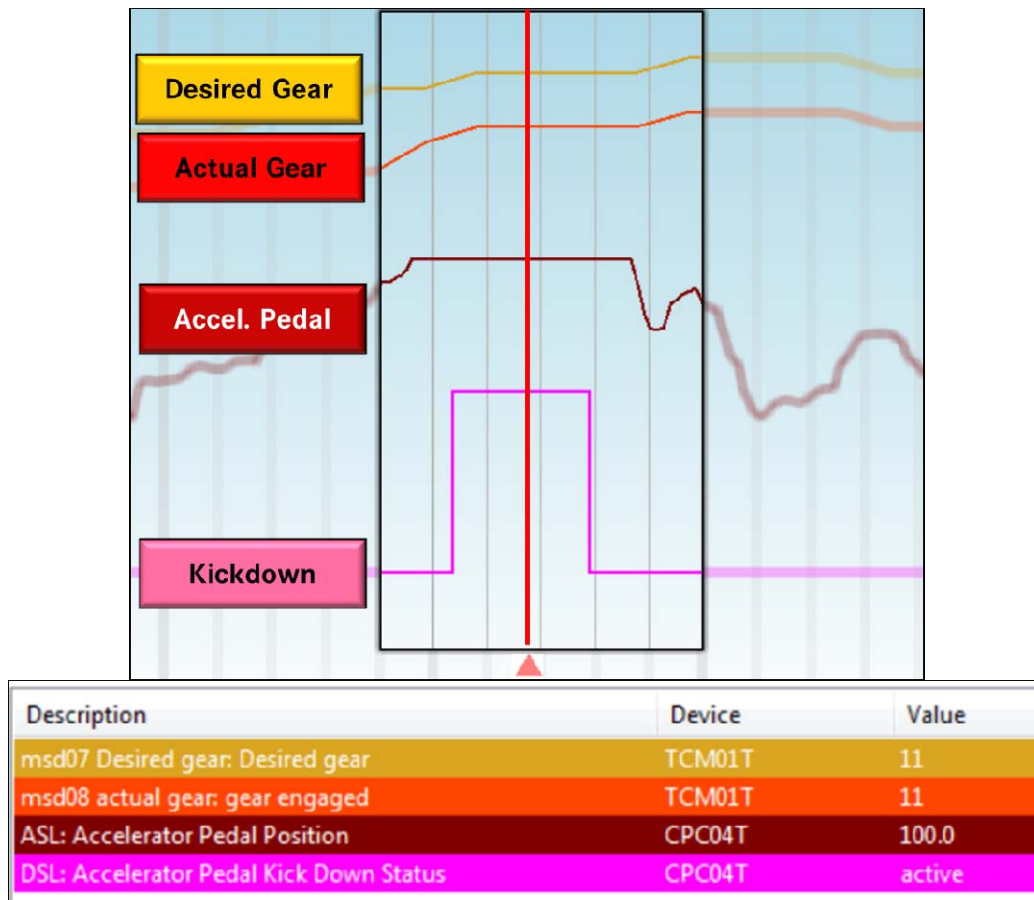
Shown above is a log file from a vehicle that would not engage a forward gear. When the rotary ring switch was rotated to "D", the desired start gear was 2nd gear. You can clearly see that the actual gear stayed at 0 (neutral) and you can also see the clutch opening and closing trying to synchronize shaft speeds. The split position never changes. Remember, low splits are odd gears and high splits are even gears.

WILL NOT ENGAGE FORWARD GEAR CONT'D



The root cause of this failure was a damaged mainshaft pilot bearing that was towed incorrectly for a short distance. With damage to the bearing, shaft alignment was affected and the split could not function.

“HANGS” IN 11TH GEAR

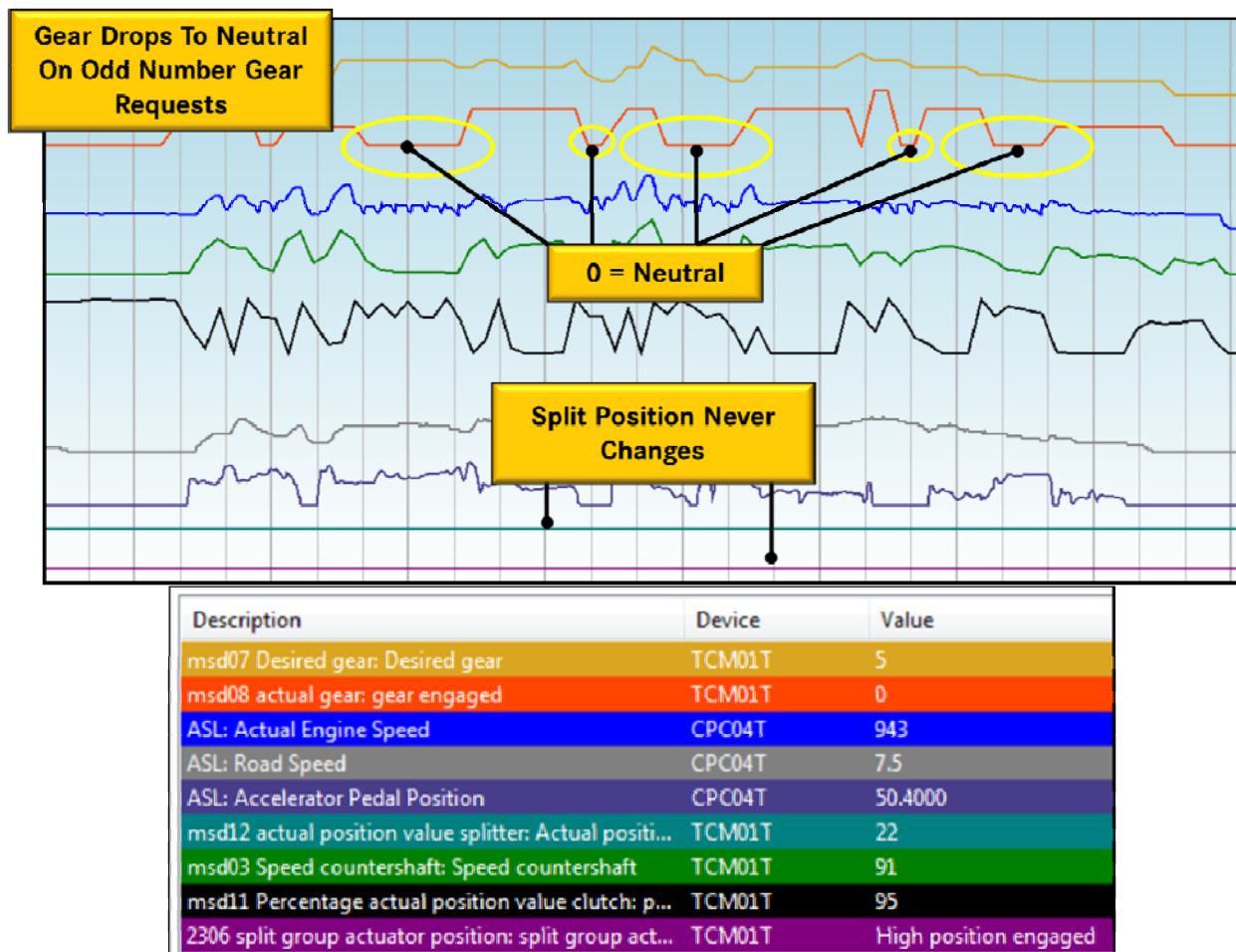


This particular log file is representative of a customer's complaint that the transmission seemed to hang or stay in 11th gear when he or she was expecting an upshift to 12th gear. By selecting both desired and actual gear in our chart, we can confirm whether or not an upshift was requested by the CPC. Next, always select the accelerator pedal to see the driver's intent during the drive cycle. In this case, the driver was commanding full throttle. The key word, or words, to this complaint is “hangs”, or “won't shift out of 11th gear”. If the pedal is depressed into the “kickdown zone” of its travel, the programming will honor that request and prevent an upshift while in 11th, or provide a downshift while in 12th. This is a common complaint from inexperienced drivers with the DT12. They inadvertently depress the throttle into the kickdown zone while in 11th gear, thus preventing a 12th gear upshift and ultimately think there is a problem with the transmission.

By selecting the kickdown status in the user section of the chart, we can clearly see that the driver inadvertently went into kickdown while at full throttle.

Note: This is a small, highlighted section from the original log-file. There were many more instances of this occurring.

GEAR DROP-OUT TO NEUTRAL COMPLAINTS



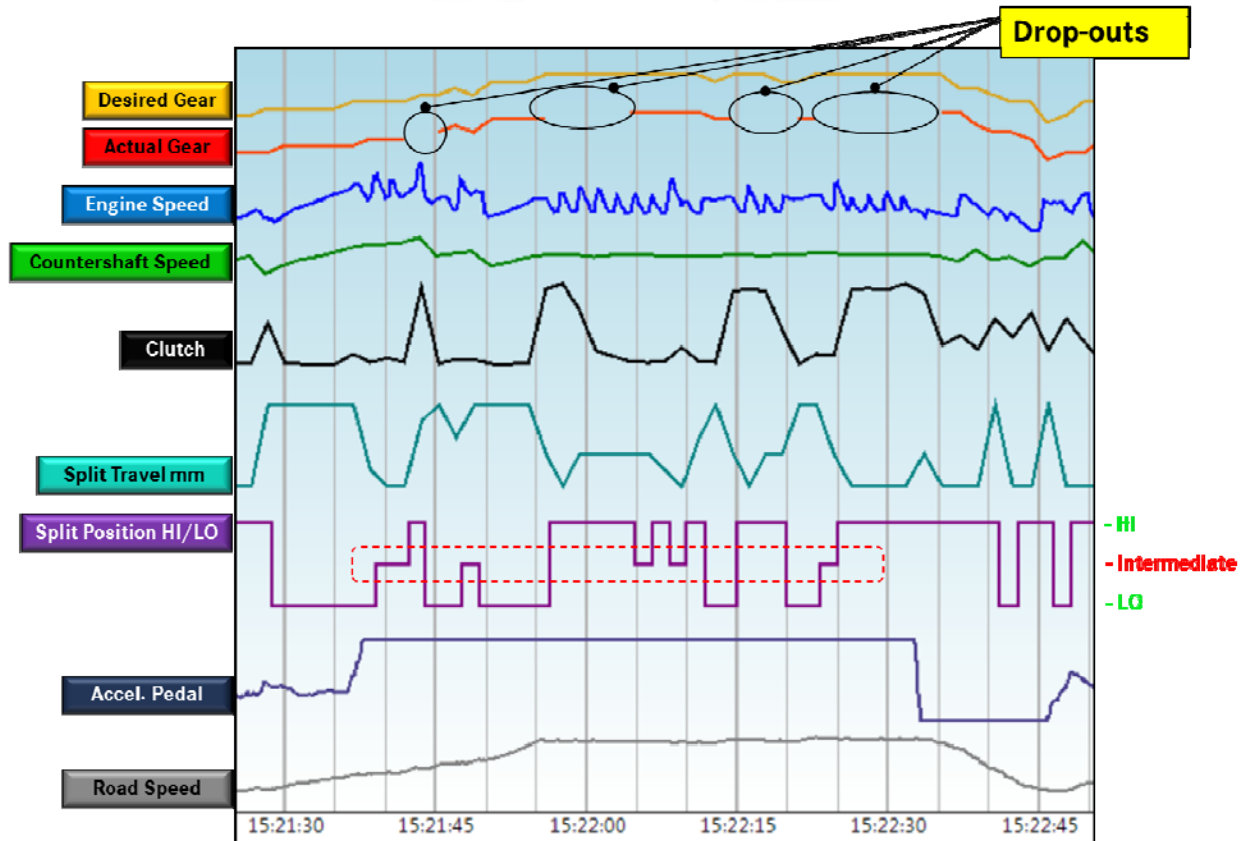
When diagnosing gear drop out, or transmission drops - to - neutral complaints, always have the desired / actual gear parameters shown first. Always ask or confirm whether it's a consistent pattern - such as "does this happen in odd or even gears only".

In the situation above, the transmission drops to neutral every time there is an odd number gear request. You may recall that all split LO shifts are odd number gears and split HI shifts are even number. The first thing we should look at are whether or not the split readings are changing. As you can see, the splits are not changing. The split position is stuck in HI only, and HI position is used for even gears.

The reaction to this is the transmission will shift to neutral and attempt another shift or attempt an even gear if the conditions are correct for that even gear i.e. road speed, shaft speeds, etc.

The root cause of this failure was a failed shift controller.

GEAR DROP-OUTS - ICUME DISPLAY READS - -



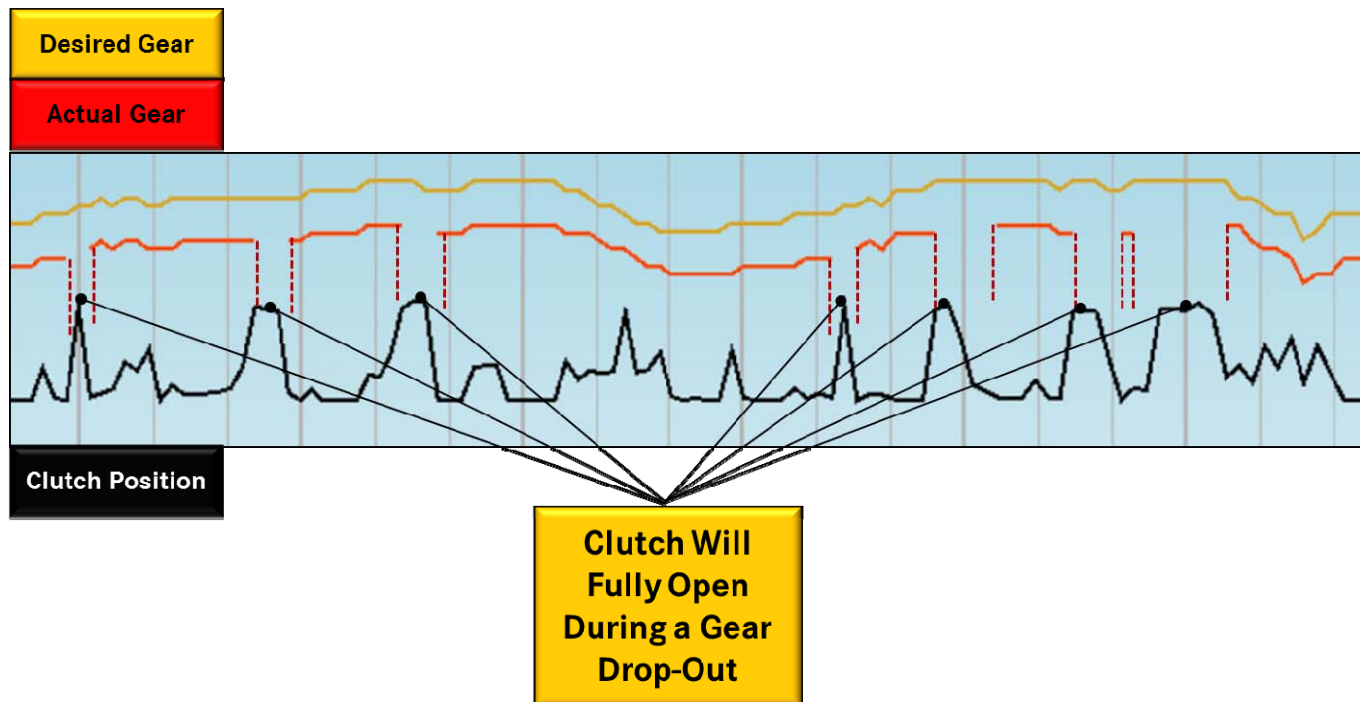
This scenario occurs when the transmission drops out of gear, but does not register Neutral on the dash. Instead, dash marks will be displayed across the panel, as well as the ABS and HSA light illuminating on the ICU4me.

The first thing to look for are any abnormal split, gear, or range travel and positions. Here we see abnormal split measurements and split positions. Split travel measurements should be clean up and down peaks and valleys. Split positions should be definitive HI / LO and not a high level of intermediate positions as shown above. Intermediate positions can cause confusion in the transmission as to what gear it is in. That is why the ABS light and HSA light often illuminate when this scenario occurs. These systems will not function correctly if the transmission is unable to determine what gear it is in.

Keep in mind that this is a non-synchronized transmission, and intermediate positions will occur at times. It is only where there is an abundance of these in combination with drop-outs that are of concern.

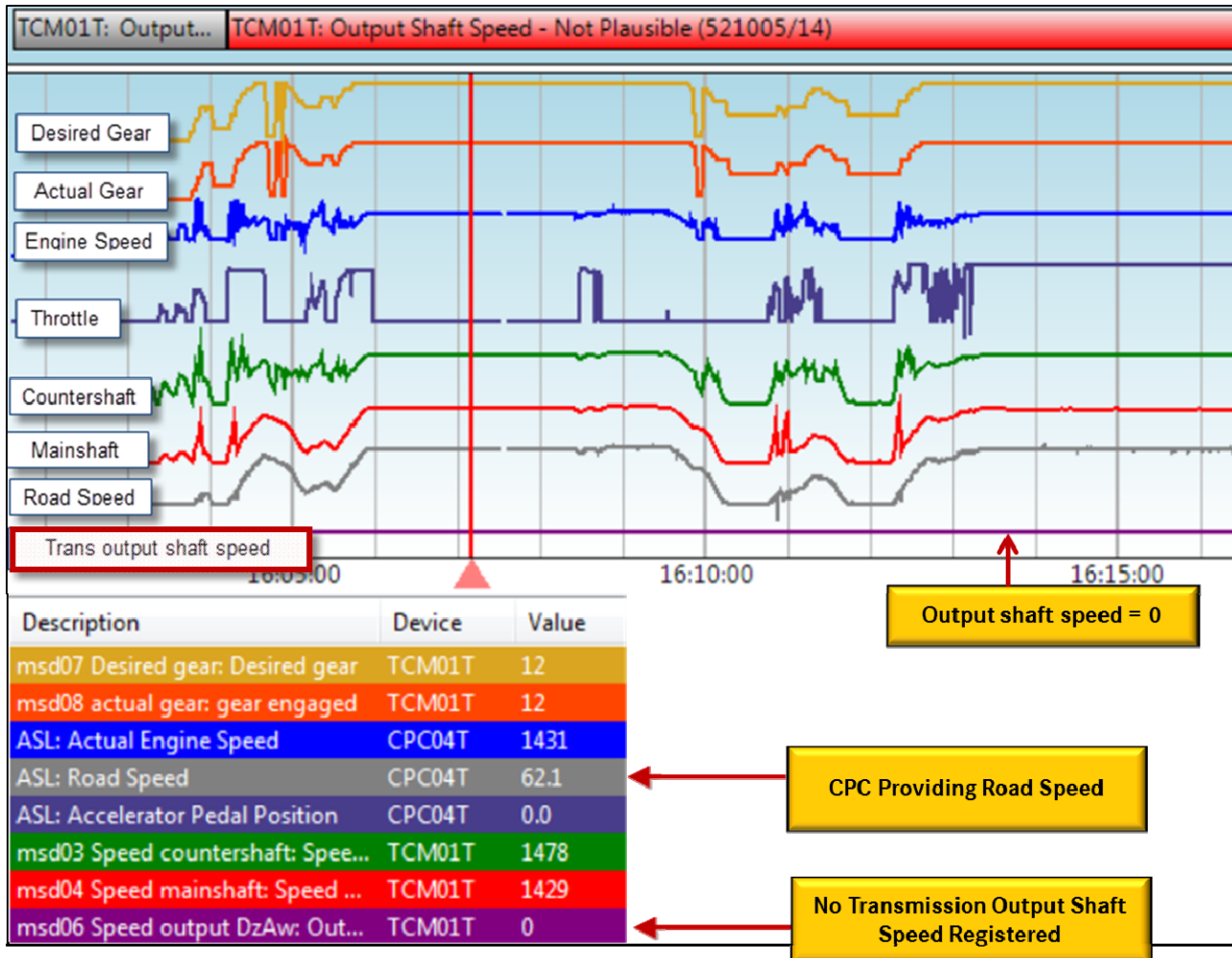


GEAR DROP-OUT OR NON-CONFIRMED NEUTRAL



Any time a gear drop out / non-confirmed neutral occurs, the clutch will fully open to protect itself and the engine until a gear can be safely achieved.

ACTIVE OUTPUT SHAFT SPEED FAULT

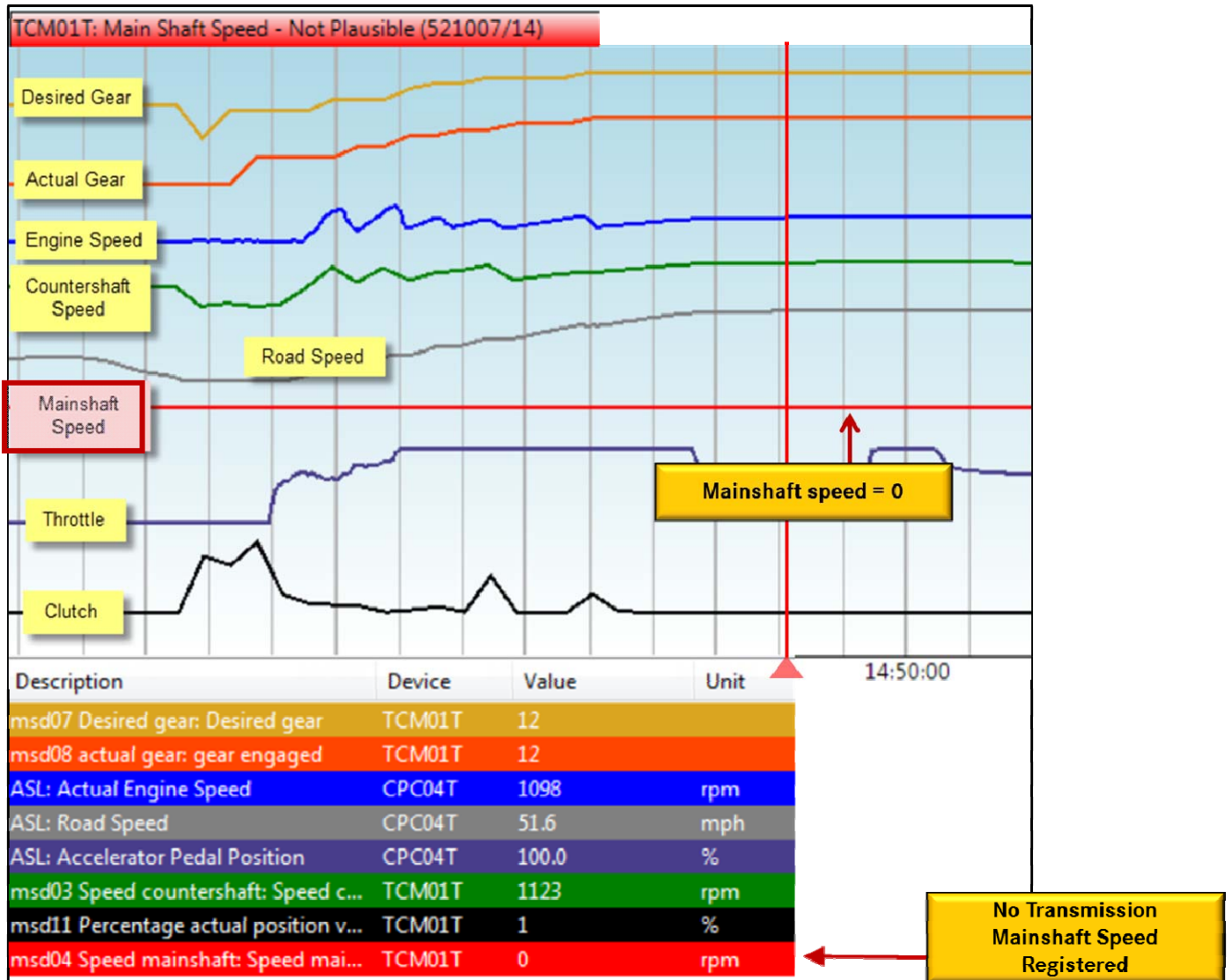


Active Output Shaft Speed (Vehicle Speed) Fault

Cause: Output shaft speed sensor

The CPC4 calculates vehicle speed based on the output shaft speed data that the TCM is broadcasting over the CAN. In the event the signal is lost, mainshaft speed and range position are used to calculate the vehicle speed for vehicle operation.

ACTIVE MAINSHAFT SPEED FAULT

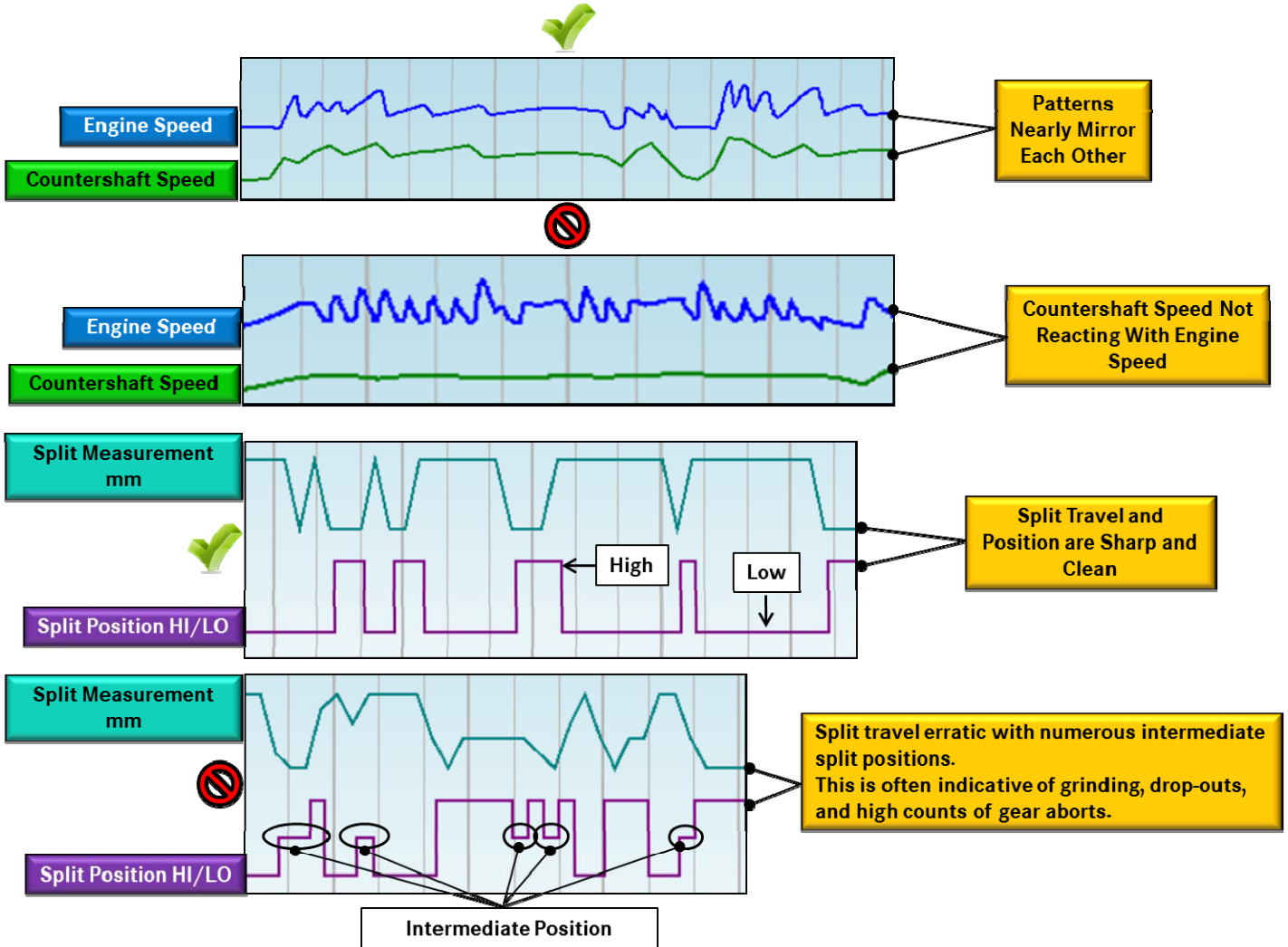


Active Mainshaft Speed Fault

Cause: Mainshaft speed sensor

If the mainshaft signal is lost, then the mainshaft speed will be calculated using the transmission output shaft speed and the range position for vehicle operation.

GEAR GRINDING COMPLAINT - GRAPH



GEAR GRINDING COMPLAINT - TEXT

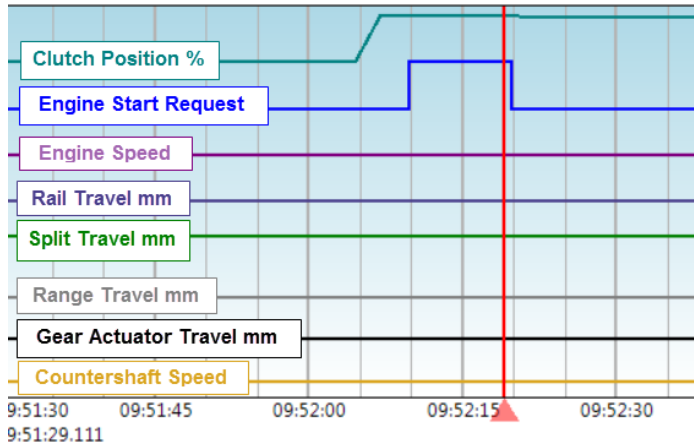
This particular scenario involves gear grinding complaints in various gears. A pattern of either odd or even gears was **unable** to be determined. As we have previously discussed, the split mechanism is the most sensitive area of the transmission. Amongst others, split aborts/grinds/failures can be caused by a faulty valve within the shift controller, or a damaged mainshaft pilot bearing. Remember, the mainshaft pilot bearing pre-load sets the proper alignment of the input and mainshaft and the input/mainshaft junction is where split shifts occur. It is recommended that split travel and positions be observed closely whenever there are grinding complaints.

One item to look at is the relationship between the engine and countershaft speed. A properly functioning transmission will show a very similar pattern between the two as shown in the top log file screen capture. Also notice that the split measurement lines are crisp, up and down slopes and that the split position shows definitive HI and LO positions.

Now observe the engine and countershaft speed relationship on an improperly functioning split system. The patterns are not similar to one another and the split measurement patterns are erratic. You may also notice the split position has numerous intermediate positions in short time span. If the split is not engaging fully, or is allowed to drift, the countershaft speed will be affected.

The root cause of this failure was debris found in the shift controller split solenoids preventing proper engagement of the split fork.

1. What portion of the learn procedure failed?



View Selection Extract Selection Zoom In Zoom Out View All				
Description	Device	Value	Unit	Min(Obs)
msd11 Percentage actual positio...	TCM01T	100	%	0
2112 Engine start request during ...	TCM01T	yes		0
ASL: Actual Engine Speed	CPC04T	0	rpm	0
msd14 actual position value rail: ...	TCM01T	23	mm	23
msd12 actual position value split...	TCM01T	20	mm	15
msd15 actual position value ran...	TCM01T	15	mm	15
msd13 actual position value gear...	TCM01T	33	mm	14
msd03 Speed countershaft: Spee...	TCM01T	0	rpm	0

2. What should you do if the split portion of the learn procedure failed ?

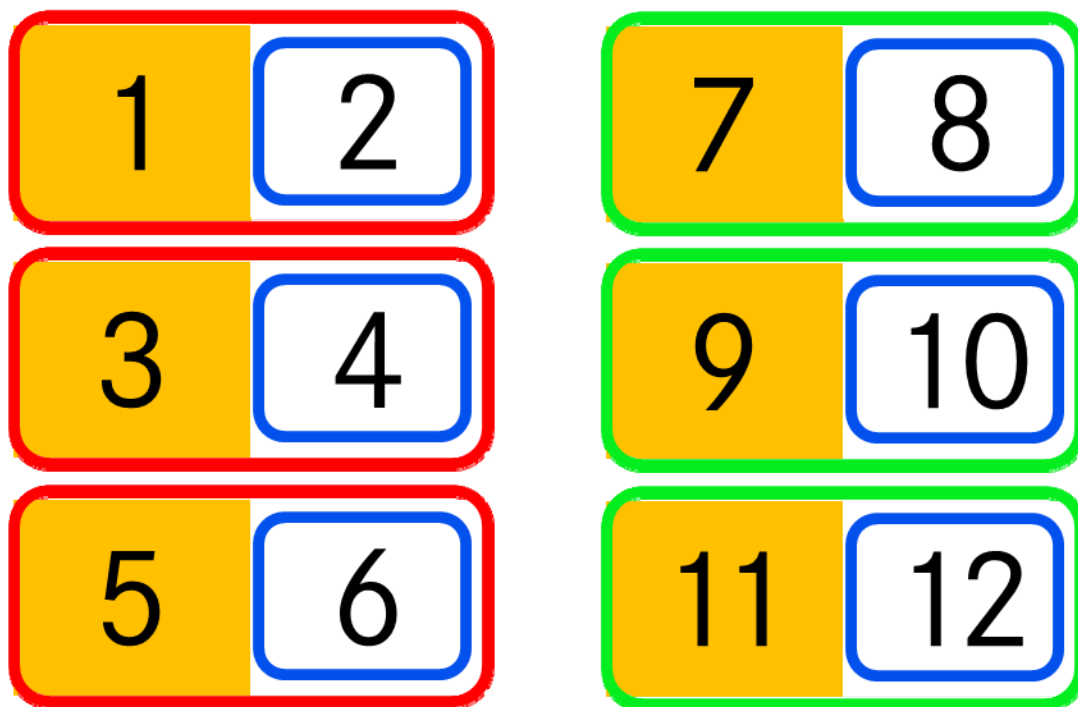


Appendix

- A. DT12 Shift Information**
 - B. DT12 Air Exercises**
 - C. Cascadia and PTCAN Information**
 - D. DT12 Related Wiring Diagrams**
 - E. Properly Towing a DT12 Vehicle**
-



SHIFT FAMILIARIZATION



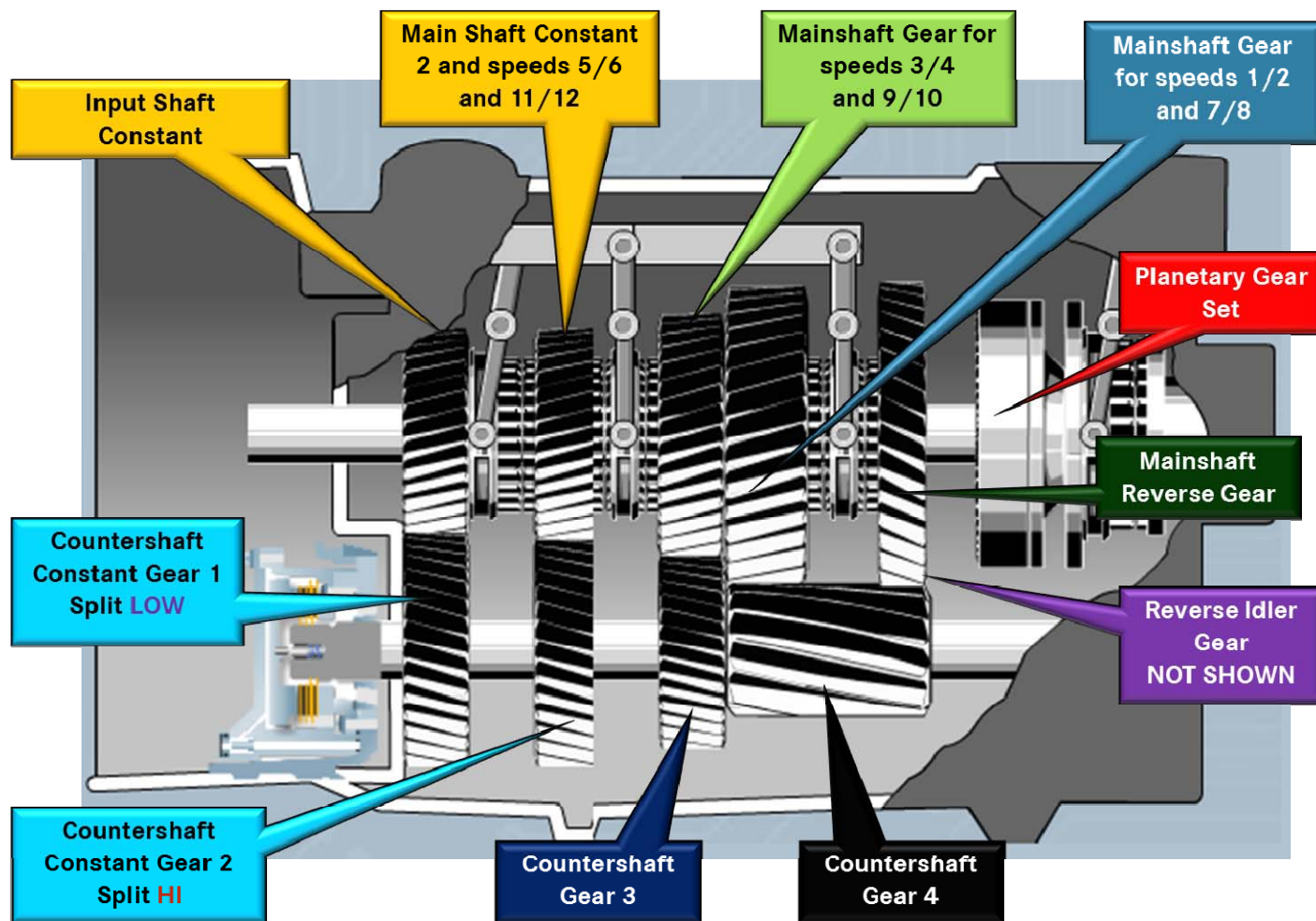
Split Low 
Split High 

Range Low 
Range High 

Shown above is a reference chart for each gear and the corresponding split and range shifts.

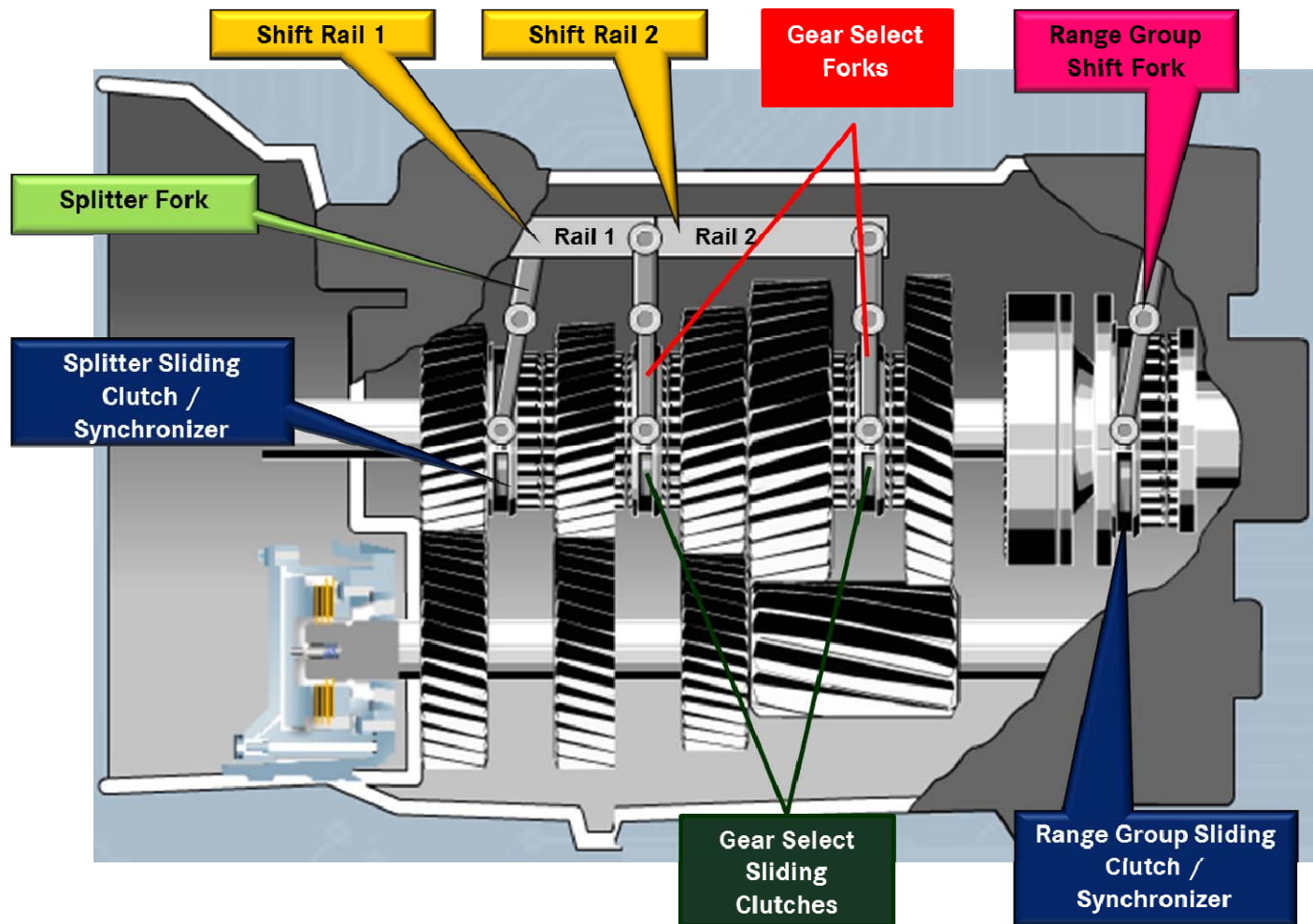


A OR B BOX DIRECT DRIVE



The following pages show the breakdown of all gears and the torque flow through the various transmission speeds.

A OR B BOX DIRECT DRIVE - CONT'D



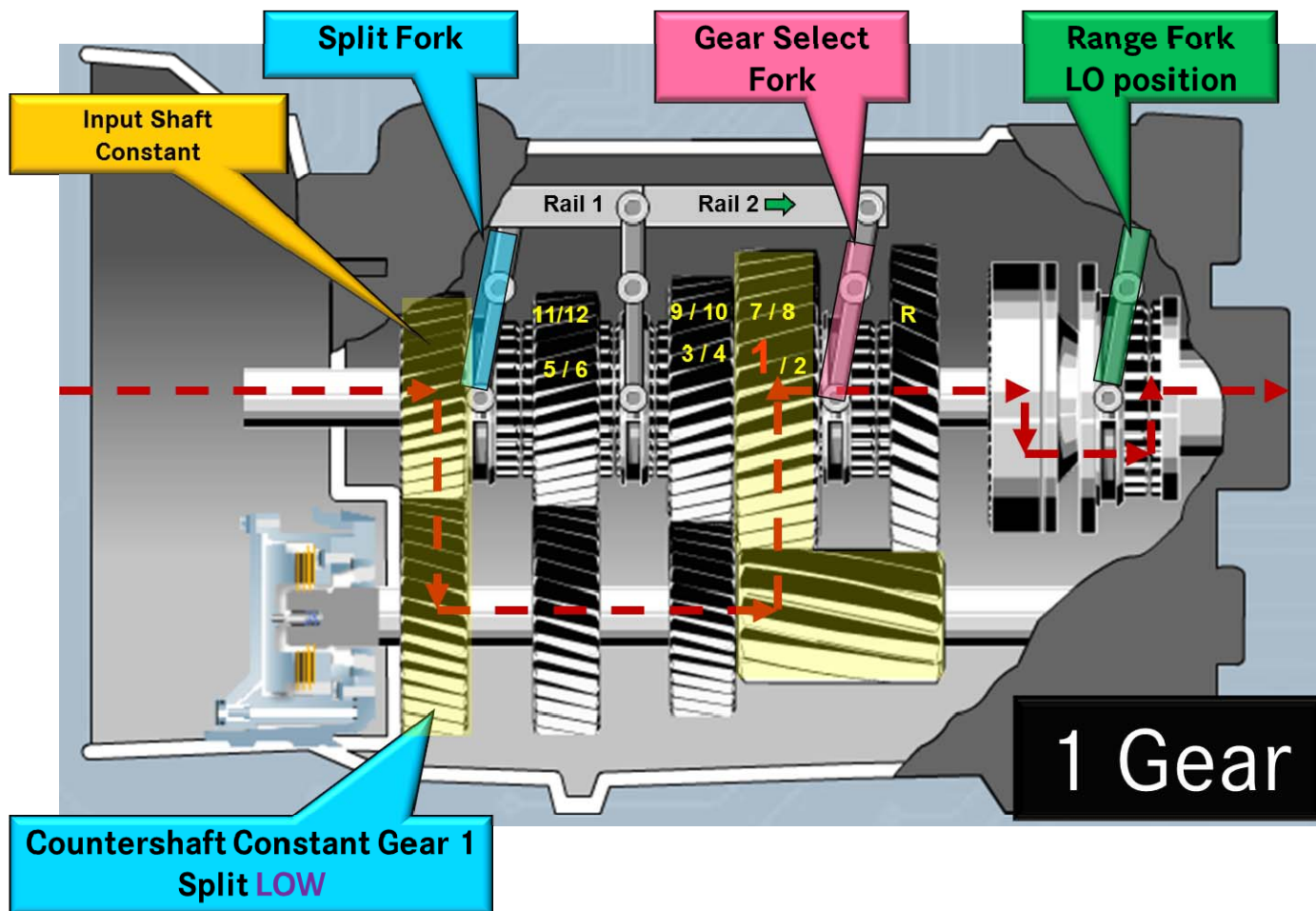


DETROIT
Transmissions

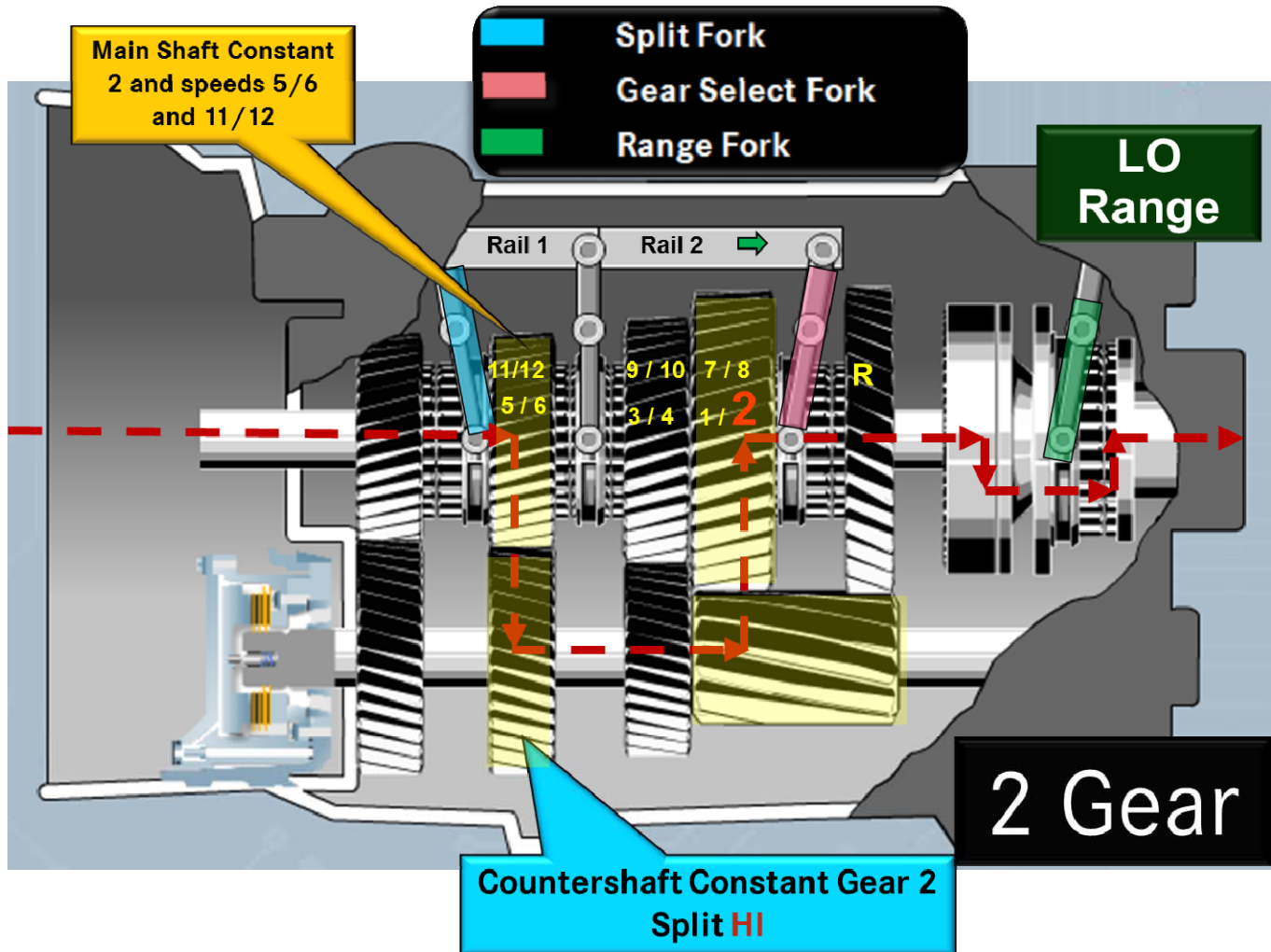
DT12

DT12 TRANSMISSIONS - DT12 APPENDIX

A OR B BOX DIRECT DRIVE - 1 GEAR



A OR B BOX DIRECT DRIVE - 2 GEAR



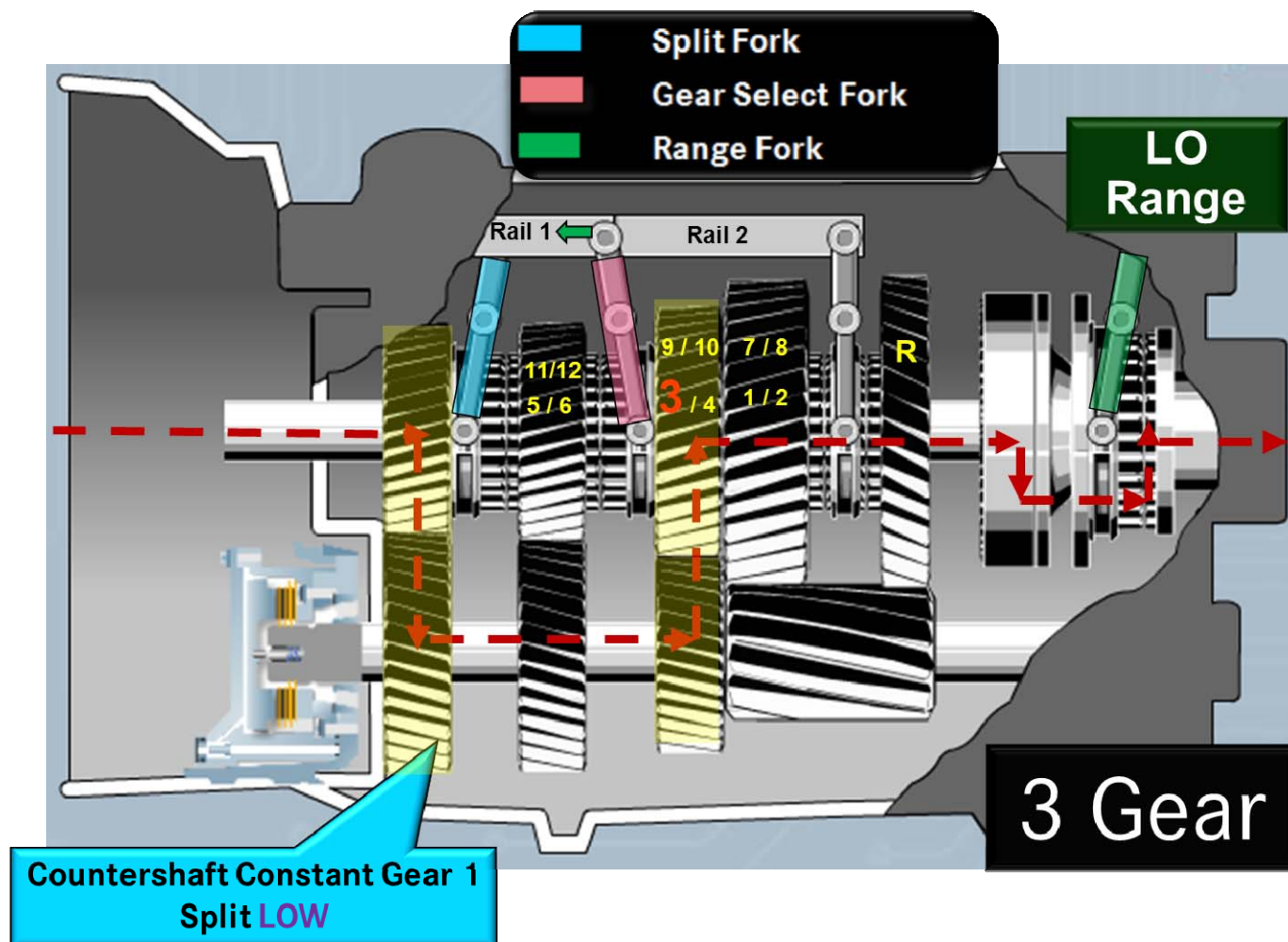


DETROIT
Transmissions

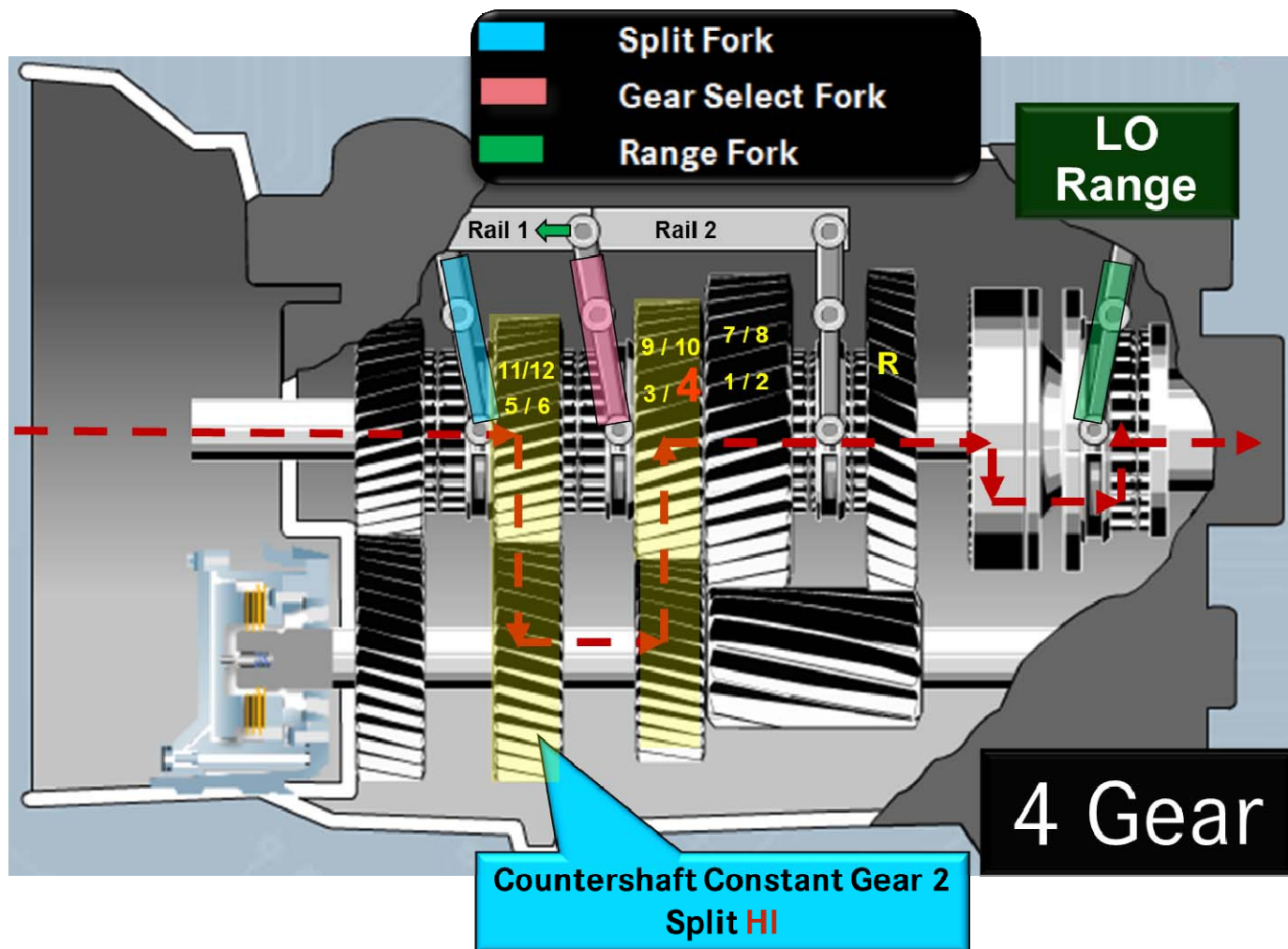
DT12

DT12 TRANSMISSIONS - DT12 APPENDIX

A OR B BOX DIRECT DRIVE - 3 GEAR



A OR B BOX DIRECT DRIVE - 4 GEAR



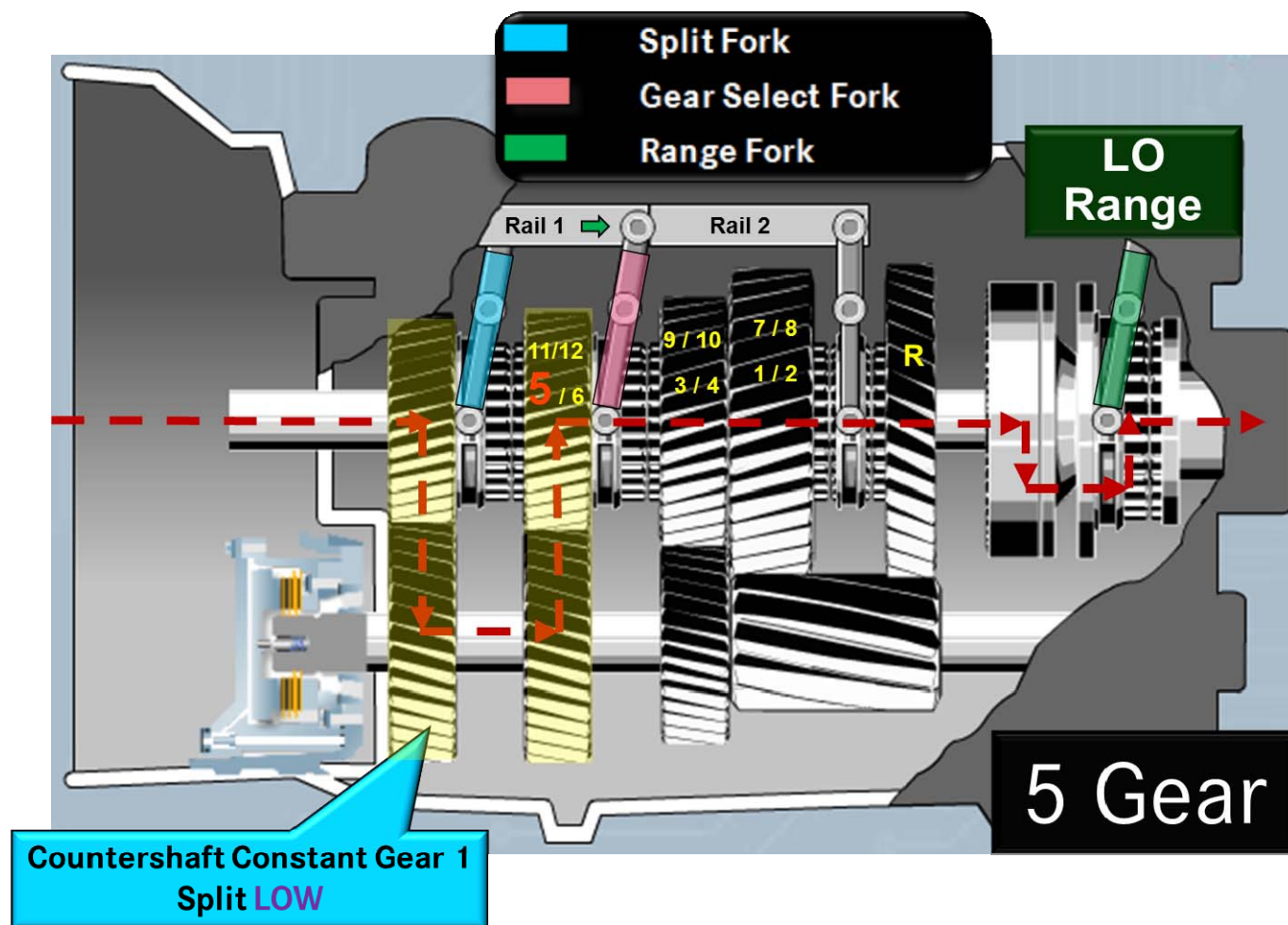


DETROIT
Transmissions

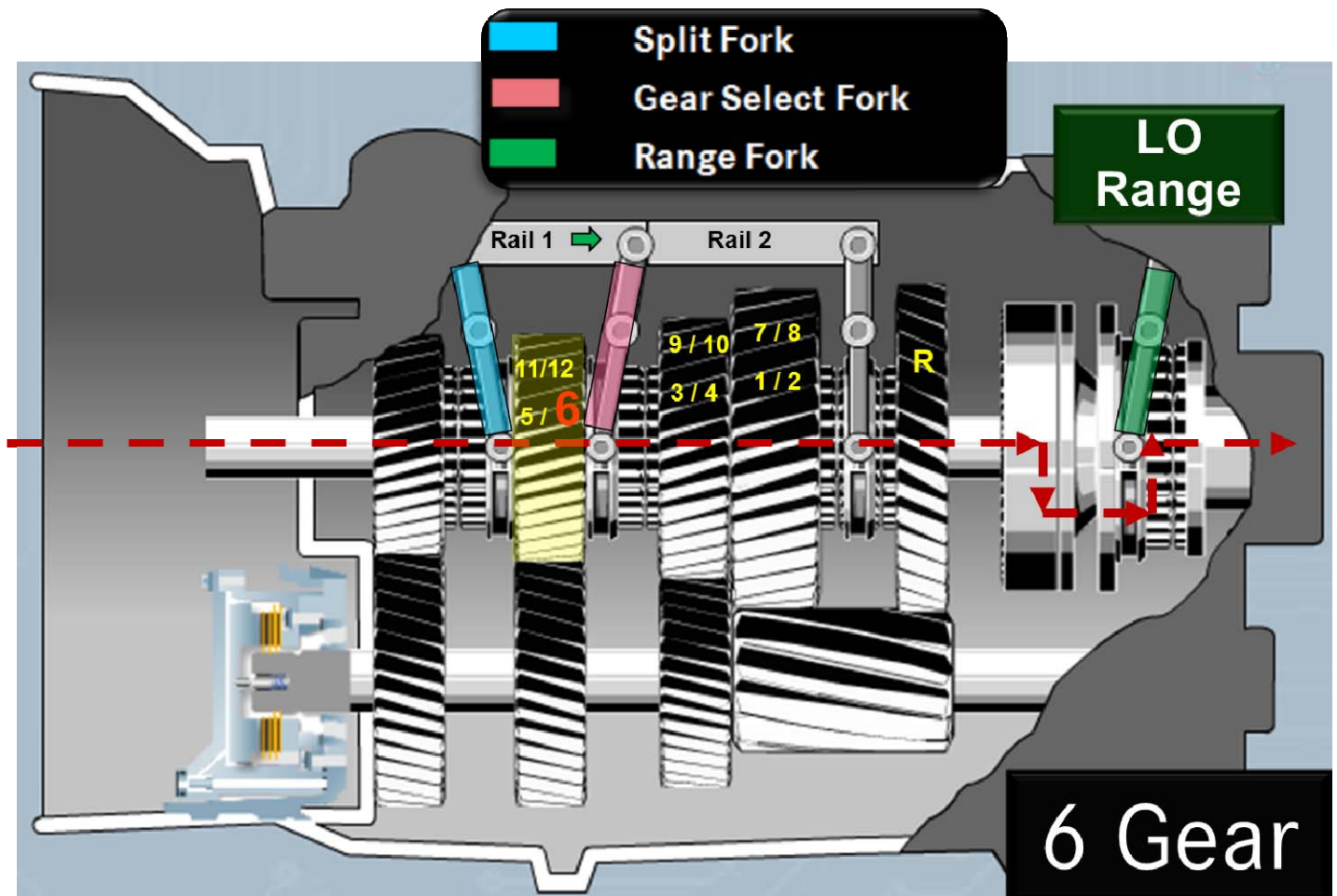
DT12

DT12 TRANSMISSIONS - DT12 APPENDIX

A OR B BOX DIRECT DRIVE - 5 GEAR



A OR B BOX DIRECT DRIVE - 6 GEAR



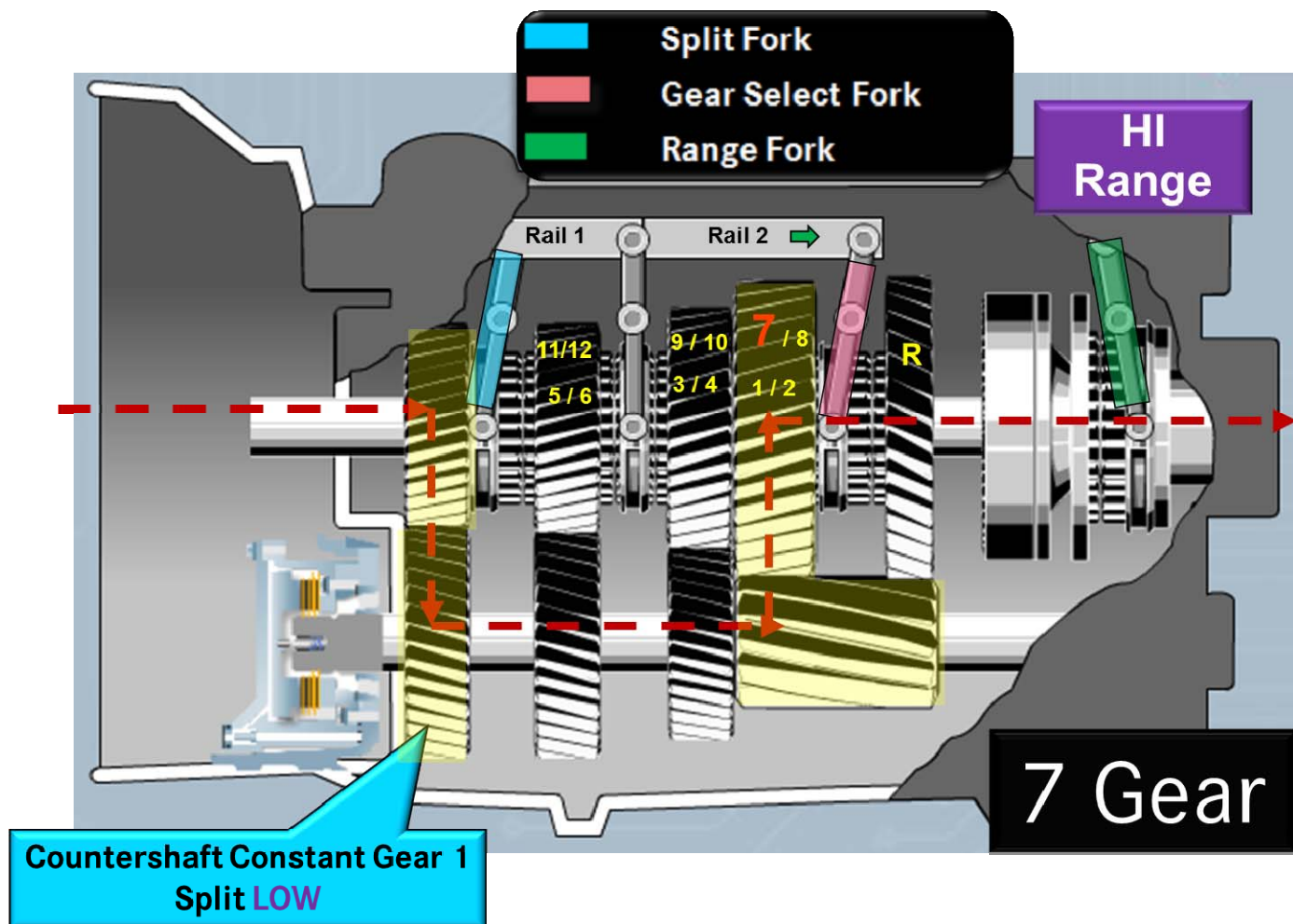


DETROIT
Transmissions

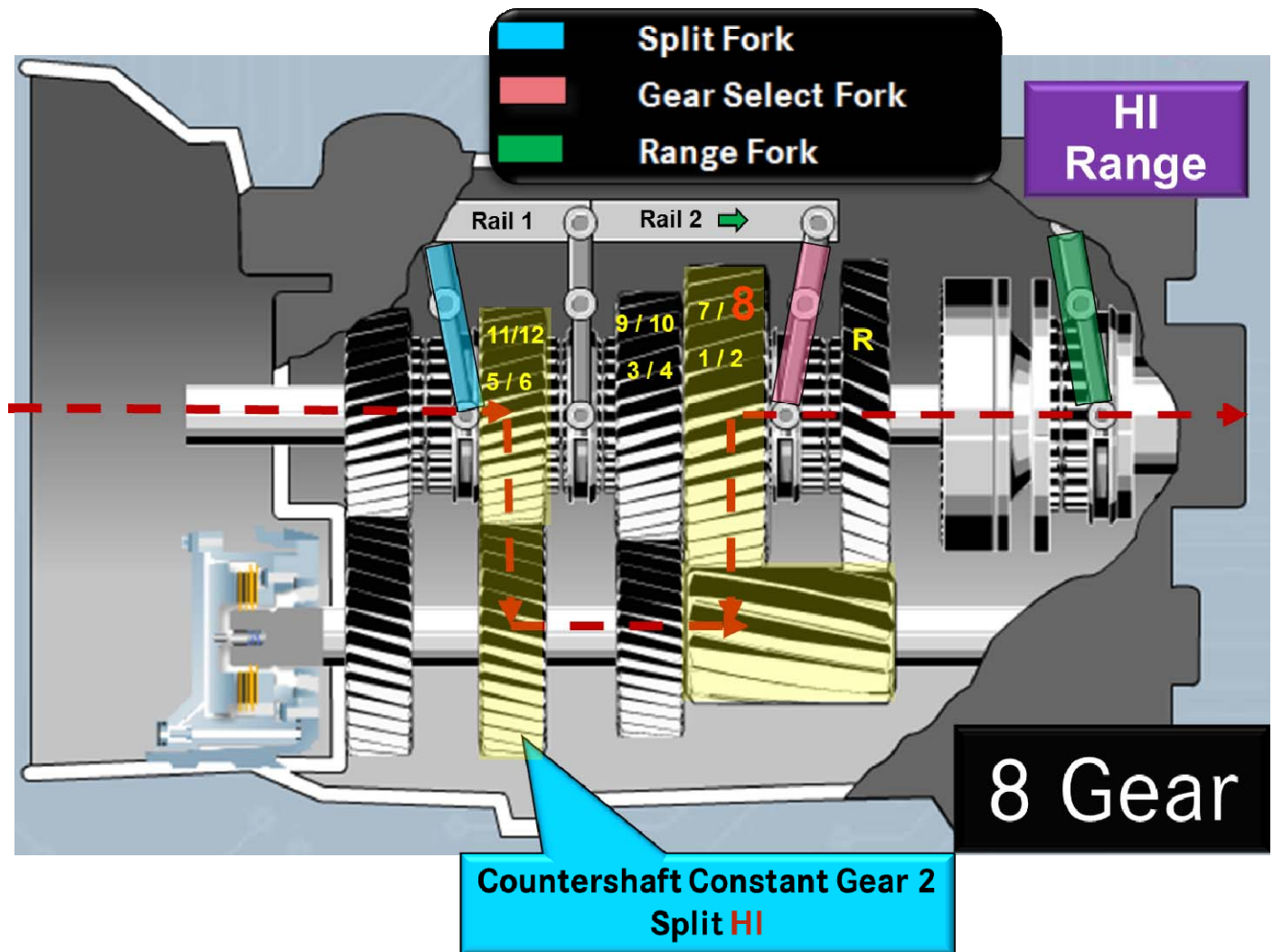
DT12

DT12 TRANSMISSIONS - DT12 APPENDIX

A OR B BOX DIRECT DRIVE - 7 GEAR



A OR B BOX DIRECT DRIVE - 8 GEAR



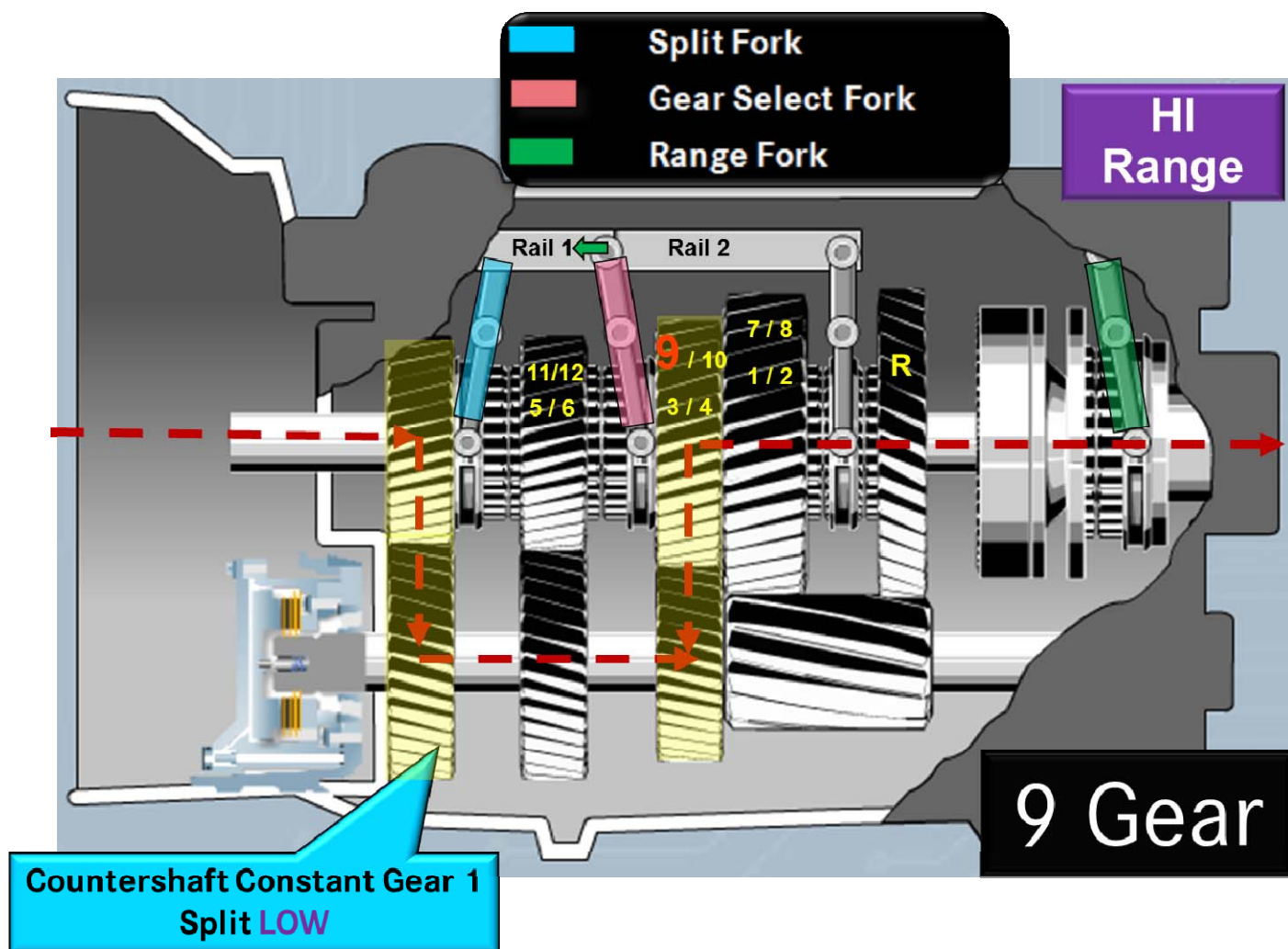


DETROIT
Transmissions

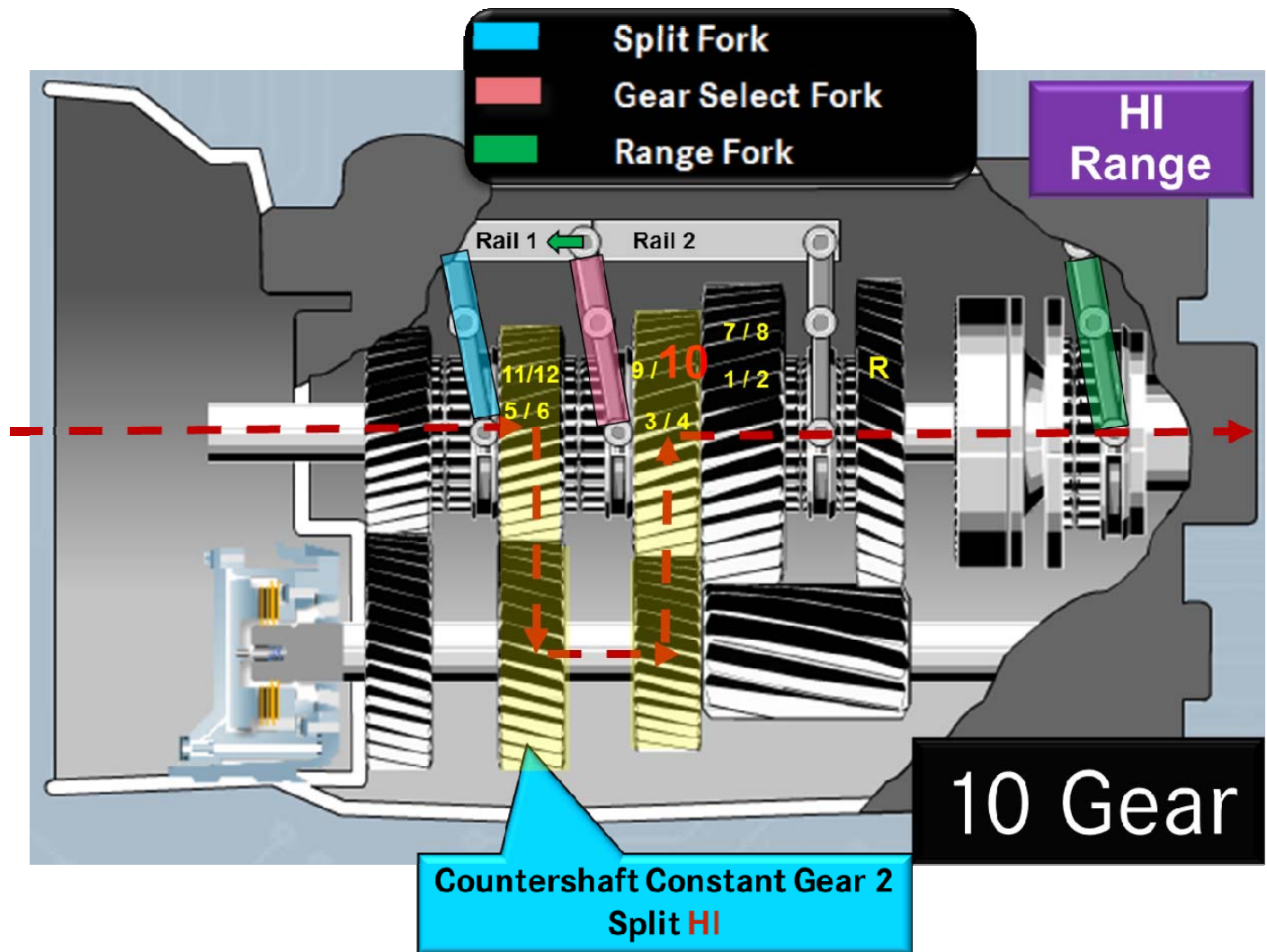
DT12

DT12 TRANSMISSIONS - DT12 APPENDIX

A OR B BOX DIRECT DRIVE - 9 GEAR



A OR B BOX DIRECT DRIVE - 10 GEAR



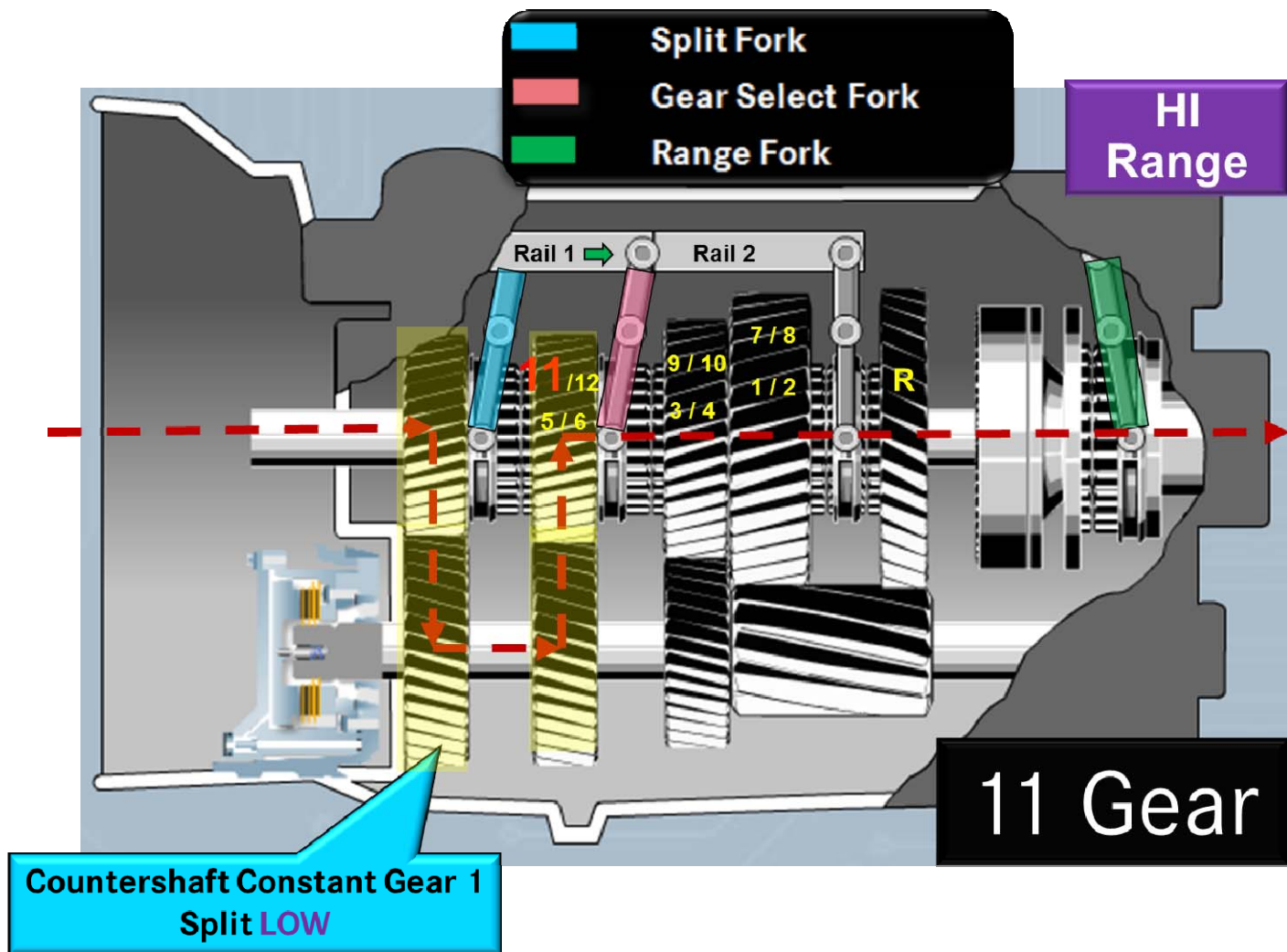


DETROIT
Transmissions

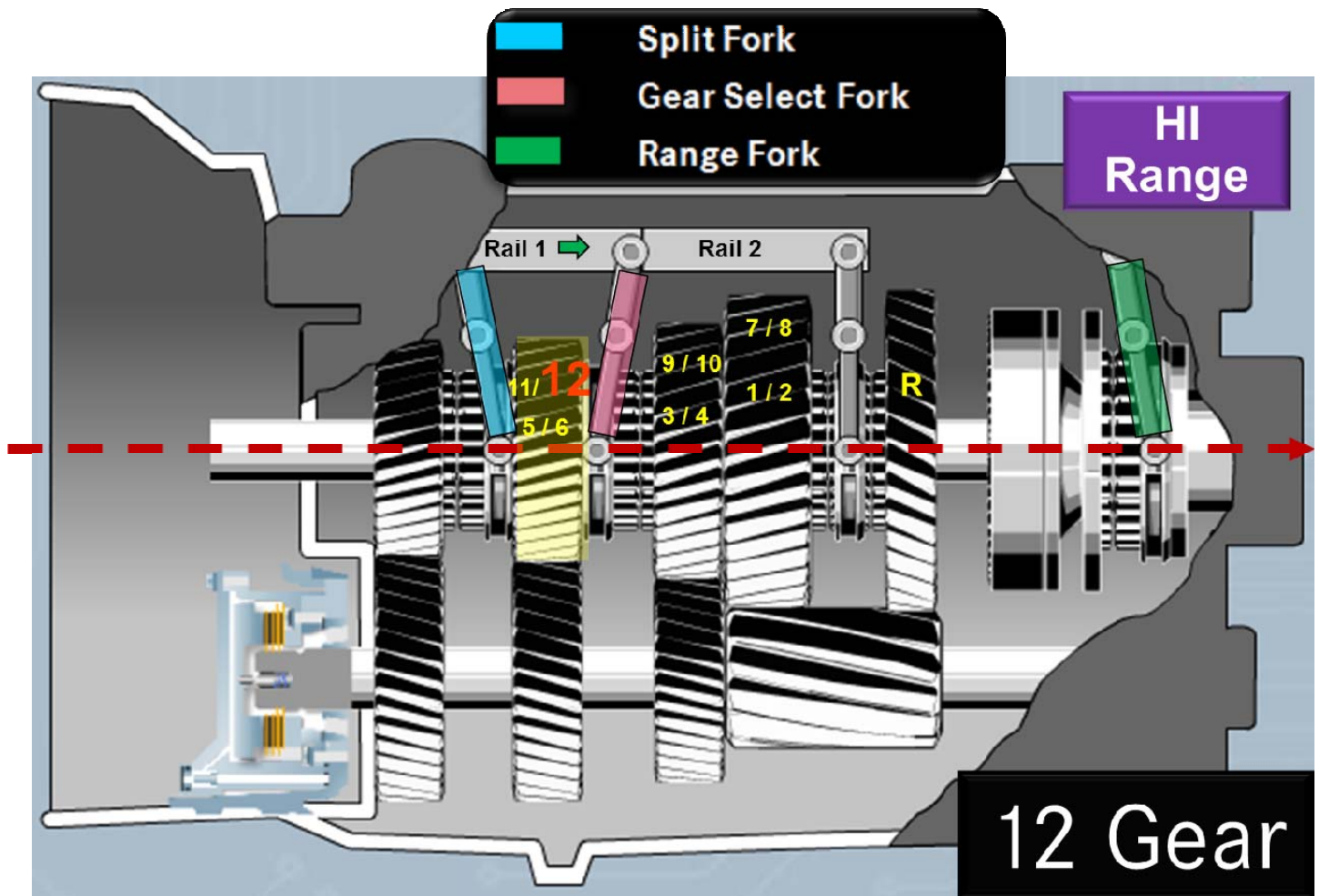
DT12

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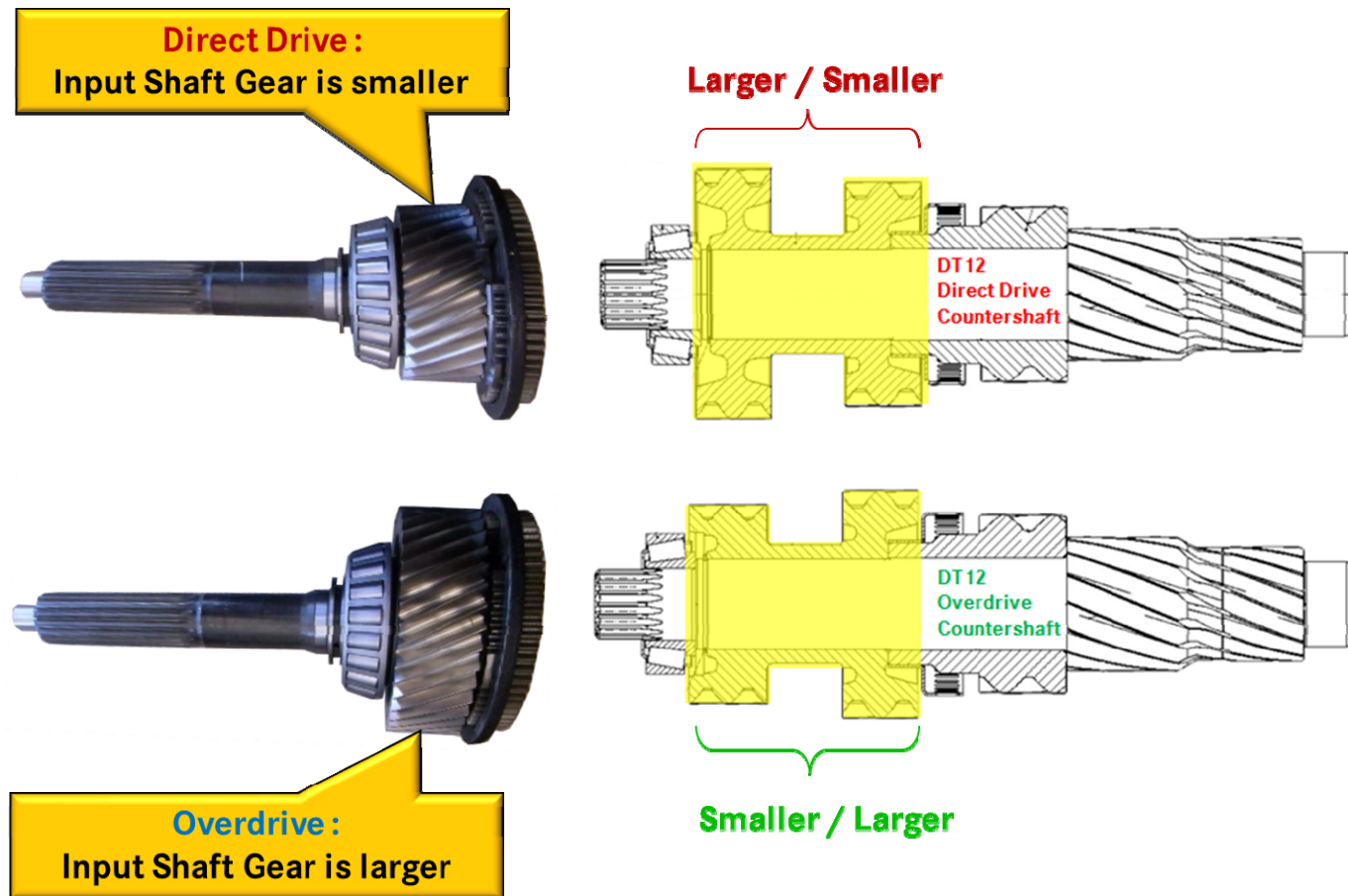
A OR B BOX DIRECT DRIVE - 11 GEAR



A OR B BOX DIRECT DRIVE - 12 GEAR



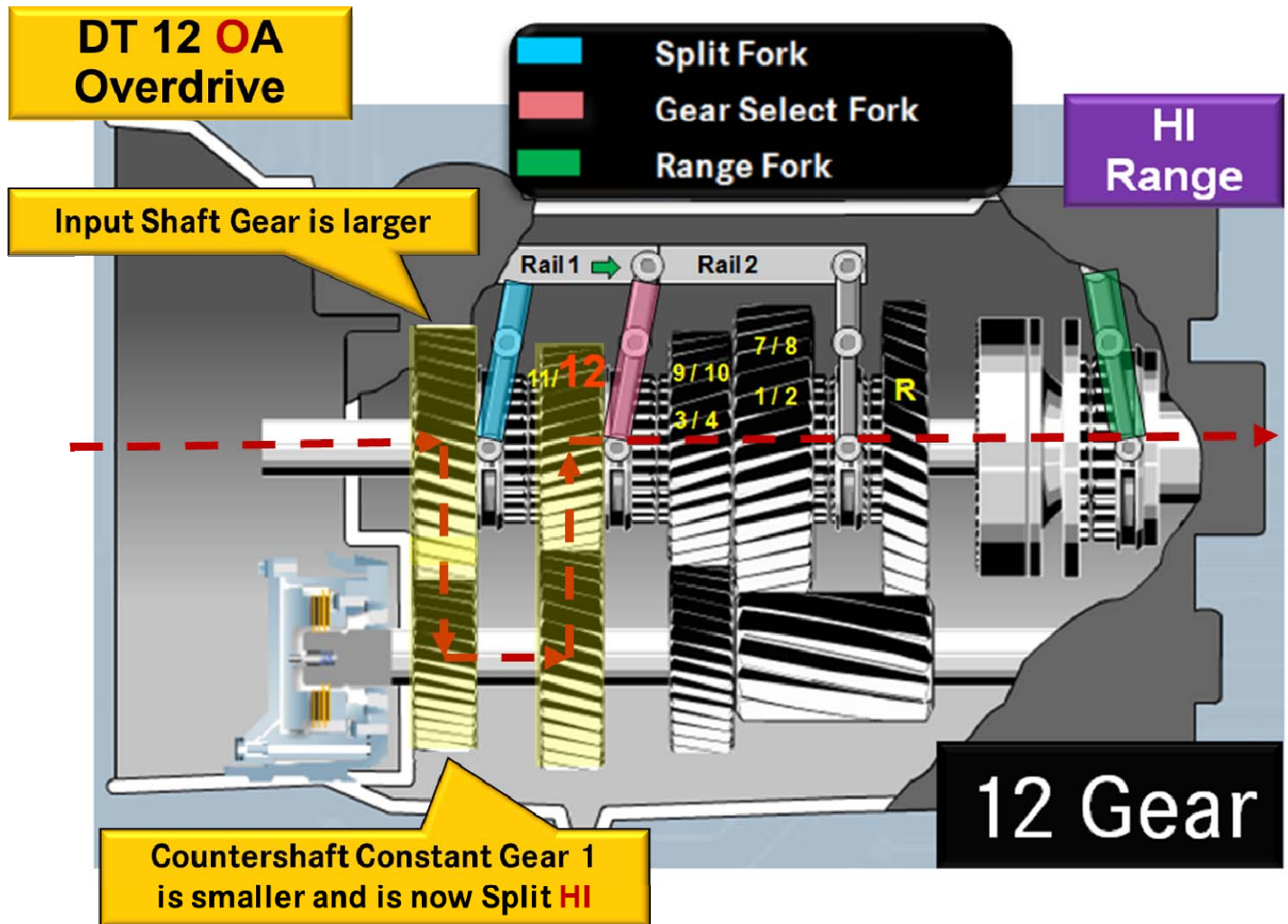
DIRECT DRIVE VS OVERDRIVE



Shown above are the differences of the input shafts and countershafts between a direct drive and overdrive. The input shaft gear on the direct drive is smaller than the input shaft gear of the overdrive.

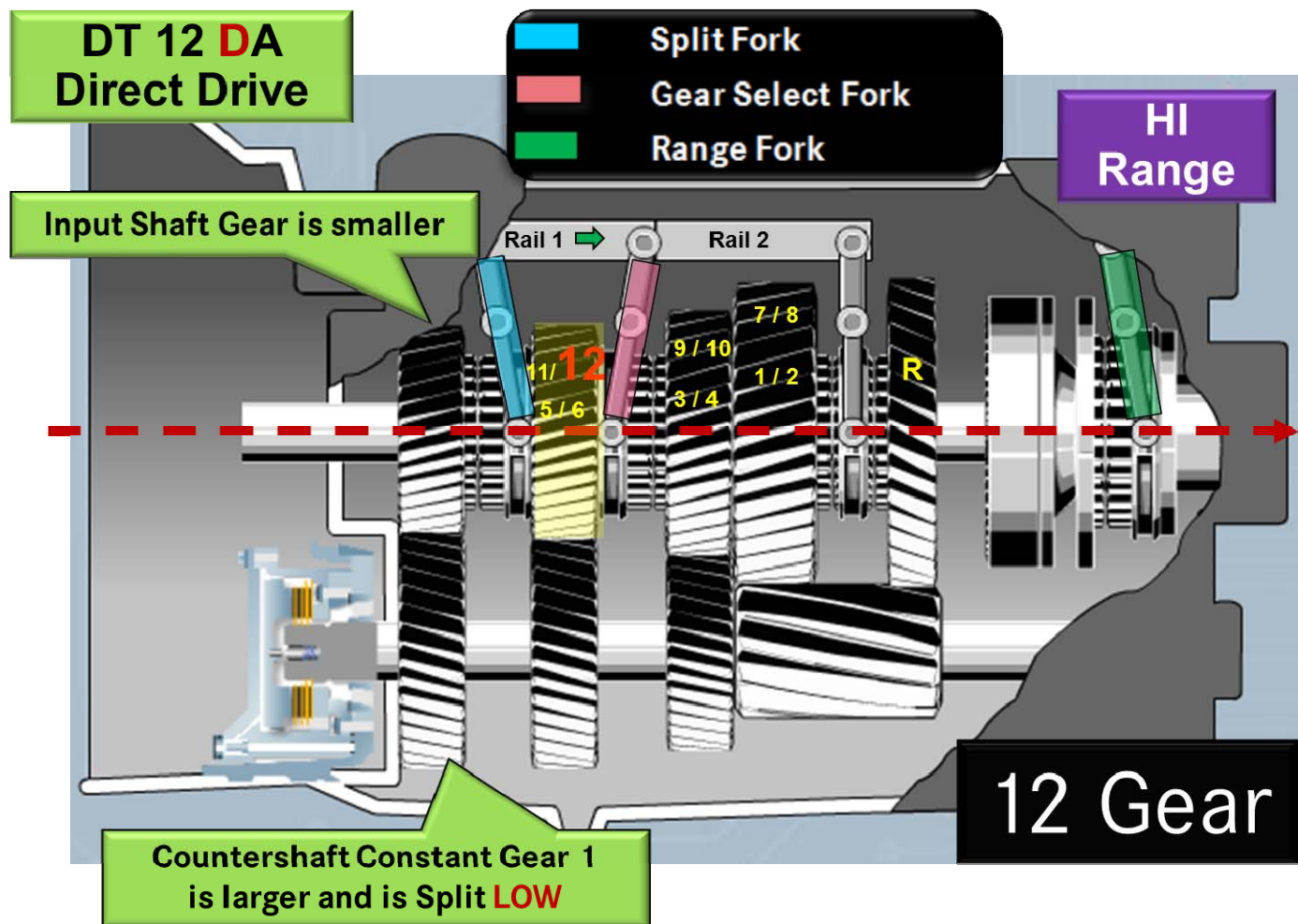
The first two countershaft gears on the direct drive have a larger / smaller configuration, while on the overdrive, it's a smaller / larger configuration.

OVERDRIVE POWER FLOW - 12 GEAR



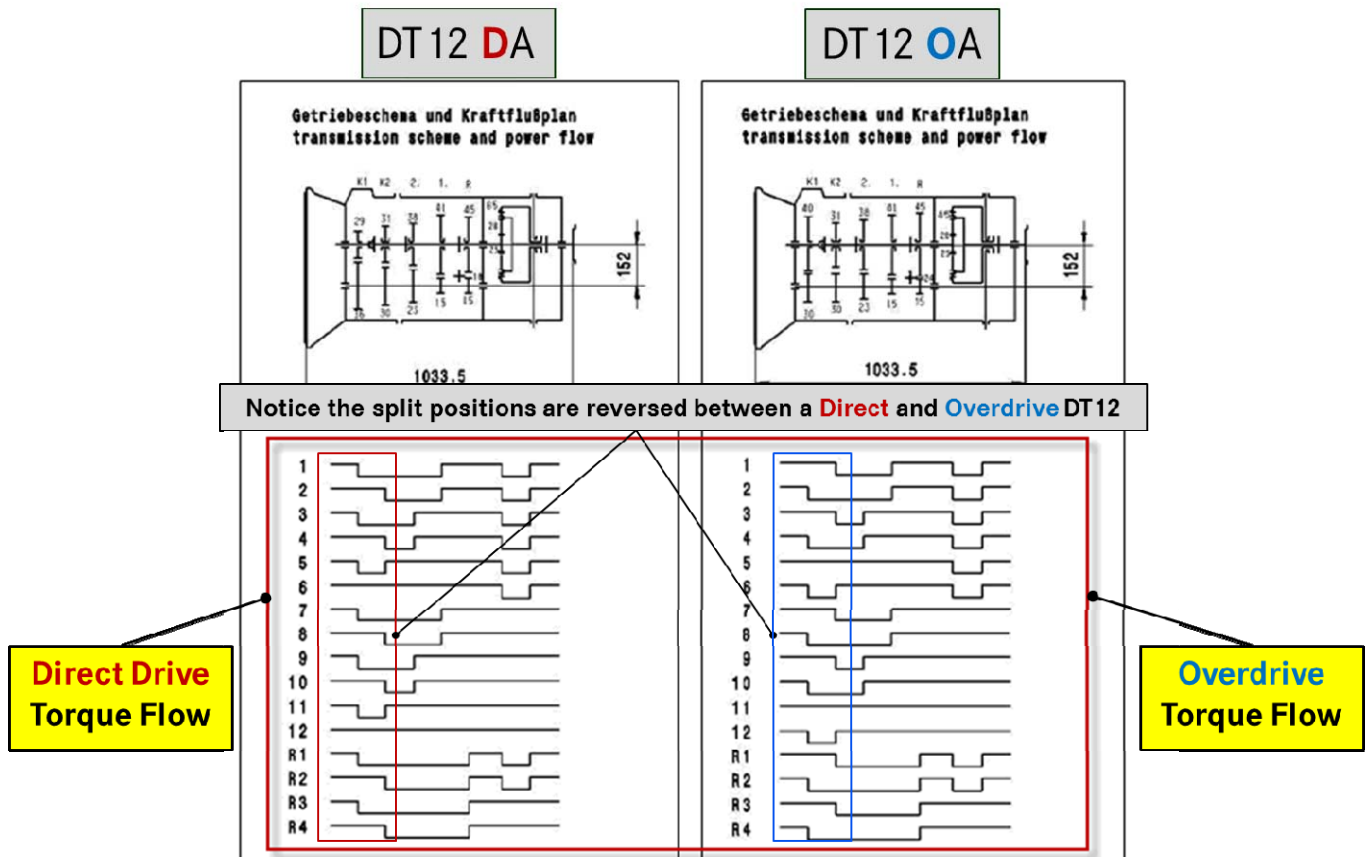
Here you can clearly see that the larger input shaft gear, as well as the smaller / larger countershaft gear combination, provides the necessary ratios to allow the output shaft to rotate faster than the input shaft - thus obtaining overdrive.

DIRECT DRIVE POWER FLOW - 12 GEAR



Direct drive power flow through in 12th gear for comparison.

DIRECT & OVERDRIVE DIFFERENCES



Here you can see the differences in torque flow between a Direct Drive and Overdrive transmission. Notice the differences in split positions between the two.

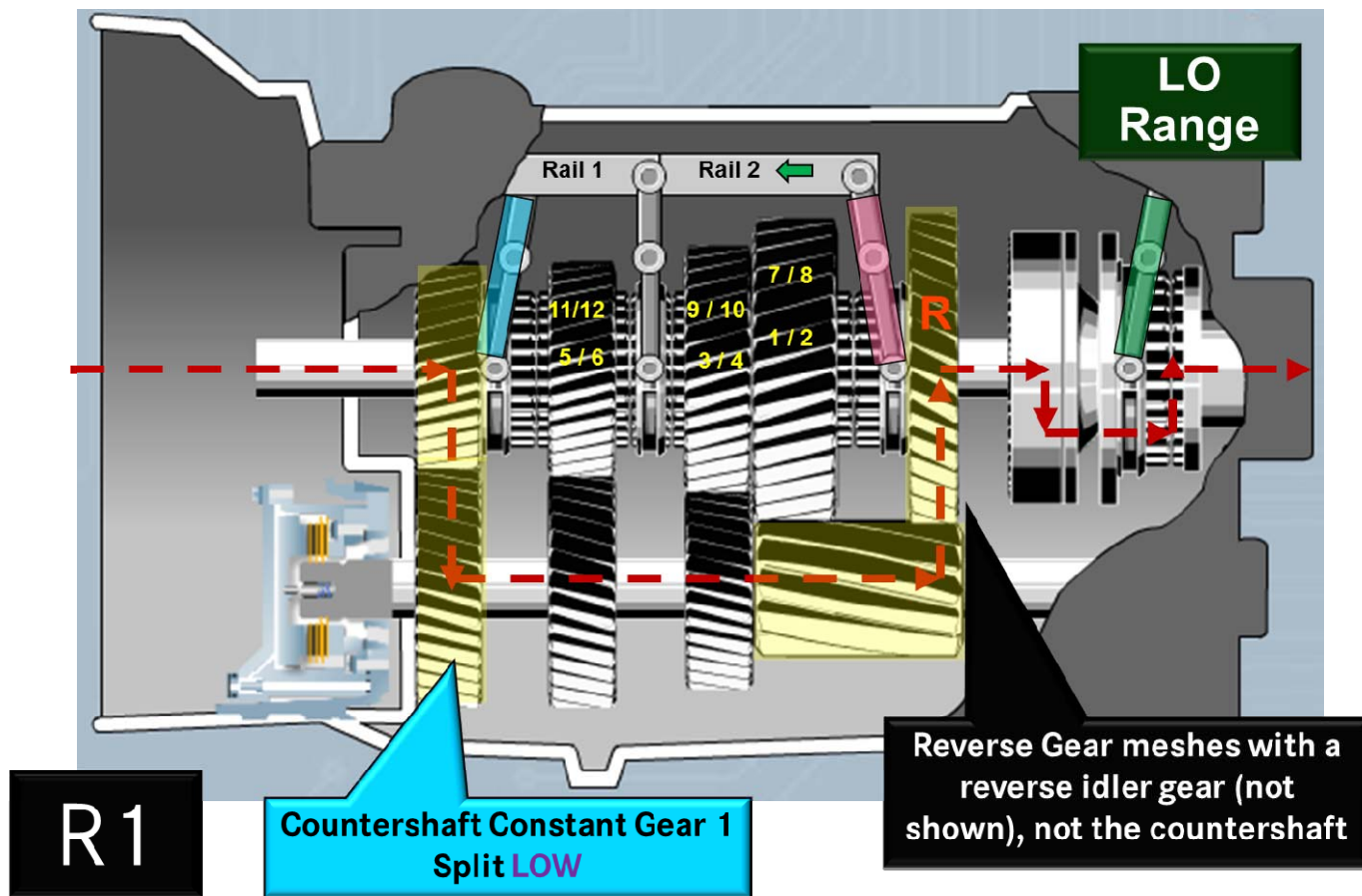


DETROIT
Transmissions

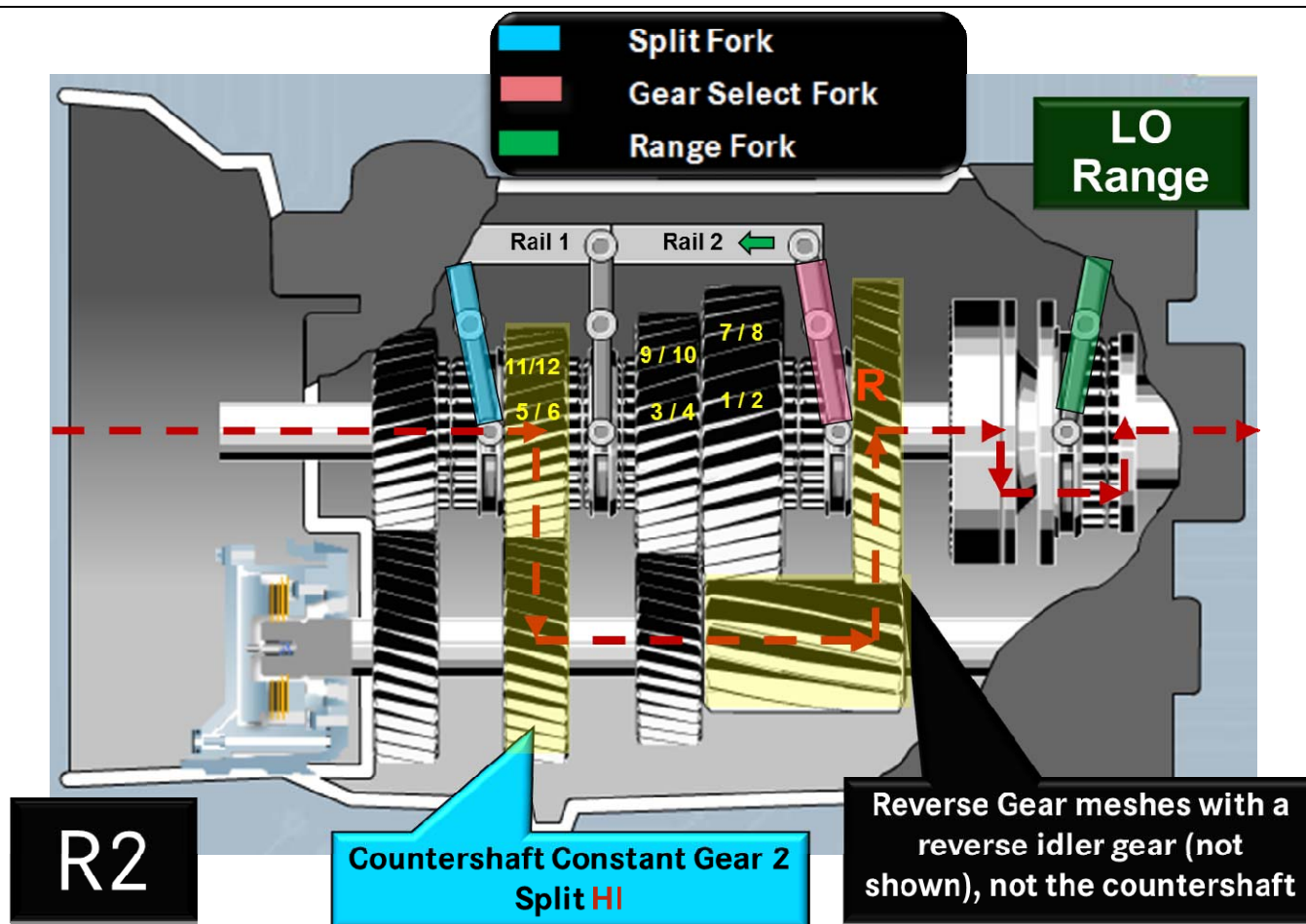
DT12

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A OR B DIRECT DRIVE - LO RANGE R1



A OR B DIRECT DRIVE - LO RANGE R2



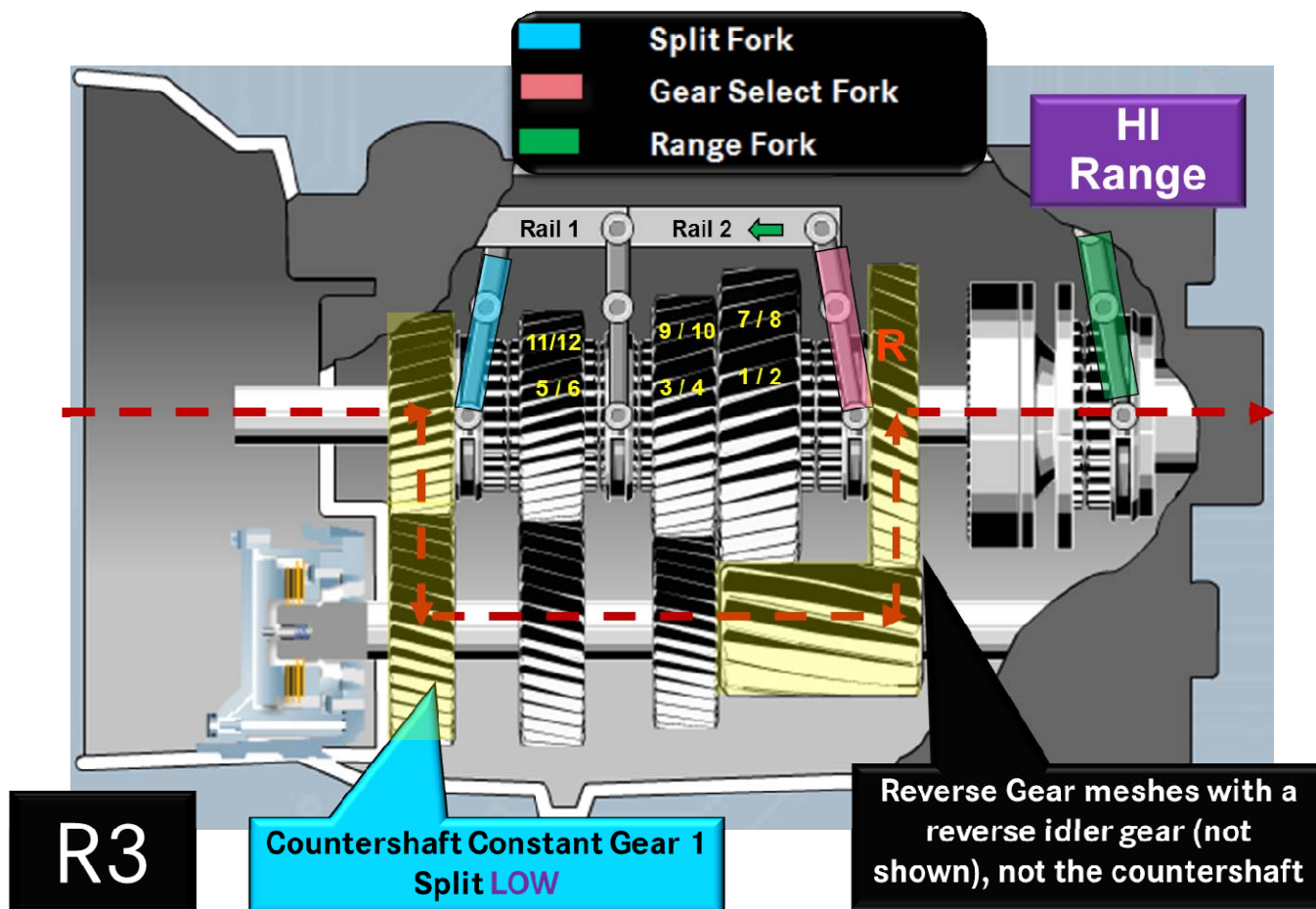


DETROIT
Transmissions

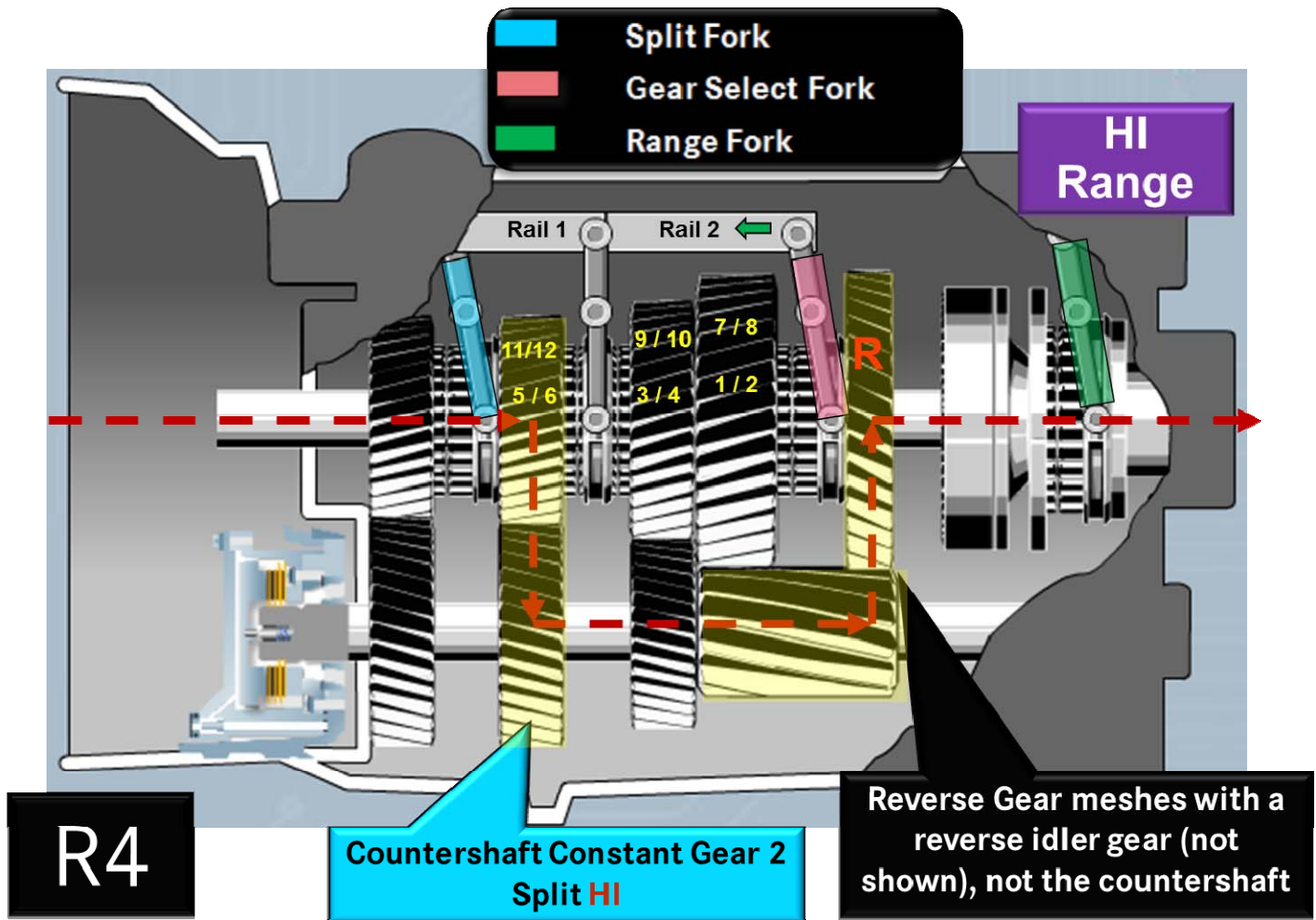
DT12

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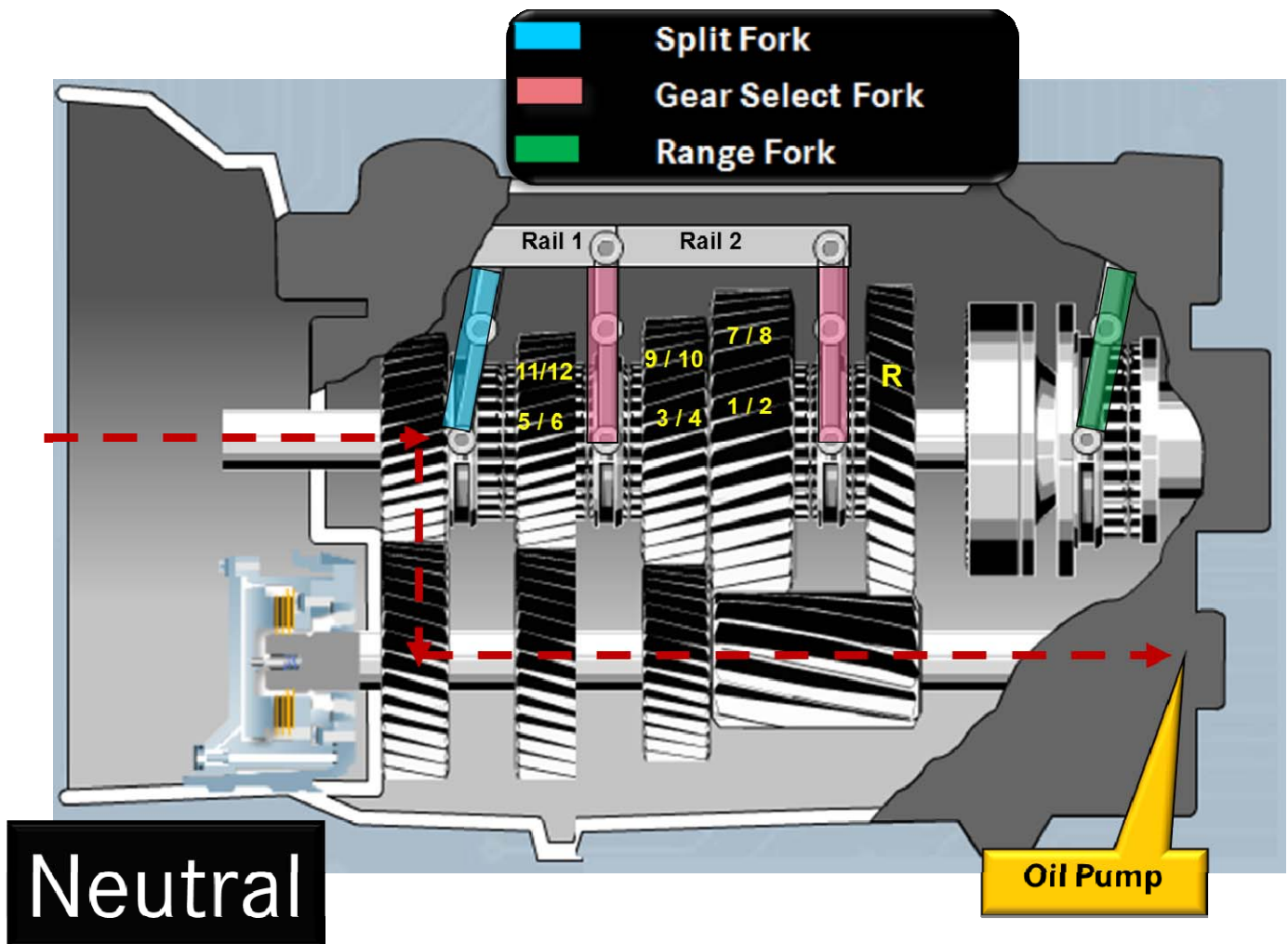
A OR B DIRECT DRIVE - HI RANGE R3



A OR B DIRECT DRIVE - HI RANGE R4



A OR B DIRECT DRIVE - NEUTRAL



Because the input shaft gear and the countershaft constant gear #1 are both fixed to their respective shafts, the countershaft will always rotate to drive the oil pump anytime the clutch is closed.

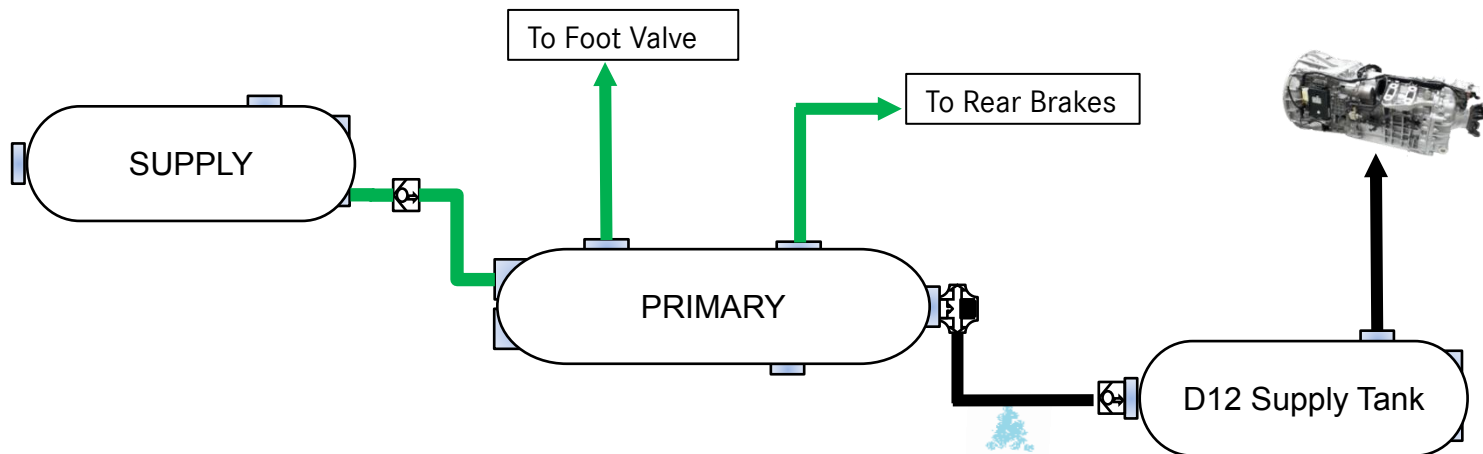
In the neutral position, NO sliding clutch collars are locking any gears to the mainshaft; however, the mainshaft gears are in fact still rotating. Because the mainshaft gears are in constant mesh with the countershaft, they will rotate anytime the countershaft is rotating. Therefore, the mainshaft gears are free-wheeling on the mainshaft whenever the transmission is in neutral.

It is critical that oil is supplied through the mainshaft drillings to lubricate the mainshaft gear needle roller bearings.

DT 12 Vehicle Exercises

The Instructor will create all leaks shown. Air system should be at full, governed pressure.

Air System Exercise: #1



Connect Diagnostic Link and select “Transmission Air Supply Pressure” and “Brake Primary Air Pressure” under the chart tab.

Monitor the transmission air and primary air pressures:

1. What did the transmission air tank pressure do?

2. What was the transmission tank’s pressure reading? _____

3. What did the primary tank pressure do?

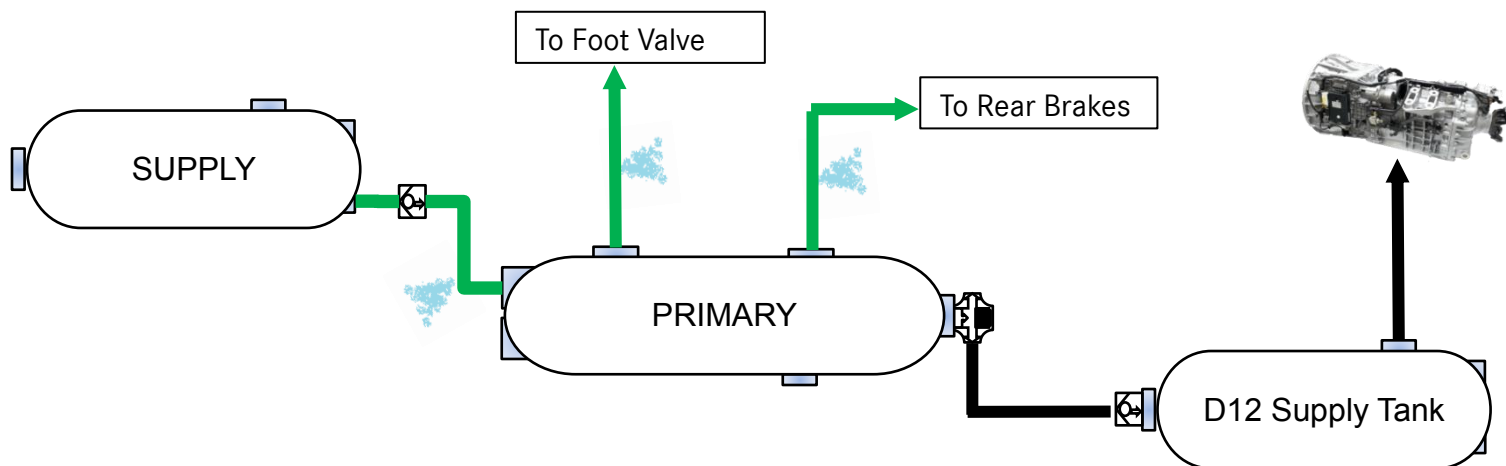
4. What was the primary tank pressure reading? _____

5. Why did the transmission tank and primary tank pressures react the way they did?

6. If the primary tank pressure dropped to 0 psi, what would be the cause?

7. If the transmission tank pressure dropped, what would be the cause?

Air System Exercise: #2



Monitor the transmission air and primary air pressures:

1. What did the transmission air tank pressure do?

2. What was the transmission tank's pressure reading?

3. What did the primary tank pressure do?

4. What was the primary tank pressure reading? _____

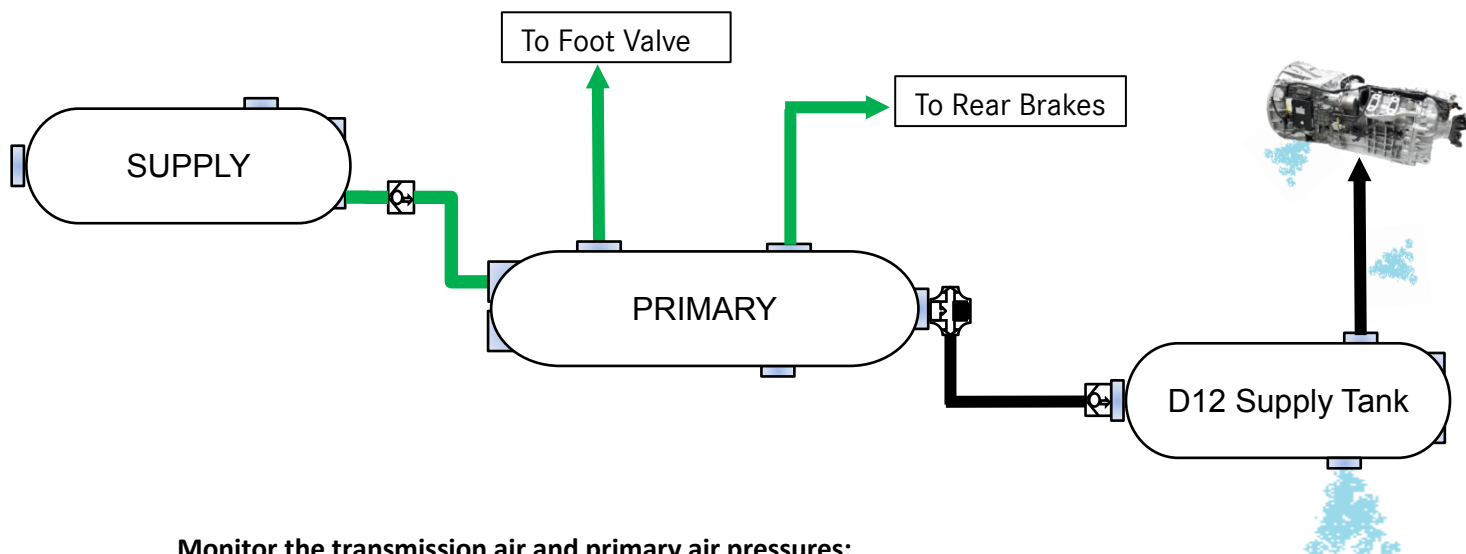


DT12

5. Why did the transmission tank and primary tank pressures react the way they did?

6. If the transmission tank pressure dropped, what would be the cause?

Air System Exercise: #3



Monitor the transmission air and primary air pressures:

1. What did the transmission air tank pressure do?

2. What was the transmission tank's pressure reading?

3. What did the primary tank pressure do?

4. What was the primary tank pressure reading?



5. Why did the transmission tank and primary tank pressures react the way they did?

6. If the primary tank pressure dropped to zero psi, what would be the cause?

7. Based on the exercises performed, can a transmission air leak cause total air system pressure loss (primary / secondary) if the PPV valve was functioning correctly and there were no other system leaks?

Air System Exercise #4

1. With the system (primary/secondary/transmission) completely drained, start the engine and observe the pressure buildup in the primary and transmission tank. At what psi does the transmission tank begin filling?

2. With only the DT12 tank drained, add clutch position in the chart in Diagnostic Link. Start the engine. What was the clutch position at engine crank? _____ Is this open or closed? _____ Release the parking brake, and engage the service brake. Cycle the rotary ring switch back and forth from N to D. At what transmission pressure does the transmission actually go into gear? _____

SS 3869 Cascadia Star Point and Detroit Share Point Information

APPLICABILITY:

This is an informational solution that is being released to bring awareness to the two Starpoint junction blocks used on Cascadia vehicles, with EPA 2013 / GHG 2014 HDEP engines. This solution only applies to these vehicles.

INFORMATION:

Both the PTCAN Share point and the Cascadia SAM module CAN link, Star point have identical mounting and similar appearance. Both components use a connector structure that is interchangeable. The primary visual difference between the two components is the connector color. The engine PTCAN Share point (part number A06-57000-002 CONFIG-JCTN BLK,PTCAN SPOINT) has a yellow connector, while the Cascadia SAM module CAN link Star point (part number A06-57000-001 CONFIG-JUNCTION BLK,STARPOINT) has a black connector . Since both use a connector structure that is interchangeable, care should be taken when mounting and hooking up the connectors to both components. The two components have different resistance values and are not interchangeable. Reference the attachment to view the components mounting locations and part number.

Solution ID: 3869

Cascadia Star Point

Part Number

A06-57000-001

CONFIG-JUNCTION BLK,STARPOINT



Detroit Engine PTCAN

Part Number

A06-57000-002

CONFIG-JCTN BLK,PTCAN





DETROIT
Transmissions

DT12

DT12 TRANSMISSIONS - DT12 APPENDIX

