



INTRODUCTION

*1st Printing
September, 2010*

TOUAREG, AUDI Q7, PORSCHE CAYENNE TR60SN "09D" Transmission

The Japanese company AISIN Co., LTD is the manufacturer and developer of the Rear Wheel Drive TR60SN transmission, which is a 6 speed, fully automatic and electronic controlled transmission. Volkswagen engineers were also involved, in conjunction with Aisin, in the development process for their vehicles and Volkswagen gave it the "09D" designation.

The TR60SN, 09D transmission is used in a wide variety of applications and engine sizes. As a result, the number of friction plates, and planetary gears (3 or 4 pinion), will vary depending on torque load requirements of the specific vehicle. The TR60SN transmission uses a gear ratio sensitive system, requiring the correct transmission interchange. The TR60-SN is currently used in the Porsche Cayenne, Volkswagen Touareg, and Audi Q7 vehicles.

The 09D transmission uses a Lepelletier arrangement, using a simple planetary coupled with a Ravigneaux type, dual planetary. This is the same type of gear set that was used in the FMX. This arrangement makes six forward speeds and reverse possible, with only five clutch packs and one freewheel.

This manual contains the procedures necessary to diagnose, rebuild and/or repair the TR60SN "09D" transmission and is intended for automotive technicians that are familiar with the operation of automatic transmissions.

We wish to thank Volkswagen® for the information that has made this booklet possible.

No part of any ATSG publication may be reproduced, stored in any retrieval system or transmitted in any form or by any means, including but not limited to electronic, mechanical, photocopying, recording or otherwise, without *written* permission of Automatic Transmission Service Group. This includes all text illustrations, tables and charts.

The information and part numbers contained in this booklet have been carefully compiled from industry sources known for their reliability, but ATSG does not guarantee its accuracy.

Copyright © ATSG 2010

WAYNE COLONNA
PRESIDENT

PETER LUBAN
TECHNICAL CONSULTANT

GERALD CAMPBELL
TECHNICAL CONSULTANT

JON GLATSTEIN
TECHNICAL CONSULTANT

GABE DE LOS REYES
TECHNICAL CONSULTANT

DALE ENGLAND
FIELD SERVICE CONSULTANT

JIM DIAL
TECHNICAL CONSULTANT

ED KRUSE
TECHNICAL CONSULTANT

GREGORY LIPNICK
TECHNICAL CONSULTANT

DAVID CHALKER
TECHNICAL CONSULTANT

ROLAND ALVAREZ
TECHNICAL CONSULTANT

GREG CATANZARO
TECHNICAL CONSULTANT

AUTOMATIC TRANSMISSION SERVICE GROUP
18635 S.W. 107 AVENUE
CUTLER BAY, FLORIDA 33157
(305) 670-4161



**TOUAREG, AUDI Q7,
PORSCHE CAYENNE
TR60SN "09D"**

INDEX

GENERAL DESCRIPTION AND VEHICLE APPLICATION CHART	3
COMPONENT APPLICATION CHART	4
IDENTIFICATION TAG LOCATION AND INFORMATION	5
CHECK FLUID LEVEL AND FLUID SPECIFICATIONS	6
SPEED SENSOR INFORMATION	7
PRESSURE SWITCH AND FLUID TEMPERATURE SENSOR INFORMATION	9
SOLENOID LOCATIONS AND IDENTIFICATION	10
INDIVIDUAL SOLENOID FUNCTION AND FAILURE RESULT	11
SOLENOID APPLICATION CHART	12
SOLENOID OPERATION	13
PASS-THRU CASE CONNECTORS AND WIRE HARNESS'	15
CASE CONNECTOR TERMINAL IDENTIFICATION	16
CASE CONNECTOR INTERNAL COMPONENT RESISTANCE CHARTS	17
TCM CONNECTOR INTERNAL COMPONENT RESISTANCE CHARTS	18
TRANSAXLE RANGE SWITCH OPERATION AND DIAGNOSIS	19
STANDARD AND TIPTRONIC SHIFT QUADRANTS	21
EMERGENCY "LIMP" MODE AND TOWING INFORMATION	22
TYPICAL WIRE SCHEMATIC	23
DIAGNOSTIC TROUBLE CODE DESCRIPTION	24
PRESSURE SPECIFICATIONS	26
PRESSURE TAP LOCATIONS AND IDENTIFICATION	27
OIL PASSAGE IDENTIFICATION	28
TRANSMISSION DISASSEMBLY	31
COMPONENT REBUILD	
TRANSMISSION CASE ASSEMBLY	52
K2 CLUTCH HOUSING ASSEMBLY	57
OUTPUT SHAFT, REAR RING GEAR ASSEMBLY	62
REAR PLANETARY ASSEMBLY	65
F1 SPRAG ASSEMBLY	66
SUN GEARS AND THRUST BEARINGS	68
K1 CLUTCH HOUSING ASSEMBLY	71
K3 CLUTCH HOUSING ASSEMBLY	75
TORQUE CONVERTER OPERATION, "2-Port" And "3-Port" Differences	79
OIL PUMP DIFFERENCES	80
TURBINE SHAFT DIFFERENCES	81
FRONT PLANETARY ASSEMBLY	82
OIL PUMP ASSEMBLY	86
VALVE BODY ASSEMBLY	91
"UPDATED" 2005-UP VALVE BODY INFORMATION	103
TRANSMISSION FINAL ASSEMBLY	114
B2 CLUTCH CLEARANCE MEASUREMENT	116
F1 ROLLER CLUTCH FREEWHEEL DIRECTION	118
B1 CLUTCH CLEARANCE MEASUREMENT	123
TRANSMISSION END-PLAY MEASUREMENT	124
TORQUE SPECIFICATIONS	133
THRUST WASHER AND BEARING IDENTIFICATION	134

AUTOMATIC TRANSMISSION SERVICE GROUP

18635 S.W. 107 AVENUE
CUTLER BAY, FLORIDA 33157
(305) 670-4161

Copyright © ATSG 2010



Technical Service Information

GENERAL DESCRIPTION

The Japanese company AISIN Co., LTD is the manufacturer and developer of the Rear Wheel Drive TR-60SN transmission, which is a 6 speed, fully automatic and electronic controlled gearbox. Volkswagen engineers were also involved, in conjunction with Aisin, in the development process for their vehicles and they gave it the 09D designation. Vehicle applications and transmission codes known at time of printing, are shown in Figure 1.

The 09D transmission is used in a wide variety of applications and engine sizes. As a result, the number of friction plates and three or four pinion carriers, will vary depending on torque load requirements of the specific vehicle. The 09D transmission uses a gear ratio sensitive system, *requiring* the correct transmission interchange, if that becomes necessary.

The Transmission Control Module (TCM) is mounted external from the transmission which makes typical electrical diagnosis available to the technician.

The TCM controls both shift timing and shift feel with the use of eight solenoids. The TCM monitors gear ratio through the input and output shaft hall effect speed sensors. It also can determine the rate of change and adapt the shifts as the friction elements wear.

TR-60SN (09D) transmissions use a Lepelletier type gear set arrangement, which consists of a simple planetary with the sun gear splined to the pump stator and coupled with a Ravigneaux type, dual planetary. This is similar to but not the same, as the type of planetary that was used in the FMX. This arrangement allows the sun gears and the planetary pinions of the Ravigneaux planetary gear-set to be driven at different speeds and makes six forward speeds and reverse possible, with only five clutch packs and one freewheel.

Lepelletier's brilliant idea has led to several different manufacturers using this gear set arrangement in their own versions of six forward speeds transmissions.

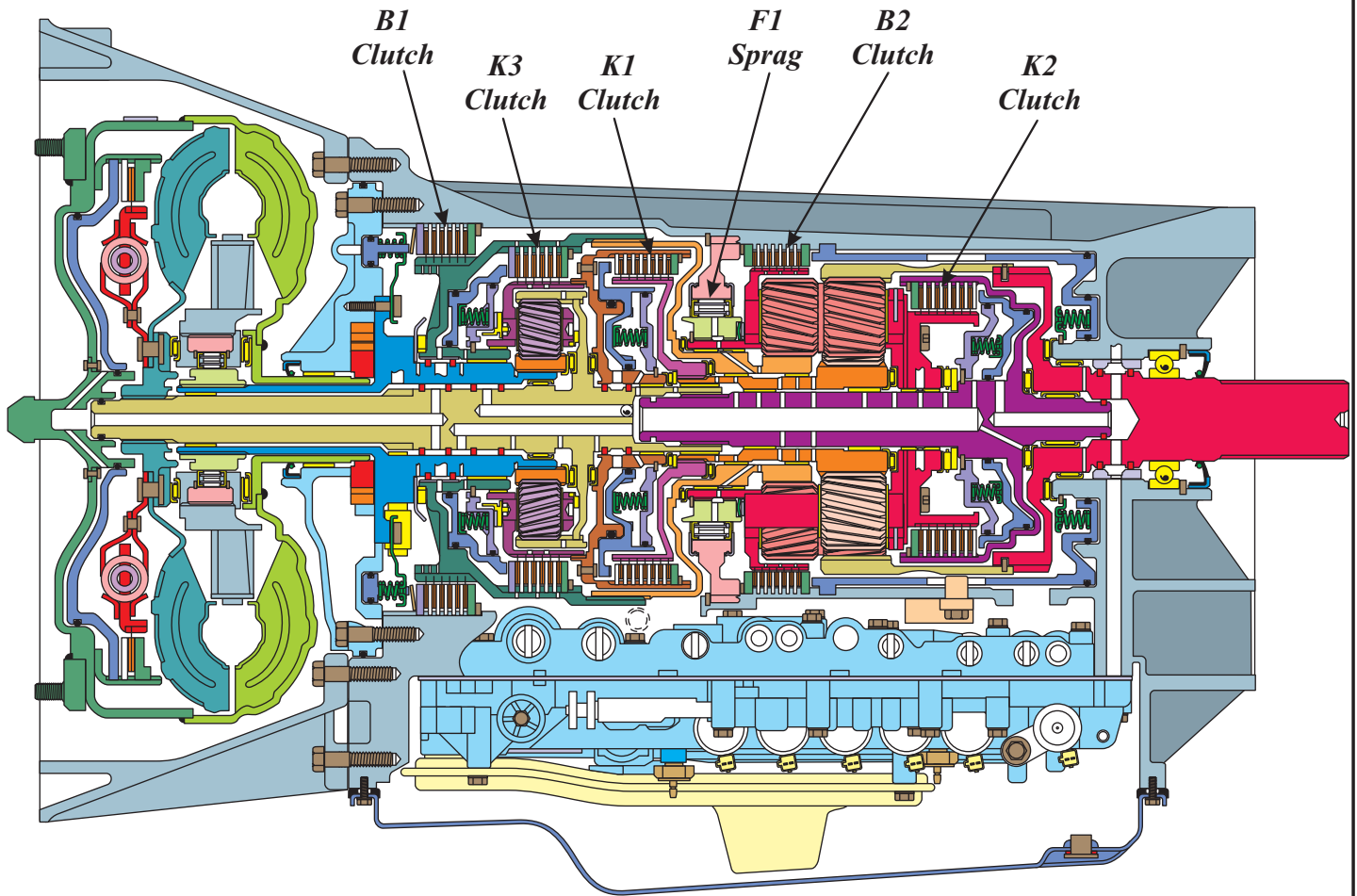
Refer to Figure 2 for the component locations and the clutch application chart for each gear.

VEHICLE APPLICATION CHART					
VEHICLE	YEAR	ENGINE	CODES	VW	AISIN
<i>AUDI, Q7</i>	<i>2007-Up</i>	<i>4.2L (V8) 257 kW</i>	<i>HPH,</i>	<i>09D</i>	<i>TR60SN</i>
<i>PORSCHE, CAYENNE</i>	<i>2003-Up</i>	<i>3.2L (V6) 162 kW</i>		<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>3.2L (V6) 162 kW</i>	<i>BAA, BMX, EXL, EXQ, HAM,</i>	<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>3.2L (V6) 177 kW</i>	<i>BAA, BMX, EXP, GLK, HAM, HAP,</i>	<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>3.6L (V6) 206 kW</i>	<i>BHK, HPG, HZW, JXU,</i>	<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>4.2L (V8) 228 kW</i>	<i>FCS, GLH, HAU, HZV,</i>	<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>4.2L (V8) 257 kW</i>	<i>AXQ, BAR, BHX, HPH, JXS, KMF,</i>	<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>3.0L (V6 Diesel) 165 kW</i>	<i>KRK,</i>	<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>4.9L (V10 Diesel) 230 kW</i>	<i>GLD, GTK, HAQ, HZX</i>	<i>09D</i>	<i>TR60SN</i>
<i>TOUAREG</i>	<i>2003-Up</i>	<i>4.9L (V10 Diesel) 258 kW</i>	<i>JXV,</i>	<i>09D</i>	<i>TR60SN</i>

Copyright © 2010 ATSG

Figure 1

COMPONENT APPLICATION CHART



COMPONENT APPLICATION CHART

<i>Gear</i>	<i>K-1 Clutch</i>	<i>K-2 Clutch</i>	<i>K-3 Clutch</i>	<i>B-1 Clutch</i>	<i>B-2 Clutch</i>	<i>F-1 Sprag</i>	<i>Torque Conv. Clutch</i>	<i>Gear Ratio (Model Dependant)</i>
<i>1st Gear</i>	<i>On</i>				<i>On*</i>	<i>Hold</i>		<i>4.148</i>
<i>2nd Gear</i>	<i>On</i>			<i>On</i>				<i>2.370</i>
<i>3rd Gear</i>	<i>On</i>		<i>On</i>				<i>On**</i>	<i>1.556</i>
<i>4th Gear</i>	<i>On</i>	<i>On</i>					<i>On**</i>	<i>1.155</i>
<i>5th Gear</i>		<i>On</i>	<i>On</i>				<i>On**</i>	<i>0.859</i>
<i>6th Gear</i>		<i>On</i>		<i>On</i>			<i>On**</i>	<i>0.686</i>
<i>Rev Gear</i>			<i>On</i>		<i>On</i>			<i>3.394</i>

* The B-2 Clutch is applied in "Tiptronic Mode" 1st gear, only for engine braking.

** During normal driving operation, the Torque Converter Clutch may be applied in 3rd thru 6th gear.

Figure 2

TRANSMISSION IDENTIFICATION

The transmission identification tag is located on the left hand side of the transmission case, as shown in Figure 3. All of the information from the ID tag will be needed to order anything from the dealer for this transmission. Currently there are no hard parts available from the dealer so you will have to rely on aftermarket sources if hard part replacement becomes necessary.

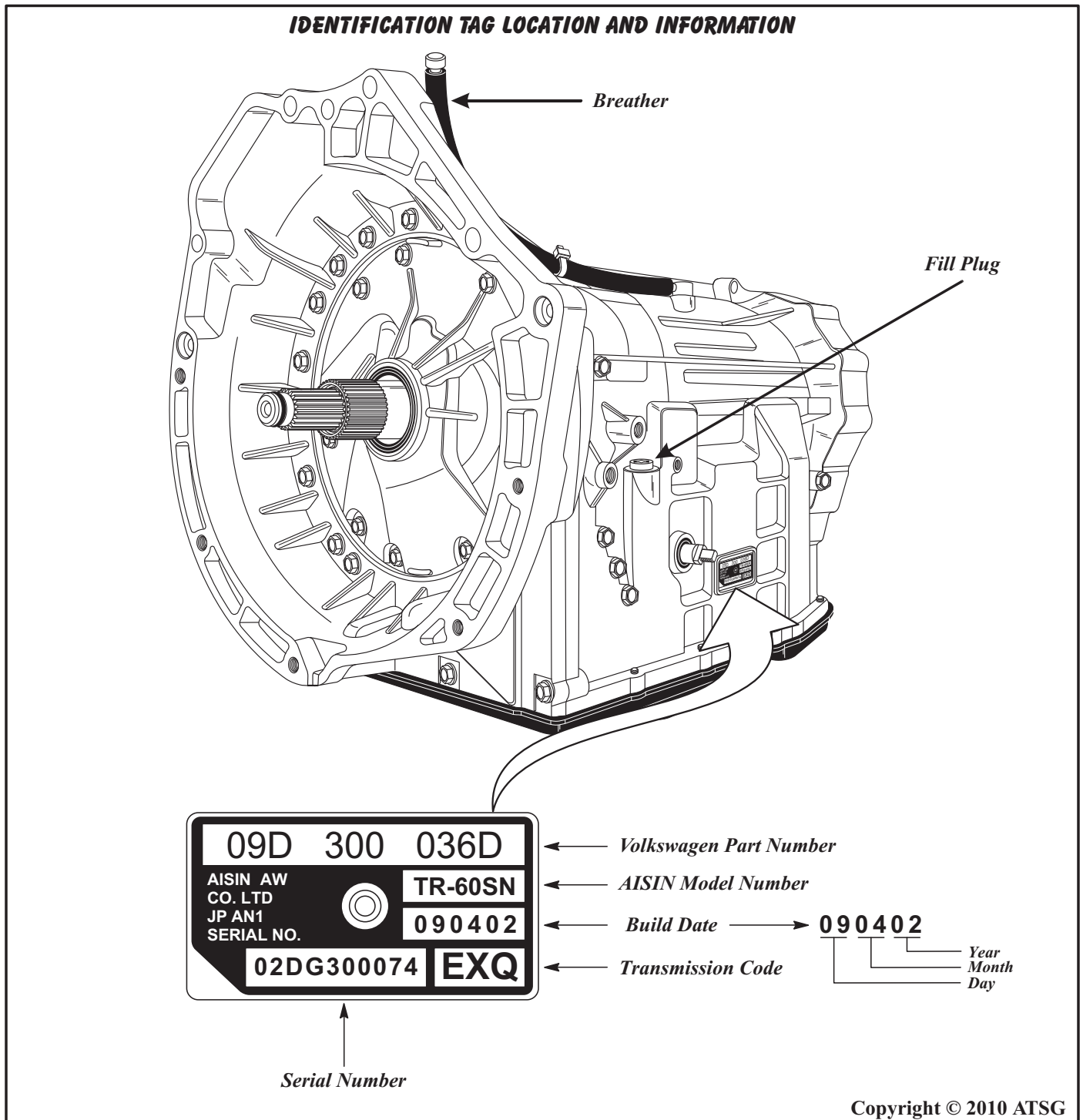


Figure 3

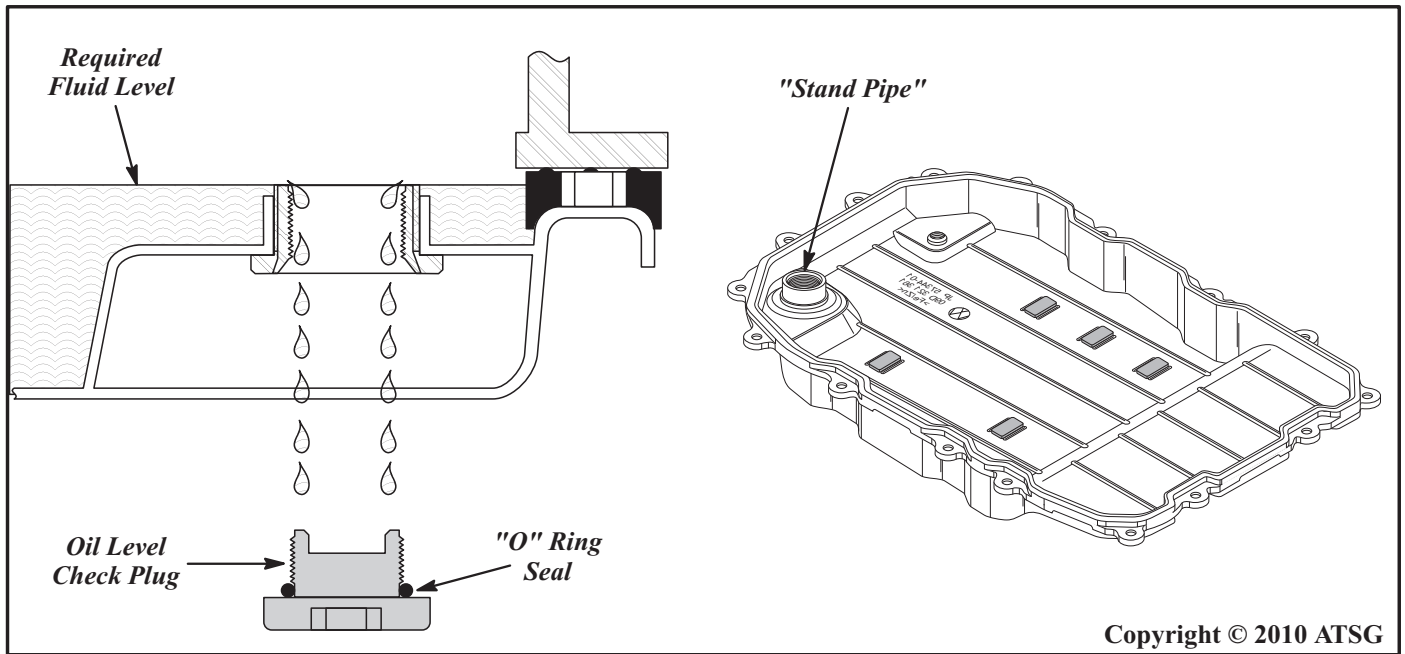


Figure 4

CHECK FLUID LEVEL AND SPECIFICATION

To "Check" for the correct fluid level, you must remove the "check" plug, which is located in the corner of the pan, and is removed with a 16 mm allen wrench, as shown in Figure 4 and 5.

We have provided you with a cut-away drawing of the bottom oil pan and the check plug so that you will understand how this system works. Notice that the oil pan actually has a "stand-pipe", as shown in Figure 4, that is stamped into and extends up above the pan rail, and is our way to establish the proper fluid level in the transmission.

- (A) Engine must be running and the manual shift lever placed in the Park position.
- (B) Transmission must be at operating temperature and parked on level surface.
- (C) By removing the "Check" plug from the oil pan, the fluid should just trickle over the "stand-pipe" and out through the center of the stand-pipe in the oil pan, as shown in Figure 4.
- (D) Always replace the "O" ring on the check plug and torque check plug to 28 N·m (20 ft.lb.)

The "Drain" plug can be removed, using a 40 Torx bit, to facilitate in draining the fluid for transmission removal, or filter change. The pan gasket can be re-used as long as there is no damage.

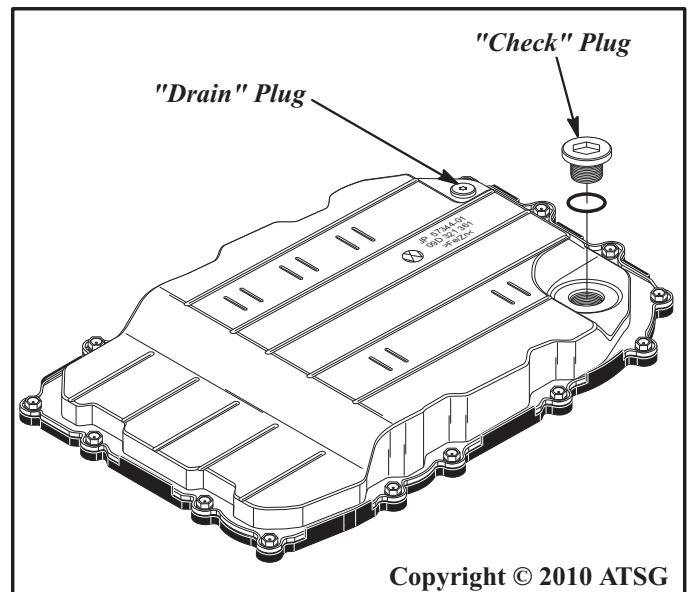


Figure 5

To "Fill" or "Add" fluid to the transmission, there is a fill plug located on the left side of the case just above and left of the manual lever seal, as shown in Figure 3.

Only the approved type of ATF fluid should be used, as shown below. Damage may result if the proper fluid is not used.

Fluid Requirements
VW Part No. G 052 025 A2
(Esso JWS 3309) Lifetime Fluid

ELECTRONIC COMPONENTS

Input Speed Sensor (G182)

The Input Speed Sensor (G182) is located in the transmission oil pump stator, as shown in Figure 7, and retained with a bolt. The ISS has a Yellow connector that mounts on the back side of the oil pump body and is also retained with a bolt, as shown in Figure 7. The ISS signal is routed through the 8-way case connector.

The ISS is triggered by rotor teeth on the turbine shaft to determine exact transaxle turbine speed, as shown in Figure 7. The TCM uses this information to control line pressure for garage shifts, control and monitor torque converter lock-up clutch, monitor gear ratios and diagnosis of shift components via the Dynamic Shift Program (DSP), which is VW's name for the shift adapt feature in the TCM.

The ISS is based on the Hall Effect principle. The signal is a square-wave signal whose frequency is proportional to turbine shaft speed. Should the Input Speed Sensor fail, the engine RPM sensor is used as a back-up, but when engine RPM sensor is used there will be no shift adapt operations, no controlled pulse width modulation for TCC lock-up (apply and release only) and no pressure control on garage shifts (N-D, N-R) which will create harsh garage shift engagements.

The Input Speed Sensor is shown in Figure 6.

Special Note:

The ISS and OSS are Hall Effect Sensors and should be checked using a scope under operating conditions. The resistance values provided in the Figures below are from new sensors. Resistance checks on these type of sensors would, at best, inform you of either open or grounded circuits within the sensor itself.

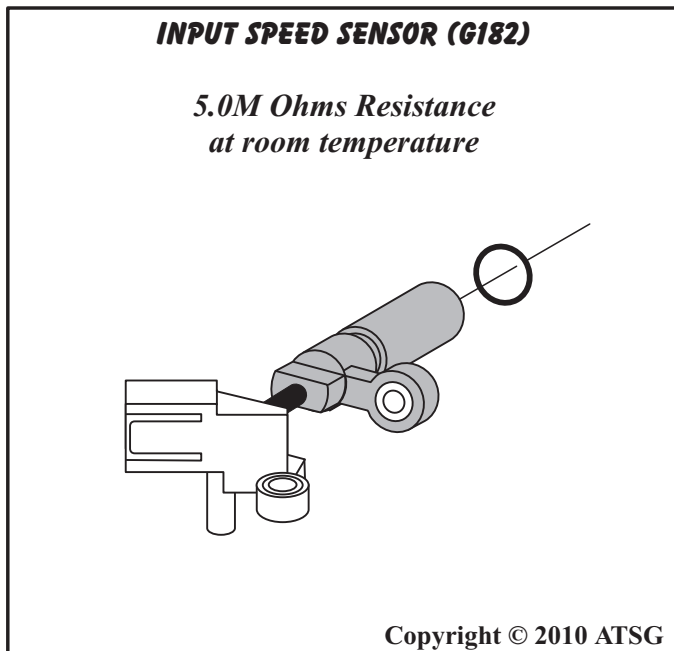


Figure 6

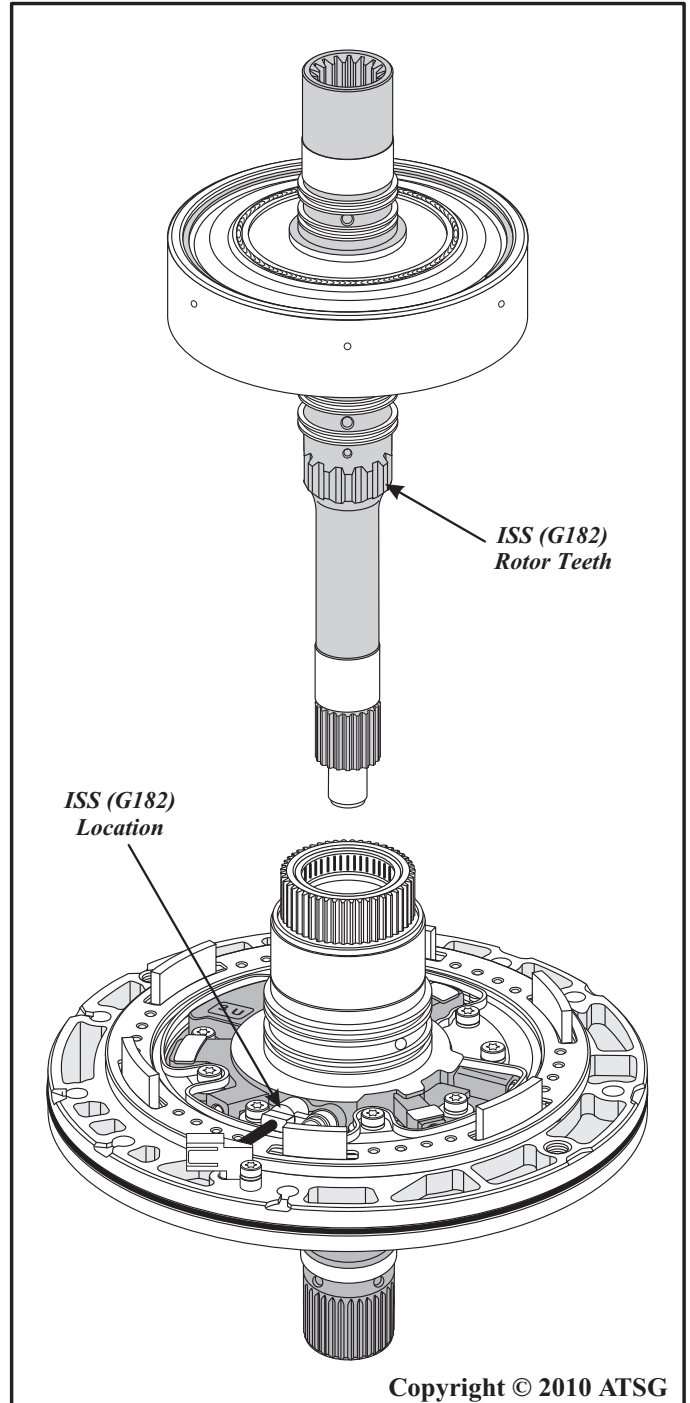


Figure 7

Output Speed Sensor (G195)

The Output Speed Sensor (G195) is located in the transmission case below the valve body, as shown in Figure 9, and retained with a bolt. The OSS has a White connector that mounts on one of the solenoid pin retaining brackets on the valve body. The OSS signal is fed through the 8-way case connector.

The OSS is triggered by the external lugs on the rear planetary ring gear, to determine exact transmission output shaft speed. The TCM uses this information to determine shift points, control and monitor torque converter lock-up clutch, monitor gear ratios and diagnosis of shift components via the Dynamic Shift Program (DSP), which is VW's name for the shift adapt feature in the TCM.

The OSS is based on the Hall Effect principle. The signal is a square-wave signal whose frequency is proportional to output shaft speed. Should the Output Speed Sensor fail, the speed signal from the ABS Control Module is used as back-up, with limited shift adapt capability.

The Output Speed Sensor is shown in Figure 8.

Special Note:

The ISS and OSS are Hall Effect Sensors and should be checked using a scope under operating conditions. The resistance values provided in the Figures below are from new sensors. Resistance checks on these type of sensors would, at best, inform you of either open or grounded circuits within the sensor itself.

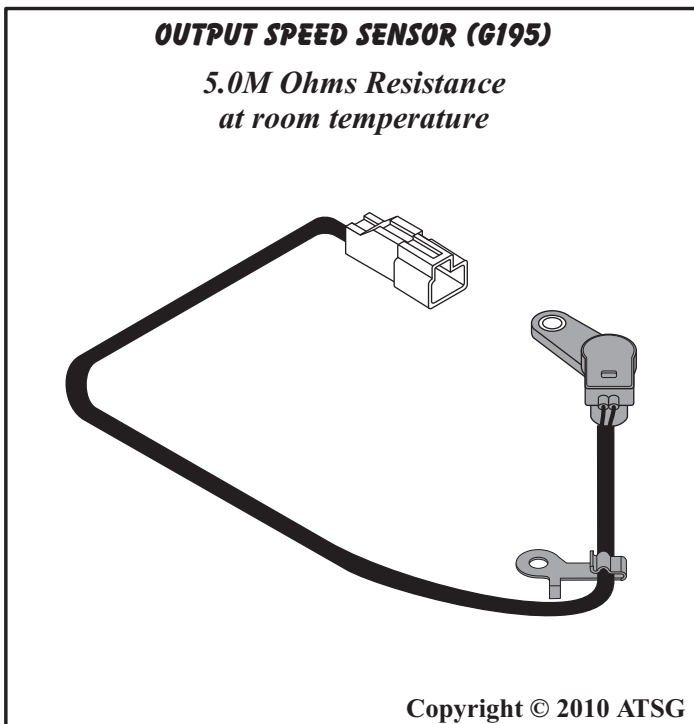


Figure 8

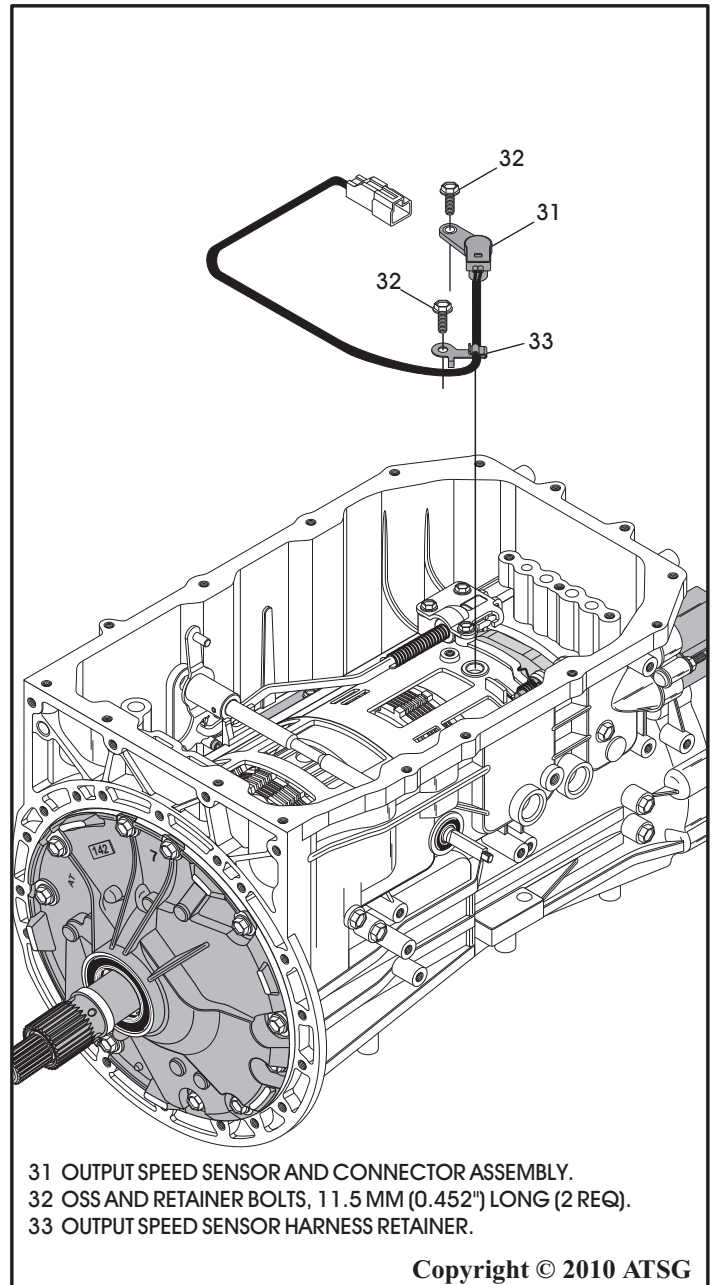


Figure 9

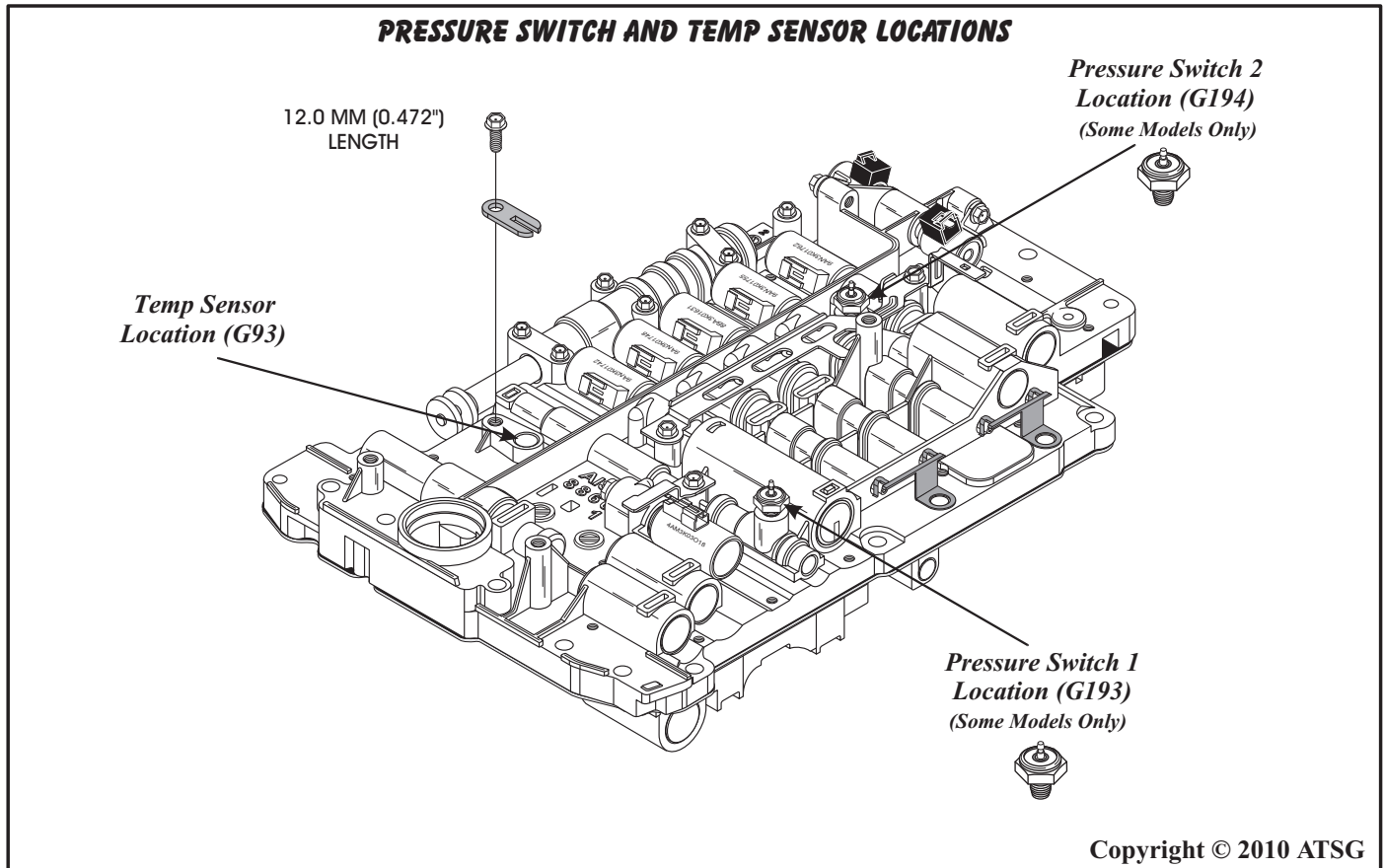


Figure 10

ELECTRONIC COMPONENTS (CONT'D)

Pressure Switches 1 (G193) And 2 (G194)

Some "09D" transmissions are equipped with two pressure switches that screw into the valve body casting in the locations shown in Figure 10. Both switches are "normally open" switches that connect to ground when pressure exceeds approx. 44 psi and are used to verify valve movement in the valve body assembly.

Pressure Switch 1 (G193) is used to verify activation of the K-1 clutch.

Pressure Switch 2 (G194) is used to verify activation of the B-2 clutch. Therefore, pressure switch 2 is closed in tiptronic mode only, 1st gear. The only other time the B-2 clutch is required is in reverse (R) gear. Pressure Switch 2 does not close in the reverse position, as reverse is engaged by the manual valve hydraulically.

Note: Pressure switches are used only on some models equipped with the "09D" transmission.

Continued on Page 10

TRANSAXLE FLUID TEMP SENSOR (G93)

<i>Temperature F° (C°)</i>	<i>Resistance</i>
<i>-22°F (-30°C)</i>	<i>37K - 51K Ohms</i>
<i>50°F (10°C)</i>	<i>5K - 8K Ohms</i>
<i>77°F (25°C)</i>	<i>3K - 5K Ohms</i>
<i>230°F (110°C)</i>	<i>230 - 265 Ohms</i>
<i>293°F (145°C)</i>	<i>100 - 120 Ohms</i>

Copyright © 2010 ATSG

Figure 11



Technical Service Information

ELECTRONIC COMPONENTS (CONT'D)

Transaxle Fluid Temp Sensor (G93)

The Transaxle Fluid Temp Sensor (G93) is located in the valve body and is mounted with a retaining plate, as shown in Figure 10. Notice in Figure 11 that an "O" ring is required, as it is mounted into an oil passage. The TFT is an integral part of the 8-way case connector and wire harness assembly.

The TFT is a negative temperature coefficient sensor, which means that as temperature rises the resistance decreases, as shown in Figure 11.

Starting at 150°C (270°F), the converter clutch is applied more frequently. If this does not result in cooling of the ATF, reduction of engine torque is initiated at 170°C (306°F).

Should the TFT fail, a substitute value is generated from the engine temperature and operating duration. There will be no controlled operation (ramping) of the converter clutch (ON or Off only) and no controlled shift adapt pressures, which usually results in harsh engagements.

Solenoid Identification And Location

The 09D transmission uses a total of 8 different solenoids located in the valve body that are used to apply or release the clutches, control the main line pressure and apply or release the torque converter clutch. They are identified and their locations are shown in Figure 12.

There are three different types of solenoids used in the "09D" transmission. There are two "Normally Closed" On/Off solenoids, one "Normally Vented" Pulse Width Modulated (PWM) solenoid, and the other five are "Normally Applied" Pulse Width Modulated (PWM) solenoids.

Refer to Figure 13 for their individual functions and Figure 12 for their locations in the valve body.

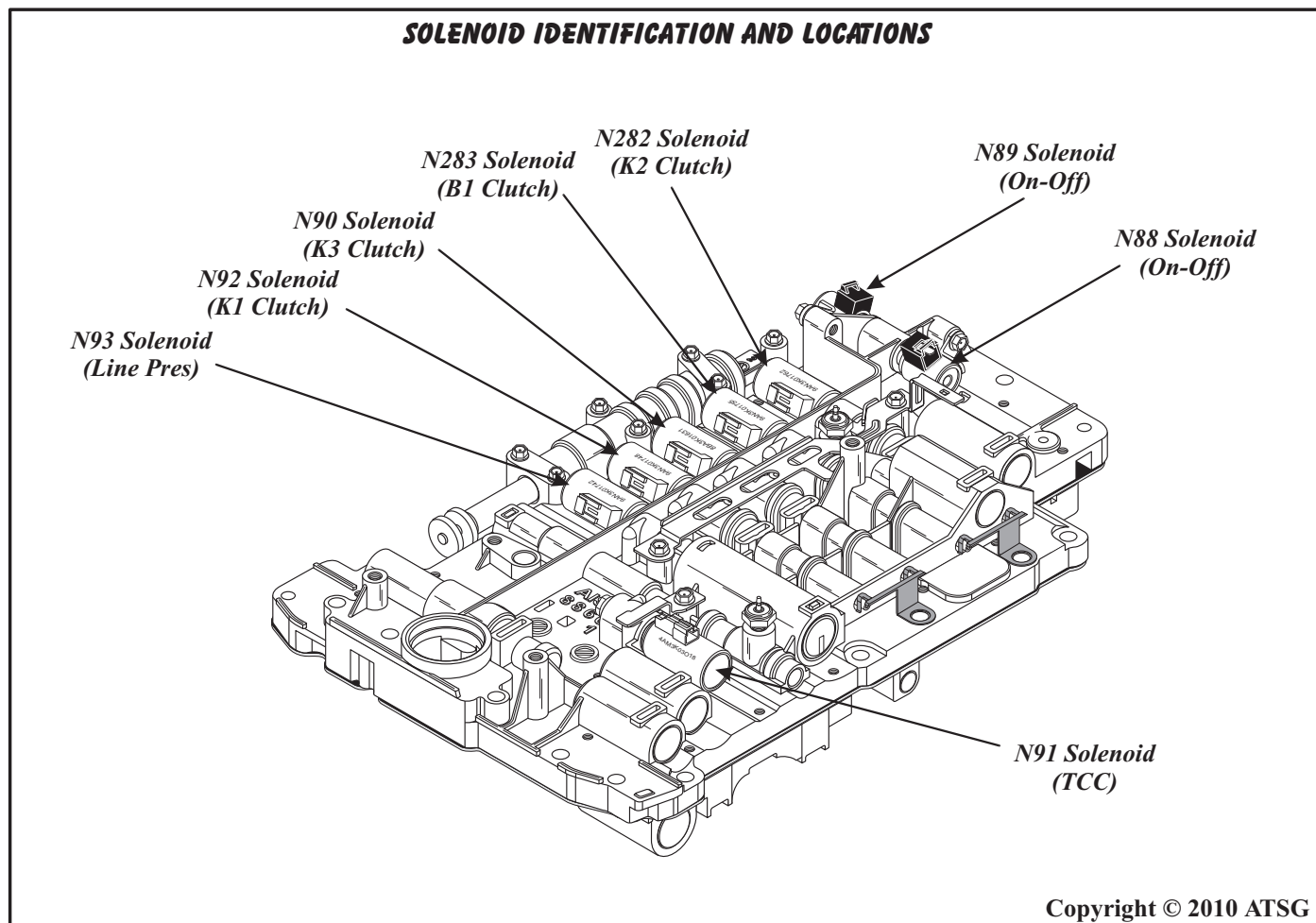


Figure 12