Scorpio AT

(Aug 2008)

MILE

MAHINDRA INSTITUTE OF LEARNING EXCELLENCE

Conditions of use of Training and Technical Information.

In consideration of Mahindra & Mahindra Ltd. disclosing to you the information as defined below you agree to comply with the following - in respect of any and all technical and training documentation) “The information":

1. The information is only to be used by specialists in the field of motor vehicle repair and maintenance. Therefore you must ensure that you have all the necessary training, knowledge, documents, skills and equipment to make safe and proper repairs and maintenance of Mahindra & Mahindra Ltd. vehicles and products.

2. The information is subject to change without prior notice. You must therefore ensure you have the most up to date information available.

3. You acknowledge and agree that you are solely responsible for all repairs and maintenance services carried out by you based on this information. Mahindra & Mahindra Ltd. Is not responsible for your any act or omission you carry out & hence is not liable to pay any damages or claims. Mahindra & Mahindra Ltd. shall not be liable for personal injury or death caused by negligence.

4. You are not permitted in anyway to copy, sell, hire, lend, lease or otherwise dispose of the information in any way. You are not permitted to pass the information to any third party without the prior written permission of Mahindra & Mahindra Ltd

5. The information is the property of Mahindra & Mahindra Ltd.

6. You must destroy the information in a confidential manner whenever the information is seize to be useful or when the agreement for use terminates, whichever is the earlier.

7. The information is only to be used of the purpose of effecting repairs and maintenance work on Mahindra & Mahindra Ltd. Vehicles and not for any other commercial reason or otherwise.

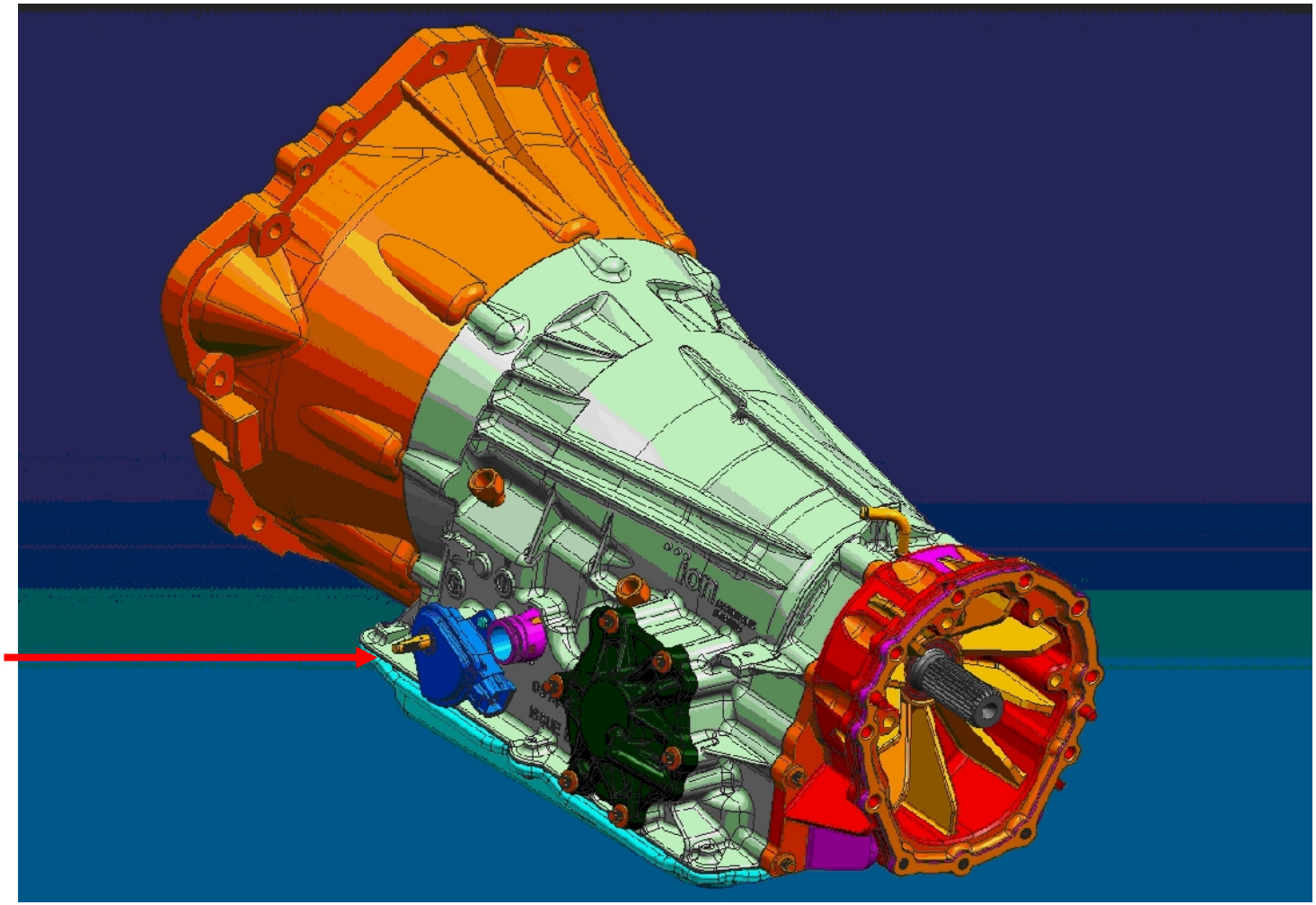
Specifications Scorpio AT

Engine	**:**	M Hawk 2.2
Type	**:**	4 cyl.Inline **,** Common rail direct injection
Transmission	**:**	M 79 - AT
Transfer case - Optional	**:**	Borg-Warner electric shift
Differential ratio	**:**	4.3 : 1
Brakes	**:**	ABS, Twin pot caliper, tandem booster, vacuum reservoir
Tyre	**:**	235 / 70 R 16 105 S (Tubeless), Alloy Rim.
Emission	**:**	BS3,EIII

Specifications - M 79

Manufacturer		**:**	**DSI Australia.**
Gear Shift		**:**	**Automatic**
Gear Pattern		**:**	**6 forward & 1 reverse.**
Gear Ratio		**:**	
	1st	:	3.53
	2nd	:	2.14
	3rd	:	1.48
	4th	:	1.16
	5th	:	0.87
	6th	:	0.68
	Rev	:	3.09
Diagnostics		**:**	16 pin DLC, K-line diagnostics by using Smart tester

Model 79 AT

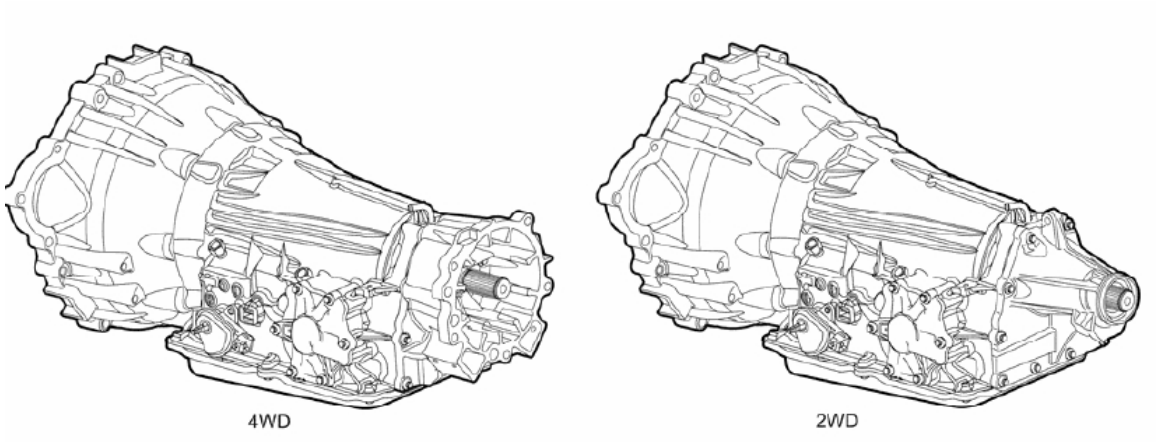


Description :

The Model 79 six speed automatic transmissions is available in two variants : Four wheel drive and Two wheel drive.

The transmission has the following features:

- Six forward speeds
- One reverse gear
- A torque converter with an integral converter lock-up clutch
- Electronic shift and pressure controls
- A single planetary gear-set
- A double planetary gear-set
- Two hydraulically controlled brake bands
- Three multi-plate clutches
- All hydraulic functions are directed by electronic solenoids to control:
- Engagement feel
- Shift feel
- Shift scheduling
- Modulated torque converter clutch applications



Engine power reaches the transmission via a torque converter with integral converter lock-up clutch.

The six forward gears and one reverse gear are obtained from a single planetary set, followed by a double planetary set. This type of gear-set arrangement is commonly known as Ravingnaux type gear-set.

The Model 79 automatic transmission is electronically controlled. The control system is comprised of the following elements:

- External transmission control unit (TCU)
- Internal embedded memory module (EMM
- Input and output speed sensors

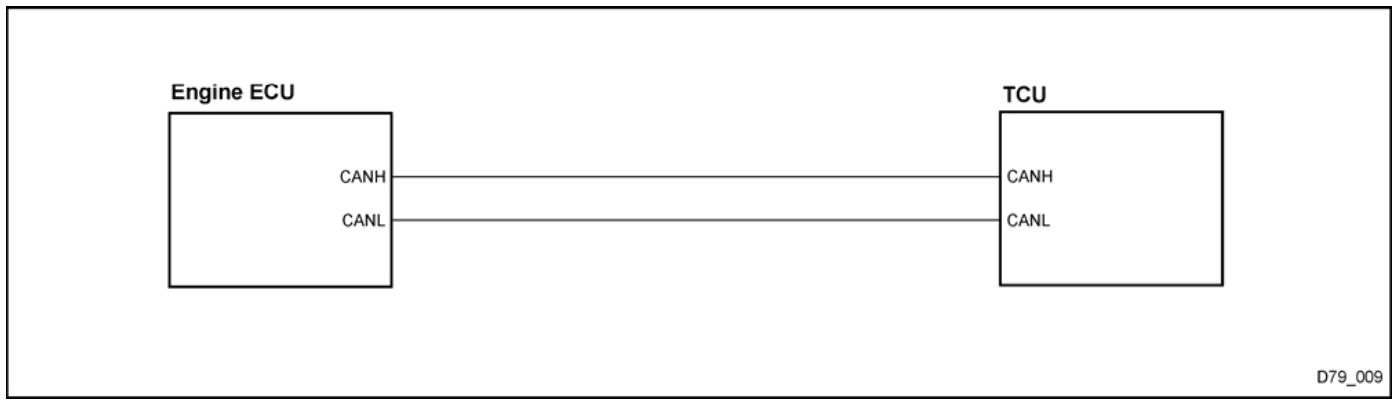
• Valve body unit comprised of four on/off solenoid valves and six variable bleed solenoids
• Torque converter

Gear selection is achieved by the control of automatic transmission fluid (ATF) flow and pressure to operate various internal clutches and bands. The TCU operates all the electrical components and provides for the control of gear selection, shift pressure and torque converter slip control.

In the event of a system fault, the TCU also provides for failure mode effect control (FMEC) to maintain maximum functional operation of the transmission.

In the event of a total loss of control or electrical power. the basic transmission functions (Park, Reverse, Neutral and Drive) are retained. The 4th gear ratio with the torque converter clutch in the unlocked state is the retained gear state the hydraulic system supports without any electrical assistance.

The transmission also contains an external P, R, N, D selector shaft position sensor (inhibitor switch) and an internal transmission fluid temperature sensor. With manual mode applications, the TCU also requires information from the transmission gear selector (TGS) shift knob to determine when the driver has initiated a manual gear selection. The TCU communicates with other vehicle electronic control modules by the controller area network (CAN).



If a major fault develops, the transmission may automatically operate in a “limp home” (failure) mode to enable the vehicle to be driven to an authorized dealer for repair. During “limp home” mode, the MIL indicator on instrument cluster will be set and the transmission will operate with limited functionality.

The level of functionality is dependant on the fault detected. When in limp home mode, the transmission indicator light on the instrument cluster will be continuously ON. Limp home mode may also be engaged if the battery charge falls below 8V.

If the transmission overheats, the shift patterns will automatically change to enable improved transmission cooling. During transmission overheat, the over temperature condition is indicated by the MIL until normal transmission operating temperature is reached.

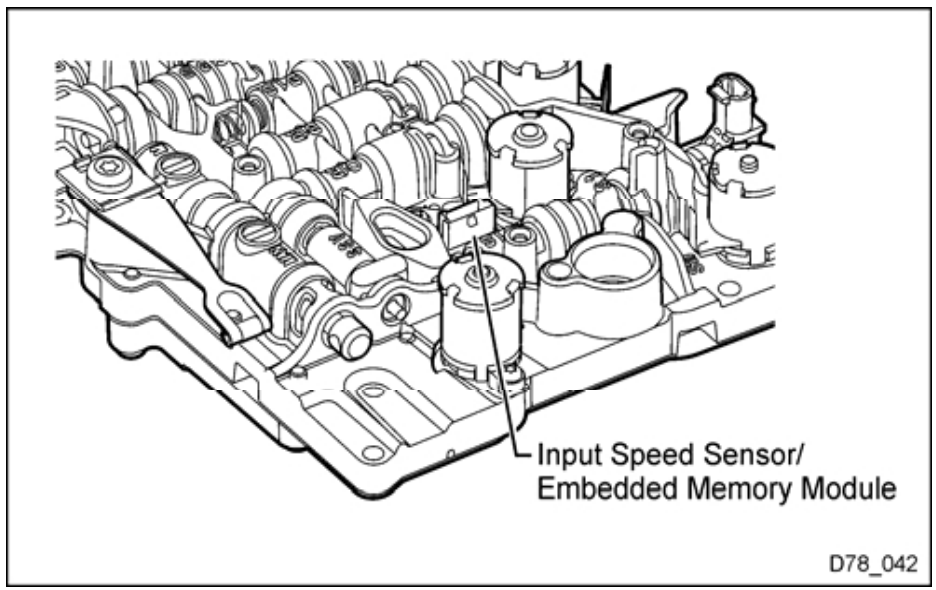
Under extreme over-temperature conditions, the transmission will disable all shifting and remain in a neutral state until it has cooled to a safe level.

The TCU also provides for transmission diagnostics, which meet the requirements of OBD II legislation, monitoring all components which may effect vehicle emissions.

Embedded Memory Module

The embedded memory module (EMM) is matched to the transmission valve body during manufacture. The EMM is integrated into the input speed sensor which is mounted on the valve body in the transmission.

The EMM data contains transmission specific characterizations information. Upon installation, the TCU will upload the data from the EMM and utilize this data in the operation of the transmission.



Sensor Inputs

Brake Pedal Position Switch

The brake pedal position (BPP) switch tells the TCU when the brakes are applied. The BPP is also used to disengage the transmission gear selector (TGS) interlock when moving out of the Park position and as part of the shifting strategy.

Engine Intake Temperature Sensor

The engine intake temperature (EIT) sensor detects intake air temperature and supplies the information to the TCU.

Barometric Pressure Sensor

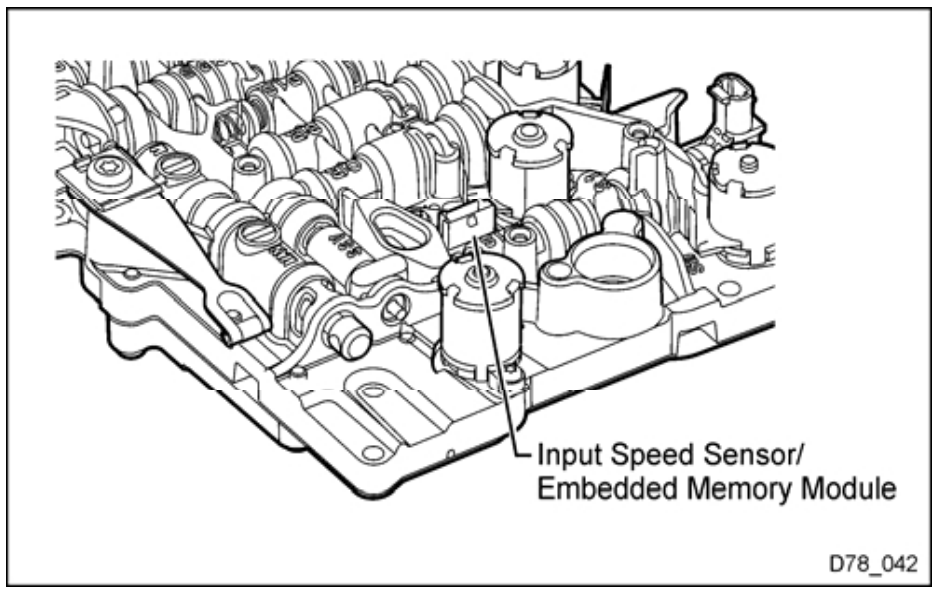
The barometric pressure (BARO) sensor detects the current air pressure and supplies the information to the TCU.

Accelerator Pedal Position Sensor

The accelerator pedal position (APP) sensor is a potentiometer mounted on the accelerator pedal. The APP sensor detects the position of the accelerator pedal and sends this information to the TCU [Through ECU]. The APP sensor signal is used for shift scheduling and torque converter clutch (TCC) lock-up.

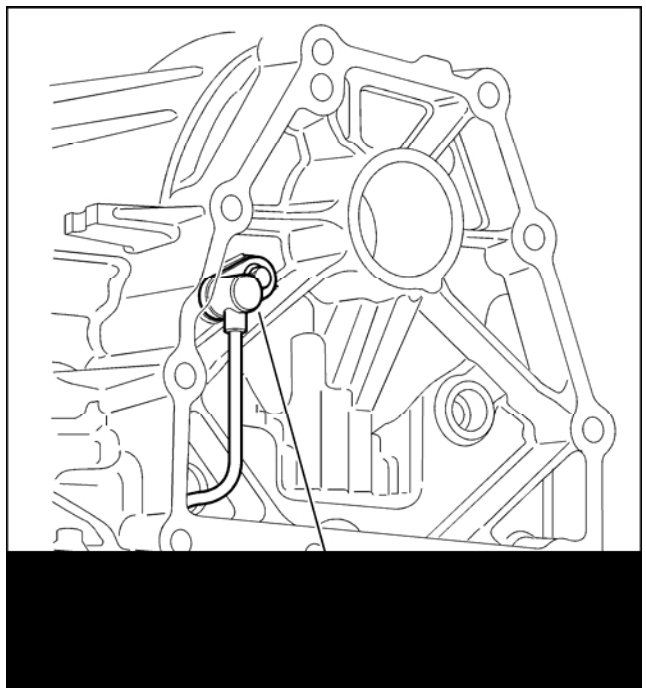
Input Shaft Speed Sensor

The input shaft speed (ISS) sensor is a hall effect type sensor. The ISS sensor is mounted internally in the transmission and is located on the valve body.



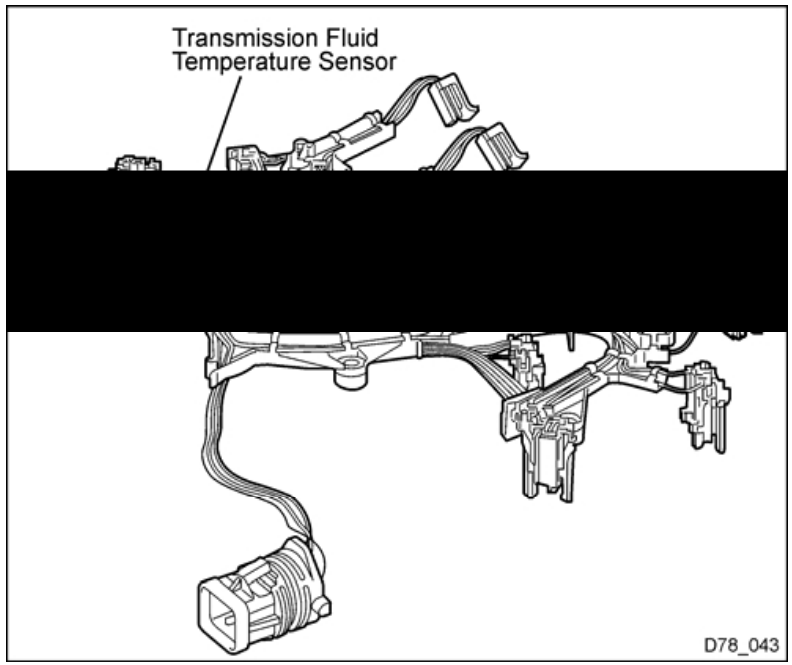
Output Shaft Speed Sensor

The output shaft speed (OSS) sensor is a hall effect type sensor. The OSS sensor is mounted internally in the transmission and is located at the rear of the transmission main case.



Transmission Fluid Temperature Sensor

The TCU utilizes one transmission fluid temperature sensor located in the valve body wiring loom. The TCU uses the sensor input to activate various shift strategies. The sensor is in the form of a temperature dependant resistor. The temperature sensor performs plausibility checks on each sensor reading. If the inputs from the temperature sensor are outside the working range it is possible the sensor is either short or open circuit



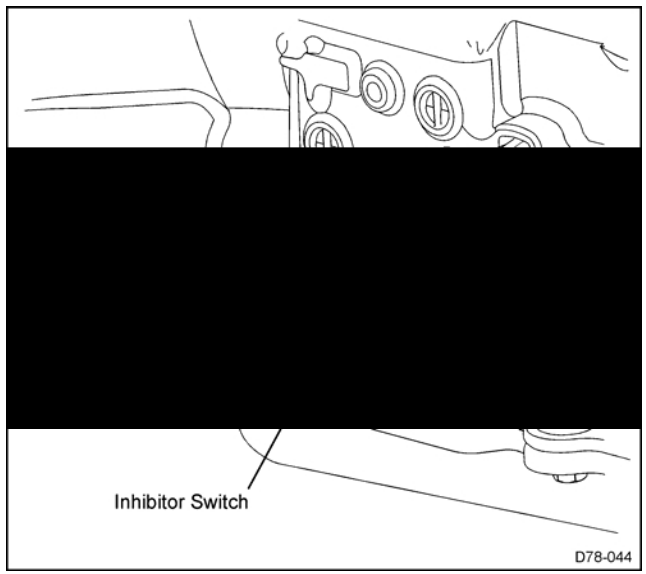
Driveshaft Speed Sensor [VSS]

The driveshaft speed sensor is a gear driven hall effect sensor mounted at the rear of the transfer case. The sensor output signal frequency is proportional to driveshaft speed. The transmission control unit uses the driveshaft speed signal to assist with controlling transmission gear shift and gear shift quality.

Do not remove the sensor & drive the vehicle, Performance will be deteriorated.

Inhibitor Switch

The TCU uses the position of this switch to determine the position of the selector lever. The selector lever is connected to the transmission via a linkage mechanism which operates the transmission selector shaft between positions Park, Reverse, Neutral and Drive. The inhibitor switch contains set resistances for each position which are read by the TCU. The TCU uses this information to control the shifts to reverse and drive.
Movement of the lever between Park, Reverse, Neutral and Drive manually controls the flow of transmission fluid, the TCU having control of the forward gear selected in Drive. If the lever is not in the Park or Neutral positions, or if the switch is disconnected, starting of the engine is inhibited.



Maintenance :

The transmission contains fully synthetic automatic transmission fluid (ATF) and is filled for life; therefore it does not require periodic servicing.

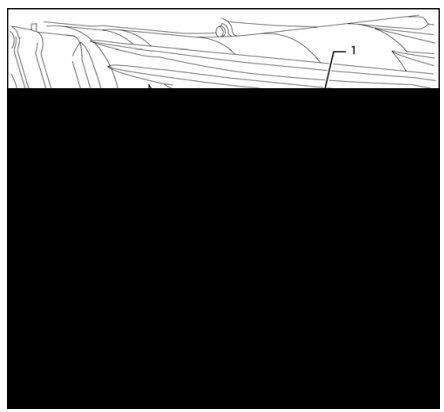
Fluid level inspection :

NOTE

As the temperature of the transmission fluid greatly affects the fluid level, this procedure must only be carried out with the transmission fluid temperature at 50°C. If the transmission fluid temperature is greater than 50°C and the correct procedure is not followed, the result could be a false reading of the fluid level.

Fluid level inspection must be carried out with the vehicle level.

Recommended Lubricant only to be used.



Fluid level inspection :

01.Raise the vehicle on a certified hoist. Refer to the vehicle repair manual for the location of support points.

02.Place a drain container below the fluid level hole and remove the transmission fluid level plug (1).

03.If fluid starts to drain from the fluid level hole, reinstall the fluid level plug. If no fluid drains from the fluid level hole, fill the transmission until fluid starts to drain from the level hole and reinstall the plug.

04.Lower the vehicle.

05.Connect the diagnostic scan tool to the vehicle’s diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.

06. With an assistant observing the transmission fluid temperature with the scan tool, drive the vehicle for five minutes, or until the transmission oil temperature is just below 50°C.

07. Raise the vehicle on a certified hoist.

08. With the transmission gear select (TGS) lever in the neutral position, start the engine and allow running until the transmission fluid temperature reaches 50°C and then turning off the engine.

09.Place a drain container below the fluid level hole and remove the transmission fluid level plug. Allow transmission fluid to drain from the fluid level hole for 10 seconds.

10.Reinstall the fluid level plug and tighten the plug to the correct torque specification.

Transmission fluid level plug
Torque specification... ... 30 - 35 Nm

11.Lower the vehicle to the ground and road test the vehicle to check vehicle operation and for fluid leaks.

Advanced Six Speed Features

Early Downshifts with Hard Braking and Skip Shifts :

When heavy braking is detected, the transmission downshifts early and skips gears to provide increased engine braking to provide gear selection for tip-in.

Gear Hold Going Uphill / Downhill

If the accelerator pedal is released when traveling uphill, up shifts are prevented to reduce busyness on grades. If the accelerator pedal is released when traveling downhill, up shifts are prevented to enhance engine braking.

Up shift Prevention with Fast-off Accelerator Pedal

Up shifts are prevented when the throttle is backed off very quickly to reduce busyness in sporty driving.

Drive and Reverse Engagement

A soft engagement feature avoids harsh take up of drive when selecting Drive or Reverse. This is achieved by limiting engine speed and engine torque which results in a rapid, but progressive engagement of either Drive or Reverse when moving from the Park or Neutral positions. Drive and Reverse engagements from either Park or Neutral are performed in less than 2.2 seconds.

Drive is inhibited when engine speed is >2000 rpm and the accelerator pedal position is >30%. Reverse engagement is prevented until engine speed is less than 1400 rpm and the accelerator pedal position is less than 12% and vehicle speed is less than 10 km/h

Converter Clutch Lock-Up in All Gears

The transmission features converter clutch lock-up in all gears. This feature provides improved fuel economy and vehicle performance. It also improves transmission cooling efficiency when towing heavy loads at low speeds, e.g. in city driving or hill terrain.

Transmission Control Monitoring System

The TCU monitors all input and outputs to identify possible failures. If a fault is detected, the TCU takes the appropriate action to ensure the transmission maintains a safe mode of operation, without sacrificing transmission durability or driver safety.

Supply Monitoring

If the battery voltage is either too high or too low, the TCU will detect a fault condition.

Solenoid Supply Monitoring

While the solenoid drivers are being activated, they are monitored for open circuits, short circuits to ground and short circuits to supply.

Gear Ratio Monitoring

The gear ratio diagnostic checks if each gear ratio is correctly engaged.

Torque Converter Monitoring

The TCU checks if the torque converter can be locked correctly. If torque converter lock-up does not occur correctly the TCU performs the appropriate fail-safe action of opening the torque converter clutch.

Shift Energy Management

This function involves reducing or increasing the engine output torque during shifting. The aim when up shifting is to reduce the energy which is dissipated in the friction elements of the transmission. This is done by reducing the engine torque during the ratio change without interrupting the tractive drive. This function is used for:

Increasing the transmission service life by shortening the slipping time

Improving the shift comfort by reducing the step change in torque caused by the gearshift

Transferring a higher engine power, this is allowed by the mechanical in-gear strength of the
transmission

Real-time control of engine torque is required to maintain maximum shift quality and transmission durability. The TCU has the ability to control the engine torque during the gearshift to synchronise with the operation of the transmission clutches.

Pressure Modulation

To provide a high level of shift comfort and durability, the hydraulic pressure in the shift related friction elements of the transmission must be matched accurately to the transmission input torque. This hydraulic pressure is composed of a hydraulically pre-set basic pressure and a controlling pressure which is set by one of the variable bleed solenoids.

The transmission input torque can be directly calculated from the following operating parameters: engine torque signals, engine speed or any signals transmitted from the engine management ECU by CAN, and converter slip. Separate pressure characteristics for each gear change make it possible to adapt precisely to the particular shift operation. High and Low range operation has different parameters to optimize shift quality.

Shift Map Selection

The driver can manually select between normal (S) and winter modes (W) via the mode switch. Depending on the transmission temperature, uphill and downhill grades and altitude, shift maps will be selected by the TCU to suit the driving conditions. The following maps are available.

Normal Mode

Normal Mode is selected when the lever is in the D position with the mode switch in the normal (S) position and the transmission is within normal temperature ranges. Shift schedule points are optimised for fuel efficiency and general driving conditions.

Uphill and Downhill Mode

In this mode, depending on the load of the vehicle, adaptive shift maps are selected to progressively adjust the shift points and torque converter lock points.

Altitude Mode

Shift points are automatically adjusted at higher altitudes to compensate for changes in engine torque where the torque produced by the engine is greatly reduced by the effects of reduced barometric pressure and temperature.

Winter Mode

When winter mode is selected, starting in second gear is facilitated. To prevent wheel spin on slippery surfaces, the transmission will not allow first gear unless manually overridden.

Low Range Schedule

When the transfer case is in 4L position, the transmission uses a different shiftmap to optimise low range driving. Similar to winter mode, 1st gear is inhibited. The transmission may skip gears, e.g. 2-4, to optimise engine rpm.

Warm up Schedule

Used typically when transmission fluid temperature is below 20°C. The torque converter will not lock-up below 20°C to assist in transmission warm - up.

Hot Mode

The hot mode is progressively applied between temperatures of 110° - 145°C. The torque converter lock-up is increased to prevent heat generation by the torque converter.

As additional assistance to the hot mode, the following are activated:

Above 110°C - the electrical radiator fans are switch ON

Above 130°C - the engine torque will be reduced and the MIL on the instrument cluster will be lit

Above 145°C - the transmission will neutralize until the next ignition cycle

Activation of the hot mode inhibits other transmission performance features including uphill and downhill compensation and altitude compensation. Some degradation in shift feel may be experienced as the torque converter is not unlocked during shifting. The fluid temperature must be below 105°C to exit all hot modes.

Shift Strategy

Gear Change : Transmission gear change is controlled by the TCU. The TCU receives inputs from various engine and vehicle sensors to select shift schedules and to control the shift feel and torque converter clutch (TCC) operation at each gear change.

Coast down : Coast down downshifts occur at 0% pedal when the vehicle is coasting down to a stop.

Torque Demand : Torque demand downshifts occur (automatically) when the driver demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the torque converter clutch (TCC) to provide added acceleration.

Range Mode (Manual Mode) : When the lever is first moved to the manual “M” position, the transmission will select the lowest possible gear for the current driving conditions. The transmission will automatically up shift to limit maximum engine speed.

Stall Test

Stall testing can be performed on the Model 79 6 speed automatic transmission to determine if the transmission clutches can hold the full engine torque without slipping.

NOTE : Stall testing should not be performed for more than 10 seconds.

To perform the transmission stall test, proceed as follows:

1. Apply the park brake.
2. Start the engine.
3. Depress the brake pedal.
4. Move the transmission gear select (TGS) lever to D position.
5. Fully depress the accelerator pedal for 6 seconds and observe engine speed.
6. Release the accelerator pedal.
7. Move the TGS lever to R position.
8. Fully depress the accelerator pedal for 6 seconds and observe engine speed.
9. If the engine speed is more than 3000 rpm; replace the transmission.

Vehicle toeing

In the event of a vehicle breakdown, the vehicle can be towed, providing the main driveshaft has been removed prior to towing. Failure to do this will lead to a failed transmission due to insufficient lubrication to transmission bearings.

Caution :

1. The vehicle can not be push started.
2. For towing the propeller shaft has to be disconnected

Failure to do so will cause permanent damage to the transmission and the torque converter. This is because the oil pump inside the transmission is only working if the engine is running. Without oil pump running- all components will seize.

TCU Reset Procedure (Replacement Transmission/TCU)

It is necessary to perform a green offset reset or adaptive reset procedure to reset the adaptive data stored within the transmission control unit (TCU) when the transmission and/or TCU have been replaced.

Green Offset Reset :

Carried out when a replacement transmission and/or TCU has been installed in a vehicle.

Adaptive Reset :

Carried out when one of the following has occurred:

- Transmission has been replaced
- TCU has been replaced

To perform a green offset reset procedure, proceed as follows:

1.Connect the diagnostic scan tool to the vehicle's diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.

2.With the transmission gear select (TGS) lever in Park, turn the ignition key to the ON position (engine not running).

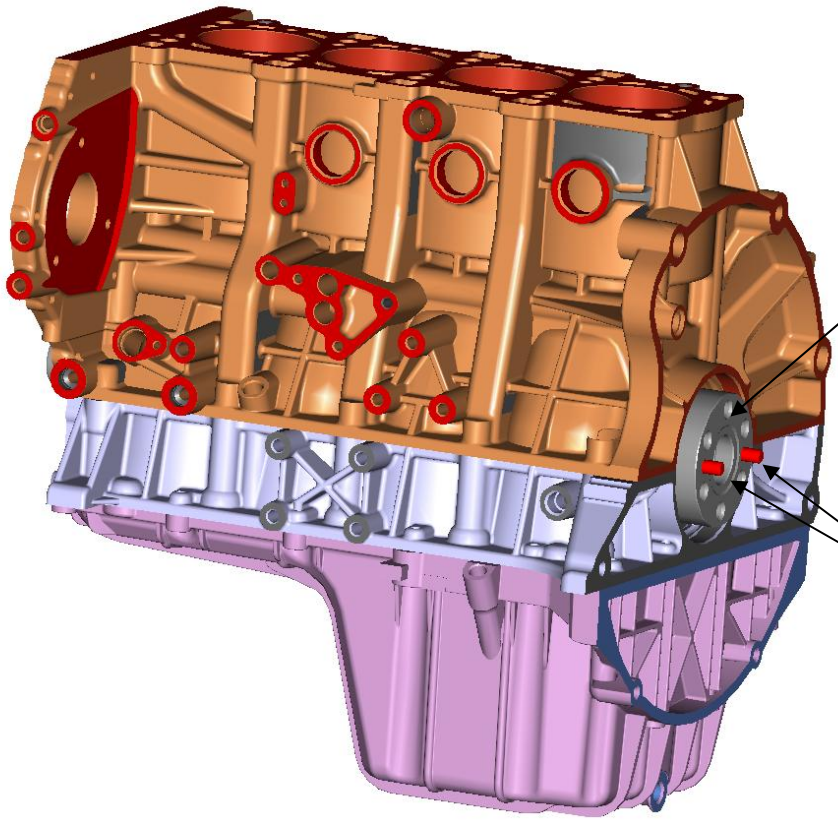
3.Go to the ECU reset section.

4.Tick the ECU reset.

5.Click

The diagnostic tool will reset the Transmission ECU

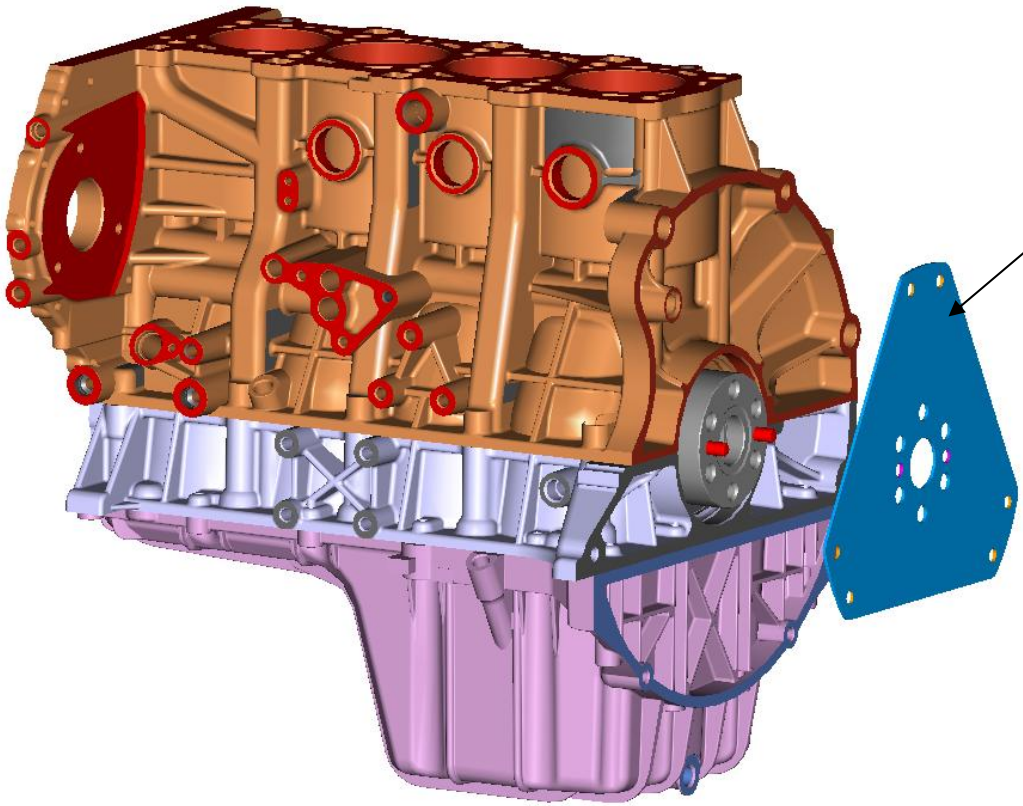
Engine Docking Stage 1

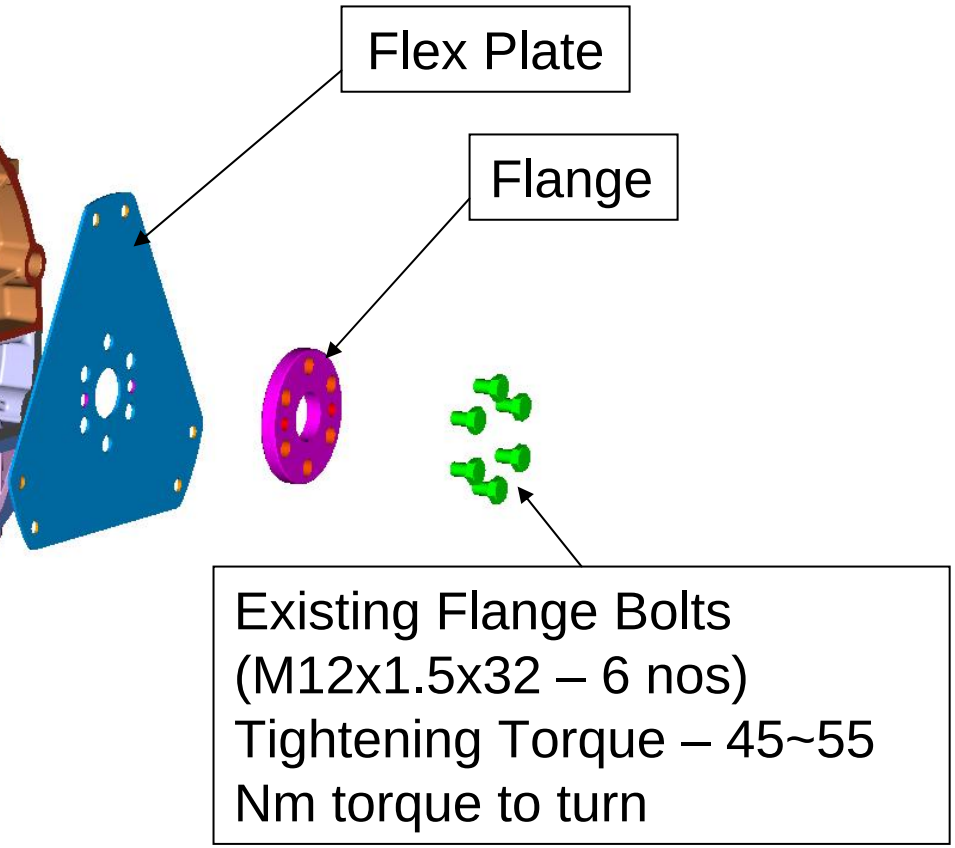


AT specific Crankshaft having 2 Dowel Holes - Ø10 mm

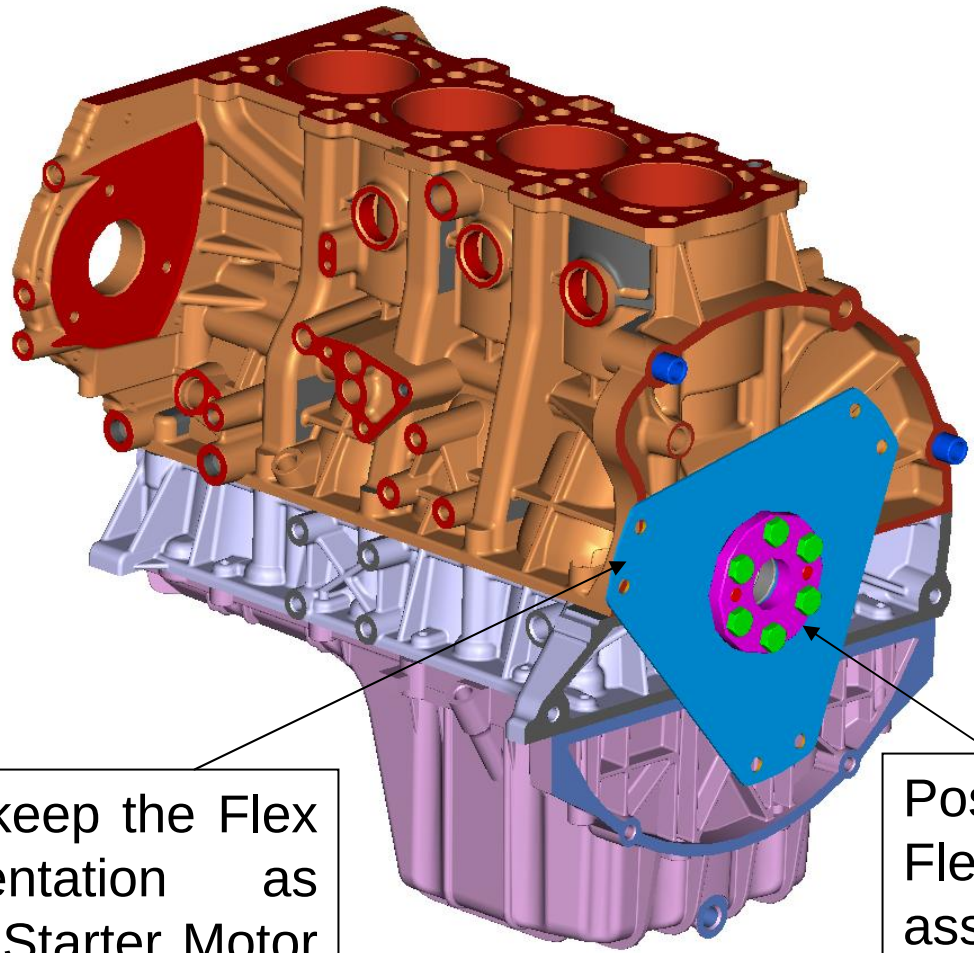
Existing Dowel Pins (Commonized with NEF CRDE)

Engine Docking Stage 2





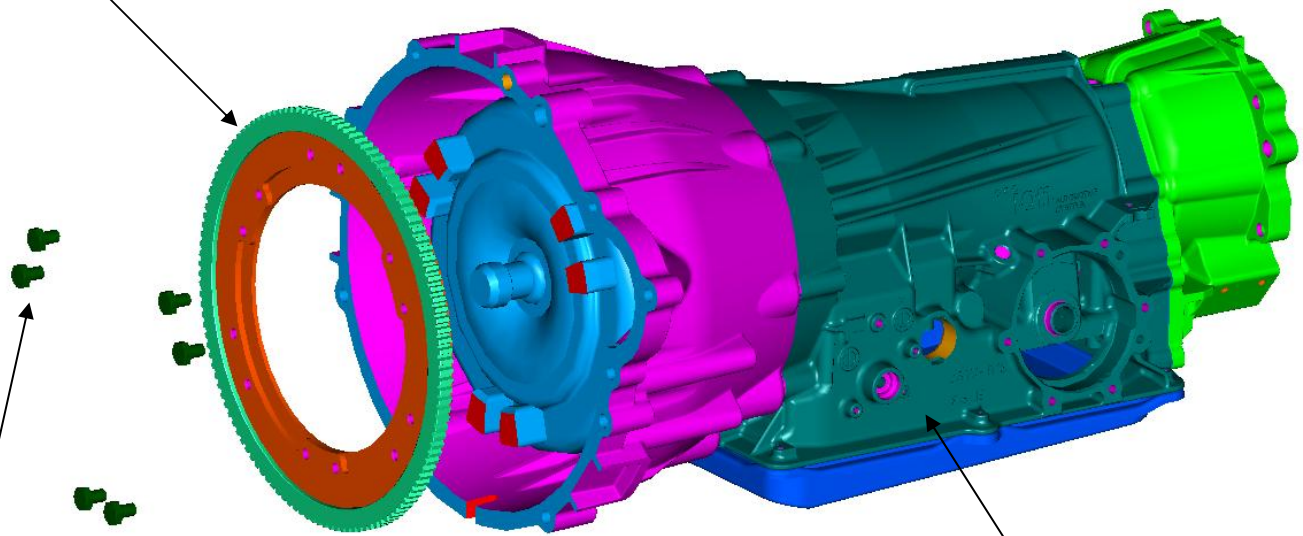
Engine Docking Stage 3



Must try to keep the Flex Plate orientation as depicted (in Starter Motor Mounting area); will help at the time of AT docking.

Post assembly view - for Flex Plate & Flange assembly on to the Engine

Engine Docking Stage 4

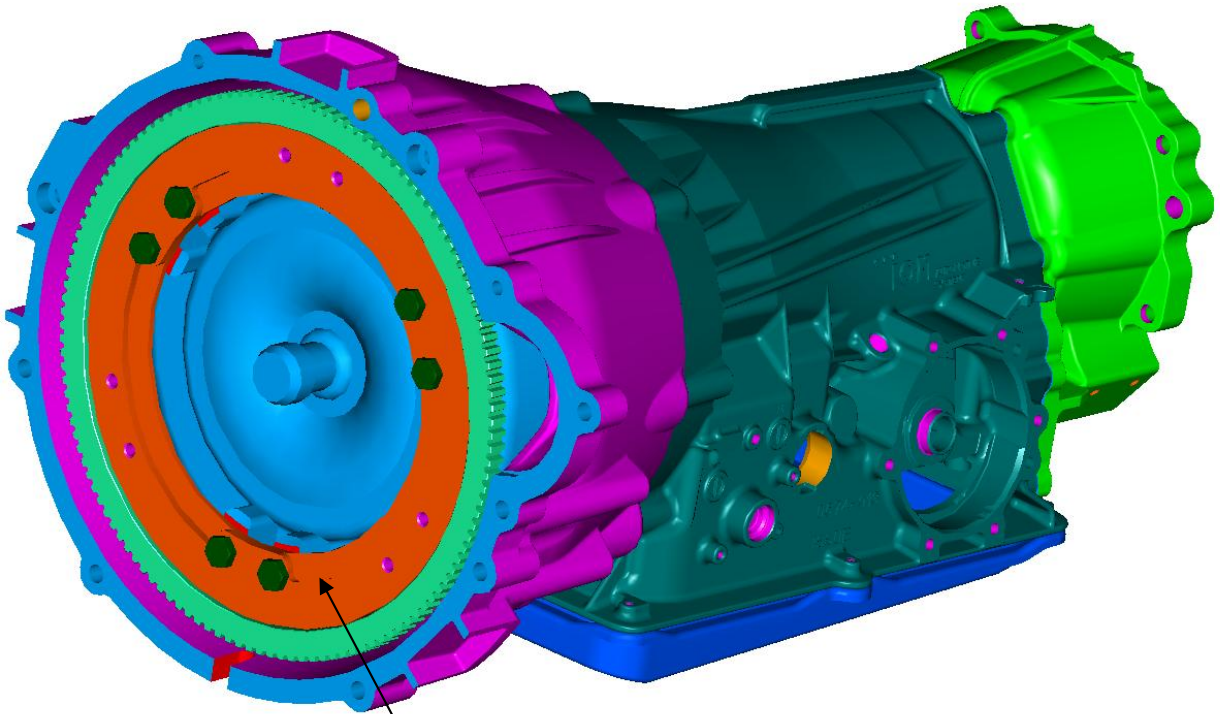


Flange Bolts [M8x1.25x20 – 6 nos]
Tightening Torque : 35~42 Nm

Automatic Transmission – 6 Speed
as received from DSI

Note: Use the alignment tool to locate the adaptor ring to the TC. Not using it can cause errors due to lack of concentricity

Engine Docking Stage 5



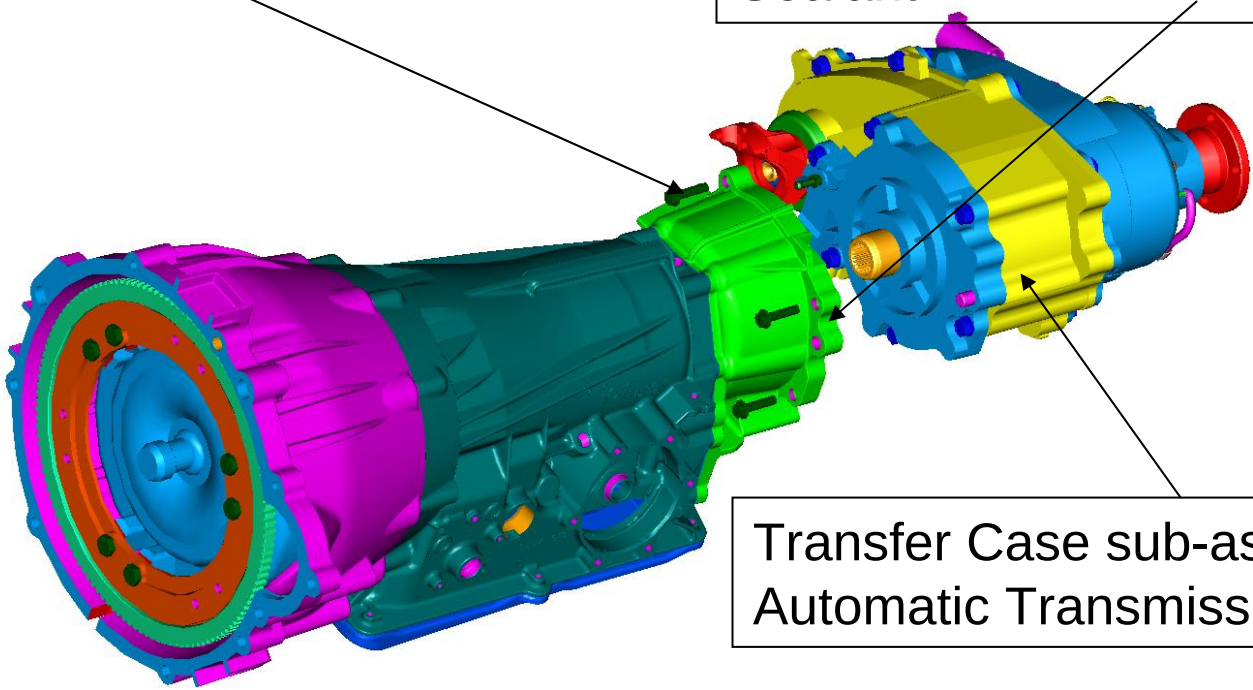
Post assembly view - for Adapter Ring Assembly on to the Automatic Transmission

Engine Docking Stage 6

Existing Hex. Bolts (4 Nos – 20~25 Nm Tightening Torque); M10x1.5x40 (1 no. – 20~25 Nm tightening Torque); Existing Washers are also to be used.

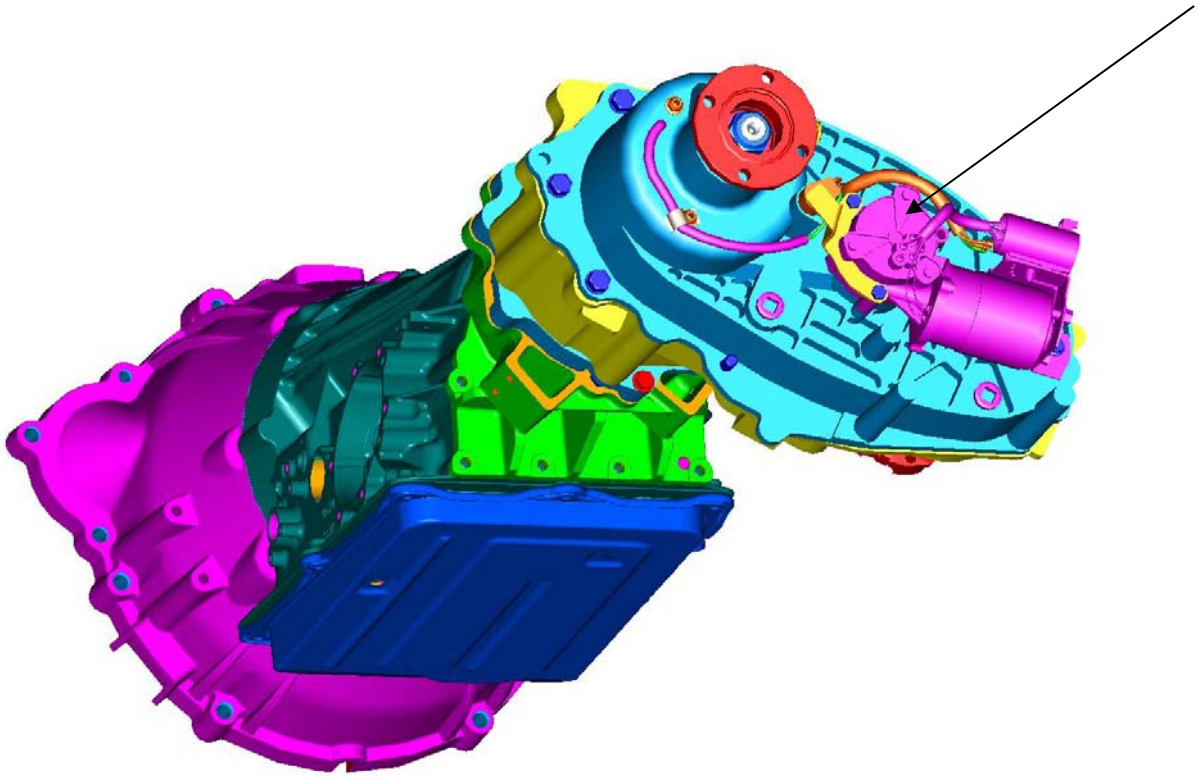
Existing liquid Gasket (Sealant) to be applied before assembling;

Incases of DSI Hsg; Gaps at 3 locations to be filled with extra Sealant.



Transfer Case sub-assembly with Automatic Transmission

Post assembly view - For Transfer Case Assembly on to the Automatic Transmission

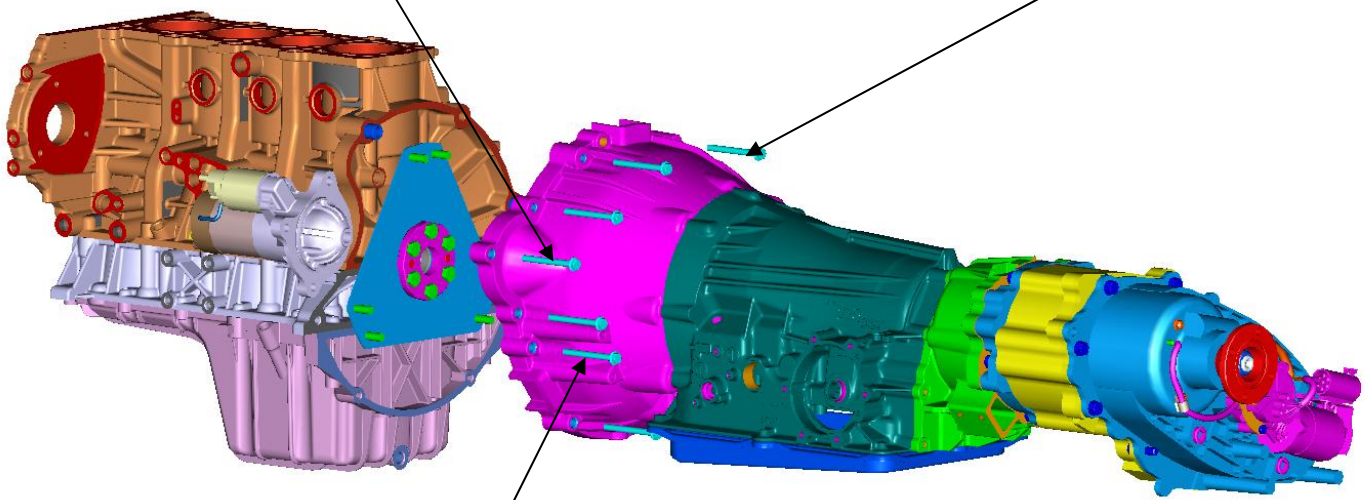


Engine Docking Stage 7

Starter Motor Mtg. bolts are same as today; to be provided by Electrical Group

For PDC Housing -

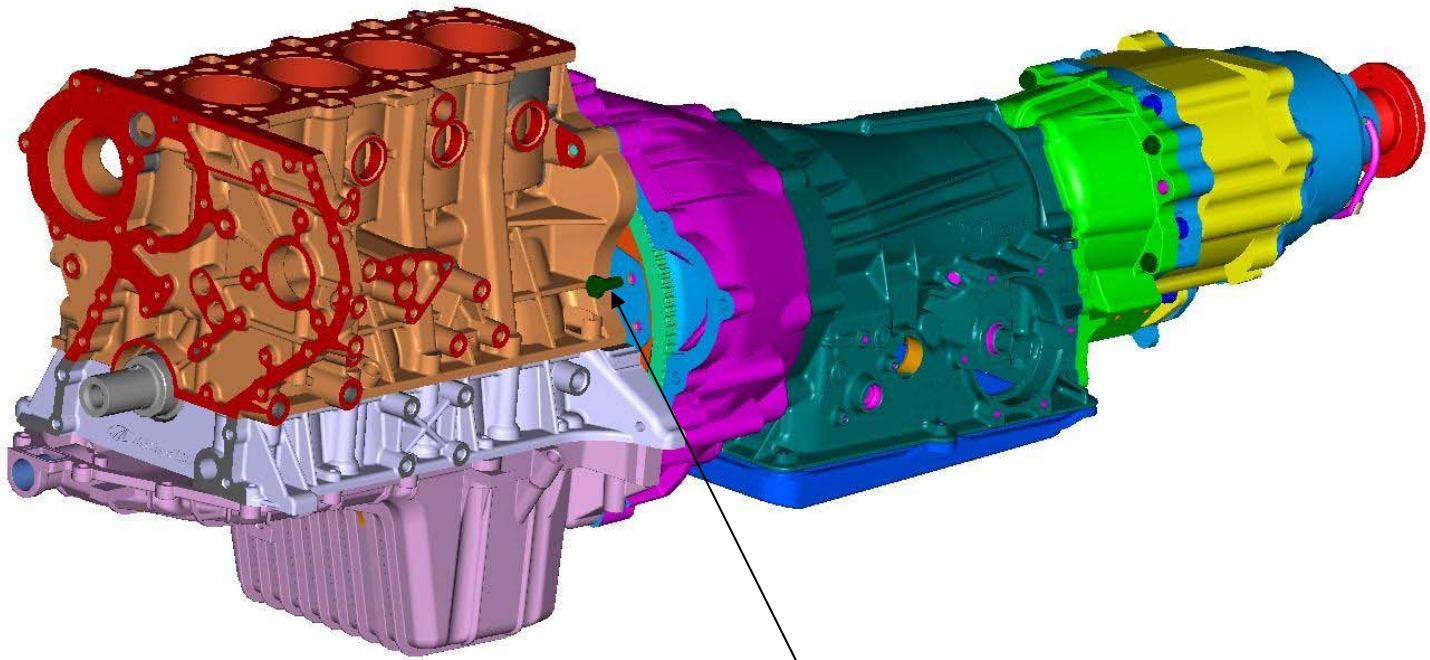
Existing Flange Bolts M10x1.5x55 (4 Nos – 40~50 Nm), M10x1.5x75 (3 Nos – 40~50 Nm)



For DSI made Housing -

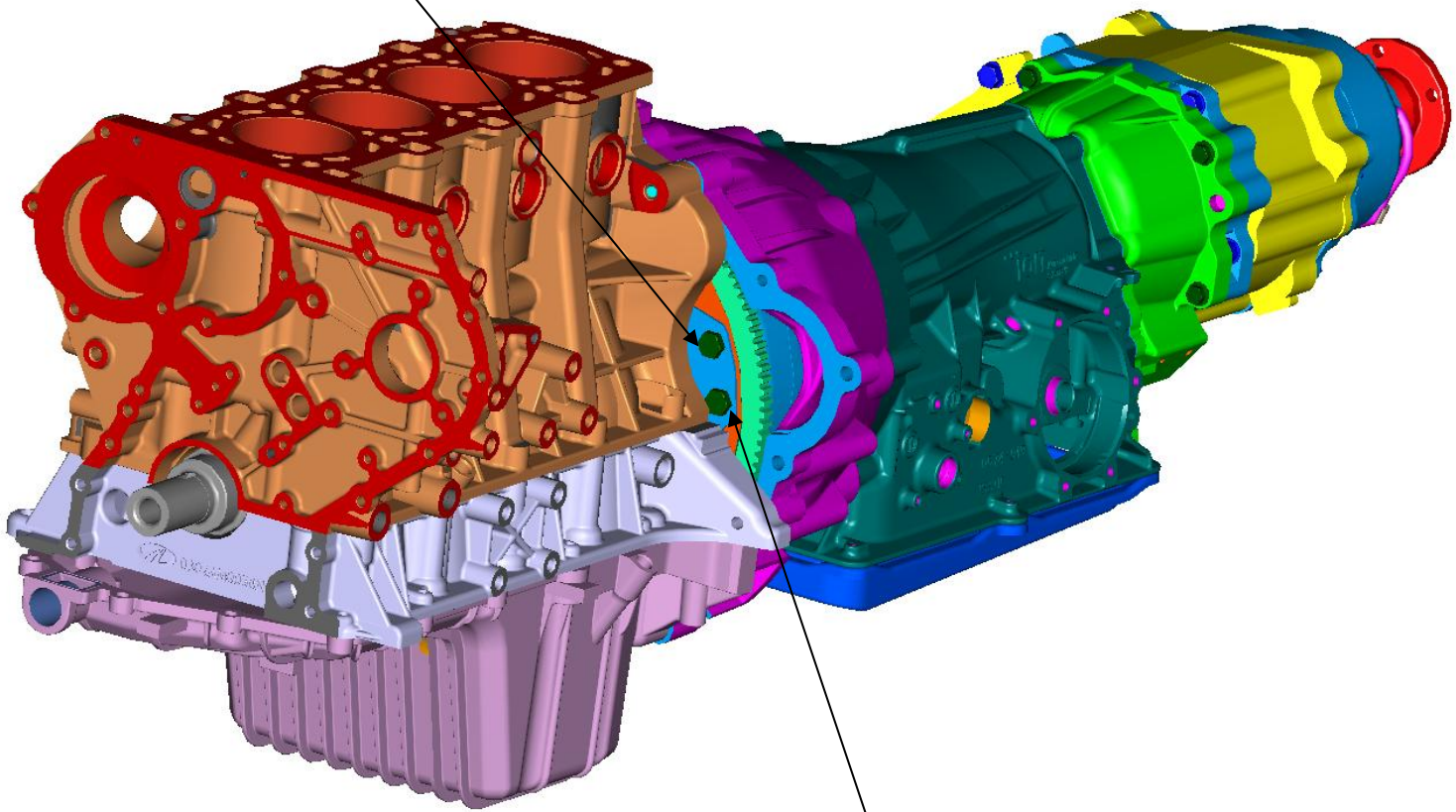
Existing Flange Bolts M10x1.5x30 (4 Nos – 40~50 Nm); M10x1.5x50 (3 Nos – 40~50 Nm)

Engine Docking Stage 8



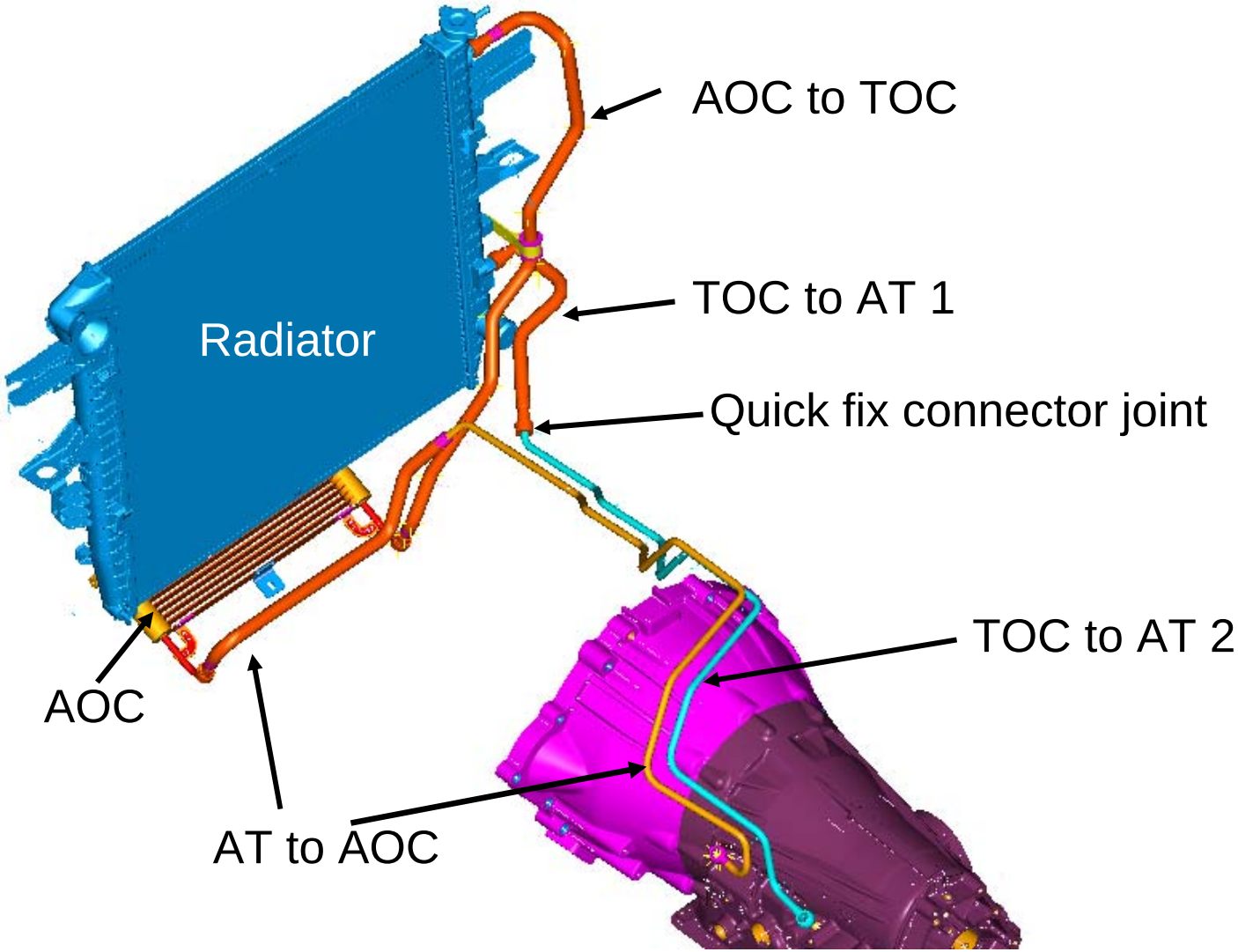
Flange Bolts M8x1.25x20 –
(6 nos 35~42 Nm)

Post assembly view - For Flex Plate & Adapter Ring coupling; View after Automatic Transmission Docking



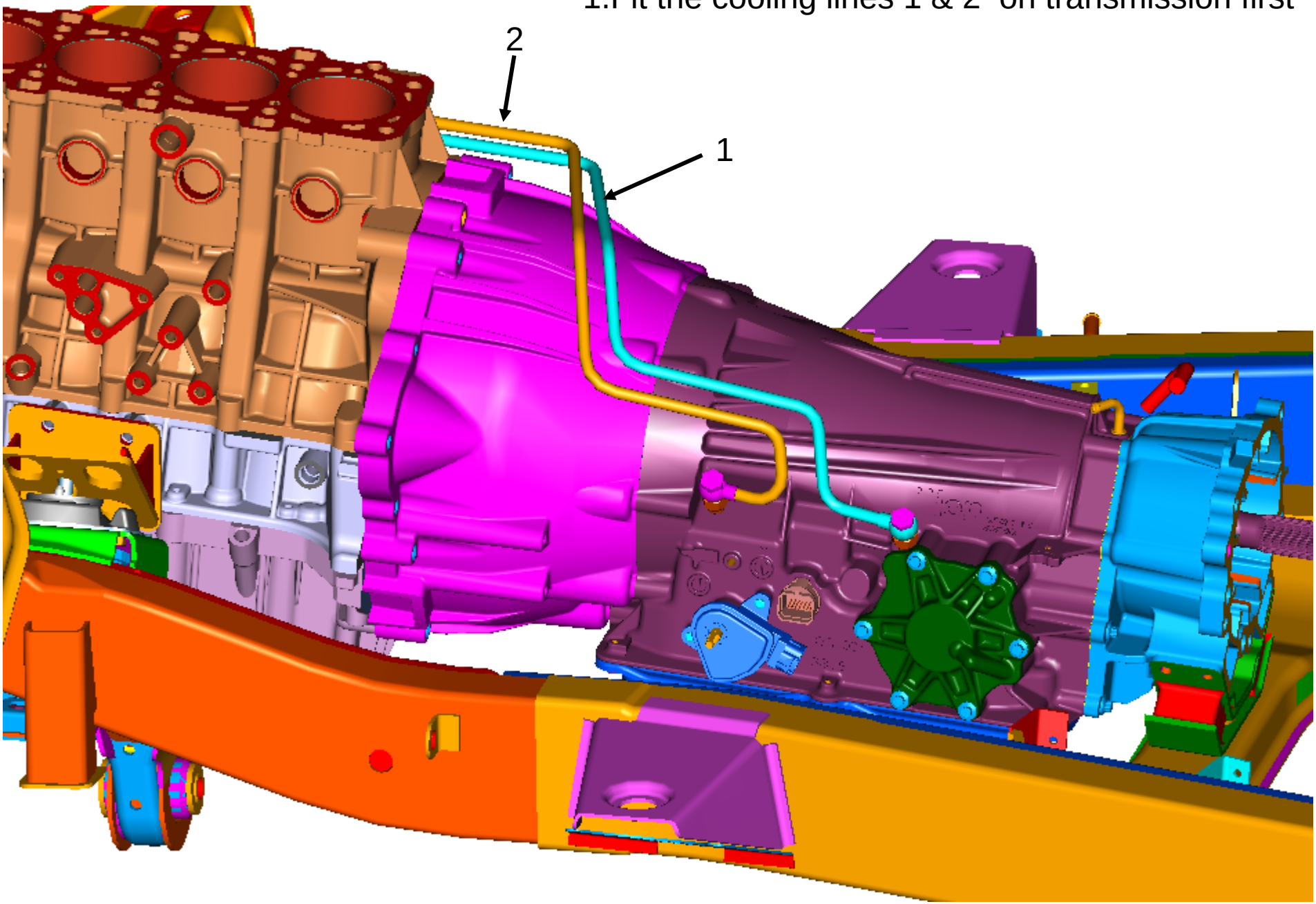
Flange Bolts M8x1.25x20 – 6 nos. 35~42 Nm

Remove and refitting the oil cooler line

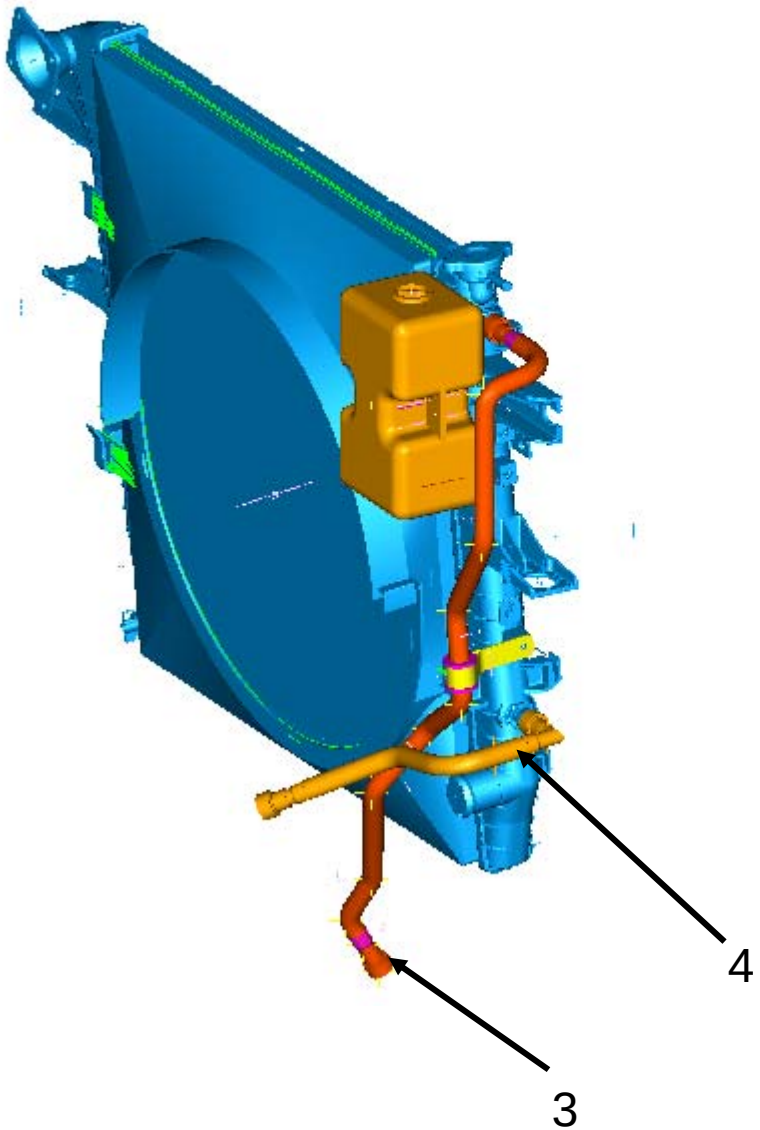


AOC : Auxiliary oil cooler.
TOC : Transmission oil cooler.

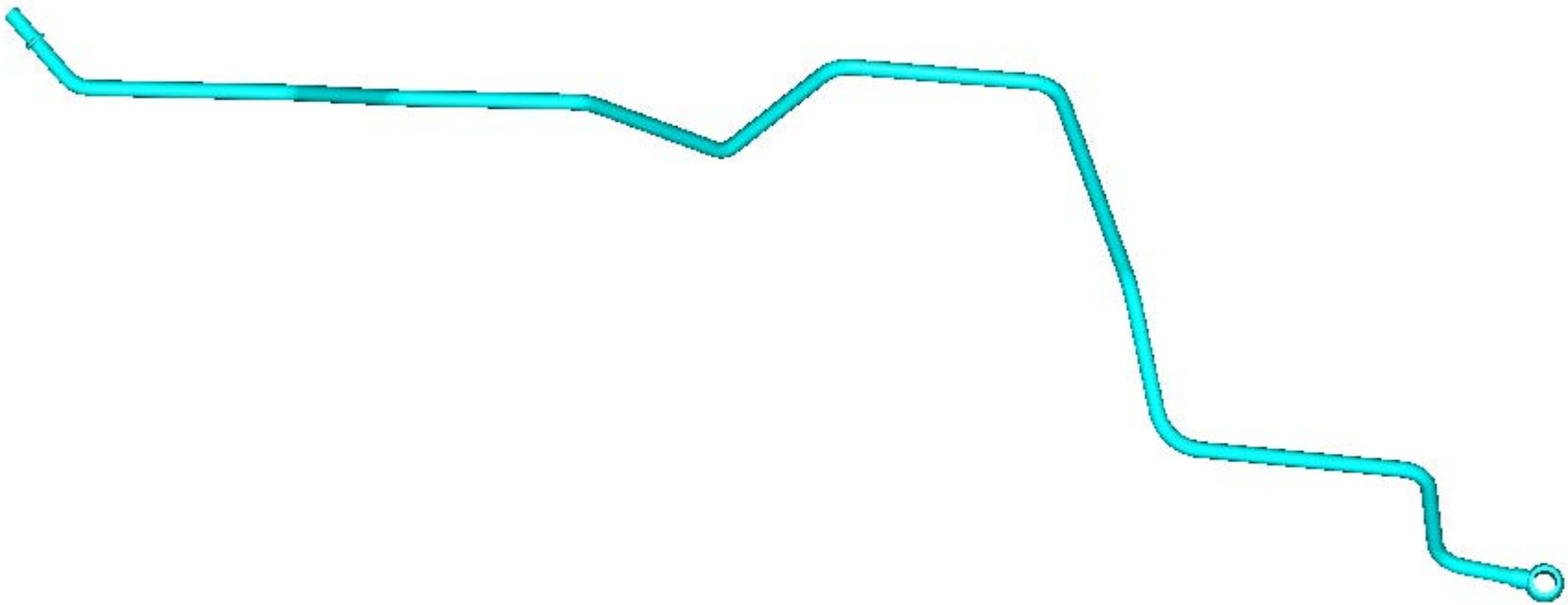
1.Fit the cooling lines 1 & 2 on transmission first



2. Fit other cooling lines 3&4 on radiator end

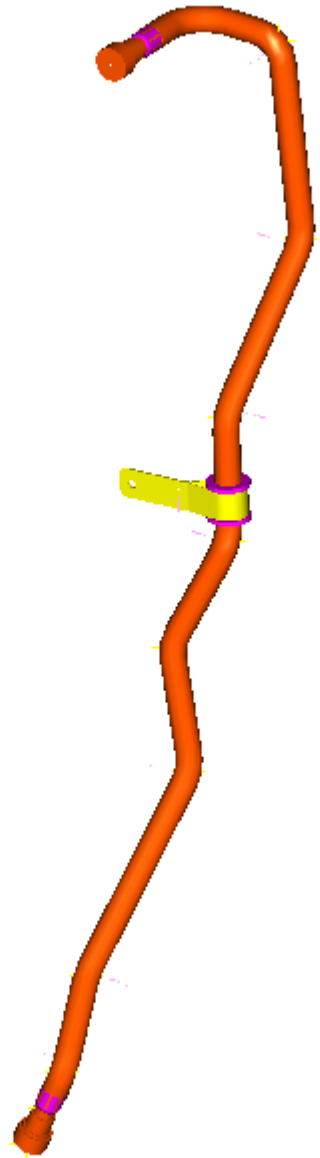


Oil lines at radiator end

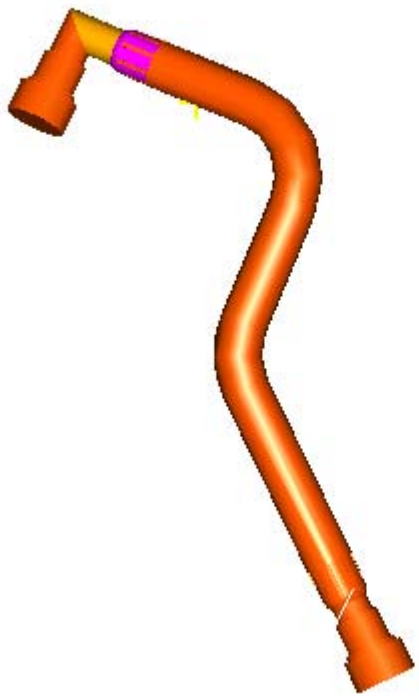


1) Oil line TPC to AT 2

2) Oil line AT to AOC

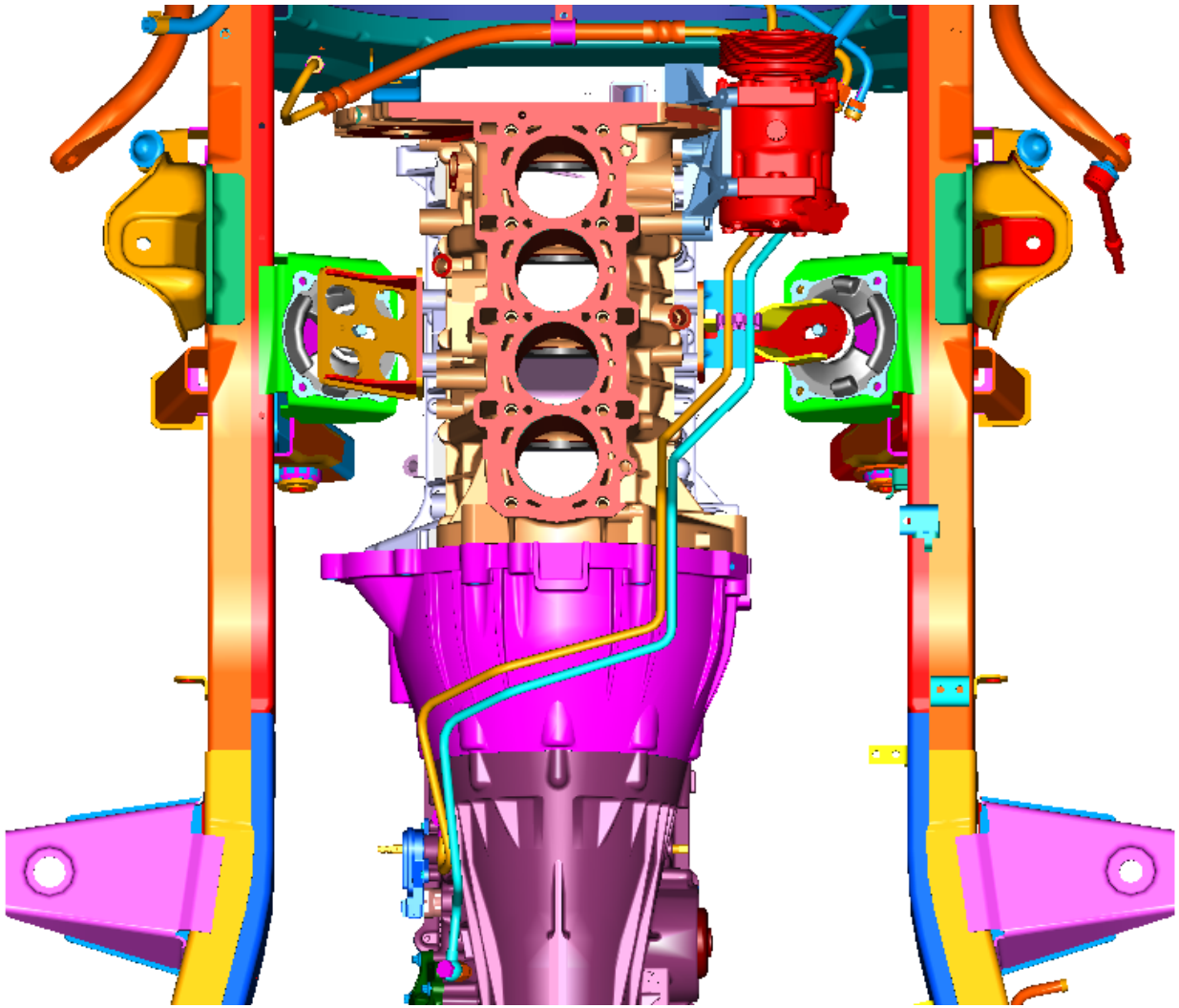


3) Oil line AOC to TOC

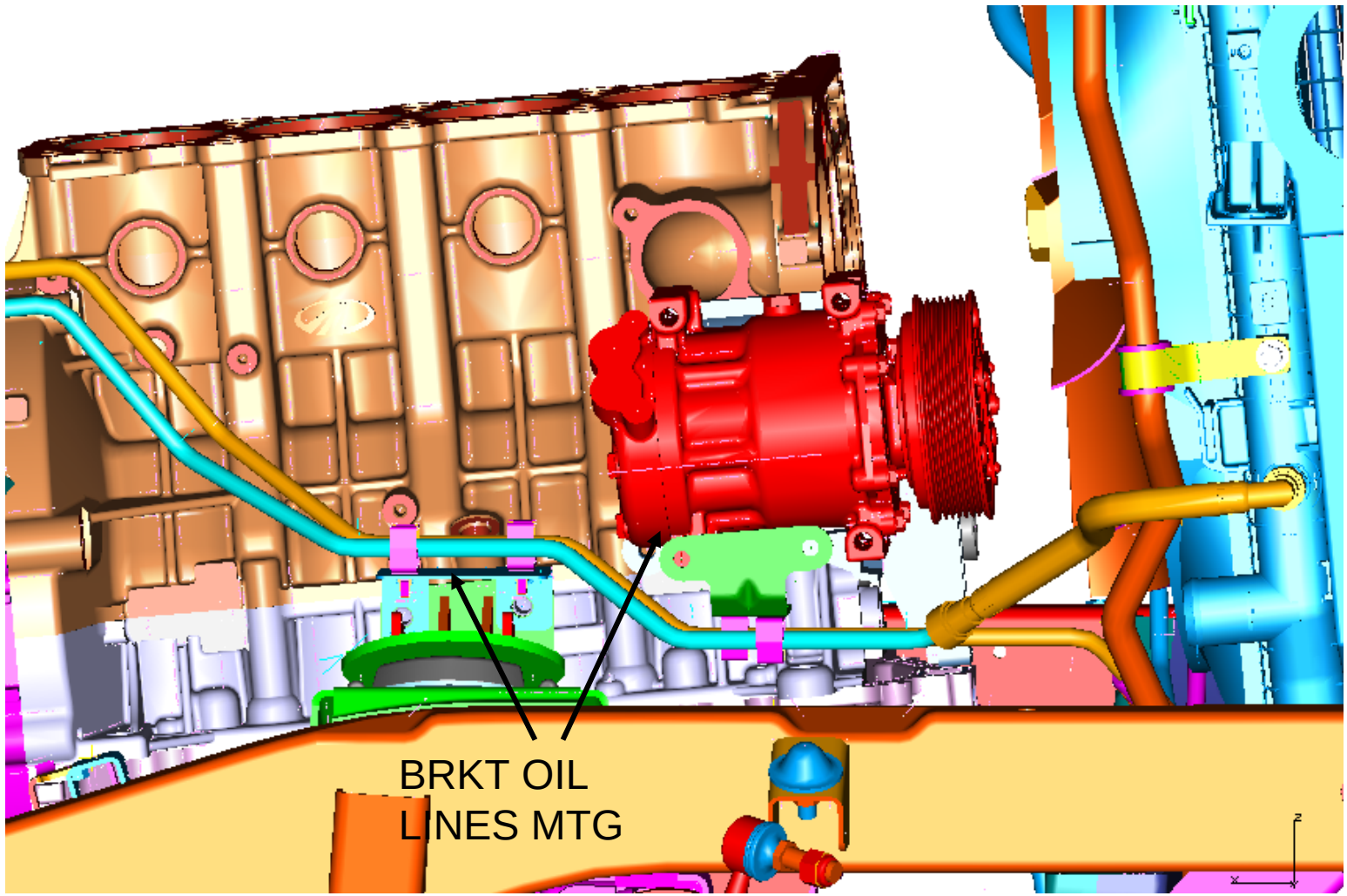


4) Oil line TOC to AT 1

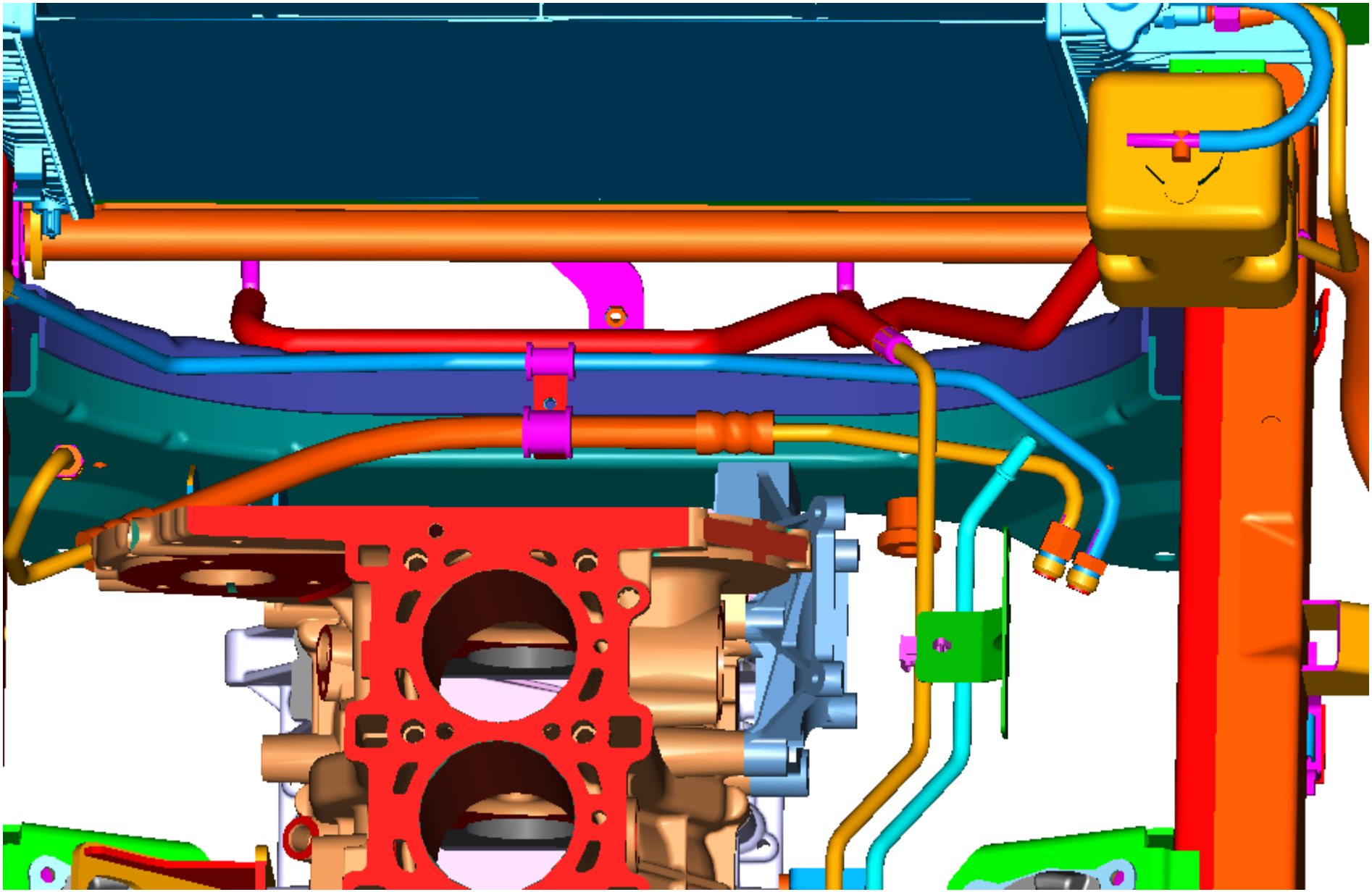
Top view



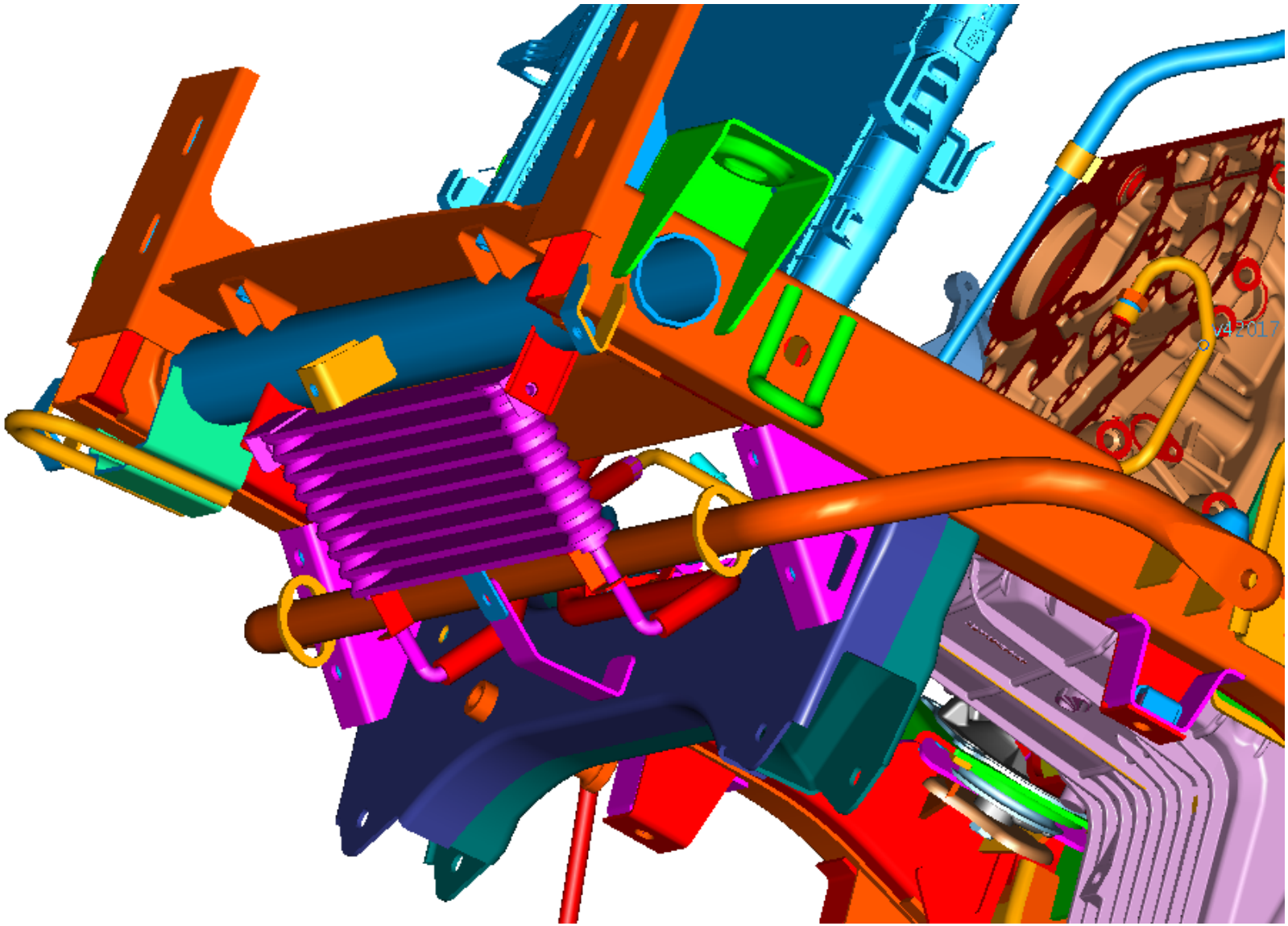
Right hand side view



Top view (radiator end)



Side view (radiator end)



AOC mtg arrangement