Diagnostic Sheet
FROM: Maserati TSO
TO: Maserati Network

Maserati
PERSONAL SERVICE LAB
MASTERS OF CARE

Grecale Steering Rack Diagnosis

DATE: October 7, 2024

This Diagnostic Sheet serves as a guide and provides additional diagnostic info for possible Steering rack anomalies.

MODELS: M182 Grecale (All MY).

SECTION: 05.10 – 1 COMPLETE STEERING RACK UNIT

This diagnostic sheet is divided into three different sections:

A) Generic checks

B) Mechanical checks:

- Checklist B.1: Noise by steering on a not-moving and moving vehicle - Rattle noise
- Checklist B.2: Noise by steering on a not-moving and moving vehicle - Stick & Slip noise
- Checklist B.3: Noise by steering on a not-moving and moving vehicle - Squeak noise
- Checklist B.4: Hard steering

C) Electric/electronic checks:

- Checklist C.1: The vehicle tends to drift from the imposed trajectory and/or there is lack of correct realignment of the steering wheel.
- Checklist C.2: The Electric Power Steering lack of assistance and the fault lamp is ON.
- Checklist C.3: The Electric Power Steering lack of assistance and the fault lamp is OFF.
- Checklist C.4: Noise coming from the Electric Power Steering.
- Checklist C.5: The Electric Power Steering lacks correct realignment of the steering wheel at low vehicle speeds.
- Checklist C.6: The Electric Power Steering works correctly but there are error codes detected on EPS and/or error messages on the instrument cluster.

The last page is an overview of the main steering rack components.

Section A – Generic checks

VIN	Model	Odometer	Date

Dealer	Reference Person	Phone number

CUSTOMER COMPLAINT (fill one or more cells)	
Noise	
Lack of assitance from steering rack	
Warning messages	
Other (please specify)	

CONDITIONS IN WHICH THE FAULT HAS BEEN DETECTED (fill one or more cells)	
Vehicle speed	
Acceleraton	
Deceleration	
Braking	
Overtaking	
Narrow bend	
Slight bend	

ROAD CONDITIONS WHEN THE FAULT HAS BEEN DETECTED (fill one or more cells)	
Dry/tarmac surface	
Rainy surface	
Dirty Surface	
Bumpy surface	
Cold/iced surface	
Lane markings visible	
Lane markings not visible/intermittent	
Presence of roadworks	

ENVIRONMENTAL CONDITIONS (fill one or more cells)	
Foggy	
Sunny	
Rainy	
Dark	
Other (please specify)	

SYSTEM STATUS WHEN THE FAULT HAS BEEN DETECTED

CHECK THAT THE STEERING ANGLE IS 0° (OR VERY CLOSE TO 0°) USING THE DIAGNOSTIC TOOL, IN STRAIGHT AHEAD CONDITIONS	
Steering angle in straight ahead conditions	

NOTES

Section B – Mechanical checks

In this section, the following checklists are reported:

- **Checklist B.1: Noise by steering on a not-moving and moving vehicle - Rattle noise**
- **Checklist B.2: Noise by steering on a not-moving and moving vehicle - Stick & Slip noise**
- **Checklist B.3: Noise by steering on a not-moving and moving vehicle - Squeak noise**
- **Checklist B.4: Hard steering**

Checklist B.1: Noise by steering on a not-moving and moving vehicle - Rattle noise

STEP	ACTION	👍	!	🔧
1	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the Mechanical steering gear fixing screws are correctly tightened to the vehicle subframe	Go to step 2.	One/or more fixing screws are not tightened according to fixing torque required	Tighten Mechanical steering gear fixing screws to the vehicle subframe according to fixing torque required
			Noise is still present	Go to step 2
2	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the Mechanical steering gear OBJs nuts are correctly tightened to the vehicle knuckles (Left and right wheel)	Go to step 3.	One/or both OBJs nuts are not tightened according OBJ nut fixing torque required	Tighten mechanical steering gear OBJ nuts to the vehicle knuckle according to fixing torque required
			Noise is still present	Go to step 3
3	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the I-Shaft yoke pin is correctly fixed to the Mechanical steering gear pinion spline.	Go to step 4.	I-Shaft yoke pin is not correctly fixed	Fix I-Shaft yoke pin to the Mechanical steering gear pinion spline according to fixing torque required
			Noise is still present	Go to step 4
4	BELLOWS INTEGRITY CHECK	OK	DETECTED ISSUES	ACTION
	Check that the bellows areas linked to the Mechanical steering gear housing and IBJs don't show any damage/hole/scratch on all relevant area (including also relevant bellow clamps and clips)	Go to step 5.	Bellow and/or bellow clamp/clips areas are damaged or cut.	Replace damaged bellows with new one/ones with relevant Service bellow Kit.
5	TIGHTENING TORQUE CHECK – soft bushes	OK	DETECTED ISSUES	ACTION
	In case Mechanical Steering gear presents soft bushes on foot mount area (also called silent blocks), check that rubber & steel plate parts of soft bushes are not damaged.	Go to step 6.	Rubber and/or steel plate parts of one or more soft bushes are damaged	Open a BOL to require authorization for steering rack replacement
6	CHECK OF WHEEL ALIGNMENT	OK	DETECTED ISSUES	ACTION
	Check that settings of vehicle's suspension and steering line are correct (toe-in angle, camber angle, straight ahead alignment with rims aligned and steering wheel at zero angle, suspensions travel). Check the proper alignment of the rear suspension and if no noise is detected.	Go to step 7.	Issue with the vehicle's suspension settings.	Repair and reinstate correct suspension settings.
			Noise is still present	Go to step 7
7	STEERING CHECK ON A NOT-MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	At Engine off and vehicle on a flat surface (possibly on paved ground) please conduct quick steering wheel rotations, to left and right direction. Check if no noise is detected.	Go to step 9	Noise is identified with a "toc-toc" RATTLE noise at the rotation inversion, coming from driver vehicle side	Go to step 8.
			Same as above, but from passenger side.	Go to step 8.
8	STEERING CHECK	OK	DETECTED ISSUES	ACTION
	In order to exclude any presence of	Go to step 9	Excessive clearance	Replace OBJs and open a

	clearance on OBJs, replace both OBJs and repeat the manoeuvre. Check if no noise is detected.		on OBJ ball pin	BOL, reporting the result of the analysis.
			Noise is still present.	Open a BOL to require authorization for steering rack replacement
9	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	Perform a vehicle test on a bumpy road or passing through some artificial bumps or pits. Check if no noise is detected.	End of diagnosis.	A "Rattle" Noise is detected.	Open a BOL to require authorization for steering rack replacement

Checklist B.2: Noise by steering on a not-moving and moving vehicle - Stick & Slip noise

STEP	ACTION	👍	!	🔧
1	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the Mechanical steering gear fixing screws are correctly tightened to the vehicle subframe	Go to step 2.	One/or more fixing screws are not tightened according to fixing torque required	Tighten Mechanical steering gear fixing screws to the vehicle subframe according to fixing torque required
			Noise is still present	Go to step 2
2	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the Mechanical steering gear OBJs nuts are correctly tightened to the vehicle knuckles (Left and right wheel)	Go to step 3.	One/or both OBJs nuts are not tightened according OBJ nut fixing torque required	Tighten Mechanical steering gear OBJ nuts to the vehicle knuckle according to fixing torque required
			Noise is still present	Go to step 3
3	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the I-Shaft yoke pin is correctly fixed to the Mechanical steering gear pinion spline.	Go to step 4.	I-Shaft yoke pin is not correctly fixed	Fix I-Shaft yoke pin to the Mechanical steering gear pinion spline according to fixing torque required
			Noise is still present	Go to step 4
4	BELLOWS INTEGRITY CHECK	OK	DETECTED ISSUES	ACTION
	Check that the bellows areas linked to the Mechanical steering gear housing and IBJs don't show any damage/hole/scratch on all relevant area (including also relevant bellow clamps and clips)	Go to step 5.	Bellow and/or bellow clamp/clips areas are damaged or cut.	Replace damaged bellows with new one/ones with relevant Service bellow Kit.
5	TIGHTENING TORQUE CHECK – soft bushes	OK	DETECTED ISSUES	ACTION
	In case Mechanical Steering gear presents soft bushes on foot mount area (also called silent blocks), check that rubber & steel plate parts of soft bushes are not damaged.	Go to step 6.	Rubber and/or steel plate parts of one or more soft bushes are damaged	Open a BOL to request authorization for steering rack replacement
6	CHECK OF WHEEL ALIGNMENT	OK	DETECTED ISSUES	ACTION
	Check that settings of vehicle's suspension and steering line are correct (toe-in angle, camber angle, straight ahead alignment with rims aligned and steering wheel at zero angle, suspensions travel). Check the proper alignment of the rear suspension and if no noise is detected.	Go to step 7.	Issue with the vehicle's suspension settings.	Repair and reinstate correct suspension settings.
			Noise is still present	Go to step 7
7	STEERING CHECK ON A NOT-MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	At Engine off and vehicle on a flat surface (possibly on paved ground) please conduct a VERY SLOW steering wheel rotation, to right direction, of circa 90 degrees. Stop and repeat the same maneuver to left direction. Check if no noise is detected.	Go to step 8.	A Stick&slip Noise is detected.	Open a BOL to request authorization for steering rack replacement
8	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	With Engine on and vehicle on a flat surface (possibly on paved ground) please conduct a VERY SLOW steering wheel rotation, to right direction, of circa 90 degrees. Stop and repeat the same maneuver to left direction. Check if no noise is detected.	End of diagnosis.	A Stick&slip Noise is detected.	Open a BOL to request authorization for steering rack replacement

Checklist B.3: Noise by steering on a not-moving and moving vehicle - Squeak noise

STEP	ACTION			
1	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the mechanical steering gear fixing screws are correctly tightened to the vehicle subframe	Go to step 2.	One/or more fixing screws are not tightened according to fixing torque required	Tighten mechanical steering gear fixing screws to the vehicle subframe according to fixing torque required
			Noise is still present	Go to step 2
2	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the Mechanical steering gear OBJs nuts are correctly tightened to the vehicle knuckles (Left and right wheel)	Go to step 3.	One/or both OBJs nuts are not tightened according OBJ nut fixing torque required	Tighten Mechanical steering gear OBJ nuts to the vehicle knuckle according to fixing torque required
			Noise is still present	Go to step 3
3	TIGHTENING TORQUE CHECK	OK	DETECTED ISSUES	ACTION
	Check that the I-Shaft yoke pin is correctly fixed to the Mechanical steering gear pinion spline.	Go to step 4.	I-Shaft yoke pin is not correctly fixed	Fix I-Shaft yoke pin to the Mechanical steering gear pinion spline according to fixing torque required
			Noise is still present	Go to step 4
4	BELLOWS INTEGRITY CHECK	OK	DETECTED ISSUES	ACTION
	Check that the bellows areas linked to the Mechanical steering gear housing and IBJs don't show any damage/hole/scratch on all relevant area (including also relevant bellow clamps and clips)	Go to step 5.	Bellow and/or bellow clamp/clips areas are damaged or cut.	Replace damaged bellows with new one/ones with relevant Service bellow Kit.
5	TIGHTENING TORQUE CHECK – soft bushes	OK	DETECTED ISSUES	ACTION
	In case Mechanical Steering gear presents soft bushes on foot mount area (also called silent blocks), check that rubber & steel plate parts of soft bushes are not damaged.	Go to step 6.	Rubber and/or steel plate parts of one or more soft bushes are damaged	Open a BOL to request authorization for steering rack replacement
6	CHECK OF WHEEL ALIGNMENT	OK	DETECTED ISSUES	ACTION
	Check that settings of vehicle's suspension and steering line are correct (toe-in angle, camber angle, straight ahead alignment with rims aligned and steering wheel at zero angle, suspensions travel). Check the proper alignment of the rear suspension and if no noise is detected.	Go to step 7.	Issue with the vehicle's suspension settings.	Repair and reinstate correct suspension settings.
			Noise is still present	Go to step 7
7	STEERING CHECK ON A NOT-MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	Switch on the engine and immediately conduct a steering wheel rotation, to right direction, till the end of rack travel and turn back to left direction. Check if no noise is detected.	Go to step 8.	Squeak Noise is detected.	Open a BOL to request authorization for steering rack replacement
8	STEERING CHECK ON A NOT-MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	Switch on the engine and repeat the maneuver after few minutes, conducting a steering wheel rotation, to right direction, till the end of rack travel and turn back to left direction. Check if no noise is detected.	Go to step 9.	Squeak Noise is detected.	Open a BOL to request authorization for steering rack replacement
9	STEERING CHECK ON A NOT-MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	After vehicle is switched on and engine temperature as per fully operational, conduct a steering wheel rotation, to right	Go to step 10.	Squeak Noise is detected.	

	direction, till the end of rack travel and turn back to left direction. Check if no noise is detected.			Open a BOL to request authorization for steering rack replacement
10	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	Switch on the engine on a moving vehicle and immediately conduct a steering wheel rotation, to right direction, till the end of rack travel and turn back to left direction. Check if no noise is detected.	Go to step 11.	Squeak Noise is detected.	Open a BOL to request authorization for steering rack replacement
11	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	Switch on the engine on a moving vehicle and repeat the maneuver after few minutes, conducting a steering wheel rotation, to right direction, till the end of rack travel and turn back to left direction. Check if no noise is detected.	Go to step 12.	Squeak Noise is detected.	Open a BOL to request authorization for steering rack replacement
12	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	After vehicle is switched on and engine temperature as per fully operational, on a moving vehicle, conduct a steering wheel rotation, to right direction, till the end of rack travel and turn back to left direction. Check if no noise is detected.	End of diagnosis.	Squeak Noise is detected.	Open a BOL to request authorization for steering rack replacement

Checklist B.4: Hard steering

STEP	ACTION			
1	PINION/RACK FREE PLAY CHECK	OK	DETECTED ISSUES	ACTION
	With straight wheel deactivate the column I-shaft and applying a radial/axial force on the pinion check if there is a pinion/rack free play	Go to step 2.	Excessive pinion/rack free play	Open a BOL to request authorization for steering rack replacement
2	RACK FLOWING CHECK	OK	DETECTED ISSUES	ACTION
	Deactivate the front wheels, deactivate the OBJs from vehicle chassis. Check the suitable rack flow, moving the Mechanical steering gear to right direction, till the end of rack travel and turn back to left direction.	Go to step 3.	Hardness or softness rack travel	Open a BOL to request authorization for steering rack replacement
3	GREASE LEAKAGE CHECK	OK	DETECTED ISSUES	ACTION
	Visual check that there are not traces of leakage of grease from bellows or from ring nut.	Go to step 4.	Grease leakage	Open a BOL to request authorization for steering rack replacement
4	BELLOWS INTEGRITY CHECK	OK	DETECTED ISSUES	ACTION
	Check that the bellows areas linked to the Mechanical steering gear housing and IBJs don't show any damage/hole/scratch on all relevant area (including also relevant bellow clamps and clips)	Go to step 5.	Bellow and/or bellow clamp/clips areas are damaged or cut.	Replace damaged bellows with new one/ones with relevant Service bellow Kit.
5	CHECK OF WHEEL ALIGNMENT	OK	DETECTED ISSUES	ACTION
	Check that settings of vehicle's suspension and steering line are correct (toe-in angle, camber angle, straight ahead alignment with rims aligned and steering wheel at zero angle, suspensions travel). Check the proper alignment of the rear suspension and if no noise is detected.	Go to step 6.	Issue with the vehicle's suspension settings.	Repair and reinstate correct suspension settings. Perform new axles balance calibrating angles, convergence and camber of front and rear wheels.
6	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	With Engine on and vehicle on a flat surface please position the steering wheel at the end of right stroke and perform a 360 °maneuver with the vehicle, letting the steering wheel return to the center by itself. Stop and repeat the same maneuver to the left. Check the steering feeling.	Go to step 7.	Steering wheel remains stuck and vehicle goes around itself.	Open a BOL to request authorization for steering rack replacement
7	STEERING CHECK ON A NOT-MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	Please check any constriction about tie rods articulation (gripped ball pins).	Go to step 8.	OBJ ball pin gripped and no constraints on IBJs.	Replace damaged OBJ/s with new one/s with relevant Service OBJ Kit. Please send the damaged original OBJ to ZF for analysis.
			IBJ ball pin gripped	Open a BOL to request authorization for steering rack replacement

			An hard steering feeling is still detected.	Open a BOL to request authorization for steering rack replacement
8	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	With Engine on and vehicle on a flat surface please conduct a steering wheel rotation, to right direction, of about 90 degrees. Stop and repeat the same maneuver to left direction. Check the steering feeling.	End of diagnosis.	A hard steering feeling is detected.	Go to step 9.
9	STEERING CHECK ON A MOVING VEHICLE	OK	DETECTED ISSUES	ACTION
	Please check any constriction about tie rods articulation (gripped ball pins).	End of diagnosis.	OBJ ball pin gripped and no constraints on IBJs.	Replace damaged OBJ/s with new one/s with relevant Service OBJ Kit. Please send the damaged original OBJ to ZF for analysis.
			IBJ ball pin gripped	Open a BOL to request authorization for steering rack replacement
			An hard steering feeling is still detected.	Open a BOL to request authorization for steering rack replacement

Section C – Electric/Electronic checks

In this section, the following checklists are reported:

- **Checklist C.1: The vehicle tends to drift from the imposed trajectory and/or there is lack of correct realignment of the steering wheel.**
- **Checklist C.2: The Electric Power Steering lack of assistance and the fault lamp is ON.**
- **Checklist C.3: The Electric Power Steering lack of assistance and the fault lamp is OFF.**
- **Checklist C.4: Noise coming from the Electric Power Steering.**
- **Checklist C.5: The Electric Power Steering lack of correct realignment of the steering wheel at low vehicle speeds.**
- **Checklist C.6: The Electric Power Steering works correctly but there are error codes detected on EPS and/or error messages on the instrument cluster.**

Checklist C.1: The vehicle tends to drift from the imposed trajectory and/or there is lack of correct realignment of the steering wheel.

STEP	ACTION			
1	CHECK OF THE DRIFT	OK	DETECTED ISSUES	ACTION
	Check that the drift is not noticed while braking.	Go to step 3.	The drift is noticed while braking.	Go to step 2
2	CHECK OF BRAKING SYSTEM	OK	DETECTED ISSUES	ACTION
	Check that braking system components, i.e. callipers, discs brake and pads are ok.	Go to step 3.	Problem detected on braking components.	Repair the problem on the braking system.
3	CHECK OF THE DRIFT	OK	DETECTED ISSUES	ACTION
	Check the behavior of the vehicle on a straight lane with good friction surface and verify that the vehicle can keep the straight ahead direction. While steering gently in both directions check that the steering wheel realignment is correct while removing the hands from it.	Go to step 4.	The drift of the vehicle is noticed when the steering wheel is released after an angle correction on the left or the right, with different realignment in each direction.	Go to step 4.
			The vehicle is unable to keep the straight ahead direction.	Go to step 5.
4	RIMS CHECK	OK	DETECTED ISSUES	ACTION
	Check rims for any damages.	Go to step 5.	The drift is still present.	Go to step 5.
5	TIRES CHECK	OK	DETECTED ISSUES	ACTION
	Check: - inflating pressure of tires is correct; - that all tires are in good conditions and are not too worn; - no damage is visible on the rims	Go to step 6.	Inflating pressure isn't correct.	Inflate the tires with the correct pressure.
			Damaged or worn tires.	Replace tires and perform tires balancing.
			Damaged rims.	Replace damaged rims.
6	CHECK OF WHEEL ALIGNMENT	OK	DETECTED ISSUES	ACTION
	Check that the wheel alignment and steering line are correct (toe-in angle, camber angle, straight ahead alignment with rims aligned and steering wheel at zero angle). Check the alignment of the rear suspension.	Go to step 7.	Issue with the wheel alignment.	Repair and reinstate correct wheel alignment. Check the steering angle alignment, in case is not aligned perform the calibration of steering angle on the alignment bench.

7	CHECK OF THE DRIFT	OK	DETECTED ISSUES	ACTION
	Verify that the drift is no longer present.	End of diagnosis.	The drift is still Present.	Go to step 8.
8	CONNECT THE DIAGNOSTIC TOOL	OK	DETECTED ISSUES	ACTION
	Connect the diagnostic tool, switch the key to the RUN position (ignition on) and check if it possible to start a diagnostic communication with the EPS ECU.	Go to step 10.	Lack of Communication.	Go to step 9.
9	CHECK THE REASON OF THE LACK OF COMM.	OK	DETECTED ISSUES	ACTION
	Perform the following checks and, for each action, check that communication with the EPS ECU is restored. In the case that this is not true, go directly to the following step (ref. wiring diagram on Modis): - Check that power and signal connectors are correctly fitted to the EPS unit; - Check that the supply voltage on the DC power pins is at least 11 V; - Check that there are no interruptions on the EPS wiring harnesses; - Check that the fuse is ok (not blown) and correctly inserted into the fuse holder; - Check that the chassis ground connection from the battery negative terminal is ok; - Check that the CAN line is ok - especially from EPS to BCM and then from the BCM to the IPC	Go to step 10.	Poor electric connections (loose/bent/corroded pins).	Open a BOL and report the problem, with pictures and references to the related wiring diagrams.
			Incorrect 12V power supply	Recharge or replace the 12 V battery (ref. MAS003090 or newer) and check that alternator is working correctly.
			Fault on electric connections (open lines or short circuits).	Open a BOL and report the problem, with pictures and references to the related wiring diagrams.
			Fault on CAN electric connections.	Open a BOL and report the problem, with pictures and references to the related wiring diagrams.
10	CHECK THE REASON OF THE LACK OF COMM.	OK	DETECTED ISSUES	ACTION
	Switch the key to the RUN position (ignition on) and check with the diagnostic tool that no errors are present on EPS ECU; NOTE: In case there are more than one DTC present, perform the actions expected for each detected DTC.	End of diagnosis.	Presence of one of the DTCs reported at step 10.1 (NOTE: please refer to DTC code only and not to its description, which may vary depending on the different translations)	**See step 10.1**

10.1	DTC	ACTION
	0x405100 Steering Wheel Position Sensor	If the problem persists, check that both 10way sensor harnesses are correctly seated into the connector on the under-side of the ECU and into the Sensor connector on the Gearbox; check the harness for damage. Check the connectors for bent pins and foreign objects or debris. Perform the calibration of steering angle on the alignment bench. If the harness is fitted correctly and not damaged but the fault is raised every ignition cycle, then open a BOL to require the replacement of the EPS system. Along with this document, send a copy of the scan report via BOL.
	0x405154 Steering Wheel Position Sensor-Missing Calibration	Perform the steering angle calibration procedure (through EPS active diagnosis).
	0xC41500 Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"	Check the correct connection of the wheel speed sensors and that the sensors are working correctly through the diagnosis on BSM ECU.
	0xC41541 0xC41582	Problem caused by BSM module. Check the faults on BSM and, if necessary, open a BOL to require authorization to replace it.

	Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"-General Checksum Failure / Alive Counter Incorrect or not updated			
	0x405164 Steering Wheel Position Sensor-Signal Plausibility Failure	If the problem persists, check that both 10way sensor harnesses are correctly seated into the connector on the under-side of the ECU and into the Sensor connector on the Gearbox; check the harness for damage. Check the connectors for bent pins and foreign objects or debris. Perform the calibration of steering angle on the alignment bench. Steer CW and CCW till end of travel. Check if error persists. In such a case, please open a BOL to require the replacement of the EPS system. Along with this document, send a copy of the scan report via BOL.		
11	CHECK FOLLOWING THE REPAIR	OK	DETECTED ISSUES	ACTION
	Perform the following cycle: switch the key from RUN (ignition on) to START (engine on); wait 10 seconds after engine is on; steer to the right till the rack end stop, then to the left to till the rack end stop and finally align the steering wheel to the drive ahead position and then switch the key from RUN (engine on) to IGN_LK (engine off, ignition on); switch the key from IGN_LK (ignition off) to RUN (cluster on) and check that no errors are detected.	End of diagnosis.	DTC present.	Contact BOL team specifying that the vehicle's drift is still present. Provide the complete scan report and wait for actions.

Checklist C.2: The Electric Power Steering lack of assistance and the fault lamp is ON.

STEP	ACTION			
1	CHECK WITH DIAGNOSTIC TOOL	OK	DETECTED ISSUES	ACTION
	Connect the diagnostic tool, switch the key to the RUN position (ignition on) and check if it possible to start a diagnostic communication with the EPS ECU.	Go to step 3.	Lack of Communication.	Go to step 2
2	CHECK THE REASON OF THE LACK OF COMM.	OK	DETECTED ISSUES	ACTION
	Perform the following checks and, for each action, check that communication with the EPS ECU is restored. In the case that this is not true, go directly to the following Step: - Check that power and signal connectors are correctly fitted to the EPS unit; - Check that the supply voltage on the DC power pins is at least 11 V; - Check that there are no interruptions on the EPS wiring harnesses; - Check that the fuse is ok (not blown) and correctly inserted into the fuse holder; - Check that the fuse is ok (not blown) and inserted correctly into the fuse holder; - Check that the chassis ground connection from the battery negative terminal is ok; - Check that the CAN line is ok - especially from EPS to BCM and then from the BCM to the IPC	Go to step 3.	Missed electric connections.	Repair the vehicle's line electric connections. [Electric Scheme]
			Incorrect Battery Voltage or Alternator not working properly.	Recharge or replace the 12 V battery (ref. MAS003090 or newer) and check that alternator is working correctly.
			Fault on electric connections.	Repair the vehicle's electric connections or replace fuses. [Electric Scheme]
			Fault on electric connections.	Repair the vehicle's CAN connections. [Electric Scheme]
3	CHECK WITH DIAGNOSTIC TOOL	OK	DETECTED ISSUES	ACTION
	Switch the key to the RUN position (ignition on) and check with the diagnostic tool that no errors are present on EPS ECU; NOTE: In case there are more than one DTC present, perform the actions expected for each detected DTC.	Go to step 4.	Presence of one of the DTCs reported at step 3.1 (NOTE: please refer to DTC code only and not to its description, which may vary depending on the different translations)	**See step 3.1**

3.1	DTC	ACTION
	0x559200 Electronic Power Steering motor Circuit	Perform at least 3 ignition cycles and check if the issue persists. In such a case, open a BOL to request for authorization to replace the EPS unit. Send a complete scan report via BOL.
	0x559300 Steering Torque Sensor Circuit	Check that the 10-way sensor harness is correctly seated into the connector on the under-side of the ECU and into the Sensor connector on the Gearbox; check the harness for damage. Check the connectors for bent pins and/or foreign objects or debris. If the harness is fitted correctly and not damaged but the fault is raised every ignition cycle then open a BOL to request for authorization to replace the EPS unit. Send a complete scan report via BOL.
	0x405100 Steering Wheel Position Sensor-	Check angle sensor harness, if the fault persists reflash EPS SW if newer SW version is available. Otherwise open a BOL to request for authorization to replace the EPS unit.
	0x405154 Steering Wheel Position Sensor-Missing Calibration	Perform the steering angle calibration procedure (through EPS active diagnosis).
		Clear DTCs; Reflash software & calibration; if problem persists open a BOL to request for authorization to replace the EPS unit.

	0x405164 Steering Wheel Position Sensor-Signal Plausibility Failure			
	0x612916 Battery Voltage-Circuit Voltage Below Threshold	Check that the 10-way Motor Position harness is correctly seated into the connector on the under-side of the ECU; check the harness for damage. Check the connectors for bent pins and/or foreign objects or debris. If the harness is fitted correctly and not damaged but the fault is raised every ignition cycle then replace the EPS system. Along with it, send a copy of the diagnostic document highlighting the step that has allowed the unit's replacement.		
	0x612917 Battery Voltage-Circuit Voltage Above Threshold	Check the battery connections, the EPS power fuse, the EPS power connector and its wiring, the battery health/charge status (through Picoscope battery test) and if the alternator charges properly.		
	0x62109A ECU Over Temperature-Component or System Operating Conditions	Clear DTCs; Reflash software & calibration; if problem persists open a BOL to request for authorization to replace the EPS unit.		
	0x621098 ECU Over Temperature-Component or System Over Temperature	No repair is necessary to devalidate the fault. Key off and wait until the system is working again within the normal temperature thresholds.		
	0x621700 Electic Power Steering Module Internal-	1) Calibrate MPS offset if MPS offset is not calibrated; 2) Clear DTCs; Reflash software & calibration; Replace ECU 3) Clear DTCs; Reflash EPS Software if newer SW version is available; otherwise replace EPS system		
	0x6008E95 ECU Internal Performance-Performance or Incorrect Operation	Updating calibration (reference to ATM fault repair action). Open a BOL to request authorization for steering rack replacement if the are hardware failures.		
	0x621766 Electric Power Steering Module Internal-Signal Has Too Many Transitions / Events	Open a BOL to request authorization for steering rack replacement		
	0x55C100 EPS Mechanical Performance-	Open a BOL as Support Request		
	0x621F00 ECU Not Initialized-	Perform the PROXI write procedure.		
	0x622300 ECU Configuration Mismatch-	Realign the PROXI vehicle configuration across all the ECUs again using the appropriate procedure		
	0x621C00 ECU Not Programmed/Flash Required-	Reflash the EPS with correct SW		
4	CHECK FOLLOWING THE REPAIR	OK	DETECTED ISSUES	ACTION
	Perform the following cycle: switch the key from RUN (ignition on) to START (engine	End of diagnosis.	DTC present.	Contact BOL team specifying that the lack of assistance

	on); wait 10 seconds after engine is on; steer to the right till the rack end stop, then to the left to till the rack end stop and finally align the steering wheel to the drive ahead position and then switch the key from RUN (engine on) to IGN_LK (engine off, ignition on); switch the key from IGN_LK (ignition off) to RUN (ignition on) and check that no errors are detected.			and the fault lamp ON are still present. Provide complete scan report and wait for actions.

Checklist C.3: The Electric Power Steering lack of assistance and the fault lamp is OFF.

STEP	ACTION			
1	CHECK WITH DIAGNOSTIC TOOL	OK	DETECTED ISSUES	ACTION
	Connect the diagnostic tool, switch the key to the RUN position (ignition on) and check if it possible to start a diagnostic communication with the EPS ECU.	Go to step 3.	Lack of Communication.	Go to step 2
2	CHECK THE REASON OF THE LACK OF COMM.	OK	DETECTED ISSUES	ACTION
	Perform the following checks and, for each action, check that communication with the EPS ECU is restored. In the case that this is not true, go directly to the following Step: - Check that power and signal connectors are correctly fitted to the EPS unit; - Check that the supply voltage on the DC power pins is at least 11 V; - Check that there are no interruptions on the EPS wiring harnesses; - Check that the fuse is ok (not blown) and correctly inserted into the fuse holder; - Check that the fuse is ok (not blown) and inserted correctly into the fuse holder; - Check that the chassis ground connection from the battery negative terminal is ok; - Check that the CAN line is ok - especially from EPS to BCM and then from the BCM to the IPC	Go to step 3.	Missed electric connections.	Repair the vehicle's line electric connections. [Electric Scheme]
			Incorrect Battery Voltage or Alternator not working properly.	Recharge or replace the 12 V battery (ref. MAS003090 or newer) and check that alternator is working correctly.
			Fault on electric connections.	Repair the vehicle's electric connections or replace fuses. [Electric Scheme]
			Fault on electric connections.	Repair the vehicle's CAN connections. [Electric Scheme]
3	CHECK WITH DIAGNOSTIC TOOL	OK	DETECTED ISSUES	ACTION
	Switch the key to the RUN position (ignition on) and check with the diagnostic tool that no errors are present on EPS ECU; NOTE: In case there are more than one DTC present, perform the actions expected for each detected DTC.	Go to step 4.	Presence of one of the DTCs reported at step 3.1 (NOTE: please refer to DTC code only and not to its description, which may vary depending on the different translations)	**See step 3.1**

3.1	DTC	ACTION
	0x559200 Electronic Power Steering motor Circuit	Clear DTCs; Reflash EPS Software if newer SW version is available; Otherwise open a BOL to ask for the replacement of EPS system.
	0x559300 Steering Torque Sensor Circuit	Check torque sensor harness, if the fault persists reflash EPS SW if newer SW version available. Otherwise open a BOL to ask for the replacement of EPS system.
	0xC14000 Lost Communication With Body Control Module	Problem caused by BCM (Body Control Module) ECU. Check the faults on BCM and if necessary, open a BOL to ask for repair/replacement of that component to fix the problem.
	0xC42200 Implausible Data Received From Body Control Module	Problem caused by BCM (Body Control Module) ECU. Check the faults on BCM and if necessary, open a BOL to ask for repair/replacement of that component to fix the problem.
	0xC42241 Implausible Data Received From Body Control Module-General Checksum Failure	Problem caused by BCM (Body Control Module) ECU. Check the faults on BCM and if necessary, open a BOL to ask for repair/replacement of that component to fix the problem.

	0xC42282 Implausible Data Received From Body Control Module-Alive / Sequence Counter Incorrect / Not Updated	Problem caused by BCM (Body Control Module) ECU. Check the faults on BCM and if necessary, open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xC10000 Lost Communication With ECM/PCM "A"	Problem caused by ECM (Engine Control Module) ECU. Check that the ECM is correctly supplied (power and fuse) and if necessary open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xC40100 Implausible Data Received from ECM/PCM "A"	Problem caused by ECM (Engine Control Module) ECU. Check that the ECM is correctly supplied (power and fuse) and if necessary open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xC40141 Implausible Data Received From ECM/PCM "A"-General Checksum Failure	Problem caused by ECM (Engine Control Module) ECU. Check that the ECM is correctly supplied (power and fuse) and if necessary open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xC40182 Implausible Data Received From ECM/PCM "A"-Alive / Sequence Counter Incorrect / Not Updated	Problem caused by ECM (Engine Control Module) ECU. Check that the ECM is correctly supplied (power and fuse) and if necessary open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xC41500 Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"-	Check the correct connection of the wheel speed sensors and that the sensors are working correctly through the diagnosis on BSM ECU.		
	0xC41541 Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"-General Checksum Failure	Problem caused by BSM (Braking System Module) ECU. Check the faults on BSM and if necessary open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xC41582 Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"-Alive / Sequence Counter Incorrect / Not Updated	Problem caused by BSM (Braking System Module) ECU. Check the faults on BSM and if necessary open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xC12100 Lost Communication With Anti-Lock Brake System (ABS) Control Module "A"	Problem caused from BSM (Braking System Module) ECU. Check that the BSM is correctly supplied (power and fuse) and if necessary open a BOL to ask for repair/replacement of that component to fix the problem.		
	0xD00B00 High Speed FD-CANR Communication Bus Performance	Check the vehicle CAN connections and check on other ECUs as well to detect which part of the CAN network has problems. If wirings are ok and it is only EPS which is not able to communicate on CAN bus then open a BOL to ask for the replacement of EPS system (possible permanent damage on CAN transceiver due to electrostatic discharges).		
	0xD04E00 High Speed FD-CAN2 Communication Bus Performance	Check the vehicle CAN connections and check on other ECUs as well to detect which part of the CAN network has problems. If wirings are ok and it is only EPS which is not able to communicate on CAN bus then open a BOL to ask for the replacement of EPS system (possible permanent damage on CAN transceiver due to electrostatic discharges).		
4	CHECK FOLLOWING THE REPAIR	OK	DETECTED ISSUES	ACTION
	Perform the following cycle: switch the key from RUN (ignition on) to START (engine on); wait 10 seconds after engine is on; steer to the right till the rack end stop, then to the left to till the rack end stop and finally align the steering wheel to the drive ahead position and then switch the key from RUN (engine on) to IGN_LK (engine off, ignition on); switch the key from IGN_LK (ignition off) to RUN (ignition on) and check that no errors are detected.	End of diagnosis.	DTC present.	Contact BOL team specifying that the lack of assistance and the fault lamp OFF are still present. Provide complete scan report an wait for actions.

Checklist C.4: Noise coming from the Electric Power Steering.

STEP	ACTION	👍	!	🔧
1	CHECK TIGHTENING TORQUE	OK	DETECTED ISSUES	ACTION
	Check tightening torque bolt between I-shaft and steering gear pinion.	Go to step 2.	Tightening torque not ok.	Replace bolt and tighten to recommended torque.
2	CHECK TIGHTENING TORQUE	OK	DETECTED ISSUES	ACTION
	Check tightening torque bolt between electric steering and I-shaft.	Go to step 3.	Tightening torque not ok.	Replace bolt and tighten to recommended torque.
3	CHECK ASSEMBLY	OK	DETECTED ISSUES	ACTION
	Check that the assembly between electric steering and cluster does not show anomalies and that the screws are tightened at the right torque.	Go to step 4.	Tightening torque not ok or assembly anomalies found.	Restore tightening torque or restore assembly anomalies found.
4	CHECK TIGHTENING TORQUE	OK	DETECTED ISSUES	ACTION
	Check tightening torque nut between steering wheel and electrical steering.	Go to step 5.	Tightening torque not ok.	Restore tightening torque
5	CHECK ASSEMBLY	OK	DETECTED ISSUES	ACTION
	Check that the steering wheel regulation device, including the lock leverage, does not shows anomalies.	Go to step 6.	Device anomalies: the steering wheel can be moved inside and outside with the lock leverage in closing position.	Open a BOL to request authorization for steering rack replacement. Send scan report via BOL.
6	CHECK INTERFERENCE	OK	DETECTED ISSUES	ACTION
	Check that no interferences are present between electric steering and plastic parts in the surrounding areas (upper and lower covering parts).	Go to step 7.	Interferences present between electric steering and plastic parts in the surrounding areas.	Do not execute any intervention up to the electric steering: restore correct assembly of the covering parts.
7	CHECK TYPE OF NOISE	OK	DETECTED ISSUES	ACTION
	Check if the noise seems to be as a “CLICK” or a “FROG NOISE”.	Go to step 10.	Noise seems to be a “CLICK”.	Go to step 8.
			Noise seems to be a “FROG NOISE” and it is present with standstill vehicle or in movement, despite of the steering direction.	Go to step 9.
8	CHECK LIGHTS COMMAND DEVICE	OK	DETECTED ISSUES	ACTION
	Check that the noise is no longer present after lights command device is removed.	Restore the defective component (lights command device).	Noise still present	Go to step 10.
9	CHECK NOISE AREA	OK	DETECTED ISSUES	ACTION
	Check, with the plastic coverings removed, that the noise does not come from the electric motor of the electric steering.	Go to step 10.	Noise comes from the electric motor.	Open a BOL to request authorization for steering rack replacement. Send scan report via BOL.
10	CHECK NOISE MODALITY	OK	DETECTED ISSUES	ACTION
	Check if the noise is “Torque reversal” type, consisting in a noise that is present with the steering wheel at end of rack position (sharp bump) that disappears when the end of rack position is reached and a small rotation (few degrees) in the opposite direction is made.	Go to step 11.	Noise still present	Check the steering motor unit and, if required, open a BOL to ask for EPS replacement. Send a scan report via BOL.
11	CHECK NOISE MODALITY	OK	DETECTED ISSUES	ACTION

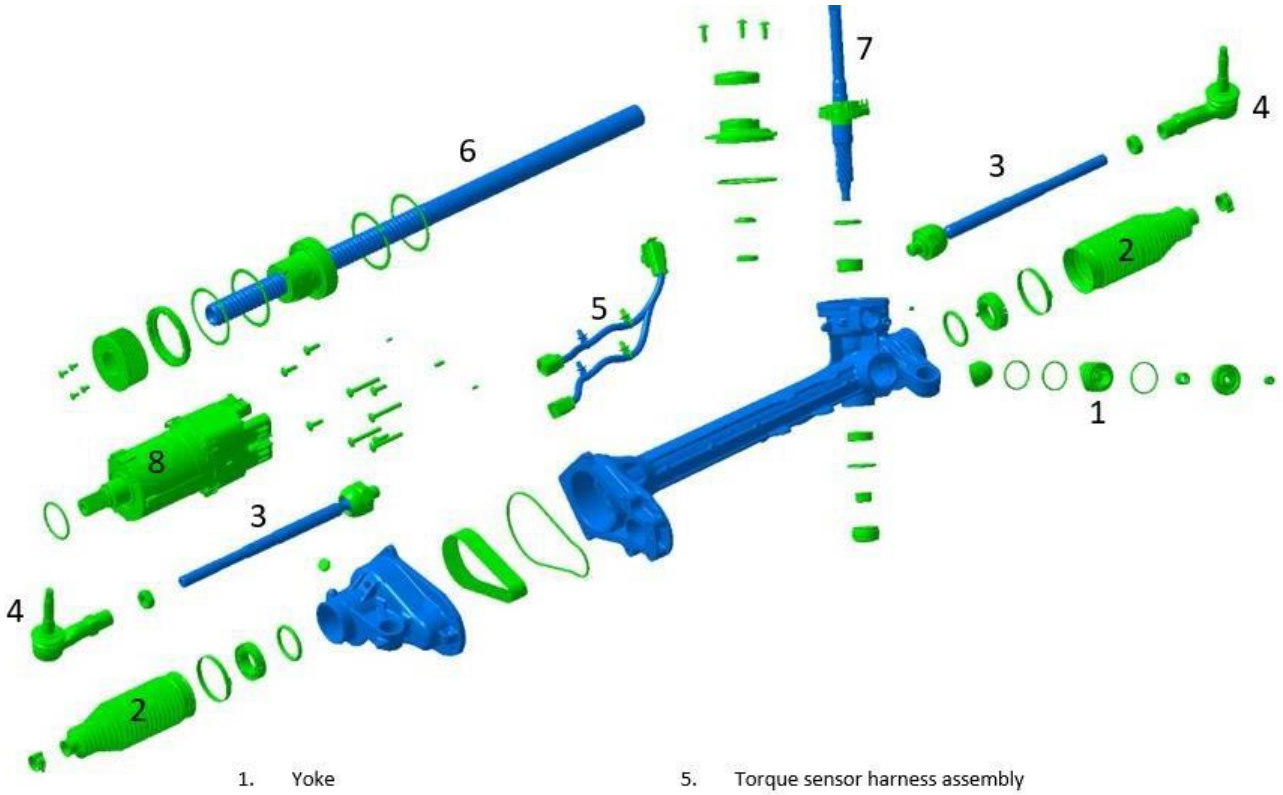
	Check if the noise seems to be a rattle noise, coming from the left side of the vehicle, that increase intensity if a steering to the right maneuver is performed on bumpy surface.	Go to step 12.	Noise still present	Check the steering motor unit and, if required, replace it. Replace EPS unit. Along with the EPS unit send a copy of the scan report highlighting the step that has allowed the unit's replacement.
12	CHECK OF THE FUNCTIONALITY AFTER REPAIR	OK	DETECTED ISSUES	ACTION
	Check that the noise is no more present.	End of diagnosis.	Noise comes from the electric motor.	Open a BOL specifying that the noise is not associated with any noise present in this diagnostic procedure.

Checklist C.5: The Electric Power Steering lack of correct realignment of the steering wheel at low vehicle speeds.

STEP	ACTION			
1	CHECK WITH THE DIAGNOSTIC TOOL	OK	DETECTED ISSUES	ACTION
	Connect the diagnostic tool check that no errors are present on EPS ECU. NOTE: In case there are more than one DTC stored, perform the actions expected for each detected DTC.	End of diagnosis.	Presence of one of the DTCs reported at step 1.1 (NOTE: please refer to DTC code only and not to its description, which may vary depending on the different translations)	**See step 1.1**
1.1	DTC	ACTION		
	0x620300 Current VIN Missing/Mismatch	Problem caused by Body Computer Module ECU (BCM). Check the faults on BCM and if necessary repair/replace that component to fix the problem.		
	0x612913 Battery voltage – Circuit open	Problem caused by the battery of the vehicle or power supply wiring. Check the connection to the battery and the power supply wirings. Perform a battery test with Picoscope and report the results on the BOL.		

Checklist C.6: The Electric Power Steering works correctly but there are error codes detected on EPS and/or error messages on the instrument cluster.

STEP	ACTION			
1	CHECK WITH THE DIAGNOSTIC TOOL	OK	DETECTED ISSUES	ACTION
	Connect the diagnostic tool check that no errors are present on EPS ECU. NOTE: In case there are more than one DTC stored, perform the actions expected for each detected DTC.	End of diagnosis.	Presence of one of the DTCs reported at step 1.1 (NOTE: please refer to DTC code only and not to its description, which may vary depending on the different translations)	**See step 1.1**
1.1	DTC	ACTION		
	0xC10100 Lost Communication with TCM	Problem caused by TCM (Transmission Control Module) ECU. Check the faults on TCM and if necessary open a BOL to require its replacement.		
	0xC40241 Implausible Data Received From TCM-General Checksum Failure	Problem caused by TCM (Transmission Control Module) ECU. Check the faults on TCM and if necessary open a BOL to require its replacement.		
	0xC40200 Implausible Data Received From TCM	Problem caused by TCM (Transmission Control Module) ECU. Check the faults on TCM and if necessary open a BOL to require its replacement.		
	0xD112F00 Lost Communication with Vehicle Domain Control Module "A" Note: This is applicable only for BEV.	Problem caused by VDCM Check that the VDCM is correctly supplied (power and fuse) and if necessary open a BOL to require its replacement.		
	0xC15C00 Lost Communication With Automated Driving System Control Module "A"	Problem caused by CADM (Central ADAS Decision Module). Check that the CADM is correctly supplied (power and fuse) and if necessary open a BOL to require its replacement.		
	0xC45D41 Invalid Data Received From Automated Driving System Control Module "A"-General Checksum failure	Problem caused by CADM (Central ADAS Decision Module). Check the faults on CADM and if necessary open a BOL to require its replacement.		
	0xC45D00 Invalid Data Received From Automated Driving System Control Module "A"	Problem caused by CADM (Central ADAS Decision Module). Check that the CADM is correctly supplied (power and fuse) and if necessary open a BOL to require its replacement.		
	0xC45D41 Invalid Data Received From Automated Driving System Control Module "A"-General Checksum failure	Problem caused by CADM (Central ADAS Decision Module). Check that the CADM is correctly supplied (power and fuse) and if necessary open a BOL to require its replacement.		
	C12100 Lost Communication With Anti-Lock Brake System (ABS) Control Module "A"	Problem caused from BSM (Braking System Module) ECU. Check that the BSM is correctly supplied (power and fuse) and if necessary open a BOL to require its replacement.		
	C41500 Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"	Check the correct connection of the wheel speed sensors and that the sensors are working correctly through the diagnosis on BSM ECU. Problem caused by BSM (Braking System Module) ECU. Check the faults on BSM and if necessary open a BOL to require its replacement.		
	C41541 Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"-General Checksum Failure	Problem caused by BSM (Braking System Module) ECU. Check the faults on BSM and if necessary open a BOL to require its replacement.		
	C41582 Invalid Data Received from Anti-Lock Brake System (ABS) Control Module "A"-Alive / Sequence Counter Incorrect / Not Updated	Problem caused by BSM (Braking System Module) ECU. Check the faults on BSM and if necessary open a BOL to require its replacement.		
	C10000 Lost Communication With ECM/PCM "A"	Problem caused by ECM (Engine Control Module) ECU. Check that the ECM is correctly supplied (power and fuse) and if necessary open a BOL to require its replacement.		
	C40100 Implausible Data Received from ECM/PCM "A"	Problem caused by ECM (Engine Control Module) ECU. Check the faults on ECM and if necessary open a BOL to require its replacement.		
	C40141 Implausible Data Received From ECM/PCM "A"-General Checksum Failure	Problem caused by ECM (Engine Control Module) ECU. Check the faults on ECM and if necessary open a BOL to require its replacement.		
	C40182 Implausible Data Received From ECM/PCM "A"-Alive / Sequence Counter Incorrect / Not Updated	Problem caused by ECM (Engine Control Module) ECU. Check the faults on ECM and if necessary open a BOL to require its replacement.		



1. Yoke
2. Boot
3. Inner ball joint assembly (IBJ)
4. Outer ball joint (OBJ)
5. Torque sensor harness assembly
6. Rack
7. Pinion
8. Motor