



Measurement of Clutch Pedal Characteristics

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. Recording of the clutch pedal characteristic in vehicle at idle engine speed including its characteristic modulation points (disengagement, engagement and stall point).

Additional tests should be performed as also covered in this procedure (e.g., when entering in a new hardware phase). These tests should be defined upfront by the Design Release Engineer together with the Design Validation Engineer.

Additional tests contain:

- Investigations at given temperature conditions.
- Investigations with increased engine speed.
- Investigations on supporting spring.

1.2 Applicability. For all vehicles with manual transmission, benchmark vehicles included.

1.3 Remarks. Not applicable.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References. None.

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.3 A room with power supply, exhaust gas extraction and level ground.

3.1.4 Depending on the test amount a cooling chamber with power supply, exhaust gas extraction and level ground.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

April 2018

Page 1 of 13



Documents

Document Sharing Hub

3.2 Equipment.

3.2.1 Computer supported measuring system for logging the clutch pedal force and the clutch pedal travel. Software package that will calculate and plot the load (x-axis) vs. travel (y-axis) and will overlay the reserve points in the x-axis. A valid calibration status is mandatory.

- Sampling rate: ≥ 100 Hz.
- Resolution of the Analog to Digital (AD) Converter: ≥ 16 bit.

3.2.2 Measuring plate for travel sensor mounting in the legroom at the driver's side.

3.2.3 Pedal force load cell (measurement range up to 500 N, full bridge) with valid calibration status.

3.2.4 Travel sensor with a measurement range of 200 mm displacement and valid calibration status.

3.2.5 Goniometer with a minimum measurement range of ± 60 degrees for adaption and analysis of travel sensor adjustment and reproducible fixation of pedal force load cell on the pedal plate. A valid calibration status is mandatory.

3.3 Test Vehicle/Test Piece. Test vehicle must be operable with desired actuation system, hydraulic clutch actuation components and pedal box according to the development status.

3.4 Test Time.

Calendar time: 5 d

Test time: 2 h to 8 h

Coordination time: 4 d

3.5 Test Required Information. Possible sources:

- Statement of Requirements (SOR).
- Vehicle Technical Specifications (VTS).
- Subsystem Technical Specifications (SSTS).
- Analysis/Development and Validation (A/D/V) Plan.
- Bill of Design (BoD)/Bill of Materials (BoM).
- Validation Cross Reference Index (VCRI).
- Application Engineer.
- Development Groups.
- Drawings.

3.5.1 Documentation.

3.5.1.1 General Information/Numbering.

- Project.
- Vehicle number.
- Engine.
- Transmission.
- Drive.
- Date of measurement.
- Mileage of test vehicle.

3.5.1.2 Clutch Component Measurement.

- Release force characteristic measured with complete clutch system (pressure plate, clutch disk, flywheel).
- Release force characteristic measured with clutch set (pressure plate, clutch disk).
- Pressure plate lift off of system, set and single part.
- Spring deflection of clutch disk.
- Free travel of clutch disk.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

April 2018

Page 2 of 13

Documents
Document Sharing Hub

3.5.1.3 Part Numbers of Further Components.

- Single Mass Flywheel (SMF) and Dual Mass Flywheel (DMF).
- Clutch disk.
- Clutch pressure plate.
- Concentric Slave Cylinder (CSC).
- Elbow connector (Peak torque limiter).
- Hydraulic pipe.
- Clutch Master Cylinder (CMC).
- Pedal box.
- Supporting spring type/mounting.

3.5.1.4 Additional Information.

Status of engine calibration (if available).

3.6 Personnel/Skills. The personnel must be familiar with the process of actuating the clutch pedal properly for the measurement, finding the clutch disengagement reserve by synchronizer method, the process of finding 1st roll by vehicle movement method and the process of finding the engine stall point by using the clutch pedal.

Test engineer to evaluate results and to perform subjective rating of the investigated system.

4 Procedure

4.1 Preparation for Measurement of Clutch Pedal Characteristic.

4.1.1 The bleeding of the hydraulic system must be sufficient.

4.1.2 If the clutch system is new 1 km minimum shall be driven with a minimum of 50 normal clutch actuations (e.g., at shifting) and also a minimum of ten (10) vehicle launches (with low energy impact).

4.1.3 Attach vehicle to the exhaust gas extraction. Check fuel and radiator fluid for cold chamber conditions if needed.

4.1.4 Remove the pedal rubber from clutch pedal.

4.1.5 Install the measurement equipment for pedal force and pedal travel according the geometric specifications.

4.1.5.1 The pedal travel sensor shall be mounted in direction of the elongated secant between the non-actuated and fully depressed clutch pedal position. The distance between the pivots of the measurement device for pedal travel shall be in the range of (350 mm to 450 mm) (see Appendix A, Figure A1). The lower limit may be reduced to 250 mm in case of insufficient legroom.

4.1.5.2 The pedal force cell has to be mounted in pedal box specific clutch pedal plate angle (mean angle of plate measured to even).

4.1.5.3 The distance between the surface of the pedal plate and the attachment point of the travel sensor shall be in the range of (10 mm to 20 mm) (see Appendix A, Figure A1).

4.1.5.4 When the installation of the measurement equipment is completed the angles of the travel sensor measured to even shall be verified to be within a difference of 0.5 degree maximum for the non-actuated and fully depressed clutch pedal.

4.1.6 Run engine at idle for approximately 1 minute to 2 minutes until the final idle speed is reached.

4.2 Conditions.

4.2.1 Environmental Conditions. The test shall be performed at a room temperature in a range of +20 °C to +35 °C with transmission oil temperature from +20 °C to +40 °C. For additional testing (e.g., when parts are of new design), conditions may have temperatures outside the preferred range such as investigations in cold temperature conditions at -40 °C, -30 °C or hot testing with transmission oil temperature approximately +80 °C.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Recording of the Clutch Pedal Trace (see Appendix B, Figure B1).

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

April 2018

Page 3 of 13

Documents
Document Sharing Hub

4.3.1.1 Start engine and await stabilisation of idle speed.

4.3.1.2 Operate clutch 5x directly before beginning of the measurement.

4.3.1.3 Start measurement.

4.3.1.4 Slowly push the clutch pedal down to the pedal stop and afterwards release it up to the rest position. It is essential that the actuation is induced at the center of the installed force cell. A stick (e.g., with a hard rubber tip) is recommended for this actuation which is controlled by hand.

4.3.1.5 Speed distribution for this actuation:

- 0 mm to 5 mm pedal travel: < 5 mm/s.
- 5 mm to 20 mm pedal travel: Approximately 20 mm/s.
- Mean pedal travel range: 40 mm/s to 60 mm/s.
- Range around pedal down stopper: Approximately 10 mm/s.

4.3.1.6 Stop measurement and save data.

4.3.1.7 The clutch pedal characteristic shall be performed twice. If both recorded pedal traces do not fit together the measurement shall be repeated.

4.3.2 Recording of the Clutch Pedal Trace at Different RPM (see Appendix F, Figure F1). If the stay out behavior of the pressure plate is required, In addition to recording the idle speed, the clutch pedal trace shall be recorded at: 0 RPM, 2000 RPM, 3000 RPM, continuing in 1000 RPM steps up to n_{fuel} cut off.

It may be required to overcome a restricted engine RPM limit when the vehicle is stationary. By doing so, make sure to adhere to the safety requirements.

Note: Measurements at increased engine speed should be performed after all measurements which require idle speed.

4.3.3 Determination of the Engagement Point (EP) at Idle Speed.

4.3.3.1 Start engine and await stabilization of idle speed.

4.3.3.2 Open the parking brake to ensure vehicle movement.

4.3.3.3 Start measurement.

4.3.3.4 Push the clutch pedal down to the bottom.

4.3.3.5 Shift 1st gear and slowly release the clutch pedal.

4.3.3.6 Define the engagement point at the clutch pedal travel position as soon as the vehicle starts moving forward.

4.3.3.7 Stop measurement and save data.

4.3.3.8 The determination of the engagement point shall be performed twice. If both recorded engagement points do not fit together (deviation should be < 2 mm) the measurement shall be repeated.

4.3.4 Determination of the Disengagement Point (DP).

4.3.4.1 Start engine and await stabilization of idle speed.

4.3.4.2 Start measurement.

4.3.4.3 Tighten the parking brake to ensure the vehicle not to move.

4.3.4.4 Push the clutch pedal down to the bottom.

4.3.4.5 Shift halfway into reverse gear.

4.3.4.6 Smoothly release the clutch pedal while slightly moving the shift lever forward and backward until the first scratching noise from the transmission can be heard.

4.3.4.7 The disengagement point is obtained by slowly disengaging until the clutch disconnects engine and transmission, no scratching noise from the gears can be heard and no pulsation at the shift lever can be felt. Keep clutch pedal at this position.

4.3.4.8 Stop measurement if disengagement point is found and save data.

4.3.4.9 The determination of the disengagement point shall be performed twice. If both recorded disengagement points do not fit together (deviation should be < 2 mm) the measurement shall be repeated.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

April 2018

Page 4 of 13

Documents
Document Sharing Hub