



Clutch Cover Misadjustment Test

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. This test is conducted to determine the stability of the clutch wear adjust mechanism.

1.2 Applicability. This test procedure is applicable to all vehicles with manual transmission and a self-adjusting wear compensation clutch system. It is especially recommended for the 1st time validation of a new designed clutch system.

1.3 Remarks. This standard is a globally harmonized test procedure, which has been developed for use within Global Propulsion Systems (GPS). The maneuvers have been aligned with various clutch system suppliers.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15628 GMW15631 GMW16439

2.3 Additional References.

- Analysis Development Validation (ADV) Plan
- Drawings/Component Technical Specifications (CTS)
- Statement of Requirements (SOR)
- Subsystem Technical Specifications (SSTS)
- Vehicle Technical Specifications (VTS)

3 Resources

3.1 Facilities.

This testing should be conducted at proving grounds or clutch supplier facilities only under controlled testing conditions by not placing the general public safety at risk. Reference Section 6.

For Part A and Part B a large, flat and empty test area is recommended.

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.

3.2 Equipment.

Note: All instrumentation is to be calibrated as required; record instrumentation details and date of calibration on a data sheet, unless the information is otherwise preserved in the testing facility records.

3.2.1 Data recording device for the measurements as described in 3.2.3 and 3.2.4.

3.2.2 Measurement equipment to measure the clutch pedal characteristic according to GMW15628.

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3.2.3 Mandatory Sensors.

- Ambient temperature (if not covered otherwise)
- Air temperature in the clutch housing near upper circumference of clutch pressure plate
- Air temperature in the clutch housing at the Concentric Slave Cylinder (CSC)/release bearing
- Clutch pedal travel bus-signal or sensor
- Hydraulic clutch fluid pressure sensor (for installation example see Appendix C, Figure C1 and Figure C2)
- Engine speed on bus or sensor at flywheel

Minimum sampling rate:

- For temperatures 1 Hz, for others 100 Hz
- Resolution of the Analog/Digital (AD)-converter: ≥ 16 bit

3.2.4 Optional Sensors.

- Transmission input shaft speed
- Release bearing travel
- Accelerator pedal position (bus)

3.3 Test Vehicle/Test Piece.

3.3.1 Test Vehicle. A test vehicle equipped as follows:

- Test vehicle with clutch and manual transmission according to specification
- Test vehicle to be ballasted to curb mass plus driver and observer (if required)
- Hydraulic clutch actuation components and pedal box according to representative development phase
- Engine calibration milestone level for test execution: 65% or greater. The engine performance shall be checked prior to test in order to ensure the specified engine torque and power (see 0)
- Tires in good condition
- If the test vehicle is equipped with a revolution matching feature it has to be switched off during the test, if possible

Note: The transmission synchronization might be damaged during the test. For some transmissions (e.g., F17 or D16) it is recommended to replace it after the test.

3.3.2 Test Pieces. At least two new sets of test pieces are recommended. Each set (clutch cover, clutch disc, flywheel) has to be measured prior to testing (see also 4.1.2). For each set a new CSC has to be used.

3.4 Test Time.

Calendar time: 2x 6 days

Test time: 2x 12 h

Coordination time: 2x 4 days

3.5 Test Required Information. Possible sources are:

- Analysis Development Validation (ADV) Plan
- Development Groups/Design Release Engineer
- Drawings/Component Technical Specifications (CTS)
- Statement of Requirements (SOR)
- Subsystem Technical Specifications (SSTS)
- Test piece information
- Vehicle Technical Specifications (VTS)

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3.6 Personnel/Skills.

3.6.1 Trained test driver to run the test. The person has to fulfill the following criteria:

- Very proficient in driving vehicles with a manual transmission
- Proficient in evaluating the clutch pedal force characteristics
- Proficient in determining the disengagement reserve through the transmission synchronizer method

3.6.2 Experienced test engineer to evaluate results.

3.6.3 Skilled mechanic to mount and dismount test parts according valid process requirements, e.g., counter-force free installation. The mechanic shall be skilled in clutch and Dual Mass Flywheel (DMF) system technology.

4 Procedure

4.1 Preparation.

4.1.1 Confirm engine torque meets program requirements.

4.1.2 Use a new and measured clutch system. Mark "wear-adjusting tabs" with respect to clutch cover. Scribe a fine, straight line across cover and tab (to allow for detecting any movement in mechanism after test). Photos recommended (see examples in Appendix A, Figure A1).

4.1.3 Install test clutch in vehicle. Make sure the clutch pedal is in its full upright position so the Clutch Master Cylinder (CMC) compensation port is open to the reservoir. If the Concentric Slave Cylinder (CSC) is disconnected from the hydraulic hose, make sure there is no preload on the clutch when attaching the transmission for a pre-fill hydraulic system.

4.1.4 Install instrumentation (and recording equipment) specified by test engineer in vehicle and calibrate.

4.1.5 Ballast vehicle to curb mass plus driver and observer (if required).

4.1.6 Check of pedal travel and force before (and after) the test according to GMW15628 (without 0 run-in). If necessary re-adjust and/or bleed hydraulic clutch system. In order to make sure that pedal travel value correlates between GMW15628 vs. drive recorder, compare both measurement results. In case of deviation re-adjust drive recorder settings in regard to pedal travel. The clutch trace should include at least:

- Clutch pedal load vs. travel curve
- Clutch disengagement point (reserve)
- Clutch engagement point (1st roll)
- Clutch stall point
- Clutch position at maximum force F_{maximum} (F_{max})

Pedal travel and force measurements during this test procedure should always be conducted with engine on in idle.

A/C should be switched off for all maneuvers in the test procedure.

Record vehicle number, vehicle odometer, (and clutch component serial numbers) on clutch trace. Label as "pre-break-in" on clutch trace.

4.1.7 Check pedal force before the test by recording hydraulic clutch fluid pressure over pedal travel (simplified measurement).

- Clutch pedal load vs. travel curve
- Clutch F_{max} position

4.1.8 Record vehicle number, vehicle odometer, (and clutch component serial numbers) on clutch trace. Label as "pre-break-in" on clutch trace.

Prepare datasheet (see example in Appendix B) and use it for documentation during the test.

4.1.9 Break-In.

Run-in the vehicle by the following procedure (driving in plane), if the clutch system was not driven for 50 km or more at normal conditions prior the test. Necessity shall be determined at test engineers' discretion:

- Launch in 1st gear at 40% of maximum engine RPM for gasoline/gas (diesel: at $\approx$ 2100 rpm)

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- Shift up: 2 → 3 → 4 → (5 ^{Note 1}), shifting at 80% of maximum engine RPM
- Shift down: (5 ^{Note 1}) → 4 → 3 → 2, shifting at 95% of target gear

Note 1: (5): 5th gear only for six-speed-transmissions.

Repeat preceding cycle 20 times.

Record a clutch trace (as in 0). Label as "post-break-in, pre-test" on clutch trace.

4.1.10 Ensure vehicle parking brake is functional and is adjusted to correct specifications.

4.1.11 Warm engine thoroughly by driving at least 15 km (10 mi) at 75 km/h (50 mph) in high gear.

4.1.12 Park vehicle at test location. Ensure good ambient airflow to the engine compartment.

For Part A and Part B:

- a. Apply parking brake and place transmission in neutral.
- b. It is recommended to put stop blocks on both non-driving wheels (especially important if the vehicle is equipped with electronic parking brake which might disengage unnoticed during the maneuvers).
- c. Make sure the test location allows for any inadvertent forward surge of the vehicle during test.

4.2 Conditions.

4.2.1 Environmental Conditions. None specified.

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. Unless otherwise specified the test shall be performed in following sequences.

PART A.

- Engine start and shut down (4.3.1)
- Engine start and shut down with depressed clutch pedal (4.3.2)
- Clutch pedal actuation in idle (4.3.3)
- Clutch pedal actuation with rising rpm and falling rpm (4.3.4)
- Clutch pedal actuation at engine 1000 rpm steps with different actuation speeds (4.3.5)
- Engine blip cycles (4.3.6)

PART B.

- Aborted engine start by clutch engagement (4.3.7)
- Engine start and clutch engagement (4.3.8)
- Engine stop and clutch engagement (4.3.9)
- Clutch snap engagement (4.3.10)

PART C.

- Engine stop during drive (4.3.11)
- Clutch pedal actuation during engine stop in drive (4.3.12)
- Aborted engine auto stop by clutch re-engagement (4.3.13)
- Extreme and forced downshifts (4.3.14)
- Throttle blip downshifts (4.3.15)
- Wide Open Throttle (WOT) acceleration through all gears and downshifting (4.3.16)
- Heat clutch (4.3.17)
- Clutch pedal actuation during engine stop in drive (4.3.18)
- Aborted engine auto stop by clutch re-engagement (4.3.19)

Make sure vehicle is parked securely for unintended drive off and parking brake is fully applied (see 0).

4.3.1 Engine Start and Shut Down. Put the transmission in neutral gear. Without pushing the clutch pedal start engine, idle for 5 s and shutdown engine. Execute cycle 30 times. Record a clutch trace (as in 0). Label

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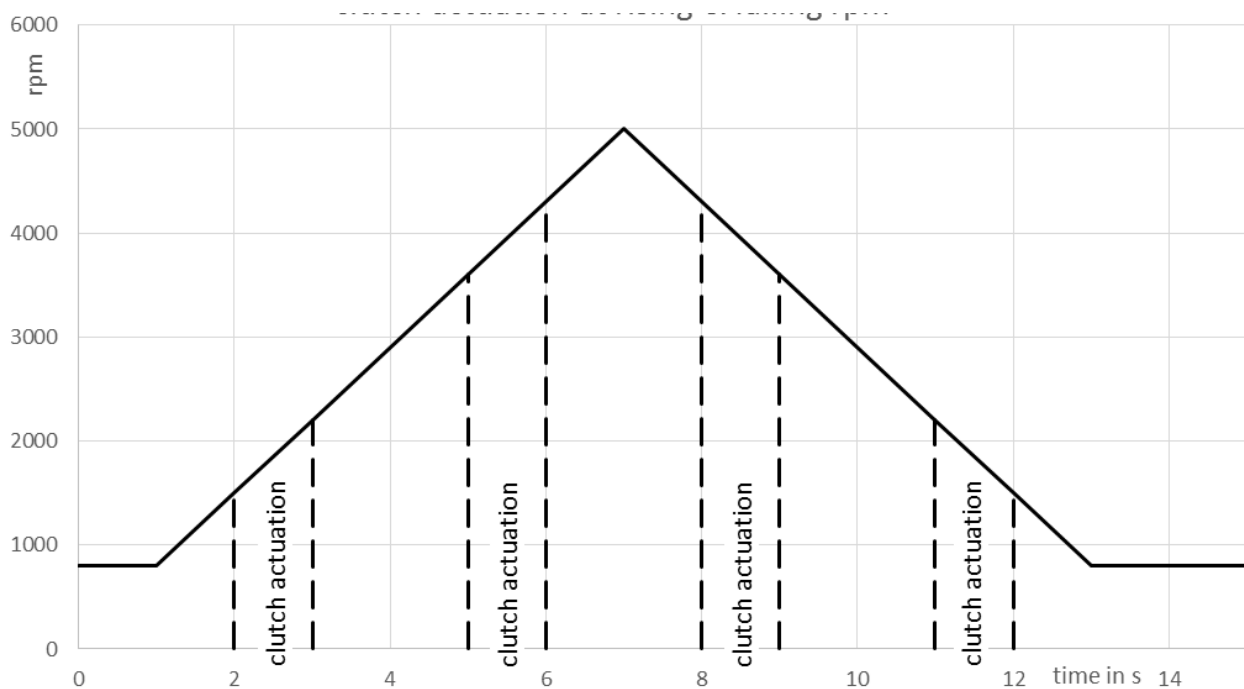
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as "post 30 engine start cycles, without clutch pedal." If the vehicle only allows to start the engine with a depressed clutch pedal, skip this paragraph (4.3.1).

4.3.2 Engine Start and Shut Down with Depressed Clutch Pedal. Put the transmission in neutral gear. Push down the clutch pedal (and keep it pushed during the whole cycle) and start engine, idle for 5 s and shut down engine. Execute cycle 30 times. Record a clutch trace (as in 0). Label as "post 30 engine start cycles, depressed clutch pedal."

4.3.3 Clutch Pedal Actuation in Idle. Put the transmission in neutral gear. With engine on in idle, cycle the clutch pedal through full travel 30 times as follows. Push clutch pedal down quickly within < 0.5 s, hold pedal down for 1 s, release pedal quickly (see 7.1) within 0.5 s, leave pedal in up position for 1 s. Record a clutch trace (as in 0). Label as "post 30 engine-on cycles."

4.3.4 Clutch Pedal Actuation with Rising rpm and Falling rpm (Figure 1). Put the transmission in neutral gear. Start engine, increase rpm from idle to red line, and let engine return to idle. During engine speed increase and during engine speed decrease cycle the clutch pedal at standard speed (see 7.1 Glossary) through full travel two times each. Each cycle from idle to maximum rpm to idle should take approximately 15 s. Execute 30 times.



Note: If launch map reduces rpm during clutch pedal actuation, continue cycle and ignore temporary rpm reduction.

Figure 1: Clutch Actuation at Rising and Falling rpm

Record a clutch trace (as in 0). Label as "post 30 rising and falling engine rpm cycles."

4.3.5 Clutch Pedal Actuation at Engine 1000 rpm Steps with Different Actuation Speeds (Figure 2). Put the transmission in neutral gear. Start engine, increase rpm in steps of 1000 rpm from idle to maximum rpm. At each step keep rpm constant and cycle the clutch pedal five (5) times with 1 s break after each pedal return at the following conditions:

- Five (5) times rapid (push down pedal as fast as possible and release as fast as possible, see also 7.1 Glossary).
- Five (5) times standard (1 s for each clutch cycle).
- Five (5) times slow (2 s for each clutch cycle).

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