

Submitted for recognition as an American National Standard

Vehicle Idle Gear Rattle Evaluation Procedure

Foreword—Idle gear rattle is a disturbance which can exist with manual transmission equipped vehicles and which can occur when the vehicle is parked, the transmission is in neutral, the clutch is engaged, and the engine is at idle. The noise is a repetitive metallic tapping sound generated by the impacting of transmission gear teeth. This is caused by minute fluctuations in the engine flywheel rotational velocity. These fluctuations occur at the engine's firing frequency and are due to torque variances caused by the compression stroke and power stroke of the internal combustion engine. A number of variables can affect the severity of idle gear rattle. These variables should be noted when testing vehicles, and they can be investigated as a means for reducing the disturbance. See 3.7.

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1. Scope—This SAE Standard describes a procedure to be used to evaluate a disturbance known as “idle gear rattle” which can exist in vehicles equipped with manual transmissions and clutches. Other types of noises associated with operation at idle are also briefly described.

1.1 Purpose—This SAE Standard defines a procedure, which can be used to obtain meaningful standardized comparisons of idle gear rattle among several vehicles. The procedure can be used in evaluating field complaints in current model vehicles or it can be used in the development of future models. The purpose is to promote commonization of the procedure and results.

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2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J373—Housing Internal Dimensions for Single and Two Plate Spring Loaded Clutches
SAE J617—Engine Flywheel Housings
SAE J1463—Pull Type Clutch—Transmission Installation Dimensions
SAE J1479—Automotive Pull Type Clutch Terminology
SAE J1731—Pilot Bearings for Truck and Bus Applications
SAE J1857—Flywheel Dimensions for Truck and Bus Applications
SAE J2407—Clutch Installation and Release Linkage Requirements for Truck and Bus Applications

2.1.2 TMC PUBLICATIONS—Available from The Maintenance Council, American Trucking Associations, 2200 Mill Road, Alexandria, VA 22314

TMC RP 633 (T)—Effects of Drivetrain Torsionals
TMC RP 638 (T)—Heavy Duty Clutch Maintenance Guidelines
TMC RP 639 (T)—Spec'ing Heavy Duty Clutches

3. Procedure—The procedure involves evaluating the vehicle in a standardized set of conditions using a prescribed subjective evaluation scale. Different evaluators may get different results. However, the procedure will assist in determining the relative merit of different alternatives. This can be useful in determining vehicle build specifications or defining needed developmental steps. The procedure may also be performed using sound level measurements in place of the subjective evaluations.

3.1 Evaluation Scale—Most vehicle manufacturers use a one to ten scale, however, ratings of 1, 2, 9, and 10 are rarely used. A rating of 8 is the practical goal. The ratings are defined as follows:

10 Excellent / no trace of disturbance
9 Excellent / slight trace of disturbance
8 Good / fully acceptable to typical user
7 Fair / disturbance evident at low sound level
6 Acceptable / improvement desirable
5 Unacceptable / at field complaint level
4 Poor / strongly in need of improvement
3 Not commercially acceptable
2 Not commercially acceptable / greatly in need of improvement
1 Not commercially acceptable / offensive

3.2 Standard Vehicle Conditions—Following are the base conditions, which are used for every specific evaluation mode:

- a. Vehicle parked alongside a continuous wall (to reflect the sound back to the evaluator)
- b. Parking brake set
- c. Evaluator located in driver's seat
- d. Transmission in neutral, no shifting loads applied to lever
- e. Ambient temperature noted
- f. Engine operating at a stabilized idle speed, speed noted
- g. Clutch pedal up, clutch engaged

3.3 Specific Evaluation Modes—Following are the additional specific conditions under which evaluations are made. The standard vehicle conditions of 3.2 are in effect for each of these evaluation modes:

- a. Transmission Operating Temperature—Transmission oil temperature monitored and evaluation performed COLD (oil temperature = ambient temperature), INTERMEDIATE (oil temperature stabilized at 37.8 to 43.3 °C (100 °F to 110 °F) and HOT (maximum stabilized normal oil temperature)
- b. Engine Accessory Loading—UNLOADED (all accessories off) and LOADED (lights on, major electrical accessories on, and air conditioning running)
- c. Power Steering Loading—STEERING STRAIGHT and UNLOADED (no force applied to the rim of the steering wheel) and STEERING TURNED and LOADED (steering turned to full lock position with enough turning effort applied to the steering wheel by the evaluator to cause the power steering pump to labor)
- d. Vehicle Cab Side Windows—UP and DOWN

3.4 Engine Idle Operation Related Noises—The following types of noises can result from operating under the vehicle conditions and evaluation modes previously described:

- a. Idle Gear Rattle—This is a stabilized metallic knocking or tapping sound coming from the transmission. Disengaging and engaging the clutch can help focus on this sound, but care should be taken not to confuse it with transmission rollover noise, See part c below.
- b. Clutch Release Linkage Rattle—Linkage rattle can also be confused with idle gear rattle. Linkage rattle is usually caused by joint looseness or incorrect clutch release yoke gap adjustment. It is often cured through the installation of OEM provided kits that apply a light pre-load to the joint, through a fresh application of grease to the joints, or by correcting the clutch release yoke gap. Clutch release linkage rattle can be isolated through a simple test. The clutch pedal is depressed with a load that is just sufficient to eliminate clutch free pedal travel. Noises that are eliminated during the application of this light pedal load are usually linkage rattle.
- c. Transmission Rollover Noise—Rollover noise is the basic whirring sound the transmission makes when the input shaft and countershafts are being driven by the engine. It is controlled by the parameters used in designing the transmission and is beyond the scope of this document.

3.5 Evaluation Notes—The following additional considerations should be noted:

- a. The evaluator should focus on idle gear rattle or clutch release linkage rattle since these noises can be affected through vehicle component modifications. Transmission rollover noise is best resolved by the manufacturer of the transmission.
- b. Evaluations can be done for a range of engine idle speeds (within 150 rpm of the nominal idle speed) to establish vehicle sensitivity to idle speed variation.
- c. Engine accessory loads usually include lights, air conditioning, air compressor, PTO's, and electrical accessories.
- d. Depending on the objectives of the evaluation, the number and type of specific evaluation modes may be abbreviated.
- e. Overall best results often involve compromises. A complete evaluation of the various alternative designs can help identify the location and severity of those compromises.

3.6 Scoring Evaluation Results—The overall rating per evaluation mode is the lowest rating of the mode. The overall rating of the installation is the lowest rating of the installation.

3.7 Key Variables—The following key variables are known to have a great affect on the severity of idle gear rattle and they should be noted when recording data:

- a. Vehicle evaluator
- b. Ambient temperature
- c. Vehicle body/chassis/powertrain configuration
- d. Engine specifications (Power, Torque, Emissions Level, timing, etc.)
- e. Engine fuel quality
- f. Engine idle speed
- g. Engine accessory loading condition (fully loaded, or unloaded)
- h. Clutch driven disc(s) damper torsional spring rate & hysteresis characteristics
- i. Clutch adjustment state (the best indicator of this is the clutch release yoke gap)
- j. Clutch release linkage condition (new, worn, greased or not greased, and the presence of noise suppression devices)
- k. Transmission specifications
- l. Transmission Oil (Type, Weight and Manufacturer as well as testing temperature)
- m. Power Take-Off (PTO) specifications (Type as well as operating conditions such as engaged or not engaged, and delivering power or not delivering power)
- n. Vehicle underbody sound absorption materials
- o. Vehicle steering load condition (straight ahead and unloaded or turned to lock and loaded)
- p. Cab windows up or down

3.8 Sample Evaluation Data Sheet—A suggested format for the data sheet is shown in Figure 1.

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