Maximum Allowable Rotational Speed for Internal Combustion Engine Flywheels–SAE J1456 DEC84

SAE Recommended Practice
Approved December 1984

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PREPRINT

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SAE Recommended Practice

Report of the Engine Committee, approved December 1984. Rationale statement available.

1. Purpose—This recommended practice is intended to establish maximum allowable rotational speeds for flywheels under centrifugally imposed stresses.

2. Scope—This practice applies to flywheels and flywheel-starter ring gear assemblies used with internal combustion engines of the spark ignition and diesel type equipped with a governor or speed limiting device. Engine sizes are those capable of using SAE No. 6 through SAE No. 00 flywheel housings.

This practice applies to methods used to determine the rotational speed capability of flywheels for stresses imposed by centrifugal forces only.

2.1 Exclusions

2.1.1 GENERAL—This practice does not encompass the selection of flywheel profile, materials, and manufacturing methods.

The influence of the following items which may reduce the speed capability of the flywheel below acceptable speed limit are not considered in this practice and must be evaluated separately:

(a) Material fatigue.

(b) Material yielding before the limiting speed or burst speed is reached.

(c) Clutch heat loading and cracks.

(d) Additional loading due to drive coupling members assembled to flywheel or due to flywheel drive system type used.

2.1.2 APPLICATION SPEED RESTRICTIONS—This practice does not apply to any application where the engine is not equipped with a governor or speed limiting device or when overspeed (No) may exceed 50% above rated engine speed (N_R); (No. > 1.5 N_R).

2.1.3 FIELD USAGE AND REWORK RESTRICTIONS—This practice does not apply when the following is done without the approval of the engine manufacturer:

2.1.3.1 The flywheel profile is reworked for another application.

2.1.3.2 The flywheel clutch friction face is refaced beyond the material removal limits recommended by the engine manufacturer.

2.1.3.3 The engine and flywheel package is used in an application other than the one for which it was originally designed.

2.1.3.4 The flywheel is removed from the original engine and installed on another engine where the rated speed or overspeed requirement is higher.

3. Rotational Speed Criteria

3.1 General—Flywheel limiting speed or burst speed capability should be established by spin test(s) and must be adjusted to minimum expected material tensile strength value.

Flywheel speed capability may also be established by an analytical method if the analytical method used closely correlates with the spin test results and spin test data is available on similar profile, size, and same material flywheels.

Flywheel material strength is to be established by test bars removed from the critical areas of the flywheel. Strength data obtained from separately poured test bars is not to be used for burst speed evaluation.

3.2 Predetermined Speed Limit or Minimum Burst Speed—Flywheel predetermined speed limit or minimum burst speed is to be based on the following relationship:

$$N_B = 2.50 \times N_R$$

where:

N_R = Application governed rated full load engine speed (rpm)

N_B = Predetermined speed limit, actual or corrected minimum burst speed of flywheel (rpm)

3.2.1 BURST SPEED CORRECTION—When the spin test flywheel material has higher strength than the specified minimum tensile strength, the measured test burst speed (N_T) shall be derated by the following formula to obtain the corrected minimum burst speed (Nc).

$$Nc = N_T \sqrt{\frac{\text{Minimum Specified Tensile Strength}}{\text{Measured Tensile Strength of Test Specimen}}}$$

The corrected minimum burst speed must be equal to or greater than the minimum burst speed requirement ($Nc \geq N_B$).

4. General Instructions

4.1 Flywheel Drawing Specifications—Flywheel material expected minimum strength and hardness specification should be defined and critical areas or sections should be shown on the drawings. Unless otherwise indicated, the following areas shall be considered as critical areas or sections:

(a) Flywheel hub.

(b) Thin section in hub area with abrupt profile and section thickness change.

(c) Thick heavy outer rims joining with thin body sections utilizing a small fillet radius.

(d) Thin rims of deep pot type flywheels where the rim has deep clutch or coupling mounting holes or balance holes.

(e) Rims of pot type flywheels which are interrupted by radially cut slots such as those used for driving the clutch intermediate pressure plate, etc.

4.2 Flywheel Redesign—Flywheel speed capability should be reconsidered when flywheel profile or material specifications or heat treatment are altered, or when casting process or supplier is changed.

4.3 Hardness Checks

4.3.1 Hardness readings can be used to indicate strength and uniformity of the material after material hardness-to-strength relationship has been established. See Fig. 1 for recommended number and location of check points.

CAUTION: Hardness readings are not a substitute for tensile bar data. When estimating the tensile strength of gray iron from the measured hardness values, exercise caution; hardness to strength relationship can vary considerably.

4.3.2 Hardness readings are to be taken on surfaces ground flat to 3.2 μm (125 μin) AA or less on flywheels selected for spin testing.

4.4 Tensile Test Bars—Tensile test bars removed from the critical areas of the flywheels should be machined per ASTM E-8 (latest issue).

4.5 Spin Testing

4.5.1 The required number of flywheels for spin testing is to be selected by the engine manufacturer. It is recommended that three flywheels, randomly selected, be spin tested. If the flywheels burst, the lowest test burst speed is to be used for establishing the rotational speed capability of the flywheel. See paragraph 3.2.1 for correcting the test burst speed.

4.5.2 For flywheel spin testing procedure, see SAE Recommended Practice, J1240.