



Engine Accessory Drive Belt Alternator Starter Tensioner

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 Scope. This standard covers supplier requirements for engine accessory drive belt alternator starter (BAS) tensioners.

1.2 Mission/Theme. This standard contains all information necessary to design, analyze, develop, validate, and manufacture accessory drive BAS tensioners.

1.3 Classification. This standard covers only BAS tensioners. There are two other accessory drive belt tensioner specifications that cover linear, GMW16326, and conventional rotary mechanical tensioners, GMW16244.

2 References

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

2.1 External Standards/Specifications.

ACEA A3/B3	ISO 1431-1	ISO 9001	JIS Z8732
ANSI 1.35	ISO 3745	ISO 11469	SAE J2236

2.2 GM Standards/Specifications.

GM7400M	GMW3059	GMW14671	GMW16290
GMW2	GMW3116	GMW15282	GMW16291
GMW5	GMW3286	GMW16244	GMW16326
GMW3044	GMW3359		

2.3 Additional References.

- Global Engine Durability (GED) Test
- Global Low Speed Durability (GLSD) Test
- Kinsler, L. E. & Frey, A. R. (2000). *Fundamentals of Acoustics* (4th edition). New York: Wiley.
- Statement of Requirements (SOR)
- Transmission/Engine Durability (TEDD) Test
- Tucker's Pottery Supplies, Inc., 15 W. Pearce Street. Unit No. 7, Richmond Hill, Ontario, Canada. info@tuckerspotttery.com

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

3.1.1 Appearance. The surface of the tensioner must be as-cast aluminum with minimal die checking.

3.1.2 Content.

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3.1.2.1 Physical Content. A mechanical tensioner consists of two castings, a base and an arm, with a spring between them. Damping sub-components are contained in this spring housing. The arm rotates relative to the stationary base. A pulley is at the end of the arm. Construction details are at the discretion of the supplier, but must result in fulfilling the requirements of this specification.

A hydraulic tensioner is required and consists of a hydraulic damping strut connected to an arm. The arm has a pivot and an idler pulley.

Note: This specification covers tensioners which operate on both sides of a motor-generator unit. It is preferred to use two separate tensioners, one on each side, to accomplish the function, one hydraulically damped on the slack side of the drive, and one friction damped, rotary construction. In this case, the two tensioners must still meet the durability requirements of this specification, as well as the normal use tensioner specifications GMW16244 (coulomb damped rotary arm designs), and GMW16326 (linear strut/hydraulic designs).

Single tensioners with Powertrain Control Module (PCM) controlled changeable load capability will be covered in another document. In the meantime, direct communication with the Technical Specialist will be used to guide development and testing.

3.1.2.1.1 Drawing. This specification shall be referenced "Must meet requirements of GMW16327" and shall appear on the detail drawing.

No tensioner design shall be proposed by the supplier which uses other than the design pre-approved by the Technical Specialist.

Parts must be pre-validated, before they can be quoted to satisfy a Statement of Requirements (SOR) and prior to any experimental part build.

3.1.2.1.2 Cross Sectional View. Detail released drawing shall detail all internal parts. Each sub-component part shall be listed by supplier part number, material and latest change date. Plastic and elastomeric parts, as well as greases, shall be described by specifying the second tier source and material supplier for that sub-component and the material source alpha numeric description of the grade and base polymer involved.

3.1.2.1.3 Pulley. Idler pulleys shall contain pre-approved, double row ball bearings. Pulley construction options shall be described as specified in GMW16290 and GMW16291, for example:

- Steel: Grade and finish expressed as GMW callouts.
- Thermoset plastic: Note this material shall not be used for Belt Alternator Starter (BAS) applications.
- Thermoplastic: This material cannot be used for BAS applications.
- Powdered iron: For backside applications only and low volume. Copper impregnation required.
- Ball bearing: Double row with approved sources/content only.
- Seal: Elastomer material and lip design type.
- Grease: Source and grade/type.
- Cage: Polymer material and grade.
- Shield design showing full bearing coverage and labyrinth configuration.
- Pulley bolt shall have a flange with a minimum 23.5 mm diameter flat on the underside to cover the bearing inner race. This will reduce the stress in the bolted joint, and prevent yield of the shield under the clamp load.

3.1.2.1.4 Charts. Written information shall be charted for clarity.

3.1.2.1.5 Confidentiality. The drawing(s) shall be reserved as a record to specify the design being quoted. It shall not be shown to another source or copied for distribution outside General Motors.

3.1.2.1.6 Internal Configuration.

3.1.2.1.6.1 Pivot Bearings. Must be constant diameter pivot independent of the damping package with bushing of sufficient length/clearance to meet wear and parallelism dimension in 3.2.2.1.2. BAS tensioners shall be two separate units, or a common spring/damping unit with two independent arms or two pulleys on the same arm. All constructions require Technical Specialist approval.

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3.1.2.1.6.1.1 Pivot Bushings. These cannot be polyamide standard constructions used on non-BAS applications. These must be very high durability **DU**-style designs with poly tetra fluoro ethylene (PTFE) coating or other durable designs for BAS applications. These materials must have Technical Specialist approval.

3.1.2.1.6.2 Mechanical Tensioner Pivot Couple Compensation. Pulley centerline to bearing centroid offset couple must be compensated for internally to avoid diagonal point wear on the pivot bushing. Design also requires pre-approval.

3.1.2.1.6.3 Mechanical Tensioner Damping Package. Must be stable over time after break-in and be completely independent of the pivot for consistency over time. This means short break-in, < 5 minutes on the cable durability test, and stabilized damping within the specified value in 4.3.3 for the life of the part. All designs require Section 4 durability testing of six samples minimum, unless otherwise specified representing range of damping element variation possible in production. Generic design performance must be demonstrated prior to source consideration for an engineering application.

3.1.2.1.6.4 Mechanical Tensioner Spring Tangs. Offset couple over length of spring between tangs must be compensated via angular tang location relative to arm at nominal position so that arm parallelism can be held over normal range of operation.

3.1.2.1.6.5 Sealing. Contamination protection designs for each opening to atmosphere using casting overlap labyrinth designs, or elastomers, or resin seals must be provided to meet the requirements of the most severe application. If non-metallic materials are used, these must meet requirements of ozone exposure 70 h at 100 ppm with a zero (0) rating per ISO 1431-1 as well as heat aging for 1008 h at 130 °C to 150 °C (depending upon material) with 50% retention of elongation and tensile strength per SAE J2236. These provisions are required, but the specific implementation may vary on each application and will be implemented on an application by application basis. Parts run on hot cycle test must be exposed to these tests prior to start of 4.3.7.4.1.

3.1.2.1.6.5.1 Hydraulic Tensioner. This slack side tensioner must be designed with 360 degree sealing for the arm pivot. Labyrinth sealing is not adequate as a design approach, but rather elastomeric seals. The hydraulic strut sealing is unique as a function of supplier.

3.1.2.1.6.5.2 Mechanical Tensioner. Must be designed similar to 3.1.2.1.6.5.1 but with labyrinth sealing for arm and spring housing split line. The labyrinth must be continuous and not allow a straight path from the atmosphere to the internal parts. Separation between castings must not exceed 1.0 mm. Exceptions would require a longer labyrinth overlap by design proven by testing to verify the function and durability of the design.

3.1.2.1.7 Idler Pulley Bearings. The idler pulley bearings must have two (2) rows of balls and meet specification GMW16291 (reference appendix titled **5203/Double Row Ball Bearing Supplier and Content Approvals**) relative to grease, seal, and cage versus supplier. Improved plastic cage materials (higher temperature capability) and seal materials (abrasion/wear; tear resistance at temperature) are encouraged, and will be added to the bearing specification as they become available.

3.1.2.1.8 Idler Bearing Dust Shields. Idler bearing dust shields are required on both sides of the bearing. They must cover 100% of the bearing face with a maximum clearance of 1.00 mm (or longer labyrinth) to at least two surfaces (not flat but rather semi-labyrinth). There shall be no straight path from outside the bearing dust shield to the plane of the bearing inner race and seal lip interface.

3.1.2.1.9 Installation Provision. An arm rotation provision must be provided as dictated by the packaging and accessibility to the tensioner.

In general, the two tensioners must be shipped into GM assembly plants in the collapsed or install position to aid in belt installation. Pins or clips/brackets must be quoted to accomplish this.

3.1.2.1.9.1 Hydraulic Tensioner. These tensioners require high torque to rotate, so the rotation provision will vary, depending on packaging and arm configuration. Either internal or proud provisions may be required in hex or square shape.

3.1.2.1.9.2 Mechanical Tensioner. Conventional 13 mm square features will generally be provided where possible, but pulley bolts are a possible option, depending upon packaging.

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3.1.2.1.10 Fracture Resistance. The rotation feature and stops in the arm and base castings must be capable of resisting twice the loads applied by the spring or a greater value in the SOR in cases where the access is limited or awkward. Performance must be demonstrated on six samples of parts off of each cavity of production tooling.

3.1.2.1.11 Arm to Spring Housing Angular Location Indicator. This feature may be required in a visible location as installed in vehicle. Technical Specialist and Release engineer approval is required.

3.1.2.1.11.1 Location Indicator Configuration. Since there are two tensioners and no certain null position, the positional indicator requirement may be waived. The configuration is application specific, and will be discussed and agreed upon with the supplier and the Release Engineer.

3.1.2.1.12 Mechanical Tensioner Anti-Rotation/Angular Location Feature. A pin or other feature on the tensioner mounting surface must be provided to control its angular location. General Motors Powertrain (GMPT) Engineering approval is required.

3.1.2.1.12.1 This feature not required with multiple bolt mounting.

3.1.2.1.13 Multiple Ear Attachment Provision. Tensioner mounting holes must conform to net hole/net slot design concept. One hole must be 8.00 mm minimum to 8.20 mm maximum, and the other hole in the same plane must be a slot with its major centerline intersecting the center of the net hole. Width is to be 8.00 mm to 8.20 mm and length of 9.50 mm.

3.1.2.1.14 Shipping Features/Hardware. In general, tensioners must be shipped in the collapsed or installation position by inclusion of a pin between the mechanical tensioner base and arm or a clip, bracket or pin, or added casting with a pin or other feature for hydraulic tensioner struts.

3.1.2.2 Functional Content. The tensioner provides load to the belt through its pulley to prevent slip, and damping to resist torsional input vibration. Some function is addressed in the requirements of the tests in Section 4.

3.1.2.2.1 Tensioner Travel. Tensioners must have sufficient travel to avoid stop contact across relevant component variation and during some operating conditions, or to assist assembly.

3.1.2.2.1.1 Hydraulic Tensioner. Must have sufficient travel to accommodate the layout geometry, which must provide high strut velocity to achieve high damping. Travel must accommodate all system dimensional variation including temperature expansion and contraction, as well as strut "jacking" which will extend the strut and stretch the belt significantly from torsional vibration or motor generator unit (MGU) torque.

3.1.3 Ambient Environment. Varies by application, but is assumed to be -40 °C to 121 °C. Exposure to contaminants is covered in Section 4.

3.1.4 Interfaces. The belt/pulley interface is covered in Appendix A, Table A1.

3.1.5 Usage Definition. General purpose.

3.2 Product Characteristics.

3.2.1 Performance Requirements. Durability and noise performance are addressed in Section 4.

3.2.1.1 Specification Values. Design must be capable of default values shown in applicable paragraphs. Sensitive or quiescent applications, however, may be assigned more or less stringent values from Table A1 in Appendix A, corresponding to Alpha codes in text.

3.2.2 Physical Characteristics.

3.2.2.1 Dimensions and Capacity. Dimensional requirements are in Appendix A, Table A1.

3.2.2.1.1 Dimensional. To be reflected on engineering drawing. Gage Repeatability and Reproducibility (Gage R&R) as well as procedure/fixture for measurement must be reported with dimensional capability/measurement, prior to the GMPT Beta design phase. Note that shadowgraphs for measuring compliance to pulley profile requirements are not permissible in favor of digital profilometers or laser/vision systems. The measurement technique must be approved by the Technical Specialist.

3.2.2.1.2 Tensioner Mounting Surface Offset to Idler Pulley Bearing Seat. With the tensioner against its mounting surface and the arm rotated to its nominal position, and design hub load applied in the design direction relative to the arm centerline, the plane of the mounting surface must be parallel to the plane of the idler pulley bearing seat within 0.33 degrees (L). This value may increase to 0.38 degrees (M) at 240 000 km.

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In addition, the dimension from plane of mounting to plane of bearing seat must be within 0.4 mm (± 0.2 mm) (**N**) at nominal arm location. See Appendix A, Table A1.

3.2.2.1.3 Mounting Surface Flatness. The surface flatness must be within 0.08 mm (**P**). This is intended to imply machining on sensitive applications; usually with ear mounting. Normal flatness is 0.12 mm for as-cast applications. See Appendix A, Table A1.

3.2.2.1.4 Pulley Centerline to Bearing Seat. The pulley centerline (or reference surface) must be located relative to bearing seat within 0.25 mm (**R**) excluding free rock. This applies to groove side pulleys, but only at the specific request of the Release Engineer. See Appendix A, Table A1.

3.2.2.1.5 Pulley Runout. The radial and lateral runouts are to be within 0.25 mm. Exceptions for very large pulleys must be approved by the Release Engineer and Technical Specialist.

3.2.2.1.6 Pulley Bearing Free Rock. There is no specific free rock requirement, since it is not generally measured in the bearing industry. It is a function of clearance and race curvature, which is at the discretion of the supplier and approved by GM through validation. Mounted clearance is a function of the pulley design, and the specified clearance from the bearing supplier. Measurement may be performed by rotating the outer race about a centered ball on one side with 2 N side force applied on the other side.

Note: Can also be calculated from radial clearance range with a given source/race curvature (usually 1.02 times to 1.03 times the ball diameter).

3.2.2.1.7 Hydraulic Tensioner Configuration. The idler pulley groove/belt running surface centerline (same as belt centerline), and the damping strut centerline and the arm pivot bushing fore-aft centerline must be co-planar.

3.2.2.2 Mass Properties. Not applicable.

3.2.3 Reliability.

3.2.3.1 Reliability Evaluation Point. Evaluated by performance to validation test series in Section 4 and manufacturing process approval.

3.2.3.2 Reliability Requirements. Supplier must meet requirements of Section 4, and have production manufacturing process approved by global Technical Specialist.

3.2.4 Serviceability. This is a system issue, which is not covered in this specification. An arm rotation feature is required to facilitate belt installation and removal.

3.2.5 User System/Subsystem/Component/Part Interface. The supplier must meet the packaging environment of the math data delivered with the SOR.

3.3 Design and Construction.

3.3.1 Materials, Processes and Parts Selection Guidelines. All sub-component materials must be specified by the supplier, and approved by the Technical Specialist.

General material specifications shall be North American controlled standards, e.g., GM, GMW, SAE International, ASTM, and Metal Powder Industries Federation (MPIF) where possible. International standards, such as DIN, JIS and the like may be acceptable, as may be supplier internal standards. All material specifications require GM Materials Engineer and Technical specialist approval.

3.3.1.1 Material Guidelines.

3.3.1.1.1 Restricted and Reportable Substances. All component parts must meet GMW3059. This includes, but is not limited to, hexavalent chrome free finishes.

3.3.1.1.2 Part Cleanliness. Every detail drawing must call out, "Parts as delivered to assembly plant shall be clean and free of debris, residual abrasive material and corrosion products adversely affecting function or appearance".

3.3.1.1.3 Coatings/Platings/Finishes. All finishes must be called out on the detail drawing to the appropriate GM specification. If an Electrophoretic Priming Operation (ELPO) or powder epoxy finish is used, the following are options:

- Clean, zinc phosphate and paint black by cathodic ELPO conforming to GMW14671 Type A-U/H with scribed 168 h salt spray testing only. Corrosion and creepback must meet the requirements of GMW3286 and GMW15282, respectively. No other testing is required.

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