



Engine Accessory Drive Idler Pulley

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 standard covers supplier requirements for engine accessory drive idler pulleys. An idler pulley is a pulley with an integral, central ball bearing.

1.2 Applicability. This standard covers all types of engine accessory drive idler pulleys.

1.3 Remarks. This standard contains all information necessary to design, analyze, develop, validate, and manufacture accessory drive idler pulleys.

2 References

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

2.1 External Standards/Specifications.

ACEA A3/B3	ISO 1431-1	JIS G 4805	SAE J1459
AIAG CQI-9	ISO 9001	SAE J403	SAE J2236
DIN 17230	ISO 11469	SAE J404	

2.2 GM Standards/Specifications.

GMW2	GMW3116	GMW3396	GMW15725
GMW5	GMW3286	GMW14671	GMW16290
GMW3059	GMW3359	GMW15282	

2.3 Additional References.

- Aluminum Alloys: ADC 10, ADC 12
- Automotive Industry Action Group (AIAG), Southfield, Michigan (www.aiag.org)
- C&U Group Limited, Shanghai, China (www.cugroup.com)
- Cixing Group Company, Limited (Bearing CW) Zhejiang, China (<http://cwbearing.en.ningboexport.com>)
- General Bearing Corporation (GBC), West Nyack, New York (www.generalbearing.com)
- GM Global Fastening Catalog
- GMB Korea Corporation, Gyeongsangnam-do, Korea (www.gmb.co.kr)
- Hutchinson Transmission Systèmes, Joué-lès-Tours Cedex, France (www.hutchinsontransmission.com)
- MATHread, Incorporated, Wixom, Michigan (www.mathread.com)
- NSK Americas, Ann Arbor, Michigan (www.nsk.com)
- NTN Bearing Corporation of America, Mount Prospect, Illinois (www.ntnamerica.com)
- Schaeffler Group USA Incorporated, Fort Mill, South Carolina (www.schaeffler.ca)
- SIMDRIVE 3D Accessory Drive Analysis Software, CONTECS Engineering Services GmbH, Berlin, Germany (www.contecs-engineering.de)
- SKF USA Incorporated, Lansdale, Pennsylvania (www.skf.com)

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- Statement of Requirements (SOR)
- Tucker's Pottery Supplies Incorporated, Ontario, Canada (www.tuckerspotttery.com)
- Winkelmann MSR Technology GmbH & Co. KG, Ahlen, Germany (www.winkelmann-flowforming.de/)
- Zhejiang BH Bearing Company, Limited, Zhejiang, China (www.bahuan.com)

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

3.1.1 Appearance. Not applicable.

3.1.2 Content.

3.1.2.1 Physical Content. Idler pulleys have a central ball bearing surrounded by a pulley of various materials. Pulleys can have grooves or flat surfaces, depending on which side of the belt interfaces with them. Attaching bolts and dust shield(s) and spacers, along with a retainer are often included, depending upon the application.

3.1.2.2 Functional Content. Function is addressed in the requirements of the tests in this specification. See Section 4.

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

3.1.4 Interfaces. The belt/pulley interface is covered by Appendix A (Figures A1, A2 and A3).

3.1.5 Usage Definition. General purpose.

3.2 Product Characteristics.

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

3.2.2 Physical Characteristics.

3.2.2.1 Dimensions and Capacity. Dimensional requirements are in Appendix A (Figures A1, A2 and A3).

3.2.2.2 Mass Properties. No requirements.

3.2.3 Reliability.

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

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

3.2.4 Serviceability. Idler pulleys are attached to the engine or a bracket with a single, central bolt, which must be removable without detaching the engine mounts.

3.2.5 User System/Subsystem/Component/Part Interface. The release engineer of the application will supply a pulley concept and the necessary engine component interfaces for packaging of the supplier pulley design. The supplier is responsible for the pulley design, which need not be similar to the supplied concept, which rather accommodates their manufacturing process.

3.3 Design and Construction.

3.3.1 Materials, Processes and Parts Selection Guidelines. Must meet the requirements of GMW16290 as well as the requirements expressed in this section.

3.3.1.1 Material Guidelines.

3.3.1.1.1 Steel. Grade and finish: The finish must meet GMW14671 Type A-U/H except with scribed 168 h salt spray as the only required test.

- Includes pulley, dust shields; spacer as applicable.

3.3.1.1.2 Powdered Metal. Used for low volume applications to save investment cost for tooling. Grade and finish must be approved by Technical Specialist.

- For heat treated parts: Applicability and effectiveness of heat treating processes shall be determined using AIAG CQI-9 special process. Heat Treat System Assessment (HTSA), published by Automotive Industry Action Group (AIAG), and records maintained.

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- Painting requires steam treating preparation or copper impregnated powder (copper is expensive and not typically used). Process requires Materials Engineer and Global Technical Specialist approval.

3.3.1.1.3 Bolt. Specification is: 10.9 Hardness, 10 mm × 1.5 pitch or 8 mm × 1.25 pitch, with heavy hex flange head or as specified in the latest GM Global Fastening Catalog.

- Finish must meet GMW3359 or latest Fastener Engineering requirements in Statement of Requirements (SOR).

3.3.1.1.4 Thermoplastic. This material is limited in availability at this juncture for North American backside pulley applications because of a limited global supply base. If used, the source of the resin material and the description of grade/type and base polymer must be specified and preapproved by the Global Technical Specialist.

3.3.1.1.5 Thermoset. This material is only available from two (2) approved suppliers (Winkelmann in Germany and Hutchinson in France). The source of the resin material and its description of grade/type and base polymer must be specified. Only injection molded manufacturing process parts can be approved.

3.3.1.1.6 Ball Bearing. Chart size and sources: Performance must be preapproved. Source specific approved bearing content is described in this specification in Table B1 in Appendix B, and no other content may be used.

3.3.1.1.6.1 Seal must be Polyamide (PA) or Hydrogenated Acrylonitrile Butadiene Rubber (HNBR) preapproved by the Technical Specialist. Nitrile is not acceptable.

- Lip design must be generally a two or three (2 or 3) lip type with at least one (1) lip in contact with inner race.

3.3.1.1.6.2 Grease source and grade/type as expressed by source with reference specification of bearing supplier.

- Oil and stiffener must be specified separately.
- Corrosion protection must be provided and demonstrated by lab testing and preapproved by the Technical Specialist.
- Hoot noise resistance must be demonstrated by lab testing and approved by the Global Technical Specialist.

3.3.1.1.6.3 Separator/cage thermoplastic material and grade must be specified.

- For polyamide or other plastic, continuous operating temperature must be specified and meet 120 °C minimum. All currently approved separators are polyamide with Polyphthalamide (PPA) as an option.

3.3.1.1.7 Material Specifications. Material specifications shall be GMW, SAE International (SAE), ASTM International (ASTM), and Metal Powders Industries Federation (MPIF). Regional Standards such as DIN, JIS, ES or BS and the like, as well as supplier internal standards, may be acceptable, when the aforementioned Standards are not available. These require GM Materials Engineer and Technical Specialist preapproval.

3.3.1.1.7.1 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."

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

- Clean, zinc phosphate and paint black by cathodic electrodeposition per GMW14671 Type A-U/H except 168 h salt fog is the only required test. Salt corrosion and creepback must meet GMW3286 and GMW15282 respectively.
- Clean, zinc phosphate and paint black with powder epoxy conforming to GMW14671.
- Zinc Nickel plating is permitted, but not Zinc Iron. Plating must meet the same GMW14671 specification as called out in this section.

3.3.1.1.7.3 Metals. Callouts are required on the detail drawing as:

- **Die Cast Aluminum:** Shall employ GMW5 specification. A380 is equivalent to GMW5M-AI-C-D-Si8Cu3Fe, and 383 is equivalent to GMW5M-AI-C-D-Si10C2Fe1. ADC 10 and ADC 12 are commonly used and approved optional materials for Europe and Asia.

Note: The GMW5 callouts follow ISO 9001, based on chemical symbols applicable to all the light metals and their alloys. International symbols are used in GMW5 to cover the major alloying elements and significant residual elements. Alloying elements, defined as those with an upper and lower limit (other than zero) in the chemical composition are listed left to right in order of decreasing content, or in alphabetical order in the

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case of equal percentages. Each chemical symbol is followed by whole numbers denoting the nominal percent present in the alloy.

- **Steel:** GMW2M (GMW2) per SAE J403 with the finishes in 3.3.1.1.7.2.

3.3.1.1.7.4 Polymers. Callouts are required on the detail drawings using applicable GMW, ASTM, or SAE specifications. Include information on the group, class, grade, and glass content, as applicable.

3.3.1.1.8 Recycling. Some plastic parts are subject to recycling consideration. Generally, pulleys and internal tensioner parts are not in this classification. At the direction of the Release or Materials Engineer, it may be necessary to mold in a symbol to identify the material for potential use in collecting and handling of parts for recycling. In such cases, the drawing note shall read: "Mark parts per ISO 11469. The marking size and location per GMW15725."

3.3.1.1.9 Reground Plastic. Thermoset and thermoplastic plastic parts shall be made of 100% virgin polymer, and must be called out as such. Thermoplastic parts must have a note on the detail drawing designating the permissible level of regrind (even if zero, which is normally the case). The note shall read: "Regrind Content: Re XXHS maximum per GMW15725." Levels will vary depending on the nature of the composite reinforcement and the length of fiberglass fibers when used. No callout presence shall default to 100% virgin material. No post-industrial or post-consumer material shall be used, but rather home scrap (runners/sprues) from the same process, when allowed. See GMW3116 Recycling Design Guide for more information.

3.3.1.2 Processes Guidelines. See 7.3.

3.3.1.3 Parts Guidelines. Not applicable.

3.3.2 Design Guidelines and Constraints.

3.3.2.1 Construction. Most idler pulleys consist of a pulley, ball bearing, dust shields, a spacer and a bolt with some kind of assembly retention. This specification will cover all of these parts and specific applications may add or delete content as necessary.

3.3.2.1.1 Pulley. The pulley design is to be done by the source with supporting Finite Element Analysis (FEA) loaded by duty cycle supplied by Release Engineer and based on belt loads. Engine vibration loads are to be added from the accessory drive design analysis software, SIMDRIVE 3D, or sometimes supported by the supplier analysis.

3.3.2.1.1.1 Belt Running Surface. If plastic, since these parts are difficult to mold, the belt running surface must be free of sinks or facets resulting from molding process. The object is to produce a flat running surface with minimum crown. Crown must not exceed 0.10 mm and must be within the profile of the running surface of the belt which is also 0.10 mm. Concavity is not permissible. Nicks or flash shall not exceed 0.10 mm.

3.3.2.1.1.2 Backside Pulleys. Flanges are not permitted. Changes in profile parallel to rotating axis must be within 0.1 mm and not tilted relative to it. The width of the belt running surface must be the belt width plus 3.0 mm minimum. Belt width is defined as 3.56 mm multiplied by the number of ribs. No plastic material shall be used for these applications in North America, unless approved by the Technical Specialist.

3.3.2.1.1.3 Groove Side Pulleys. Flanges required on both sides to meet Appendix A (Figures A1, A2 and A3) profiles or 6.0 mm larger than Diameter Over Balls (DOB) as a minimum if width is limited. If restricted by packaging, an alternative self-correcting flange design is required. Profile to be as shown in Figures A1 through A3 in Appendix A.

3.3.2.1.1.4 Center Web Section. The configuration of the pulley web section is at discretion of supplier, but must provide clearance to the surrounding componentry. Consideration of bearing walking must be analyzed.

3.3.2.1.2 Ball Bearing. Capacity shall be specified for a given application. In general B10 life is required.

- 6203 is the default type for general purpose usages.
- 6303 is used for some tight side idlers with higher loads.
- 5203 is a double row bearing used to carry high loads without the misalignment sensitivity of the free rock associated with single row bearings.
- Double 6203 or 6303 bearing can be used for high load applications, but require an internal sleeve on the Inner Diameter (ID) to equalize load sharing between them.
- For cooling fan integral shaft bearings, a higher temperature and higher performance grease is required, beyond what is used for water pumps, to meet the higher temperature environment. Global Technical

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Specialist approval is required of suppliers, manufacturing locations and internal grease, seals and cages. Some high load applications will require meeting a B2 life requirement instead of the normal B10 requirement. Reference Table D1, Appendix D.

- Special bearings are required in some applications to address packaging and load requirements. In these cases, the bearing content requires application approval by the Release Engineer and the Global Technical Specialist.

3.3.2.1.2.1 Bearing Supplier. Only tested and proven suppliers may be used. NTN Bearing Corporation of America, Schaeffler Group, General Bearing Corporation (GBC), C&U Group Limited, and NSK Americas have approved bearings for idler pulleys or accessories. SKF is in the validation phase of the approval process.

Only the pre-validated internal content is permitted to be used per Table B1 in Appendix B. Only plastic cages are allowed.

3.3.2.1.2.2 Bearing. Steel bearing race and ball steel is 52100 per SAE J404 for USA suppliers. The European standard is 100Cr6 steel per DIN 17230. Japanese steel per JIS G 4805, SUJ2 is similar to both. GCr15 is also an equivalent grade. All these grades are transparent in performance and durability. The bearing balls must be grade 20 or better in roundness.

3.3.2.1.2.3 Grease. Grease consists of an oil and a stiffener. The base oil is usually fully synthetic ester or ether based, and/or a synthetic hydrocarbon oil such as a Poly Alpha Olefin (PAO), with a thickener base of ether, or urea, or fluorocarbon. Corrosion inhibitors must be added to protect against salt penetration. A basic fact sheet from the grease supplier must be submitted to the Technical Specialist and Release Engineer along with validation results.

3.3.2.1.2.4 Seal. At this juncture, standard lip pressure and two or three lips (with one contacting race) designs are used. Vented seals are disallowed. Polyacrylate material is required. The bearing suppliers are encouraged to explore other materials such as ethylene acrylic and HNBR which have better properties and perhaps better abrasion resistance.

3.3.2.1.2.5 Cage. Polyamide material has shown improved life and is the material of choice. For temperatures exceeding 120 °C continuous, more temperature tolerant polymers are required. For up to 150 °C continuous applications, a higher temperature material such as PPA, which has a heat deflection temperature over 260 °C can be used. Bearing suppliers are encouraged to explore these materials.

3.3.2.1.3 Bolt. It is required that the bolt flange cover 100% of the bearing inner race. This means that the flange on the bolt head must be flat to a minimum diameter of 23.5 mm on its underside. This prevents cantilever of the shield between the bearing inner race and the bolt flange. MATPoint fasteners (MAThread, Incorporated) are generally required except for a specific application as directed by the Release Engineer. A 15 mm hex is required. Axi-rad retention of the bolt is required.

3.3.2.1.4 Contaminant Shield. Must cover 100% of the bearing diameter and have a labyrinth construction. This labyrinth must include at least two (2) non-parallel surfaces with a maximum 1.0 mm clearance between the shield and the bearing. There shall be no straight path between the outside atmosphere and the bearing seal lip. Both sides of the bearing must be shielded in this matter. The bolt may not serve as a shield on the front side but rather an independent shield. The spacer, if used, on the back side of the pulley may be a shield if it meets the above requirements. Materials used for shields may be steel, aluminum; powdered metal, but the choice must be based on a capability to resist 45 kN of clamping load in the bolted joint. The shield function can be accomplished for tensioner pulley bearings by incorporating it into the arm casting.

For some bearing suppliers, there may be shields incorporated into the seal design to avoid a separate shield and its cost, mass, and assembly. These designs may differ from the broad definition in 3.3.2.1.4, but may still be adequate or superior in protecting the seal contact lip. These designs require approval of the Global Technical Specialist after testing for contamination protection as compared to the typical separate designs that they replace.

3.3.2.1.5 Spacer. On applications where a spacer is required, care must be taken to provide for 45 000 N of clamp load. It is also required to provide parallelism between the surfaces which contact the engine and the inner race within 0.05 mm. It is further required that these surfaces be flat within 0.05 mm. Perpendicularity between the rotational axis of the bearing and the engine mounting surface projected to the belt running plane must be such that ≤ 0.5 degree misalignment between the belt and pulleys in the system is maintained, including all affected components in the stack up. All of these tolerances and dimensions must appear on the detail

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drawing and be confirmed by Variation Simulation Analysis (VSA), or equivalent as approved by the Global Technical Specialist on the part of Global Propulsion Systems.

3.3.2.1.6 Bolt Retention. In designs which consist of an assembly shipped with a bolt, the bolt must be retained such that the assembly remains intact during shipping and handling. This is to be accomplished by use of a plastic Axi-rad retainer or equivalent, if approved by the Release Engineer. Care must be taken to maintain sufficient surface area in the bolted joint to prevent yielding under clamp load. Testing must be done to ensure that no loosening occurs during shipping and handling.

3.3.2.1.7 Other Construction Issues. The variables chosen for specification are:

- Seal: Material and lip design, note that light contact pressure seals are not to be used.
- Grease: Source and type, grade and source alpha-numeric designation.
- Separator: Polyamide (PA).
- Ball to race clearance, usually between 10 µm and 25 µm, is not specified, but is unique to each pulley design at the discretion of the supplier.
- Race design shall be **standard**, reduced free rock race curvature is not to be used for these applications.
- Ball roundness is to be grade 20 or less for all applications.
- Grease fill volume is to be at the recommendation of the bearing supplier, since it is a function of the separator design (swept volume).

3.3.3 Identification and Marking. Not applicable.

3.3.4 Workmanship. Not applicable.

3.3.5 Interchangeability. Not applicable.

3.4 Documentation. See individual paragraph requirements.

3.5 Support of System/Subsystem/ Component/Part After Sale. Supplier must provide root cause analysis and corrective action to issues identified in service/warranty by Supplier Quality and/or Product Engineering.

3.6 System/Subsystem/Component/ Part Operator Training. Not applicable.

3.7 System/Subsystem/Component/ Part Characteristics. Not applicable.

3.7.1 System/Subsystem/Component/ Part Definition. Not applicable.

4 Validation

4.1 General. Not applicable.

4.2 Validation Cross Reference Index. Not applicable.

4.3 Supporting Paragraphs. Test Series.

4.3.1 Steel Salt Exposure. Steel contamination protection is validated by conventional salt test rigs to the appropriate GM specification for all but the ball bearing.

4.3.2 Pulley Rotary Fatigue. This dead weight pulley test must be run on the assembly and must comprehend:

- Engine revolutions per 240 000 km (150 000 mi): 525×10^6 multiplied by drive ratio. Note: Trucks require 322 000 km (200 000 mi) durability, so duration must be longer, based on 4/3 ratio.
- Duty cycle of hub load versus speed (rpm) versus percent of time supplied by Release Engineer.
- Equivalent constant load and cycles may be developed based on duty cycle and equivalent damage theory based, in turn, on the establishment of S-N curves for bearing grease, seals, and cages as a function of load, speed, and temperature. No arbitrary test cycles are permitted. Supplier proposals require Release Engineer and Global Technical Specialist approval.
- For steel pulleys, 30×10^6 revolutions are required to validate a design for infinite life.
- A minimum of three (3) pulleys must be rotary fatigue tested.
- If plastic pulleys are used, the design stress must be such that fatigue is not an issue (< 35 MPa) to avoid testing to determine the fatigue behavior of the material (S-N curve). Actual number of cycle testing to an equivalent load is the normal method of validation.

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