



Requirements for Cranking Motors - Requirement Part

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 document defines the general requirements for all cranking motor types. The requirements cover the cranking motor including the solenoid.

1.2 Mission/Theme. Cranking motors are used in vehicles to crank the engine to start it.

1.3 Classification. The cranking motor specification consists of the requirement part GMW3145 and the verification part GMW3163.

If not otherwise specified, the requirements shall be checked as specified to GMW3163.

2 References

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

2.1 External Standards/Specifications.

ISO 20653

VDA 260

2.2 GM Standards/Specifications.

GMW3059

GMW3163

GMW3097

GMW15357

2.3 Additional References.

Cranking Subsystems Applications Guide

2.4 Order of Precedence. Requirements, and associated verification, on electrical/electronic subsystems and components in motor vehicles is valid in the following order of precedence:

2.4.1 Requirements stated in applicable legal demands.

2.4.2 Requirements stated in the relevant specification for the actual subsystems and components (e.g., a vehicle technical specification (VTS), subsystem technical specification (SSTS) or component technical specification (CTS) Statement of Requirements (SOR)/template drawings).

2.4.3 Requirements stated in this GM Worldwide Engineering Standard.

2.4.4 Requirements stated in other GM Worldwide Engineering Standards. Requirements stated in other documents.

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

3.1.1 Appearance. In the as received condition, the cranking motor shall not show any visible damage or defects which affect the appearance. The dimensions and their tolerances specified in the drawings or approval documents shall be met by the cranking motor.

3.1.2 Content. Not applicable.

3.1.2.1 Physical Content. Not applicable.

3.1.2.2 Functional Content. Not applicable.

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3.1.3 Ambient Environment. The cranking motor is installed at the engine; the environment for the cranking motor is vehicle application specific and specified in the cranking motor component technical specification.

3.1.4 Interfaces.

3.1.4.1 Connector to Battery +. The connector to battery + shall be as specified on the part drawing.

3.1.4.2 Connector to Terminal 50. The connector to terminal 50 shall be as specified on the part drawing.

3.1.5 Usage Definition. Not applicable.

3.2 Product Characteristics. Deviations from this specification or additional requirements shall be agreed upon. These requirements shall be specified in the respective documents and shall be contained in test certificates, reports, etc.

3.2.1 Performance Requirements.

3.2.1.1 Basic Electrical Requirements.

3.2.1.1.1 Overvoltage Protection. After stressing to GMW3163, the cranking motor shall be fully functional.

3.2.1.1.2 Reverse Polarity Voltage Protection. After stressing the cranking motor to GMW3163, it shall be fully functional.

3.2.1.1.3 Electromagnetic Compatibility. The cranking motor shall comply with the requirements of Conducted Transient Emissions in GMW3097, when evaluated in accordance with GMW3097.

If cranking motors are equipped with electronic devices, e.g., electronic controlled solenoids, GMW3097 will be valid without exceptions.

3.2.1.1.4 Environmental Requirements. The cranking motors shall meet the requirements of the relevant specifications described in 3.2.1.1.5 thru 3.2.1.1.15.

After each stressing, the cranking motors shall be fully functional.

3.2.1.1.5 Requirements to Temperature Resistance. Upon completion of the High/Low Temperature Storage Test defined in GMW3163, the cranking motor shall meet the requirements defined in 3.2.1.2.1.

3.2.1.1.6 Fluids Compatibility. Upon completion of the test in GMW3163, the cranking motor shall meet the requirements defined in 3.2.1.2.1.

3.2.1.1.7 Cyclic Corrosion Laboratory Test. Cranking motor cosmetic corrosion level must be a minimum of nine (9) after test. Corrosion level rating is based on throttle cable bracket as shown in GMW15357.

3.2.1.1.8 Off Road Vehicle Durability Simulator. No incident where the motor fails to crank shall occur. At the end of the test, the motor output shall be $\geq 80\%$ of the initial value.

3.2.1.1.9 High Humidity Resistance. At the end of the test in GMW3163, the cranking motors shall be fully functional.

3.2.1.1.10 Resistance to Water Ingress.

3.2.1.1.10.1 Motor Frame Water Ingress. After the stress to GMW3163, the maximum amount of water measured shall be $\leq 10 \text{ cm}^3$. The cranking motor shall be fully functional, a mechanical performance loss of 20% is allowed, compared to delivery condition.

3.2.1.1.10.2 High Pressure Protection. After stressing to GMW3163, there shall be no damages. The cranking motor shall be fully functional, a mechanical performance loss of 20% is allowed, compared to delivery condition.

3.2.1.1.10.3 Solenoid Sealing Test. At the end of seven (7) cycles of GMW3163, no water may have entered the solenoid. Water found in any other part of the motor is permitted.

3.2.1.1.11 Mechanical Strength. The cranking motor shall be vibration tested to GMW3163.

Successful completion of the initial vibration test shall be considered a pass. In addition, the cranking motor shall be fully functional.

No mechanical shock requirement and no free fall requirement are valid for the cranking motor.

3.2.1.1.12 Cranking Motor Durability. The cranking motor shall withstand the number of cycles defined below when tested as described in GMW3163.

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3.2.1.1.12.1 Number of Durability Cycles.

- Conventional Starter: 46 000
- Manual Transmission Start/Stop Starter: 300 000 (50 000 cycles for key start and 250 000 cycles for auto start)
- Automatic Transmission Start/Stop Starter: 350 000 (50 000 cycles for key start, 10 000 cycles for Change of Mind (CoM) start, and 290 000 cycles for auto start)

3.2.1.1.12.2 The conventional starter motor mechanical performance shall be $\geq 90\%$ of the initial performance values after 20 000 cycles and $\geq 80\%$ at the end of the 46 000 cycles. Pinion and ring gear is to be monitored for wear or damage with engagement failures or incidents of ring gear milling recorded. Three (3) consecutive or 50 total engagement failures shall constitute a test failure. The cranking motor must be able to crank the engine to speed as specified in the SOR at $-30\text{ }^{\circ}\text{C}$ and warm start with dual mass flywheel (DMF).

- For Start/Stop Starters, refer to the Cranking Motor SOR Appendix C.

3.2.1.1.12.3 Samples shall be tested to failure or three times life depending on starter type. Starter technical specialist and/or design release engineer (DRE) have the final approval on the number of samples to be tested to failure. The number of samples Weibull analysis shall result in a B5 life of the minimum number of durability cycles.

3.2.1.1.13 Customer Abuse. The cranking motor shall be able to sustain 50 engagement attempts of the motor pinion into a ring gear rotating at $1000\text{ rpm} \pm 50\text{ rpm}$ with no functional damage to the starter. The mechanical performance shall be $\geq 80\%$ of the value of the initial test.

3.2.1.1.14 Dynamometer/Engine Bench Test. The motor shall be capable of operation on an engine according to an engine durability program as specified by the responsible GM location. After stressing, the cranking motor shall be fully functional, but a mechanical performance loss of 20% is allowed, compared to delivery condition.

3.2.1.1.15 Low Air Pressure Requirement. For cranking motors, no low air pressure requirement is valid.

3.2.1.2 Cranking Motor Specific Requirements.

3.2.1.2.1 Room Temperature Motor Performance Test. At room temperature, the recorded torque characteristic curve and the recorded speed characteristic curve shall correspond to the specified characteristic curves as shown on the two dimensional (2D) drawing, or exceed them. The mechanical performance characteristic curve shall be derived from the recorded torque and speed curve.

For information, the supplier shall deliver an additional set of characteristic curves (torque and speed) showing the performance of the cranking motor at $-30\text{ }^{\circ}\text{C}$, for battery characteristics as:

Open Circuit Voltage: 12.0 V (Direct Current (DC))

Crank Circuit Resistance: 10 m Ω

3.2.1.2.2 Coast Down Time. The rotor stopping time shall be $\leq 1.5\text{ s}$ when new or $\leq 2.5\text{ s}$ after durability testing.

3.2.1.2.3 Solenoid Pull-In Performance. At cranking motor temperatures between $-40\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ and $125\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ($100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ after durability testing), the voltage at the voltage source necessary to contact the main contacts shall not exceed 11.5 V. After energizing the solenoid, the plunger shall not return to its initial position at a voltage $> 4.5\text{ V}$ at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

3.2.1.2.4 Stall Current Overload. After stressing to GMW3163, the cranking motor shall be fully functional.

3.2.1.2.5 Ring Gear Impact Loading Test. After stressing to GMW3163, the cranking motor shall be fully functional.

3.2.1.2.6 Overrun Speed Range. After stressing to GMW3163, the cranking motor shall be fully functional.

3.2.1.2.7 Contact Icing. The motor shall show no failure to demonstrate continuity at contact closure when tested to GMW3163.

3.2.1.2.8 Demagnetization Test. The starter motor shall be able to withstand a worst case maximum current draw at a temperature most susceptible to demagnetization with a reduction of torque $< 10\%$ at any measured current value of the room temperature motor performance curve.

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