

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

3.1.1 Terms and Definitions.

3.1.1.1 Component Definition. A piece of hardware delivered to General Motors with a unique GM Part Number. The actuator motor assembly usually consists of an electrical motor, usually with a means of an output gear reduction and typically an embedded sensor to provide position feedback to a control module.

3.1.1.2 Part Definition. An element that is used to construct a component such as a transistor, circuit board, housing, motor, and potting material, etc.

3.1.1.3 Temperature and Voltage Definitions. See Table 1.

Table 1: Temperature and Voltage Definitions

Phrase	Symbol	Definition
Minimum Temperature	$T_{\min}$	Minimum limit value of the ambient temperature at which the component is required to operate.
Maximum Temperature	$T_{\max}$	Maximum limit value of the ambient temperature at which the component is required to operate.
Post Heating Temperature (soak back)	TPH	Maximum limit value of the ambient temperature which may temporarily occur after vehicle cut-off and at which the component may be operated for a brief period, i.e., on the engine and in its environment.
Repaint and Storage Temperature	TRPS	Maximum temperature which can occur during repainting, but at which the component is not operated. Accounts for high temperature storage and paint booth exposure.
Room Temperature	T_{room}	Ambient room temperature.
Minimum Voltage	$U_{\min}$	Minimum limit value of the supply voltage at which the component is required to operate during the test.
Nominal Voltage	U_{nom}	Nominal supply voltage at which the component is operated during the test.
Nominal Voltage, Alternator	UA	Nominal supply voltage with generator operating (i.e., alternator voltage) at which the component is operated during the test.
Nominal Voltage, Battery	UB	Nominal supply voltage with generator not operating (i.e., battery voltage) at which the component is operated during the test.
Maximum Voltage	$U_{\max}$	Maximum limit value of the supply voltage at which the component is required to operate during the test.

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3.1.1.4 Operating Type. Operating type is defined in Table 2.

Table 2: Operating Types

Operating Type		Electrical State
1		No voltage is applied to the component.
	1.1	Component is not connected to wiring harness.
	1.2	Component is connected to wiring harness.
2		The component is electrically connected with supply voltage UB (battery voltage, generator not active) with all electrical connections made.
	2.1	Component functions are not activated (e.g., sleep mode, OFF mode).
	2.2	Component with electric operation and control in typical operating mode.
3		The component is electrically operated with supply voltage UA (engine/generator active) with all electrical connections made.
	3.1	Component functions are not activated (e.g., sleep mode, OFF mode).
	3.2	Components with electric operation and control in typical operating mode.

3.1.1.5 Functional Status Classification (FSC). FSC is defined in Table 3.

Table 3: Functional Status Classification (FSC)

Class	Definition of FSC Class
A	All functions of the component perform as designed during and after the test.
B	All functions of the component perform as designed during the test. However, one or more of them may go beyond the specified tolerance. All functions return automatically to within normal limits after the test. Memory functions shall remain FSC A. FSC A is also acceptable for components that are classified as FSC B.
C	One or more functions of the component do not perform as designed during the test but return automatically to normal operation after the test. FSC A or B are also acceptable for components that are classified as FSC C.
D	One or more functions of the component do not perform as designed during the test and do not return to normal operation after the test until the component is reset by any "operator/use" action. FSC A, B, or C are also acceptable for components that are classified as FSC D.
E	One or more functions of the component do not perform as designed during and after the test and cannot be returned to proper operation without repairing or replacing the component. FSC A, B, C, or D are also acceptable for components that are classified as FSC E.

3.1.1.6 Definition of Codes Used for International Protection (IP) by Enclosures. The example in Figure 1 explains the use of letters in the IP Code. For details see ISO 20653, Protection of Electrical Equipment against Foreign Objects, Water and Access.

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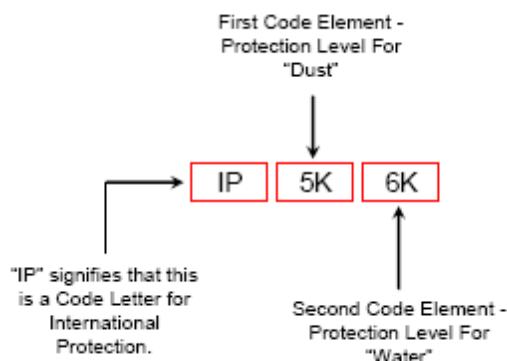


Figure 1: IP Code Example

Tables 4 through 6 provide IP code letters for dust, water, and sealing.

Table 4: Code Letter for IP by Enclosures – Dust

First Code Element	Brief Description	Requirements
X	Not required	None - Shall only be used in conjunction with Water IP Codes 6K, 8, or 9K.
5K	Dust-protected	Dust shall only penetrate in quantities which do not impair performance and safety.
6K	Dust-tight	Dust shall not penetrate.

Table 5: Code Letter for International Protection by Enclosures – Water

Second Code Element	Brief Description	Requirements
2	Water drips with enclosure inclined by 15 degrees	Vertical drips shall not have any harmful effects, when the enclosure is tilted at any angle up to 15 degrees on either side of the vertical.
3	Water spray	Water spray which sprays against the enclosure from any direction at a 60 degree angle shall not have any harmful effects.
4K	Splash water with increased pressure	Water which splashes against the enclosure from any direction with increased pressure shall not have any harmful effects.
6K	Strong high-velocity water with increased pressure	Water which is directed against the enclosure from any direction as a strong jet with increased pressure shall not have any harmful effects.

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Table 6: Code Letter for International Protection by Enclosures – Sealing

Second Code Element	Brief Description	Requirements
8	Seal – Continuous Immersion in Water	Water shall not penetrate in a quantity causing harmful effects if the enclosure is continuously immersed in water under conditions which shall be agreed between supplier and GM.
9K	Water during high-pressure/steam-jet cleaning	Water which is directed against the enclosure from any direction shall not have any detrimental effect.

3.1.1.7 Parameter Tolerances Definition. Unless stated otherwise, the tolerance parameters stated in Table 7 shall define acceptable limits for all validation testing required for this specification.

Table 7: Parameters and Tolerances

Parameter	Tolerance
Ambient Temperature	Specification $\pm 3^{\circ}\text{C}$
Room Temperature	$23^{\circ}\text{C} \pm 5^{\circ}\text{C}$
Test Time	Specification $\pm 0.5\%$
Room Ambient Relative Humidity	30% to 70%
Chamber Humidity	Specification $\pm 5\%$
Voltage	Specification $\pm 0.1\text{ V}$
Current	Specification $\pm 1\% \text{ A}$
Resistance	Specification $\pm 10\% \Omega$
Random Acceleration	Specification $+10\% G_{\text{rms}}$
Mechanical Shock	Specification $\pm 10\% \text{ G}$
Frequency	Specification $\pm 1\% \text{ Hz}$
Force	Specification $\pm 3\% \text{ N}$
Distance (Excluding Dimensional Check)	Specification $\pm 3\% \text{ m}$

Note: G_{rms} = Arithmetic mean of the squares of a set of acceleration rates relative to gravity, $9.8 \text{ m/s}^2 \text{ (G)}$, Ω = Ohms.

3.1.2 Content.

3.1.2.1 Physical Content. The actuator motor assembly may be part of a transfer case system such as an active system, full time system, or part time system, may be used on a Rear Drive Module (RDM) or disconnecting Power Transfer Unit (PTU).

3.1.2.1.1 Typical transfer case actuator motor assembly. See Figure 2.

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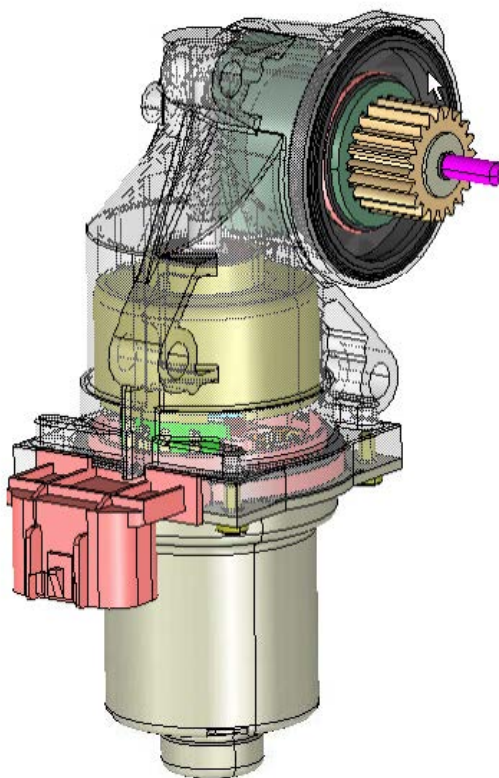


Figure 2: Typical Transfer Case Actuator Motor Assembly

3.1.2.2 Functional Content. Not applicable.

3.1.3 Ambient Environment. The actuator motor assembly operates underbody and is subject to all climatic and environmental conditions common to exterior mounted powertrain components.

3.1.4 Interfaces. The actuator motor assembly is mounted to the exterior of a transfer case, RDM or disconnecting PTU and typically is mated to a shaft that converts rotational motion to linear motion in order to apply a clutch pack, engage a dog clutch, shift gear ratios, change modes, etc.

3.1.5 Usage Definition. Actuator motors of this type are commonly used on transfer case, RDM and disconnecting PTU systems that employ a means of electrically shifting the unit and/or controlling (modulating) torque output to a secondary axle. The actuator motor may also contain a sensor that provides position feedback to a separate module.

3.1.6 Sampling Plans. Validation tests specified as success tests are based on sampling plans. The sampling plans indicate the relationship between the quantity of test articles on test and the associated duration that the test must complete without any failures to demonstrate that reliability requirements have been achieved. All sampling plans provided in this specification are subject to revision based on changes to anticipated failure modes (Weibull slope/characteristic life), target customer or region, and/or materials used.

3.2 Product Characteristics.

3.2.1 Performance Requirements. All articles on test must satisfy performance requirements prior to start of testing, during testing, at intermediate check points, and at the conclusion of testing as indicated in the validation test flow. Specific criteria for satisfactory performance are product specific and delineated in the respective Component Technical Specification (CTS)/Statement of Requirements (SOR). Performance verification is aligned with GMW3172 functional/parametric tests. Where indicated, five (5) point functional/parametric testing occurs at:

- Point 1 (T_{min} , U_{min}).
- Point 2 (T_{min} , U_{max}).

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