

Standard for D.C. Brush Motor - HVAC Blowers

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STANDARD FOR D.C. BRUSH MOTOR - HVAC BLOWERS

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1.0 SCOPE

This standard sets forth the performance and durability requirements for 12-volt, D.C. brush-type electric motors used for automobile Heating, Ventilation, and Air Conditioning (HVAC) blowers and outlines Production Validation and Continuing Conformance testing.

2.0 REFERENCE DOCUMENTS AND DEFINITIONS

Requirement Hierarchy — In the event there is a conflict between this standard, and any drawings/specifications, prioritize requirements as follows:

- 1st - Applicable drawing(s)
- 2nd - Application Specific Requirements
- 3rd - USCAR standard
- 4th - Other related standards or specifications

2.1 Applicable Drawings/Specifications

The applicable drawings/specifications for the HVAC motor shall contain or reference the following:

- All dimensional requirements
- Performance requirements/conditions
- Supplier part number
- Direction of Rotation
- Positive terminal identification
- Reference to applicable portions of this and other standards
- The typical mating connector and terminals
- Federal Motor Vehicle Safety Standard (FMVSS) Requirements

Wherever possible the applicable electrical connector should be used in conducting the test sequences contained in this document to simulate actual in-vehicle conditions.

The circuitry shall be terminated using connectors that comply with SAE/USCAR-2, Standard for Automotive Electrical Connection Systems, and the SAE/USCAR-12, Wiring Component Design Guidelines.

2.2 Application Specific Requirements

The application specific requirements shall identify the parameters that differ from the general specifications in this document. The application specific requirements may or may not be an integral part of the applicable drawings.

2.3 Test Categories

2.3.1 Design Verification Tests

Design Verification tests are frequently used to evaluate specific areas of the design. They are a tool for evaluating design alternatives, proposed improvements, cost reduction proposals, or determining root causes of field problems.

2.3.2 Production Validation Tests

Production Validation tests are the acceptance tests for production part approval.

2.3.3 In-Process Validation (Continuing Conformance) Tests

In-process Validation tests are tests to ensure continuing conformance of production samples to the specified requirements.

3.0 OUTLINE

This engineering standard is a supplement to the released motor drawings/specifications and any applicable HVAC subsystem drawings/specifications. Details of test procedures are provided where necessary. Tests in each section shall be performed in the stated sequence. A glossary of terms and details for selected test fixtures and equipment are provided in this standard.

4.0 GENERAL REQUIREMENTS

4.1 Record Retention

Record retention shall comply with PPAP and QS-9000.

4.2 Sample Documentation

Engineering test samples shall be identified by part number, serial number, and motor build date unless otherwise noted.

4.2.1 Required Data Package

The required data package for the appropriate level of submission is to be included with the sample submission to the customer. The data package shall include the applicable test data for each performance parameter, and the serial number of each part in the submission.

4.2.2 Design Verification Samples

Design Verification samples are prototype motors representing the production intent design. Sample sizes are given in Appendix A.

4.2.3 Production Validation Samples

Production Validation samples are defined as motors taken from a 300-unit minimum production run generated from production tools and processed before the first volume shipment. Sample sizes are given in Appendix B.

4.2.4 In-Process Validation (Continuing Conformance) Samples

In-Process Validation samples are motors randomly selected for inspection from lots that have been subjected to all normal high volume production processing, including final packaging.

An inspection lot is defined as the total number of motors of a given basic design produced in one shift. An inspection lot may be divided into two or four sublots at the supplier's option. Each subplot shall be inspected in accordance with the Continuing Conformance tests described in Appendix C.

If variations of a basic motor design (termination, finish, etc.) are produced in a lot (or subplot), the sample size will remain the same but shall include as many of the variations as possible.

In-Process Validation samples are also subject to certain reliability tests. See Appendix C.

4.3 Safety/Environmental Requirements

When required, products and processes used by suppliers to manufacture products shall conform to employee and consumer health, employee safety, and environmental requirements contained in the customer's drawings/specification.

4.4 Materials and Process Standards

Suppliers are expected to subscribe to appropriate Materials and Process Standards that are called out by the customer. The supplier shall not change any material or process requirements subsequent to Design Verification approval without the written consent of the customer's releasing department.

Suppliers shall use the most recent versions of any applicable reference documents or standards.

4.5 Default Test Conditions

When specific test conditions are not given either in the product design specification or elsewhere in this standard, the following basic conditions shall apply:

- a) Room Temperature = $23 \pm 2^{\circ}\text{C}$ ($73^{\circ} \pm 4^{\circ}\text{F}$)
- b) Atmospheric Pressure = 650 - 800 mm Mercury
- c) Voltage = 13.5 ± 0.1 vdc

4.6 Equipment

Unless otherwise specified, Table 1 represents recommended equipment.

TABLE 1 - Equipment

ITEM	DESCRIPTION	REQUIREMENTS
1	DC Power Supply (Regulated)	• 0-20 V • 0-125 A
2	Digital Multimeter	• Capable of measuring the following at $\geq 0.5\%$ accuracy: – 0-50 Volts DC – 0-10 Amps DC – 0-10 Megohms
3	Current Shunts	• 100 A/100 mv @ $\pm .25\%$
4	Millivolt Meter	• Capable of measuring 0-100 mvdc @ $\geq 0.5\%$ accuracy
5	Thermocouples	• Type "J," "T," or "K," and as required
6	Data Logger	• As required
7	Temperature Chamber	• -40°C to $+110^{\circ}\text{C}$ (-40°F to $+230^{\circ}\text{F}$) • 0 to 95% RH
8	Vibration Controller	• Random
9	Salt Spray Chamber	• Per latest revision of ASTM B117
10	Megohmmeter	• Capable of measuring ≥ 1000 Megohms @ 500 Volts DC
11	Dynamometer	• Capable of measuring 0-800 oz. in. (0-6.00 N·m) • 1000 rpm Drag Torque ≤ 3.2 oz. in. (0.023 N·m) • Torque Resolution ≤ 1.6 oz. in. (0.01 N·m)

4.7 Measurement Resolution

Meters and gages used in measurements of the test sample shall be capable of measuring to one tenth of the specified resolution. For example, even though a 0.1 mm and 0.10 mm might be the same dimension, calipers capable of 0.01 mm resolution may be used to measure the first dimension but a micrometer with 0.001 mm resolution is required to measure the second dimension.

4.8 Equipment Calibration

Instrumentation shall be calibrated according to QS-9000.

4.9 Customer Notification of Nonconformance

Should a test nonconformance occur, notify the customer to determine what further actions are required.

4.10 General Endurance Objective

The objective of the design and construction of the blower motor is to be capable of operating in its intended environment and application, without malfunction, for at least 4000 hours on the agreed cyclic speed schedule.

4.11 Design Verification

The supplier shall conduct Design Verification tests on samples during each phase of motor development (as defined by the customer) according to Appendix A.

4.12 Production Validation

The supplier shall conduct Production Validation testing on production samples according to Appendix B before the first volume shipment.

4.13 Failure Mode and Effect Analysis (FMEA)

Within 90 days of source selection, the supplier shall prepare a preliminary design FMEA and review it with the customer. A customer-approved design FMEA shall be required before program tooling release. The supplier shall complete a Process FMEA and review it with the customer before the start of Production Validation testing.

4.14 Quality Control

- A supplier who furnishes finished parts is responsible for the quality of all components of the shipped assembly, whether component parts are processed/manufactured by the supplier or purchased from another source. If required, parts shall be purchased only from customer-approved sources. If required by the customer, an itemized list of important characteristics shall be submitted with motor approval samples.
- Any change to the components, processes, materials, or subcontracted suppliers requires prior customer approval.
- 100 Percent Production Tests
 - a) Functionally test blower motors at room temperature at conditions which meet or correlate to those shown on the applicable drawing/specification.
 - b) Subjectively evaluate the blower motors for noise. The minimum evaluation condition shall be a voltage sweep of the motor at no load throughout its low speed/high speed range; the sweep shall have a minimum duration of 6 seconds. A suitable listening environment is required. The motor shall not be noisier than a noise master motor or equivalent recording.

4.14 (Continued):

- c) Observe the commutation wave form and confirm that the wave form is characteristic of a population of motors known to be in good working order.

4.15 Jury Evaluation

If a jury evaluation is conducted for specific or overall noise characteristics, the following rating scale, Table 2, is recommended with a minimum acceptable level specified by the customer.

TABLE 2 - Noise Rating Scale

RATING	CLASSIFICATION
10	Superior
9	Excellent
8	Very Good
7	Good
6	Satisfactory
5	Borderline
4	Unsatisfactory
3	Bad
2	Very Bad
1	Intolerable

5.0 PERFORMANCE REQUIREMENTS/TESTS

5.1 Motor Performance

5.1.1 Procedure

1. Mount the motor on a dynamometer capable of absorbing the output power of the motor on a continual basis, as well as being able to exceed its stall torque.
2. Perform the following as indicated on the applicable drawing/specification:
 - a) Adjust the cooling air flow (5 CFM, unless otherwise specified).
 - b) Apply regulated voltage to motor terminals.
 - c) Adjust load for proper torque.

NOTE: The tolerances for the values used in step 2 are as follows:

Air Flow ± 0.50 CFM, Voltage ± 0.05 vdc, Torque ± 0.5 oz. in. (.0035 N·m)