GM	WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17143

Wire-Rope Pull Test Procedure for Stator Winding Wire Welds of Electric Motors

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. For evaluation of fracture strength of electric motor stator winding wire welds and documentation of comparative test data.

1.2 Applicability. Applies to rectangular copper wire with cross sectional area < 13 mm^2 and Width-to-Depth (WxD) aspect ratio < 1.2.

1.3 Remarks. This test method covers the tension testing of stator winding wire welds at room temperature with a stainless steel rope at room temperature which shall be 10 °C to 38 °C.

2 References

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

2.1 External Standards/Specifications.

ASTM E4	ASTM E8/E8M	ISO 6892	ISO 7500-1

2.2 GM Standards/Specifications.

None

3 Resources

3.1 Facilities. Figure 1 shows the tension testing of stator winding wire welds with a stainless steel rope. Tensile testing machines and load cells used for rope-pull testing shall conform to the requirements of ASTM E4 or ISO 6892. A load cell < 10 kN shall be used. Alternative load cells shall be approved by GM Materials Engineering. Method of gripping shall meet the requirement of ASTM E8/E8M or ISO 7500-1. Wedge Grips are recommended for this test. Breaking strengths of 7x7 strand 304 stainless steel wire ropes (Figure 2) shall be > 2138 N for 1.59 mm diameter rope and > 1203 N for 1.29 mm diameter rope, respectively.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

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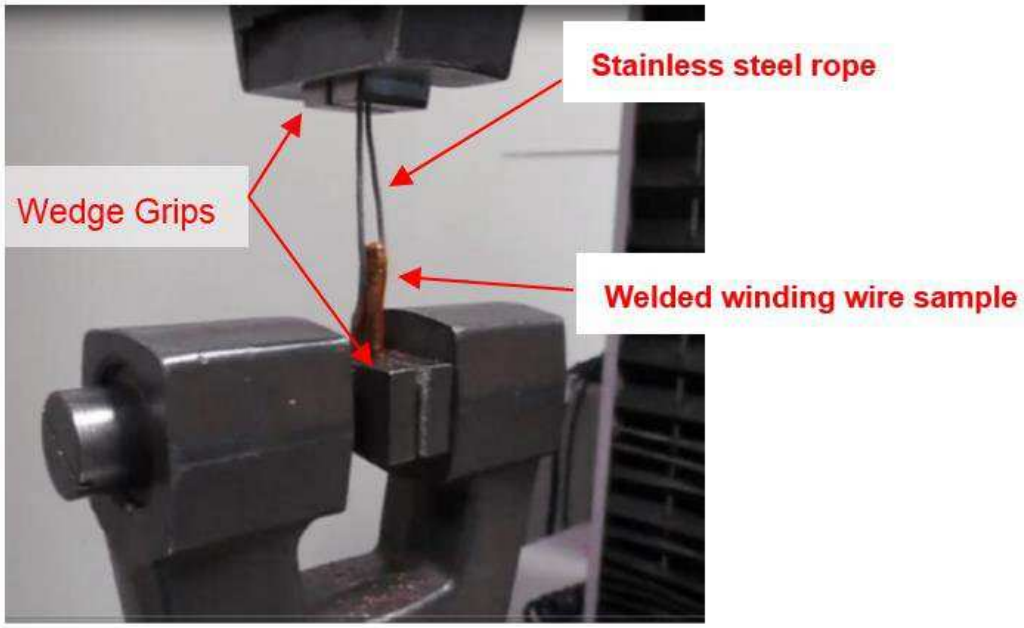

Figure 1: Rope Pull Test

Figure 2: A Representative 7x7 Strand 304 Stainless Steel Wire Rope

3.2 Equipment. Machines used for tension testing shall conform to the requirements of Practices of ASTM E4 or ISO 6892. The forces used in determining tensile strength and yield strength shall be within the verified force application range of the testing machine as defined in Practices of ASTM E4 or ISO 6892.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time. Varies based on supplier capabilities, equipment and experience. See 4.3 and Appendix A for more details.

3.5 Test Required Information.

3.5.1 Test Sample Requirement. A representative stator winding wire weld test sample is shown in Figure 3. Three dimensional requirements shall be met:

a. Total sample length (A): 50 mm minimum (see Figure 3).

b. Distance (B) between the weld tip and the location where C shall be measured: 9 mm to 11 mm (see Figure 3).

c. Spacing (C) between two copper wires: 1.4 mm to 1.9 mm for 1.29 mm diameter ropes; 1.8 mm to 2.3 mm for 1.59 mm diameter ropes (see Figure 3).

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Relative flatness between the two copper wires shall be < 3 mm (see Figure 3). If test samples are obtained from a stator, the detailed instruction in Appendix A shall be followed for cutting and straightening the samples. A minimum five samples shall be tested.

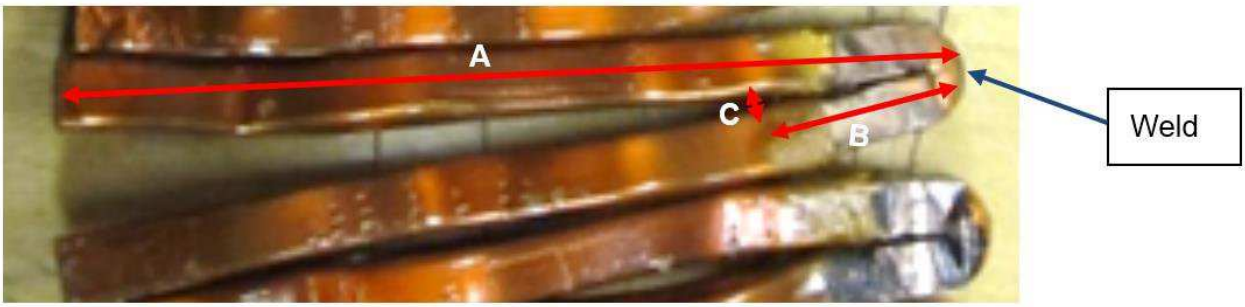

Figure 3: Test Sample Requirement

3.5.2 Pull Test Metal Rope Requirement. For rectangular copper wire with cross-sectional area 6 mm^2 to 13 mm^2 and aspect ratio < 1.2 (see Figure 4), use 1.59 mm diameter 7x7 strand 304 stainless steel wire ropes (Figure 4) which breaking strength is > 2138 N. See Table 1.

For rectangular copper wire with cross-sectional area < 6 mm^2 and aspect ratio < 1.2 (see Figure 3), use 1.29 mm diameter 7x7 strand 304 stainless steel wire ropes which breaking strength is > 1203 N. See Table 1.

Table 1: Pull Test Metal Rope Requirement

Wire Rope			Copper Wire Dimension	
Diameter (mm)	**Strands**	**Load Capacity (N)**	**Cross Sectional Area (mm^2)**	**Aspect Ratio (WxD)**
1.59	7x7	2138	6 to 13	≤ 1.2
1.29	7x7	1203	≤ 6	≤ 1.2

Alternative ropes shall be approved by GM Materials Engineering.

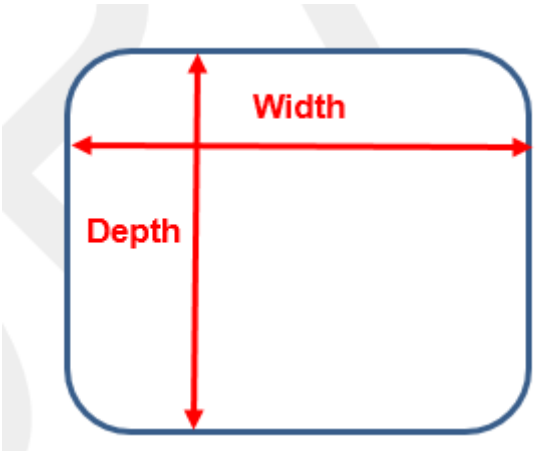

Figure 4: A Representative Rectangular Copper Wire Cross-Section

3.6 Personnel/Skills. Test technician familiar with test facilities and equipment.

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4 Procedure

4.1 Preparation. Not applicable.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Test Procedure of Specimen Mounting.

4.3.1.1 Mount the copper winding wire weld sample in lower wedge grip (Figure 5 and Figure 6) as follows:

- Gripped length: > 27 mm.
- Ungripped length: 23 mm to 27 mm.

4.3.1.2 Pass the stainless steel rope between the two copper wires and mount the two rope ends to the upper grip (Figure 6) as follows:

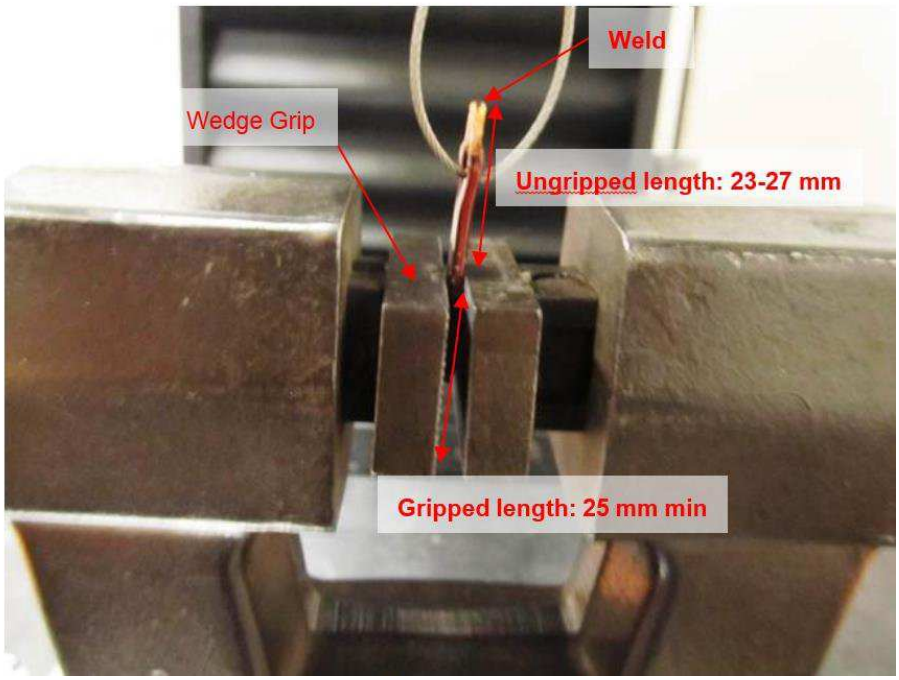
- Gripped length: > 30 mm.
- Ungripped length: 20 mm to 25 mm.
- Spacing of gripped ends: 18 mm to 22 mm.

4.3.2 Test Procedure.

4.3.2.1 Run test machine in stroke control with displacement rate 40 mm/minute to 55 mm/minute.

4.3.2.2 Record load-displacement or load-time graphs (Figure 7). Data collection rate or number of points shall be able to record the peak load within a maximum 5 N force range.

4.3.2.3 Report the peak load for each sample (Figure 7).



Note: min = minimum.

Figure 5: Winding Wire Weld Sample Setup Requirement

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