SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS2695D

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Noncurrent 2008-10

Superseding AMS2695C

Connections, Electrical Solderless, Wire-Wrapped

RATIONALE

AMS2695D results from a five year review and update of this specification.

NONCURRENT NOTICE

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as October 2008. It is recommended, therefore, that this specification not be specified for new designs.

"NONCURRENT" refers to those specifications which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. "NONCURRENT" specifications are available from SAE upon request.

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1. SCOPE:

1.1 Purpose:

This specification covers electrical connections made with single, solid, round copper or copper alloy wire wrapped around copper alloy terminals without the use of solder.

1.2 Application:

This connection method has been used typically to provide mechanically and electrically stable electrical connections for electronic application.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2422	Plating, Gold, for Electronic and Electrical Applications
AMS 4701	Copper Wire, Oxygen-Free, 99.95 (Cu+Ag), Annealed

3. TECHNICAL REQUIREMENTS:

3.1 Materials and Equipment:

3.1.1 Wire:

3.1.1.1 The bare wire shall be a solid, round, copper or copper-alloy conductor with hardness sufficient to provide the proper degree of indenting of the wire and the terminal corner. Copper conductors shall conform to AMS 4701 or an acceptable equivalent.

3.1.1.2 The bare wire may be coated with a continuous and unbroken coating of tin, tin-lead alloy, silver, or gold, as specified. Minimum coating thickness shall be 0.00005 inch (1.27 µm) for all coatings with a maximum thickness of 0.0015 inch (38 µm) for tin-lead alloy coating.

3.1.1.3 The insulation bond strength to the conductor shall be sufficient to allow proper stripping of the wire with manual or automatic tools.

3.1.2 Terminal (Wrapost):

3.1.2.1 Terminals shall be made of beryllium copper, phosphor bronze, or other copper alloy as specified on the drawing. Hardness shall be adequate to prevent damage or deterioration during wire-wrapping and provide reasonable reuse capabilities.

3.1.2.2 Terminals shall have edges with a maximum radius of 0.003 inch (0.08 mm) with edge burrs not exceeding 0.0015 inch (38 µm) and shall be straight and parallel within 0.005 inch per inch (0.005 mm/mm). The tip shall terminate in a radius or bevel to facilitate insertion into the wrapping tool.

3.1.2.3 When specified, terminals may be gold plated in accordance with AMS 2422 to eliminate surface deterioration in corrosive environments.

3.1.3 Tools:

3.1.3.1 The wire wrap tool shall be a hand, air, or electrically powered tool capable of wrapping the wire under tension around a single terminal or two parallel terminal pins. New tools or tools that have been repaired, readjusted, or modified shall be adequately tested to demonstrate the capability of producing connections in accordance with this specification.

3.1.3.2 The unwrapping tool shall be a hand tool with a helical wedge top for the separation of wire from the terminal when the tool is threaded between the wire and terminal.

3.2 Procedure:

3.2.1 Description:

3.2.1.1 Solderless wire wrapped connections are made by wrapping a specified number of turns of wire, under tension, around a single-post or two-pin rectangular terminal having sharp corners. The sharp corners of the terminal (wrapost) produce high pressure points resulting in indentations of the wire or both the wire and terminal to provide electrical continuity and mechanical stability of the connections.

3.2.1.2 When specified, a modified solderless wrapped connection shall consist of not less than one-half turn of insulated wire in addition to the required number of uninsulated wire turns to provide improved vibration characteristics. To accomplish a half turn, the wire must be in contact with at least three corners of the terminal (See Figure 1).

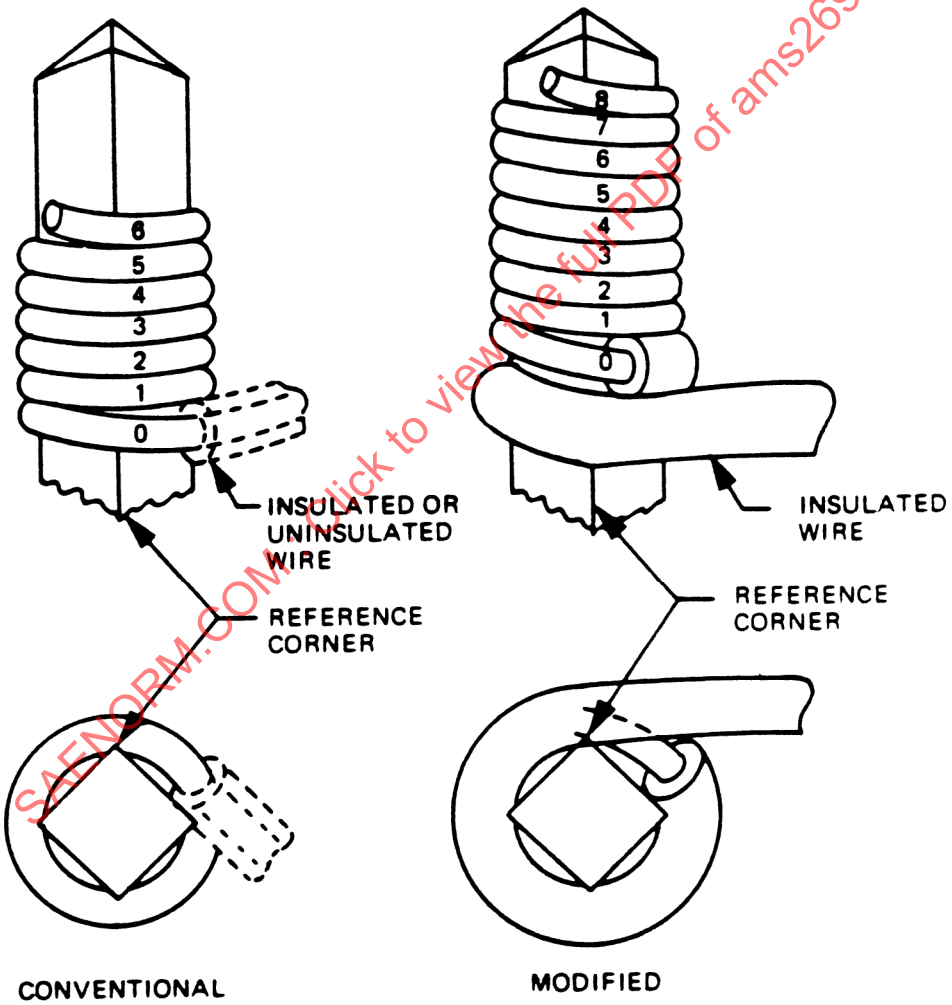

FIGURE 1

3.2.2 Process:

3.2.2.1 Solderless wire-wrapped connections shall be made with either hand or automatic wrapping tools as in 3.1.3.1 capable of wrapping connections which conform to all requirements of this specification. The sequence of operations for making wrapped connections shall be as follows (See Figure 2):

3.2.2.1.1 Insert the stripped wire into the feed slot (hand tools only).

3.2.2.1.2 Bend the bar wire, or insulated wire when a modified connection is specified, into the notch in the tool to anchor the wire (hand tools only).

3.2.2.1.3 Place the large hole of the tool over the terminal.

3.2.2.1.4 Rotate the tool spindle around the terminal.

3.2.2.1.5 Remove the tool from the terminal.

3.2.2.2 Prior to wrapping, the wire shall be positioned radially so that subsequent routing of the unwrapped portion does not tend to unwrap the connection.

3.3 Properties:

Wire-wrapped connections shall conform to the following requirements.

3.3.1 Wire Turns:

3.3.1.1 The minimum number of effective wire turns shall be as shown in Table 1.

TABLE 1 - Minimum Wire Turns

Wire Size AWG	Number of Turns minimum
30	8
28	8
26	6
24	5
22	5
20	4
18	4
16	3

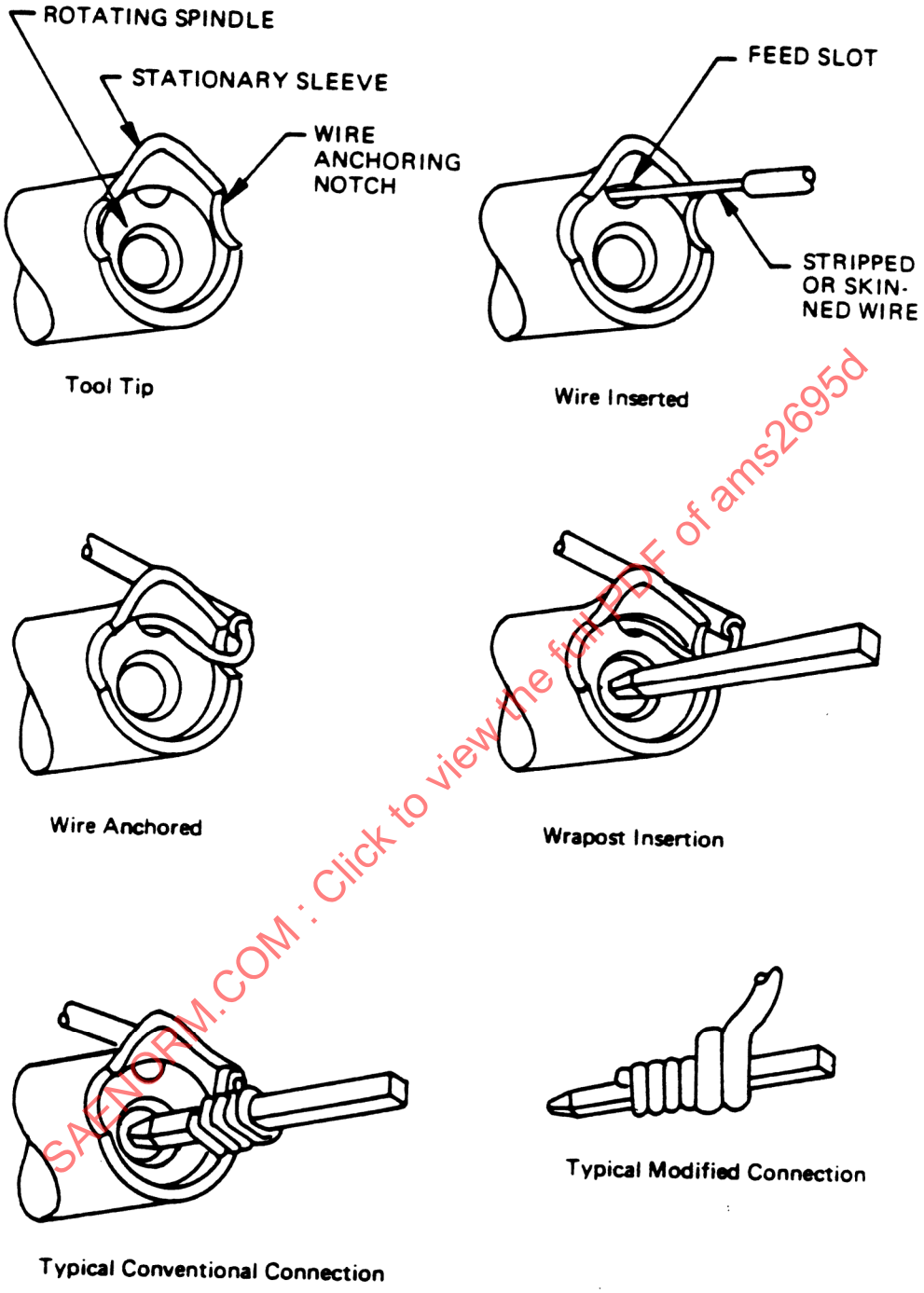

FIGURE 2

3.3.1.2 The wire helix shall be closely wound on the terminal with the turns not overlapping or breaking. The first turn of insulated wire in a modified connection may overlap the last turn of uninsulated wire in a connection below it on the same terminal. The maximum allowable space between the turns of wire, excluding the first and last, shall be 0.005 inch (0.13 mm).

3.3.1.3 The clipped and dressed end of the wire shall not extend more than 0.020 inch (0.51 mm) beyond the diameter of the connection.

3.3.2 Stripping Force:

3.3.2.1 The minimum stripping force necessary to first dislodge a wrapped connection when tested by using a stripping fixture as shown in Figure 3 shall be as shown in Table 2.

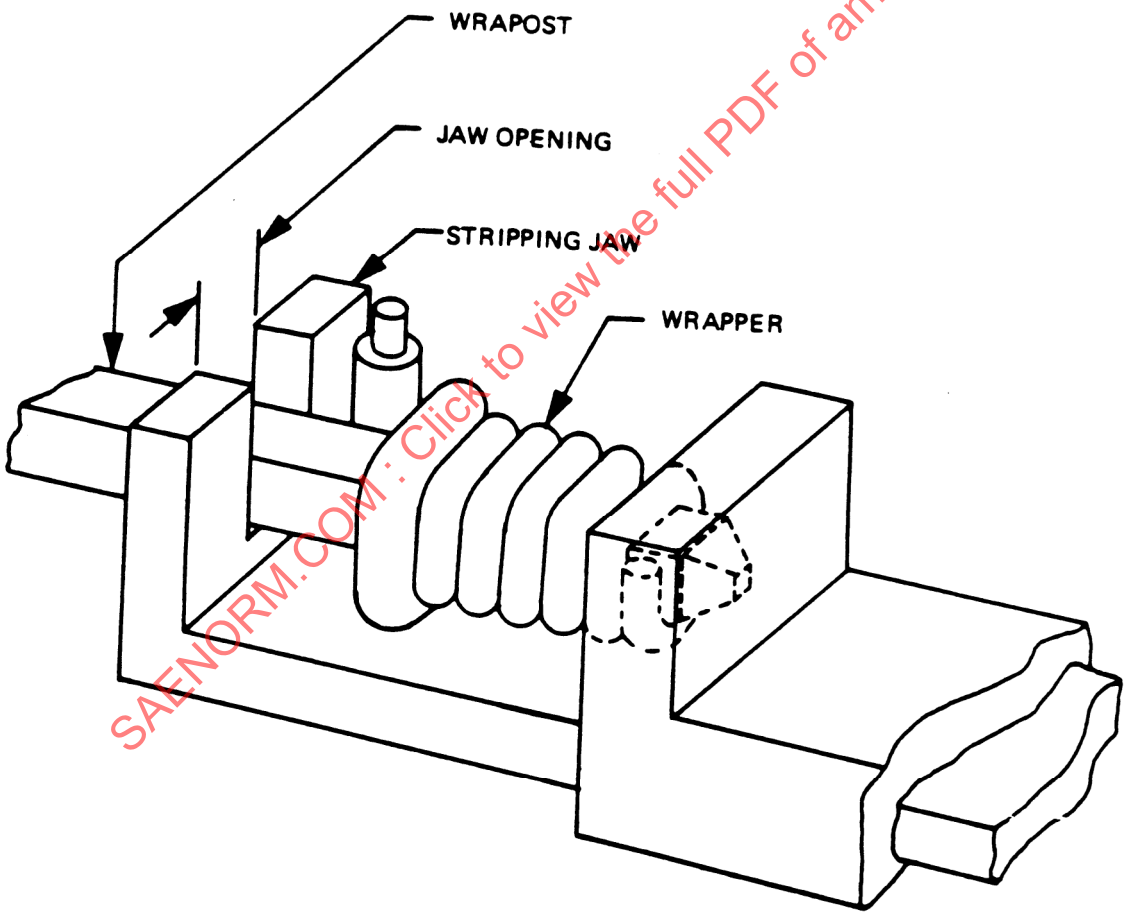

FIGURE 3 - Stripping Test Fixture

TABLE 2 - Stripping Force

Wire Size AWG	Stripping Force, minimum Pounds Force	Stripping Force, minimum Newtons
30	4	17.8
28	5	22.2
26	6	26.7
24	7	31.1
22	8	35.6
20	8	35.6
18	15	66.7
16	15	66.7

3.3.2.2 The stripping force shall be applied at a uniform rate not to exceed 1 inch (25 mm) per minute linear velocity. The stripping jaw shall engage at right angles to the axis of the terminal. Clearance between the terminal and the test fixture jaws shall not exceed 0.015 inch (0.38 mm).

3.3.2.3 The stripping force shall be measured with a gage to an accuracy of not less than 1% of the reading in the test range.

3.3.3 Unwrap:

3.3.3.1 The wire shall withstand being unwrapped from the terminal and straightened without breaking or cracking.

3.3.3.2 Visual examination of the unwrapped wire shall show a uniform indentation in the wire created by the terminal edges.

3.3.4 Gas Tight:

3.3.4.1 The total gas tight area between the terminal and the wire of a wrapped connection shall be at least equal to the area of the cross-section of the wrapping wire.

3.3.4.2 To determine the gas tight area, the sample connection, if the terminal is plated, shall be suspended in a test tube containing approximately 1 to 2 mL of aqua regia. The sample connection shall remain suspended over the solution for at least five minutes until the fumes have attacked the plating.

3.3.4.3 Sample connections treated as in 3.3.4.2 or which contain unplated terminals shall be suspended in a test tube containing approximately 1 mL of ammonium sulfide solution and shall remain suspended over the solution until the terminal turns black. The sample shall then be removed, rinsed, dried, and unwrapped so as not to scratch the terminal. The gas tight areas shall remain bright, after rinsing, in sharp contrast with the exposed blackened areas of the terminal.