SAE Aerospace
An SAE International Group

AEROSPACE RECOMMENDED PRACTICE

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Guidelines for Wire Identification Marking Using the Hot Stamp Process

FOREWORD

This SAE Aerospace Recommended Practice (ARP) is intended to serve as a guide toward standard practice and is subject to change to keep pace with experience and technical advances.

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1. SCOPE:

1.1 These guidelines have been written to provide process information regarding the hot stamp method of marking wire identification directly on aerospace wires and cables.

1.2 This document is not intended to encourage the use of hot stamp marking or to endorse the related process. This method of marking wire identification may be prohibited on any aerospace vehicle wiring that is required to conform to the provisions of MIL-W-5088L or AS50881. Methods which do not deform wire or cable insulation, such as Ink Jet, Dot Matrix or UV Laser marking are encouraged as a means of minimizing the possibility of insulation damage, particularly on insulation constructions of less than 0.010 in wall thickness.

1.3 In recognition that the present use of hot stamp wire marking is widespread and may continue for an extended period, the guidelines provided in this document are intended to provide process control information necessary to minimize the possibility of insulation damage.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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

AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid For Aircraft
AS50881	Wiring, Aerospace Vehicle
AS4373	Test Methods For Insulated Electric Wire

2.1.2 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-W-5088L	Wiring, Aerospace Vehicle
TT-I-735	Isopropyl Alcohol
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
MIL-PRF-5624	Turbine Fuel, Aviation, Grade JP-4, JP-5, and JP-5/JP-8 ST
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-T-83133	Turbine Fuel, Aviation, Kerosene Types, NATO F-34 (JP-8) and NATO F-35

2.2 Definitions:

HOT STAMP MARKING: Hot stamp marking uses a heated typeface to transfer pigment from a ribbon or foil to the surfaces of wires or cables.

PRESSURE: In the context of this specification, pressure shall be interpreted as the pneumatic air pressure required to provide suitable force to the printhead to obtain acceptable markings.

DWELL TIME: The specific length of time that is required to mark each individual character on a wire or cable.

TEMPERATURE: In the context of this specification, temperature shall be interpreted as the machine setting for the heat applied during the marking process.

2.3 Symbols and Abbreviations:

UV Ultraviolet
psi Pounds per square inch

3. REQUIREMENTS:

3.1 Materials:

3.1.1 Foils: A variety of types of marking foils are available from various manufacturers. The type of ribbon or foil to be used for a specific application is generally selected to provide compatibility with the manufacturer's marking equipment and the wire or cable's insulation material and construction. Resistance to abrasion and resistance to aircraft fluids can also vary with the type of foil used. The specific color of identification marking also affects the selection of foil types. Consult your wire marking equipment and foil manufacturers for product recommendations for specific applications.

CAUTION: The foils should be stored in accordance with the foil manufacturer's recommendations and not used after the stated shelf life has expired.

3.2 Equipment:

3.2.1 Marking Machines: A variety of wire marking machines have been developed and are in use at various facilities. Each has specific attributes. These machines are generally adjustable in terms of marking temperature, pressure and dwell time.

CAUTION: Typewheels, marking type and fixtures must be selected on the basis of the outside diameter, not gauge, of the wire to be printed. The proper selection and sizing of these items is critical to achieving maximum efficiency of the printer with a minimum of insulation penetration. It is not recommended that the Hot stamp process be used on wire with outside diameters of less than 0.035 in.

3.2.2 Adjustments: Consult your wire marking equipment manufacturer for specific adjustments of the recommended temperature, pressure and dwell time settings for each type of wire insulation construction to be marked. It may be advisable to send examples of wire to be marked to the equipment manufacturer as a means of ensuring that appropriate machine settings are identified. This can be particularly helpful when new wire constructions are encountered. Wires of the same part number from different manufacturers will vary in their markability. Settings for temperature, pressure and dwell time may need to be frequently adjusted in order to maintain acceptable wire marking contrast and durability. With some insulation materials, adjustments may be required for each new reel of wire to be marked, even if the wire is of the same part number and manufacturer as the previously marked reel. The pressure necessary to obtain suitable print results is determined by the substrate being printed, the length of text to be applied, and the condition of the equipment being used. In areas of high air demand, an air accumulator may be required in order to maintain print head pressure and assure consistent print quality.

3.2.3 Typewheels: The selection of appropriate typewheels is dependent on character height, width and radius, the type of marking equipment used, the durometer or resiliency of the wire insulation and the outside diameter of the wire to be marked.

CAUTION: To avoid insulation damage, it is recommended that curved face type be used on smaller diameter wires. Consult the specific manufacturer's instructions for recommended typewheels.

3.3 Maintenance:

3.3.1 All printing equipment shall be kept clean. Dereeling apparatus for transporting wire between its reel or container and the marking equipment shall be inspected frequently to ensure that it is smooth running and free of surface irregularities, burrs, etc., which might damage wire or cable insulation. Regular maintenance of pneumatic systems is required so as to assure that a clean, dry air source providing 100 psi regulatable air is provided.

CAUTION: Typewheels and wire fixtures should be inspected regularly and replaced on an as-needed basis to allow the best results when printing.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Quality Control Inspection:

4.1.1 Frequency of Inspection: Tests and examinations of 4.1.2 and 4.1.3 shall be performed on an ongoing basis at such times and with such quantity of samples as specified by the wire marking processor's quality assurance activity. As a minimum, these examinations should be performed whenever a different reel of wire or cable is put on the machine, whenever adjustments have been made to pressure, temperature, or dwell time, and when any change to equipment or marking foils has taken place.

4.1.2 Legibility: All characters must be legible and completely understood from a distance of 14 in without additional magnification when placed on a flat work surface using a light source that provides an illumination of 30 ft candles. Characters are considered to be completely understood if a composite of the identification marking can easily be deciphered from the characters visible in adjacent marks. Identification marks that exhibit bleeding, are smudged, faint, or incomplete, are considered unacceptable.

4.1.3 Mandrel Wrap Examination: A specimen of marked wire that is at least 12 in long shall be subjected to 5 cycles of bending at room temperature. One complete cycle shall consist of tightly winding the wire (5 loops minimum) around a mandrel, specified in Table 1, unwinding and reverse winding the wire. At least 1 marked pattern shall be on the outside of the wire during the wrapping. After the fifth cycle, there shall be no visible evidence of cracking, piercing, wrinkling or splitting of the insulation when subjected to magnification between 6 and 10 times in an ambient light of 30 ft candles. Specimens used for this test should not be used for installation on an aircraft.

TABLE 1 - Bend Test Mandrel Diameters

Wire Size	Mandrel Diameter (±0.03 in)
26	0.125
24	0.125
22	0.250
20	0.250
18	0.250
16	0.375
14	0.500
12	0.500
10 and larger	10X wire outside diameter

4.1.4 Acceptance Tests: 100% of wires and cables marked with the hot stamp method shall be subjected to the following dielectric test. Tests should be conducted using an in-line spark tester or a wet dielectric test (see 4.2.6). Leakage current shall not exceed 20 mA when subjected to a dielectric withstanding voltage at the specified voltage at 60 Hz rms, for a minimum of 20 s. Voltage shall be ramped up and down at a rate of 500 V/s. For insulated wires, a 2500 V potential shall be applied between the conductor and the surface of the insulation. For single conductor shielded and jacketed cable, a 1000 V potential shall be applied between the shield and the surface of the outer jacket insulation. This procedure is not applicable to coaxial and other RF cables, and shielded MIL-C-85485 Filter Line Cable, which has a semi-conductive shield jacket. Any sign of dielectric failure, such as arc-over, flashover, leakage current in excess of 20 mA or a steady increase in leakage current shall be cause for rejection.

CAUTION: It has been demonstrated that bead chain spark testers may not always detect all dielectric failures.