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Superseded by AMS 2658

**Determination of Aluminum Alloy Tempers Through
Electrical Conductivity Measurement (Eddy Current)**

RATIONALE

Stress corrosion cracking of 2024 aluminum fitting nuts in the early 1960s necessitated development of Eddy Current and Hardness requirements at Boeing. This had to be used for inspection of heat treatment of hydraulic fittings and necessitated release of ARP891 to establish inspection requirements for Military and Industry Standard fittings. The ARP891 was released in 1967.

In 1980 the AMS-D committee issued the AMS 2658 which covered additional aluminum alloys and temper conditions, more than used for hydraulic fittings. This resulted in duplication of Eddy Current and Hardness requirements in two different SAE standards.

Following discussion of this between SAE G-3 and AMS-D and some minor changes to AMS 2658 the SAE G-3 agreed to cancel the ARP891 and to replace it by AMS 2658.

CANCELLATION NOTICE

This document has been declared "CANCELLED" as of July 2006. By this action, this document will remain listed in the Numerical Section of the Aerospace Standards Index.

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1. SCOPE:

This recommended practice establishes a procedure for checking the tempers of aluminum alloys through eddy current conductivity measurements and defines criteria for acceptance or rejection.

2. APPLICABLE SPECIFICATIONS AND STANDARDS:

Military:

MIL-F-5509	Fittings, Flared Tube, Fluid Connection
MIL-F-18280	Fittings, Flareless Tube, Fluid Connection

Other:

ASTM B193-57 Standard Method of Test for Resistivity of Electrical Conductor Materials

3. REQUIREMENTS:

3.1 Environment:

The tests shall be conducted at room temperature, i.e. 70 ± 10 F. No special arrangements are required to control the humidity in the test area.

3.2 Standards and Test Parts:

The conductivity standard coupons shall be calibrated every two years by comparing their individual electrical conductivities with appropriate master standards. Information for calibration with master standards or regarding procurement of secondary and tertiary standards may be obtained by contacting the Technical Division of SAE. An alternate method is to fabricate master standard bars per the Standard Method of Test for Resistivity of Electrical Conductor Materials, ASTM B193-57.

The test can be conducted on as-forged or rough machined surfaces not exceeding a roughness of 200 RHR.

3.2 (Continued):

Surfaces with identification stamps or similar irregularities should be avoided. Such irregular or rough surfaces should be checked by moving the probe slowly along the surface until an area with maximum meter deflection is found. The test parts shall have a minimum thickness as shown in Table II.

3.3 Area of Test Parts:

For direct (uncompensated) readings the part to be inspected must have a flat area at least as large as shown in Table II. Conductivity measurements on parts with cylindrical surfaces or flat areas smaller than the probe face require correction per 4.1.16.

3.4 Electrical Conductivity:

Acceptable electrical conductivity values and corresponding indicated hardness shall be as specified in Table I.

4. RECOMMENDED PROCEDURES:

4.1 Procedure for Magnaflux ED 500 Instrument with Flex-ECII Probe¹:

4.1.1 Attach the probe to the instrument.

4.1.2 Switch the instrument on, leave the sensitivity knob at a low setting.

4.1.3 Rotate the balance control so that the meter reads between 100 and 200 μ A.

4.1.4 Allow 20 minutes for warm-up.

4.1.5 Set the frequency control to 5 and rotate the lift-off knob clockwise to stop.

4.1.6 Place the probe on standard #1 and note the direction of meter deflection.

NOTE: The standards #1 (32% IACS) and #2 (45% IACS) referred to in this procedure show readings of 210 and 440 μ A. The standards #1 and #2 are conductivity coupons per paragraph 3.2. They were selected to calibrate for a conductivity range to check 2024 T6 temper. If other standards are being used, their values must be substituted for 210 and 440.

4.1.7 Reduce the frequency setting to the next lower number (in this case from 5 to 4) and repeat step 4.1.6. Keep the needle on the scale by adjusting the balance control.

4.1.8 Repeat 4.1.6 and 4.1.7 until the direction of meter deflection reverses.

1. Or other test equipment which meets the requirements set forth in paragraph 5.2.

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- 4.1.9 At this frequency rotate the lift-off control connector clockwise to stop and repeat step 4.1.6. The meter should now deflect in the opposite direction from the deflection obtained before rotating the lift-off control. If not, move the frequency control one step back.

TABLE I - The Values Listed are % I.A.C.S. * and Corresponding Indicated Rockwell Hardness Bar Stock and Forgings

TEMPER ALLOY	0 **	T351	T4	T851	T6	T73
2014	<u>48.6 - 50.7%</u> H 95 Max		<u>31.5 - 34.8%</u> B 65 - 80		<u>35.2 - 39.7%</u> B 78 Min	
2024	<u>46.8 - 48.5%</u> H 90 Max	<u>28.8 - 31%</u> E 95 Min		38 - 42%	<u>34 - 40%</u> B 69 Min	
6061	<u>42.3 - 48.5%</u> H 75 Max		<u>37.6 - 40.5%</u> E 70 Min		<u>40 - 44.8%</u> E 85 Min	
7075	<u>44.5 - 47.8%</u> H 95 Max				<u>31.4 - 34.8%</u> B 82 Min	<u>38 - 42%</u> B 79 Min

Note: Sheet and Plate 2014 T4 32.5 - 34%
2014 T6 37 - 39%

* I. A. C. S. - International Annealed Copper Standard

**0 - Indicates Annealed Condition

Note: The hardness values in this table are not intended as an option to or replacement for conventional Brinell hardness and tensile tests. They apply to hardness testing of finished or semi-finished parts where Brinell or tensile testing is not feasible.

- 4.1.10 Rotate the lift-off control gradually until the meter reads the same (within 20 μ A or less) with the probe firmly against standard #1 and for the probe 5 in. or higher over the standard.

NOTE: It is normal that the meter needle deflects when the probe is put on and removed from the standard.

- 4.1.11 Increase the sensitivity slightly and repeat step 4.1.10. This is to be repeated until the sensitivity dial reaches the stop in the clockwise direction. If necessary, the balance has to be corrected to keep the meter needle on scale.

NOTE: The lift-off control is the fine adjustment of the operating frequency, while the frequency control is the coarse adjustment. During step 4.1.11 the lift-off control may reach the stop in clockwise direction without the sensitivity reaching maximum in the clockwise direction. If this happens, the frequency control has to be rotated to the next lower number and the lift-off control rotated counter-clockwise to stop. Then step 4.1.11 can be completed to the requirement above.

- 4.1.12 Complete balancing for lift-off as follows: Place a nonconductive shim on the standard, then place the probe on the shim.