

INCH-POUND

MIL-DTL-45210B(MR)
 29 March 1999
 SUPERSEDING
 MIL-W-45210A(MR)
 15 January 1965

DETAIL SPECIFICATION

WELDING, RESISTANCE, SPOT: WELDABLE ALUMINUM ALLOYS

This Specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers resistance spot welding procedures for weldable aluminum alloys.

1.2 Materials. The materials to be welded under this specification include sheet, bar, and shapes of non heat-treatable alloys and the 60XX series of heat-treatable alloys.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Non-Government Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN WELDING SOCIETY (AWS)

AWS-4 Metals and Their Weldability Welding Handbook, Volume 4

(Copies should be obtained from the American Welding Society, 550 NW LeJeune Road, Miami, FL 33126.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the 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.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, US Army Research Laboratory, Weapons and Materials Research Directorate, ATTN: AMSRL-WM-M, Aberdeen Proving Ground, MD 21005-5069 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order (see 6.2) and before production has commenced, samples of the specified item shall be made available to the contracting officer or his authorized representative for approval in accordance with 4.2 - 4.5. The approval of the first article samples authorizes the commencement of production but does not relieve the supplier of responsibility for compliance with all applicable provisions of this specification. The first article samples and test forgings shall be manufactured by the process proposed for use on production.

3.2 Recorded welding procedures. Unless otherwise specified in the contract or order, the contractor, prior to production fabrication of any weldment, shall establish or have the manufacturer establish and record the cleaning and welding procedures to cover all welding to be performed under this specification. A change in any of the factors listed in table I shall require revision of the recorded test procedures.

3.3 Welding factors. The factors to be included in the welding procedure shall be as shown in table I.

3.4 Surface preparation. The material surfaces shall be cleaned by a suitable method to remove dirt, oils, and deleterious oxides in the weld area. All required coatings or sealants shall be included as a part of the recorded welding procedure and shall not be considered foreign matter.

3.5 Welding equipment requirements.

3.5.1 Welding machine. The welding machine shall consist of a suitable source of electrical energy, suitable electrodes, means of adequately cooling the electrodes, and a means of reliably controlling and indicating the magnitude of the current, the welding force, and the time of current flow to fulfill the requirements specified herein. The force and current controls shall operate so that there is an absence of current flow (i.e. zero current) prior to applying the welding force at the electrodes. Also, the current shall be cut off before the force is removed.

TABLE I. Factors in the recorded welding procedure and changes requiring quality control test.

Factors to be included in recorded welding procedure	Procedural changes requiring revised procedures and test
1. Metal alloy composition	When a change in alloy or alloy composition outside the aluminum producer's declared chemical range is made to either of the metals that are to be joined.
2. Thickness range of metal	When the thickness range is changed.
3. Weld time range	When weld cycle range is changed.
4. Metal cleaning	When method of cleaning is changed from the recorded methods in the welding procedure.
5. Welding Current	When current setting changes outside the declared range are made.
6. Type of current	When a change in type or polarity is made.
7. Electrode force range	When changes outside the declared range are made.

3.5.2 Weld timer. The weld timer for single impulse welding shall be used to control the following timing functions: squeeze time, weld time, and hold time.

3.6 Shear load. For information (design) purposes, typical minimum ultimate shear load per spot weld shall be as shown in table II.

TABLE II. Typical minimum ultimate shear load per spot weld

Thickness (inch) thinner part *	Typical minimum ultimate shear load (pound-force) per spot weld (for design purposes)
0.10	50
0.020	135
0.032	235
0.040	310
0.050	430
0.063	610
0.080	855
0.090	1000
0.100	1170
0.112	1340
0.125	1625

* For intermediate thickness, direct interpolation may be used.

4. VERIFICATION

4.1 Certification of welding equipment and recorded welding procedures. Prior to welding the first production assembly of each specific design, the contractor or the manufacturer, or both shall weld and test the welds in one assembly or specimen under Government surveillance. The assembly or specimen shall be welded in accordance with the recorded welding procedure. This certification test shall be carried out on each welding machine that will be used for the production of weldments for each specific design.

4.1.1 Certification testing. The specific welding unit used must demonstrate that it has the electrical and mechanical capacity for producing the weldment that is being tested. Any new design and/or material used in a part must be tested to ensure that the welding unit demonstrates an acceptable electrical and mechanical capacity for producing the new weldment. These tests shall be carried out on all welding machines used for production of weldments on each new design/material.

4.2 Welding specimens. When a specimen is used, the material thickness, composition range, weld edge distance, spot spacing, and the general weld area contour and metal fit shall be the same as the production part. When the application of weld primer or sealer is required by the recorded welding procedure for production assemblies, the specimens shall have these materials applied before welding in the same manner as applied to the production parts. When a substantial amount of magnetic material such as the assembly fixtures, locators, etc., are inserted in the throat of the welding machine during the welding of a production part, this condition shall be closely duplicated for the specimen.

4.3 Visual examination of welded assembly or specimen. All welds shall be subject to visual examination. The outer surface of all welds shall be smooth and free of cracks, tip pickup, pits, metal expulsion, and other defects which indicate that the welds were made with contaminated electrodes, or with improperly prepared surfaces.

4.4 Tolerances. Tolerances on spot weld spacing and edge distance shall be in accordance with applicable drawings.

4.5 Peel testing. The welded assembly or specimen shall be subjected to the peel test. The peel test shall be conducted by separating the welded components by driving a chisel between them in an unwelded area or by peeling one sheet back against the weld until failure occurs around the periphery of the weld or until the part fails. Failure of the base metal outside the weld area shall be considered evidence that the welds are satisfactory. The minimum average button diameter as measured in two perpendicular directions at the faying surface shall conform to table III.

TABLE III. Button diameter requirements.

Thickness of thinner part, inch*	Minimum bottom diameter, inch*
0.010	0.08
0.020	0.11
0.032	0.14
0.040	0.16
0.050	0.18
0.063	0.20
0.080	0.23
0.090	0.24
0.100	0.26
0.112	0.27
0.125	0.28

* For intermediate thickness, direct interpolation may be used.

4.6 Reporting of results. The manufacturer shall record the results of this certification and shall submit copies of the results together with the recorded welding procedure through the contractor and contracting officer for review by the procuring activity.

4.7 Rejection. Failure of the welded assembly or specimens to meet the requirements for visual examination (see 4.3) or the peel test (see 4.5) shall result in the rejection of the recorded welding procedure.

4.8 Quality control. The contractor shall establish or have the manufacturer establish and use a systematic quality control procedure.

4.9 Sampling. Periodically during a production run, a welded assembly or specimen shall be tested as outlined in paragraphs 4.3, 4.4, and 4.5. The frequency of this testing shall be specified by the contracting officer after reviewing the production rates and types of assemblies. The contractor or the manufacturer, or both, shall keep a record of these tests indicating date, time, machine identification, machine settings, and results.

4.10 Rejected Welds. If unsatisfactory welds are found during a production quality control inspection, the production run shall be stopped and necessary corrections made to the equipment or welding procedure. After correction, a weldment or comparable specimen shall be welded and shall conform to the inspection requirements in 4.3, 4.4, and 4.5 before resuming production. The series of weldments in the period subsequent to the last acceptance quality control inspection shall be rejected or may be rewelded in accordance with 4.11.

4.11 Rewelding of rejected weldments. A weldment from each rejected series may be rewelded in accordance with the corrected procedure. The repaired weldment shall be tested for compliance with 4.3, 4.4, and 4.5. If the weldment passes the inspection requirements, the remainder of the rejected series of weldments may be rewelded in accordance with the corrected procedure. A sample shall not be used for determining weld quality of repair welding.

5.0 PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Resistance welding under this specification is military unique. It is used in spot welding of weldable aluminum alloys used for stowage boxes, vehicle fenders, air ducts, van skins, etc.

6.2 Ordering Data. Purchasers should exercise any desired options offered herein and acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type of material (see 1.2).
- (c) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).
- (d) When first article is required (see 3.1).
- (e) Mechanical properties, if different from table II (see 3.6)
- (f) Destination of test samples (see 4.5).
- (g) Packaging requirements (see 5.1).

6.3 Definitions.

6.3.1 Contractor. The term "contractor" is defined as the organization having a direct contract with the procuring activity.

6.3.2 Contracting officer. The term "contracting officer" means the person executing a contract on behalf of the Government and any other officer.

6.3.3 Manufacturer. The term "manufacturer" is defined as the organization actually performing the operations covered by this specification.

6.3.4 Procuring activity. The term "procuring activity" refers to the activity of the Government which actually initiates the request for procurement and maintains the records of the procurement.

6.4 Reference information. The Welding Handbook Volume 4, Metals and Their Weldability contains information pertaining to minimum spot weld spacing.

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6.5 Subject term (key word) listing.

certification
non heat-treatable alloys
peel test
60XX heat-treatable alloys
shear load
welding machine
weldments
weld timer

CONCLUDING MATERIAL

Custodian:

Army - MR

Preparing activity:

Army - MR

Project No. THJM-A405

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL**INSTRUCTIONS**

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter must be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-DTL-45210B(MR)	2. DOCUMENT DATE (YYMMDD) 990329
3. DOCUMENT TITLE WELDING, RESISTANCE, SPOT: WELDABLE ALUMINUM ALLOYS		
4. NATURE OF CHANGE (<i>Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed</i>)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) Commercial DSN (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY		
a. NAME US Army Research Laboratory Weapons & Materials Research Directorate	b. TELEPHONE (Including Area Code) (1) Commercial (410) 306-0725 (2) DSN 458-0725	
C. ADDRESS (Include Zip Code) ARL/WMRD ATTN: AMSRL-WM-M Aberdeen Proving Ground, MD 21005-5069	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340	