MIL-W-45205B(MR)
6 April 1982
SUPERSEDING
MIL-W-45205A(MR)
28 October 1966

MILITARY SPECIFICATION

WELDING, GAS METAL-ARC AND GAS TUNGSTEN-ARC, ALUMINUM ALLOYS, READILY WELDABLE FOR STRUCTURES, EXCLUDING ARMOR

This specification is approved for use by Army Materials & Mechanics Research Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the welding of aluminum alloys for structural applications other than armor by the gas metal-arc or gas tungsten-arc welding process.

1.2 Classification. Welding performed under this specification shall be classified in accordance with the nature of the service requirements of the weldment as follows:

Class A - Weldments whose failure could result in injury to personnel or in an assigned mission not being fulfilled (see 6.2).

Class B - Weldments whose failure would not result in injury to personnel or in unfulfillment of an assigned mission (see 6.2).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

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 Materials and Mechanics Research Center, ATTN: DRXMR-SSS, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

SPECIFICATIONS

FEDERAL

QQ-R-566 - Rods, and Electrodes; Welding, Aluminum and Aluminum Alloys

MILITARY

DoD-D-1000 - Drawings Engineering and Associated Lists
MIL-E-16053 - Electrodes, Welding, Bare Aluminum Alloys

STANDARDS

FEDERAL

FED-STD-100 - Engineering Drawing Practices
FED. Test Method STD. No. 151 - Metals: Test Methods

MILITARY

MIL-STD-22 - Welded Joint Designs
MIL-STD-453 - Inspection, Radiographic

(Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN WELDING SOCIETY

ANSI/AWS A2.4 - Symbols for Welding and Nondestrutive Testing, including Brazing
ANSI/AWS A3.0 - Welding Terms and Definitions

(Application for copies should be addressed to American Welding Society, 2501 Northwest 7th Street, Miami, Florida 33125.)

(Technical society and technical associations specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Materials.

3.1.1 Base materials. The base materials considered by this specification shall be aluminum alloys which are weldable by the processes stipulated in 1.1.

3.1.2 Filler metal. Unless otherwise specified (see 6.2), the aluminum welding rods shall conform to QQ-R-566; bare electrodes shall conform to MIL-E-16053. When the filler metal is not specified and a suitable type is not available in the applicable specification, a commercial type shall be selected which is capable of depositing a weld which will either meet or exceed the minimum mechanical requirements of the base material as specified on the drawings, contract or order.

3.1.3 Shielding gas. The shielding gas used shall be of uniform composition and quality. Impurities, particularly moisture as shown by dew point determination, shall be within maximum guaranteed by the contractor. The shielding gas used shall be suitable for the welding of aluminum.

3.1.4 Joint design. Joint design shall be in accordance with MIL-STD-22.

3.2 Preproduction requirements.

3.2.1 Preparation of welding procedures and drawings. Unless otherwise specified (see 6.2) prior to the production fabrication of any weldment, the contractor or manufacturer shall prepare in accordance with DoD-STD-100 and DoD-D-1000 an isometric, perspective, or other suitable drawing of the structure showing the location of each joint and shall establish a recorded joint welding procedure(s) to cover all welding (including a general outline for the repair of base metal and repair of welded joints) to be performed under this specification (see 6.2.2).

3.2.1.1 Submittal of procedures and drawings for certification. For class A weldments, the recorded joint welding procedure and drawings shall be submitted in triplicate to the contracting officer who will forward two copies to the procuring activity for certification. For Class B weldments, the recorded joint welding procedure shall be retained by the contractor or manufacturer and made available to the Government upon request. Prior to repair of base metal and repair of welded joints for both Class A and B weldments, the recorded joint welding procedure, drawings, and a general outline for the repair of base metal and repair of welded joints shall be submitted in triplicate to the contracting officer who will forward two copies to the procuring activity for certification.

3.2.1.2 Factors. Factors to be included in the recorded joint welding procedure are listed in table I along with the requirements for recertification.

3.2.1.3 Recertification of welding procedure. When changes are made in any of the factors as indicated in table I, the recorded joint welding procedure shall be revised, and, if class A, shall be resubmitted through the contracting officer for review. Class B weldments need only be recertified when the joint geometry is changed.

TABLE I. Factors required in the joint welding procedure and the changes in the factors wherein the welding procedure must be recertified.

Factors required	The recorded joint welding procedure for class A weldments shall be re-certified when:
1. Alloy of base material	A change in alloy outside the aluminum producer's declared chemical range is made, unless a specific waiver is granted by the contracting officer.
2. Thickness of the base material	The basis thickness plus tolerance is changed.
3. Alloy of filler metal	A change in the alloy of the filler metal is made or when a change in brand of the same composition of filler metal is made except when the new brand is qualified under MIL-E-16053.
4. Filler metal sizes for all passes.	The filler metal diameter is changed.
5. Position of welding	Change in welding position.
6. Welding process (see 1.1) and operation (manual, semi-automatic and automatic)	There is a change from one process or operation to another.
7. Shielding gas composition	A change is made in the composition of the gas involving one or more of the following: (1) A change from one inert-gas to another. (2) When using mixed inert-gas shielding, a change in excess of plus or minus 30 percent of the minor gas constituent. (3) When active gases or other additives are combined with the inert-gas.
8. Shielding gas flow	A change of plus or minus 25 percent is made in the rate of gas flow for each nozzle size shown in each welding procedure.
9. Joint design	The originally established geometry or basic dimensions plus tolerances are changed.

TABLE I. Factors required in the joint welding procedure and the changes in the factors wherein the welding procedure must be recertified. (cont'd)

Factors required		The recorded joint welding procedure for class A weldments shall be re-certified when:
10.	Number and sequence of passes	Number, sequence, or both are changed.
11.	Welding current and arc-voltage range for all passes	Outside the limits established in recorded joint welding procedure.
12.	Type of current, A.C. or D.C. and polarity if D.C is used.	A change in type of current, and in the case of D.C., the type polarity.
13.	Method of joint edge preparation	A change is made from mechanical to thermal, a combination of mechanical and thermal to mechanical or thermal; or vice versa.
14.	Method of preparing root joint before welding second side.	Method of preparation is changed.
15.	Backing or spacer strip if used.	Backing or spacer strip is added or removed; or basic type of material of backing or spacer strip is changed.
16.	Starting, preheat and interpass temperature ranges.	Range is changed.
17.	Method of preweld and interpass cleaning	Method of cleaning is changed.
18.	Postheating	Any change from the approved heat treatment is made.
19.	Type and diameter of tungsten electrode	Any change in type and diameter of tungsten electrode.

3.2.1.4 Procedure for repair welding. The welding procedure for the repair of welded joints (see 3.2.1) shall include the applicable factors listed under table I and in addition shall include the following:

(a) Method to be used in (chipping or other) for removing defects.
(b) Method of inspection used to insure removal of defects.
(c) Contour of cavity prior to welding, such as minimum root dimensions and included angle.

3.2.1.5 Workmanlike specimens. When required (see 6.2) prior to the production fabrication of any welded joints, the contractor shall prepare workmanlike specimens of all welded joints representing the acceptable weld quality to be used in production. These specimens shall also represent the minimum acceptable cleaning procedure. These specimens shall be prepared using the welding procedures to be used in production and may be either an actual part or sample simulating all of the proposed welds. Specimens prepared to represent multiple pass welds shall be made in such a manner as to have at least two inches of each layer of weld metal exposed. Visual examination for Class A workmanlike specimens (see 4.2) shall be free of the following defects:

a. Undercut
b. Overlap
c. Surface cavities
d. Surface cracks in weld metal, or in heat-affected zone of base metal.
e. Lack of weld penetration

Visual examination for Class B workmanlike specimens (see 4.2) shall be free of surface cracks in weld metal, or in heat-affected zone of base metal and free from lack of weld penetration. Permissible undercut shall not exceed 10 percent plate thickness, or 1/16 inch, whichever is lesser. Overlap will be permitted not to exceed 2T in any 6T length. Fine scattered (average pore diameter equal to or less than 0.030 inches) porosity exceeding 13 pores in any one square inch of weld face shall be rejected. Not more than two pores may exceed 0.030 inches in diameter; coarse scattered (average diameter greater than 0.030 inches) porosity exceeding 2 pores in any one square inch of weld face shall be rejected. No single pore may exceed 0.060 inches in diameter, linear surface porosity in excess of 0.500 inches or in excess of 25 percent of total length, whichever is less, shall be rejected.

All workmanlike specimens shall be approved by the procuring agency prior to engaging in production welding.

3.2.1.6 Mechanical test specimens. When specified (see 6.2), the contractor shall prepare a welded test specimen of the specified type for mechanical testing (see 4.3) to determine the suitability of the joint welding procedure to be used in production.

3.2.2 Position drawings for radiographic inspection. When radiography is specified on the drawings, in the contract or order, a position drawing or drawings shall be prepared in accordance with DoD-STD-100 and DoD-D-1000 (see 6.2.2) for each weldment by the design agency employing symbols in accordance with AWS A2.4 and using welding terms and definitions in accordance with AWS A3.0. The position drawings shall contain the following information, as applicable:

(a) Location of joints in weldment
(b) Joint type (welding symbols may be used as shown in AWS, A2.4)
(c) Thickness of plate
(d) Location of films
(e) Position of films
(f) Direction of radiation
(g) Soundness standard for each joint
(h) Film type
(i) Kilovoltage
(j) Focal distance
(k) Penetrameter used

This information shall be submitted to the contracting officer for approval.

3.2.3 Qualification of welder or welding operator. The qualification of the welder or welding operator will not be required by the Government contracting agency. It is the responsibility of the contractor, however, to determine the extent of welder training needed to produce items in accordance with the requirements of this specification.

3.3 Production requirements.

3.3.1 Fabrication. Fabrication of all weldments shall be in accordance with the contractor's certified recorded joint welding procedure.

3.3.2 Soundness. Unless otherwise specified (see 6.2), soundness as determined by radiographic or macroscopic inspection will not be required (see 3.2.2 and 3.4).

3.4 Workmanship. The appearance of weldments produced shall be equal to or better than that shown by the appropriate workmanlike specimen (see 3.2.1.5).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Visual examination. All class A weldments shall be visually examined to determine compliance with this specification. The number of Class B weldments shall be visually examined for compliance with this specification at the frequency specified in the contract or order (see 6.2). Undercut, overlap, surface cavities, surface cracks in weld material, or in heat-affected zone of base metal shall be cause of rejection of weldment (see 3.2.1.5).

4.3 Testing and inspection. When radiographic inspection and tests for mechanical properties are specified on the drawings, in the contract or order, methods of inspection and test specimens shall be in accordance with MIL-STD-453 and Fed. Test Method Std. No. 151, as applicable, at the frequency specified in the contract or order (see 6.2).

4.3.1 Testing. Unless otherwise specified on the drawings, in the contract or order, the amount and type of testing other than visual, shall be performed at the discretion of the contractor or manufacturer.

5. PACKAGING

5.1 Not applicable.

6. NOTES

6.1 Intended use. The intended purpose of this specification is to cover general welding of aluminum alloys for structural uses other than armor. Example of weldment classification are as follows:

Class A	Class B
1. Pressure and liquid tight containers	1. Storage containers
2. Turret platform	2. Heater duct work
	3. Fenders
	4. Heat deflectors

6.2 Ordering data.

6.2.1 Procurement requirements. Purchasers should select the preferred options permitted herein and include the following information in procurement documents.

(a) Title, number and date of this specification.
(b) Class of weldment required (see 1.2).
(c) Filler metal requirements (see 3.1.2).
(d) Preparation of welding procedure, if not required (see 3.2.1).
(e) If workmanlike specimens, are required (see 3.2.1.5).
(f) Mechanical test specimens, when required (see 3.2.1.6).
(g) Soundness, if required (see 3.3.2).
(h) Visual examination number of Class B weldments (see 4.2).
(i) Frequency of radiographic and mechanical property tests (see 4.3).

6.2.2 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n) (2) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs:

Paragraph No.	Data requirement title	Applicable DID No.
3.2.1	Drawings, Engineering and Associated Lists	DI-E-7031
3.2.1	Qualification Data, Welding Procedure	UDI-H-23384

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the acquiring activity or as directed by the contracting officer).

6.3 Difference between contractor and manufacturer. The term "contractor" as used in this specification is defined as the organization having a direct contract with the Government agency. The term "manufacturer" is defined as the organization actually performing the operations covered by this specification. The contractor may or may not be the manufacturer; hence, when "contractor or manufacturer" is used, it designates them as separate parties or as one and the same when "or both" is used.

Custodian:
Army - MR

Preparing activity:
Army - MR

Review activities:
Army - AR, AT

Project No. THJM-A012

User activities:
Army - ME, AL

(WP #0003A/ID0909A FOR AMMRC USE ONLY)

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	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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