

MIL-STD-1881(AT)
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MILITARY STANDARD
BRAZING SILVER. GENERAL PROCESS FOR



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MIL-STD-1881(AT)

DEPARTMENT OF DEFENSE
Washington, DC 20301

Brazing Silver, General Process for.

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1. This Military Standard is approved for use by US Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: DRSTA-GSS, Warren, MI 48090, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

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FOREWORD

This Military standard establishes acceptance criteria for brazing using silver brazing alloy. The requirements are presented in a self-contained form. This is not an acquisition document.

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1. SCOPE

1.1 Purpose. The procedures covered by this standard are intended to insure silver brazing operations meet prescribed requirements.

1.2 Scope. This standard covers three brazing processes using silver brazing alloy.

1.2.1 Classification. Braze joints shall be butt and lap joints classified as follows:

Class 1 - Joints subjected to high stresses or fatigue loading.

Class 2 - Joints subjected to intermediate stresses.

Class 3 - Joints subjected to low stresses.

1.2.2 Type. The types of brazing process designated on the engineering drawing shall be in accordance with the following:

<u>Type</u>	<u>Description</u>
Torch Brazing	TB
Induction Brazing	IB
Furnace Brazing	FB

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2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this standard to the extent specified herein.

SPECIFICATIONS
MILITARY

MIL-H-6875	- Heat Treatment of Steels.
MIPD-G-62410	- General Heat Treatment.
MIPD-M-62414	- Metal Texturing, Process for (liquid honing).
MIPD-C-62423	- Coating, Metallic, Electrodeposited, Process for.
MIPD-N-62425	- Nickel Plating, Process for.
MIL-T-81533	- 1-1-1, Trichloroethane (Methyl Chloroform Inhibited, Vapor Degreasing).

STANDARDS
MILITARY

MIL-STD-248	- Welding and Brazing Procedure and Performance.
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(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the acquisition activity or as directed by the contracting officer.)

(Copies of MIPD specifications and standards may be obtained from the US Army Tank-Automotive Command, ATTN: DRSTA-GSS, Warren, MI 48090).

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

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)
SAE Standards and Recommended Practices

AMS 2750	- Pyrometry.
AMS 5510	- Steel Sheet, Strip, and Plate, Corrosion and Heat Resistant (UNS S32100).
AMS 5525	- Plate, Sheet and Strip, Corrosion and Heat Resistant (UNS K66286).
AMS 5597	- Plate, Sheet and Strip, Corrosion and Heat Resistant (UNS N07718).

(Copies may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Avenue, Warrendale, PA 15096).

AMERICAN WELDING SOCIETY

AWS A2.4	- Welding Symbols.
AWS A3.0	- Welding Terms and Definitions (including Brazing).

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(Copies of the above publications may be obtained from the American Welding Society, 2501 Northwest 7th Street, Miami, Florida 33125.)

(Technical society and technical association specifications and standards are generally available for reference from libraries.)

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3. DEFINITIONS.

3.1 Brazing. A group of welding processes that produce coalescence of materials by heating to a suitable temperature and by using filler metal having a liquidus above 840°F (450°C) and below the solidus of the base metals. The filler metal is distributed between the closely fitted joint surfaces by capillary attraction.

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4. GENERAL REQUIREMENTS

4.1 Equipment.

4.1.1 Brazing furnace. The brazing furnace shall be suitable for the intended purpose and capable of meeting the following conditions:

- a. The furnace atmosphere or lack of one (vacuum), shall be controllable to prevent decarburization or oxidation of carbon or low alloy steels and to prevent casing, carburizing, or nitriding of corrosion and heat resisting steels.
- b. Uniform heating and cooling of the work load.
- c. Uniform temperature in all areas of the work zone in accordance with MIL-H-6875.

4.1.2 Temperature measuring instrumentation and controls. All brazing-heat treat furnaces shall be equipped with temperature controllers and recording instruments.

4.1.3 Fixtures. Brazing fixtures shall be made of non-gassing heat resistant materials, be capable of maintaining proper braze clearance, have dimensional stability, and shall have compatible coefficients of expansion with parts being joined.

4.1.4 Brazing equipment. Brazing equipment other than furnaces (induction coils, transformers, control panels, torches, regulators, etc), shall be suitable for the intended purpose and be capable of consistently reproducing quality brazements.

4.1.5 Braze alloy paste applicators. Braze alloy applicators shall be capable of dispensing the required size and amount of braze alloy paste. The materials of the applicators shall be not detrimental to the alloy paste used and may be of tube, bulb, cartridge, or air gun type.

4.1.6 Abrasive blast equipment. An air pressure source providing 40 pound-force per square inch (psi) minimum of clean, dry filtered air shall be required for both wet and dry abrasive blast operations.

4.2 Material.

4.2.1 Braze alloy. The braze alloy powder, paste, wire, or preform shall conform to the requirements of the specification specified on the engineering drawing.

4.2.2 Fluxes. The fluxes shall be capable of dissolving any oxides and prevent the additional formation of oxides on the filler metal and base material during the heating. Fluxes may be in the form of powder, paste, vapor gas, or coating on the filler metal.

4.2.3 Vapor degreaser solvent. Stabilized 1-1-1 trichloroethane MIL-T-81533 or equivalent type solvent.

4.2.4 Abrasive wheels. Silicon carbide impregnated cloth wheels.

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4.2.5 Wire brush. The wire brush shall have austenitic stainless steel bristles.

4.2.6 Cleaning solvent. Acetone, methyl ethyl ketone (MEX) or isopropyl or methyl alcohol of commercial grade.

4.2.7 Abrasive for abrasive blast.

4.2.7.1 Dry. Silicon carbide, 325 mesh or equivalent.

4.2.7.2 Wet abrasive slurry. The wet abrasive slurry shall be in accordance with MIPD-M-62414.

Note: Aluminum oxide grit shall be not considered an equivalent material.

4.2.8 Heat shields. Heat shields shall be made from AMS 5510 metal or fiber-fraX cloth.

4.3 Required procedures and operations.

4.3.1 Cleaning. Part surfaces shall be thoroughly cleaned using appropriate solvents (ref 4.2.6).

4.3.2 Preparation of parts. All surfaces to be brazed shall be prepared by one or more of the following methods.

4.3.2.1 Polishing. Mating surfaces shall be prepared for brazing by polishing with a silicon carbide impregnated cloth wheel or wire brush (ref. 4.2.4 and 4.2.5).

Note: Polishing is not applicable to plated or otherwise specially prepared surfaces.

4.3.2.2 Vapor degrease. When required to maintain cleanliness, parts and fixtures to be placed in brazing furnace shall be vapor degreased (ref. 4.2.3).

4.3.2.3 Abrasive blast (mechanical cleaning). All surfaces to be brazed shall be either dry or wet abrasive blasted to produce a surface roughness in the 30 to 80 microinch range as follows:

- a. Dry abrasive blast. Dry abrasive blasting shall be accomplished using the specified material and air pressure (ref. 4.1.6 and 4.2.7.1).

Note: After dry abrasive blasting, parts shall be handled in a manner which will prevent contamination of the part surface.

- b. Wet abrasive blast. Wet abrasive blasting shall be performed in accordance with MIPD-M-62414 (ref. 4.2.7.2) with the exception of the final operation of slushing in protective oil.

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4.3.2.4 Final wipe. Wet abrasive blasted parts shall have the areas to be braze wiped with a clean, lint free wiper and wet with a suitable solvent (ref. 4.2.6).

4.3.2.5 Stress relief. Details which have been formed, pierced, or punched in the area to be brazed and are made of the following materials, shall be stress relieved in accordance with MIPD-G-62410 as specified herein:

- a. AMS 5510 (321) - MIPD-G-62410(L1) (UNS S32100)
- b. AMS 5525 (A286) - MIPD-G-62410(L5) (UNS K66286)
- c. AMS 5597 (718) - MIPD-G-62410(L7S) (UNS N07718)

Note: Stress relief must be performed before nickel plate is applied (see 4.3.2.6).

4.3.2.6 Nickel plate. Nickel plate shall be required on the braze joint area of stainless or corrosion resistant steels and superalloy parts having the equal or larger percentage by weight of the following alloying elements:

- a. Titanium - 0.70 percent.
- b. Aluminum - 0.40 percent.
- c. Titanium plus aluminum - 0.70 percent.

4.3.2.6.1 Application. Nickel plate 0.4 to 0.8 mil (0.010 to 0.020 mm) thick shall be applied in accordance with the requirements of MIPD-C-62423 or MIPD-N-62425 and the following:

- a. The nickel plate shall extend approximately 0.1 inch minimum beyond the braze joint areas indicated by the braze symbol on the engineering drawing unless part geometry does not permit this allowance.
- b. The nickel plate shall be applied to each joint surface or surfaces immediately before the braze cycle, and to the required braze joint surface or surfaces for each subsequent braze cycles.

Note: The nickel plating does not apply to rebraze cycles.

4.3.2.7 Cleaning. The nickel plated braze joint surface shall be thoroughly wiped with a suitable solvent (ref 4.2.6).

4.3.2.8 Assembly. The detail parts shall be assembled in the position specified on the assembly drawing.

4.3.2.8.1 Braze joint clearance. The optimum joint clearance between mating surfaces shall be 0.001 to 0.005 inch with the following exceptions:

- a. When one of the mating surfaces is knurled (0.003 to 0.005 inch deep), a minimum gap clearance is not required.
- b. Isolated areas of the braze gap may have clearances up to 0.010 inch.

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4.3.3 Brazing. The required class and type of braze process (ref 1.2.1 and 1.2.2) shall be as specified in the tail of the brazing symbol on the engineering drawing. Braze symbols shall be interpreted in accordance with AWS A2.4.

4.3.3.1 Flux. The surface to be brazed shall be completely covered with flux when required.

4.3.3.2 Torch braze. Parts shall be preheated by torch to bring the joint area to the flow temperature of the braze alloy. The braze alloy shall be introduced at one edge of the joint or in a groove provided for the purpose and shall flow by capillary action to fill the braze joint area.

4.3.3.3 Induction braze. The fluxed details and braze alloy shall be assembled in the induction brazing unit and the joint area shall be induction heated to the braze alloy flow temperature. The braze joint may be supplementary face fed provided the braze alloy in the joint has reached its flow temperature and melted.

4.3.3.4 Furnace braze. The fixtured assemblies and braze alloy shall be induction heated to the temperature required to produce good flow of the braze alloy. Suitable protective atmospheres including vacuum, shall be used to prevent scaling or degradation of the braze alloy or base material.

4.3.3.5 Multiple cycles. Application of braze alloy and the braze cycle shall be repeated as required for assemblies requiring more than one braze cycle to complete the assembly operation.

4.3.4 Post braze cleaning. Post braze cleaning shall be performed to remove all residual flux from assembly. If rinsing in hot water 180°F (82°C) minimum does not remove flux, a cleaning procedure approved by the acquisition activity may be used.

4.3.5 Post braze treatments. All post braze heat treatments shall require approval by the acquisition activity prior to use.

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5. DETAIL REQUIREMENTS

5.1 Approvals. The equipment (see 4.1) and basic heat treat and brazing procedures shall be approved by the acquisition activity and shall be subject to periodic review (see MIL-STD-248).

Note: If a supplier has more than one facility, each facility and brazing personnel shall require separate approval for any given part configuration.

5.1.1 Work instruction submittal. When specified on the purchase order, specific process procedures and the revision or change of such work instructions shall be submitted to the acquisition activity for review prior to use. The acquisition activity reserves the right to disapprove any work instruction and change or revision submitted for review.

5.1.2 Reports. Unless otherwise specified, the supplier shall furnish three copies of a certificate with each shipment. The certificate shall state the following:

- a. Purchase order number.
- b. Part number and revision letter.
- c. Quantity.
- d. Brazing heat (lot) number.
- e. Conformance to this standard, latest revision.
- f. Brazing process used.

5.2 Monitoring equipment.

5.2.1 Accuracy of furnace control instruments. The accuracy of temperature measuring and controlling instruments shall be checked in accordance with the requirements of MIL-H-6875 and AMS 2750.

5.3 Certification.

5.3.1 Operators. Torch braze operators shall be qualified by a procedure acceptable to the acquisition activity and brazing personnel (see MIL-STD-248).

5.3.2 Process technique. When specified on the purchase order, initial substantiation tests shall be conducted using this process procedure (equipment, heat treatment, brazing process, etc) to determine conformance to the engineering drawing requirements for each part configuration.

5.4 Test methods.

5.4.1 Inspection. The method of braze inspection and acceptance levels shall be in accordance with the applicable inspection specifications cited on the engineering drawing.

Custodian:
Army - AT

Preparing activity:
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Project No. THJM-A209

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-STD-1881(AT)	2. DOCUMENT TITLE Brazeing, Silver, General Process for
3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION (Mark one) <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____
b. ADDRESS (Street, City, State, ZIP Code)	

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)