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SUPERSEDING
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MILITARY SPECIFICATION

BRAZING OF STEELS, COPPER, COPPER ALLOYS, NICKEL ALLOYS, ALUMINUM AND ALUMINUM ALLOYS

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope - This specification presents general fabrication and quality requirements for steel, copper and copper alloy, nickel and nickel alloy, aluminum and aluminum alloy assemblies produced by brazing processes using brazing filler metals having a lower melting point than the base metal. The filler metal is distributed between the joint surfaces usually by gravity in the case of wide gaps and capillary action in closely fitting components.

1.2 Classification - Brazing methods shall be of the following types:

1.2.1 Brazing methods -

Type I - Torch or gas burner brazing.
Type II - Furnace brazing.
Type III - Induction brazing.
Type IV - Resistance brazing.
Type V - Dip brazing.

* 1.2.2 Quality of joint - Quality of joint shall be of the following grades:

Grade A - Joints for critical fittings and structural applications (see 6.9)

Grade B - Joints for non-critical fittings and non-critical structural applications

* 1.2.2.1 Grade A shall apply to all joints where grade quality is not specified.

2. APPLICABLE DOCUMENTS

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

FSC - THJM

SPECIFICATIONS

Federal

O-F-499	Flux, Brazing, Silver Alloy, Low Melting Point
QQ-B-655	Brazing Alloys, Aluminum and Magnesium, Filler Metal
QQ-C-576	Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed or Machined Edges, (Plate, Bar, Sheet, and Strip)
QQ-R-566	Rods, Welding, Aluminum and Aluminum Alloy
QQ-R-571	Rods, Welding, Copper and Nickel Alloys
QQ-S-561	Solder, Silver

Military

MIL-I-6866	Inspection, Penetrant, Method of
MIL-I-6870	Inspection Requirements, Nondestructive, for Aircraft Material and Parts
MIL-P-8853	Paste, Copper Brazing, Water Thinning
MIL-B-15395	Brazing Alloys, Silver
MIL-R-19631	Rods, Welding, Copper and Copper Alloy
MIL-B-20148	Brazing Alloys, Aluminum, and Aluminum Alloy Sheets and Plates, Aluminum Brazing Alloy Clad

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inpsection by Attributes
MIL-STD-453	Inspection, Radiographic

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring 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.

Society of Automotive Engineers

AMS 3410	Flux, Brazing, Silver
AMS 3411	Flux, Brazing, Silver, High Temperature
AMS 3412	Flux, Brazing, Aluminum
AMS 3415	Flux, Aluminum, Dip Brazing
AMS 3416	Flux, Aluminum, Dip Brazing
AMS 4054	Sheet, Alclad
AMS 4055	Sheet, Alclad
AMS 4184	Wire, Brazing
AMS 4185	Wire, Brazing
AMS 4701	Wire, Copper, Annealed
AMS 4764	Brazing Alloy, Copper Base
AMS 4766	Brazing Alloy, Silver Base
AMS 4767	Brazing Alloy, Silver Base
AMS 4768	Brazing Alloy, Silver Base
AMS 4769	Brazing Alloy, Silver Base
AMS 4770	Brazing Alloy, Silver Base
AMS 4771	Brazing Alloy, Silver Base
AMS 4772	Brazing Alloy, Silver Base
AMS 4774	Brazing Alloy, Silver Base
AMS 4775	Brazing Alloy, Nickel Base
AMS 4776	Brazing Alloy, Nickel Base
AMS 4777	Brazing Alloy, Nickel Base
AMS 4778	Brazing Alloy, Nickel Base
AMS 4779	Brazing Alloy, Nickel Base
AMS 4780	Brazing Alloy, Manganese Base

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 485 Lexington Avenue, New York, New York 10017.)

American Welding Society

AWS - A5.8 - 62T Brazing Filler Metal

(Application for copies should be addressed to American Welding Society, United Engineering Center, 345 East 47th Street, New York, New York 10017.)

3. REQUIREMENTS

3.1 Material -

3.1.1 Filler metal - Unless otherwise specified by the procuring activity, filler metal shall conform to the specifications listed in 2.1 and 2.2 except that copper brazing filler metal shall be deoxidized copper without residual deoxidizing agents (See 6.7).

3.1.2 Fluxes - Unless otherwise specified by the procuring activity, fluxes shall conform to the applicable specifications listed under 2.1 and 2.2. Fluxes shall be employed as necessary, to promote proper wetting of the parent metal surfaces. Fluxes shall dissolve or remove any oxides and prevent additional oxidation of the filler metal and base metal during heating. Fluxes may be applied in the form of powder, paste, vapor, gas or coating on filler rods. The application of flux is generally not required when parts are to be joined by the molten flux (dip) brazing process, or in furnace brazing when an inert or reducing atmosphere is used.

3.1.3 Selection of brazing alloy, flux combinations - Unless otherwise specified on drawings, the brazing alloys and flux combination shall be selected in accordance with Tables I, II, III, and IV.

3.2 Preparation of joints -

* 3.2.1 Cleaning - The mating surfaces and adjacent areas of all parts to be joined shall be thoroughly cleaned to remove all oil, grease, paint, dirt, scale, artificial oxide films, conversion coatings, or any other foreign substances.

3.2.2 Deburring - Burrs shall be removed to permit proper fitting of parts and flow of filler metal.

3.2.3 Fit - Unless otherwise specified by the procuring activity, the clearance between mating surfaces of steel parts, being furnace brazed, shall not exceed 0.001 inch for Grade A, 0.002 inch for Grade B. The clearance between mating surfaces when other methods are used shall not exceed 0.003 inch for Grade A, 0.006 inch for Grade B, except in areas of a joint or joints where one or both mating surfaces are intentionally bevelled. In fabrication of aluminum assemblies where sheet, clad with brazing metal is employed, the joints shall make contact as the cladding material provides sufficient clearance. When a cladding material is not employed, parts shall be positioned and assembled so that the clearance between mating surfaces is within tolerances specified on drawings.

3.2.4 Assembly of parts - Parts to be joined shall be held in position by jigs, clamps, supports or be self-fixturing. Fixtures used to hold parts and assemblies in alignment during brazing, shall be designed to allow expansion of the parts during heating and contraction during cooling. Jigs, fixtures, and clamps shall be of noncontaminative materials and should only involve point or line contact. When authorized by the procuring activity, staking, pinning, riveting, tack-welding or spot welding may be used for positioning of parts, but shall not be located in areas subjected to high stresses in service. On closed assemblies, vent holes shall be located and drilled as specified. Stop-off materials may be used to restrict flow of filler metal where required.

3.2.5 Application of filler metal - Sufficient brazing alloy, in the form of wire, washers, sheet, powder with a residue free of chemical

TABLE I

Filler Metal, Flux Combinations for Brazing Low Carbon Steel, Low Alloy Steel and Corrosion and Heat Resistant Steel

Base Metal	Filler Metal			Flux Specification	Brazing Temp. °F Range
	Type	AWS-ASTM Classification	Specification		
Low Carbon Steel	Silver Alloy	BAgMn	AMS 4766		1780-2100
		BAg-1	MIL-B-15395 Grade VII	O-F-499 AMS 3410	1145-1400
		BAg-1a	QQ-S-561 Class 4 MIL-B-15395 Grade IV AMS 4770	O-F-499 AMS 3410 AMS 3411	1175-1400
Low Alloy Steel		BAg-3	QQ-S-561 Class 5 MIL-B-15395 Grade V AMS 4774	AWS Type 3B O-F-499 AMS 3410 AMS 3411	1270-1500
		BAg-13	AMS 4772	AMS 3411	1575-1775
		BAg-19	AMS 4767		1610-1800
Corrosion and Heat Resistant Steel	Copper	BCu-1	QQ-C-576* AMS 4701 MIL-P-8853	AWS Type 3B - - -	20[illegible] 2100
		RB CuZn-A	QQ-R-571* MIL-R-19631*	AMS 3411	1670-1750
	Cu-Mn-Ni	- - -	AMS 4764	- - -	
	Ni-Cr-Fe-B-Si	BNi-1	AMS 4775	AWS - Type 3B	1950-2200-
		- - -	AMS 4776		1975-2200
		BNi-2	AMS 4777		1850-2150
	Ni-Si-B	BNi-3	AMS 4778		1850-2150
		BNi-4	AMS 4779		1850-2150
	Ni-Cr-Si	BNi-5	- - -		2100-2200
	Mn-Ni-CO-B		AMS 4780		1875-2175

* See Paragraph 3.1.1

TABLE II

Filler Metal, Flux Combination for Brazing Aluminum and Aluminum Alloys

Base Metal	Filler Metal				Specification	Flux		
	AWS-ASTM Classification	Federal Classification	Alum. Assoc. Classification	Commercial No.		Furnace and Torch	Dip	Brazing Temp. °F Range
1100	BAlSi-2	---	4343	713	QQ-B-655 MIL-B-20148		AMS 3415	1110-1150
3003	BAlSi-3	FS-RAl 716	4145	716	AMS 4184 QQ-B-655 QQ-R-566	AMS3412	AMS 3416	1060-1120
	BAlSi-4	FS-RAl 718	4047	718	AMS 4185 QQ-B-655 QQ-R-566			1080-1120
3004 1/ 5005 5050 6061 6062 6063 6951 A612 Cast C612 Cast	BAlSi-3 BAlSi-4	FS-RAl 716 FS-RAl 718	4145 4047	716 718	AMS-4184 QQ-B-655 QQ-R-566 QQ-B-655 QQ-R-566 AMS 4185 MIL-B-20148	AMS 3412	AMS 3416	1060-1120 2/ 1080-1120 2/
43 Cast 356-T4 Cast	BAlSi-3	FS-RAl 716	4145	716	QQ-B-655 QQ-R-566	AMS 3412	AMS 3416	1060-1120
No. 11 Brazing Sheet No. 12 Brazing Sheet	1/ BAlSi-2	---	4343	1/ 713	MIL-B-20148	AMS 3412	AMS 3416	1110-1150
No. 21 Brazing Sheet No. 22 Brazing Sheet	BAlSi-2	---	4343	713	AMS 4054 AMS 4055 MIL-B-20148	AMS 3412	AMS 3416	1110-1150
No. 23 Brazing Sheet No. 24 Brazing Sheet	BAlSi-5	---	4045	714	MIL-B-20148	AMS 3412	AMS 3416	1090-1120

1/ Cladding on brazing sheet, where added filler alloy is desired, alloy 718 is recommended

2/ Maximum brazing temperature for alloys 6061 and cast A612 is 1100°F

TABLE III

Filler Metal, Flux Combinations for Brazing Copper and Copper Base Alloys

Base Metal	Filler Metal			Flux Specification	Brazing Temp. °F Range
	Type	AWS-ASTM Classification	Specification		
Copper and Copper Base Alloys	Silver	BAg-1a	QQ-S-561 Class 4 MIL-B-15395 Grade IV AMS 4770	O-F-499 AWS Type 3A	1175-1400
		BAg-8 BAg-8a			1435-1650 1410-1600
	Copper	BCuP-5 *	QQ-S-561 Class 3	O-F-499 AWS Type 3A	1300-1500
	Phos-phorus	BCuP-3 *	- - -		

* Use only for copper alloys with less than 10 percent nickel.

TABLE IV

Filler Metal, Flux Combinations for Brazing Nickel and Nickel Base Alloys

Base Metal	Filler Metal			Flux Specification	Brazing Temp. °F Range
	Type	AWS-ASTM Classification	Specification		
Nickel and Nickel Base Alloys	Silver	BAg-1	MIL-B-15395 Grade III AMS 4769	O-F-499 AWS Type 3A AMS 3410 AMS 3411	1145-1400
		BAg-1a	MIL-B-15395 Grade VII QQ-S-561 Class 4 MIL-B-15395 Grade IV AMS 4770		1175-1400
		BAg-3	QQ-S-561 Class 5 MIL-B-15395 Grade V AMS 4771		1270-1500
		BAg-2	MIL-B-15395 Grade VIII AMS 4768		1295-1550
	Copper	BCu-1	QQ-C-576 * QQ-R-571 * MIL-R-19631 *	AWS Type 3B	2000-2100
	Ni-Cr-Fe-B-Si	BNi-1	AMS 4775		1950-2200
		---	AMS 4776		1975-2200
		BNi-2	AMS 4777		1850-2150
	Ni-Si-B	BNi-3 BNi-4	AMS 4778 AMS 4779		1850-2150 1850-2150
	Ni-Cr-Si	BNi-5	---		2100-2200
	Manganese Base Ni-Co-B		AMS 4780		1875-2175

* See Paragraph 3.1.1

agents, or plated form, shall be pre-placed in close proximity to the joint, on one side only, in sufficient quantity to produce a satisfactory joint. Joints, having one end inaccessible to visual inspection, shall have the filler metal placed at the blind end prior to assembly, whenever it is practicable to do so.

3.3 Methods and procedures -

3.3.1 Type I - Torch brazing - Depending upon the temperature and amount of heat required, fuels such as acetylene, propane, city gas, natural gas and hydrogen may be used with air, compressed air or oxygen. Parts shall be preheated with a neutral or slightly reducing flame to bring the entire joint uniformly to the liquidus temperature of the filler metal, but no higher than necessary to provide a satisfactory joint. Localized overheating shall be avoided. The filler metal shall be introduced at one edge of the interstice or in a groove provided for one of the mating surfaces, and shall flow by capillary action to fill the interstice.

3.3.2 Type II - Furnace brazing -

3.3.2.1 Equipment - Furnaces shall be of suitable design and construction for the purpose, and shall provide uniform temperatures within the working zones. Automatic temperature-controlling and recording devices, preferably of the potentiometer type, shall be provided to satisfactorily control furnace temperatures. Temperature variations within the brazing ranges shall be no greater than plus or minus one and one-half percent from the control point. Means shall be provided for controlling the furnace atmosphere as required. Dew point and composition of atmospheres shall be sufficiently controlled to prevent oxidation or carburization of carbon steels, low alloy steels, and stainless steels. In carbon and low alloy steels, decarburization shall not exceed a depth of 0.003 inch.

3.3.2.2 Procedure - Parts shall be assembled with proper fit in the joint areas and fixed in alignment as required. Flux may be used in addition to control of furnace atmosphere. Assemblies, cradled and racked, shall be placed in the furnace in such manner that the atmosphere can reach all parts of the brazing assembly readily and bring the entire assembly to brazing temperature in the shortest possible time. Parts shall be held in the furnace until the filler metal has melted and formed the desired bonding. After brazing has been accomplished, assemblies shall be cooled in protective atmospheres, as required, to prevent oxidation.

* 3.3.2.2.1 Grain refinement - Unless otherwise specified by the procuring activity, carbon and low alloy steel parts which have been copper brazed or when Ni-Cr-Be-B-Si, Ni-Si-B, Ni-Cr-Si or Mn-Ni-Co-B filler metals are used shall be given a grain-refining heat treatment subsequent to brazing.

3.3.3 Type III - Induction brazing -

3.3.3.1 Equipment - Induction coils shall be of suitable design and construction so as to provide suitable heating of the joint areas. Coil design must allow for corner effect on rectangular parts and surface irregularities which will be in the heat zone.

3.3.3.2 Procedure - The mating surfaces shall be coated with flux, or enclosed in a suitable atmosphere, the filler metal placed in position and the joint area heated by placing within or near a suitable induction coil.

3.3.4 Type IV - Resistance brazing -

3.3.4.1 Equipment - The current and electrode size shall be selected so that the heat will be distributed over a large enough area to allow the brazing alloy to flow freely, but not large enough to cause overheating.

3.3.4.2 Procedure - Assembled parts shall be placed between two electrodes and current passed through the system. Heating of the joint area is generated by contact with the electrodes. Heating shall be discontinued as soon as the filler metal has flowed and formed fillets.

3.3.5 Type V - Dip brazing - Dip brazing may be performed by dipping the assembled joint, with the filler metal preplaced, in a bath of molten flux or by dipping the parts into a bath of molten brazing alloy covered with a layer of flux. The flux shall be a type which has a stable flowability within the brazing temperature range, and possesses satisfactory fluxing properties. The flux bath shall be free of metallic impurities.

3.3.5.1 Preheating - Assemblies shall be preheated in a suitable furnace and atmosphere, when required, to a temperature of 25° - 100°F. below the solidus temperature of the brazing alloy.

3.3.5.2 Procedure - The assembly shall be removed from the preheat furnace and immediately dipped into the molten bath at a uniform rate, so that the position of the preplaced filler metal is not disturbed. Brazing times are dependent upon the shape and cross section of the assembly. Brazing is complete when the filler metal has flowed evenly into the joints. At this point the assembly shall be removed slowly from the bath, at a rate that will not cause loss of the molten filler metal. The composition and quantity of brazing flux shall be adjusted periodically. The operating temperature of the molten flux bath shall not exceed the liquidus temperature of the specified brazing alloy by more than 10° F. and shall not vary more than plus or minus 10°F.

3.4 Post brazing treatment -

3.4.1 Cooling - Assemblies shall be cooled after brazing in such manner that no cracks occur and internal stress and distortion is minimized. When heat treatment is used in conjunction with brazing, cooling procedures may be revised accordingly.

3.4.2 Flux removal - Immediately after brazing and cooling, flux shall be removed by a method which is not injurious to the surface finish, and which will not remove parent metal and filler metal to below drawing tolerances. A suitable test, such as the absence of a typical chloride precipitate in a 5 percent aqueous solution of silver nitrate on the cleaned and rinsed part, may be used to determine that flux has been adequately removed.

3.4.3 Heat treatment of assemblies - After completion of the brazing operation, heat treatment shall be limited to temperatures below the solidification temperature of the respective brazing alloy. Brazed assemblies may be heat treated to relieve stresses or improve mechanical properties. Heat treatment shall be in accordance with applicable specifications or drawings.

3.4.4 Passivation of brazed stainless steel assemblies - Assemblies that have been silver-brazed shall not be given a nitric acid treatment for passivation. Copper or nickel brazing alloys with less than 7 percent chromium are also attacked by the passivation treatment and shall not be passivated.

* 3.5 Quality of joint - Quality of joint shall be Grade A or Grade B.

3.5.1 Contour - The contour of an outside filler joint shall be of a uniform radius with a minimum amount of excess braze or flash over the adjacent surfaces.

* 3.5.2 External defects - For Grade A and B joints.

3.5.2.1 External porosity (pinholes) - This defect is the result of gases being expelled. It appears as a small, round, smooth surfaced pocket on the surface of the filler metal. The maximum diameter permissible is .015 inch with a depth of not more than 10 percent of the braze depth. The total number of pinholes of maximum diameter permitted shall be one per linear inch of braze metal, or one per joint when the braze length is less than one linear inch, unless otherwise specified.

3.5.2.1.1 Concentrated surface porosity - An area of concentrated porosity, the largest dimension of which is 50 percent of the braze fillet width is acceptable, provided that the sum of diameters of the pinholes in the area does not exceed .015 inch. No more than one such area of maximum size or two or more with a total equivalent diameter shall occur per linear inch of braze fillet.

3.5.2.1.2 Linear surface porosity - Linear surface porosity is defined as any surface porosity where the majority of porosity is lined up in straight lines. Linear porosity is acceptable providing its length does not exceed 3/16 inch and the sum of the diameters of the pinholes in this length does not exceed 0.015 inch. Linear porosity shall be acceptable provided no more than one such defect occurs per linear inch of braze or one per joint where the braze circumference or length is less than one linear inch.

3.5.2.2 Blisters - This surface condition, resulting from the overheating of the base metal shall be cause for rejection.

3.5.2.3 Residual flux - No residual flux shall be permitted on the surface of a brazed joint.

3.5.2.4 Excess braze metal - Brazing filler metal in excess of that required for the joint is acceptable providing the excess filler metal does not interfere with the function of the completed assembly.

3.5.2.5 Unmelted brazing alloy - The presence of unmelted brazing alloy in a joint is generally undesirable, and may be cause for rejection of the part. However it shall be acceptable for wide-gap brazing when permitted by applicable drawings or specifications.

3.5.2.6 Undercutting - Melting or erosion of the base metal on the outside surface, adjacent to the brazed joint, is undesirable and shall be controlled by limiting this to a maximum of 5 percent of the stock thickness, and 15 percent cumulative, of the braze length.

3.5.2.7 Penetration - Filler alloy must appear at all edges of a joint indicating proper flow through the joint. Lack of penetration shall be cause for rejection of the part.

* 3.5.3 Internal defects - For Grade A joints only

3.5.3.1 Total aggregate area - The unbrazed area including trapped flux, scattered porosity, and voids shall not exceed 20 percent of the faying surface of the respective joint for aluminum and aluminum alloys and 15 percent for all other metals.

3.5.3.2 Maximum extent of a single defect - No single unbrazed area shall exceed 20 percent of the overlap distance of the joint for aluminum and aluminum alloys, and 15 percent in all other metals.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 Sampling -

4.2.1 Lot size - For purposes of sampling a lot shall consist of all brazed parts of the same design or kind manufactured by the same process during one continuous period and submitted for acceptance at one time.

4.2.2 Sampling - A random sample shall be selected from each inspection lot in accordance with MIL-STD-105, AQL of 2.5 percent defects and subjected to the dimensional, visual and radiographic examinations specified.

4.3 Inspection and test - Inspection and test procedure shall be in accordance with the requirements of MIL-I-6870 and as specified herein.

4.4 Test methods -

4.4.1 Visual examination - Brazed joints shall be visually examined to determine the quality of joint as specified in 3.5.1 and 3.5.2. Fluorescent or dye penetrant MIL-I-6866 procedures may be used as inspection aids. All indicated flaws shall be checked visually under ten power magnification.

* 4.4.2 Radiographic examination - For Grade A joints only; radiographic inspection shall be conducted in accordance with MIL-STD-453 on Grade A joints to determine the quality of brazing as specified in 3.5.3.

4.4.3 Dimensional inspection - Samples from each inspection lot, selected in accordance with 4.2.2 shall be inspected for compliance with dimensional requirements of the applicable drawings and specifications.

4.5 Rejection - Brazed assemblies not conforming to the requirements of this specification shall be rejected.

4.5.1 Resubmitted inspection lots - Lots found unacceptable may be resubmitted in accordance with MIL-STD-105

5. PREPARATION FOR DELIVERY

5.1 The requirements of Section 5 are not applicable to this specification.

6. NOTES

6.1 Induction brazing - Induction brazing is particularly suited to the brazing of sleeve joints in tubing and other types of joints lying near the surface of the part, inasmuch as the major heating effect is at the surfaces. In the case of joints at an appreciable distance below the surface, there is a danger of overheating at the surface before the joint reaches the flow temperature of the filler alloy.

6.2 Metal dip brazing - Molten metal dip brazing is particularly suitable for brazing of small parts such as wires and strips of metal.

6.3 Furnace brazing with copper filler metal - Furnace brazing with copper filler metal is suitable for the production of high-strength joints, where close fits, in the range of 0.0015 inch interference to 0.0005 inch clearance between mating surfaces, are required.

6.4 Silver brazing -Clearances between joint members is important in silver brazing. When tubular members are being joined, consideration must be given to the coefficient of expansion of the metals and the method of heating. Joints with 0.001 to 0.003 inch thickness of brazing alloy generally possess the highest strength.

6.5 Stainless steel - Stainless steel may be brazed by any of the methods in 6.1 to 6.4. However, due to the rapid formation of chromium oxide on the surface of some stainless steel alloys during silver brazing, added precautions are necessary. The joint should be cleaned and degreased immediately before brazing. Fluxes for stainless steel should be capable of dissolving the oxides formed in heating the steel and should have a low melting point. Heating of the joint should be uniform and should be as low as possible compatible with the complete melting of the filler metal. If the brazed joint is to be subjected to prolonged exposure to high humidity or to atmosphere contaminated with salts, brazing alloy conforming to Class 5 of QQ-S-561 should be used.

6.6 Monel - Nickel-base alloys are subject to intergranular penetration (cracking) of molten silver-containing brazing alloys in the presence of stress, whether this be applied or residual (cold work). Parts of assembly should be free of stress (stress relieved or annealed) and adequately supported during brazing operations to avoid any applied stress during the period when the brazing alloy is molten. Age-hardenable alloys should be brazed in the solution treated condition and age hardening operations carried out after the brazing operation is complete.

6.7 Copper-phosphorus alloys shall not be used in the brazing of steel or nickel alloy parts and copper alloys with more than 10 percent nickel content.

6.8 Torch brazing - A neutral or slightly oxidizing flame is needed for tough pitch copper brazing to prevent hydrogen embrittlement. A neutral or slightly reducing flame is used for aluminum brazing.

* 6.9 Critical fittings and structural applications - Critical fittings and structural applications is one, the single failure of which would cause significant danger to operating or other personnel or would result in a significant operational penalty. In the case of missiles, aircraft and other vehicles, this includes loss of major components, loss of control, unintentional release or inability to release armament stores, or failure of weapon installation components.

* 6.10 Changes from previous issue - The outside margins of this document have been marked "*" to indicate where changes (deletions, additions, etc.) from the previous issue have been made. This has been done as a convenience only and the Government assumes no liability whatsoever for inaccuracies in the notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content as written irrespective of the marginal notations and relationship to the previous issue.

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Air Force - 11, 85

User activities:
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