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August 29, 1974
SUPERSEDING
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April 6, 1967

FEDERAL SPECIFICATION

UNIONS, BRASS OR BRONZE, THREADED PIPE CONNECTIONS AND SOLDER-JOINT TUBE CONNECTIONS

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers bronze or brass union with threaded pipe or solder-joint tube connections for joining nonferrous pipe and tubing.

1.2 Classification.

1.2.1 Union designation. Unions covered by this specification shall be designated in the following form (see 6.2 and 6.5):

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XX

Federal Specification
Number

Type, Style, and Size
Code Number

1.2.1.1 Type, style, and size. The type, style, and size of unions are identified by the two digits which indicate its application characteristics (see Table I).

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Table I. Union characteristic designators

	TYPE I		TYPE II		TYPE III		TYPE IV	
SIZE (in inches)	Style A	Style B	Style A	Style B	Style A	Style B	Style A	Style B
1/8	01	02	03	04	05	06	07	08
1/4	09	10	11	12	13	14	15	16
3/8	17	18	19	20	21	22	23	24
1/2	25	26	27	28	29	30	31	32
3/4	33	34	35	36	37	38	39	40
1	41	42	43	44	45	46	47	48
1-1/4	49	50	51	52	53	54	55	56
1-1/2	57	58	59	60	61	62	63	64
2	65	66	67	68	69	70	71	72
2-1/2	73	74	75	76	77	78	79	80
3	81	82	83	84	85	86	87	88

Type I - Cast Bronze or Brass, Threaded Pipe Ends, Class 125.
 Style A - female pipe thread to female pipe thread
 Style B - female pipe thread to male pipe thread

Type II - Cast Bronze or Brass, Threaded Pipe Ends, Class 250.
 Style A - female pipe thread to female pipe thread
 Style B - female pipe thread to male pipe thread

Type III - Cast Bronze, Wrought Copper or Wrought Bronze,
 Solder-Joint Tube Ends
 Style A - female tube to female tube
 Style B - female tube to male tube

Type IV - Cast Bronze, Wrought Copper or Wrought Bronze,
 Solder-Joint Tube End to Threaded Pipe End
 Style A - female tube to female threaded pipe
 Style B - female tube to male threaded pipe

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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.

Federal Standards

Fed. Std. No. 123 - Marking for Domestic Shipment (Civil Agencies)
Fed. Test Method Std. No. 151 - Metals; Test Methods

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards, at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal specifications required by activities outside the Federal Government for bidding purposes are available, without charge, from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks, and the Index of Federal Specifications and Standards, from established distribution points in their agencies.)

Military Specification

MIL-V-3 - Valves, Fittings, and Flanges (Except for Systems Indicated Herein), Packaging of

Military Standards

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-109 - Quality Assurance Terms and Definitions
MIL-STD-129 - Marking for Shipment and Storage

(Copies of Military Specifications and Standards, required by suppliers in connection with specific procurement functions, should be obtained from the procuring activity or as directed by the contracting officer.)

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

American National Standards Institute, Inc. (ANSI)

B2.1 - Pipe Threads (Except Dryseal)

(Applications for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

American Society for Testing and Materials (ASTM)

B62 - Composition Bronze or Ounce Metal Castings

B88 - Seamless Copper Water Tube

B145 - Leaded Red Brass and Leaded Semi-Red Brass Sand Castings

(Application for copies should be addressed to the American society for testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

National Motor Freight Traffic Association, Inc. Agent

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., Tariff Order Section, 1616 P Street, N.W., Washington, DC 20036.)

Uniform Classification Committee, Agent

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 S. Riverside Plaza, Chicago, IL 60606.)

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

3. REQUIREMENTS

3.1 Standard commercial product. The unions shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's current standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer's standard commercial product shall be included in the unions being furnished. Standard commercial product is a product which has been or will be sold on the commercial market through advertisements or manufacturer's catalogs or brochures, and represents the latest production model(s).

3.2 First article. When specified (see 6.2), the contractor shall furnish a union for first article inspection and approval (see 4.2.1, and 6.3).

3.3 Materials.

3.3.1 Type I and II unions. Materials shall be ASTM B62 alloy 836, or ASTM B145 alloy 838 or alloy 844.

3.3.2 Type III and IV wrought copper or wrought bronze unions. Materials shall be not less than 83 percent copper content or ASTM B62 alloy 836.

3.3.3 Type III and IV cast bronze unions. Materials shall be ASTM B62 alloy 836 or chemical and tensile requirements of ASTM B145 alloy 838 or alloy 844.

3.4 Metal thickness. The unions shall have a metal thickness as given in Table II.

Table II. Metal thickness

Wrought		Cast		
Union Size	Types III and IV	Solder Cups	Bodies	
		Types III and IV	Types I, III, IV	Type II
1/8	0.022	0.05	0.08	0.10
1/4	0.026	0.05	0.08	0.11
3/8	0.031	0.05	0.09	0.12
1/2	0.036	0.05	0.09	0.13
3/4	0.041	0.06	0.10	0.16
1	0.046	0.07	0.11	0.17
1-1/4	0.050	0.07	0.12	0.19
1-1/2	0.055	0.08	0.13	0.20
2	0.064	0.09	0.15	0.22
2-1/2	0.074	0.10	0.17	0.24
3	0.083	0.11	0.19	0.26

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Notes: (a) Dimensions are in inches.

(b) Metal thicknesses are nominal, and at no point shall the thickness be less than 90 percent of the thickness given.

3.5 End connections. Threaded end connections of Type I, II, and IV unions shall have right hand threads in accordance with the style of union. Minimum useful thread lengths shall be as given in Table III; otherwise, threads shall meet the National Pipe Thread (NPT) requirements of ANSI B2.1. Solder joint tube ends of Type III and IV unions shall meet the dimensional characteristics given in Table III.

3.6 Flow diameter. At no point within the unions shall the flow diameter be less than the dimensions given in Table III.

3.7 Tensile strength., The minimum applied force for tensile strength testing under paragraph 4.6.2 shall be as given in Table III.

3.8 Size. The size of the unions are identified by the nominal size as listed in Table III. Threaded pipe connections correspond to "nominal pipe size" and solder-joint tube connections correspond to "standard water tube size."

Table III. Union characteristics

Union size	Thread length on ends	Male solder-joint		Female solder joint		Flow diameter	Tensile strength Testing force	
		Outside diameter	Length	Inside diameter	Cup depth			
	Min.	Min.	Max.	Min.	Min.	Max.	Min.	Min.
1/8	0.25	0.249	0.251	0.375	0.253	0.255	0.312	0.18
1/4	0.32	0.374	0.376	0.385	0.378	0.380	0.312	0.30
3/8	0.36	0.499	0.501	0.437	0.503	0.505	0.375	0.39
1/2	0.43	0.624	0.626	0.562	0.628	0.630	0.500	0.52
3/4	0.50	0.874	0.876	0.812	0.878	0.880	0.750	0.74
1	0.58	1.1235	1.1265	0.968	1.128	1.1305	0.906	0.98
1-1/4	0.67	1.3735	1.3765	1.031	1.378	1.3805	0.968	1.23
1-1/2	0.70	1.623	1.627	1.56	1.629	1.6315	1.093	1.47
2	0.75	2.123	2.127	1.406	2.129	2.1315	1.343	1.94
2-1/2	0.92	2.623	2.627	1.531	2.629	2.6315	1.468	2.38
3	0.98	3.123	3.127	1.718	3.129	3.1315	1.656	2.89

Note: Dimensions are in inches.

3.9 Marking. Each union shall be marked with the manufacturer's name or trademark, and may be marked with the nominal union size. When the manufacturer's standard practice allows for size marking, such marking may be applied. Class 250 unions shall also be marked with the numerals "250." Depressed markings shall not cause the wall thickness to fall below the minimum requirements.

3.10 Union connections. The threads for the union connection shall be in accordance with the manufacturer's standard practice.

3.11 Seating. Seating joints shall be ball-type or ball-to-cone type.

3.12 Pressure surfaces. All surfaces subject to pressure in the tightening of the unions shall be finished smooth and true to insure proper seating of component parts.

3.13 Finish. When cast unions are furnished, finish shall be as cast.

3.14 Wrench surfaces. Wrench surfaces shall be provided on all components having a thread. The wrench surfaces may be a polygon, two opposing flattened surfaces, or a round surface with no less than two ribs raised above the surface controlling the minimum wall thickness. Nuts shall have a polygon wrench surface.

3.15 Resistance to leakage. All unions shall withstand an air pressure of at least 60 pounds per square inch gage (PSIG) and shall show no visible evidence of leakage when tested in accordance with 4.6.3.

3.16 Workmanship. All parts shall be sound, smoothly cored, true to form, uniform in texture and strength, and free from cold shuts, porosity, or other defects that may affect their serviceability. Repair processes, such as plugging or filling with cold solder, shall not be permitted. All parts shall be thoroughly cleaned, and all fins shall be removed.

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 in the contract or order, the supplier 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

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inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Inspection of materials and components. In accordance with 4.1, the supplier is responsible for insuring that materials and components used were manufactured, examined, and tested to the extent specified, in accordance with the requirements of referenced subsidiary specifications and standards. The terms and definitions of MIL-STD-109 shall apply.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2.1).
- b. Quality conformance inspection (see 4.2.2).

4.2.1 First article inspection. First article inspection shall be performed on a union when a first article sample is required (see 3.2). This inspection shall include the examination of 4.5 and the tests of 4.6. Failure of the first article to pass the examination or any of the tests shall be cause for rejection. The first article may be a standard production item from the supplier's current inventory provided the product meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining units to be furnished under the contract. A certificate of compliance from an independent laboratory, approved by the contracting officer, will be accepted as evidence that the first article has passed the required tests. Tests shall be conducted as outlined in the referenced documents and as herein specified.

4.2.2 Quality conformance inspection. Quality conformance inspection shall be performed on the sample unions selected in accordance with 4.4. This inspection shall include the examination of 4.5 and the test of 4.6.3.

4.3 Inspection lot. All units of the same type, style, size and composition offered to the Government at one time shall be considered a lot for purposes of inspection. The sample unit shall be one union.

4.4 Sampling for examination. A random sample of unions shall be selected from each lot offered to the Government in accordance with MIL-STD-105 at inspection level II. The acceptable quality level shall be 1.5 percent defective for major defects and 4.0 percent defective for minor defects.

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4.5 Examination. Each unit selected in accordance with 4.4 shall be examined to verify compliance with the requirements of this specification. Examination shall be conducted as specified in Table IV.

Table IV. Classification of defects

Categories	Defects
Major:	
101	Type, style, and size not as specified.
102	Threads not as specified.
103	Bearing surfaces not smooth.
104	Dimensions not as specified.
105	Poor workmanship.
Minor:	
201	Identification marking not as specified.

4.6 Tests.

4.6.1 Chemical analysis. The first article, when a first article is required, shall be subjected to chemical analysis in accordance with Method 111 or 112 of Fed. Test Method Std. No. 151 to determine conformance to the compositions specified.

4.6.2 Tension test. The first article, when a first article is required, shall be subjected to tension loading to verify conformance with 3.7. Suitable test rods shall be fastened to the union ends; then the union assembly shall be firmly screwed together. The test assembly shall be secured in the testing machine using spherically seated adapters to minimize cramping and to aid in axial loading. The test rods should be as long as can be conveniently accommodated in the tensile testing machine.

4.6.3 Leakage test. All unions shall be tested at an air pressure of 60 PSIG, minimum, while under water, or to a hydrostatic pressure of 250 PSIG, to assure tightness and soundness (see 3.15). Any visible leakage shall be cause for rejection of the union.

4.7 Inspection of preparation for delivery. Preparation for delivery requirements of the unions shall be inspected to determine conformance with the applicable requirements of section 5 of this specification.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A or C, as specified (see 6.2).

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5.1.1 Level A. The unions shall be packaged in accordance with the applicable level A requirements of MIL-V-3.

5.1.2 Level C. The unions shall be packaged in accordance with the supplier's standard practice.

5.2 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level A. The unions shall be packed in accordance with the applicable level A requirements of MIL-V-3.

5.2.2 Level B. The unions shall be packed in accordance with the applicable level B requirements of MIL-V-3.

5.2.3 Level C. The unions shall be packed in a manner which will insure arrival at destination in satisfactory condition and be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

5.3 Marking. (See 6.2).

5.3.1 Civil agencies. In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with Fed. Std. No. 123.

5.3.2 Military activities. In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with the requirements of MIL-STD-129.

6. NOTES

6.1 Intended use. The unions covered by this specification are intended for use and compatibility with: standard weight copper or brass pipe, copper water tube covered by ASTM B88, cast bronze threaded fittings covered by ANSI B16.15, cast bronze solder-joint pressure fittings covered by ANSI B16.18, and wrought copper and bronze solder-joint pressure fittings covered by ANSI B16.22.

6.2 Ordering data. Purchasers should select the preferred options offered herein and include the following data in procurement documents:

6.2.1 Procurement requirements.

- (a) Title, number, and date of this specification.
- (b) Definitive Federal Specification part number required (see 1.2.1 and 6.5).
- (c) When first article is required for inspection and approval see 3.2).
- (d) Level of packaging and level of packing required (see 5.1 and 5.2).
- (e) Marking required (see 5.3).

6.2.2 Contract data requirements. When this specification is used in a procurement which incorporates a DD Form 1423 and invokes the provisions of paragraph 7-104.9(n) of the Armed Services Procurement Regulation, the data requirements identified below will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of ASPR 7-104.9(n) are not invoked, the data specified below shall be delivered in accordance with the contract requirements. Deliverable data required by this specification is cited in the following paragraph.

Paragraph	Data Requirement	Applicable DD 1664
4.2.1	Certificate of Compliance	DI-E-2121

(Copies of Data Item Descriptions required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

6.3 First article. When a first article is required, it shall be tested and approved under the appropriate provisions of paragraph 7-104.55 of the Armed Services Procurement Regulation. The first article may be a standard production item from the manufacturer's current inventory. The first article should consist of one unit. The contracting officer should include specific instructions in all procurement instruments regarding arrangements for examinations, test, and approval of the first article.

6.4 Definitions. The following definitions, as used in this specification, are included for informational purposes only.

6.4.1 Union. A union is a fitting comprised of three components: a head piece, a tail piece, and a joining nut, and is used to connect two similar sized tubes, pipes, fittings, or a combination of tubes, pipes, and fittings.

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6.4.2 Head piece. A head piece is that component of a union that has an internal female pressure seating surface, and an external male thread that mates with the joining nut to draw the head and tail pieces together.

6.4.3 Tail piece. A tail piece is that component of a union that has an external male pressure seating surface to mate with the head piece forming a sealed joint, and an external land to couple internally with the, joining nut to effect the drawing of head and tail pieces together.

6.4.4 Nut. A nut is the component of a union that couples around the tail piece land and threads onto the head piece to draw the head and tail pieces together.

6.5 Definitive Federal Specification part number. The Federal Specification part number is a definitive part number which corresponds to the type, style, and size of unions covered by this specification and defines the requirements of the options presented under this specification. The Federal Specification number and the type, style, and size code number are combined to form the definitive Federal Specification part number as shown below:

Federal Specification Part Number	WW-U-516 - XX
Federal Specification Number	WW-U-516
Type, Style, and Size Code Number	XX

6.6 Pressure-temperature ratings. The recommended pressure-temperature ratings for the bodies, seats, and threaded connections are given in Table V. The recommended pressure-temperature ratings for the solder-joints are given in Table VI. When the tables are in conflict, the lower of the two ratings shall apply.

Table V. Pressure-temperature ratings by type

Temperature Degrees F	Class 125 Type I	Class 250 Type II
-20 to 150	200	400
200	190	385
250	180	365
300	165	335
350	150	300
400	125	250

Table VI. Pressure-temperature ratings of solder joints

Solder used in joints	Working temperature degrees F	Nominal copper water tube sizes			
		Water		Steam	
		1/8 to 1"	1-1/4 to 2"	2-1/2 to 3"	All sizes
50-50 Tin-Lead	100	200	175	150	
	150	150	125	100	
	200	100	90	75	
	250	85	75	50	15
95-5 Tin-Antimony	100	500	400	300	
	150	400	350	275	
	200	300	250	200	
	250	200	175	150	15
Solder melting at or above 1100 deg F	125	500	400	300	
	250	300	210	170	120
	350	270	190	155	120

Note: Ratings are in pounds per square inch.

6.7 Metric equivalent values. Metric values can be calculated by the following formulas:

To convert:	To:	Multiply by:
Inches	Millimeters (mm)	25.4 *
Pounds	Kilograms	0.4536
Square inches	Square millimeters	645.16 *
PSI	Newton/Square meters	6894.757
PSI	Bars	0.06894757
Pounds/Inch	Newton/meter	175.1268
Feet	Meters	0.3048 *

Note: Where an asterisk is shown, the figure is exact.

Metric equivalent formulas are added to this specification for informational and training purposes only. They are not included as a requirement and shall not be used for any inspection and acceptance criteria. It must be noted that figures given may be approximate and the nominal values for size are 1/8 inch smaller than the measured dimensions.

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6.8 Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

MILITARY CUSTODIANS:

Army - ME

Navy - YD

Air Force - 82

Preparing activity:

Navy - YD

Civil Agency Coordinating Activity:

GSA-FSS

Review activity:

Army - GL

User activities:

Army - CE

Navy - CG, MC

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein. Price 40 cents each.

NOTICE OF
VALIDATION

INCH-POUND
WW-U-516B
12 February 1990

FEDERAL SPECIFICATION

UNIONS, BRASS OR BRONZE, THREADED PIPE
CONNECTIONS AND SOLDER-JOINT TUBE CONNECTIONS

WW-U-516B, dated August 29, 1974, has been reviewed and determined to be valid for use in aquisition.

CUSTODIANS:

Army - ME
Navy - YD
Air Force - 99

Preparing activity:

Navy - YD

Review activities:

Army - GL
Air Force - 82
DLA - CS

User activities:

Army - CE
Navy - CG, MC

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

WW-U-516B
AMENDMENT 1
March 16, 1995

FEDERAL SPECIFICATION

UNIONS, BRASS OR BRONZE, THREADED PIPE CONNECTIONS
AND SOLDER-JOINT TUBE CONNECTIONS

The General Services Administration has authorized the use of this amendment, which forms a part of WW-U-516B, dated August 29, 1974, by all federal agencies.

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Delete 3.15 in its entirety and substitute the following:

"3.15 Resistance to leakage. All unions shall be capable of withstanding an air pressure of at least 60 pounds per square inch gage (PSIG) or hydrostatic pressure of not less than 250 PSIG without leakage when tested in accordance with 4.6.3."

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Delete 4.6.3 in its entirety and substitute the following:

"4.6.3 Leakage test. The first article, when a first article is required, and production units selected in accordance with 4.4, shall be air tested at no less than 60 PSIG while under water, or to a hydrostatic pressure of 250 PSIG, to verify conformance to 3.15."

MILITARY INTERESTS:

Custodians:

Navy - YD1
Air Force - 99

Review Activities:

Army - CE, GL, ME
Navy - CG, MC
Air Force - 82
DLA - CS

CIVIL AGENCY COORDINATING ACTIVITY:

GSA - FSS

PREPARING ACTIVITY:

Navy - YD1

(Project 4730-0395)

AMSC N/A

FSC 4730

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