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13 July 1973
SUPERSEDING
MIL-S-13282A
1 May 1964

MILITARY SPECIFICATION

SILVER AND SILVER ALLOYS

This specification is approved for use by all departments and Agencies of the Department of Defense.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers fine silver and two silver-copper alloys.

1.2 Classification. Silver shall be furnished in one of the following grades, forms, and tempers, as specified (see 6.2).

Grades
- A - Fine silver.
- B - Sterling silver.
- C - Coin silver.

Forms
- Plate
- Sheet
- Strip
- Wire
- Rod
- Bar
- Ingots
- Cathodes
- Anodes

Tempers
- Annealed
- 1/8 Hard
- 1/4 Hard
- 1/2 Hard
- 3/4 Hard
- Hard
- Spring

FSC 9660

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.

SPECIFICATIONS

FEDERAL

PPP-B-576 - Box, Wood, Cleated, Veneer, Paper Overlaid
PPP-B-601 - Box, Wood, Cleated-Plywood
PPP-B-621 - Boxes, Wood Nailed and Lock-Corner
PPP-B-636 - Box, Fiberboard
PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall

MILITARY

MIL-B-121 - Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-L-10547 - Liners, Case, Waterproof

STANDARDS

FEDERAL

Fed. Test Method Std. No. 151 - Metals; Test Methods.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.

(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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

E 8 - Tension Testing of Metallic Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103).

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 Preproduction samples. When specified in the contract, five sample units representative of the material to be produced under the contract will be required to determine compliance with the acceptance test requirements of this specification.

3.2 Chemical composition. The material shall conform to the chemical requirements specified in table I.

TABLE I. Chemical composition, percent

Grade	Silver	Copper	Zinc, maximum	Iron, maximum	Cadmium, maximum	Lead, maximum	Maximum other impurities
A	99.90 min. 1/	0.10 max. 1/	-----	0.005	-----	0.025	2/
B	92.5 $^{+1.0}_{-0.4}$	7.5 $^{+0.4}_{-1.0}$	0.06	.05	0.05	.03	0.06
C	90.0 $^{+1.0}_{-0.4}$	10.0 $^{+0.4}_{-1.0}$	.06	.05	.05	.03	.06

1/ For anodes, the silver content shall be 99.95 percent minimum and silver plus copper shall be 99.98 percent minimum. For all other forms, silver plus copper shall be 99.95 percent minimum.

2/ Bismuth - 0.001 percent maximum. For electroplating (anodes), tellurium and selenium shall each be 0.001 maximum.

3.2.1 When specified in the contract or order, a chemical analysis report, showing the percentage of each element, shall be furnished by the contractor.

3.3 Mechanical properties.

3.3.1 Tensile requirements for sheet and strip. Silver and silver alloy sheet and strip shall be capable of meeting the requirements of table II.

TABLE II. Tensile strength requirements, sheet and strip

Temper	Reduction in Brown & Sharpe Nos.	Percent reduction	Tensile strength, psi		Elongation, percent in 2 in., minimum
			Minimum	Maximum	
Grade A					
Annealed	0	-------	24,000	30,000	25
1/2 hard	2	-------	30,000	37,000	8
Hard	4	-------	37,000	44,000	3
Spring	8	-------	44,000	51,000	1
Grade B					
Annealed	0	-------	35,000	45,000	20
1/2 hard	2	21	46,000	55,000	4
Hard	4	37	54,000	62,000	2
Spring	8	60	63,000	70,000	1
Grade C					
Annealed	0	-------	36,000	47,000	20
1/2 hard	2	21	47,000	57,000	4
3/4 hard	3	29	53,000	63,000	2
Hard	4	37	58,000	68,000	1
Spring	8	60	67,000	75,000	1

3.3.2 Tensile requirements for wire and rod. Silver and silver alloy wire and rod shall be capable of meeting the requirements of table III.

TABLE III. Tensile strength requirements, wire and rod

Temper	Reduction in Brown & Sharpe Nos.	Percent reduction	Tensile strength, psi		Elongation, percent in 2 in. or 4X Diam., minimum
			Minimum	Maximum	
Grade A					
Annealed	0	-------	24,000	30,000	25
1/4 hard	1	21	30,000	37,000	4
Hard	4	60	42,000	49,000	2
Spring	8	84	46,000	54,000	1
Grade B					
Annealed	0	-------	35,000	45,000	20
1/4 hard	1	21	47,000	55,000	4
Hard	4	60	63,000	71,000	2
Spring	8	84	72,000	82,000	1
Grade C					
Annealed	0	-------	36,000	47,000	20
1/8 hard	1/2	11	42,000	52,000	8
1/4 hard	1	21	47,000	57,000	4
3/4 hard	3	50	61,000	71,000	3
Hard	4	60	65,000	74,000	2
Spring	8	84	74,000	82,000	1

3.3.3 Tensile requirements for other forms. The tensile properties of other forms, when required, shall be as specified in the contract or order, (see 6.2).

3.3.4 Bend requirements for sheet and strip. Sheet and strip, all grades, having a temper of 1/2 hard or less, shall be capable of being bent through 180° around a radius equal to the thickness of the sheet or strip without any signs of flaking or fracture.

3.3.5 Twist requirements for wire and rod. Wire and rod, grades B and C having a temper of 1/4 hard or less shall be capable of being twisted through 7 forward and 7 reverse 360° turns within a length of 3 inches without exhibiting seams, slivers, or other discontinuities that would be detrimental.

3.4 Microstructure. The microconstituents of grades B and C shall be uniformly distributed so that segregations are not present in the material.

3.5 Dimensions. The width, length, thickness and diameter of the material, as applicable, shall be as specified in the individual contract.

3.5.1 Dimensional tolerances

(a) Sheet and strip. Thickness, width, and straightness tolerances for sheet and strip shall conform to the requirements of tables IV, V, and VI, respectively. Thickness and width tolerances shall be plus and minus.

TABLE IV. Thickness tolerances, sheet and strip

Thickness, inch	Tolerance, ±inch		
	Up to 9 in. wide, incl.	Over 9 to 14 in. wide, incl.	Over 14 to 20 in. wide, incl.
Up to 0.004, incl.	0.0003	0.0005	------
Over 0.004 to 0.006, incl.	.0004	.0006	------
Over .006 to .009, incl.	.0006	.0008	0.0012
Over .009 to .013, incl.	.0008	.0010	.0015
Over .013 to .017, incl.	.0010	.0014	.0018
Over .017 to .021, incl.	.0012	.0016	.0020
Over .021 to .026, incl.	.0015	.0020	.0025
Over .026 to .037, incl.	.0020	.0020	.0025
Over .037 to .050, incl.	.0020	.0020	.0025
Over .050 to .073, incl.	.0025	.0025	.0030
Over .073 to .130, incl.	.0025	.0025	.0030
Over .130 to .187, incl.	.0030	.0030	.0030
Over .187 to .205, incl.	.0030	.0030	.0035
Over .205 to .300, incl.	.0030	.0030	.0035

TABLE V. Width tolerances, sheet and strip

Width, inches	Tolerance, ±inch					
	Slit metal			Square sheared metal	Sawed metal	
	Up to 0.062 in. thick, incl.	Over 0.062 to 0.125 in. thick, incl.	Over 0.125 in. thick		Up to 0.5 in. thick,	Over 0.5 in. thick
Up to 2, incl.	0.003	0.008	0.015	0.062	0.031	0.062
Over 2 to 6, incl.	.003	.015	.015	.062	.031	.062
Over 6 to 20, incl.	.005	.015	.015	.062	.031	.062

TABLE VI. Straightness tolerances, sheet and strip
(Maximum edgewise curvature in 6 feet.)

Width, inches	Tolerance, inch					
	Slit metal			Square sheared metal		Sawed metal
	Coiled	Flat	Flat and straightened	Up to 0.125 in. thick, incl.	Over 0.125 to 0.250 in. thick, incl.	
Up to 2, incl.	0.500	0.500	0.250	0.025	0.031	0.031
Over 2 to 6, incl.	.500	.500	-----	.025	.031	.031
Over 6 to 13, incl.	.500	.500	-----	.031	.062	.050

(b) Wire and rod. Diameter tolerances for wire and rod shall conform to the requirements of table VII. All tolerances shall be plus and minus.

TABLE VII. Diameter tolerances, wire and rod

Diameter, inch	Tolerance, ±inch
0.012 to 0.030, incl.	0.0002
Over .030 to .060, incl.	.0003
Over .060 to .187, incl.	.0005
Over .187 to .250, incl.	.0010
Over .250 to .375, incl.	.0015
Over .375 to .750, incl.	.0020

(c) Bar, plate, ingots, cathodes and anodes. The dimensional tolerances of bar, plate, ingots, cathodes and anodes as required, shall be as specified in the contract or order, (see 6.2).

3.6 Identification marking. Silver and silver alloys shall be legibly identified with the manufacturer's name, brand or trademark and the grade, temper, and specification number. Identification shall be such as not to adversely affect use of the material.

3.7 Workmanship. Silver and silver alloys furnished under this specification shall be free of dull surfaces, die marks and seams.

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

4.2 Classification of inspection. Inspection shall be classified as follows:

(a) Preproduction inspection.
(b) Acceptance inspection of individual lots.

4.2.1 Preproduction inspection. Preproduction inspection, when required (see 3.1) shall consist of the following:

(a) Chemical analysis (see 3.2 and 4.6.1)
(b) Tensile properties (see 3.3.1, 3.3.2, 3.3.3 and 4.6.2)
(c) Bend tests (see 3.3.4 and 4.6.3)
(d) Twist tests (see 3.3.5 and 4.6.4)
(e) Microscopic examination (see 3.4 and 4.7)
(f) Dimensions (see 3.5 and 4.5)
(g) Identification marking (see 3.6 and 4.5)
(h) Workmanship (see 3.7 and 4.5)

4.2.2 Lot acceptance inspection. Lot acceptance inspection shall consist of the inspection covered by 4.2.1 plus preparation for shipment (see section 5 and 4.5.2).

4.3 Lot. A lot shall consist of all silver material of the same grade, temper, form, and size in one shipment.

4.4 Sampling.

4.4.1 For preproduction testing. When specified in the contract or order, a representative sample of five units will be required to determine compliance with the requirements of the contract and specification. Preproduction tests will be accomplished at an activity designated by the procuring activity.

4.4.2 For acceptance testing.

(a) Sampling for chemical analysis. One sample shall be taken from each lot of silver material. Unless otherwise specified in the contract or order, the sample shall consist of approximately 10 grams of chips.

(b) Sampling for tension tests. Two tension test samples shall be taken from each lot.

(c) Sampling for bend and twist tests. Five samples each for the bend and twist tests shall be taken from each lot.

(d) Sampling for microscopic examination. Two samples for microscopic examination shall be taken from each lot.

(e) Sampling for examination. Unless otherwise specified in the contract or order, sampling for dimensional and workmanship examination shall be done in accordance with MIL-STD-105, Inspection Level II, AQL 1.0 percent. Samples for dimensional and workmanship examination shall be evaluated separately.

4.5 Examination. Each sample unit selected in accordance with 4.4.2(e) shall be visually and dimensionally examined to determine compliance with the requirements for dimensions (see 3.5), identification marking (see 3.6), and workmanship (see 3.7). Straightness of each sample unit shall be determined as specified in 4.5.1.

4.5.1 Straightness. Straightness shall be determined by placing the piece on a level surface so that the arc or departure from straightness is horizontal. The maximum depth of arc shall be measured to the nearest 1/32 inch by means of a straightedge and a steel scale.

4.5.2 Preparation for shipment. Examination of the packing and marking for shipment shall be made for conformance to the requirements of section 5.

4.6 Tests.

4.6.1 Chemical analysis. The samples selected in accordance with 4.4.2(a) shall be analyzed by the wet chemical method in accordance with method 111 of Fed. Test Method Std. No. 151 or the spectrochemical method in accordance with method 112 of Fed. Test Method Std. No. 151 to determine conformance to 3.2. In case of dispute, the analysis by method 111 shall be the basis for acceptance or rejection.

4.6.2 Tension tests. All tension tests shall be conducted in accordance with ASTM E 8.

4.6.3 Bend test. Samples selected in accordance with 4.4.2(c) shall be bent 180° around a radius equal to the thickness of the sheet or strip. Bends shall be made 90° to the direction of rolling. The material shall be examined for conformance to 3.3.4.

4.6.4 Twist test. Samples of grades B or C silver alloy having a temper of 1/4 hard or less, selected in accordance with 4.4.2(c), shall be subjected to 7 forward and 7 reverse 360° turns within a length of 3 inches. The material shall be examined for conformance to 3.3.5.

4.7 Microscopic examination. Samples selected in accordance with 4.4.2(d) shall be examined at a suitable magnification to determine compliance with 3.4.

4.8 Rejection.

4.8.1 Examination defects. Any sample unit having one or more defects shall be rejected. If the number of nonconforming sample units in the sample exceeds the acceptance number specified in MIL-STD-105 for that sample size, the entire lot shall be rejected, subject to the resubmittal paragraph of MIL-STD-105.

4.8.2 Test failures. A lot shall be rejected for failure to meet any of the test requirements when tested in accordance with 4.6 and 4.7, subject to the retest provisions of Fed. Test Method Std. No. 151.

5. PREPARATION FOR DELIVERY

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

5.1.1 Level A. The silver material shall be wrapped in grade A paper conforming to MIL-B-121.

5.1.1.1 Unless otherwise specified on the contract or order, the inside diameter of material supplied in coils or on spools shall be in accordance with the supplier's standard practice.

5.1.2 Level C. The silver material shall be packaged in accordance with the manufacturers' standard commercial practice.

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

5.2.1 Level A. The silver material packaged as specified in 5.1 shall be packed in close fitting boxes of the overseas class or type, conforming to one of the following specifications: PPP-B-576, PPP-B-601, PPP-B-621, PPP-B-636 or PPP-B-640.

5.2.1.1 Unless otherwise specified, wood and wood-cleated containers shall be lined with a case liner conforming to MIL-L-10547 and sealed in accordance with the appendix of that specification. Fiberboard boxes closed, waterproofed and reinforced in accordance with the appendix of the box specification will not require case liners.

5.2.1.2 Unless otherwise specified in the contract or order, the gross weight of wood or wood cleated boxes shall not exceed 200 pounds, and the gross weight of fiberboard boxes shall not exceed the limitations of PPP-B-636. If a gross weight exceeding 200 pounds is authorized for wood or wood cleated boxes, the boxes shall be provided with skids.

5.2.1.3 Strapping and closure shall be in accordance with the appendix to the applicable container specification.

5.2.2 Level B. The silver material packaged as specified in 5.1 shall be packed in close fitting boxes defined under paragraph 5.2.1, except the containers shall be of the domestic type or class and case liners will not be required.

5.2.3 Level C. All silver material, packaged as specified (see 6.2), shall be packed in containers to provide a compact and non-shifting load and to insure acceptance at destination. Containers, shipments and container closures shall comply with carrier regulations as applicable to the mode of transportation.

5.3 Marking. Unless otherwise specified in the contract or order, marking of shipments shall be in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. This silver is intended for use in the following types of applications:

6.1.1 All types of electrical contacts such as headed rivets, springs, wire, composite forms, slip rings, and special assemblies for make and break and sliding contact applications.

6.1.2 Applications where mechanical strength and hardness are required with high thermal and electrical conductivity.

6.1.3 Anodes are for use in electroplating.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Grade, form, and temper required (see 1.2).
(c) When preproduction samples are required (see 3.1).
(d) When a chemical analysis report is required (see 3.2.1).
(e) When required, mechanical properties of bar, plate, ingots, and cathodes (see 3.3).
(f) Dimensions required (see 3.5).
(g) When strip is to be furnished in lengths, other than random flat lengths or supplied in coils or on spools in accordance with supplier's standard practice (see 3.5).
(h) Dimensional tolerances of bar, plate, ingots, cathodes and anodes (see 3.5.1(c)).
(i) When a sample for chemical analysis of other than 10 grams is required (see 4.4.2(a)).
(j) When sampling for examination other than in accordance with 4.4.2(e) is required (see 4.4.2(e)).
(k) Maximum gross weight of containers with contents.
(l) Special marking, if required (see 5.3).
(m) Packaging and packing level required (see 5.1 and 5.2).

6.3 Grade A silver is commercially known as "999.0 fine silver", grade B as sterling or "925.0 fine", and Grade C as "coin silver" or "900.0 fine".

6.4 Resistivity and electrical conductivity of silver materials. The resistivity and electrical conductivity of the silver materials covered by this specification are shown in table VIII for information only.

TABLE VIII. Resistivity and electrical conductivity

Form	Grade	Temper	ρ, Resistivity, microhms/cm^3 max.	Electrical conductivity percent min. IACS[1]
Sheet and strip	A	Annealed	1.724	100
		1/2 hard	1.749	98
		Hard	1.777	97
		Spring	1.796	96
	B	Annealed	2.155	80
		1/2 hard	2.211	78
		Hard	2.298	75
		Spring	2.298	75
	C	Annealed	2.052	84
		1/2 hard	2.102	82
		3/4 hard	2.128	81
		Hard	2.155	80
		Spring	2.298	75
Wire and rod	A	Annealed	1.724	100
		1/4 hard	1.749	98
		Hard	1.796	96
		Spring	1.815	95
	B	Annealed	2.155	80
		1/4 hard	2.211	78
		Hard	2.298	75
		Spring	2.298	75
	C	Annealed	2.052	84
		1/8 hard	2.102	82
		1/4 hard	2.102	82
		3/4 hard	2.128	81
		Hard	2.155	80
		Spring	2.298	75

1 International Annealed Copper Standard (Based on Copper = 100% Conductivity). See Bureau of Standards Circular No. 31.

6.5 In the interest of economy, it is desired in packing that fiberboard boxes be used to the greatest extent practicable.

Custodians:
Army - MR
Navy - AS
Air Force - 84

Review:
Army - MU, MI
Navy - AS

User:
Army - ME
Air Force - 11

Preparing activity:
Army - MR

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