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16 January 1981
SUPERSEDING
MIL-R-17131B
24 August 1973
(See 6.3)

MILITARY SPECIFICATION

RODS AND POWDERS, WELDING, SURFACING

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

1. SCOPE

1.1 Scope. This specification covers welding rods and powders to be used for the purpose of overlaying with a material resistant to erosion and abrasion,

1.2 Classification. Welding rods and powders shall be of the following forms, types and sizes as shown in table I, as specified (see 6.2.1).

TABLE I. Forms, types, and sizes.

Form	Type	Size
		Diameter (inches)
Rods	MIL-RCoCr-A-1, -2, and -3 MIL-RCoCr-C-1 and -2 MIL-RNiCr-B-1 and -2 MIL-RNiCr-C-1 and -2 MIL-RNiCr-D-2 MIL-FReMoC MIL-RFeCrCo	1/8 (0.125) 3/16 (0.188) 1/4 (0.250) 5/16 (0.313) 3/8 (0.375)
Powders	MIL-PNiCr-B-2 MIL-PNiCr-C-2 MIL-PNiCr-D-2 MIL-PCoCr-E-1 and -2	Mesh, ASTM sieve 80/325

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 3112, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

20 APPLICABLE DOCUMENTS

201 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 specification to the extent specified herein,

SPECIFICATIONS

MILITARY

MIL-B-117 - Bags, Sleeves and Tubing - Interior Packaging,
MIL-W-10430 - Welding Rods and Electrodes; Preparation for Delivery of.,
MIL-I-45208 - Inspection System Requirements.

STANDARDS

FEDERAL

FED-STD-151 - Metals; Test Methods.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

PUBLICATION

NAVAL SEA SYSTEMS COMMAND

NAVSEA 0900-LP-003-8000 - Surface Inspection Acceptance Standards for Metals.

(Copies of specifications, standards, drawings, and publications required by contractors 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 NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

Z49.1 - Safety in Welding and Cutting.

(Application 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)

B 214 - Sieve Analysis of Granular Metal Powders.

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

AMERICAN WELDING SOCIETY (AWS)
A3. 0 - Welding Terms and Definitions.

(Application for copies should be addressed to the American Welding Society, Inc., 2501 N.W. 7th Street, Miami, FL 33125.)

DEPARTMENT OF LABOR
Code of Federal Regulations, Title 29
Part 1910 - Occupational Safety and Health Standards.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

UNIFORM CLASSIFICATION COMMITTEE AGENT
Uniform Freight Classification Ratings, Rules and Regulations,

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South 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.)

39 REQUIREMENTS

3.1 Definitions. For the purpose of this specification, the welding terms and definitions contained in AWS A3.0 shall apply

3.2" Materials, Mater ials shall be such as to produce rods and powders conforming to the requirements of this specification.

3.2.1 Contamination. The contractor shall maintain process control procedures in order to prevent contamination of the surfacing filler metals, especially by the sources specified in 3.2.1.1 through 3.2.1.4.

3.2.1.1 Marking material. Marking material containing halogens, antimony, arsenic, bismuth, copper, lead, phosphorus, sulfur, tin, or zinc in excess of 250 parts per million (p/m) each, shall not be used for identification. Paints shall not be used.

3.2.1.2 Lubricants. Lubricants used in machining, grinding or other cold processing," marking materials used for in-process identification, and other possible contaminants such as sulfur, lead, or iron from grinding wheels, shall be removed pr ior to any heat treatment, hot forming or welding.

3.2.1.3 supplies. Supplies which come into contact with the surfacing filler metals during processing shall not contain any element Which under processing operations could adversely affect the properties of the material.

3.2.1.4 Mercury, During the manufacturing process, examination and tests, the surfacing filler metals shall not have come in direct contact with mercury or any of" its compounds nor with any mercury containing devvice employing a single boundary of containment.

3. 2.1.5 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term 'recovered materials means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.3 Size.

3.3.1 Length. Unless otherwise specified (see 6.2.1), welding rods shall be furnished in standard lengths of 12 to 18 inches. A minimum length of 8 inches may be furnished but no more than 20 percent of any order shall be shorter than the standard length.

3.3,2 Nominal diameter. The nominal diameter of rods shall be in accordance with table I.

3.3.2.1 Tolerance on diameter. The actual diameter of any rod shall not vary more than 15 percent from the nominal diameter.

3.3.3 Nominal mesh size. The nominal mesh size range of powder shall be in accordance with table I.

3.3.3.1 Tolerance on mesh size. The total weight of powder larger and smaller than the nominal mesh size range shall not exceed 2 percent *of* the sieve analysis sample weight.

3.4 Surfacing filler metal identification.

3.4.1 Rod identification. At least one legible rod type designation or classification number (see table II) shall be applied to each rod approximately 1 inch from one end. The designation shall be applied by imprinting: indenting *or* attaching a pressure- sensitive plastic-coated tape imprinted with the designation. Equal-size block characters shall be used. Their height shall be approximately 50 to 100 percent of the rod diameter but need not exceed 5/32 inch height. The imprints shall be made with fade-proof ink which is resistant to damage by oils, solvents, atmospheric conditions, shipping, handling and use.

3.4.2 Powder identification. At least one legible powder type designation or classification number (see table 111) shall be applied to each unit container of powder. The designation shall be imprinted on the unit container or imprinted on a pressure-sensitive plastic coated tape and attached to the unit container. Equal-size block characters approximately 5/32 inch high shall be used. The imprints shall be made With fade-proof ink which shall be resistant to damage by oils, solvents, atmospheric conditions, shipping, handling, and use.

3.5 Chemical composition. The surfacing filler metals shall conform to the chemical composition shown in table II for rods and table III for powders.

TABLE II. Chemical composition[1/] percent[2/] (by weight) of rods.

Type	Chromium	Cobalt	Nickel	Boron	Tungsten	Molybdenum	Carbon	Iron	Silicon	Manganese	Other elements
MIL-RCoCr-A-1	26.0-32.0	Remainder	3.0	--------	3.0-6.0	1.0	0.9-1.4	3.0	0.4-2.0	1.0	0.5
MIL-RCoCr-A-2	26.0-32.0	Remainder	3.0	--------	3.0-6.0	1.0	0.9-1.4	0.5	0.4-2.0	1.0	0.5
MIL-RCoCr-A-3	28.0-32.0	Remainder	1.5	--------	5.0-6.0	1.0	1.2-1.4	1.25	1.2-1.4	0.5	0.5
MIL-RCoCr-C-1	26.0-33.0	Remainder	3.0	--------	11.0-14.0	1.0	2.0-3.0	3.0	0.4-2.0	1.0	0.5
MIL-RCoCr-C-2	25.0-33.0	Remainder	3.0	--------	11.0-14.0	1.0	2.0-3.0	0.5	0.4-2.0	1.0	0.5
MIL-RNiCr-B-1	10.0-16.0	1.25	71.0-81.0	2.0-4.0	---------	--------	0.40-0.8	3.0-5.0	3.0-5.0	---	1.0
MIL-RNiCr-B-2	10.0-12.5	0.20	78.0-83.0	2.0-2.75	---------	--------	0.45-0.65	0.50	3.0-5.0	---	0.5
MIL-RNiCr-C-1	12.0-18.0	1.00	65.0-75.0	2.5-4.5	---------	--------	0.50-1.0	3.5-5.5	3.5-5.5	---	1.0
MIL-RNiCr-C-2	13.5-16.0	0.20	72.0-78.0	3.0-4.0	---------	--------	0.65-0.85	0.5	3.5-5.5	---	0.5
MIL-RNiCr-D-2	24.0-28.0	0.20	63.0-68.0	3.0-3.75	---------	--------	0.85-1.05	0.5	3.75-4.5	---	0.5
MIL-RFeMoC	1.50	---------	---------	--------	---------	9.0-11.0	3.5-4.0	Remainder	1.0	1.0	3.0
MIL-RFeCrCo	22.0-27.0	21.0-30.0	12.0-16.0	--------	---------	7.0-9.0	2.25-2.75	Remainder	2.0	---	0.5

1/ Analysis shall be made for the elements for which specific values are shown in table II. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements

TABLE III. Chemical composition[1/] percent[2/] (by weight) of powders.

Type	Chromium	Cobalt	Nickel	Boron	Tungsten	Molybdenum	Carbon	Iron	Silicon	Manganese	Other elements
MIL-PNiCr-B-2	10.0-12.5	0.20	Remainder	2.00-2.75	-------	-------	0.45-0.65	0.5	3.0-5.0	-------	0.5
MIL-PNiCr-C-2	13.5-16.0	0.20	Remainder	3.0-4.0	-------	-------	0.65-0.85	0.5	3.5-5.5	-------	0.5
MIL-PNiCr-D-2	24.0-28.0	0.20	Remainder	3.0-3.75	-------	-------	0.85-1.05	0.5	3.75-4.50	-------	0.5
MIL-PCoCr-E-1	26.5-30.0	Remainder	3.0	---------	3.5-4.5	1.0	1.40-1.80	0.5	0.70-1.50	0.5	0.5
MIL-PCoCr-E-2	28.0-32.0	Remainder	3.0 max	---------	7.0-9.5	1.0 max	1.10-1.70	0.75 max	1.0 max	1.0 max	0.5

[1/] Analysis shall be made for the elements for which specific values are shown in table III. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements is not present in excess of the limits specified in "Other elements" in the last column in the table.

[2/] Single values shown are maximum percentages.

3.6 Surface finish. Rods shall be of uniform quality and free from segregation, oxides, slivers, seams, or other irregularities which would impair their usefulness.

3.7 Usability.

3.7.1 During deposition, the filler metal shall flow freely and smoothly over the surface of the test plate previous deposit without boiling or excessive activity (see 4,3.3.4).

3.7.2 The weld metal surface shall be free of slag inclusions and porosity.

3.7.3 The deposited surfacing material shall meet the requirements of NAVSEA 0900-LP-O03-8000 for liquid penetrant inspection (see 4.3.3.4) of hard surfacing material of valves and valve seats.

3.8 Alloy identity. Each end of wire to be spliced during processing shall be tested for alloy identity (see 4.3.3.1), except when splicing is done to repair a wire break without removing the wire from the process line.

3.8.1 Both ends of each wire, drawn to finish size, shall be tested for alloy identity (see 4.3.3.1) before cutting to length.

3.9 Production equipment. When a change is made in a production run of one MIL-type rod or powder to another, inspection shall be performed prior to starting the new run to assure that equipment and process lines are purged of material from the previous production run. This inspection shall be performed for all equipment used in manufacturing operations where the material is not segregated and positively identified, e.g., cutting to length.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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.

4.1.1 Inspection system. The contractor shall provide and maintain an inspection system accept ible to the Government for supplies and services covered by this specification. The inspection system shall be in accordance with MIL-I-45208.

4.2 Sampling for quality conformance inspection.

4,2.1 Lot definition.

4.2.1.1 All inspection and tests except the weld test. All rods and powder of the same type ard size produced from the same heat or melt at one plant shall be considered a lot.

4.2.1.2 Weld test. All rods or powders of the same type produced from the same heat or melt at one plant regardless of size shall be considered a lot for the purpose of the weld test.

4.2.1.3 Lot identification. Each heat or melt shall be uniquely identified by the filler metal manufacturer's control number or other marking which shall appear on each unit package and shipping container. The marking which designates the lot shall be in a position which permits ready location by the consignee. If control numbers or symbols must be decoded for identification of the heat or melt, the manufacturer shall furnish the consignee the key or instruction necessary to interpret the code system used.

4.2.2 Smpling for inspection of filled containers.

4.2,2.1 Filled shipping containers. From each lot as defined in 4.2.1,1, a random sample of shipping containers filled with unit containers of rods or powder shall be selected in accordance with MIL-STD-105 at inspection level S-4 and acceptable quality level (AQL) 6.5 to verify compliance with section 5.

4.2.2.2 Filled unit containers. From each lot as defined in 4.2.1.1, a random sample of filled unit containers shall be selected in accordance with MIL-STD-105 at inspection level S-4 and acceptable quality level 6.5 to verify compliance with section 5.

4.2.3 Sampling for inspection of rods or powders.

4.2.3.1 Visual and dimensional examination of rods. From each lot as defined in 4.2,1.1, a random sample of rods shall be selected in accordance with MIL-STD-105 at inspection level S-4 and acceptable quality level 4.0 to verify compliance with this specification. Lot size shall be expressed in pounds. Sample size shall be the number of electrodes to be examined. The rods selected in this sample shall be taken from packages selected in the packaging inspection sample (see 4.2.2.1).

4.2,3.2 Chemical analysis. From each lot as defined in 4.2.1.1, a sufficient quantity of rods or powders shall be randomly selected from each of two packages to provide one sample for chemical analysis in accordance with 4.3.3.2.

4.2.3.3 Sieve analysis. From each lot as defined in 4.2.1.1, a quantity of powder shall be selected from separate packages to form two separate samples. The sample size shall be 100 grams when the-powder density is greater than 1,50 grams. per cubic centimeter, (g/cm^3) 50 grams when less than 1,50 g/cm^3 (see 4.3.3.3).

4.2.3.4 Weld test. From each lot as defined in 4.2.1,2, a sufficient quantity of rods or powders shall be randomly selected from each of two packages for the weld test of 4.3.3.4.

4.3 Quality conformance inspection.

4.3.1 Containers.

4,3,1.1 Procedure, Each of the filled shipping containers selected in accordance with 4. 2.2.1 and each unit package selected in accordance with 4.2.2.2 shall be examined for defects of construction, unsatisfactory markings, and for weight of contents.

4.3.1.2 Acceptance criteria. Any filled shipping container or unit package with one or more defects shall be rejected. If the number of defective filled shipping containers or unit-packages exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.3.2 Visual and dimensional examination.

4.3.2.1 Procedure. Each of the sample rods selected in accordance with 4.2.3.1 shall be examined to determine conformance with the requirements of 3.3, 3,4, and 3.6.

4.3.2.2 Acceptance criteria, Any rod with one or more defects shall be rejected. If the number of rods exceeds the acceptance number for the expropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.3.3 Tests.

4.3.3.1 Alloy identity

4.3.3. 1.1 Procedure. The alloy identity test method may include chemical analysis, metal sorting devices, other approved methods, or a combination of methods. The test method shall be-approved by the Naval Sea Systems Command, Department of the Navy, Washington, DC 20362.

4.3. 3.1.2 Acceptance criteria. If the test demonstrates that the material does not conform to the type specified, the material shall be rejected.

4.3.3.2 Chemical analysis

4.3.3.2.1 Procedure, Chemical analysis shall be performed in accordance with FED-STD-151.

4,3. 3.2.2 Acceptance criteria. If any sample fails to conform to the requirements specified in table II or table III, as applicable, the lot of material represented by the sample shall be rejected.

4.3.3.3 Sieve analysis.

4,3,3.3,1 Procedure. The samples selected in accordance with 4.2.3.3 shall be tested in accordance with ASTM B 214.

4,3. 3.3.2 Acceptance criteria. A lot represented by a sieve analysis in which the sum of the weight of the sample retained on the 80 mesh sieve plus the weight of the sample passed through the 325 mesh sieve exceeds 2 percent of the sample weight shall be rejected.

4.3.3.4 Weld test (when specified (see 6.2.1)).

4.3.3.4,1 Procedure. Test assemblies shall be prepared on which samples obtained in accordance with 4.2.3.4 shall be deposited by hard-surfacing processes as specified below:

MIL-RCoCr-A-l
MIL-RCoCr-A-2 - Oxyacetylene (1-1/2 to 3X feather)
MIL-RCoCr-A-3 - Tungsten Inert Gas Welding (TIG)
All other rods - As specified by the command or agency concerned (see 6.2.1)
All powders - Plasma Transferred Arc (PTA)

A minimum overlay of four square inches minimum shall be deposited, consisting of three layers for rods and two layers for powder, on a test piece six inches by three inches by 3/4 inch minimum As an alternate for powders, the test piece may be two to three inches in diameter by six inches minimum length. The test piece shall be a weldable grade of low carbon steel for deposits of cobalt, nickel and iron base rods and type 302 or 304 stainless steel for all powder deposits, unless otherwise specified by the command or agency concerned. During welding the operating characteristics shall be noted and compliance with 3.7 verified. After cooling and visual examination of the finished weld, the surface of the overlay shall be ground smooth and five randomly located hardness readings taken. After hardness testing, the assembly shall be sectioned to provide a minimum of three coupons for macro-examination at 10X magnification in the polished and etched condition.

4.3,3.4.2 Acceptance criteria, weldability. If any sample fails to conform to the requirements of 3.7, the lot represented by the sample shall be rejected.

4. 3.3.4.3 Acceptance criteria, visual examination. If any sample fails to conform to the requirements of 3.7, the lot represented by the sample shall be rejected,

4.3.3,4.4 Acceptance criteria, hardness. The minimum hardness of the overlay shall be as specified (see 6.2.1).

4.3.3.4.5 Acceptance criteria, macro-examination. The macro surfa being examined shall be evaluated for porosity to the weld acceptance standard for class 2, (1/4 inch thickness) of NAVSEA 0900-LP-003-800. No lack of bond is permitted. .

4.3.4 Certificate of tests. A certificate of quality conformance of the tests specified in 4.3.3 (i.e., chemical analysis, sieve analysi when applicable, and hardness when required) containing actual quantita test results including the process and range of amperage employed in ma the required usability test for quality conformance inspection for eac accepted lot included in a particular shipment shall be furnished to th consignee with the shipment. The quality conformance test result data shall be submitted on the form shown on figure 1.

4.3.5 Replacement, retest, rejection, and resubmittal.

4.3.5.1 Replacement of test specimens. A test specimen may be discarded and a replacement test specimen selected in accordance with FED-STD-151.

4.3.5.2 Retest for chemical analysis.

4.3.5.2. 1 When one or more representative test specimen(s) does n conform to specification requirements for the tested characteristic, or a single retest of each nonconforming characteristic may be performed t establish product acceptability.

4,3.5.2.2 Retests shall be performed on twice the number of representative specimens that were originally nonconforming. Retest specimens shall be taken from the same sampling pieces and adjacent to the original nonconforming specimen.

4,3.5.2.3 Retest for other tests or examination are not permitted

4.3.5.3 Rejection. When any retest specimen does not conform to specification requirements for the characteristic being retested, the l represented by that specimen shall be rejected.

4.3.5.4 Resubmittal of rejected lots. A rejected lot may be resubmitted for acceptance testing provided that the rejected lot is reworked, as necessary to correct the nonconforming condition. Reworki shall consist of any procedure required to correct physical, mechanical or dimensional deficiencies in nonconforming material or In nonconformi unit packages and shipping containers to meet specification requirement without adversely affecting its other required characteristics.

4.3.5.5 When a rejected lot consists of more than one piece, each remaining piece in the lot may be tested for the nonconforming characteristic and each piece that conforms to specification requiremer may be offered for acceptance.

4.4 Packaging inspection. The packaging, packing, and marking sha be inspected for compliance with section 5 of this document.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions.)

5.1 Packaging.

5.1.1 Rods. Rods shall be packaged level A in class 6a unit containers or level C in accordance with MIL-W-10430 (see 6,2,1). The container net weight shall be 5 or 10 pounds (see 6.2.1).

5.1.2 Powder levels A and C. Powder shall be packaged in units of 10 pounds maximum In resealable, moistureproof plastic or metal containers. Plastic bags, when used, shall conform to MIL-B-117, and shall be cushioned and placed within a carton, can, or container to prohibit movement or damage to the bag.

5.2 Packing.

5.2.1 Rods. Rods packaged as specified shall be packed level A, B or C as specified (see 6.2.1) in accordance with MIL-W-10430.

5.2.2 Powder. Powder packaged as specified In 5.1.2 shall be packed for the level specified as follows:

(a) Level B shipping container shall be as specified under level A packing of MIL-W-10430 for class la and class 1c containers.
(b) Level B shipping containers shall be as specified under level B packing of MIL-W-1043O for class 1c containers.
(c) Level C shipping containers shall conform to the level C packing requirements of MIL-W-10430.

5,3 Marking. In addition to any special marking required (see 6.2.1) or herein, marking shall be in accordance with MIL-W-10430.

5.3.1 Special marking. In addition to the marking requirements for interior packages cited in MIL-W-10430, unit containers and exterior packages shall include the National Stock Number when furnished with the

contract or order. In addition all interior packages shall carry the following caution label, as a minimum, or equal prominently displayed legible type on the package:

WARNING: Protect yourself and others. Read and understand this lab

FUMES AND GASES can be dangerous to your health. ARC RAYS can injur eyes and burn skin. ELECTRIC SHOCK can kill.

Read and understand the manufacturer's instructions and your employer's safety practices.
Keep your head out of the fumes.
Use enough general ventilation or exhaust at the arc or both to keep fumes and gases from your breathing zone, and the general area.
Wear correct eye, ear and body protection.
Do not touch live electrical parts.
See American National Standard Z49.1 "Safety in Welding and Cutting" published by the American Welding Society, 2501 N.W. 7th St., Miami, FL 33125; OSHA Safety and Health Standards, 29 CFR 1910, are for sale from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

DO NOT REMOVE THIS LABEL

Significant toxic constituents when present in the rods or powder in greater than trace amounts shall be identified on the caution label so that normal ventilation can be increased accordingly. These constitue include but are not limited to those itemized in the applicable sectio of ANSI Z49.1.

6. NOTES

6.1 Intended use. The welding rods and powders covered by this specification are intended for applications for resisting wear and imp covering a range of conditions where corrosion, erosion, and abrasion considered factors in choosing the proper rod or powder. The inter- changeable use of basic types should not be done without the approval the command or agency concerned.

6.1.1 Types MIL-RCoCr-A-l and -2. Rod types HIL-RCoCr-A-l and -2 are intended for deposition by the oxyacetylene process. Carbon picku from the oxyacetylene flame, which is characteristic of this process, usually necessary to obtain desirable hardness levels in the hardsurfa deposit.

6.1.2 Type MIL-RCoCr-A-3. Rod type MIL-RCoCr-A-3 is intended for deposition by the tungsten- inert gas (TIC) process and contains sufficient carbon to attain desirable hardness levels in the hardsurfaced deposit. Deposition by the oxyacetylene process will increase the carbon content and hardness of the deposit and may result in excessively hard and brittle deposits. Therefore, this type of rod should not be used with the oxyacetylene process.

6.1.3 Type MIL-RCoCr-C. This alloy is more resistant to abrasion than type MIL-RUoCr-A and will attain a minimum hardness of 50 Rockwell C. It is more brittle, of higher strength, and considerably less resistant to thermal shock.

6.1.4 Type MIL-RNiCr-B. This alloy is similar to types MIL-RFeCrCo, MIL-RNiCr-C, and MIL-RNiCr-D in respect to hardness and resistance to certain types of abrasion.

6.1.5 Type MIL-RNiCr-C. This alloy is similar to type MIL-RCoCr-C in respect to hardness and resistance to certain types of abrasion and intended for use with tank sprockets.

6.1.6 Type MIL-RNiCr-D. This alloy iS similar to types MIL-RFeCrCo, MIL-RNiCr-B, and MIL-RNiCr-C in respect to hardness and resistance to certain types of abrasion.

6.1.7 Type MIL-RFeMoC. This alloy is intended for use with tank treads, pins, and bearings.

6,1,8 Type MIL-RFeCrCo. This alloy is similar in hardness and resistance to certain types of abrasion, to type NIL-RCoCr-A. For some purposes it is an alternate and may be used interchangeably.

6.1.9 Type MIL-PCoCr-E-l . This alloy may be expected to attain a minimum hardness of 43 Rockwell C. It has intermediate properties between type MIL-RCoCr-A and MIL-RCoCr-C.

6.1.10 Type MIL-PCoCr-E-2. This alloy is more resistant to abrasion than MIL-PCoCr-E-l. It is somewhat less resistant to thermal shock.

6.1.11 Hardsurfacing processes. For purposes of specifying a process to make the usability test, rods are commonly deposited by oxyacetylene gas welding or by inert gas tungsten arc welding while it Is recommended that powders be deposited by the plasma transferred arc process.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number and date of this specification. .
(b) Form , type, size, and quantity required (see l.2).
(c) Specify rod nominal length and its length tolerance, if required (see 3.3.1),
(d) Additional marking and standard or National stock number.

(e) Weld test, if required (see 4.3.3.4).
(f) Weld test assembly hard surfacing process for all other rods other than MIL-RCoCr-A-1, -2, and -3 (see 4.3.3.4.1).
(g) Minimum hardness value (see 4.3.3.4.4).
(h) Size of unit package required (see 5.1.1).
(i) Applicable levels of packaging and packing required (see 5.1 and 5.2).
(j) Special marking, if required (see 5.3).

6.2.2 Rods and powders shall be ordered by the pound.

6,3 Changes from previous issue. Asterisks (*) are not used in this revision to identify changes with respect to the previous Issue, due to the extensiveness of the changes.

Custodians:
Army - AR
Navy - SH
Air Force - 11
Review activities:
Navy - AS
DLA - GS
User activities:
Navy - tic, OS

Preparing activity:
Navy - SH
(Project 3439-0377)

CERTIFICATION OF QUALITY CONFORMANCE TESTS

Manufacturer or Distributor _____ Customer's Name _____

Address _____

Date _____ Customer's Order No. _____

Specification MIL-_____

Type MIL-_____

Diameter & Length _____ Hardness Readings

Lot No. _____ 1. _____

Chemical Analysis 2. _____
Complete

3. _____

Chromium _____ 4. _____

Cobalt _____ 5. _____

Nickel _____

Boron _____

Tungsten _____ Sieve Analysis (Weight-percent)

Molybdenum _____ Retained on No. 80 Sieve _____

Carbon _____ Passing No. 325 Sieve _____

Iron _____ Total _____

Silicon _____ Alloy identity tests:
(a) Core wire _____

Manganese _____ (b) Finished electrodes _____
(if required (see 3.8))

Weld Test Assembly

Type of hard facing process used _____
Range of amperage employed _____

We hereby certify that the above material has been tested in accordance with the listed specification and is in conformance with all requirements.

_____

NOTES:
1. Items not applicable to the type of surfacing filler metal involved shall be marked N/A.
2. See 4.3.4.

FIGURE 1. Certification of quality conformance tests.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

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	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

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