

# AEROSPACE MATERIAL SPECIFICATION



AMS 5821F

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Superseding AMS 5821E

Steel, Corrosion Resistant, Welding Wire  
12Cr (SAE 51410 Modified)  
Ferrite Control Grade

UNS S41081

## 1. SCOPE:

### 1.1 Form:

This specification covers a corrosion-resistant steel in the form of welding wire.

### 1.2 Application:

This wire has been used typically as filler metal for gas-tungsten-arc or gas-metal-arc welding of corrosion-resistant steels of similar composition where the weld area is required to have strength and corrosion resistance comparable to those of the parent metal and ferrite control of the wire is provided by the composition (See 3.1), but usage is not limited to such applications.

## 2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

### 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2248	Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2813	Packaging and Marking of Packages of Welding Wire, Standard Method
AMS 2814	Packaging and Marking of Packages of Welding Wire, Premium Quality

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## 2.1 (Continued):

AMS 2816	Identification, Welding Wire, Tab Marking Method
AMS 2819	Identification, Welding Wire, Direct Color Code System
AMS 5505	Steel Sheet, Strip, and Plate, Corrosion and Moderate Heat Resistant, 12Cr (SAE 51410 Modified), Ferrite Controlled, Annealed
ARP1876	Weldability Test for Weld Filler Metal Wire
ARP4926	Alloy Verification and Chemical Analysis Inspection of Welding Wire

## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 353	Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

## 3. TECHNICAL REQUIREMENTS:

## 3.1 Composition:

Wire shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon (3.1.3)	0.11	0.15
Manganese	--	0.60
Silicon	--	0.50
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	11.50	12.50
Nickel	--	0.75
Molybdenum	--	0.20
Aluminum	--	0.05
Copper	--	0.50
Tin	--	0.05
Nitrogen	--	0.08

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2248.

3.1.2 Chemical analysis of initial ingot, bar, or rod stock before drawing, other than those analyses required to be done on the finished wire, is acceptable provided the processes used for drawing or rolling, annealing, and cleaning, are controlled to ensure continued conformance to chemical composition requirements.

3.1.3 Shall be determined on the finished wire.

3.2 Condition:

Cold worked, annealed, descaled, and bright finished in a temper and with a surface finish which will provide proper feeding of the wire in machine welding equipment.

3.3 Fabrication:

3.3.1 Wire shall be formed from rod or bar descaled by a process which does not affect the composition of the wire. Surface irregularities inherent with a forming process that does not tear the wire surfaces are acceptable provided the wire conforms to the tolerances of 3.6.

3.3.2 Butt welding is permissible provided both ends to be joined are alloy verified using a method capable of distinguishing the alloy from all other alloys processed in the facility, or the repair is made at the wire processing station. The butt weld shall not interfere with uniform, uninterrupted feeding of the wire in machine welding.

3.3.3 In-process annealing, if required, between cold rolling or drawing operations, shall be performed in vacuum or protective atmospheres to ensure freedom from surface oxidation and absorption of other extraneous elements.

3.3.4 Residual elements, drawing compounds, oxides, dirt, oil, dissolved gasses and other foreign materials picked up during wire processing that can adversely affect the welding characteristics, the operation of the equipment, or the properties of the weld metal, shall be removed by cleaning processes that will neither result in pitting nor cause gas absorption by the wire or deposition of substances harmful to welding operations.

3.4 Properties:

Wire shall conform to the following requirements:

3.4.1 Weldability: Melted wire shall flow smoothly and evenly during welding and shall produce acceptable welds. ARP1876 may be used to resolve disputes.

3.4.2 Response to Heat Treatment: Weld metal deposits, approximately 1/4 inch (6.4 mm) thick, on AMS 5505 steel sheet shall have hardness of 39 to 44 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18, after being heated to 1700 °F ± 10 (927 °C ± 6), held at heat for 60 minutes ± 6, and cooled in still air and double tempered by heating to 600 °F ± 10 (315 °C ± 5), holding at heat for 2 hours ± 0.25, cooling in still air, reheating to 600 °F ± 10 (316 °C ± 6), holding at heat for 2 hours ± 0.25, and cooling in still air.

3.4.3 Spooled Wire: Shall conform to 3.4.3.1 and 3.4.3.2.

3.4.3.1 Cast: Wire, wound on standard 12 inch (305 mm) diameter spools, shall have imparted to it a curvature such that a specimen sufficient in length to form one loop with a 1-inch (25-mm) overlap, when cut from the spool and laid on a flat surface, shall form a circle 15 to 50 inches (381 to 1270 mm) in diameter.

3.4.3.2 Helix: The specimen on which cast was determined, when laid on a flat surface and measured between adjacent turns, shall show a vertical separation not greater than 1 inch (25 mm).

3.5 Quality:

Wire, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to welding operations, operation of welding equipment, or properties of the deposited weld metal.

3.6 Sizes and Tolerances:

Wire shall be supplied in the sizes and to the tolerances shown in 3.6.1 and 3.6.2.

3.6.1 Diameter: Shall be as shown in Table 2.

TABLE 2A - Sizes and Diameter Tolerances, Inch/Pound Units

Form	Nominal Diameter Inch	Tolerance	
		Inch Plus	Inch Minus
Cut Lengths	0.030, 0.035, 0.045	0.001	0.001
Cut Lengths	0.062, 0.078, 0.094, 0.125, 0.156, 0.187	0.002	0.002
Spools	0.007, 0.010, 0.015	0.0005	0.0005
Spools	0.020, 0.030, 0.035, 0.045	0.001	0.001
Spools	0.062, 0.078, 0.094	0.002	0.002

TABLE 2B - Standard Diameters and Tolerances, SI Units

Form	Nominal Diameter Millimeters	Tolerance	Tolerance
		Millimeter Plus	Millimeter Minus
Cut Lengths	0.76, 0.89, 1.14	0.025	0.025
Cut Lengths	1.57, 1.98, 2.39, 3.18, 3.96, 4.75	0.05	0.05
Spools	0.18, 0.25, 0.38	0.013	0.013
Spools	0.51, 0.76, 0.89, 1.14	0.025	0.025
Spools	1.57, 1.98, 2.39	0.05	0.05

3.6.2 Length: Cut lengths shall be furnished in 18, 27, or 36 inch (457, 686, or 914 mm) lengths, as ordered, and shall not vary more than +0, -0.5 inch (-13 mm) from the length ordered.

#### 4. QUALITY ASSURANCE PROVISIONS:

##### 4.1 Responsibility for Inspection:

The vendor of wire shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the wire conforms to specified requirements.

##### 4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1), response to heat treatment (3.4.2), sizes and tolerances (3.6), and alloy verification (5.2.1) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Weldability (3.4.1), cast (3.4.3.1), and helix (3.4.3.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

##### 4.3 Sampling and Testing:

Shall be in accordance with AMS 2371 and as specified herein.

##### 4.4 Reports:

The vendor of wire shall furnish with each shipment a report showing the results of tests for the full chemical composition of each heat, and for the carbon content of each lot, and stating that the wire conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 5821F, nominal size, and quantity.