

# National Bureau of Standards

## Certificate of Analysis

### Standard Reference Material 1270

### 21/4 Cr - 1 Mo Low Alloy Steel, A 336 (F-22)

In cooperation with  
American Society for Testing and Materials  
and  
Steel Founders' Society of America

This SRM is in the form of disks 32 mm (1 1/4 in) in diameter and 19 mm (3/4 in) thick, intended for use in optical emission and x-ray spectrometric methods of analysis.

Element	Certified Value, <sup>1</sup> % by wt.	Estimated Uncertainty <sup>2</sup>
Carbon	0.077	0.002
Manganese	.626	.025
Phosphorus	.0065	.0020
Sulfur	.0065	.0010
Silicon	.247	.004
Copper	.114	.002
Nickel	.174	.002
Chromium	2.34	.02
Vanadium	0.013	.001
Molybdenum	.956	.006
Cobalt	.038	.002

1. The certified value listed for a constituent is the *present best estimate* of the "true" value based on the results of the cooperative program for certification.
2. The estimated uncertainty listed for a constituent is based on judgment and represents an evaluation of the combined effects of method imprecision, possible systematic errors among methods, and material variability. (No attempt was made to derive exact statistical measures of imprecision because several methods were involved in the determination of most constituents.)

**METALLURGICAL CONDITION:** The structure of the specimens is that resulting from hot working, followed by annealing.

The overall coordination of the technical measurements leading to certification was performed under the direction of J. I. Shultz, Research Associate, ASTM-NBS Research Associate Program.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. E. Michaelis.

Washington, D.C. 20234  
June 11, 1981

George A. Uriano, Chief  
Office of Standard Reference Materials

(over)

## PLANNING, PREPARATION, TESTING, ANALYSIS:

The planning for this SRM was coordinated through the Task Group on Temper Embrittlement, American Petroleum Institute. In addition, this SRM is expected to serve as Supplement No. 1 to the "1200 Series" of irons and steels. The material was melted and cast into a single ingot at Esco Corporation, Portland, Ore., (L. E. Finch), under an NBS contract with the Steel Founders' Society of America (SFSA). The single ingot was fabricated at the Puget Sound Naval Shipyard, Bremerton, Wash., G. Foltz. The ingot first was forged to a slab. Then, portions of suspected inhomogeneity were cut to discard (5% corresponding to the ingot bottom, 15% from the top, and 25% from the middle lengthwise). The remaining slab sections were forged and swaged to rods oversize 32 mm in diameter, sub-critical annealed, and centerless ground to the final size of 32 mm in diameter.

Extensive homogeneity testing was carried out at the National Bureau of Standards by metallographic studies, C. H. Brady; by optical emission analysis, J. A. Norris; and by x-ray fluorescence analysis, P. A. Pella.

Composite samples for chemical analyses were prepared in the form of millings, cut from the full cross section of specimens representative of the entire lot of material.

Cooperative analyses for certification, carried out under the auspices of the ASTM/NBS Research Associate Program, were performed in the following analytical laboratories:

Babcock & Wilcox Co., Alliance Research Center, Alliance, Ohio; C. W. Goddard, J. M. Kibler, G. K. Dray, J. H. Phillips, and G. R. Taylor; and the Tubular Products Division, Beaver Falls, Pa., H. W. Price.

Chicago Bridge & Iron Co., Research Division, Plainfield, Ill., J. F. Newbury and P. S. Abella.

Climax Molybdenum Co. of Michigan, Ann Arbor, Mich., R. C. Binns.

Lukens Steel Co., Coatesville, Pa., J. H. Morris.

National Bureau of Standards, Inorganic Analytical Research Division, Washington, D.C., E. R. Deardorff, S. Hanamura, E. J. Maienthal, T. C. Rains, and R. K. Bell, Assistant Research Associate, ASTM/NBS Research Associate Program.

Phoenix Steel Corp., Claymont, Del., J. A. Crawley.

Elements other than those certified may be present in this material as indicated below. These are *not certified*, but are given as additional information on the composition.

<u>Element</u>	<u>Concentration</u> <u>% by weight</u>
Aluminum	( 0.005 )
Antimony	( .02 )
Arsenic	( .02 )
Barium	----
Bismuth	(<.0001)
Boron	( .0033)
Calcium	----
Cerium	( .01 )
Gold	( .0001)
Hafnium	----
Lead	( .0016)
Magnesium	----
Niobium	( .008 )
Nitrogen	----
Oxygen	----
Selenium	(<.0001)
Silver	( .0001)
Strontium	----
Tantalum	( .005 )
Tellurium	(<.0001)
Thallium	(<.0001)
Tin	( .02 )
Titanium	( .003 )
Tungsten	( .003 )
Zinc	----
Zirconium	( .010 )

( )Determined

---- Not added nor determined