



Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	1.126	11.24	0.014	0.038	0.63	0.024	0.33	0.200	0.045
2	1.128	11.25	0.016	0.039	0.634	0.026	0.341	0.21	0.0475
3	1.13	11.26	0.018	0.040	0.636	0.026	0.351	0.218	0.0482
4	1.130	11.27	0.0198	0.041	0.64	0.028	0.351	0.222	0.049
5	1.134	11.30	0.020	0.0435	0.646	0.030	0.355	0.228	0.049
6	1.138	11.31	0.020	0.0441	0.656	0.0303	0.358	0.230	0.0494
7	1.138	11.40	0.021	0.0444	0.658	0.0307	0.37	0.23	0.052
8	1.138	11.41	0.023	0.0445	0.659	0.0315	0.376	0.233	0.055
9	1.147			0.046		0.033	0.378	0.234	
10				0.047				0.242	
Average	1.134	11.305	0.0190	0.0428	0.645	0.0288	0.3567	0.2247	0.0494
Std Dev	0.007	0.066	0.0029	0.0031	0.012	0.0030	0.0159	0.0125	0.0030
Certified	1.13	11.30	0.019	0.043	0.64	0.029	0.36	0.22	0.049

Analysis	Al	Co	N	Nb	Sn	V	B	Ti
1	0.015	0.0063	0.0396	0.045	0.0046	0.29	0.00008	0.002
2	0.017	0.007	0.0410	0.048	0.0059	0.302	0.00017	0.0020
3	0.018	0.0082	0.0412	0.0488	0.006	0.313		
4	0.019	0.0096	0.0422	0.0496	0.0071	0.315		
5	0.019	0.0106	0.0436	0.051	0.0072	0.318		
6	0.0196	0.012	0.0446	0.057	0.0073	0.319		
7	0.0200			0.059	0.008	0.321		
8	0.0202				0.008	0.33		
9	0.023				0.010	0.35		
Average	0.0190	0.0090	0.0420	0.0512	0.0071	0.318	0.00013	0.0020
Std Dev	0.0022	0.0022	0.0018	0.0050	0.0015	0.017	0.00006	
Certified	0.019	0.009	0.042	0.05	0.007	0.32	(0.0001)	(0.002)

Data in parentheses are not certified but provided for information only.

**Analysis:** Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs. The laboratories participating in the testing normally followed the requirements of ISO Guide 25. The individual values listed above are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 352, E 354, E 1019, plus additional ICP, and AA spectrometric methods. The following Certified Reference Materials were used to validate the analytical data listed above: NIST SRM 5L, 16f, 73c, 122g, 125b, 153a, 160b, 342a, 348a, 365; ECRM 085-1, 088-1, 235-1, 184-1, 478-1, 481-1; BCS 455/1, 456/1, 494, 495; BAM 126-1

**Co-operating Laboratories:** Some of the co-operating laboratories were:  
 Analytical Associates, Detroit, Michigan  
 Anarem Company, Prague, Czech Republic  
 Brammer Standard Co., Inc., Houston, Texas  
 Crucible Specialty Metals, Syracuse, New York  
 J. Dirats and Co., Inc., Westfield, Massachusetts  
 Shiva Laboratories, Inc., Cicero, New York  
 VHG Laboratories, Inc., Manchester, New Hampshire



## Referenced Documents

*ASTM documents available from ASTM, 1916 Race Street, Philadelphia, PA, 19103.*

E 350 - 90 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E 352 - 93 Standard Test Methods for Chemical Analysis of Tool Steels and Other Similar Medium and High-Alloy Steels

E 354 - 93 Standard Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and other Similar Iron, Nickel, and Cobalt Alloys

E 826 - 85 (Reapproved 1990) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E-2 SM 9-43 Suggested Method for Optical Emission Vacuum Spectrometric Analysis of Hadfield Steel

E 1019-93 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

*ISO Guides available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.*

ISO Guide 25 (Third edition, 1990), General requirements for the competence of calibration and testing laboratories.

ISO Guide 30 (Second edition, 1991), Terms and definitions used in connection with reference materials.

ISO Guide 31 (First edition, 1981), Contents of certificates of reference materials.

ISO Guide 33 (First edition, 1989), Uses of certified reference materials.

ISO Guide 35 (Second edition, 1989), Certification of reference materials - General and statistical principles.

*Other useful documents available at no cost from NIST, U.S. Department of Commerce, Gaithersburg, MD 20899.*

NBS Special Publication 260-100, Handbook for SRM Users

NIST Special Publication 829, Use of NIST Standard Reference Materials for Decisions on Performance of Analytical Chemical Methods and Laboratories