

European Certified Reference Material (EURONORM-CRM)
Certificate of Chemical Analysis

EURONORM-CRM No. 268-1 (Tool Steel)

Laboratory means (4 values), mass content in %

Line No.	C	Si	Mn	P	S	Cr	Mo	Ni	As	B	Co	Cu	N	Sn	V	W	Sb
1	1.1105	-----	0.2748	0.0179	0.0141	4.5043	-----	0.1357	-----	0.0006	0.0273	0.1159	1.9316	-----	8.3390	-----	0.0015
2	1.1126	0.3436	0.2803	0.0188	0.0143	4.5223	-----	0.1394	0.0054	0.0006	0.0273	0.1160	1.9450	0.0073	8.3646	3.6360	0.0016
3	1.1225	0.3560	0.2804	0.0192	0.0145	4.5453	3.1452	0.1399	0.0055	0.0006	0.0278	0.1193	1.9782	0.0073	8.3686	3.6456	0.0016
4	1.1270	0.3560	0.2824	0.0200	0.0146	4.5460	3.1565	0.1405	0.0055	0.0008	0.0282	0.1204	1.9844	0.0074	8.3852	3.6547	0.0016
5	1.1289	0.3574	0.2825	0.0201	0.0149	4.5575	3.1750	0.1405	0.0058	0.0008	0.0286	0.1206	2.0059	0.0075	8.4065	3.6624	0.0016
6	1.1300	0.3612	0.2830	0.0202	0.0151	4.5624	3.1977	0.1408	0.0061	0.0009	0.0289	0.1212	2.0173	0.0075	8.4250	3.6649	0.0017
7	1.1309	0.3657	0.2849	0.0202	0.0153	4.5652	3.1994	0.1411	0.0062	0.0010	0.0290	0.1214	2.0198	0.0076	8.4355	3.6814	0.0017
8	1.1331	0.3693	0.2873	0.0207	0.0153	4.5732	3.2053	0.1412	0.0062	0.0011	0.0290	0.1220	2.0201	0.0076	8.4448	3.6850	0.0017
9	1.1354	0.3731	0.2908	0.0207	0.0154	4.5835	3.2083	0.1415	0.0062	0.0011	0.0292	0.1228	2.0389	0.0078	8.4520	3.6857	0.0017
10	1.1370	0.3757	0.2915	0.0208	0.0156	4.5886	3.2110	0.1427	0.0063	0.0012	0.0293	0.1230	2.0511	0.0079	8.4595	3.6910	0.0018
11	1.1405	0.3760	0.2920	0.0209	0.0157	4.5950	3.2183	0.1434	0.0063		0.0294	0.1233	2.0568	0.0079	8.4624	3.7218	0.0018
12	1.1429	0.3791	0.2931	0.0211	0.0158	4.6000	3.2231	0.1446	0.0063		0.0294	0.1239	2.1192	0.0079	8.5361	3.7227	0.0019
13	1.1447	0.3797	0.2959	0.0213	0.0159	4.6100	3.2308	0.1450	0.0064		0.0294	0.1245	2.1230	0.0079	8.5461	3.7251	0.0019
14	1.1463	0.3801	0.2969	0.0214	0.0159	4.6139	3.2404	0.1451	0.0065		0.0294	0.1250	2.1275	0.0080	8.5940	3.7670	0.0022
15	1.1488	0.3855	0.3004	0.0216	0.0160	4.6235	3.2429	0.1474	0.0065		0.0294	0.1264		0.0083	8.6211	3.7670	-----
16	1.1532	0.3858	0.3019	0.0217	0.0161	4.6499	3.2627	0.1481	0.0067		0.0298	0.1266		0.0083	8.6351	3.7921	-----
17		0.3873	0.3022	0.0218	0.0168			0.1481	0.0067		0.0299	0.1274		0.0083	8.6525	3.8088	
18		0.3880	0.3027	0.0221				0.1524			0.0300	0.1292					
19		0.3889	0.3031	0.0224				0.1524			0.0305	0.1315					
20		-----	0.3054	0.0224				-----			-----						
21			0.3106	0.0226													
M(M)	1.1340	0.3727	0.2925	0.0209	0.0154	4.5775	3.2083	0.1437	0.0062	0.0009	0.0290	0.1232	2.0299	0.0078	8.4781	3.7070	0.0017
s(M)	0.0122	0.0134	0.0100	0.0013	0.0008	0.0383	0.0329	0.0045	0.0005	0.0002	0.0009	0.0041	0.0620	0.0004	0.1007	0.0534	0.0002
s(w)	0.0058	0.0043	0.0031	0.0008	0.0004	0.0163	0.0167	0.0020	0.0003	0.0001	0.0004	0.0014	0.0160	0.0002	0.0317	0.0277	0.0001

Line No.	Nb	Ta	Ti
1	0.0002	0.00006	0.00004
2	0.0006	0.00017	0.00007
3	0.0010	0.00018	0.00007
4	0.0013	0.00019	0.00013
5	0.0013	-----	0.00013
6	0.0013		0.00015
7	0.0013		0.00038
8	0.0019		0.00074
9			0.00118
10			-----

Additional values for information µg/g: Ag: 0.6; Al: 0.5; Au: 0.3; Ba: 0.1; Bi: 0.2; Ca: 4. Ga: 19; Pb: 1.6; Re 1.3; Zn 10

M(M): Mean of the intralaboratory means
s(M): Standard deviation of the intralaboratory means
s(w): Intralaboratory standard deviation

The laboratory mean values have been examined statistically to eliminate outlying values.

Where a "-----" appears in the table it indicates that an outlying value has been omitted by either the Cochran or Grubbs test.

CERTIFIED VALUES, mass content in %

	C	Si	Mn	P	S	Cr	Mo	Ni	As	B	Co	Cu	N	Sn	V	W	Sb
M(M)	1.134	0.373	0.293	0.0209	0.0154	4.578	3.208	0.1437	0.0062	0.0009	0.0290	0.1232	2.030	0.0078	8.478	3.707	0.0017
C(95%)	0.007	0.007	0.005	0.0006	0.0004	0.021	0.019	0.0022	0.0003	0.0002	0.0005	0.0020	0.036	0.0002	0.052	0.029	0.0002

C(95%) is the half-width confidence interval where "t" is the appropriate Student's t value and "n" is the number of acceptable laboratory means. For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 sections 6.1 and 10.5.2.

$$C(95\%) = \frac{t \cdot s(M)}{\sqrt{n}}$$

This certified reference material was prepared and issued by:



Isafjordsgatan 28A, 164 40 Kista, Sweden



after approval by all the participating laboratories and all the producing organisations: (France- ArcelorMittal Maizières/CTIF; Germany-Iron and Steel CRM Working Group: Steel institute VDEh, Bundesanstalt für Materialforschung und -prüfung (BAM) & MPI für Eisenforschung; Nordic Countries-Nordic CRM Working Group.

Kista, June 2019

Description of the sample

The ECRM 268-1 is available in the form of milling chips in bottles containing 100 g. It is also available as 38 mm diameter discs 25 mm thick. The chips were passed through a 2000 µm aperture sieve and further sieving was carried out to exclude chips passing through a 250 µm aperture sieve.

Participating laboratories

AB Sandvik Materials Technology, Sandviken (Sweden)
ALS Scandinavia AB, Luleå (Sweden)
ArcelorMittal Maizières Research SA, Maizières-lès-Metz (France)
Aubert & Duval, Aciérie des Ancizes, Les Ancizes (France)
Böhler Edelstahl GmbH & Co KG, Kapfenberg (Austria)
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany)
National Centre for Metallurgical Research (CENIM), Madrid (Spain)
Deutsche Edelstahlwerke, Specialty Steel GmbH & Co. KG, Witten (Germany)
Dunafer Labor Nonprofit Ltd., Dunaújváros (Hungary)
ELTRA GmbH, Haan (Germany)
ESAB AB, Göteborg (Sweden)
Höganäs Sweden AB, Höganäs (Sweden)
Industeel France - Le Creusot, Le Creusot (France)
Institute of Certified Reference Materials, Yekaterinburg (Russia)
Kanthal, Sandvik AB, Hallstahammar (Sweden)
LECO Technical Services Lab, Saint Joseph (USA)
Luxcontrol, Esch-sur-Alzette (Luxembourg)
MPI für Eisenforschung GmbH Düsseldorf (Germany)
Outokumpu Stainless AB, Avesta (Sweden)
Pattinson & Stead (2005) Ltd, Middlesbrough (United Kingdom)
Ridsdale & Co Ltd, Middlesbrough (United Kingdom)
Swerim AB, Kista (Sweden)
TSP-D Umwelt und Betriebsanalytik, Linz (Austria)
Uddeholms AB, Hagfors (Sweden)
VDM Metals GmbH, Werdohl (Germany)

Intended use & stability

ECRM 268-1 is intended for the verification of analytical methods, such as those used by the participating laboratories, for the calibration of analytical instruments in cases where the calibration with primary substances (pure stoichiometric metals or compounds) is not possible, and for establishing values for secondary reference materials.

It will remain stable, provided that the bottle remains sealed and is stored in a cool and dry atmosphere. When the bottle has been opened the lid should be secured immediately after use. If the contents should become discoloured (eg. oxidised) due to atmospheric contamination they should be discarded.

Traceability

The assigned values for each material are achieved by inter-laboratory characterization, each laboratory using the method of their choice, details of which are given below. These methods are either stoichiometric analytical techniques or methods which are calibrated against pure metals or stoichiometric compounds. Most methods used were either international or national standard methods or methods which are technically equivalent.

Methods used

Element	Line number	Method
C	1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16 3, 11	Combustion, infrared absorption Gravimetry
Si	2, 4, 7, 8, 10, 11, 12, 15, 17 3, 5, 6, 9, 13, 14, 16, 18, 19	Gravimetry, dehydration with perchloric acid ICP-OES
Mn	1, 2, 11 3, 5, 6, 7, 8, 9, 13, 14, 15, 16, 17, 18, 19, 20, 21 4, 12 10	MAS, periodate oxidation ICP-OES ICP-MS FAAS
P	1 2, 15 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 17, 18, 19 14, 20, 21 16	MAS, molybdenum blue, extraction ICP-MS ICP-OES MAS, phosphovanadomolybdate, extraction MAS, molybdenum blue after separation of interfering elements

Element	Line number	Method
S	1	ICP-MS
	2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 17	Combustion, infrared absorption
	4	Acidimetric titration, absorption in H ₂ O ₂ or AgNO ₃
	8	Gravimetry as BaSO ₄ without separation
	16	MAS, methylene blue, evolution as H ₂ S in hypophosphoric and formic acid Medium
Cr	1, 2, 3, 5, 7, 10, 11, 12, 13, 14, 15, 16	ICP-OES
	4, 6, 8, 9	Titration with Fe (II), oxidation with persulphate
Mo	3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 16	ICP-OES
	10	MAS, thiocyanate in presence of Sn (II), hydroxide separation
	15	MAS, thiocyanate in presence of Sn (II), extraction
Ni	1, 2, 4, 5, 7, 8, 10, 11, 12, 13, 15, 18, 19	ICP-OES
	3	ETAAS
	6, 14, 17	FAAS
	9, 16	ICP-MS
As	2, 6, 11, 13, 14, 15	ICP-MS
	3, 8	MAS, diethyldithiocarbamate, separation as arsine
	4, 7, 16, 17	ETAAS
	5, 9, 10, 12	ICP-OES
B	1, 2, 4, 6, 10	ICP-MS
	3, 5, 8, 9	ICP-OES
	7	MAS, curcumin
Co	1, 3, 4, 7, 8, 9, 11, 12, 13, 14, 15, 17, 18, 19	ICP-OES
	2, 5, 6, 10	ICP-MS
	16	FAAS
Cu	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	ICP-OES
	6, 7	ICP-MS
	16	FAAS
N	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	Thermal conductivity, decomposition in graphite crucible
Sn	2, 3, 6, 7, 9, 11, 15	ICP-OES
	4, 5, 10, 12, 13, 14	ICP-MS
	8, 16, 17	ETAAS
V	1, 2, 3, 6, 8, 9, 11, 13, 14, 15, 16, 17	ICP-OES
	4, 5, 7, 10, 12	Titration with Fe (II), oxidation with Mn (VII)
W	2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16	ICP-OES
	11, 17	MAS, thiocyanate, sodium hydroxide separation
	13	MAS, thiocyanate formed in a strongly acid reducing medium
Sb	1, 3, 12, 13	ETAAS
	2, 4, 5, 8, 9, 11, 14	ICP-MS
	6	FAAS
	7, 10	ICP-OES
Nb	1, 3, 4, 5, 7	ICP-MS
	2, 6, 8	ICP-OES
Ta	1, 2, 3, 4	ICP-MS
Ti	1, 5, 6, 7, 9	ICP-OES
	2, 3, 4, 8	ICP-MS

Abbreviations:

FAAS	Flame Atomic Absorption Spectrometry
ICP-OES	Inductively Coupled Plasma - Optical Emission Spectrometry
ICP-MS	Inductively Coupled Plasma - Mass Spectrometry
ETAAS	Electrothermal Atomic Absorption Spectrometry
MAS	Molecular Absorption Spectrometry

Further information

For information regarding the preparation, certification and supply of these European Certified Reference Materials (EURONORM-CRMs) and the use of the statistical information given on this certificate, please refer either to the producer of this Certified Reference Material or to Technical Reports CEN/TR 10317:2015 and CEN/TR 10350:2013, both of which are available from the national standards body in your country.

Further information and advice on this or other Certified Reference Materials or Reference Materials produced by Swerim AB may be obtained from the address below.

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