

**CERTIFIED REFERENCE MATERIAL  
CERTIFICATE OF CHEMICAL ANALYSIS**

**REFERENCE – CRM N° TL-1000**  
**Steel EN 20Mn6-1.0485**  
**LABORATORY MEANS (2 values) – Mass content %**

Line n°	C	Si	Mn	P	S	Cr	Mo	Ni	Al	B	Co	Cu
1	0,1630	0,2165	1,385	0,0125	0,0135	0,0593	0,0067	0,0281	0,0200	0,00010	0,0030	0,0111
2	0,1640	0,2180	1,392	0,0125	0,0140	0,0596	0,0070	0,0287	0,0203	0,00010	0,0033	0,0112
3	0,1640	0,2200	1,398	0,0132	0,0143	0,0600	0,0070	0,0288	0,0206	0,00015	0,0035	0,0113
4	0,1643	0,2201	1,400	0,0132	0,0146	0,0600	0,0071	0,0297	0,0209	0,00019	0,0035	0,0114
5	0,1649	0,2205	1,409	0,0134	0,0151	0,0602	0,0071	0,0300	0,0209	0,00020	0,0036	0,0115
6	0,1650	0,2223	1,410	0,0135	0,0151	0,0615	0,0071	0,0302	0,0215	0,00022	0,0037	0,0115
7	0,1657	0,2225	1,415	0,0135	0,0153	0,0620	0,0072	0,0305	0,0217	0,00025	0,0038	0,0115
8	0,1675	0,2233	1,416	0,0135	0,0154	0,0623	0,0072	0,0305	0,0218	0,00027	0,0040	0,0115
9	0,1676	0,2235	1,418	0,0138	0,0154	0,0629	0,0073	0,0305	0,0220		0,0040	0,0115
10	0,1677	0,2239	1,420	0,0138	0,0155	0,0630	0,0075	0,0306	0,0220		0,0040	0,0117
11	0,1690	0,2240	1,423	0,0140	0,0158	0,0630	0,0075	0,0308	0,0221		0,0042	0,0117
12	0,1695	0,2240	1,423	0,0140	0,0159	0,0631	0,0076	0,0308	0,0224		0,0043	0,0119
13	0,1696	0,2248	1,425	0,0140	0,0159	0,0635	0,0076	0,0308	0,0225		0,0045	0,0121
14	0,1700	0,2282	1,428	0,0141	0,0162	0,0635	0,0078	0,0309	0,0225		0,0047	0,0122
15	0,1708	0,2283	1,430	0,0141	0,0164	0,0636	0,0079	0,0309	0,0226		0,0048	0,0123
16	0,1709	0,2285	1,430	0,0141	0,0165	0,0637	0,0080	0,0310	0,0228		0,0050	0,0123
17	0,1710	0,2285	1,431	0,0141	0,0167	0,0640	0,0081	0,0310	0,0229		0,0050	0,0125
18	0,1710	0,2290	1,434	0,0141	0,0168	0,0643	0,0081	0,0313	0,0230		0,0051	0,0125
19	0,1713	0,2294	1,435	0,0143	0,0169	0,0644	0,0082	0,0315	0,0230		0,0052	0,0125
20	0,1723	0,2300	1,436	0,0145	0,0172	0,0645	0,0085	0,0319	0,0232		0,0055	0,0130
21	0,1733	0,2301	1,438	0,0145	0,0174	0,0647	0,0087	0,0320	0,0235			0,0131
22	0,1738	0,2311	1,438	0,0148	0,0175	0,0651		0,0320	0,0236			0,0135
23	0,1740	0,2320	1,440	0,0150	0,0180	0,0653		0,0330	0,0237			0,0136
24	0,1747	0,2328	1,441	0,0150	0,0181	0,0660		0,0336	0,0244			
25	0,1750	0,2339	1,446	0,0153	0,0182	0,0661		0,0338	0,0245			
26			1,455	0,0154	0,0185	0,0673		0,0345	0,0245			
27			1,463	0,0159	0,0190	0,0673		0,0346	0,0247			
28			1,466	0,0160	0,0190	0,0676			0,0247			
29			1,471	0,0161	0,0194				0,0249			
M <sub>M</sub>	0,1692	0,2258	1,428	0,0142	0,0164	0,0635	0,0076	0,0312	0,0226	0,00018	0,0042	0,0120
s <sub>M</sub>	0,0037	0,0048	0,021	0,0009	0,0016	0,0023	0,0005	0,0016	0,0014	0,00006	0,0007	0,0007
s <sub>w</sub>	0,0030	0,0015	0,008	0,0004	0,0004	0,0005	0,0003	0,0005	0,0005	0,00003	0,0001	0,0003

Line n°	Nb	Ti	Ca
1	0,0270	0,00080	0,00010
2	0,0274	0,00095	0,00015
3	0,0275	0,00095	0,00030
4	0,0278	0,00100	0,00030
5	0,0279	0,00100	0,00036
6	0,0282	0,00105	0,00040
7	0,0283	0,00115	0,00040
8	0,0283	0,00115	0,00040
9	0,0284	0,00115	0,00040
10	0,0285	0,00125	0,00047
11	0,0286	0,00125	0,00047
12	0,0288	0,00130	0,00050
13	0,0289	0,00135	0,00055
14	0,0290	0,00140	0,00070
15	0,0294	0,00140	
16	0,0295		
17	0,0298		
18	0,0298		
19	0,0300		
20	0,0302		
21	0,0303		
22	0,0303		
23	0,0305		
24	0,0308		
25	0,0310		
26	0,0310		
27	0,0311		
28	0,0319		
29			
M <sub>M</sub>	0,0293	0,0011	0,00039
s <sub>M</sub>	0,0013	0,0002	0,00015
s <sub>w</sub>	0,0005	0,0001	0,00001

As	N	Sn	V
0,0010	0,0065	0,00027	0,0029
0,0012	0,0067	0,00035	0,0029
0,0013	0,0086	0,00040	0,0030
0,0014	0,0086	0,00050	0,0030
0,0014	0,0086	0,00060	0,0030
0,0014	0,0089	0,00075	0,0032
0,0016	0,0096	0,00075	0,0032
0,0016	0,0098	0,00085	0,0032
0,0017	0,0098	0,00100	0,0033
0,0020	0,0101	0,00100	0,0033
0,0020	0,0101	0,00100	0,0033
0,0022	0,0102	0,00130	0,0036
0,0024	0,0103	0,00130	0,0040
	0,0104	0,00135	0,0040
	0,0105	0,00200	0,0042
	0,0111	0,00225	
		0,00240	
0,0016	0,0093	0,0011	0,0033
0,0004	0,0013	0,0006	0,0004
0,0001	0,0003	0,0001	0,0001

M<sub>M</sub> : Mean of intralaboratory means  
s<sub>M</sub> : Standard deviation of intralaboratory means  
s<sub>w</sub> : Intralaboratory standard deviation

The laboratory mean values have been examined statistically with the Cochran and Grubbs Test to eliminate outlying values.

Values given in italic are for information only and are not certified.

Additional values for information : Mg ~ 0,5 ppm and W ~ 2 ppm

**CERTIFIED VALUES – Mass content in %**

Element	C	Si	Mn	P	S	Cr	Mo	Ni	Al	B
M <sub>M</sub>	0,1692	0,2258	1,428	0,0142	0,0164	0,0635	0,0076	0,0312	0,0226	0,00018
C (95%)	0,0016	0,0020	0,008	0,0004	0,0006	0,0009	0,0002	0,0007	0,0005	0,00005

Element	Co	Cu	Nb	Ti	Ca
M <sub>M</sub>	0,0042	0,0120	0,0293	0,0011	0,00039
C (95%)	0,0003	0,0003	0,0005	0,0001	0,00009

C(95%) : half-width confidence interval =  $\frac{t \times s_M}{\sqrt{n}}$  where t is the appropriate Student's t value and n is the number of acceptable mean values  
For further information regarding the confidence interval for the certified value see ISO Guide 35 : 2006 sections 6.1 et 10.5.2.

## METHODS USED

Element	Line n°	Methods
C	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,20,21,22,23,24,25 15,19	Optical Emission Spectrometry (spark) (OES) Combustion + Infrared (Comb/IR)
Si	1,2,3,5,6,7,8,10,11,12,13,14,15,16,17,19,20,21,22,23,24,25 4,9 18	Optical Emission Spectrometry (spark) (OES) X-Ray Fluorescence spectrometry (XRF) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES)
Mn	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,19,20,21,22,24,25,26,27,28,29 14,15 23	Optical Emission Spectrometry (spark) (OES) X-Ray Fluorescence spectrometry (XRF) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES)
P	2,3,4,5,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29 1 6 25	Optical Emission Spectrometry (spark) (OES) X-Ray Fluorescence spectrometry (XRF) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS)
S	2,3,4,5,6,7,9,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29 8,11 1 10	Optical Emission Spectrometry (spark) (OES) Combustion + Infrared (Comb/IR) X-Ray Fluorescence spectrometry (XRF) Glow Discharge + Mass Spectrometry (GD/MS)
Cr	1,2,3,4,8,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28 7 12 6 5	Optical Emission Spectrometry (spark) (OES) X-Ray Fluorescence spectrometry (XRF) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS)
Mo	1,2,3,4,6,8,10,11,12,13,14,15,16,17,18,19,20,21 5 7 9	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS)
Ni	1,2,3,5,6,7,8,9,10,11,12,15,16,17,18,20,21,22,23,24,25,26 19,27 4 13 14	Optical Emission Spectrometry (spark) (OES) X-Ray Fluorescence spectrometry (XRF) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Glow Discharge + Mass Spectrometry (GD/MS) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES)
Al	1,2,5,6,7,8,10,11,12,13,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29 3 4 9 14	Optical Emission Spectrometry (spark) (OES) X-Ray Fluorescence spectrometry (XRF) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS)
B	1,2,3,4,6,7,8 5	Optical Emission Spectrometry (spark) (OES) Molecular Absorption Spectrometry (MAS)
Co	1,2,3,4,5,6,8,9,11,12,13,14,15,16,17,18,19,20 7 10	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Glow Discharge + Mass Spectrometry (GD/MS)
Cu	1,2,3,4,6,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23 5 7 8	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS)
Nb	1,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24,26,28 16,25 2 27	Optical Emission Spectrometry (spark) (OES) X-Ray Fluorescence spectrometry (XRF) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS)
Ti	1,2,3,5,8,9,10,11,12,13,14,15 4 6 7	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Glow Discharge + Mass Spectrometry (GD/MS)
Ca	1,2,3,5,6,7,8,9,10,11,12,13,14 4	Optical Emission Spectrometry (spark) (OES) Glow Discharge + Mass Spectrometry (GD/MS)

As	1,5,6,7,8,9,10,11,12,13 2 3 4	Optical Emission Spectrometry (spark) (OES) Glow Discharge + Mass Spectrometry (GD/MS) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES)
N	1,2,3,4,5,6,7,8,9,12,14,15,16 10,11,13	Optical Emission Spectrometry (spark) (OES) Combustion + Infrared (Comb/IR)
Sn	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17 1 2	Optical Emission Spectrometry (spark) (OES) Glow Discharge + Mass Spectrometry (GD/MS) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES)
V	1,2,5,6,7,8,9,11,12,13,14,15 3 4 10	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS)

## DESCRIPTION OF THE SAMPLE

The steel TL-1000 is a disc of 20 mm high and 36 mm diameter.

## INTENDED USE - STABILITY

The solid (disc) sample TL-1000 is intended for establishing and checking the calibration of instruments, such as Optical Emission Spectrometers and X-ray Spectrometers, for the analysis of samples of similar materials.

For best analytical results, use the same method for preparing the analytical surface on all reference materials as you use for production specimens.

The entire thickness of the disc can be used. It is recommended to avoid overheating the sample during surface preparation.

If the sample is stored and / or used in a normal environment [protected from heat, corrosive atmosphere, excessive humidity ...], the chemical composition of this sample does not undergo any evolution, whatever the duration of storage.

## SAFETY NOTICE

A Material Safety Data Sheet (MSDS) is not required for this material. This material will not release or otherwise result in exposure to a hazardous chemical, under normal conditions of use.

## TRACEABILITY

The traceability of CRM TL-1000 has been established in accordance with the ISO Guides 30-35 and the International vocabulary of basic and general terms in metrology.

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 above. 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.

## PARTICIPATING LABORATORIES

A2M INDUSTRIE	FR- 42490 FRAISSES
ACCIAIERIE BERTOLI SAFAU	FR- 57070 METZ
ACIERIE ET FONDERIE DE LA HAUTE SAMBRE	FR- 59145 BERLAIMONT
AMETEK	FR- 78990 ELANCOURT
APAVE SUDEUROPE SAS	FR- 69160 TASSIN LA DEMI LUNE
ARCELORMITTAL ATLANTIQUE ET LORRAINE DUNKERQUE	FR- 59760 GRANDE SYNTHE
ARCELORMITTAL ATLANTIQUE ET LORRAINE	FR- 57191 FLORANGE CEDEX
ARCELORMITTAL MEDITERRANEE	FR- 13776 FOS-SUR-MER Cedex
ARCELORMITTAL RESEARCH	FR- 57283 MAIZIERES LES METZ
AUBERT ET DUVAL FIRMINY	FR- 42704 FIRMINY
AUBERT ET DUVAL LES ANCIZES	FR- 63770 LES ANCIZES
BRAMMER STANDARDS CO.,INC	US- 77069 HOUSTON
BUREAU VERITAS LABORATOIRES	FR- 95310 SAINT-OUEN L'AUMONE
CETIM	FR- 44308 NANTES Cedex 3
CETIM	FR- 42952 SAINT-ETIENNE Cedex 1
CNPE DE CHINON	FR- 37420 AVOINE
CRITT-MDTS	FR- 08000 CHARLEVILLE-MEZIERES
ENVIFORM a.s.	CZ- 73961 TRINEC
EVANS ANALYTICAL GROUP	FR- 31170 TOURNEFEUILLE
FONDERIE ET ACIERIE DE DENAIN	FR- 59220 DENAIN
INDUSTEEL FRANCE CREUSOT	FR- 71201 LE CREUSOT CEDEX
INDUSTEEL FRANCE RIVE DE GIER	FR- 42803 RIVE-DE-GIER CEDEX
INSTITUTE FOR CERTIFIED REFERENCE MATERIALS (ICRM)	RU- 620057 EKATERINBURG
INSTYTUT METALURGII ZELAZA (IMZ)	PL - 44100 GLIWICE
LABORATOIRE METALLURGIQUE DE L'EST	FR- 54340 POMPEY
LABORATOIRES POURQUERY	FR- 69354 LYON CEDEX 07
LES BRONZES INDUSTRIES	FR- 57360 AMNEVILLE
METALCONTROL	FR- 77100 MEAUX
PRECICAST	FR- 41100 THORE LA ROCHETTE
SAFRAN SNECMA	FR- 92702 COLOMBES CEDEX
TECHLAB	FR- 57072 METZ CEDEX 3

## REFERENCES

- ISO 5725-2 : Accuracy (trueness and precision) of measurement methods and results – Part 2 : Basic method for the determination of repeatability and reproducibility of a standard measurement method
- ISO GUIDE 35 : Reference Materials – General and statistical principles for certification
- E826-85 : Standard practice for testing homogeneity of Materials for the Development of Reference Materials