

**CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CHEMICAL ANALYSIS**

REFERENCE – CRM N° TL-1002
Steel 18CrNiMo7-6 + FP / 1.6587

CERTIFIED VALUES – Mass content in %

Element	C	Si	Mn	P	S	Cr	Mo	Ni	Al
M_M	0,1895	0,3088	0,5658	0,0140	0,0087	1,615	0,3037	1,502	0,0274
C (95%)	0,0017	0,0028	0,0030	0,0004	0,0002	0,009	0,0021	0,009	0,0006

Element	Cu	N	As	B
M_M	0,0260	0,0043	0,0026	0,00032
C (95%)	0,0006	0,0002	0,0002	0,00003

M_M : Mean of intralaboratory means

C(95%) : half-width confidence interval = $\frac{t \times s_M}{\sqrt{n}}$ where t is the appropriate Student's 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.

INDICATIVE VALUES – Mass content in %

Element	V	Co	Ti	Nb	Sn
M_M	<i>0,004</i>	<i>0,004</i>	<i>0,0012</i>	<i>0,0017</i>	<i>0,0016</i>

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

LABORATORY MEANS (4 values) – Mass content in %

Line n°	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu	N	As	B
1	0,1783	0,2950	0,5498	0,0113	0,0068	1,557	0,2906	1,455	0,0255	0,0224	0,0037	0,0020	0,00017
2	0,1796	0,2983	0,5500	0,0115	0,0074	1,561	0,2937	1,460	0,0256	0,0238	0,0038	0,0020	0,00025
3	0,1800	0,2985	0,5560	0,0120	0,0076	1,575	0,2953	1,472	0,0258	0,0240	0,0040	0,0020	0,00027
4	0,1833	0,3004	0,5560	0,0125	0,0077	1,575	0,2963	1,472	0,0258	0,0243	0,0040	0,0022	0,00028
5	0,1835	0,3015	0,5563	0,0128	0,0078	1,580	0,2965	1,473	0,0259	0,0243	0,0041	0,0025	0,00029
6	0,1835	0,3016	0,5565	0,0130	0,0081	1,585	0,2970	1,479	0,0260	0,0245	0,0041	0,0025	0,00030
7	0,1836	0,3018	0,5568	0,0131	0,0082	1,588	0,2975	1,486	0,0260	0,0248	0,0041	0,0025	0,00030
8	0,1843	0,3020	0,5575	0,0131	0,0082	1,593	0,2982	1,486	0,0260	0,0250	0,0042	0,0026	0,00030
9	0,1862	0,3023	0,5580	0,0134	0,0083	1,598	0,2996	1,487	0,0260	0,0255	0,0043	0,0026	0,00032
10	0,1865	0,3023	0,5605	0,0137	0,0083	1,600	0,3000	1,490	0,0262	0,0255	0,0043	0,0026	0,00033
11	0,1865	0,3038	0,5605	0,0138	0,0084	1,602	0,3014	1,490	0,0268	0,0258	0,0044	0,0027	0,00033
12	0,1873	0,3050	0,5619	0,0138	0,0084	1,605	0,3018	1,492	0,0268	0,0258	0,0046	0,0029	0,00033
13	0,1873	0,3060	0,5625	0,0138	0,0085	1,607	0,3020	1,493	0,0270	0,0259	0,0047	0,0030	0,00035
14	0,1875	0,3065	0,5631	0,0138	0,0085	1,610	0,3025	1,496	0,0271	0,0259	0,0047	0,0031	0,00038
15	0,1878	0,3073	0,5643	0,0139	0,0085	1,612	0,3025	1,498	0,0273	0,0260	0,0047	0,0033	0,00040
16	0,1883	0,3079	0,5648	0,0140	0,0085	1,614	0,3033	1,502	0,0275	0,0260	0,0050	0,0034	0,00040
17	0,1889	0,3084	0,5650	0,0140	0,0085	1,615	0,3036	1,504	0,0277	0,0262	0,0051		0,00041
18	0,1890	0,3090	0,5665	0,0140	0,0086	1,617	0,3038	1,504	0,0278	0,0262			0,00046
19	0,1894	0,3090	0,5665	0,0140	0,0086	1,621	0,3043	1,505	0,0283	0,0263			
20	0,1896	0,3090	0,5684	0,0142	0,0086	1,623	0,3046	1,505	0,0285	0,0268			
21	0,1898	0,3097	0,5690	0,0143	0,0087	1,627	0,3046	1,506	0,0285	0,0272			
22	0,1900	0,3098	0,5695	0,0145	0,0087	1,627	0,3054	1,510	0,0287	0,0273			
23	0,1900	0,3105	0,5703	0,0146	0,0087	1,628	0,3058	1,513	0,0299	0,0273			
24	0,1901	0,3122	0,5708	0,0147	0,0087	1,630	0,3060	1,519	0,0302	0,0279			
25	0,1908	0,3125	0,5715	0,0148	0,0087	1,632	0,3075	1,524	0,0303	0,0281			
26	0,1908	0,3138	0,5715	0,0153	0,0088	1,635	0,3090	1,528	0,0305	0,0285			
27	0,1914	0,3170	0,5723	0,0153	0,0088	1,638	0,3091	1,529		0,0300			
28	0,1916	0,3188	0,5732	0,0155	0,0088	1,638	0,3098	1,530					
29	0,1920	0,3287	0,5733	0,0155	0,0089	1,638	0,3098	1,532					
30	0,1920	0,3193	0,5737	0,0160	0,0089	1,639	0,3105	1,533					
31	0,1930	0,3200	0,5750	0,0160	0,0090	1,640	0,3108	1,536					
32	0,1931	0,3204	0,5801	0,0160	0,0092	1,642	0,3125	1,560					
33	0,1938	0,3218	0,5820		0,0092	1,643	0,3140						
34	0,1939		0,5853		0,0093	1,653	0,3158						
35	0,1943				0,0093	1,667							
36	0,1945				0,0093								
37	0,1970				0,0094								
38	0,1980				0,0096								
39	0,2016				0,0096								
40	0,2023				0,0097								
41					0,0099								
42					0,0101								
43					0,0104								
M_M	0,1895	0,3088	0,5658	0,0140	0,0087	1,615	0,3037	1,502	0,0274	0,0260	0,0043	0,0026	0,00032
S_M	0,0053	0,0079	0,0086	0,0012	0,0007	0,026	0,0060	0,024	0,0016	0,0016	0,0004	0,0004	0,00007
S_W	0,0026	0,0031	0,0042	0,0004	0,0003	0,011	0,0026	0,011	0,0004	0,0004	0,0002	0,0001	0,00004

Line n°	V	Co	Ti	Nb	Sn
1	0,0018	0,0011	0,0007	0,0001	0,0011
2	0,0028	0,0028	0,0007	0,0004	0,0013
3	0,0030	0,0033	0,0007	0,0011	0,0013
4	0,0030	0,0034	0,0008	0,0013	0,0015
5	0,0030	0,0034	0,0010	0,0014	0,0015
6	0,0032	0,0035	0,0011	0,0016	0,0022
7	0,0032	0,0035	0,0013	0,0016	0,0020
8	0,0032	0,0036	0,0013	0,0021	0,0023
9	0,0033	0,0037	0,0013	0,0023	
10	0,0034	0,0038	0,0013	0,0024	
11	0,0038	0,0040	0,0014	0,0029	
12	0,0042	0,0040	0,0014	0,0030	
13	0,0042	0,0040	0,0015		
14	0,0044	0,0045	0,0015		
15	0,0046	0,0048	0,0015		
16	0,0047	0,0050	0,0018		
17	0,0047	0,0050	0,0020		
18	0,0057	0,0058			
19	0,0062	0,0063			
20	0,0070				
M_M	0,0040	0,0040	0,0012	0,0017	0,0016
S_M	0,0013	0,0011	0,0004	0,0009	0,0005
S_W	0,0001	0,0002	0,0001	0,0001	0,0001

M_M : Mean of intralaboratory means
S_M : Standard deviation of intralaboratory means
S_W : Intralaboratory standard deviation

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

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Additional values for information (mass content in %) : Bi < 0,00005 ; Ca ~ 0,001 ; Mg < 0,0005 ; Pb < 0,0005 ; Sb < 0,005 ; Ta < 0,005 ; Zn < 0,005 ; Zr < 0,005 ; H < 0,0005 ; O ~ 0,02

METHODS USED

Element	Line n°	Methods
C	2,5,6,8,12,14,15,16,20,26,28,29,30,31,33,34,35,36,37,38,39,40 1,4,7,9,10,11,13,17,18,19,21,22,23,24,25,27,32 3	Optical Emission Spectrometry (spark) (OES) Combustion + Infrared (Comb/IR) Glow Discharge + Mass Spectrometry (GD/MS)
Si	2,4,5,7,8,9,10,11,14,15,16,18,23,24,25,26,27,28,29,30,31,32 1,3,12,17,20,21,22,33 6 13 19	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Glow Discharge Spectrometry (GDS) Glow Discharge + Mass Spectrometry (GD/MS)
Mn	3,5,7,8,9,10,11,12,13,14,15,16,17,18,20,21,22,23,24,25,27,30,31,32,33 1,2,4,6,28,34 19 26 29	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge Spectrometry (GDS) Glow Discharge + Mass Spectrometry (GD/MS) X-Ray Fluorescence spectrometry (XRF)
P	2,3,4,6,9,11,12,13,14,17,18,20,21,22,23,24,25,27,28,29,30,32 1,7,8,15,19,26,31 16 5 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) Glow Discharge Spectrometry (GDS)
S	1,2,3,4,5,9,13,15,16,17,21,22,24,26,28,30,36,39,41,43 6,7,10,11,12,14,19,23,25,27,31,32,33,34,35,37,38,40,42 8 18,29 20	Combustion + Infrared (Comb/IR) Optical Emission Spectrometry (spark) (OES) Glow Discharge Spectrometry (GDS) Glow Discharge + Mass Spectrometry (GD/MS) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES)
Cr	1,3,4,6,7,9,11,12,15,16,17,18,20,22,23,24,25,26,27,28,30,31,32,35 2,5,8,10,14,19,21,29,34 13 33	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge Spectrometry (GDS) X-Ray Fluorescence spectrometry (XRF)
Mo	2,3,4,5,6,8,11,12,13,14,15,16,19,21,23,27,28,29,30,31,32,33,34 1,7,9,10,17,20,24,25,26 22 18	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge Spectrometry (GDS) X-Ray Fluorescence spectrometry (XRF)
Ni	4,7,8,9,10,11,12,14,15,17,20,22,23,25,27,28,29,30,31,32 1,2,3,5,16,19,21,24,26 6 18 13	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge Spectrometry (GDS) X-Ray Fluorescence spectrometry (XRF) Glow Discharge + Mass Spectrometry (GD/MS)
Al	1,2,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21,22,26 3,23,24,25 20 5	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge Spectrometry (GDS) Glow Discharge + Mass Spectrometry (GD/MS)
Cu	1,3,5,8,9,10,11,12,13,14,15,16,17,20,21,22,23,24,25,26,27 4,6,7,18,19 2	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS)
N	1,2,3,4,6,7,8,10,11 12,13,14,15,16,17 5,9	Reduction fusion + Thermal conductivity (Fusion/Cond th) Optical Emission Spectrometry (spark) (OES) Reduction fusion + Infrared (Fusion/IR)
As	1,2,3,7,9,10,12,14,15,16 4,5,6,8 11 13	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)
B	1,2,3,4,5,6,7,8,11,12,13,14,16,17,18 9 10,15	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS)

V	3,4,8,11,12,13,14,15,16,17,18,19,20 1,2,7,9,10 6 5	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)
Co	1,4,7,8,11,12,13,14,15,16,17,18,19 2,3,6,9 5 10	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)
Ti	2,5,6,7,8,9,10,11,12,13,14,16,17 1 4 15 3	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Inductively Coupled Plasma + Mass Spectrometry (ICP/MS) Flame Atomic Absorption Spectrometry (FAAS) Glow Discharge + Mass Spectrometry (GD/MS)
Nb	3,4,5,6,7,8,9,11,12 1,10 2	Optical Emission Spectrometry (spark) (OES) Inductively Coupled Plasma + Optical Emission Spectrometry (ICP/OES) Glow Discharge + Mass Spectrometry (GD/MS)
Sn	5,6,7,8 1,2 4 3	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)

DESCRIPTION OF THE SAMPLE

The steel TL-1002 is a disc of 20 mm high and 48 mm diameter. It is also available in the form of milling chips in bottles containing 100g. The chips were passed through a 1250 µm aperture sieve and further sieving was carried out to exclude chips passing through a 400 µm aperture sieve.

INTENDED USE – STABILITY

The solid (disc) sample TL-1002 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-1002 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
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 OCAS NV	BE- 9060 ZELZATE
ARCELORMITTAL RESEARCH	FR- 57283 MAIZIERES LES METZ
ASCOMETAL FOS SUR MER	FR- 13771 FOS SUR MER Cedex
BRAMMER STANDARD	US- 77069 HOUSTON
BUREAU VERITAS LABORATOIRES	FR- 95310 SAINT OUEN L'AUMONE
CNPE DE CHINON – Pôle Chimie Laboratoires	FR- 37420 AVOINE
CRITT-MDTS	FR- 52800 NOGENT
EAG LABORATORIES	FR- 31100 TOULOUSE
ENVIFORM a.s.	CZ- 73961 TRINEC
FILAB	FR- 21000 DIJON
FRAMATOME-CENTRE TECHNIQUE LE CREUSOT	FR- 71205 LE CREUSOT
FRAMATOME-ETABLISSEMENT LE CREUSOT	FR- 71203 LE CREUSOT
INDUSTEEL FRANCE LE CREUSOT	FR- 71201 LE CREUSOT Cedex
INDUSTEEL FRANCE RIVE DE GIER	FR- 42803 RIVE-DE-GIER CEDEX
IRT M2P	FR- 57270 UCKANGE
LABORATOIRE METALLURGIQUE DE L'EST	FR- 54340 POMPEY
LES BRONZES INDUSTRIES	FR- 57360 AMNEVILLE
LUKASIEWICZ RESEARCH NETWORK – UPPER SILESIAN INSTITUTE OF TECHNOLOGY	PL- 44100 GLIWICE
MANOIR INDUSTRIES	FR- 27108 VAL DE REUIL Cedex
RESCOLL	FR- 33615 PESSAC CEDEX
TECHLAB	FR- 57070 SAINT JULIEN LES METZ

REFERENCES

- ISO 17034:2016 : General requirements for the competence of reference material producers
- ISO/GUIDE 35:2017 : Reference materials – Guidance for characterization and assessment of homogeneity and stability
- ISO 5725-2 : 2019 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
- ASTM E826-14 : Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry

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