S1 TITAN 600-800

Alloy(2) LE Calibrations (P/N: 730.0081)

Low Alloy	Al	Si	P	S	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Nb	Mo	W	Pb
Analysis range, %	LLD-1.2	LLD-2	LLD-0.1	LLD-0.3	LLD-0.2	LLD-1.8	LLD-20.9	LLD-19.5	61.3-100	LLD-8	LLD-8.8	LLD-3.2	LLD-1	LLD-8.4	LLD-6.1	LLD-0.2
LLD	10.4	183.4	52.2	39	87.1/27.6	34.4/17.4	58.3/26.5	234.6	N.A.	38.5	55	26.1	21.2	23.3	47.6	74.5
SEC %	0.036	0.09	0.014	0.028	0.007/0.006	0.073/0.044	58.3/26.5	0.24	0.43	0.037	0.023	0.016	0.002	0.035	0.039	0.007
Phase	2	2	2	2	2/1	2/1	2/1	1	1	1	1	1	1	1	1	1

Tool Steel	Al	Si	P	S	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zr	Nb	Mo	Sn	W	Pb
Analysis range, %	LLD-1.3	LLD-2	LLD-0.1	LLD-0.3	LLD-2.9	LLD-1.9	LLD-19.4	LLD-1.9	0.1-100	LLD-17	LLD-71.1	LLD-0.3	LLD-0.1	LLD-0.1	LLD-26.6	LLD-0	LLD-18.1	LLD-0.2
LLD	19.7	149.5	55.9	38	12.5/71	17.8/73.1	21.3/54.2	52.8	N.A.	78.7	69.1	27.4	20.2	21.6	25.1	145	58.7	84
SEC %	0.014	0.088	0.013	0.033	0.01/0.006	0.041/0.034	21.3/54.2	0.017	0.54	0.11	0.034	0.007	0.001	0.002	0.089	0.013	0.085	0.005
Phase	2	2	2	2	2/1	2/1	2/1	1	1	1	1	1	1	1	1	1	1	1

Stainless Steels	Al	Si	P	S	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zr	Nb	Mo	Ta	W	Pb
Analysis range, %	LLD-1.2	LLD-3.8	LLD-0.1	LLD-0.3	LLD-2.2	LLD-9.5	LLD-25.9	LLD-19.5	31.2-100	LLD-17.9	LLD-48.2	LLD-3.5	LLD-0.01	LLD-0.6	LLD-8.4	LLD-0.7	LLD-6.1	LLD-0.2
LLD (Fe pure)	702.6	203.2	43.6	23.2	122.1/19.9	92.1	69.7	60.9	47.2	25.1	50.8	31	19.6	21.2	23.4	55.4	64.6	71.7
SEC %	0.059	0.074	0.013	0.04	0.003/0.02	0.022	0.23	0.049	0.75	0.057	0.12	0.014	0.003	0.005	0.041	0.008	0.034	0.007
Phase	2	2	2	2	2/1	1	1	1	1	1	1	1	1	1	1	1	1	1

Nickels	Al	Si	P	S	Ti	V	Cr	Mn	Fe	Co	Ni	Cu
Analysis range, %	LLD-6	LLD-2.5	LLD-0.1	LLD-0.1	0-4.8	LLD-1	0-30.6	LLD-1.8	0-98.8	0-57.6	0-99.6	LLD-29.7
LLD	715.7	141.3	54.8	29.9	14.9/115.8	17.3/94.8	12.9/55	31.9	33.7	56.3	50.7	29.2
SEC %	0.092	0.059	0.009	0.017	0.044/0.067	0.01/0.022	12.9/55	0.17	0.43	0.097	0.76	0.099
Phase	2	2	2	2	2/1	2/1	2/1	1	1	1	1	1

	Zr	Nb	Mo	Ru	Sn	Hf	Ta	W	Re	Pb
Analysis range, %	LLD-0.3	LLD-5.1	LLD-26.6	0-3.5	LLD-0	0-1.5	LLD-11.9	LLD-10	0-5.8	LLD-0.2
LLD	22	21.3	27.2	40.3	142.6	99.1	77.2	67.4	66.2	65.8
SEC %	0.008	0.027	0.17	0.18	0.015	0.027	0.13	0.034	0.016	0.003
Phase	1	1	1	1	1	1	1	1	1	1

Cobalts	Al	Si	P	S	Ti	Cr	Mn	Fe	Co	Ni
Analysis range, %	LLD-5.8	LLD-1.2	LLD-0.03	LLD-0.03	LLD-3.3	LLD-30.6	LLD-1.9	LLD-96.5	0-100	0-62.8
LLD	250.6	97.5	41.3	1.4	16.6/51.1	14.9/58.8	45.2	54.9	32.6	25.1
SEC %	0.085	0.063	0.011	0.006	0.037/0.048	0.28/0.51	0.05	0.11	0.32	0.084
Phase	2	2	2	2	2/1	2/1	1	1	1	1

	Zr	Nb	Mo	Ru	Sn	Hf	Ta	W	Re	Pb
Analysis range, %	LLD-0.1	LLD-2.4	LLD-9.6	LLD-3.5	LLD-0	LLD-1.4	LLD-11.9	LLD-15.4	LLD-5.8	LLD-0.2
LLD	24.1	22	25	63.7	153.8	113.1	70.3	63.2	57.8	73
SEC %	0.004	0.037	0.041	0.071	0.015	0.043	0.078	0.13	0.049	0.004
Phase	1	1	1	1	1	1	1	1	1	1

Zincs	Al	Si	Mn	Fe	Ni	Cu	Zn	Sn	Pb	Bi
Analysis range, %	0.5-27.4	LLD-1.3	LLD-3.6	LLD-1	LLD-1.5	LLD-59.1	28.9-100	LLD-0.2	LLD-1.8	LLD-0.02
LLD	519.9	12.2	46.4	35.4	21.8	90	22.4	347	68.9	177.1
SEC %	0.24	0.026	0.007	0.006	0.005	0.066	0.72	0.01	0.006	0.001
Phase	2	2/1	1	1	1	1	1	1	1	1

S1 TITAN 600-800

Alloy(2) LE Calibrations (P/N: 730.0081)

Coppers	Al	Si	P	S	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se
Analysis range, %	LLD-13.9	LLD-3.7	LLD-0.9	LLD-0.1	LLD-0.8	LLD-1.8	LLD-5.2	LLD-4.5	LLD-0.3	LLD-69.6	21.5-100	0-39.3	LLD-0.5	LLD-1.2
LLD	875.4	178.6	64.4	6	126.6	14.1/54.4	33.1	31	24.9	48.9	32.3	20.2	34.1	12.5
SEC %	0.12	0.18	0.01	0.015	0.005	0.012/0.004	0.036	0.046	0.008	0.35	0.82	0.11	0.082	0.008
Phase	2	2	2	2	2/1	2/1	1	1	1	1	1	1	1	1

	Zr	Nb	Mo	Ag	Sn	Cd	Sb	Te	Pb (LB1)	Bi
Analysis range, %	LLD-0.4	LLD-1.4	LLD-0.1	LLD-3	LLD-9.9	LLD-0.3	LLD-1	LLD-0.5	LLD-8.4	LLD-5
LLD	35.7	33.3	33.4	138.8	212.7	167.6	219.6	301.5	78.7	31.8
SEC %	0.01	0.008	0.005	0.014	0.074	0.007	0.013	0.007	0.04	0.019
Typical accuracy: ±%	0.02	0.02	0.02	0.02	0.1	0.1	0.1	0.1	0.2	0.03
Phase	1	1	1	1	1	1	1	1	1	1

	Phase 1 reported elements, solder matrix								
Solders	Cu	Zn	Ag	Cd	In	Sn	Sb	Au	Pb
Analysis range, %	LLD-100	LLD-100	LLD-100	LLD-100	LLD-100	LLD-99.9	LLD-99.8	LLD-100	0-100
LLD	42.3	44.9	130.2	236	13.3	489.1	582.2	113.1	97.5
SEC %	0.19/0.19	0.17/0.17	0.078/0.084	0.036/0.036	0.21/0.21	0.27/0.27	0.1/0.1	0.058/0.058	0.74/0.77
Phase	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1

	Aditional elements reported in phase 2 (other Alloy type calibration Sn/Pb matrix													
Solders	Al	Si	P	S	Ti	V	Cr	Mn	Fe	Co	Ni	As	Se	Zr
Analysis range, %	LLD-100	0.1-100	LLD-26.7	LLD-99.9	LLD-99.4	LLD-99.7	LLD-99.9	0.9-100	LLD-100	LLD-100	LLD-99.6	LLD-99.5	LLD-99.8	LLD-98.9
LLD	238.9	94.6	33.5	42.1	120.5	85.8	68.6	34	52	27.5	72.4	16.7	17.1	33
SEC %	0.15	0.2	0.08	0.34	0.054	0.032	0.16	0.027	0.38	0.13	0.16	0.27	0.22	0.14
Typical accuracy: ±%	Al Ka1	Si Ka1	P Ka1	S Ka1	Ti Ka1	V Ka1	Cr Ka1	Mn Ka1	Fe Ka1	Co Ka1	Ni Ka1	As Ka1	Se Ka1	Zr Ka1
Phase	2	2	2	2	2	2	2	2	2	2	2	2	2	2

		Aditional elements reported in phase 2 (other Alloy type calibration Sn/Pb matrix											
Solders	Nb	Mo	Ru	Rh	Pd	Hf	Ta	W	Re	Ir	Pt	Hg	Bi
Analysis range, %	LLD-100	0.2-100	100-100	100-100	LLD-100	100-100	100-100	100-100	100-100	99.9-99.9	100-100	LLD-0.1	LLD-100
LLD	30.2	27.2	82.1	46.4	48.1	105.6	110.1	76.1	92.3	76.4	67.5	29.2	67.1
SEC %	0.009	0.066	0.084	0.7	0.015	1.57	0.73	0.19	0.16	0.46	0.41	0.004	0.098
Phase	2	2	2	2	2	2	2	2	2	2	2	2	2

Light Alloys - Ti	Al	Si	Ti	V	Cr	Mn	Fe	Cu	Zr	Nb	Mo	Pd	Sn	Ta	W
Analysis range, %	0.1-14.3	LLD-1	68.4-99.8	LLD-15.1	LLD-13	LLD-1.4	0-1.9	LLD-3.8	LLD-5	LLD-7	LLD-15	LLD-0.2	LLD-11.1	LLD-1	LLD-0.1
LLD	461.9	127.1	381.1	137.4	168.6	54	71.9	21.6	13.1	15.8	23	51.9	93.4	36.7	27
SEC %	0.15	0.033	0.66	0.08	0.062	0.017	0.042	0.011	0.024	0.039	0.053	0.005	0.031	0.011	0.005
Phase	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

Light Alloys - Al/Mg	Mg	Al	Si	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Zr	Sn	Pb	Bi
Analysis range, %	LLD-7.9	LLD-9.1	0-17.7	LLD-0.1	0-0.1	LLD-0.3	0-2.4	LLD-1.3	LLD-0.5	LLD-2.2	0-6.3	0-6.8	LLD-0.2	LLD-6.3	LLD-0.1	LLD-0
LLD	211.7	176.4	44	7.2/72.8	48.6/29.4	43.7/24.8	16.1/12.9	24.2/8.2	63.9/35.8	10.4/3.6	5.2/3.8	3.2/2.8	6.2/4.8	38.3/29.8	7.5/7.8	7.7/7.7
SEC %	0.067	0.046	0.3	0.005/0.007	0.003/0.004	0.004/0.007	0.013/0.024	0.016/0.025	0.008/0.011	0.016/0.014	0.035/0.019	0.046/0.074	0.002/0.002	0.004/0.003	0.003/0.002	0.002/0.002
Phase	2	2	2	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1

Full MultiMatrix FP	Mg	Al	Si	P	S	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Analysis range, %	LLD-99.9	LLD-100	LLD-100	LLD-26.7	LLD-99.9	LLD-99.4	LLD-99.7	LLD-99.9	LLD-100	LLD-100	LLD-100	0-99.6	LLD-100	LLD-100
SEC %	0.25	0.43	0.24	0.14	0.26	0.18	0.054	0.55	0.08	0.33	0.38	0.42	0.53	0.27

	As	Se	Y	Zr	Nb	Mo	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb
Analysis range, %	LLD-99.5	LLD-99.8	LLD-99.9	LLD-98.9	LLD-100	LLD-100	LLD-100	LLD-100	LLD-100	LLD-100	LLD-100	LLD-100	LLD-99.9	LLD-99.8
SEC %	0.29	0.53	0.017	0.082	0.1	0.13	0.12	0.23	0.16	0.3	0.077	0.11	0.35	0.092

	Te	Hf	Ta	W	Re	Ir	Pt	Au	Hg	Pb	Bi
Analysis range, %	LLD-0.5	LLD-100	LLD-100	LLD-100	LLD-100	LLD-99.9	LLD-100	LLD-100	0-86.2	LLD-100	LLD-100
SEC %	0.018	0.14	0.13	0.33	0.14	0.11	0.37	0.45	0.14	0.2	0.087

S1 TITAN 600-800

Alloy(2) LE Calibrations (P/N: 730.0081)

Calibration: FP based (with empirical corrections), with normalization based on BRUKER Intensity scaling when sample is smaller than mask

Analysis range: Concentration range covered by reference samples in the calibration of the application. Can be extened by 15% with FP based calibrations. Empirical calibrations should only be used within the range.

Lower Limit of Detection (LLD): The smallest concentration which can be detected.

a) In this document LLD is specified for a given matrix in three sigma 99.7% confidence level (3 sigma); 60 second phase 1 analysis time, 180 second phase 2 analysis time

b) Individual elemental LLD's improve as a function of the square root of the analysis time.

Actual lower limit of detection range depends on several factors such as matrix interferences, overlapping elements, level of statistical confidence and testing time. Measurement of concentration close to the low analysis range requires typically long

Standard Error of Calibration (SEC): Average error (deviation) between certified and XRF value of the samples used for the calibration expressed as an absolute value in weight %.

Typical accuracy: Typical average error within the analysis range when large set of reference samples are measured. Notice that error of the individual sample may differ significantly from this value. Measurement time: 30s (2) or less than 10 sec (1)

Phase: Number indicates on which measurement phase the listed LLD was determined

TRACER 5i / S1 TITAN 600-800
Alloy Calibration: Multimatrix FP
P/N: 730.0081

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Phase 1: 40 kV, TiAl filter

Phase 2: 15 kV, no filter