



CALIBUS

Ferrous Calibration Datasheet

Calibration Ranges for Ferrous Calibrations

CALIBUS 5 - Ferrous												
Elements	Fe Global Fe-1000		Low Alloy Steels Fe-1010		Stainless Steels Fe-1020		Tool Steels Fe-1030		High Mn Steels Fe-1040		Cast Iron Fe-1050	
	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %
Al	0.005	1.7	0.007	1.3	0.007	1.7	0.005	1.6	0.013	0.26	0.005	0.12
C	0.03	4.5	0.03	1.3	0.03	2.5	0.088	2.2	0.03	2.5	0.96	4.5
Co	0.01	17	0.01	0.5	0.01	17	0.01	8				
Cr	0.005	34	0.005	4.5	0.012	31.5	1.85	14	0.062	3.3	0.034	34
Cu	0.005	4.5	0.005	0.5	0.007	4.5	0.04	0.48	0.025	0.5	0.02	2.2
Mn	0.007	23	0.007	2.1	0.018	16.1	0.047	1.7	0.11	23	0.069	4.6
Mo	0.01	9.5	0.015	1.1	0.01	5.6	0.022	9.5	0.01	2	0.018	4
Ni	0.01	48.2	0.01	4.4	0.08	48.2	0.07	0.55	0.03	3.5	0.051	32
Si	0.02	4.7	0.02	3.9	0.02	4	0.044	1.5	0.057	1.7	0.246	4.7
Ti	0.007	1.2	0.02	1.2	0.02	1			0.02	0.35	0.007	1
V	0.005	9.5	0.005	0.9	0.005	9.5	0.035	2.5	0.005	0.85	0.005	1.2
W	0.2	19.2					0.2	19.2				
Mg											0.005	0.14

Calibrations created using Certified Reference Samples (CRMs) only. These values are taken from a production CALIBUS instrument, please note that detection limits of individual instruments may vary.

The calibration ranges represented are provisional and subject to further testing.

Ferrous Calibrations – Accuracy and Repeatability

Content Range	Non-Global Programs (e.g. Low Alloy Steel, Tool Steel)	Global Program
≤ 0.3	0.06	0.08
0.3 - 1	0.1	0.12
1 - 2	0.15	0.2
2 - 5	0.25	0.3
5 - 10	0.5	0.5
≥ 10	0.6	0.6

The accuracy standard for the CALIBUS instrument requires the average of test values to fall within the given ranges from those certified for a CRM.

Accuracy ranges are given for mass-% content ranges, and differ between global programs (e.g. Fe-1000) and non-global programs (e.g. Fe-1010, Fe-1020, etc).

Content Range	Carbon	Other Elements
0.1 - 0.3	10	8
0.3 - 2	8	5
2 - 100	5	3

The precision standard for the CALIBUS instrument requires the relative standard deviation (RSD) value to be less than the values given, dependent on content range. Carbon RSD values given separately.

For content lower than 0.1%, the content range of a sample set of at least 8 values should be less than 0.04.

Calculated using data measured on production CALIBUS instruments.

Data provided is a typical representation of CALIBUS performance, individual instrument performance may vary.

Fe-1010 – Low Alloy Steels Calibration

Sample Data – SS-407/2

ID	Fe	C	Si	Mn	Cr	Ni	Mo	Cu	V	Co	Al	Ti	Zr
Run1	93.6	0.432	0.702	0.169	3.00	0.601	0.847	0.424	0.19	0.00909	0.0156	<0.001	<0.001
Run2	93.4	0.444	0.687	0.260	3.03	0.588	0.870	0.424	0.21	0.00794	0.0255	0.0259	<0.001
Run3	93.7	0.440	0.678	0.183	3.00	0.559	0.815	0.419	0.18	0.00473	0.0169	0.0087	<0.001
Run4	93.5	0.453	0.681	0.199	3.05	0.588	0.856	0.428	0.19	0.00409	0.0243	0.0067	<0.001
Run5	93.6	0.442	0.672	0.189	3.03	0.570	0.839	0.425	0.19	0.01067	0.0203	0.0080	<0.001
Run6	93.7	0.429	0.677	0.183	3.01	0.567	0.821	0.421	0.19	0.00390	0.0219	0.0082	<0.001
Run7	93.6	0.428	0.668	0.183	3.03	0.581	0.851	0.426	0.19	0.00388	0.0224	0.0077	<0.001
Run8	93.6	0.433	0.665	0.187	3.04	0.565	0.840	0.424	0.18	0.00340	0.0289	0.0078	<0.001
Run9	93.6	0.440	0.667	0.183	3.05	0.593	0.833	0.427	0.19	0.00323	0.0229	0.0069	<0.001
Run10	93.5	0.436	0.668	0.207	3.04	0.563	0.836	0.418	0.20	0.00308	0.0286	0.0426	<0.001
Run11	93.6	0.441	0.685	0.179	3.06	0.562	0.863	0.427	0.19	0.00904	0.0232	0.0085	<0.001
Run12	93.6	0.443	0.672	0.174	3.07	0.568	0.864	0.421	0.19	0.00288	0.0255	0.0089	<0.001
AVG	93.6	0.438	0.677	0.191	3.04	0.575	0.845	0.424	0.19	0.00549	0.0230	0.0117	<0.001
CRM		0.49	0.66	0.195	3.03	0.527	0.83	0.397	0.19	0.0068	0.04		
SD PPM	680	70	104	227	220	135	163	31	81	27	39		
RSD	0.07	1.59	1.53	11.9	0.72	2.35	1.92	0.727	4.24	49.3	16.9		

Analysis results obtained from **Certified Reference Sample SS-407/2** using the **Fe-1010** calibration for low alloy steel samples on a production CALIBUS instrument. Results given in mass-%.

Data set includes data from 12 burns, the average composition values for the data set, the certified composition values for the CRM used, the standard deviation of the data for each element expressed in Parts Per Million (PPM), and the relative standard deviation (RSD).

Data provided is a typical representation of CALIBUS performance, individual instrument performance may vary.

Fe-1020 – Stainless Steels Calibration

Sample Data – 339-A

Mode	Fe	C	Si	Mn	Cr	Ni	Mo	Cu	V	Co	Al	Ti	Nb
Run1	64.0	0.170	0.712	1.83	17.2	13.1	2.72	0.0259	0.0486	0.0770	0.0401	<0.001	<0.001
Run2	64.1	0.171	0.723	1.84	17.1	13.1	2.73	0.0272	0.0502	0.0696	0.0465	<0.001	<0.001
Run3	64.6	0.171	0.688	1.76	17.0	13.0	2.65	0.0281	0.0466	0.0636	0.0563	<0.001	<0.001
Run4	64.4	0.169	0.685	1.77	17.0	13.0	2.78	0.0294	0.0467	0.0770	0.0459	<0.001	<0.001
Run5	64.4	0.175	0.695	1.82	17.1	12.8	2.79	0.0309	0.0466	0.0519	0.0886	<0.001	<0.001
Run6	64.6	0.176	0.685	1.85	17.1	12.8	2.71	0.0296	0.0501	0.0616	0.0554	<0.001	<0.001
Run7	64.4	0.176	0.698	1.77	17.0	13.0	2.79	0.0282	0.0490	0.0664	0.0588	<0.001	<0.001
Run8	64.6	0.167	0.657	1.73	16.9	13.0	2.68	0.0307	0.0466	0.0606	0.0540	<0.001	<0.001
Run9	64.8	0.166	0.675	1.78	16.9	12.9	2.65	0.0295	0.0461	0.0521	0.0530	<0.001	<0.001
Run10	64.3	0.201	0.710	1.88	17.2	12.6	2.75	0.0259	0.0463	0.0497	0.1799	<0.001	<0.001
Run11	64.4	0.176	0.674	1.80	17.1	12.9	2.73	0.0286	0.0463	0.0491	0.0651	<0.001	<0.001
Run12	65.0	0.165	0.669	1.72	16.8	12.8	2.62	0.0323	0.0447	0.0539	0.0555	<0.001	<0.001
AVG	64.5	0.173	0.689	1.79	17.0	12.9	2.72	0.0289	0.0473	0.0610	0.0666	<0.001	<0.001
CRM		0.16	0.64	1.71	17	12.9	2.79	0.021	0.007	0.007	0.004	0.002	0.005
SD PPM	2617	91	186	469	1226	1462	546	19	17	96	361		
RSD	0.41	5.22	2.69	2.61	0.72	1.13	2.01	6.49	3.51	15.7	54.2		

Analysis results obtained from **Certified Reference Sample 339-A** using the **Fe-1020** calibration for stainless steel samples on a production CALIBUS instrument. Results given in mass-%.

Data set includes data from 12 burns, the average composition values for the data set, the certified composition values for the CRM used, the standard deviation of the data for each element expressed in Parts Per Million (PPM), and the relative standard deviation (RSD).

Data provided is a typical representation of CALIBUS performance, individual instrument performance may vary.

Fe-1030 – Tool Steels Calibration

Sample Data – SS-482/1

Mode	Fe	C	Si	Mn	Cr	Ni	Mo	Cu	W	V	Co	Al	Nb
Run1	75.6	0.674	0.0955	0.179	4.01	0.111	0.424	0.0777	17.4	1.08	0.247	<0.001	0.0410
Run2	75.7	0.672	0.108	0.180	3.94	0.113	0.417	0.0770	17.4	1.02	0.248	0.00445	0.0806
Run3	75.9	0.663	0.0891	0.177	3.95	0.109	0.411	0.0776	17.3	1.03	0.250	0.00169	0.0771
Run4	76.5	0.623	0.109	0.177	3.89	0.108	0.400	0.0783	16.8	1.01	0.250	0.00155	0.0785
Run5	76.3	0.628	0.102	0.172	3.91	0.103	0.408	0.0776	16.9	1.03	0.250	0.00167	0.0731
Run6	76.0	0.639	0.0979	0.187	3.94	0.108	0.418	0.0775	17.2	1.03	0.251	0.00156	0.0587
Run7	76.1	0.638	0.110	0.175	3.96	0.104	0.411	0.0775	17.1	1.06	0.255	0.00226	0.0502
Run8	75.9	0.649	0.104	0.183	3.93	0.110	0.420	0.0771	17.3	1.05	0.251	0.00149	0.0630
Run9	75.7	0.650	0.0975	0.193	3.99	0.107	0.416	0.0769	17.4	1.09	0.252	0.00143	0.0644
Run10	75.9	0.638	0.0959	0.198	3.92	0.106	0.413	0.0777	17.3	1.03	0.247	0.00556	0.0681
Run11	75.9	0.642	0.117	0.211	3.90	0.110	0.404	0.0774	17.3	1.04	0.249	0.00375	0.0762
Run12	75.9	0.627	0.0955	0.183	3.92	0.115	0.416	0.0770	17.3	1.02	0.254	0.00310	0.0680
AVG	76.0	0.645	0.102	0.185	3.94	0.109	0.413	0.0774	17.2	1.04	0.250	0.00244	0.0666
CRM		0.67	0.14	0.26	4		0.40		17.8	1.04	0.290		
SD PPM	2471	162	76	107	338	34	65	4	1971	232	23		115
RSD	0.33	2.51	7.49	5.80	0.86	3.12	1.57	0.49	1.14	2.23	0.92		17.3

Analysis results obtained from **Certified Reference Sample SS-482/1** using the **Fe-1030** calibration for tool steel samples on a production CALIBUS instrument. Results given in mass-%.

Data set includes data from 12 burns, the average composition values for the data set, the certified composition values for the CRM used, the standard deviation of the data for each element expressed in Parts Per Million (PPM), and the relative standard deviation (RSD).

Data provided is a typical representation of CALIBUS performance, individual instrument performance may vary.

Fe-1040 – High Mn Steels Calibration

Sample Data – SS-495/3

Mode	Fe	C	Si	Mn	Cr	Ni	Mo	Cu	V	Al	Ti
Run1	80.4	0.826	0.597	14.3	2.11	1.49	0.303	0.0209	0.0194	<0.001	<0.001
Run2	80.7	0.821	0.594	14.0	2.10	1.49	0.295	0.0219	0.0229	<0.001	<0.001
Run3	80.7	0.831	0.580	14.0	2.10	1.49	0.298	0.0225	0.0226	<0.001	<0.001
Run4	80.6	0.833	0.616	14.0	2.11	1.49	0.291	0.0229	0.0229	<0.001	<0.001
Run5	80.7	0.828	0.600	13.9	2.11	1.50	0.288	0.0235	0.0243	<0.001	<0.001
Run6	80.7	0.825	0.610	13.9	2.11	1.49	0.296	0.0225	0.0231	<0.001	<0.001
Run7	80.7	0.832	0.612	13.9	2.10	1.48	0.300	0.0230	0.0241	<0.001	<0.001
Run8	80.6	0.833	0.611	14.0	2.11	1.49	0.301	0.0235	0.0234	<0.001	<0.001
Run9	80.8	0.831	0.612	13.8	2.10	1.48	0.299	0.0234	0.0242	<0.001	<0.001
Run10	80.8	0.821	0.608	13.9	2.10	1.48	0.293	0.0228	0.0219	<0.001	<0.001
Run11	80.8	0.829	0.620	13.8	2.10	1.49	0.294	0.0233	0.0210	<0.001	<0.001
Run12	80.8	0.827	0.599	13.9	2.10	1.48	0.291	0.0230	0.0231	<0.001	<0.001
AVG	80.7	0.828	0.605	13.9	2.10	1.49	0.296	0.0228	0.0228	<0.001	<0.001
CRM		0.8134	0.5948	14.04	2.029	1.585	0.3042			0.0093	
SD PPM	1101	41	107	1094	35	60	43	7	14		
RSD	0.14	0.50	1.77	0.78	0.16	0.40	1.47	3.21	6.08		

Analysis results obtained from **Certified Reference Sample SS-495/3** using the **Fe-1040** calibration for high manganese steel samples on a production CALIBUS instrument. Results given in mass-%.

Data set includes data from 12 burns, the average composition values for the data set, the certified composition values for the CRM used, the standard deviation of the data for each element expressed in Parts Per Million (PPM), and the relative standard deviation (RSD).

Data provided is a typical representation of CALIBUS performance, individual instrument performance may vary.

Fe-1050 – Cast Iron Calibration

Sample Data – 245-B

Mode	Fe	C	Si	Mn	Cr	Ni	Mo	Cu	V	Al	Ti	Mg	Sn
Run1	93.2	2.93	1.60	1.34	0.185	0.214	0.125	0.103	0.0788	0.0457	0.137	0.00641	0.0475
Run2	93.2	2.81	1.62	1.44	0.171	0.218	0.122	0.105	0.0750	0.0388	0.138	0.00941	0.0480
Run3	93.2	2.91	1.58	1.41	0.186	0.206	0.128	0.101	0.0768	0.0323	0.146	0.00796	0.0513
Run4	93.1	2.95	1.55	1.48	0.185	0.207	0.128	0.102	0.0758	0.0336	0.139	0.0102	0.0496
Run5	93.2	2.95	1.52	1.44	0.193	0.208	0.132	0.100	0.0756	0.0304	0.127	0.00854	0.0483
Run6	93.2	2.93	1.54	1.38	0.190	0.207	0.125	0.100	0.0748	0.0286	0.123	0.00766	0.0464
Run7	93.3	2.86	1.57	1.35	0.181	0.201	0.119	0.103	0.0712	0.0318	0.111	0.00753	0.0463
Run8	93.2	3.02	1.49	1.41	0.197	0.205	0.126	0.099	0.0768	0.0271	0.123	0.00775	0.0490
Run9	93.2	2.90	1.53	1.43	0.186	0.205	0.126	0.103	0.0711	0.0419	0.116	0.00958	0.0480
Run10	93.4	2.86	1.54	1.33	0.177	0.206	0.123	0.103	0.0706	0.0298	0.117	0.00734	0.0473
Run11	93.2	2.94	1.53	1.39	0.188	0.196	0.125	0.102	0.0721	0.0258	0.123	0.00737	0.0433
Run12	93.2	2.92	1.55	1.38	0.182	0.206	0.130	0.099	0.0740	0.0291	0.144	0.00723	0.0479
AVG	93.2	2.91	1.55	1.40	0.185	0.207	0.126	0.102	0.0744	0.0329	0.129	0.00808	0.0477
CRM		2.95	1.59	1.38	0.197	0.194	0.115	0.081	0.055	0.038	0.11	0.003	0.076
SD PPM	759	521	342	429	66	53	34	18	25	59	111	11	19
RSD	0.08	1.79	2.20	3.07	3.57	2.58	2.71	1.77	3.36	17.89	8.64	13.27	3.93

Analysis results obtained from **Certified Reference Sample 245-B** using the **Fe-1050** calibration for cast iron samples on a production CALIBUS instrument. Results given in mass-%.

Data set includes data from 12 burns, the average composition values for the data set, the certified composition values for the CRM used, the standard deviation of the data for each element expressed in Parts Per Million (PPM), and the relative standard deviation (RSD).

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