

## SPECTROPORT & SPECTROTEST mobile metal analyzer

# Boron Steels – When High Wear Resistance is Required

- Highly cost-effective versus prohibitive expenses of off-spec products
- Grade identification mode, to determine a grade and ensure sample meets specified limits
- Grade verification/control mode, to confirm sample fits preselected grade specifications

Alloys must be accurately sorted, identified, and verified to meet the chemical composition specified by a customer or an industry. As an example, for organizations performing metal producing or processing, an alloy mixup at the shipping dock or on the factory floor risks an expensive, inconvenient batch rework — or a catastrophic lost contract.

There are different industries and applications requiring boron-alloyed heat-treatable steels. Typical applications for the use of such steels can be found in agriculture, construction and automotive. Just to name a few products, in automotive they are suspension components or drive shafts and harrows and plows in agriculture or concrete mixer drums in construction. The strength properties of the boron-alloyed steels are - in addition to the carbon and manganese - achieved by the low proportion of boron.

Boron is typically alloyed between 8 to 50ppm (0.0008 - 0.005%). 10MnB5 to 46MnB5 or 27MnCrB5-2 and 39MnCrB5-2 are some common types of boron-alloyed heat-treatable steels.

The boron content must be checked to ensure, for instance, that the correct alloy has been processed for a product and thus the ordered product specification can be shipped.

Fortunately, such a check can be easily, accurately, and affordably accomplished using advanced solutions from SPECTRO Analytical Instruments: either the flagship SPECTROTEST mobile metal analyzer, or the more portable SPECTROPORT metal analyzer.

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To perform the check, select spark mode, so the probe head is purged with argon gas. Hold the probe to a sample and push start. Results are typically displayed within 10 seconds.

Spark Analyzer Pro Mobile - Routine Measurement V.1.40.0008 [Conc.]												
Sample Name												
183B												
	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Co	Cu	
1	0.053	1.03	1.83	0.013	0.011	0.20	0.047	1.11	0.14	0.11	0.56	
2	0.051	1.03	1.82	0.015	0.010	0.20	0.048	1.10	0.15	0.11	0.55	
3	0.053	1.02	1.84	0.014	0.012	0.20	0.049	1.10	0.14	0.11	0.55	
<x>	0.052	1.03	1.83	0.014	0.011	0.20	0.048	1.10	0.14	0.11	0.55	
	Nb	Ti	V	W	Pb	Sn	As	Zr	Ca	Ce	B	
1	0.006	0.012	0.004	0.31	<0.010	0.058	<0.005	0.075	<0.0005	0.007	0.0005	
2	0.007	0.012	0.003	0.31	<0.010	0.055	<0.005	0.076	<0.0005	0.007	<0.0005	
3	0.006	0.012	0.004	0.30	<0.010	0.058	<0.005	0.085	<0.0005	0.007	0.0005	
<x>	0.006	0.012	0.004	0.30	<0.010	0.057	<0.005	0.079	<0.0005	0.007	0.0005	
	Zn	La	Fe	CEV	CE<.18							
1	0.006	<0.002	94.4									
2	0.006	<0.002	94.4	0.51	0.24							
3	0.006	<0.002	94.4	0.52	0.24							
<x>	0.006	<0.002	94.4	0.52	0.24							

SPECTROTEST: certified reference material to show performance on low level boron values CKD 183B with 5ppm boron

Spark Analyzer Pro Mobile - Routine Measurement V.1.40.0008 [Conc.]												
Sample Name												
186B												
	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Co		
1	0.39	1.44	1.35	0.016	0.009	1.50	0.26	1.63	0.038	0.006		
2	0.39	1.44	1.34	0.015	0.010	1.48	0.26	1.62	0.038	0.006		
3	0.39	1.43	1.35	0.015	0.008	1.49	0.26	1.60	0.037	0.007		
<x>	0.39	1.43	1.35	0.015	0.009	1.49	0.26	1.62	0.038	0.006		
	Cu	Nb	Ti	V	W	Pb	Sn	As	Zr	Ca		
1	0.23	0.004	0.049	0.017	0.051	<0.010	0.021	<0.005	0.003	0.0007		
2	0.23	0.004	0.053	0.017	0.051	<0.010	0.021	<0.005	<0.003	0.0008		
3	0.23	0.005	0.052	0.018	0.043	<0.010	0.023	<0.005	<0.003	0.0006		
<x>	0.23	0.004	0.051	0.017	0.048	<0.010	0.021	<0.005	0.003	0.0007		
	Ce	B	Zn	La	Fe	CEV	CE<.18					
1	<0.006	0.0009	0.007	<0.002	93.0	1.09	0.64					
2	<0.006	0.0009	0.009	<0.002	93.0	1.09	0.64					
3	<0.006	0.0009	0.008	<0.002	93.0	1.09	0.64					
<x>	0.006	0.0009	0.008	<0.002	93.0	1.09	0.64					

SPECTROTEST: certified reference material to show performance on low level boron values CKD 186B with 9ppm boron

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# Boron Steels – When High Wear Resistance is Required

Element	Measured Value [%]			
	1	2	3	Average
C	0.13	0.13	0.13	0.13
Si	0.19	0.20	0.20	0.20
Mn	1.33	1.32	1.32	1.32
P	0.017	0.016	0.014	0.016
S	0.007	0.007	0.007	0.007
Cr	0.35	0.34	0.34	0.34
Mo	0.012	0.014	0.011	0.012
Ni	0.039	0.041	0.042	0.041
Al	0.033	0.035	0.034	0.034
Co	0.009	0.016	0.017	0.014
Cu	0.014	0.015	0.012	0.014
Nb	<0.007	<0.007	<0.007	<0.007
Ti	0.031	0.031	0.034	0.032
V	0.009	0.008	0.008	0.008
W	<0.04	<0.04	<0.04	<0.04
Pb	<0.011	<0.011	<0.011	<0.011
Sn	<0.002	<0.002	<0.002	<0.002
As	<0.005	<0.005	<0.005	<0.005
Zr	<0.007	<0.007	<0.007	<0.007
B	0.0006	0.0006	0.0007	0.0006
Fe	97.8	97.8	97.8	97.8

Element	Measured Value [%]		
	1	2	X
C	0.28	0.29	0.28
Si	0.27	0.28	0.27
Mn	1.29	1.29	1.29
P	0.015	0.018	0.017
S	0.008	0.009	0.008
Cr	0.25	0.25	0.25
Mo	0.041	0.044	0.043
Ni	0.12	0.12	0.12
Al	0.019	0.019	0.019
Co	0.009	0.020	0.014
Cu	0.24	0.24	0.24
Nb	<0.007	<0.007	<0.007
Ti	0.038	0.037	0.038
V	0.009	0.008	0.009
W	<0.04	<0.04	<0.04
Pb	<0.011	<0.011	<0.011
Sn	0.018	0.017	0.017
As	0.007	0.007	0.007
Zr	<0.007	<0.007	<0.007
B	0.0031	0.0032	0.0031
Fe	97.3	97.3	97.3









SPECTROPORT: on the spot testing to identify the boron-alloyed steel

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# Boron Steels – When High Wear Resistance is Required

Both instruments can also do a conformity check of the analysis result to given norms (grade specifications) – the grade control / verification mode.

Spark Analyzer Pro Mobile - Routine Measurement V. 1.140.0008 [Conc.]

Sample Name	Grade Norm	Grade ID										
	TXC03	1.7160										
	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Co	Cu	
1	0.18	0.26	1.24	0.015	0.024	1.07	0.030	0.11	0.022	0.010	0.21	
2	0.19	0.26	1.24	0.016	0.025	1.07	0.030	0.12	0.023	0.010	0.21	
3	0.19	0.26	1.24	0.017	0.027	1.07	0.030	0.12	0.022	0.009	0.22	
I<	0.14		1.00			0.80						
>X>	0.19	0.26	1.24	0.016	0.025	1.07	0.030	0.12	0.022	0.010	0.21	
I>	0.19	0.40	1.30	0.035	0.035	1.10	0.050	0.30	0.050	0.10	0.40	
	Nb	Ti	V	W	Pb	Sn	As	Zr	Ca	Ce	B	
1	0.004	0.009	<0.002	<0.030	<0.010	0.030	0.007	<0.003	0.001	<0.006	0.0010	
2	0.005	0.009	<0.002	<0.030	<0.010	0.030	0.009	<0.003	0.001	<0.006	0.001	
3	0.005	0.009	<0.002	<0.030	<0.010	0.030	0.008	<0.003	0.002	<0.006	0.001	
I<											0.0008	
>X>	0.005	0.009	<0.002	<0.030	<0.010	0.030	0.008	0.003	0.002	0.006	0.001	
I>	0.030	0.025	0.030	0.10	0.050						0.005	
	Zn	La	Fe	CEV	CE<.18							
1	0.009	<0.002	96.7	0.63	0.32							
2	0.007	<0.002	96.7	0.64	0.33							
3	0.011	<0.002	96.7	0.64	0.33							
I<												
>X>	0.009	<0.002	96.7	0.63	0.33							
I>												
Grade Norm	Grade Name	Grade Description	Element	Internal Min.	Value	Internal Max.						
      							 					
Edit Smpl (Shft A) iCAL (F8) Flush (F) Srch Grade (F4) Export (F5) Print (F6) Meas Step (F3)							Fe-10-MO   Fe base UV-Verification   Quantitative Analysis					

SPECTROTEST: grade control mode used to verify boron-alloyed steels

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# Boron Steels – When High Wear Resistance is Required

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Additionally, there is the grade search mode available with which SPECTROPORT and SPECTROTEST can deliver also a list of the most probable grades (many variants of the same exists) in case the documentation (labeling) of a part is missing.

SPECTROPORT and SPECTROTEST also offer the ability to add individual defined pseudo elements – for example CEV or  $CE < .18$  (valid only for carbon values  $< 0.18\%$ ) for different carbon equivalent definitions as shown in the screenshots.

Why is the carbon equivalent mentioned here in combination with boron-alloyed heat-treatable steels? Because the strength properties of the boron-alloyed steels achieved due to the combination of the low boron but higher carbon and manganese content. And steel alloys can only be welded without special measures if they contain no more than approx. 0.2% carbon. The weldability decreases with increasing carbon content. The carbon equivalent is a value that helps to assess weldability and the tendency to crack in a steel material. However, there are many factors that affect weldability.

The example just shows that sometimes more information is needed to control the production processes.

### Conclusion

The result tables show the ability of SPECTROPORT and SPECTROTEST to perform the quality control measures necessary to ensure the correct processing and use of boron-alloyed heat-treatable steels where needed.