Elvatech
Advanced XRF equipment and solutions

ElvaX ProSpector for Positive material identification

Introduction

ElvaX ProSpector implements fast and accurate PMI (Positive Material Identification) testing at any steps of alloy manufacturing or in-process alloy installation. Composition and grade of an alloy determine its durability, heat and corrosion resistance. Knowing alloy grade allows engineers, suppliers, plant workers to be sure in material properties.

X-Ray fluorescence handheld spectrometer is an ideal tool for PMI because of excellent precision for metals in wide concentration range (from ppm to 100%), fast results getting (several seconds) and non-destructive testing. Also ElvaX ProSpector analyzer uses standard-less fundamental parameters algorithm with specify coefficients for different alloy types, so you don't need to do any calibration for various samples.

Application

ElvaX ProSpector rapidly and accurately identifies pure metals and alloy grades including, but not limited to:

- Magnesium alloys;
- Aluminum alloys;
- Titanium alloys;
- Stainless steels;
- Low alloy steels;
- Tool steels;
- Cobalt alloys;
- Nickel alloys;
- Copper alloys, brasses and bronzes;
- Zinc alloys;
- Solders;
- Precious alloys;

Analyzer software offers several testing modes:

- Composition. Displaying measured concentration of metals in unknown alloy.
- Grade ID. Software compares measured alloy with those saved in internal alloy library and shows the best matched alloy IDs.
  Testing screen in Grade ID mode is shown on figure 1.

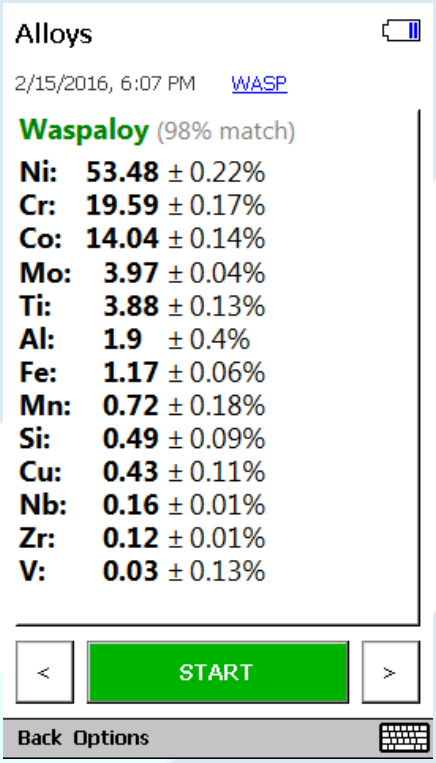

Figure 1. Testing screen of "Grade ID" mode.

- Compare to alloy. Displaying both measured and certified concentrations of a specific alloy ID, as shown at figure 2.

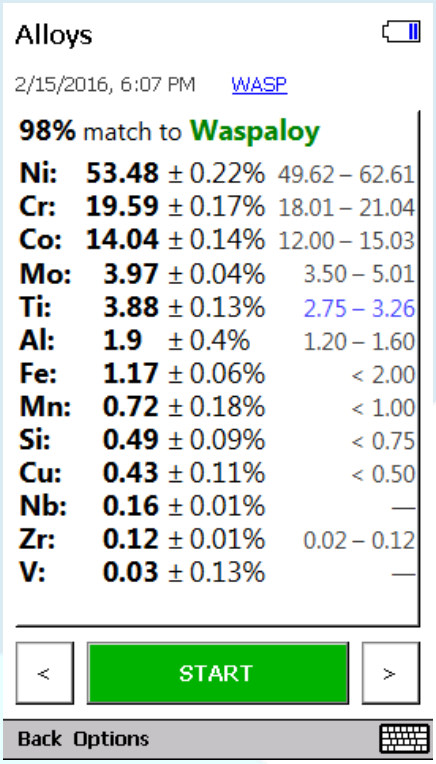

Figure 2. Testing screen of "Compare to alloy" mode.

- Pass/Fail. It is a useful mode for grading a specific alloy ID. Displaying "Pass" message when measured alloy fully complies alloy grade what you want, and "Fail" in other case. See figure 3.

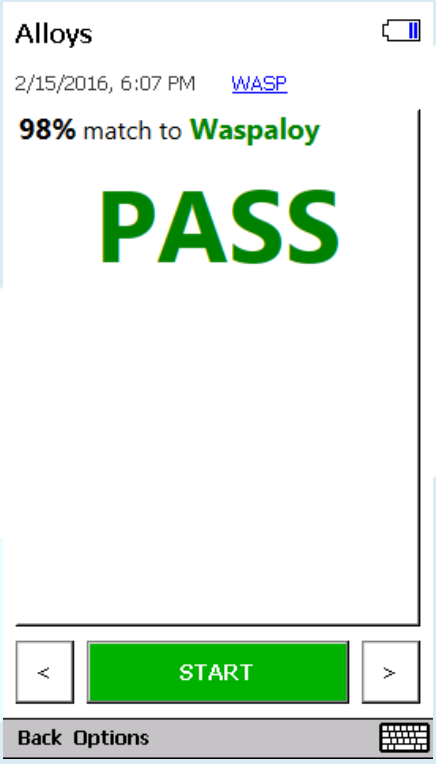

Figure 3. Testing screen of "Pass/Fail" mode.

Instrumentation

There are two models of ElvaX ProSpector: Standard Edition (SE) and Light Edition (LE).

Standard edition equipped with 40 kV Tungsten anode tube and Si-PIN detector and allows to determine elements from Cl to U.

For light alloys analysis (alloys, which contain Mg-S), ProSpector Light Edition is needed. It equipped with 40 kV Rhodium anode tube, 5 different filters and high resolution large area Silicon Drift Detector (SDD), which provides excellent energy resolution, low detection limits and high productivity.

If you want to analyze magnesium and aluminum alloys and measure light elements in other alloys, then Prospector LE is needed.

Device has user-friendly software interface and requires very little operator training. Because of lightweight (only 1.5 kg) and long operation time (about 8 hours on one battery) ElvaX ProSpector is a best choice for rapid in-process positive material identification.

Method

Alloy analysis requires minimal sample preparation. The most samples can be measured directly, but if any surface impurity or rust is presented, then analyzed surface must be polished.

Prospector has internal fundamental parameters calibration with specific settings for each alloy type (steels, copper alloys, nickel alloys, aluminum alloys and etc.). Software automatically selects settings for measured alloy class.

ProSpector SE provides standard alloy grading in 15-20 seconds, and ProSpector LE can identify standard alloys in just 5 seconds and light alloys in 15-20 seconds! Measurement time is adjusted automatically.

Eight certified reference materials of different alloy classes were analyzed by ElvaX ProSpector LE: magnesium, aluminum, titanium, nickel alloys, stainless steel, low alloy steel, brass and bronze.

Beam parameters was the same for each measurement, total analysis time is 20 s. Anode voltage in main mode was 35 kV with Al800 filter and 12 kV without filter in light mode.

Results

Tables 1-8 show the certified and measured values for each alloy type.

Element	Concentration, %		
	Certified	Measured	Uncertainity
Mg	91.05	90.9	0.3
Al	8.39	8.4	0.3
Si	0.05	0.14	0.03
Mn	0.19	0.2	0.01
Fe	0.02	0.02	0.0
Cu	0.07	0.07	0.0
Zn	0.23	0.22	0.01

Table 1. Magnesium alloy AZ80A (UNS M11800).

Element	Concentration, %		
	Certified	Measured	Uncertainity
Mg	0.23	0.2	0.6
Al	96.61	96.99	0.08
Si	0.87	0.65	0.07
Ti	0.14	0.11	0.02
Cr	0.091	0.08	0.01
Mn	1.24	1.24	0.02

Fe	0.61	0.56	0.01
Ni	0.027	0.02	0.0
Cu	0.13	0.12	0.01
Zn	0.053	0.04	0.0

Table 2. Aluminum alloy grade 3030 (UNS A93030).

Element	**Concentration, %**		
	Certified	**Measured**	**Uncertainity**
Al	4.14	3.9	0.4
Ti	91.81	92	0.3
Fe	0.37	0.32	0.02
Zr	0.17	0.17	0.01
Sn	3.48	3.5	0.06

Table 3. Titanium alloy Grade 6 (UNS R54520).

Element	**Concentration, %**		
	Certified	**Measured**	**Uncertainity**
Ti	0.32	0.29	0.07
Cr	16.65	16.74	0.07
Mn	1.91	1.92	0.07
Fe	66.43	66.78	0.09
Ni	11.51	11.65	0.07
Cu	0.31	0.31	0.03
Mo	2.09	2.11	0.01

Table 4. Stainless steel grade 316 (UNS S31600).

Element	**Concentration, %**		
	Certified	**Measured**	**Uncertainity**
Si	2.24	2.24	0.08
Ti	0.126	0.12	0.21
Cr	0.139	0.14	0.05
Mn	1.29	1.52	0.08
Fe	95.01	95	0.11
Ni	0.71	0.56	0.07
Cu	0.099	0.09	0.03
Mo	0.117	0.12	0.01
W	0.061	0.08	0.04

Table 5. Low alloy steel AISI 9260.

Element	Concentration, %		
	Certified	Measured	Uncertainity
Al	1.54	1.9	0.4
Si	0.403	0.49	0.09
Ti	3.904	3.88	0.13
Cr	19.76	19.59	0.17
Mn	0.65	0.72	0.18
Fe	1.197	1.17	0.06
Co	13.77	14.04	0.14
Ni	53.51	53.48	0.22
Cu	0.47	0.43	0.11
Zr	0.146	0.12	0.01
Mo	3.98	3.97	0.04
Nb	0.149	0.16	0.01

Table 6. Nickel alloy Waspaloy.

Element	Concentration, %		
	Certified	Measured	Uncertainity
Al	10.2	10.3	0.4
Si	0.11	0.09	0.06
Mn	0.42	0.44	0.06
Fe	3.05	2.97	0.08
Ni	0.45	0.32	0.04
Cu	85.2	85.3	0.3
Zn	0.41	0.33	0.09
Sn	0.105	0.18	0.09

Table 7. Bronze grade UNS C61900.

Element	Concentration, %		
	Certified	Measured	Uncertainity
Al	0.387	0.62	0.24
Si	0.203	0.32	0.05
Fe	0.081	0.09	0.06
Ni	0.239	0.21	0.04
Cu	60.81	60.69	0.16
Zn	37.07	37.06	0.17
Pb	1.07	0.99	0.06

Table 8. Brass grade UNS C37000.

Another important parameter of XRF device is the repeatability of the analysis. The SS316 was measured 10 times over a period of time. An average, standard deviation (Std Dev) and relative standard deviation (RSD) for Fe, Cr, Ni, Mo content was calculated from this data. Results are given in Table 9.

measure #	Fe, %	Cr, %	Ni, %	Mo, %
1	66.81	16.76	11.59	2.13
2	66.81	16.78	11.57	2.13
3	66.82	16.77	11.58	2.14
4	66.85	16.77	11.54	2.13
5	66.84	16.77	11.57	2.13
6	66.81	16.76	11.57	2.14
7	66.82	16.77	11.59	2.14
8	66.85	16.72	11.6	2.13
9	66.84	16.75	11.58	2.14
10	66.8	16.76	11.61	2.13
Average	**66.825**	**16.761**	**11.58**	**2.134**
Std Dev	**0.016**	**0.011**	**0.014**	**0.005**
% RSD	**0.024**	**0.066**	**0.121**	**0.234**

Table 9. Repeatability test for 316 stainless steel.

Conclusions

ElvaX ProSpector is an ideal instrument for positive material identification. It provides rapid, non-destructive and accurate analysis of different alloys.

Obtained results indicate a good correlation between certified and measured concentration values.

Because of extensive alloy grade library analyzer software can easily identify most international standard alloy IDs.

Real-time data from handheld analyzer ElvaX ProSpector save a lot of time and money in alloy production industry, alloy installation and quality assurance.