SPECTRO | AMETEK
MATERIALS ANALYSIS DIVISION

When results matter

Mobile metal analyzers: on-the-spot solutions for incoming and outgoing inspection

Introduction

Is the metal or metal alloy you're working with the right one? Does it have the chemical composition that your supplier promised, your process needs, your customer demands, or your product requires?

Metal mistakes and counterfeits are impacting supply chains worldwide. Accepting the wrong alloy at the shipping dock or on the factory floor can mean anything from a troublesome batch rework to a catastrophic loss of business. So for metal producers, metal processors, metal dealers, or service contractors worldwide, inspecting incoming and outgoing metals and their alloys has become a critical quality control (QC) task.

However, outsourcing metal sample testing to third-party laboratories introduces considerable time and expense. Even sending samples to an in-house lab can mean significant delays.

Fortunately, there's a class of instruments that lets users analyze their metal samples on the spot — easily, accurately, and affordably. This paper highlights some key capabilities of today's *mobile metal analyzers (MMAs)*.

SPECTRO xSORT in use

SPECTROTEST in use

TECHNOLOGIES AND ANALYZERS

How do MMAs work?

The key technology: *arc/spark optical emission spectrometry (OES)*. The analyzer's probe vaporizes a spot on the sample's metal surface via an electrical discharge. Light emitted during this superheated excitation is then analyzed by the instrument's optics. Since each element emits characteristic spectral lines, quantifying the light intensities of each line enables identification and measurement of elements in the sample.

In *arc mode*, the probe generates a continuous electrical arc similar to that used in welding. For even more precise measurement, in *spark mode* it generates a pulsed arc, within a sealed, argon-purged space — the sample surface closes the testing adapter.

Examples using this technology include the SPECTROPORT portable metal analyzer, as well as the SPECTROTEST mobile metal analyzer — flagship of SPECTRO's field-deployable metal analyzers. SPECTROPORT delivers advanced OES functionality in a wheeled instrument as easy to use as a handheld analyzer. This type of instrument

can perform most metal inspection tasks. A larger, more powerful unit such as SPECTROTEST is used for even more exact metal analysis without compromise, for difficult-to-identify materials, or for high sample volumes.

Note: a handheld spectrometer based on *energy-dispersive X-ray fluorescence (ED-XRF)* may sometimes be sufficient — with limitations on which elements it can measure. This technology utilizes X-rays to generate its excitation energy. Example: the SPECTRO xSORT handheld analyzer.

Instrument suppliers can help determine which technology suits which specific application.

INCOMING AND OUTGOING INSPECTIONS

The right analyzer should perform well for the type of inspection you need.

Many facilities must check new deliveries to confirm they correspond to the expected material. Some organizations demand 100% of all incoming parts be tested. With either SPECTRO analyzer, *pass/fail sorting* using the
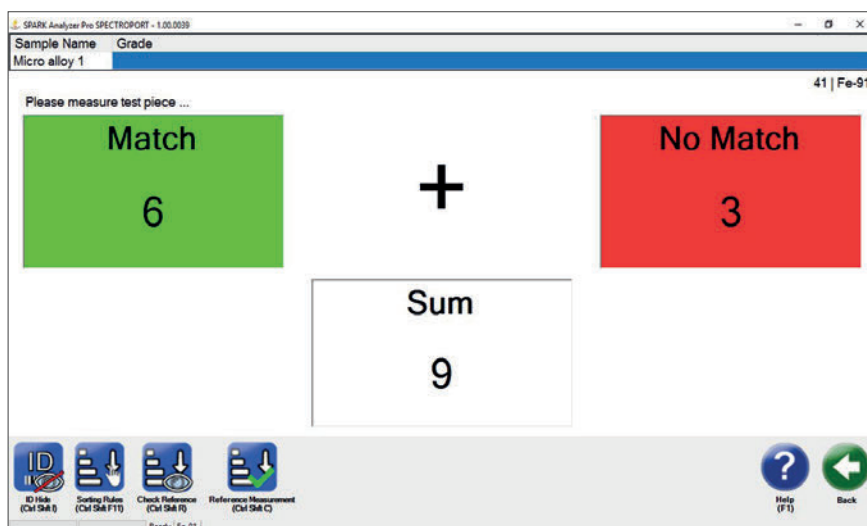
SPECTROPORT

SPECTROPORT: Pass/Fail sorting mode

instrument's arc mode does the job. Once the analyzer has stored correct values from a reference material, the user simply applies the probe to each new sample, and holds down the start button for the preset measurement time until "MATCH" or "NO MATCH" shows on the measurement screen.

In most cases, this testing takes minimal or even no sample preparation. And its measurement period is short. So time and costs are minimized: especially key when hundreds or thousands of parts are involved.

What happens when pass/fail sorting is not sufficient, because a full chemical analysis is required? Or when elements such as carbon, phosphorus, or sulfur are differentiating factors? Then components are tested directly in *analysis mode*, using arc or spark excitation depending on user requirements. For these cases predefined calibration packages need to be installed on the MMA.

In addition to these analyses, users may wish to determine the *designation* of the material (according to a given alloy classification system). Examples include quality control testing at goods receipt, in the production process, or before the delivery of finished products.

In the SPECTRO analyzers, *grade identification mode* tests whether a metal or alloy sample meets supplied specifications stored in the analyzer's material database. If the measured value falls within the limits of a specified material, this information is displayed on the screen. So even inexperienced users can quickly identify the tested alloy, for easy evaluation of the measurement results.

Spark Analyzer Pro Mobile - Routine Measurement V. 1.06.0007 [Conc]

Sample	Grade Norm	Grade ID
Stainless steel	DIN	1.4571

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Co	Cu
1	0.0199	0.554	1.96	0.0335	0.0239	16.67	2.10	11.04	0.0114	0.178	0.400
2	0.0190	0.557	1.96	0.0319	0.0247	16.70	2.09	11.05	0.0122	0.178	0.394
3	0.0199	0.556	1.98	0.0339	0.0239	16.73	2.09	11.04	0.0123	0.178	0.395
I<						16.50	2.00	10.50			
<x>	0.0196	0.555	1.97	0.0331	0.0242	16.70	2.09	11.05	0.0120	0.178	0.396
I>	0.0800	1.000	2.00	0.0450	0.0300	18.50	2.50	13.50			

	Nb	Ti	V	W	Pb	Sn	As	Zr	Ca	B	Fe
1	0.0161	0.148	0.0596	<0.0400	<0.0100	0.0159	0.0067	0.0032	0.0011	0.0028	66.7
2	0.0155	0.144	0.0593	<0.0400	<0.0100	0.0144	0.0078	0.0032	0.0009	0.0028	66.7
3	0.0147	0.147	0.0592	<0.0400	<0.0100	0.0153	0.0070	0.0032	0.0010	0.0027	66.6
I<		0.0979									
<x>	0.0155	0.146	0.0594	<0.0400	<0.0100	0.0152	0.0071	0.0032	0.0010	0.0028	66.7
I>		0.800									

Grade Norm	Grade Name	Grade Description
DIN	1.4571	X 6 CrNiMoTi 17 12 2

Stdz Values (R) iCAL (F8) Flush (F) Recall (S) Edit Smpl (Shft A) Print (F6) Meas Step (F3) Export (F5) Apply Grade (A) Srch Grade (F4) Mean/RSD (V) Help Back

SPECTROTEST: Grade verification/ control mode

SPARK Analyzer Pro SPECTROPORT - 1.00.0039

Sample Name	Grade ID
Stainless product A	1.4571

TypeC	WarnMin	<X>	WarnMax	5	4	3	2	
C / %	--	0.0175	0.080	0.0174	0.0171	0.0176	0.0174	0
Si / %	--	0.39	1.00	0.39	0.41	0.39	0.39	
Mn / %	--	1.79	2.00	1.79	1.78	1.79	1.79	
P / %	--	0.035	0.045	0.036	0.034	0.035	0.035	
S / %	--	0.0215	0.0300	0.0218	0.0197	0.0227	0.0231	0
Cr / %	16.50	17.60	18.50	17.57	17.60	17.57	17.60	
Mo / %	2.00	2.08	2.50	2.08	2.08	2.08	2.07	
Ni / %	10.50	11.68	13.50	11.68	11.70	11.71	11.68	
Al / %	--	<0.0040	--	<0.0040	<0.0040	<0.0040	<0.0040	<0
Co / %	--	0.111	--	0.111	0.108	0.110	0.110	
Cu / %	--	0.42	--	0.41	0.41	0.42	0.42	
Nb / %	--	<0.0110	--	<0.0110	<0.0110	<0.0110	<0.0110	<0
Ti / %	0.087	0.141	0.80	0.139	0.140	0.144	0.136	

Discard (Ctrl Shft D) Finish (F9) Flush (F2) iCAL (F8) Show Grade Search (F4) Show Result Adjustment (Ctrl F8) ID Hide (Ctrl Shft I) Help (F1) Back

Ready | Fe-30-MQ

SPECTROPORT: Grade verification/ control mode

Grade identification is utilized in cases where the material to be tested is unknown. When, instead, a specific grade of a known material is expected and must be confirmed, *grade control/grade verification* mode should be used. The analyzer looks to match specific material specifications. It compares measured values to the limits of the preselected grade. If the values are outside these limits, the screen shows an error message. Out-of-limit elements are highlighted in a contrasting color.

Both types of instruments can perform routine analyses for iron, aluminum, copper, nickel, cobalt, and titanium alloys. SPECTROTEST can also analyze tin, zinc, lead, and magnesium-based alloys. Its high-resolution optical system makes the determination of nitrogen in ferrous-based alloys possible. And it can also handle grade identification of duplex steels based on nitrogen, or the detection of trace amounts of lithium and sodium in aluminum-based alloys.

Reach and ease

The instrument you select must let you reach the sample spots you need to analyze.

Users should consider an analyzer's size and portability — as well as its probe design. For example, SPECTROPORT's sample probe hose is 3 meters (9.8 feet) long, helping to ensure the system's portability. But SPECTROTEST, somewhat larger, offers both 4 m (13 ft) and 8 m (26 ft) cables for greater reach.

Personal device options also increase convenience. Both SPECTROPORT and SPECTROTEST offer an application that shows the instrument's measurement display on a smartphone or tablet — handy when confined spaces or other sampling conditions make it hard to view the analyzer's own screen. Users can input a sample ID or delete a measured value this way, too. The *WebApp* can also display on a PC monitor, for simultaneous readout onsite and in the lab. For testing in hard-to-access spots, users

who can accept limitations in handling certain elements may find maximum reach and ease with handheld XRF analyzers such as SPECTRO xSORT

Ambient conditions

The choice of MMA is also governed by your working conditions.

Most MMAs require time-consuming standardizations when ambient temperatures change. So users can encounter repeated calibrations and delays. However, SPECTROPORT and SPECTROTEST maintain analytical stability regardless of most temperature shifts. So they can move from office to warehouse to field, usually without added standardizations. This stability is provided by predefined calibration packages and exclusive SPECTRO iCAL 2.0 software.

Also consider viewing conditions. So that artificial lights or sunshine won't hinder easy reading, SPECTROTEST features a bright 38.1-centimeter (15-inch) display — the industry's largest on a mobile OES instrument. Even a smaller analyzer can be designed for easier viewing and interaction: SPECTROPORT is equipped with a 26.4 cm (10.4 in) touchscreen display.

Productivity

What speed or productivity goals must your analyzer achieve? Their on-the-spot functionality lets MMAs deliver results in seconds or minutes — versus hours or days for laboratory analysis.

For the SPECTRO analyzers used as examples in this paper, results in arc mode can be displayed in as little as 2 seconds. Even more complex spark mode analyses

WebApp - Typical use when direct view to measurement screen is not possible

Nickel

Carbon
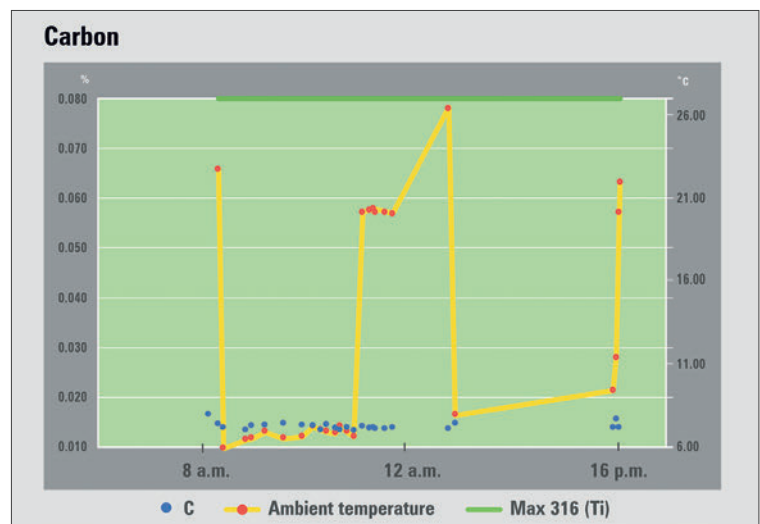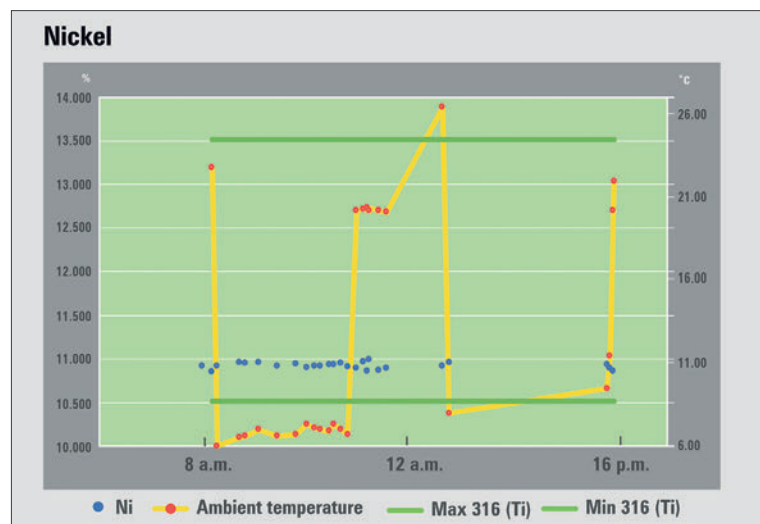
SPECTROTEST: Example of analytical stability with changing ambient temperature

may resolve in as little as 5 seconds (for example, in a ferrous-based analysis with an optimized program), and up to no more than 10 seconds.

With any mobile instrument, battery life is often critical for shift-long productivity. For instance, to function without line power, these SPECTRO analyzers offer optional rechargeable battery packs rated for up to 400 measurements in spark mode, and up to 800 measurements in arc mode with a full charge.

Documentation and archiving

Finally, what will you do with your measurement results? Make sure your MMA exports data in the format you need, supports the documentation you must generate, and allows for proper archiving.

For example, SPECTROPORT and SPECTROTEST record measurements in ASCII and XML formats simultaneously. Data can then be exported or distributed,

via PC connections, using network and WiFi connections (LAN/WLAN) or USB.

SPECTRO instruments also employ separate *Result Manager* analysis archive software. This organizes all XML files as a permanent record of measurement results for paperless documentation and auditing. It also offers filtering, sorting, and trending capabilities.

CONCLUSION
Laboratory or third-party testing aren't the only ways to avoid making metal mistakes. Mobile metal analyzers offer excellent on-the-spot solutions for a wide variety of incoming and outgoing metal inspection tasks.
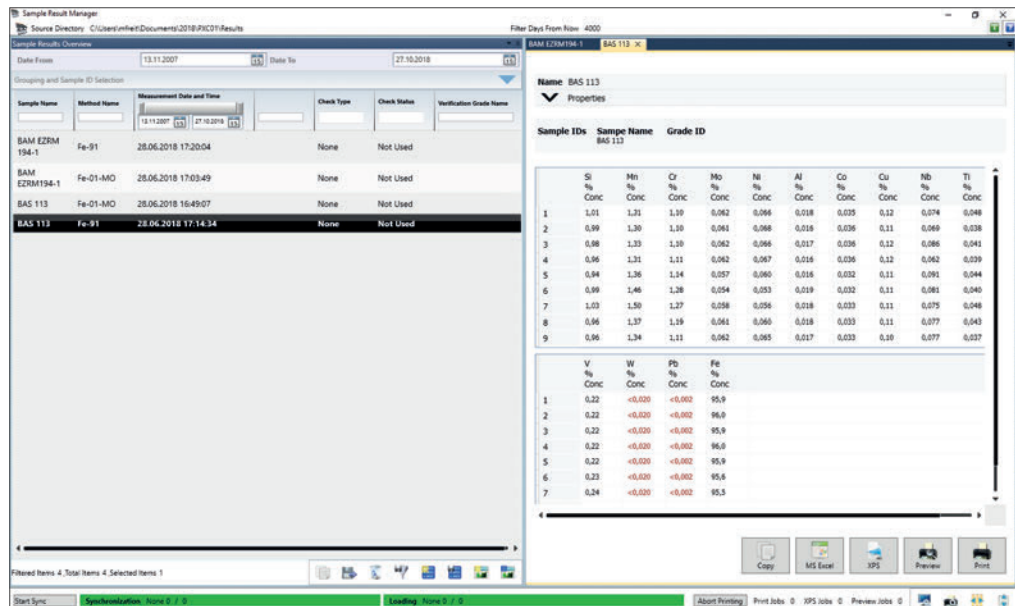
Result Manager: Archive measurement results

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