Measurable Differences – Today's Positive Material Identification (PMI)

Today the term PMI refers to two different technologies: X-ray Fluorescence (XRF) and Optical Emission Spectroscopy (OES or "spark"). Further, XRF systems have evolved from units with radioactive isotopes to units with small X-ray tubes. How do the differences impact personnel verifying whether or not new parts meet composition requirements?

XRF with Radioactive Isotopes

Since their introduction to the industry in the late 1970's, these user-friendly, portable and hardy units have sorted alloys promptly. At ambient temperature, they categorize/ differentiate Cr-Mo alloys, stainless steels, copper, titanium and major industrial alloys readily. However, they do not detect light elements such as carbon, silicon, phosphorus and sulphur. As well, if heavier elements (such as nickel and molybdenum) are present in lower concentrations (such as less than 0.5%), multiple readings on the same part can result in highly variable measurements. Consequently, one may not be able to verify if the part is compliant with the applicable specification.

XRF with X-ray Tubes

The portable and hardy X-ray tube based XRF units:

- Can differentiate between ASTM A53 Grade B with minimal silicon and ASTM A106 Grade B parts.
- Can detect light elements such as silicon, phosphorus, sulphur magnesium and aluminum.
- Obtain highly reproducible measurements even while examining heavier elements (such as nickel and molybdenum) present in lower concentrations (such as less than 0.5%).
- Can obtain individual readings in less time than the radioactive isotope based units.
- Must be operated by CGSB certified personnel.

Optical Emission Spectroscopy (OES or "spark")

The portable "spark" spectrometers:

- Can detect and measure the percentage of light elements such as carbon, silicon, phosphorus, sulphur magnesium and aluminum in a part.
- Obtain most of the measurements required to calculate the carbon equivalent so that effective welding procedures can be chosen for steel parts.
- Can be used at up to 160ºC (320ºF).
- Obtain highly reproducible measurements even while examining elements present in lower concentrations (such as less than 0.5%).
- Leave an arc burn on the part tested.

If the spark spectrometer cannot be used on the part requiring carbon content measurements, "wet chemical" analysis of filings may be needed. These may entail LECO carbon and sulphur measurements, ICP-OES (inductively coupled plasma optical emission spectroscopy) and ICP-Mass Spectrometry.

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