OLYMPUS

API 578 101:
Standards, Guidelines, and Recommended Practices for PMI

Wayne Vereb, Metal Analysis Group
Peter Faulkner, Olympus

Analytical Instruments | January 12, 2021

Olympus and Metal Analysis Group Training Collaboration

- This presentation will provide an overview of the **API 578 training** available through **Metal Analysis Group**. This course will help you understand the full technical requirements in practice, whether you need training, certification, or simply want to refresh your knowledge.

What is API 578?

- **API 578** is a recommended practice (RP) from the American Petroleum Institute (API) that provides guidelines for material verification programs in all sectors of the oil and gas industry (upstream, midstream, and downstream).

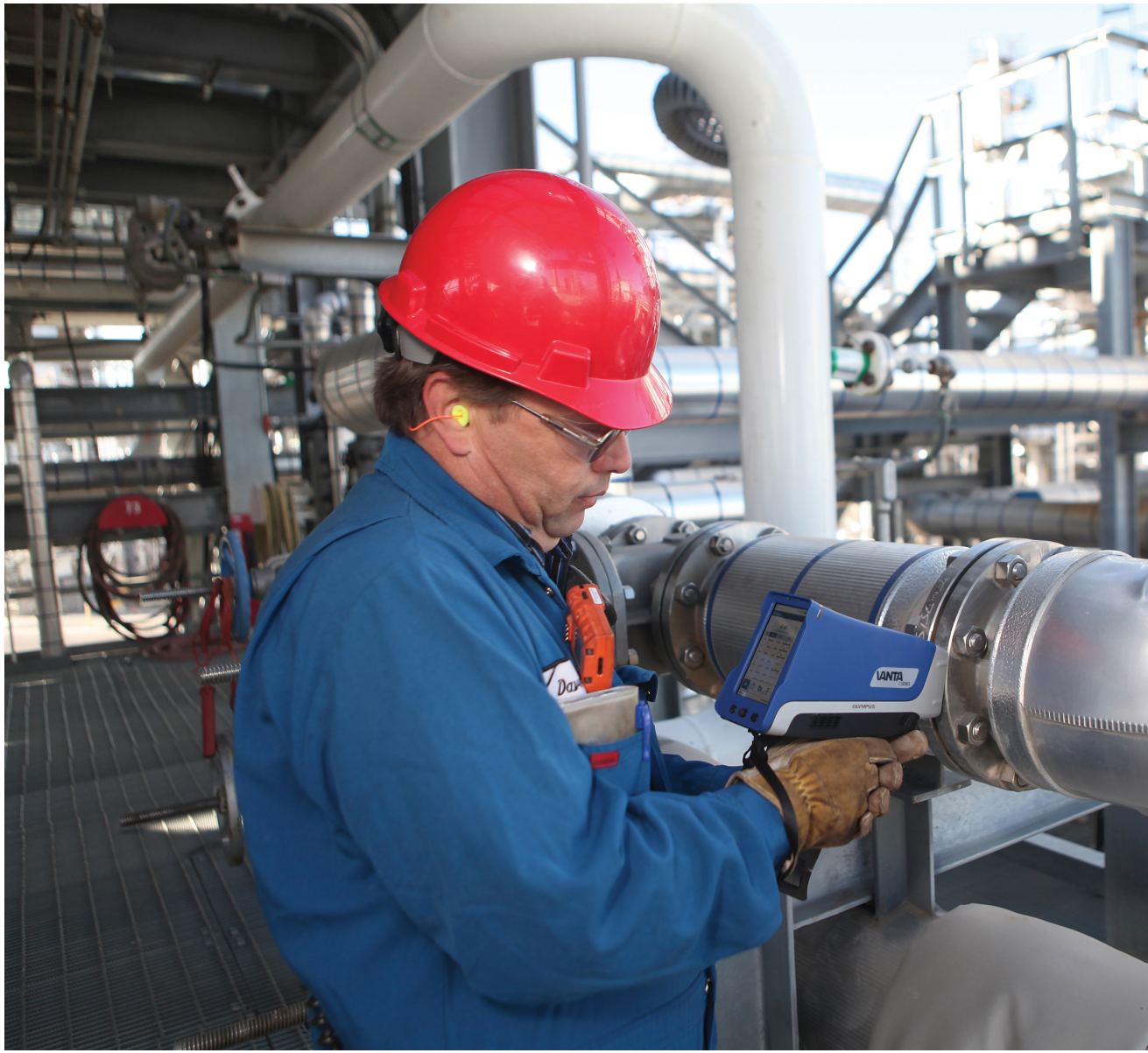
- **API 578 was put into practice to:**
  - Prevent workplace accidents due to catastrophic asset failure (assets = anything that touches the process)
  - Set up a material verification program (MVP) to prevent inappropriate assets from being put into service

- **API 578's primary function:**
  - Prevent the use nonconforming carbon steel from entering service where low alloy steel components are required
  - Prevent the use of incompatible gasket material from being put into service
  - Ensure the use of appropriate refractory anchor materials

API 578: PMI Guidelines

General Rules:

- **Establish a written program:**
  - To test all new assets and retroactively test existing assets during:
    - Maintenance
    - Repair
    - Replacement
    - Alteration
- **Components to consider for testing:**
  - Everything associated with the process:
    - Pipes, fittings, valves, flanges, and forging
    - Any pressure-containing instruments, gauges, parts or welds
- **A mill test report cannot act as a substitute for testing:**
  - Estimated that 20% of all material shipped does not match its material certification
  - Mix-ups and poorly-made materials are common



API 578: PMI Guidelines

- **Roles and responsibilities:**
  - Multiple groups are likely to be involved in a site's material verification program (MVP)
  - Each group involved needs clearly defined responsibilities

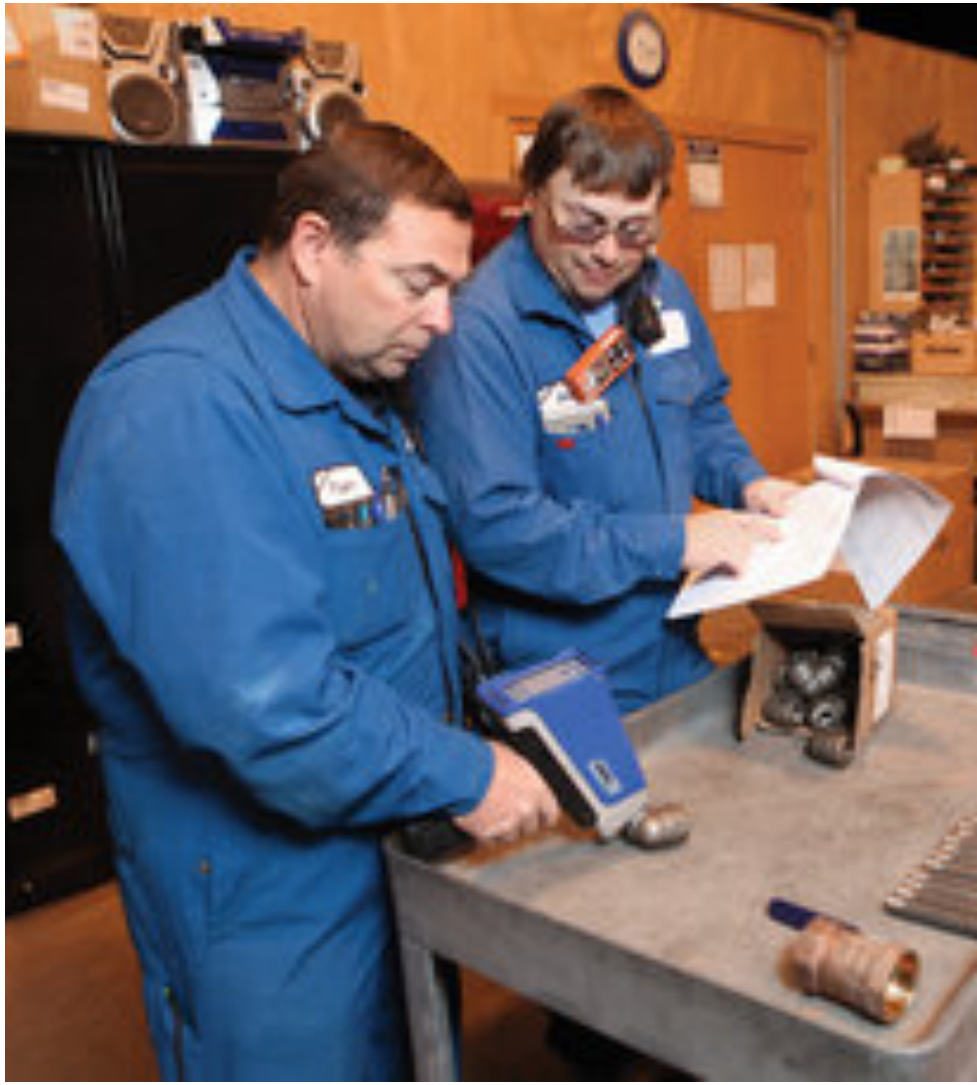
- **The MVP should consider:**
  - Testing frequency
  - Testing procedures
  - Testing methods
  - Testing sites
  - Results determination
  - Testing frequency
  - Results reporting (especially nonconformance)
  - Nonconforming part disposition
  - Record keeping, including the labeling and identification of tested parts
  - Third-party (contractors and suppliers) compliance

PMI Methods and Technologies

- **Objectives:**
  - Identify a part's alloy before putting it into service
  - Verify the alloy is correct for that service
  - Determine the best method for the PMI analysis required

- Many **analytical instruments and procedures** are suited for alloy identification:
  - Three primary alloy analysis instruments are:
    - **Handheld XRF**
    - **Handheld and portable LIBS-OES**
    - **Portable spark OES**

- Each analysis technique:
  - Has its own strengths and weaknesses
  - Will give the user a nominal alloy identification



PMI Methods and Technologies

Handheld XRF (Uses X-ray fluorescence technology)

- Compact and easy to use
- Analyzes all but the lightest elements (carbon)
- Nondestructive (no marks or blemishes)
- Variable analysis times

Handheld and portable LIBS OES: (Uses laser light to create a sample plasma)

- Compact and easy to use
- New technology that analyzes most elements of interest
- Nondestructive (micro-scratch/blemish)
- Very short analysis times

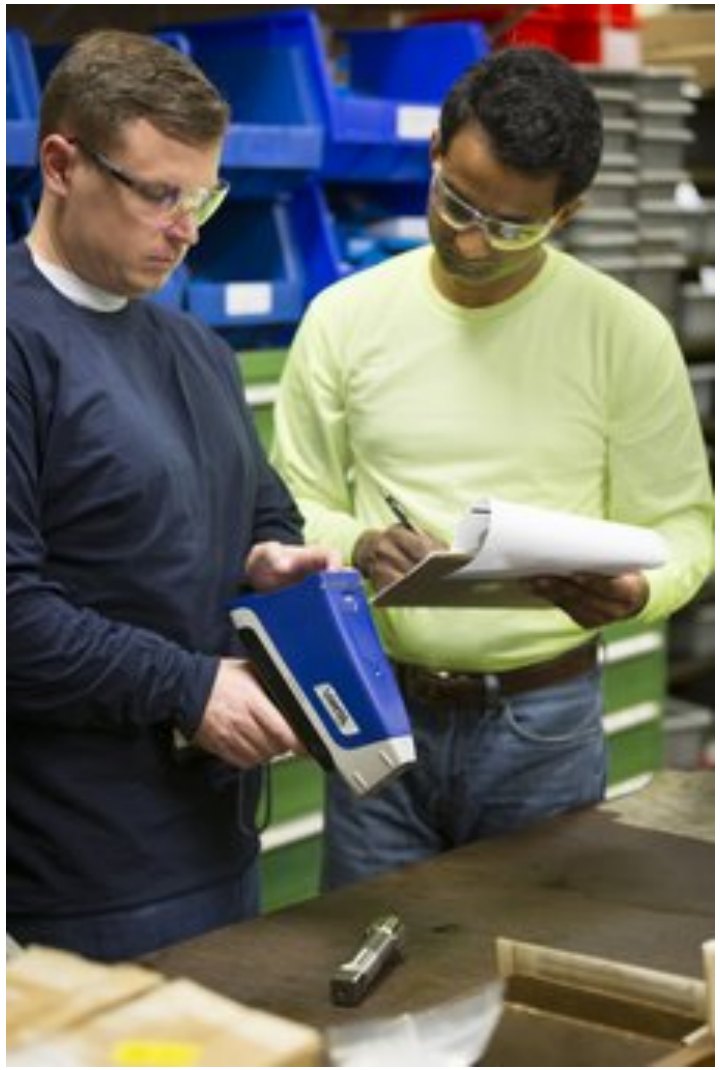
Portable spark OES

- Heavy and bulky with a long learning curve
- Well-understood analysis technology that measures all elements of interest
- Nondestructive (burn mark)
- Short analysis time

Positive Material Identification (PMI) Training

- **Aspects of PMI Training:**
  - **What analytical technique or test method to apply?**
    - XRF, LIBS, or OES
  - **Establish instrument calibration/certification frequency and protocol:**
    - Properly working instrument
    - Accuracy and precision
  - **Establish personnel qualification, knowledge, and proficiency requirements:**
    - Adequately trained personnel
    - Proficiency testing
  - **Surface preparation requirements and procedures:**
    - Best surface treatment for the analytical technique
  - **Data acceptance criteria:**
    - Outliers vs. acceptable data
  - **Documentation requirements:**
    - Establishing a proper chain of custody and documentation

Best Practices for Recording and Record Keeping



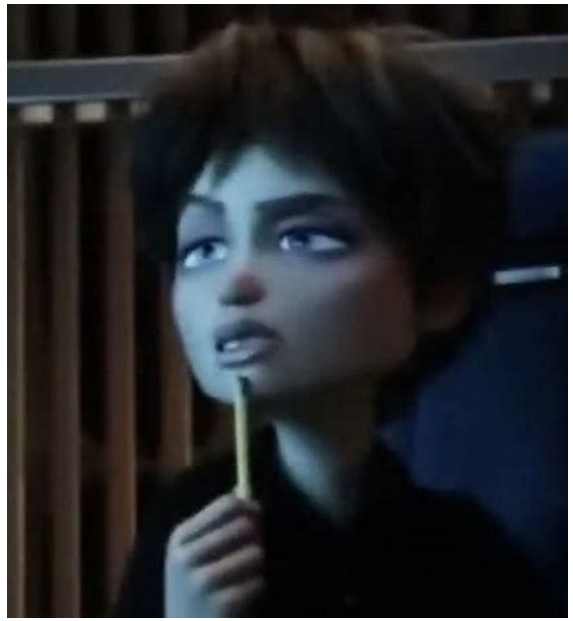
- **The basics of good record keeping:**
  - Date, time, and place
  - Testing procedure used
  - Analysis method
  - Instrument identification (crucial)
  - Tested part identification (crucial)
  - Report nonconformance and resolution
  - Report conformance
  - Labeled and tracible to the tested part (crucial)

Conclusions

- **API 578** is **not** just a **testing program:**
  - It is a **quality program** built around analytical testing
  - All aspects of a good quality program must be achieved for an API 578 program to be successful

- I will end with a quote:
  - **“Ease. People will trade *quality* for ease every time.”**

  Evelyn Deavor, villain of Incredibles 2 (Pixar 2018)



PMI Tools

- To support your API 578 PMI or QA/QC inspection needs and budget, Olympus manufactures and supports a full range of XRF analyzers:

Vanta™ M series

- Large-area silicon drift detector (SDD) for rapid low-level residual and tramp analysis, including light element detection (Si P, S)

Vanta C series

- Standard SDD for XRF testing with light element detection

Vanta L series

- PIN detector for XRF testing without light element detection

Vanta Element-S

- Standard SDD for affordable XRF testing with light element detection

Vanta Element™

- PIN detector for affordable XRF testing without light element detection

Questions?

Wayne Vereb

- WayneV@metalvp.com

Peter Faulkner, Olympus

- Peter.Faulkner@olympus.com