# PMI Just In Case

Positive Material Identification
Ferritscope Testing

**QUALITY DOCUMENT**

# POSITIVE MATERIAL IDENTIFICATION

**DOCUMENT No**

## QD-PMI-01

**REVISION**

## 03

**DATE**

## 10th October 2010

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## 1.0 Purpose

To define the scope and method of carrying out positive materials identification (PMI). This form of testing is an effective way of determining the material types in terms of chemical composition of metallic materials.

## 2.0 Scope

This procedure is a standard procedure that describes the methods for carrying out PMI on materials and components, during manufacture and in service.

All material / part types which receive PMI will be clearly detailed on the PMI report

## 3.0 References

Niton XL3T 800 Alloy Analyser Operating Manual.
API RP578 – Material Verification Program for New and Existing Alloy Piping Systems
Calibration Procedure Niton XRF Alloy Analyser - CAL-PMI-01 (latest revision).

## 4.0 Definitions

**PMI (Positive Material Identification)**
Physical testing of materials to determine the chemical composition and positively verify material composition by determining the alloy content of a component or a weld without the need to remove samples for analysis.

**XRF (X-ray Fluorescence Spectroscopy)**
A method of PMI using a portable X-ray fluorescence analyser to verify the chemical elements that establish the positive identification for a particular material.
When activated on a test item, an XRF analyser produces short wavelength electromagnetic rays. These emitted rays interact with (excite) certain elements. As a result, the excited elements then re-emit a new wavelength within a discrete energy band that is identifiable by the analyser.
When used along with material standards, the portable analyser can determine approximate chemical quantities for the target elements.

## 5.0 Training

Personnel applying this procedure shall be familiar with this procedure and only trained personnel are permitted to operate the Niton XL3T 800 Alloy Analyser

Directors of PMI Just In Case have attended a manufacturers training course in the use of the PMI equipment. Personnel subsequently employed by PMI Just In Case are trained in house. Certification of training is available on request.

## 6.0 Safety

**Exposure to Radiation:**

- Human dose to radiation is typically measured in rem, or in one-thousandths of a rem, called millirem (mrem), 1 rem = 1000mrem. The allowable limit for occupational exposure is 5,000 mrem/year for deep (penetrating) dose and 50,000 mrem/year for shallow (ie skin) dose or dose to extremities. Deep, shallow and extremity exposure from a properly used NITON XL3t analyser should be less than 200 mrem per year even if the analyser is used as much as 2,000 hours per year, with the shutter open continuously. (Source of information 'Thermo Scientific')

**General:**

- Equipment shall be used in accordance with the manufacturer's equipment operating procedures and recommendations.
- All equipment shall be inspected for obvious defects prior to use.
- Client Health and Safety procedures will be adhered to at all times by personnel representing PMI-Just In Case.
- Personal Protection Equipment (PPE) shall be worn by the operator in accordance with client recommendations.

## 7.0 Equipment

PMI test equipment and its calibration shall meet the following criteria:

- The Niton XL3T 800 Alloy Analyser has an in-built self calibrating function which can be activated through the 'Utilities' window on the menu. Calibration must be carried out by the operator on the timescales as set out in Section 8.0, and in accordance with the latest revision of PMI Just In Case Calibration Procedure CAL-PMI-01.
- In addition to the above, a certified reference material Grade 1¼ Cr ½Mo / UNS K11572 supplied by Analytical Reference Materials International Certificate No 35HN-01112007-IARM-P can be used as a comparison between readings obtained and actual certified readings to confirm the accuracy of the machine.
- Be suitable for the range of material compositions to be verified with current calibration status
- Be suitable for the range of surface curvatures and orientations to be encountered such as welds and small bore fittings.
- Be sufficiently portable to gain access to each checkpoint under evaluation.
- Be capable of providing 'direct read-out' quantative results (% composition) of the required chemical elements.

Unless otherwise specified by the client, PMI Analysis checks shall be carried out by PMI-Just In Case nominated personnel.

Inspection shall be performed using the XRF method utilising the Niton XL3T 800 Alloy Analyser.

It should be noted that this type of equipment cannot analyse the 'Light' elements such as carbon, sulphur etc. If such elements are required for analysis, then alternative equipment shall be used.

The main elements which can be detected using the Niton XL3T 800 Alloy Analyser are: Mo. Ni. Fe. Mn. Cr. Nb. Cu. V. Co, Ti and W.

## 8.0 Procedure

Surface Preparation

- The surface condition of components to be tested and the reference materials shall be free of any foreign material, including oxidation, which may interfere with the test.

- Where necessary, a small area (approximately 25mm diameter) of each checkpoint to be analysed shall be prepared for analysis by light surface grinding. This operation must be carried out by the client.

- Tools or materials used to prepare a test surface shall be isolated to groups of material to minimise the risk of erroneous results or contamination.

- Analysis shall only be carried out on surfaces that are bare metal with no residual contaminants from scales, coatings, paints or embedded remnants from contact with other materials.

Reference Set-up Samples and Equipment Checks

- For standard inspection the Niton XL3T 800 Alloy Analyser detector shall be used as a comparator check analysis during set-up. In accordance with Calibration Procedure CAL-PMI-01 these set-up checks shall be carried out as a minimum:

  - Each time the analyser is switched on

  and re-confirmed at least at the following times:

  - At intervals not exceeding each 50 determinations carried out
  - Each time a different Standard or material range is required
  - If there is a significant change in equipment or material temperature
  - Whenever the equipment has been accidently knocked or adjusted
  - Whenever any error is suspected
  - Immediately at the end of a work session

Reading Frequency

- All readings shall be taken in accordance with the relevant equipment manufacturer's operating manual.

Witness Tests

- All operations and recordings associated with check chemical analysis shall be available for third party witness.

## 9.0 Identification and Marking

When required by the client or contract, all test items analysed by PMI and verified to be within the specified tolerance shall be suitably marked.

## 10.0 Material Verification Criteria

The test sample shall match the specified grade of material.

When weld metal is tested the results shall match the consumables manufacturers deposited weld metal specification.

When welding consumables are tested the results shall match the manufacturers specification data sheet.

The Niton XL3t automatically displays best 'match' to material with a ± tolerance on each element reading correct to 2σ. Appendix I shows a sample report giving the tolerance.

## 11.0 Reporting

All analysis checks shall be the subject of a typed test report, which shall be issued on completion of the examination.

If another reporting format is required, it shall be specified by the client or contract. In such instances, the client shall supply the relevant report sheets and copies of all completed reports will be retained on file.

The test report sheet shall generally contain, as a minimum, the following information:

- Client
- Client Reference No
- Part Identification
- Date of Test
- Report No
- Procedure No, and Revision
- Equipment used
- Material type
- Operator name and Signature.

The Client will be made aware of all readings which fall outside of specification requirements as stated on drawings and responsibility of accepting or otherwise will be solely theirs.

Where required, or advised by the client, notes referring to any inaccuracies will be made in the Comment box at the end of the report.

# APPENDIX I

## POSITIVE MATERIAL IDENTIFICATION REPORT

PAGE 1 of 1

PMI - Just In Case

| | | | |
|---|---|---|---|
| CLIENT: | ABC ENGINEERING LIMITED | PMI-JIC REF: | PMI 10310 |
| WORKS ORDER No: | 54321 | CERT No: | 54321 - 001 |
| SALES ORDER No: | PO 12345 | PROCEDURE No: | QD-PMI-01 Rev 03 |
| DRAWING No: | GB-00162043 Rev 2 | EQUIPMENT: | NITON XL3T 800 |
| DESCRIPTION: | EVAP COOLER DRAINAGE PIPEWORK | SERIAL No: | 47632 |

| DESCRIPTION OF MATERIAL | IDENTIFICATION ELEMENTS | | | | | | | | | | MATERIAL (Generic Grade) | CAST No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mo % | Nb % | W % | Cu % | Ni % | Fe % | Mn % | Cr % | V % | Ti % | | |
| 3" LAP JOINT FLANGE | 2.08 | — | — | — | 9.91 | 69.24 | 1.53 | 16.02 | — | — | 316 ss | G-2507 |
| 3" STUB END | 2.00 | — | — | — | 10.06 | 68.51 | 1.49 | 17.36 | — | — | 316 ss | 164607 |
| WELD | 2.24 | — | — | — | 11.25 | 66.33 | 1.49 | 18.01 | — | — | 316 ss | 36549/1 |
| 3" PIPE | 1.98 | — | — | — | 9.76 | 69.41 | 1.21 | 16.34 | — | — | 316 ss | AVE070505 |
| WELD | 2.05 | — | — | — | 10.19 | 66.52 | 1.63 | 18.43 | — | — | 316 ss | 36549/1 |
| 3" STUB END | 2.11 | — | — | — | 9.86 | 68.41 | 1.47 | 16.97 | — | — | 316 ss | 164607 |
| 3" LAP JOINT FLANGE | 1.98 | — | — | — | 10.65 | 68.22 | 1.51 | 17.08 | — | — | 316 ss | G-2507 |
| 3" LAP JOINT FLANGE | 2.04 | — | — | — | 10.14 | 69.28 | 1.5 | 16. | — | — | 316 ss | G-2507 |
| 3" STUB END | 2.07 | — | — | — | 9.99 | 68. | 1.33 | 7.08 | — | — | 316 ss | 164607 |
| WELD | 1.89 | — | — | — | 10.34 | 67.3 | 1.71 | 57 | — | — | 316 ss | 36549/1 |
| 3" PIPE | 2.41 | — | — | — | 1 | 2 | | 8.13 | — | — | 316 ss | AVE070505 |
| WELD | 1.99 | — | — | — | 7 | 6 | 1 | 17.33 | — | — | 316 ss | 36549/1 |
| 3" 90° ELBOW | 2.32 | — | — | — | 1 | 65. | 1.55 | 18.14 | — | — | 316 ss | 108082182 |
| WELD | 2.14 | — | — | — | 10.9 | 8.74 | 1.00 | 16.45 | — | — | 316 ss | 36549/1 |
| 3" PIPE | 2. | — | — | — | 9.78 | 66.48 | 1.70 | 18.08 | — | — | 316 ss | AVE070505 |
| WELD | 99 | — | — | — | 11.84 | 65.58 | 1.49 | 18.01 | — | — | 316 ss | 36549/1 |
| 3" 45° ELBOW | | | | — | 9.62 | 70.09 | 0.59 | 16.73 | — | — | 316 ss | 63T0816 |
| WELD | 2.04 | — | — | — | 10.52 | 67.00 | 1.42 | 18.49 | — | — | 316 ss | 36549/1 |
| 3" PIPE | 2.05 | — | — | — | 10.18 | 67.59 | 1.78 | 17.19 | — | — | 316 ss | AVE070505 |
| WELD | 2.32 | — | — | — | 11.11 | 65.90 | 1.63 | 18.31 | — | — | 316 ss | 36549/1 |
| 3" 45° ELBOW | 2.02 | — | — | — | 10.05 | 69.04 | 0.86 | 16.65 | — | — | 316 ss | 63T0816 |
| WELD | 2.15 | — | — | — | 10.55 | 67.65 | 0.86 | 18.11 | — | — | 316 ss | 36549/1 |
| 3" STUB END | 2.07 | — | — | — | 10.18 | 67.38 | 1.74 | 17.45 | — | — | 316 ss | 164607 |
| 3" LAP JOINT FLANGE | 1.99 | — | — | — | 9.73 | 69.96 | 0.90 | 16.02 | — | — | 316 ss | G-2507 |



COMMENTS:

Acceptable Standard Analysis:- 316 ss : Mo 2-3% : Ni 10-14% : Mn 2% max : Cr 16-18%

<LOD = Lack of Detection

| | OPERATOR | CUSTOMER INSPECTOR | THIRD PARTY INSPECTOR |
|---|---|---|---|
| NAME: | R.Pringle | | |
| SIGNATURE: |  | | |
| DATE: | 09 October 2010 | | |