1.0 Scope

This procedure defines the minimum requirements for performing Positive Material Identification (PMI) of stainless and alloy materials and welds.

2.0 Definition

2.1 Positive Material Identification (PMI) is the verification of materials (also weld materials) by the use of analytical methods. X-ray fluorescence is the preferred method of PMI, however other methods such as wet chemical analysis or spectrometry may be applied.

2.2 The purpose of PMI, using mobile instruments, is to establish that the correct material type is being used, and to differentiate between grades of material such as 22% Cr and 25% Cr duplex steels. It is not intended to be used for accurate chemical analysis or for the verification and confirmation of a material certification reported chemistry. Where an accurate chemical analysis is required, then a wet test or spectrometry must be specified. These are destructive tests and cannot be used on production components.

3.0 Qualification of testing personnel

3.1 Only suitably experienced personnel shall undertake PMI. There is currently no recognised international qualification for PMI operators, so operators shall be trained according to equipment manufacturer's recommendations. Training records shall be available for review.

3.2 Radiation risks and hazards exist in the use of X-ray spectrometry. Local legal requirements related to use X-ray spectrometer devices for radiation protection as well as the safety measures defined by the manufacturer of the device have to be known, included in the operator training, and followed.

4.0 Calibration

4.1 The equipment shall be calibrated at regular intervals, consistent with the technique used. Prior to test, the equipment shall be checked against a known reference standard.

4.2 Calibration samples used shall be traceable to verified material certificates.

5.0 Material grade identification

5.1 If PMI is performed on individual item/assembly, traceability of the tested material to the test report is required. This traceability to the test report may be done with existing material identification numbers on items with certified material test reports. As PMI can also be performed on materials not provided with material certification and without specific material identification numbers, these items/assemblies shall be permanently marked to enable traceability of the tested material to the test report.

5.2 Marking of acceptance on tested materials is not mandatory unless it is a customer requirements or specified in the local procedures/instructions.

5.3 Items that are too small or otherwise cannot be marked, shall be supplied in labelled bags or tagged.

6.0 Application techniques

6.1 The following methods are acceptable within their technical limitations:

- Optical emissions (arc or spark) spectroscope or spectrometer instruments may be used.
- X-ray spectrometer (x-ray fluorescence or energy, dispersive techniques)

6.2 When using optical spectrometers, burns mark shall not be made on finished wetted surfaces of items. All burn marks shall be removed by grinding or by machining.

6.3 For items which are too small or unsuitable for testing using spectrometry methods e.g. gasket materials, springs, circlips, etc., material verification shall be performed by wet analysis. A suitable additional quantity of sacrificial items or specimens shall be provided for examination purposes.

7.0 Verification & Acceptance

7.1 The components, which require PMI and to what extent (%) shall be defined in the Quality Plan (Inspection & Test Plan). Elements to be verified shall be as per Table 1 of this procedure. Where the alloy to be verified does not appear in Table 1, then the elements to be verified should be agreed prior to test.

7.2 For acceptance, it must be demonstrated that materials contain the amounts of alloying elements shown in the material specification. Acceptance criteria can be per customer's specification or per local procedure as defined in the Quality Plan.

7.3 If no acceptance criteria is otherwise defined, alloys shall be acceptable if the alloying elements listed in Table 1 are within 10% of the range specified in the alloy material specification.

8.0 Discrepancies

Where a discrepancy is found, a re-test shall be performed. Available markings and certification shall be reviewed to determine whether the cause of the discrepancy is easily identifiable. Where the discrepancy is confirmed by the re-test and review, the item shall be identified and quarantined in accordance with the local process for non-conforming products until the discrepancy is resolved.

9.0 Reporting

For each item/assembly/weld tested by PMI, a report shall be completed which shall include at least the following information: ...

- Sulzer and Client order reference and plant number
- Unique component identification number (where specified), heat number or part number
- Quantity and sample size
- Test method and equipment used
- Test procedure number
- Required material grade
- Drawings or sketches esp. for pipe assemblies if required by customer or identification of parts
- Result of examination (accepted / not accepted)
- Date of Test
- Operator name

In the PMI report, detailed results of the verified elements are not included in the report sent to the customer unless:

- Detailed results are required by the order related Quality Plan (Inspection & Test Plan).
- it is a customer requirement.
- there are documented product specific or legal reasons to do so.

10.0 Elements to be verified

Table 1

Basic Alloy	Elements to be Verified
Duplex and super-duplex stainless steel	Cr, Ni, Mo, W , Cu
317 Type stainless	Cr, Ni, Mo
316 Type stainless	Cr, Ni, Mo
304 & 309 Type stainless	Cr, Ni
Stabilised stainless	Cr, Ni, Mo, Ti*, Nb*
Nickel based alloys.	Ni, Fe, Cu, Cr, Mo
Nickel steels	Ni
Low alloy steel	Cr, Ni, Mo
Martensitic stainless steel	Cr, Ni, Mo

- As appropriate
- **Note:** Element **C** cannot be measured with X-Ray