



TECHNICAL REQUIREMENTS

MECHANICAL

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POSITIVE MATERIAL IDENTIFICATION

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1. SCOPE

This specification covers the requirements for the positive material identification of alloy materials, referred herein as PMI, used in the construction of engineered equipment. Items included are exchangers, vessels, pipe spools, fittings, valves, welds, RTJ gaskets, claddings, and weld overlays, or other items required by project specifications. The contractor, or vendor, as applicable for the purchased equipment item, shall perform PMI in compliance with this specification and report the results to OL. In case OL elects to perform PMI directly, OL representatives including independent inspection agents shall have access to contractor's or vendor's facilities to perform the necessary PMI's.

2. REFERENCES

ASTM *American Society for Testing & Materials*

EN 10204 *Metallic Products – Types of Inspection Documents*

3. TERMS AND DEFINITIONS

Inspector: Appointed inspector.

Contractor: Any party in contract for the purpose of carry out works or services.

Alloy: All non-carbon steel, including but not limited to, Cr-Mo steels, austenitic, ferritic, martensitic and duplex stainless steels, nickel and copper alloys, titanium.

Bulk Material: Material purchased in bulk where individual items are not allocated a unique tag number (eg. random pipe lengths, tubes, valves, fittings, flanges, bolting, non-process strainers)

Lot: All units from a common heat of material presented for inspection against a single purchase order item. In the case of valves, or similar items, where bodies/bonnets/covers may be from different heats, the Lot shall consist of all units with the same combination of heat numbers for pressure containing components.

Sample: One, or more, units selected at random from the Lot which are to be examined to determine acceptability of the Lot.

4. VERIFICATION REQUIREMENTS

4.1 Requirements for Alloy Components in Hydrogen Service

Alloy components in hydrogen service shall undergo 100% verification of each pressure retaining part including clad and/or overlay, if purchaser unspecified otherwise. The hydrogen service designation shall be indicated on all data sheets and drawings, such as vessel data sheets, piping isometric drawings and equipment data sheets as applicable.

4.2 Requirements for Alloy Components not in Hydrogen Service

Alloy components not in hydrogen service shall undergo 100% PMI, if purchaser unspecified otherwise. This includes materials, fittings, welds, cladding, and overlays used to fabricate a vessel, exchanger, or pipe spool.

4.3 General Requirements for Alloy Components

- 4.3.1** Non pressure removable parts such as equipment internals, etc., require random 10 percent PMI.
- 4.3.2** Alloy studs, bolts, nuts, washers, etc., require manufacturer's certification of the materials. PMI shall be made on one item per heat or lot.
- 4.3.3** Alloy welding filler metals used in field or shop fabrication requiring one electrode or wire sample from each lot to have PMI. Acceptable filler metals by lot shall be segregated and controlled throughout fabrication.
- 4.3.4** Double-sided weld joints of solid alloy, both weld caps (inside and outside) must have PMI. These joints will only count as one joint for the 10% verification of non-hydrogen service items.
- 4.3.5** Alloy valves, including control valves, require PMI of accessible parts such as bodies, bonnets, and stems.
- 4.3.6** Alloy relief valves require PMI of accessible parts such as bodies, bonnets and nozzles.

5. VERIFICATION METHODS

The instruments or methods used for the examination shall be capable of identifying the material by quantitative measurement of the major alloying elements required in the applicable material specification or welding procedure specification, if purchaser unspecified otherwise. The standard methods of analysis listed in ASTM A751 are acceptable. The preferred method is x-ray emission analysis with a portable instrument such as "Texas Nuclear 9266" or "CSI X-Met 840/880". The manufacturer, vendor, or contractor performing the PMI shall submit procedures for OL approval, including calibrating, surface preparation, filler metal sample method, identification marking and traceability to original material or reporting.

6. ACCEPTANCE REQUIREMENTS

- 6.1** All materials shall comply with the requirements of the applicable material specification. Materials shall be verified to ascertain the correct major alloying elements and the correct percentages of each. As a minimum, the following elements shall be verified as shown in Table 1:

Table 1. Elements' Verification

Alloy	Elements
Chrome-molybdenum	Chromium and molybdenum
Austenitic Stainless Steel	Chromium, nickel and any other essential alloying element(s) necessary for PMI such as molybdenum, titanium, or columbium
Other alloys	All major alloying elements listed in the material specification

Note:

The concentration of each element tested must fall within the range specified by the applicable material specification.

- 6.2** If any material, component, or weld is found to be unacceptable, all other representative materials, components, or welds shall be considered suspect. The vendor has the option of the following:
- a) Scrapping all those representative materials and components and replacing with new components or filler metals, or
 - b) Performing 100% examination of the remainder of the representative materials, components, or welds, replacing each rejected item which fails the PMI check.
- 6.3** When a lot of components or filler metal is found to contain unacceptable pieces, the two next lots (from the same supplier) shall be examined 100%. If both lots are acceptable, the sampling percentage described in Paragraph 5. may be resumed.
- 6.4** The vendor (or contractor) shall be responsible for segregating rejected items and assuring that they are properly identified to prevent their unauthorized use.
- 6.5** Any repair and re-verification of alloy content shall be at the expense of the vendor unless material has been supplied by OL.
- 7. VERIFICATION RECORD**
- 7.1** Each item (pipe spool, vessel, weld, etc.) that has been verified shall be marked and recorded.
- 7.2** The preferred identification method is paint marking applied to each item (vessel, pipe spool, etc.) immediately after PMI. The paint used shall not contain additives that will have deleterious effects on the alloy materials (such as halides and zinc rich paints and markers).
- 7.3** When heat treating is performed after material verification, the identification markings must be able to withstand the heat treatments.
- 8. CONTRACTOR FIELD WORK**
- 8.1** The contractor shall establish and review with OL the procedures necessary to assure of proper alloy material components in field construction. This is particularly pertinent to the warehousing and distribution control of weld rod, small piping items such as nipples, fittings, valves, etc.
- 8.2** All bulk materials shall be verified upon receipt in the field for proper identification and a color code, or other mutually acceptable means of identification, shall immediately be applied to each piece.
- 8.3** PMI shall be accomplished by sampling of representative pieces as described in Paragraph 5.
- 8.4** Results of PMI shall be presented in report acc. to Annex A, doc. no. *OL-TR-MR-RP2*.
- 8.5** Where items are rejected after analysis, all remaining pieces of the item from the same supplier shall be sampled and analyzed as described in Paragraph 5. Rejected items shall be returned to the original source of supply.
- 8.6** Costs of PMI for shop fabricated components shall be borne by the fabricator. Costs of PMI for shop field fabrication components shall be borne by the field construction contractor.

9. GENERAL SHOP AND FIELD FABRICATION VERIFICATION REQUIREMENTS

- 9.1** The PMI checks should be performed after fabrication is completed. However, the contractor may check piping and field fittings as they are received at the field location with prior approval of OL. When properly verified and marked, these components need not be re-verified. Equipment internals and other items, including alloy RTJ gaskets, that will not be accessible for PMI after installation, must be verified just prior to installation to avoid any substitutions. All checks may be performed prior to any required heat treatments or other special processing. The PMI record shall be finalized when all welding is complete.
- 9.2** OL may elect to witness some or all PMI's. The contractor, or vendor as applicable, shall give OL at least ten (10) days' notice in advance of all PMI's.

ANNEX A. (INFORMATIVE) TECHNICAL REPORT

This annex includes technical report for the following items:

- Positive Material Identification (PMI) Report:
doc. no. *OL-TR-MR-RP2*, 1 page.