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ADNOC

ADNOC GROUP PROJECTS & ENGINEERING

POSITVE MATERIAL IDENTIFICATION OF EQUIPMENT AND PIPING

Guideline

APPROVED BY:

24/11/2021

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EFFECTIVE DATE:

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Abu Dhabi National Oil Company

GROUP PROJECTS & ENGINEERING FUNCTION/ PT&CS DIRECTORATE

CUSTODIAN	Group Projects & Engineering / PT&CS
DISTRIBUTION	Guideline applicable to ADNOC&ADNOC Group Companies

REVISION HISTORY

DATE	REV. NO	PREPARED BY (Designation/ Initial)	REVIEWED BY (Designation/ Initial)	ENDORSED BY (Designation / Initial)	ENDORSED BY (Designation / Initial)
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The Group Projects & Engineering Function is the owner of this Guideline and responsible for its custody, maintenance, and periodic update.

In addition, Group Projects & Engineering Function is responsible for communication and distribution of any changes to this Guideline and its version control.

This document will be reviewed and updated in case of any changes affecting the activities described in this document.

INTER-RELATIONSHIPS AND STAKEHOLDERS

a. The following are inter-relationships for implementation of this Guideline:

   i. ADNOC Upstream and ADNOC Downstream Industry, Marketing & Trading Directorate

   ii. ADNOC Onshore, ADNOC Offshore, ADNOC Sour Gas, ADNOG Gas Processing. ADNOC LNG, ADNOC Refining, ADNOC Fertilisers, Borouge, Al Dhafra Petroleum, Al Yasat

b. The following are stakeholders for the purpose of this Guideline:

   iii. ADNOC PT&CS Directorate

c. This Guideline has been approved by the ADNOC PT&CS is to be implemented by each ADNOC Group COMPANY included above subject to and in accordance with their Delegation of Authority and other governance-related processes in order to ensure compliance.

d. Each ADNOC Group COMPANY must establish/nominate a Technical Authority responsible for compliance with this Guideline.

DEFINITIONS

'ADNOC' means Abu Dhabi National Oil COMPANY.

'ADNOC Group' means ADNOC together with each COMPANY in which ADNOC, directly or indirectly, controls fifty percent (50%) or more of the share capital.

'Approving Authority' means the decision-making body or employee with the required authority to approve Policies and Procedures or any changes to it.

'Business Line Directorates' or **'BLD'** means a directorate of ADNOC which is responsible for one or more Group Companies reporting to, or operating within the same line of business as, such directorate.

'Business Support Directorates and Functions' or **'Non- BLD'** means all the ADNOC functions and the remaining directorates, which are not ADNOC Business Line Directorates.

'CEO' means chief executive officer.

'COMPANY' means 'Abu Dhabi National Oil COMPANY or any of its group companies. It may also include an agent or consultant authorized to act for, and on behalf of the COMPANY'.

'CONTRACTOR' means the party, which carries out the project management, design, engineering, procurement, construction, commissioning for ADNOC projects.

'Group COMPANY' means any COMPANY within the ADNOC Group other than ADNOC.

'SHALL' indicates mandatory requirements

'[PSR]' indicates a mandatory Process Safety Requirement

'Standard' means normative references listed in this Guideline.

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1. GENERAL

1.1 PURPOSE

This Guideline defines the test procedure and identification required for a program of Positive Material Identification (PMI) for use by CONTRACTORs, Consultants, Sub-Contractor's, Vendors, Suppliers performing work in all ADNOC and ADNOC Group company's Projects. This Guideline applies to metallic alloy materials purchased for use either directly by the COMPANY or indirectly through vendors, fabricators, or contractors and includes the supply, fabrication, and erection of these materials. This Guideline applies to all levels of Sub-vendors and Sub-Contractors in the Supply Chain

This Guideline provides the requirements for material control and material verification programs on ferrous and nonferrous alloys during the construction, installation, maintenance, and inspection of new equipment, process piping systems and Welds.

This Guideline covers the Procedures and Methodology to be adopted to assure that the metallic alloy material components which affect the pressure envelope of pressure containing equipment or piping, Non Pressure containing equipment or piping and reliability of all such equipment and piping is consistent with the Material Specifications as specified in Project Specifications, Datasheets and Drawings. This minimizes the potential for premature problems or failure of equipment and component.

The test methods outlined in this Guideline are intended to identify alloy materials and are not intended to establish the exact conformance of a material to a particular alloy Specification. PMI shall not be considered as a substitute for required Material test Certificate and Material Test Certificates shall not be considered as acceptable PMI.

1.2 SCOPE

This Guideline shall be implemented to reinforce those procedures, which are normally used to identify and control alloy materials during equipment fabrication and installation. The term Alloy with context of Ferrous Material excludes Plain Carbon steels and Low Temperature Carbon Steel (LTCS) but includes other Alloy steel like 1¼ Cr, 2Cr,5 Cr, Stainless Steels, Duplex and Super Duplex etc. Ferrous Alloys requiring testing include Nickel Alloys and Copper Alloys. Any deviation from this Guideline shall be identified by CONTRACTOR and shall require written approval from COMPANY.

This document is mandatory and applicable for implementation in the project execution phase onwards from the Invitation to Tender (ITT), Front End Engineering Design (FEED), Detailed Engineering, Procurement, and Site Construction, until Pre-Commissioning.

In this Guideline, the term CONTRACTOR includes all Sub-Contractor's, Suppliers, Vendors, Consultant's or any entity who is responsible for delivering some or all parts of the contract scope of work.

1.3 OBJECTIVE

The objective of this document is to guide ADNOC CONTRACTORs on the Positive Material Identification on equipment, Piping and welds. The Frequency and location of equipment and piping requiring PMI shall be derived from respective ADNOC Guidelines and referred herein in this Guideline (refer section 6, Welds)

1.4 DEFINED TERMS / ABBREVIATIONS

ADNOC	Abu Dhabi National Oil COMPANY.
AO	Asset Owner
COC	Certificate Of Conformity
FEED	Front End Engineering Design
IRN /IRC	Inspection Release Note / Inspection Release Certificate
ISO	International Organisation for Standardization
ITP	Inspection &Test Plan
MTC	Material Test Certificate
NCR	Non Conformance Report
NDT	Non Destructive Testing
PMI	Positive Material Identification
TPI	Third Party Inspection
CRA	Corrosion resistant alloy

2. REFERENCE DOCUMENTS

2.1 INTERNATIONAL CODES AND STANDARDS

The following Codes and Standards shall form a part of this Guideline. When an edition date is not indicated for a Code or Standard, the latest edition in force at the time of the contract award shall apply.

ISO 9001	: Quality Management Systems –Requirements
API RP 578	: Material verification program for New and Existing Alloy Piping Systems
MSS-SP-137	: Quality Standard for Positive Material Identification of Metal Valves, Flanges, Fittings, and Other Piping Components
ASME B 31.3	: Process Piping.
ASME B 31.1	: Power Piping.
ASME Sec II	: Boiler and Pressure Vessel code - Materials
ASTM 751	: Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM E 1476	: Standard Guide for Metals Identification, Grade Verification, and Sorting
AWS	: American Welding Society.

2.2 ADNOC SPECIFICATIONS

AGES-SP-13-001	: Criticality Rating Specification.
AGES-SP-13-002	: Procurement Inspection and Certification Requirements in Projects.
AGES-SP-13-003	: Traceability of Shop and Field Piping Materials.
AGES-GL-13-001	: Contractor QA/QC Requirements.

3. DOCUMENT PRECEDENCE

The Guidelines and codes referred in this document SHALL, unless stated otherwise, be the latest approved issue at the time of CONTACT award.

It SHALL be the CONTRACTOR's responsibility to be, or to become, knowledgeable of the requirements of the referenced Codes and Standards.

The CONTRACTOR SHALL notify the COMPANY of any apparent conflict between this Guideline, the related data sheets, the Codes and Standards and any other Guidelines or Specifications noted herein.

Resolution and/or interpretation precedence SHALL be obtained from the COMPANY in writing before proceeding with the design/manufacture.

In case of conflict, the order of document precedence SHALL be:

- UAE Statutory Legislation requirements
- ADNOC Standards, regulations and Codes of Practice
- Equipment datasheets and drawings
- Project Specifications and standard drawings
- National/International Standards

4. DEVIATION/CONCESSION CONTROL

Deviations from this Guideline are only acceptable where the VENDOR / SUPPLIER / SUB VENDOR has listed in his quotation the requirements he cannot, nor does not wish to comply with and the COMPANY/ CONTRACTOR has accepted in writing the deviations before the order is placed.

In the absence of a list of deviations, it will be assumed that the VENDOR / SUPPLIER / SUB VENDOR complies fully with this Guideline.

Any technical deviation to the Purchase Order and its attachments including, but not limited to, the Data Sheets and this Narrative guideline shall be sought by the VENDOR only through CONCESSION REQUEST format. CONCESSION REQUESTS require CONTRACTOR'S and COMPANY'S review/approval, prior to the proposed technical changes being implemented. Technical changes implemented prior to COMPANY approval are subject to rejection.

5. QUALITY ASSURANCE/QUALITY CONTROL

A copy of the CONTRACTOR'S QA/QC program shall be submitted to the COMPANY along with its quotation for review and concurrence prior to award. VENDOR'S Quality Management system shall fully satisfy all the elements of Latest edition of ISO 9001,"Quality Management Systems - Requirements" and shall be certified by an internationally accredited certifying agency. The Certificate shall be kept valid for the entire duration of the project." If CONTRACTOR'S QA/QC program is ISO 9000 certified, then only a copy of the ISO 9000 certificate is required. Unless otherwise agreed with CONTRACTOR/ COMPANY, the VENDOR'S Quality System shall fully satisfy all the elements of ISO 9001,"Quality Management Systems - Requirements" and ISO 9004 "Quality Management Systems - Guidelines".

The CONTRACTOR shall identify in documents to its VENDOR / SUPPLIER / SUB VENDOR all applicable QA/QC requirements imposed by the COMPANY, and shall ensure compliance. On request, CONTRACTOR shall provide objective evidence of its QA/QC surveillance for all levels of its activity.

The CONTRACTOR shall identify in purchase documents to its SUBCONTRACTOR all applicable QA/QC requirements imposed by the CONTRACTOR, and shall ensure compliance thereto. On

request, CONTRACTOR shall provide objective evidence of its QA/QC surveillance of its SUB CONTRACTOR activities.

The CONTRACTOR shall submit certified reports of equipment/material tests as soon as the tests are satisfactorily completed.

COMPANY / CONTRACTOR reserves the right to inspect materials and workmanship standards at all stages of manufacture and to witness any or all tests. The VENDOR / SUPPLIER, shall submit to CONTRACTOR/COMPANY a copy of its Manufacturing and Inspection Plan for review & approval within 30 days after award of contract but prior to the pre-inspection meeting

6. GENERAL

Equipment and piping components requiring PMI testing shall be noted on the applicable contract document (such as Material Selection Diagrams (MSDs), data sheets, equipment drawings, etc.

PMI shall be performed at receiving Inspection at Site or prior to shipping release from fabrication shops for Piping, Piping Spools & Bulk materials (including Welding Consumable). For, rest including Static Equipment, Rotating Equipment, Equipment Packages including skid mounted, etc. during the construction phase at one of the following stages of the project:

1. During receiving inspection when components or materials arrive at site.
2. Prior to storage in the warehouse or delivery to the on-site fabrication shop or to the field.
3. At a VENDOR / SUPPLIER / SUB VENDOR facility prior to delivery to the site.
4. At the welding shop prior to dispensing consumables for use.
5. During assembly, machining, or fabrication per the ITP, e.g., at the fabrication shop.
6. On existing piping at tie-ins of new piping to existing prior to welding in the field.

Any Pressure retaining piping bulk material procured from stockist or distributor shall be PMI tested at the Stockist / distributor Warehouse in addition to the above.

The CONTRACTOR QC inspector approved by Company shall witness the PMI Testing. The CV of the technician performing the PMI shall be approved by Company.

It is recommended that the PMI verification testing performed by the VENDOR prior to final fabrication.

For bulk piping components, prior PMI testing at various stages of procurement and subassembly may also be beneficial. However, this does not negate the requirement of testing after fabrication.

PMI testing shall be performed prior to post weld heat treatment (Unless approved otherwise by COMPANY). PMI shall be carried out prior to Painting.

Valves and any pressure components that will not be accessible after equipment or piping spool fabrication shall be PMI tested upon receipt. PMI on CRA valves parts shall be carried out during assembly of valve and addressed in the Inspection and Test Plan (ITP).

A quality plan shall be established by CONTRACTOR to prevent the inadvertent use of materials failing to pass PMI testing. COMPANY shall approve the quality plan.

The CONTRACTOR will develop a table summarizing the extent of testing, component requiring testing, and the type of colour code and marking.

The COMPANY may choose to have a third party inspector present at or perform any of the PMI testing.

Unless otherwise noted in contract document, non-ferrous materials (titanium, aluminium, etc.) other than nickel alloys and Copper Alloys do not require PMI testing.

A project Specific PMI procedure shall be developed as deliverable by CONTRACTOR and submitted to COMPANY for approval. Further each Sub-Contractor, Vendor, Sub-Vendor, Manufacturer shall submit the PMI procedure as a deliverable for approval by CONTRACTOR/COMPANY. Refer section 11 of this Guideline.

Welds:

Pressure-containing full penetration welds and tee joints, and fillet welds of slip-on flanges in equipment and piping made with alloy welding consumables shall be PMI tested in accordance with the following guidelines:

Selection of the test point locations to be examined shall be made by CONTRACTOR.

1. For piping, 100% of welds per completed pipe spool shall be PMI tested.
2. For fabricated equipment, 100% of pressure welds shall be PMI tested.

In addition, all alloy-welding consumables shall be PMI checked in the original supply condition per Manufacturer/Trade name / Batch No. The method of PMI shall be subject to CONTRACTOR / COMPANY approval.

PMI Testing of Welding Consumables:

When the welding activity conducted, one electrode or wire sample from each lot or package of alloy weld rod shall be subject to PMI testing. The remainder of the lot shall compare with sample to verify that the markings of the wires/electrodes are correct. Some weld rods have the alloying elements contained in the flux, and do not meet the alloy Specification until welded. PMI testing of weld metal (e.g. deposited weld metal or undiluted weld “buttons”) is a permissible alternative to PMI testing of an electrode or wire sample provided it is conducted immediately prior to production welding.

7. MATERIAL IDENTIFICATION

After PMI testing has been successfully completed, each pipe or equipment component shall be marked to identify the alloy type (i.e. PMI 1¼ Cr, 2Cr,5 Cr, etc).

The preferred marking methods are low stress stamps or Vibra-etch. Other marking methods require CONTRACTOR agreement and authorization.

If Color coding is proposed all practices and colour schemes should be agreed to by the Company and same is applicable for the entire project from EPC to commissioning hand over and shall be addressed in the Project specific PMI procedure.

Cut lengths of pipe from PMI-tested material are to have PMI markings transferred to all pieces. This marking is in addition to those normally required by applicable CONTRACT DOCUMENT.

Materials PMI tested shall remain identified until such time as their identity is necessarily obliterated by processing (painting, insulation, or plant operations).

8. ALLOY ACCEPTANCE

All materials shall comply with the requirements of the applicable material standards. Unless otherwise noted, a portable alloy analyser “match” of material is accepted as verification of an alloy material. If a clear match is not made, then the alloying elements specified in Appendix B for each individual alloy shall be verified by PMI testing and the results submitted to the CONTRACTOR and COMPANY. The test results shall be within the range specified by the applicable material standard.

For weld metal, Acceptance criteria shall be in accordance with the applicable AWS standard or ASME SEC II Part C (as applicable) for welding consumables or an agreed analysis range approved by CONTRACTOR & COMPANY.

When specifically noted that PMI testing of carbon content for low carbon (“L”) or high carbon (“H”) grades of stainless steel material shall be conducted, carbon content shall be verified by optical emission or wet chemical analysis.

Dissimilar Metal Welds and Weld Overlays Results from testing dissimilar metal welds should take into account the effects of dilution, which occurs during weld deposition. The Contractor should establish the minimum compositional requirements of the as-deposited weld metal necessary for the intended service for Company approval.

Components or welds which are found to comply with applicable material Specification shall be accepted. Acceptance or rejection shall take into account the accuracy of the PMI equipment used. The individual element determined for identification in Appendix B for selected alloys shall be within the range specified by the applicable material standard.

9. TEST EQUIPMENT

Test equipment or methods used for testing shall be one of the following types that will be capable of providing quantitative, recordable, elemental composition results for positive identification of the alloying elements present. The COMPANY may choose to have a third party inspector present at or perform calibration of all PMI testing.

a. **Portable X-ray Emission Analyzers:**

Texas Nuclear 9266, Texas Nuclear Metallurgist-XR, Metorex X-MET, or equivalent authorized by the CONTRACTOR & COMPANY.

b. **Mobile Optical Emission Analyzers**

Metorex ARC-MET or equivalent authorized by CONTRACTOR & COMPANY.

c. **Approved Analytical Laboratories Using**

- X-Ray Fluorescence Spectrometer
- Atomic Absorption
- X-ray emission spectrometry
- Optical spectroscopy

Equipment Calibration:

Persons performing PMI shall calibrate and/or verify the test equipment performance as specified by the equipment manufacturer. The PMI procedure shall provide the frequency interval for this calibration/verification using certified standards from same alloy family. This calibration shall be carried out at least once per shift or when changing the PMI test from one alloy family to another with in the same shift.

Safety: The technician should be aware of potential radiation exposure hazards when operating an XRF device.

10. PERSONNEL QUALIFICATION

PMI shall be performed by a trained and competent technician. Qualifications of the PMI machine operator, including make and type of PMI Machine the Operator was trained and has worked with should be submitted for review and approval by the CONTRACTOR and COMPANY prior to testing.

CONTRACTOR and COMPANY has the right to prohibit those personnel judged unqualified from performing tests.

11. TESTING PROCEDURES

Testing shall be performed in accordance with written operating procedures which have been submitted to and authorized by CONTRACTOR prior to the start of fabrication.

Operating procedures shall ensure tests are performed in accordance with this Guideline.

Written operating procedures shall contain, as a minimum, the following information:

- Description of the instrument to be used (Name and Manufacturer of the equipment)
- Description of equipment operating principle.
- Calibration procedure and frequency.
- Marking method for typical components.
- Extent and frequency of testing - Material, Components and Welds to be inspected & Surface Preparation requirements.
- Sampling plan definitions for each material in case of sampling.
- Material Identification /Marking method for typical components.
- Acceptance criteria.
- Procedure steps in detail.
- Procedure to follow when identification results are inconclusive (alloy type is unknown).
- Radiation Safety Operating and Emergency Procedures, if applicable.
- Operating personnel competency for PMI techniques - Qualifications of the PMI machine operator, including make and type of PMI Machine the Operator was trained and has worked
- Control of rejected material.
- Documentation with template of reporting.

12. REJECTION CRITERIA

If any of the major alloying elements are below the range specified by the applicable material standard or a portable analyzer indicates an incorrect match or “no match”, the component shall be rejected or a laboratory analysis may be performed at no additional cost to the COMPANY. The laboratory analysis will determine acceptance or rejection of the material.

Note: (Portable analyzer match of material is basis of acceptance).

If any of the major alloying elements are greater than the range specified by the applicable material standard, the alloy content must be reported to CONTRACTOR for acceptance or rejection.

A detailed Chemical analysis may be performed in a laboratory for the materials having very nominal deviation of Alloying Elements from the acceptable limits. Both the nominal deviation and the final laboratory analysis shall be reported. In such cases a final decision to accept or reject is left to the COMPANY.

Any raw material or fabricated item purchased with PMI requirements that cannot be traced to a PMI report, heat number, and/or MTC shall be rejected and placed under quarantine for pending PMI examination.

i. PMI examination shall be at the CONTRACTOR's, Sub-CONTRACTOR's, VENDOR's and/or Sub-VENDOR's cost.
ii. Upon discovery of a second item not traceable to a PMI report and MTC, a NCR shall be issued. All rejected materials that are identified shall be quarantined until an investigation is carried out.

13. REJECTED MATERIALS

Rejected material shall be identified by marking or tagging and segregated from acceptable material.

The VENDOR / SUPPLIER / SUB VENDOR / SUB-CONTRCTOR, as applicable, shall submit a non-conformance report (NCR) per the project quality procedures.

Materials and welds found to be incorrect on field-fabricated pipe spools or equipment shall be replaced at the Field CONTRACTOR / SUB CONTRACTOR, VENDOR / SUPPLIER / SUB VENDOR expense. Following replacement, PMI shall be conducted on all replaced components and associated welds.

If any piece, or weld from a representative percentage sample is found to be unacceptable, then the remainder of that material heat number or all welds on a completed pipe spool or equipment item (as applicable) shall be verified by performing a 100% PMI test at the VENDOR / SUPPLIER / SUB VENDOR or CONTRACTOR / SUB-CONTRACTOR expense.

When traceability of a material heat number cannot be established back to the mill certification or other positive means of identity, that material heat number, regardless of quantity, shall be rejected.

14. PMI INSPECTION REPORT

1. The PMI Inspection Report (Typical Sample report in Appendix A) shall be submitted to CONTRACTOR and shall as a minimum include the following for each inspection lot examined:

   a. VENDOR / SUPPLIER / SUB VENDOR / SUB- CONTRACTOR'S name.
   b. Date(s) of testing.
   c. Name of person and company performing the test.
   d. Method of examination (laboratory or field analyser).
   e. Analyser used for the examination.
   f. Material Specification of the material to be tested.

g. Material VENDOR / SUPPLIER / SUB VENDOR, MTR number, heat number and lot number, as applicable.
h. Inspection lot size and number of pieces or items examined.
i. Results of the test and resolution of non-conformance material.
j. Chemical elements verified by PMI and the percentage of the elements in accordance with (APPENDIX B).
k. Reports downloaded from the alloy analyser are acceptable

2. For fabricated items with multiple components and welds, the PMI Inspection Report shall also include the following:

   a. Each component receiving PMI by the VENDOR / SUPPLIER / SUB VENDOR.
   b. Each piece of equipment (with item number) receiving PMI by the shop Fabricator, including a test location map.
   c. Each pipe line (with line number and pipe spec, including the spool or fabrication drawing) showing the locations of PMI by the shop/field Fabricator or field Constructor.
   d. Existing piping PMI results for field welds of new to existing piping.
   e. Reports downloaded from the alloy analyser shall be attached for shop and field fabricated piping.

3. PMI Inspection Reports shall become part of the permanent record included in the final data package.

APPENDICES

Appendix A - Positive Material Identification Report Form

Appendix B - Alloy Elements Required for PMI Inspection

APPENDIX A: POSITIVE MATERIAL IDENTIFICATION REPORT FORM

PMI REQUESTED BY: SIGNATURE: DATE:			PURCHASE ORDER NUMBER					
PMI PERFORMED BY: SIGNATURE: DATE:			PMI WILL BE/WAS PERFORMED AT:					
ITEM OR TAG NUMBER	SAMPLE SIZE	TYPE OF MATERIAL	MILL CERT. NUMBER	HEAT NUMBER	DESCRIPTION			
TESTING RESULTS								
ITEM OR TAG NUMBER	NO. PIECES EXAM.	NO. PIECES ACCEPT.	NO. PIECES REJ.	MATERIAL IDENTIFIED AS	ADD'L NO. PIECES TESTED DUE TO REJ.	NO. PIECES ACCEPT.	NO. PIECES REJ.	TOTAL NO. REJ.
ADDRESS OF SUPPLIER RESPONSIBLE FOR REJECTION(S)								
ADDITIONAL INFORMATION								
MANHOURS AND LOSS INCURRED FROM REJECTIONS, ETC.								
				PMI Supervisor				
					Signature/Date			

APPENDIX B: ALLOY ELEMENTS REQUIRED FOR PMI INSPECTION

ALLOY	Cr	Ni	Mo	Cb	Ti	Cu	Al	C	Co	W	Fe
1¼ Cr - ½ Mo	x		x								
2¼ Cr - ½ Mo	x		x								
5 Cr - ½ Mo	x		x								
7 Cr - ½ Mo	x		x								
9 Cr - 1 Mo	x		x								
304	x	x									
304L	x	x						x*			
304H	x	x						x*			
309	x	x									
316	x	x	x								
316L	x	x	x					x*			
317	x	x	x								
321	x	x			x						
347	x	x		x							
405	x				x#		x				
410	x				x#						
410S	x				x#			x*			
430	x				x#						
904 L	x	x	x			x		x			
UNS 31803	x	x	x					x			x
Alloy 20	x	x	x	x		x					
SMO 254	x	x				x					
Hast C-276	x	x	x							x	

Alloy 600	x	x									
Alloy 601	x	x					x				
Alloy 625	x	x	x	x							
Alloy 800	x	x				x					
Alloy 825	x	x	x		x						
Monel 400		x				x					
RA 330	x	x									
RA 333	x	x	x						x	x	
9 Ni		x									
70/30 CuNi		x				x					
90/10 CuNi		x				x					
Stellites	x	x							x		
Titanium Gr 2					x						
Titanium Gr 7					x						
TitaniumGr12					x						
TitaniumGr16					x						

Note 1: A portable alloy analyzer “match” is also acceptable per section 8 of this Guideline.

* Testing of C is only required when specifically indicated on the data sheet or purchase documents.

\# Testing of Ti will prevent unacceptable substitution with Grade 409.

Note 2: The test results shall be within the range specified by the applicable material code & standards (Eg- ASTM, BS, DIN etc)