Implications of NORSOK M-650 Standard
In the Offshore Industry
A User’s Perspective

Presentation

- Originally presented at ASM International, Materials Solutions, Columbus, Ohio in October 2004
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- The presentation has been updated to reflect
  - M-630 Edition 6, Oct 2013
  - M-630 Edition 6, re-issued, April 2014
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What is NORSOK and the M-650 standard?
- History and development
  - M-650 Qualification of manufacturer’s of special materials
  - M-630 Material data sheets for piping
- Overview of NORSOK M-650 qualification process
- User Experiences
- Future: Implications for the Offshore Industry

**What is NORSOK?**

NORSOK
Industry Initiative for the Competitive Standing of the Norwegian Offshore Sector

**Standards**

- **M-630**
  Material Data Sheets for Piping
- **M-650**
  Qualification of Manufacturers of Special Materials
What is the NORSOK M-650 Standard?

- Qualification of Manufacturers of ‘Special Materials’
- Qualification process to determine the competency of manufacturers of special material grades to supply products for use in the Norwegian oil & gas industry
- It is a second party qualification of manufacturing processes for specific materials.
- It is NOT a third party accreditation

What is the NORSOK M-650 Standard?

- Main qualification requirements
  - Capability, skill, experience and understanding to handle the required material grade
  - Adequate facilities and equipment
  - Manufacture products with acceptable material properties
  - Implemented Quality Management System
When is the standard used?

- When required by the material data sheets
  - NORSOK M-630 – ‘Material Data Sheets for Piping’

- Special materials in other product forms
  - Ti forgings
  - Ni alloy forgings

- At discretion of the main contractor when material is ‘not special’ but the component is critical

- Does NOT apply to structural materials

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When is the standard used?

- Special materials defined as:
  - Duplex Stainless Steels
    - All Grades, Product Forms and Dimensions
  - High Alloyped Austenitic Stainless Steels
    - All Product Forms and Dimensions
  - Nickel Base Alloys
    - Castings
  - Titanium and its Alloys
    - Castings

- Critical components in other materials

- Special materials in other product forms
**Where did the standard come from?**

- 1980’s increased use of ‘special materials’ in the Norwegian Offshore Sector – Sleipner West Projects
  - Superior properties at low design temperatures
  - Suppliers manufacturing products outside their area of expertise
  - Components with unacceptable properties
  - Project delays

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**NORSOK M-650 Rev 1**

- Formalisation of Sleipner approval process
- Requirements:
  - Sufficient understanding and experience
  - Testing in accordance with the material data sheets
  - Documented evidence of successful manufacture of special materials
  - Qualification allowance (general)
    - Thickness + 25%
    - Weight + 50%
NORSOK M-650 Rev 2

- Complete revision of standard
- Additional Requirements
  - Additional testing requirements (informative only)
  - Heat treatment furnace survey (ISO 10423 / API 6A)
  - Quality Management System required (ISO 9001)
  - Qualification Test Record to be produced
  - Qualification allowance (general)
    - Thickness + 25%
    - Weight G + 100% Max 250kg or if G>250kg all weights

NORSOK M-650 Rev 3

- Tightens up qualification process considerably
  - Increased testing requirements (informative only)
  - All testing 3rd party witnessed (now EN 10204:2004 3.2)
  - Qualification Test Record revised
  - All qualifications valid for 5 years
  - Heat treatment furnace temperature uniformity survey (ASTM A991)
  - Qualification allowance – new restrictions
    - Thickness T + 10% below defined levels and T above them
    - Weight G + 100% below defined levels and all above them
NORSOK M-650 Rev 4 – Sept 2011

- Tightens up qualification process considerably
  - Clarification of responsibilities
  - More stringent requirements on manufacturer’s knowledge
  - Test laboratories and welded products included
  - More stringent requirements on heat treatment
  - Changes in essential variables of qualification tests
  - Changes in test requirements for flanges and machined components from forgings

NORSOK M-650 Rev 4 – Sept 2011

- Qualification allowance – new restrictions
- Super austenitic, 25Cr Super duplex, Ni alloys
  - Thickness $T \leq 60$; $T + 10\%$ max 60
  - Weight $G < 250$; $G + 100\%$
  - Thickness $T > 60$; $T$
  - Weight $G > 250$; All
- 22Cr Duplex
  - Thickness $T \leq 120$; $T + 10\%$ max 120
  - Weight $G < 250$; $G + 100\%$
  - Thickness $T > 120$; $T$
  - Weight $G > 250$; All
NORSOK M-630 Rev 6 – Oct 2013

- Material data sheets for piping
- More specific detail in test methods
- Microstructure – major change in requirements / no longer a definitive failure mode
  - “Any presence of intermetallic phases and / or precipitates shall be reported”
  - “in case intermetallic phases and / or precipitations are detected the acceptance of the product shall be based upon the corrosion and Charpy V-notch test results.

NORSOK M-630 Rev 6 – Apr 2014

- Edition 6 was re-issued in April 2014 due to a series of corrections.
- Neither the standard nor the material data sheets were up-issued.
- Changes are generally non trivial – mainly relating to castings, but need to be reviewed for other product forms.
Overview of NORSOK M-650 Process

- Manufacturing
- Visit & Inspection
- Testing
- Review & Resolution
- Certification

M-650 Process – Manufacturing

- Produced according to Manufacturing Summary
- Following company QMS and procedures
  - Made by experienced, competent and trained personnel
  - Supporting evidence and document trail
**M-650 Process – Visit & Inspection**

- Standard requires visit by purchaser to assess:
  - Facilities and equipment
  - Quality Management System and the implementation of procedures
  - Competence, knowledge, and experience of personnel and management
- Question and answer session
- End of visit: Minutes
  - Detail facts of visit
  - Document actions required to ensure manufacturer meets qualification requirements

**M-650 Process – Testing**

- Split into two categories
  - Required by the material data sheet and must be passed in order to gain qualification
  - Required by the standard and is informative only

- Testing must be 3rd party witnessed
  - EN 10204:2004 3.2
M-650 Process – Review and Resolution

- Resolution of outstanding problems:
  - Testing
  - Outstanding actions from visit
    - Quality Management System
    - Process procedures

- Compilation of Qualification Test Record

- Review of process and record by purchaser

M-650 Process – Certification

- Certificate:
  - Valid for 5 Years
  - States:
    - Standard, material, product and process
    - Tested thickness and weight
    - Qualified thickness and weight
  - Carry forward qualification / approval for future work in this product and size range
**Telling the world about your qualification**

- NORSOK do NOT approve or qualify manufacturers
- NORSOK do NOT maintain a central registry of qualified manufacturers and do NOT intend to do so
- Increasing pressure to use qualified manufacturers
- **NORSOK is a qualification process NOT an accreditation**

**User Experiences**

- Manufacturers and sub suppliers
- Oil companies and main contractors
Manufacturers and sub suppliers

- Experience
  - Improvement on per project approval process
  - Qualification process confusing, cumbersome and slow
  - Qualifications come from multiple bodies with different views

- Developments
  - Would like to see:
    - Streamlined process
    - Qualification process approval managed by independent body = one view

Oil companies and main contractors

- There is a growing divergence between NORSOK M-630 Rev 6 – Oct 2013 and Oil Company / Main Contractor specifications
  - Test locations
  - Chemistry – %N content
  - Charpy V-notch requirements and test temperatures
  - Microstructure requirements – acceptance criteria
  - Corrosion test - acceptance criteria
Oil companies and main contractors

- Issues with manufacturers
  - Quality assurance systems too generalised
  - Procedures not often dedicated to specific material grade
  - Too willing to accept orders outside area of expertise
  - Metallurgical knowledge lacking or dependent on one person
  - Quality thermal handling and heat treatment operations are key to minimising material property variations

Future: Implications for the Offshore Industry

- M-650
  - Norwegian companies operating in foreign waters are using the standard
  - Non-Norwegian oil companies are using the standard
  - Adoption as a rationalised ISO Standard
  - NADCAP / AMS 2750 becomes heat treatment standard
Future: Implications for the Offshore Industry

- Increased demand for qualified manufacturers
  - Larger pool of qualified manufacturers
  - More certainty at bid stage of availability of competent manufacturers of special materials
  - Reduced delays at fabrication yards for contractors
  - Informative testing may / will become mandatory

Web Links

- Norwegian Standards
  - All NORSOK Standards are free to download
  - [www.standard.no/petroleum](http://www.standard.no/petroleum)

- Geoff B Associates
  - [www.geoffbassociates.com](http://www.geoffbassociates.com)