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Subsea material selection – Annex B.12 and D

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Agenda

1. Introduction

- Subsea codes and standards used on NCS
- Scope covered and split between Annex B.12 and Annex D

2. Annex B.12 – Materials and fabrication requirements for equipment in riser load path

- Standardisation on low alloy steel forgings
- Standardisation on welding

3. Annex D – Materials and fabrication requirements for equipment in subsea production system

- Fasteners
- Metallic seal rings
- Fabrication requirements

Introduction

Background

- Identified a need to update material and fabrication requirement to reflect new and revised industry standards
- Agreed between EG-U and EG-M to update the subsea material requirements in NORSOK U-001
- Participants from a range of operators, contractors and suppliers started on draft in 2016

Motivation

- To provide unambiguous requirements for subsea materials and fabrication
- To reference material codes and standards that are widely used and well known in the industry

Result

- The basis is that the design code must always be followed as a minimum when it comes to testing and acceptance criteria.
- The document must be seen as an overarching document that refers to associated standards
 - It provides amendments to ISO 13628-series
 - Refers mainly to the NORSOK M-series of standards
 - Refers to DNV-RP-0034 for low alloy steel forgings in riser load path
 - Refers to DNV-RP-B204 for welding of equipment in riser load path



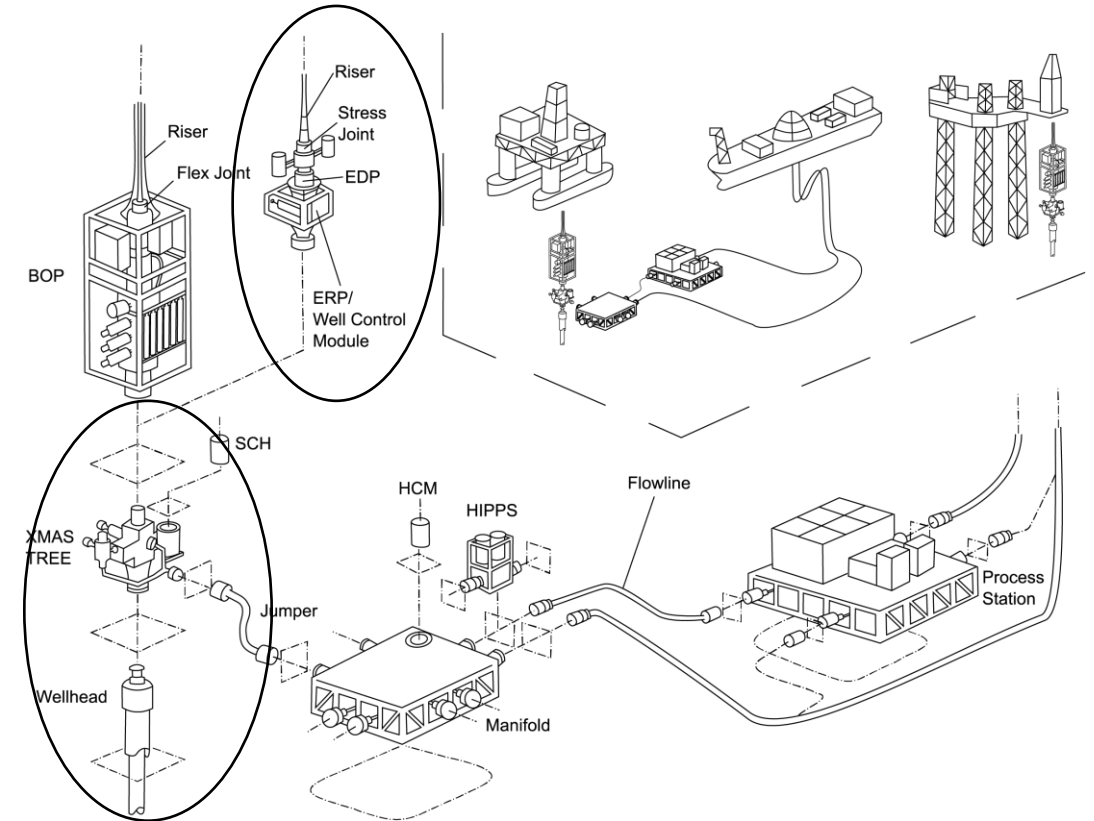


Subsea codes and standards used on NCS

Discipline	NORSOK M-series	Used subsea	Other codes and standards
Material selection	M-001	Yes	-
Structural steel	M-101 and M-120	Yes	-
Coating	M-501	Yes	-
CP	M-503	Yes	-
Welding	M-601	Yes	DNV-RP-B204
Piping	M-630	Yes – with additional requirements	Updated with HP datasheets
LAS and CS Forgings	-		DNV-RP-0034
Fasteners	M-001	Operator specifications used	API 20E and 20F
Qualification of manufactures of special materials	M-650	Yes	-
Qualification of non-metallic materials and manufacturers	M-710	Yes	-

Scope covered in Annex B.12 and Annex D

- Annex B.12 covers equipment in the riser load path:
 - Subsea wellhead
 - Tree equipment
 - Completion/workover riser systems
- Annex D covers equipment in subsea production system
 - All equipment in a subsea production system excluding what is covered in B.
 - Flowloops
 - Small bore piping
 - Outboard and inboard tree piping
- Equipment in B.12 is considered high criticality:
 - Accidental loads
 - Bending loads
 - Fatigue



Equipment in Annex B.12 is encircled

Annex B.12 – Materials and fabrication requirements for equipment in riser load path



Subsea wellhead and tree equipment (NS-EN ISO 13628-4)	C/WO workover riser system equipment (NS-EN ISO 13628-7)	Extensions joints
Components and equipment in the riser load path		
Tubing hangers	Tubing hanger orientation systems	Extension of wellhead housing to the top of the first casing or conductor string ⁽⁴⁾
Casing hangers	Subsea test trees	Extension of conductor housing to the top of the first conductor string ⁽⁵⁾
Tubing hanger running tools ⁽¹⁾	Shear subs	
Tree cap running tool (horizontal trees) ⁽¹⁾	Retainer valves	
Tree running tools	Lubricator valves	
Tree connectors	Lower workover riser packages	
Tree cap connectors	Subsea WCT-BOP's	
Tubing heads	Emergency disconnect package connectors	
Tubing head connectors	Riser connectors	
Tree valve blocks	Stress joints	
Conductor housing	Riser joints	
Subsea wellhead housings	Tension joints	
Pressure containing bolting (closure bolting)	Surface tree adapter joints	
Pressure controlling bolting	Swivels	
Primary structural bolting	Surface trees	
Pressure containing seal rings	Wireline/coiled tubing adapters	
End and outlet connectors	Primary structural bolting	
Other structural equipment	Pressure containing bolting (closure bolting).	
Other pressure containing equipment	Pressure controlling bolting	
Load shoulders and rings ⁽³⁾	Pressure containing seal rings	
	Other structural equipment	
	Other pressure containing equipment	
Components and equipment not in the riser load path ⁽²⁾		
Bonnets		
Valve blocks (production and annulus valve wing blocks)		
Production chokes		
Flowline connectors		

Table B.1 defines equipment that is covered in Annex B.12

Annex B.12 refers to equivalent clauses in Annex D where applicable

Standardisation on low alloy steel forgings

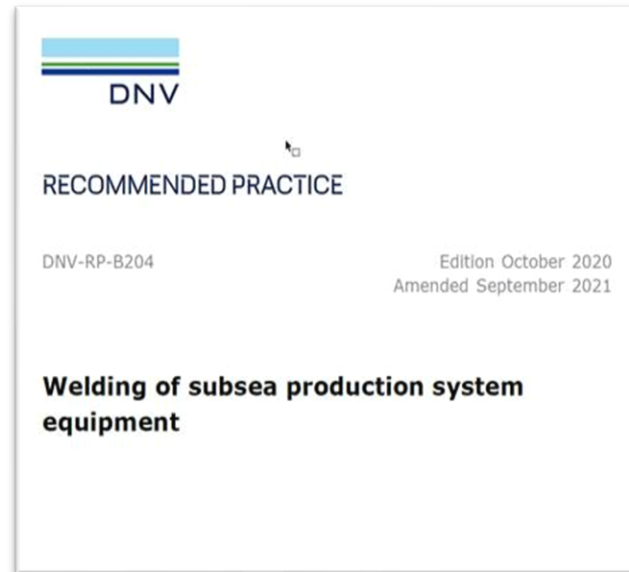
- DNV-RP-0034 mandatory for low alloy and carbon steel forgings for manufacturing and qualification
- Ensure quality and industry harmonisation
- Enable stocking and reduced lead time of forgings
- Steel forging class selection defined in table B.21
- Clear definition to reduce reoccurring discussion and enable increased use of SFC 1



SFC	Criteria
1	For components with load or load effect less or equal to 2/3 of the component yielding capacity. ¹⁾ If wall thickness and weight exceed limits in Table D.1 then SFC 2 shall apply.
2	For components with load or load effect greater than 2/3 of the component yielding capacity ¹⁾ SFC 2 shall apply regardless of wall thickness and weight.
NOTE 1 The load or load effect can be a single load or combined load design, see Table B.3	

Standardisation on welding

- DNV-RP-B204 mandatory for welding in riser load path
- Ensure quality and industry harmonisation
- Covers all welding in riser load path





Annex D – Materials and fabrication requirements for equipment in subsea production system

- The basis is that materials shall comply with product standards listed by the applicable design code or product standards with product test requirements compliant to the design code
- Material selection refers to Norsok M-001
- Surface preparation and coating refers to Norsok M-501
- Cathodic protection refers to Norsok M-503
- Qualification of non-metallic materials refers to Norsok M-710
- Piping components refers to Norsok M-630 Table 3
- Qualification of manufacturers of special materials refers to Norsok M-650/ISO 17782
- Structural steel refers to Norsok M-120
- Carbon and low alloy steel forging requirement:
 - Valves, chokes and hubs refers to DNV-RP-0034 (SFC defined in table B.21)
 - Recommendations for section thickness and weight in as heat-treated condition requiring CS and LAS qualification, is provided in table D.1
 - Requirements for other forgings refers to clause D.6 to D.8

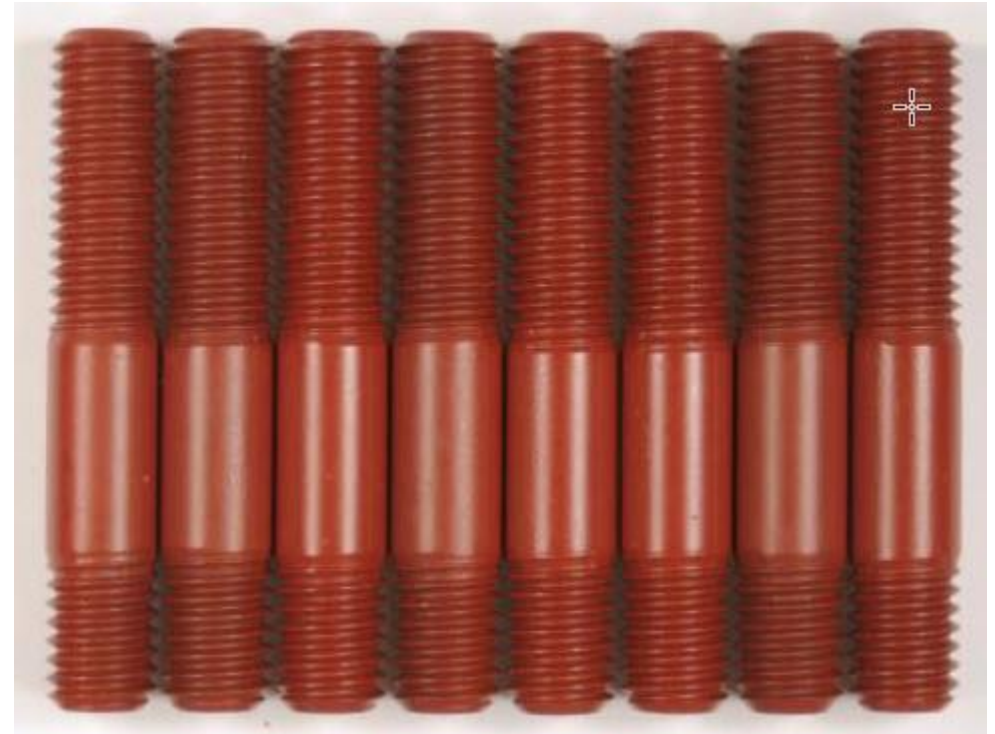
Table D.1 — Recommendations for carbon and low alloy steel qualification requirements

Alloy type	Strength (SMYS)	Standard/grade	Section thickness (t) as heat treated, recommended qualification ⁽¹⁾	Weight recommended qualification
Carbon steel, Carbon - Manganese steel, Micro alloyed Steel	SMYS ≥ 414 MPa	ASTM A694 [35] F60, F65 & F70 & modified versions	>50 mm	-
Mn-Ni-Mo low alloy steel	414 MPa ≤ SMYS < 450 MPa 450 MPa ≤ SMYS	ASTM A508 [34] Gr. 3 and modified versions	>100 mm >50 mm	
Cr-Mo low alloy steel	SMYS ≤ 414 MPa	AISI 4130 & modified versions	>250 mm	>2000 kg
	414 MPa ≤ SMYS < 517 MPa		>100 mm	>1000 kg
	517 MPa ≤ SMYS ≤ 552 MPa		>50 mm	>1000 kg
	SMYS > 552 MPa		Any dimension and weight	
Ni-Cr-Mo low alloy steel	SMYS ≤ 414 MPa	AISI 8630 & modified versions	No qualification required	
	414 MPa < SMYS ≤ 517 MPa		>200 mm	>5000 kg
	SMYS > 517 MPa ≤ 552 MPa		>130 mm	>1000 kg
	SMYS > 552 MPa		> 50 mm	>1000 kg
Cr-Mo low alloy steel	SMYS ≤ 414 MPa	ASTM A182 [33] F22 (2¼Cr1Mo & modified versions)	No qualification required	
	414 MPa < SMYS ≤ 517 MPa (65K,70K,75K)		>200 mm	>5000 kg
	517 MPa < SMYS ≤ 585 MPa (80k,85K)		>150 mm	>1000 kg
	SMYS > 585 MPa (90K,95K etc)		>100 mm	>1000 kg

NOTE 1 Section thickness (t) is the thickness for which mechanical properties are required by design.

Fasteners

- Refers to relevant industry standards
- Requirements apply to pressure-containing (retaining) bolting, pressure-controlling bolting and primary structural bolting
- Fasteners are divided into:
 - Fasteners according to API Spec 20E (BSL-2)
 - Fasteners according to API Spec 20F (BSL-2)
 - Other stainless steel and corrosion resistant fasteners
 - Other low alloy steel bolting



Metallic seal rings

- Provides manufacturing requirements for metallic pressure-containing seal rings and pressure-controlling seal ring
 - Pressure containing seal rings = seal rings which by failure would result in a release of wellbore fluid to the environment.
 - Pressure controlling seal rings = seal rings which by failure would result in the loss of wellbore pressure controlling functionality
- Seal rings shall be made from forgings, seamless pipes/tubes, or bars
- Minor error that will be corrected in AC:
 - Surface NDT is in clause D.9.3.2 which applies to qualification of gaskets. This also apply to production parts and shall be in clause D.9.3.1.



BX gasket used for API flanges

Fabrication requirements

- Welding and NDE of piping systems refers to:
 - Norsok M-601
 - NS-EN ISO 13628-6
 - NS-EN ISO 13628-15
 - DNV-RP-B204
 - New qualifications should follow DNV-RP-B204
- Welding and NDE of structural components refers to:
 - Norsok M-101 for steel
 - Norsok M-102 for aluminum

