DNV-OS-F101 Submarine Pipeline Systems

Amendments and Corrections

March 2001

Spine

Replace

DNV-OS-F101 Submarine Pipeline Systems, 2000

Page iv, Acknowledgement

Add

British Steel
Niras
Røntgen Technische Dienst bv
Seaflex
Shaw Pipeline Services Ltd.
Vallourec & Mannesmann

General (throughout the document)

Yield strength should read yield stress

Page 6, Section 1 after C279

Add

279 (b) Pressure, shut-in: The maximum pressure that can be attained at the wellhead during closure of valves closest to the wellhead (wellhead isolation). This implies that pressure transients due to valve closing shall be included.

Page 7, Section 1 C301-C302

Replace

301 *Splash Zone Lower Limit* (LSZ): Determined by:

LSZ = |L1| - |L2| - |L3|

where:

L1 = lowest astronomic tide level (LAT)

L2 = 30% of the Splash zone wave-related height defined in 302.

L3 = upward motion of the riser, if applicable.

302 *Splash Zone Upper Limit*(USZ) is determined by:

USZ = |U1| + |U2| + |U3|.

where:

U1 = highest astronomic tide level (HAT)

U2 = 70% of the splash zone wave-related height defined in 302.

U3 = settlement or downward motion of the riser, if applicable.

Page 7, Section 1 D100

Add

BM Base Material
L Load effect
PWHT Post Weld Heat Treatment
RT Radiographic Testing
ST Surface testing
ToFD Time of Flight Detection
UT Ultrasonic testing

Page 34, Section 5 D204

Add

Guidance note

For the system pressure test condition, the local test pressure is considered as incidental pressure. In order to calculate the corresponding p_{ld}, included in Δp_d above, the local test pressure shall be calculated as:

$$\Delta p_d = \gamma_p \cdot \left(\frac{p_t}{\gamma_{inc}} + \rho_t \cdot g \cdot h_{ref} - p_e \right)$$

where h_{ref} is the vertical distance between the point in question and the reference height and γ_{inc} should be 1.1. The same approach applies to when the shut-in pressure is used.

end of Guidance note

Page 35, Section 5 D301

Delete sentence

~~The load effect factors apply to all design formats unless explicitly stated.~~

Page 36, Section 5 D505

Replace

$p_b(t_2)$= Burst pressure Eq. (5.15)

α_c = Flow stress parameter accounting for strain hardening given by:

$$\alpha_c = (1-\beta) + \beta \frac{f_u}{f_y} \quad \text{but maximum 1.20}$$

$$\beta = \begin{cases} (0.4 + q_h) & for\ D/t_2 < 15 \\ (0.4 + q_h)(60 - D/t_2)/45 & for\ 15 \le D/t_2 \le 60 \\ 0 & for\ D/t_2 > 60 \end{cases}$$

$$q_h = \begin{cases} \frac{(p_{ld} - p_e)}{p_b(t_2)} \frac{2}{\sqrt{3}} & for\ p_{ld} > p_e \\ 0 & for\ p_{ld} \le p_e \end{cases}$$

Page 37, Section 5 D507

Add

Guidance Note:

The maximum yield to ultimate stress ration, α_h, is found in Table 6-3 and 6-6. The increase of this factor with 0.02 in accordance with footnote 5 and 3 in these tables respectively does not apply since it is already included in the factor 0.78.

End of Guidance Note

Page 37, Section 5 D510

Replace

510 Propagation buckling cannot be initiated unless local buckling has occurred. In case the external pressure exceeds the below criteria, buckle arrestors should be installed and spacing determined based on consequences of failure. The propagating buckle criterion reads

$$p_{pr} = 35 \cdot f_y \cdot \alpha_{fab} \cdot \left(\frac{t_2}{D}\right)^{2.5}$$

$$p_e \leq \frac{p_{pr}}{\gamma_m \cdot \gamma_{sc}}$$

Page 41, Table 5-10

Add

10^{-2}-10^{-3}	To be evaluated on a case by case basis

Page 47, Section 6 A404

Replace

404 Linepipe formed from strip (skelp) and welded with one longitudinal seam, without the use of filler metal. The longitudinal seam is generated by high frequency current (min. 100 kHz) applied by induction or conduction. The weld area (heat affected area) or the entire pipe shall be heat treated. The forming may be followed by cold expansion to obtain the required dimensions.

Page 48, Section 6 C104

Replace

104 If materials shall be used at a design temperature above 50 C, the yield strength at the T_{max} may be determined during the qualification of the manufacturing procedure specification. This information shall be obtained either by use of the curves in Section 5B 600 or by testing.

Page 51, Table 6-3

Replace(foot note ref.)

Charpy V-notch energy (KVT) min. J [6)]

Page 53, Section 6 C515

Replace

515 The hardness of base material, cladding material, HAZ, weld metal and the metallurgical bonding area shall meet the relevant requirements of this standard (see Table 6-3 and 6-6).

Page 59, Section 6 E504

Replace

504 Plates and strip shall be subject to 100% visual examination on both sides. The inspection shall be performed in a sufficiently illuminated area (approximately 500 lx) by trained personnel with sufficient visual acuity (e.g. Jaegar J-w eyesight test at 300 mm within the last 12 months). The surface finish produced by the manufacturing process, shall ensure that surface imperfections can be detected by visual inspection.

Page 63, Table 6-11

Replace

Metallographic examination	Pipe body Weldment	Q(&P[9)])	Q&P Q&P	Q&P Q&P

Add foot note

9) HFW, EBW and LBW pipes only

Page 65, Section 6 E1011

Replace

1011 Repair welding of the weld seam is allowed for SAWL and SAWH pipes only and shall be performed in accordance with qualified welding repair procedures. Requirements for welding repair procedures are given in Appendix C. Repair welding may only be performed subject the following limitations:

Page 66, Section 6 E1205

Replace

1205 The out-of-roundness for pipe ends shall be calculated by the following formula:

Page 67, Table 6-14

Replace

Greatest difference in pipe diameter between pipe ends (each pipe measured)	R [2)]	12.5%·t

Page 68, Table 6-15

Replace

Greatest difference in pipe diameter between pipe ends (each pipe measured)	10%	10%·t, but max. 3 mm

Diameter pipe body 310< $D^{1)}$ < 610mm	10%	± 0.75% $D^{1)}$, but max. ± 3.0 mm

Page71, Table 7-2

Replace

Table 7-2 Bolts and nuts for subsea use		
Bolt	Nut	Size range
ASTM A320, Grade L7	ASTM A194, Grade 4/S3 (Low-temperature requirement for Grade 4 and Grade 7 nuts)	<50mm
ASTM A320, Grade L43	ASTM A194, Grade 7	<100mm

Page 74, Section 7 D203

Replace

203 The chemical composition, taken from the product analysis, of material for hot-formed components, castings and forgings, shall not exceed the values given in Table 7-4. The notes given in Table 7-5 shall apply, except Note 9 and Note 10.

Page 74, Section 7 D205

Replace

205 For material to be quenched and tempered, the content of hardening elements Cr, Mo, Cu and Ni shall be sufficient to obtain the desired microstructure in the centre of the component. The selected chemical composition shall have adequate hardenability to ensure through thickness hardening of the respective component.

Page 79, Section 7 G107

Replace

107 Mother pipe in C-Mn steels shall be delivered in the normalised, quenched and tempered or TMCP condition.

Page 80, Section 7 G301

Replace

301 In general all the requirements given in Section 6 D100 shall apply. The chemical composition of pipe for bends shall comply with Table 6-7 and Table 6-8 as relevant.

Page 81, Section 7 G401

Replace

401 In situations where dedicated mother pipes are not available for manufacturing of bends, the factors given in G 100 and G 200, especially G108, should be considered in order to select the most appropriate pipe for bend manufacturing.

Page 83, Section 7 G905

Replace

Tensile testing:

- Base material in the arc outer radius longitudinal and transverse (total 2 specimens);
- Base material in the start transition area outer radius longitudinal and transverse (total 2 specimens) unless 903 is applicable.

Charpy V-notch impact testing:

- Base material in the arc outer radius longitudinal and transverse (total 2 sets);
- Base material in the start transition area outer radius longitudinal and transverse (total 2 sets) unless 903 is applicable.

Page 84, Section 7 G906

Replace

Tensile testing:

- Cross weld tensile testing in the arc area (one specimen);
- Cross weld tensile testing in the start transition area (one specimen) unless 903 is applicable

Charpy V-notch impact testing:

- Weld metal, FL, FL + 2 mm and FL + 5 mm in the arc (4 sets).
- Weld metal in the start transition area (1 set) unless 903 is applicable.

Page 127, Table 12-1

Replace

Table 12-1 Index and Cross references

Key word	*Reference*	*Comment/aspect*
Characteristic Material strength	5B600	f_k
	5B604	Relation to supplementary requirement U
	5B604GN	Proposed (conservative) de-rating stresses
	5B606	Reduction due to the UO/UOE process
	5D505 &506	Reduction in longitudinal direction
Crossing	2B303	Evaluation of risks
	3C204	Survey
	5B102	Minimum vertical distance
	9B300	Specification
Golden weld	9A807	Requirements
Installation	2C400	Safety class
	5H100(D)	Design criteria
	5H200	Pipe straightness
	9	Installation phase
Linepipe NDT Level	5B500	Design – general
	6B100	General introduction and designation
	Table 6-13	NDT requirements
Mill pressure test	1C200	Definition
	5B200	Link between mill pressure test and design
	5D401	Reduced mill test pressure implication on pressure containment capacity
	6E1104	Basic Requirement
	6E1105	Maximum test pressure
	6E1108	Waiving of mill test – UOE-pipes, conditions
Minimum wall thickness	5B400	Minimum 12 mm and when it applies
	5C300	When to use minimum wall thickness, relation to nominal thickness and corrosion allowance
Ovality	Eq. (5-18), (5-21)	Minimum allowed ovality for collapse
	5D800	Maximum allowed ovality, as installed
	Table 6-14, 6-15	Maximum allowed ovality, line pipe specification
Pressure - general	1C200	Definitions
	3B300	Pressure control system Table 3-1 Choice of Pressure
	Table 5-7	Pressure load effect factors Table 3-1 Choice of Pressure
	4B202, 203	Characteristic values
Pressure - incidental		
	12 F600	Benefit of lower incidental pressure
	3B300	Pressure control system
	Table 3-1	Selection of incidental pressure during pressure test and for full shut-in pressure
Reeling	5D1006	Fracture assessment – when supplementary requirement P comes into force
	5D1100	Engineering criticality assessment
	Eq. (5-25)	Capacity formula
	Table 5-8	Condition factor
	6D300	Supplementary requirement P
	6D400	Supplementary requirement D
	9E	Testing

Table 12-1 Index and Cross references (continued)		
Key word	*Reference*	*Comment/aspect*
Spiral welded	5A204	Requirements
Strain hardening	Eq. 5.26	In capacity formula; strain
	Eq. 5.24	Capacity formula SMYS/SMTS - (in α_c)
	Table 6-3	SMYS and SMTS
	Table 6-3	α_h (YS/UTS)
System pressure test	1C200	Definition
	5B200	Link to design
	5B202	Requirements
	5B203	Waiving of system pressure test
	5B204	Safety class during system pressure test
	5D400	Limit state check - pressure containment
	5D500	Limit state check -local buckling
	9O500	Execution of the test(filling, holding time etc)
Weld onto pipe	7B1203	Requirements for doubler plates etc.

Add

Table 12-1 b Characteristic material properties for design							
Symbol	*Description*	*Reference*	*Pressure Containment*	*Local buckling*			
				Collapse	*Load Controlled*	*Displacement Controlled*	*Propagating buckling*
Elastic properties							
E	Youngs modu.lus		X				
ν	Poisson's ratio		X				
α	Temperature expansion, as function of the temperature (within the actual temperature range		X				
Plastic properties							
SMYS	Specified minimum yield stress	Table 6-3 & 6-6	X	X	X	X	X
$f_{y,temp}$	Yield stress temperature derating value	5 B603, Table 5-2 and Fig. 5-1	X	X	X	X	X
SMTS	Specified minimum tensile strength	Table 6-3 & 6-6	X	-	X	-	-
$f_{u,temp}$	Tensile strength temperature derating value	5 B603, Table 5-2 and Fig. 5-1	X	-	X	-	-
α_A	Ultimate strength anisotropy factor	Table 5-2 & Table 6-3 Note 4	-	-	X	-	-
α_{fab}	Fabrication factor	Table 5-3	-	X	(X)	(X)	X
Plastic properties depending on additional requirements							
α_u (U)	increased utilisation	Table 5-2	X	X	X	X	X
α_h (P)[1]	Strain hardening value	Table 6-3 & 6-6 6D304	-	-	-	X	-
α_c (U)	Flow stress parameter	Eq. 5.23	-	-	X	-	-

Page 132, Section 12 F1100

Replace

Even though the safety factor is provided in the propagating pressure formula, it is recommended to increase this with 15% (from 35 to 30) for the propagating pressure resistance of the buckle arrestor. This to decrease the failure probability to the unconditioned safety level in line with normal ULS checks.

Page 132, Section 12 F1400

Replace

$$f_0' = \frac{f_0 + \left(0.030\left(1 + \frac{D}{120 \cdot t}\right)\left(2\varepsilon_c \frac{D}{t}\right)^2\right)}{1 - \frac{P_e}{P_c}}$$

Page 133, Section 12 G100

Replace

Assessment at Level 2 is considered safe provided that the girth welds will not be subjected to conditions during operation that may lead to failure by fatigue crack growth or unstable fracture.

Page 134, Section 12 G301

Replace

If the total displacement, V_g, is measured at a distance z ≤ 0.2a from the physical crack mouth then the CMOD can be calculated from:

Page 134, Section 12 G302

Replace

$$\delta = \frac{J}{m \cdot \frac{\sigma_{YS} + \sigma_{TS}}{2}}$$

Page 134, Section 12 H101

Replace

ksi = 6.895 MPa; 1 MPa = 0.145 ksi; ksi = 1000 psi (lb f/in^2)

Page 134-135, Section 12 I200

Delete second, fourth, fifth and second last paragraphs (are given in Section 5G200)

Page 136, Section 12 Fig. 12-3

Replace test in figure

Displacement controlled condition = NDT level 1

Page 137, Section 12 MDS

Replace in sheet, 3rd line

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Page 138, Section 12 K300

Add after first paragraph

In addition to the simplified stress criteria given below, the limit states for Concrete Crushing (K200), Fatigue (Section 5 D700) and Rotation (Section 5 H203) shall be satisfied. Reference is further made to Endal et. al . (1995) for guidance on the Rotation limit state.

(12.12)

Page 138, Section 12 K300

Replace first paragraph after sub-heading "Overbend"

For static loading the calculated strain shall satisfy Criterion I in Table 12-5. The strain shall include effects of bending, axial force and local roller loads. Effects due to varying stiffness (e.g. strain concentration at field joints or buckle arrestors) need not to be included.

Page 138, Section 12 K300

Replace first paragraph after sub-heading "Sagbend"

For combined static and dynamic loads the equivalent stress in the sagbend and at the stinger tip shall satisfy the allowable stress format ASD as given in section F1200, however, η shall be 0.87.

Page 142, Appendix A

Add

B1000 Mill pressure test

101 The Mill test pressure is lower in ISO than in this standard. The ISO requirement is:

$$p = 0.95 \cdot \frac{2 \cdot t_{min}}{D} \cdot SMYS$$

This hoop stress formula for the ISO mill pressure test is different from the formula in ISO 13623 and DNV (which are identical). Hence, the mill test pressure difference compared to this standard depends on D/t.

Page 143, Appendix B A402

Add

Guidance Note

This conversion is not applicable to API 5L type specimens

end-of-Guidance Note

Page 156, Appendix C C400

Replace

C400 Batch testing – Girth welds

(Clarification)

Page 178, Appendix D D205

Replace

205 The type and number of ultrasonic probes shall be sufficient to ensure that the base material, or the weld and the area adjacent to the weld, is;

- scanned from both sides of the weld for flaws oriented parallel to the longitudinal weld axis,
- scanned from both directions approximately parallel to longitudinal weld axis for flaws oriented transverse to the longitudinal weld axis, and
- fully covered by ultrasound beams that are approximately perpendicular to the surface of flaws that are reflecting the ultrasound.

It may be necessary to include tandem, TOFD and/or focused probes in order to enhance the probability of detection or characterisation of flaws.

Page 180, Appendix D E205

Replace last paragraph

The maximum allowable flaw sizes from the ECA shall be reduced in length and height with a flaw sizing error, that based on the data from the qualification testing will give a 95% confidence against under sizing of flaws

Page 180, Appendix D F105

Replace

105 Equipment and procedures used for the ultrasonic testing shall comply with the requirements of subsection D. The requirements for automated NDT processes given in subsection D are additional to the requirements of any code or standard referred to in this subsection where automated NDT methods are prescribed or optional.

Page 181, Appendix D F301

Replace

301 For ultrasonic testing of the base material the requirements of F100 and F200 shall apply.

Page 182, Appendix D G503

Replace the second bullet point

- a sample pipe shall be fitted with one 3.0mm Ø through drilled hole at each end. The distance from the pipe end to the hole shall be equal to the length not covered by the ultrasonic testing equipment during production testing. Prior to start of production the pipe shall be passed through the ultrasonic testing equipment at the operational scanning velocity. For acceptance of the equipment both holes need to be detected by all probes. At the manufactures option these holes may be included in the reference block.

Page 185, Appendix D G614

Replace last part

The acceptance criteria are:

- Table D-4 and lack of fusion and lack of penetration are not permitted.

Page 185, Appendix D G710

Replace

The length of the N5 notches shall be 1.5 times the probe (crystal) element size or 20 mm, whichever is the shorter. The length does not include any rounded corners. The width of the N5 notches shall not exceed 1mm.

Page 190, Appendix D, Table D-3

Replace

Undercut, if measured by mechanical means	Individual	
	Depth d	Permitted length
	d>1.0 mm	Not permitted
	1.0 mm ≥ d≥0.5 mm	50 mm
	0.5 mm ≥ d≥0.2 mm	100 mm
	<0.2 mm	unlimited
	Accumulated length in any 300 mm length of weld: <4 t, maximum 100 mm.	

Page 196, Appendix E B408

Replace

408 The recording or marking system shall clearly indicate the location of imperfections relative to the 12 o'clock position of the weld, with a ± 1% accuracy. The system resolution shall be such that each segment of recorded data from an individual inspection channel does not represent more than 2 mm of circumferential weld distance.