Standard Morgen
N-005, 17.06.2026
Pål Jensen

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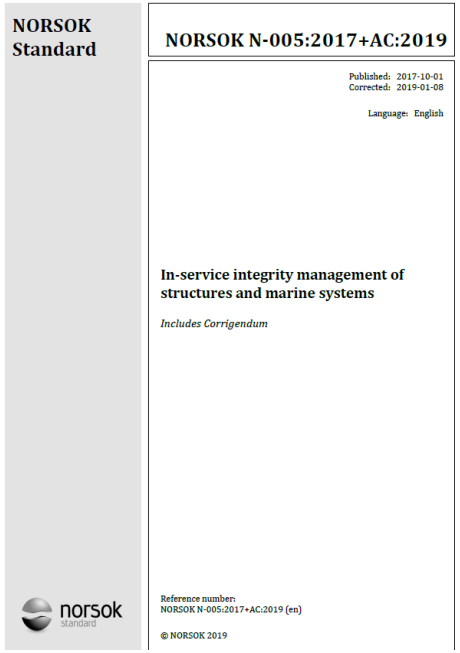
What have we done?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In-service integrity management of structures and marine systems

Includes Corrigendum

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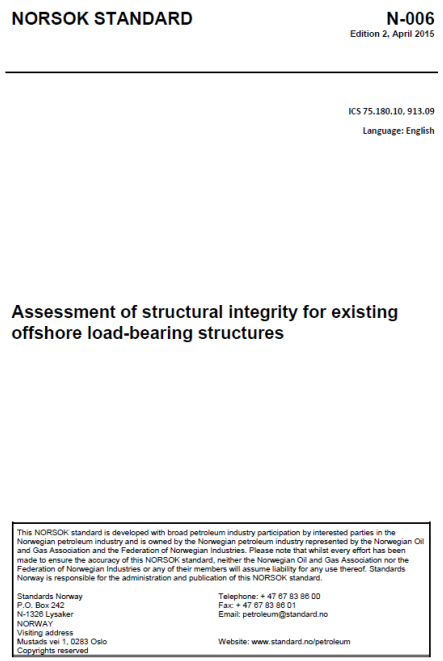
NORSOK STANDARD

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Assessment of structural integrity for existing offshore load-bearing structures

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Standards Norway
P.O. Box 242
N-1326 Lysaker
NORWAY
Visiting address
Mustads vei 1, 0283 Oslo
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Telephone: + 47 67 83 86 00
Fax: + 47 67 83 86 01
Email: petroleum@standard.no

Website: www.standard.no/petroleum

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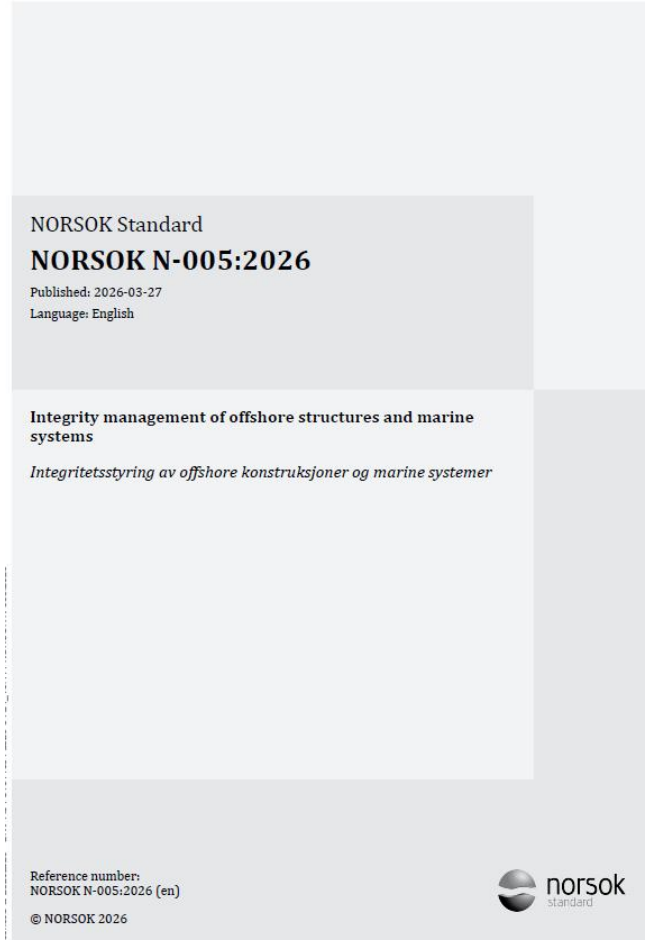
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Published: 2026-03-27

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Integrity management of offshore structures and marine systems

Integritetsstyring av offshore konstruksjoner og marine systemer

Reference number:
NORSOK N-005:2026 (en)

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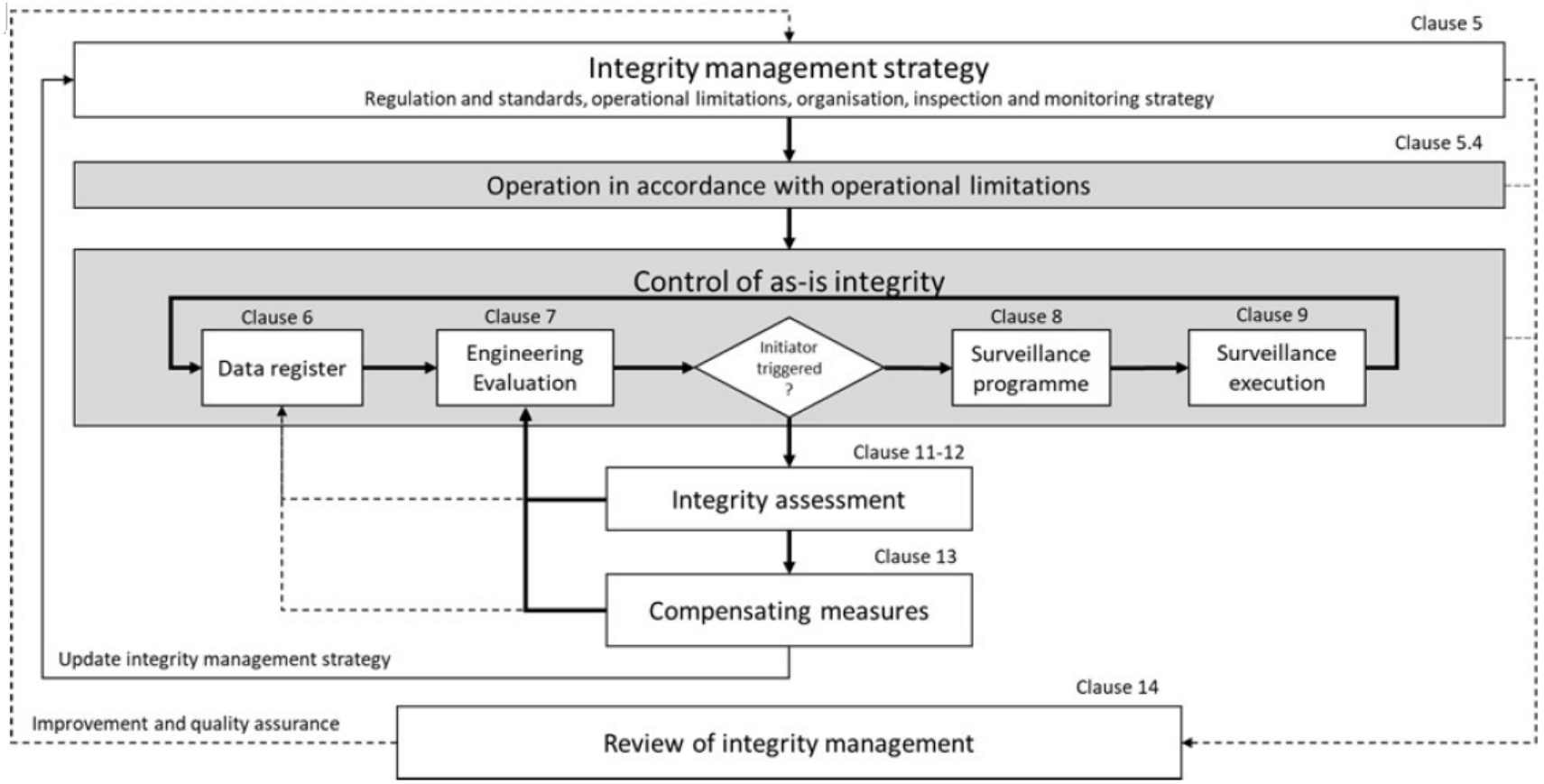
norsok standard

What is new?

- Requirements for non-linear analyses
- Unmanning
- Assessment of grouted connections
- Assessments of damaged elements like cracks, dents and corrosion
- Requirements to inspection intervals
- Structural monitoring
- Barrier management related to hazards and accidents
- Some alignments to draft ISO 19901-9

The integrity management



5. Strategy

- Integrity management of structures and marine systems shall include the processes to ensure that changes which can affect the integrity are managed in a systematic manner throughout the service life, including in decommissioned phase until removal. Examples of changes are listed in A.5.1.
- The integrity management strategy shall include a strategy for detection and management of changes and clearly state:
  - necessary operational limitations of the facility,
  - strategy for mitigations and
  - plans for preparedness, relevant to structures and marine systems.

5.4 Operation in accordance with limitations

- size of allowable visiting supply vessels and requirements for these to enter the safety zone;
- limitations in weight and centre of gravity;
- load plans for lay down areas;
- crane operational limitations;
- special considerations for drilling operations, if any;
- de-manning requirements, if relevant;
- de-ballasting restrictions for storage cells in fixed concrete structures.
- Tank filling requirements
- ……

5.6 Preparedness

- Main load-bearing structures and marine systems with a direct role in preventing major accidents shall during operation have an as-is model that is readily accessible, up-to date and ready to run. A digital twin of the structure or marine system may be a way of fulfilling this requirement. The models should be tested and documented at regular intervals or after the computer software is revised.
- Identified changes shall be implemented in the as-is model to represent current integrity. Changes that are not immediately implemented in the as-is analysis model shall be registered in a change-register for later implementation in analysis model updates.

Example Annex F Preparedness Topside

F.6 Models for preparedness

The availability of the as-is models described in Table F.4 to evaluate the global integrity in emergency situations can be considered as fulfilling the overall requirements given in 5.6.

Table F.4 — As-is models

Object	Type	Scenario	Actions[a]	Test-run interval
Main support frame or deck structure	Linear[b]	In-place	ULS 1	2 year
Topside modules[c]	Mass and stiffness contribution	In-place	ULS 1	2 year

[a] ULS 1 according to NORSOK N-003:2017+AC:2018 Table 7

[b] Including post-processing of members and joint

[c] All topside modules contributing with significant mass and stiffness

Additional as-is models can be useful but may be excluded due to an evaluation of likelihood of damage and consequence of damage. Hence, a cost-benefit evaluation may be necessary, including the evaluation of:

6 Data

- Requirements to what that shall be stored
  - Reports
  - Weight data
  - Drawings or CAD model
  - Specifications
  - Change register
  - DFI
  - ....
- Special list for each type of structure is given in annexes

CHANGE – capacity of structure

Examples of changes primarily related to the capacity of structures include:

- corrosion damage;
- degradation of the corrosion protection e.g. by consumption of anodes and by deterioration and damage of the coating;
- fatigue cracks and accumulation of fatigue damage over time which implies increased probability for crack growth and unstable fracture;
- scour around foundation;
- damage from ship impacts;
- damage from dropped objects;
- wear of mooring lines and mechanical systems;
- inspection, monitoring and test results that deviate from design assumptions.

CHANGE – actions and action effects

— marine growth beyond acceptance criteria which increases the load on members;

— metocean data (e.g. wave and crest statistics);

— seabed subsidence;

— increase or reduction in permanent and environmental actions;

— change in stiffness and response due to modification (e.g. strengthening) of the structure;

— change in mode of operation;

— increased probability of fire and explosion loads due to modification of the process plant;

— increase in supply vessel displacement or change in hull geometry visiting the facility.

CHANGE – New knowledge

- New knowledge includes:
  - new experience;
  - revised standards;
  - engineering analysis and method developments;
  - technical developments in materials, manufacturing and fabrication procedures.

7 Evaluation – Continuous process

- The evaluation activity shall include:
- a) review inspection, monitoring, surveillance and assessment data and compare with original design data
- b) review the consequence of failure of involved structural parts, with respect to safety for personnel, environment and operation
- c) estimate reduction in capacity, increase in actions and action effects and effects of new knowledge
- d) indicate or estimate likelihood of exceeding the relevant structural limit states (ULS, ALS and FLS) and limit state for stability before service life end
- e) make decisions on further actions

7 Evaluation – possible decisions

1. that the integrity is acceptable as-is (with these changes), i.e. that changes are within expected level and within acceptable limits
2. that the existing inspection programs are adequate and sufficiently executed (no further actions triggered)
3. that the effect of these changes implies further inspection (including an updated next intervention date) or structural monitoring
4. that these changes imply updates to the inspection program and the execution of inspections to monitor any further development of the change;

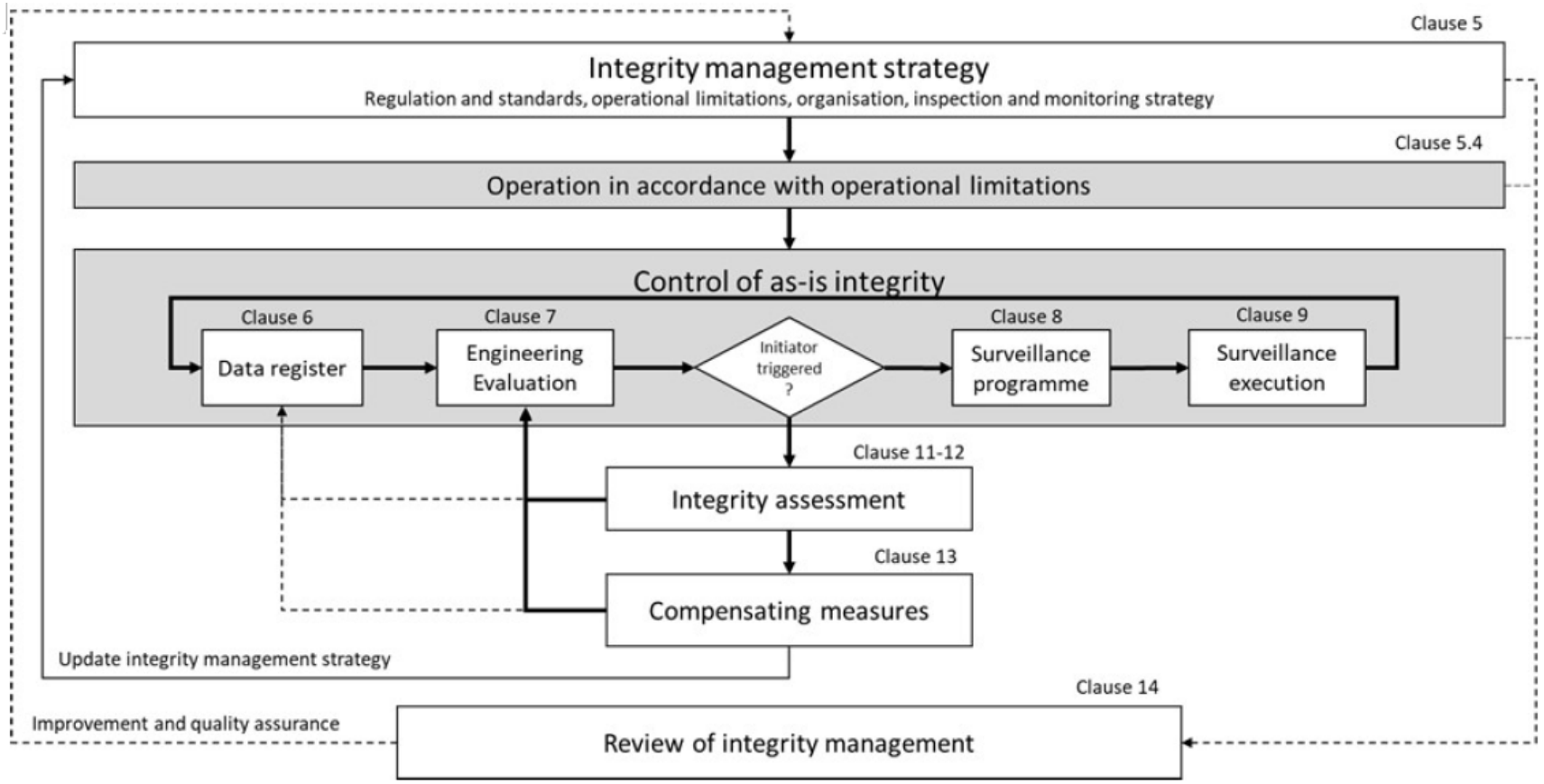
7 Evaluation – possible decisions

5. that these changes can be mitigated by simplified actions and repair.....
6. assessment is triggered (see 11.1) to gather detailed decision support and subsequent re-evaluation
7. immediate compensating measures are needed (see Clause 13) as the safety and integrity of the structure is questionable
8. adequate long-term mitigating measures (see Clause 13) as needed;

7 Evaluation

- Reported changes shall be evaluated and assessed by qualified engineers within 3 months.
- For structural components of DC4, changes that results in capacity loss less than 10 % can be accepted.
- The effect of local corrosion (pit, groove and edge) on the global capacity of plated structures may be neglected provided the extent of corrosion is limited to less than 10 % of area and remaining thickness equal to at least 70 % of nominal thickness

8 Surveillance programme



10 Monitoring

- Optional, no requirements
- Some favourable effects to gain on inspection if monitoring is made properly

11 Assessment triggers

Assessment of existing structures and marine systems shall be undertaken if one or more of the following conditions exist:

a) changes from the original design or previous assessment basis, including:

   1) modification to the facilities such that the magnitude or disposition of the permanent, variable or environmental actions on a structure;

   2) more onerous environmental conditions or criteria;

Assessments

- b) damage or deterioration of a primary structural
- c) operation of structure outside design assumptions prescribed in operational manual
- d) exceedance of design service life, if either:...
- e) new knowledge that significantly alter the understanding of the safety for human lives or the environment
- f) insufficient documentation of structural integrity;
- ...

11.4 Assessments cyclic loading

- For jacket structures, one of the following methods shall be used to document that the structure has not experienced cyclic deformations that weakens its ability to resist subsequent load-cycles:
- a) Non-linear analysis with limited permanent deformation.
- b) Cyclic storm analysis according to Clause B.8, only applicable for jackets that are unmanned and shutdown in accordance with 13.3.....

11.4 Assessments cyclic loading

Non-linear analysis with limited permanent deformation, as mentioned in 11.4.3.3, list item a), imply that:

— the combined loading in structural components do not exceed local or global buckling according to NORSOK N-004:2022+AC:2024 ;

— joints are not utilized above the capacity according to NORSOK N-004:2022+AC:2024 ;

— no plastic mechanisms are formed;

— max plastic elongation of tubular member do not exceed $\delta_x = \min\left(3 \cdot t_{min} \frac{355MPa}{f_y},\ 8 \cdot \frac{355MPa}{E} \cdot L_0 \cdot \frac{355MPa}{f_y}\right)$, where t_{min} is the minimum wall thicknesses of the tubular member, f_y is the maximum yield strength for the member and L_0 is the length of the tubular segment with thickness t_{min};

— no part of the foundation has reached the ultimate soil capacity;

— joints are, by inspection, proven to be free from fatigue cracks or the calculated fatigue loading is negligible.

12 Assessments for steel

- Formulaes for dented members
- Formulaes for cracked members
- Fomulaes for corroded members

12.1.4 Combined forces and moments

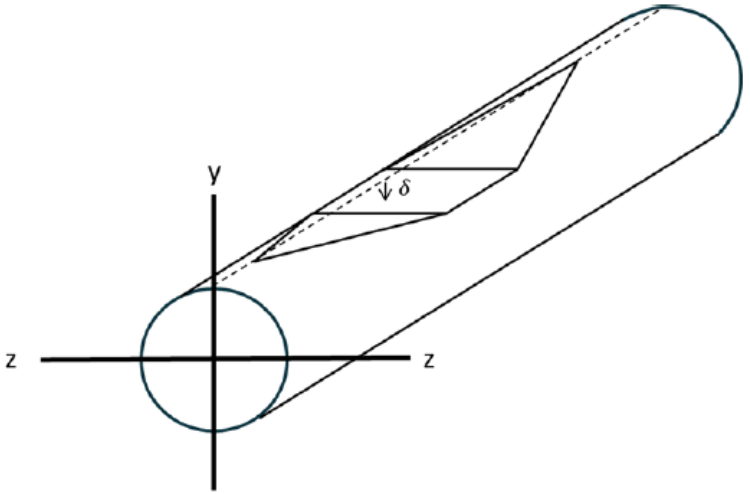
Dented tubular members under combined forces and moments should be assessed to satisfy the following condition (Formula (5) and Formula (6)):

$$\frac{N_{Sd}}{N_{dent,c,Rd}} + \sqrt{\left(\frac{N_{Sd}\cdot\Delta_y + C_{mz}\cdot M_{z,Sd}}{\left(1-\frac{N_{Sd}}{N_{E,dent}}\right)M_{dent,Rd}}\right)^{\alpha} + \left(\frac{N_{Sd}\cdot\Delta_z + C_{my}\cdot M_{y,Sd}}{1-\frac{N_{Sd}}{N_g}M_{Rd}}\right)^2} \le 1,0 \qquad (5)$$

$$\frac{N_{Sd}}{N_{dent,t,Rd}} + \sqrt{\left(\frac{M_{z,SD}}{M_{dent,Rd}}\right)^{\alpha} + \left(\frac{M_{y,Sd}}{M_{Rd}}\right)^2} \le 1,0 \qquad (6)$$

where

α = 2-3 δ/D if the dented area acts in compression



Annex B.7 Assessment of grouted connections

B.7 Assessment of grouted pile clusters

B.7.1 Grout terminates below lower yoke

The requirements given in NORSOK N-004:2022 clause B.5.3 applies for grouted connection when the grout packer terminates below the minimum distance below lower yoke plate, see Figure B.6.

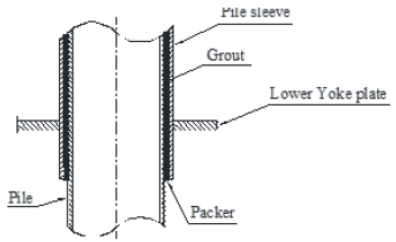


Figure B.6 — Grout termination below lower yoke plate

B.7.2 Grout terminates above lower yoke plate

B.7.2.1 General

The design as show in Figure B.7 is not covered in NORSOK N-004:2022. The requirements for a design when the grout terminates above the lower yoke plate is presented in B.7.2.

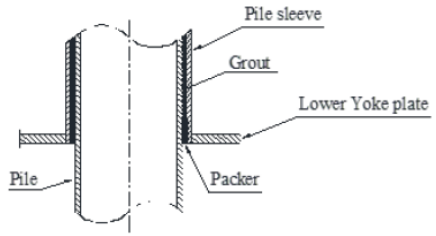


Figure B.7 — Grout termination above lower yoke plate

The connection shall be analysed by using a load model as shown in Figure B.8.

PÅL JENSEN

93221587
Pal.jensen@dnv.com
standard.no

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