

NORSOK STANDARD

**MACHINERY-
WORKING ENVIRONMENT
ANALYSES AND DOCUMENTATION**

S-005
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FOREWORD

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and eliminate unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and supported by OLF (The Norwegian Oil Industry Association) and TBL (Federation of Norwegian Engineering Industries). NORSOK standards are administered and issued by NTS (Norwegian Technology Standards Institution).

The purpose of NORSOK standards is to contribute to meet the NORSOK goals, e.g. by replacing individual oil company specifications and other industry guidelines and documents for use in existing and future petroleum industry developments.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of a NORSOK standard will be used to provide input to the international standardisation process. Subject to implementation into international standards, the NORSOK standard will be withdrawn.

Annexes are informative.

1 SCOPE

This NORSOK standard addresses methods for working environment analyses and documentation of machinery according to machinery regulations and the normative references. The methods may also be used for other technical products having similar hazards.

The scope and objectives of this standard are elaborated in Annex A1.

2 NORMATIVE REFERENCES

The following standards include provisions which, through reference in this text, constitute provisions of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognised standards may be used provided it can be shown that they meet or exceed the requirements of the standards referenced below.

NS-EN 292 – Part 1	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
NS-EN 292 – Part 2	Safety of machinery - Basic concepts, general principles for design – Part 2: Technical principles and specifications (as amended)
NS-EN 1050	Safety of machinery - Principles for risk assessment
NORSOK S-002	Working Environment

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

Declaration of Conformity: Declaration issued by the manufacturer of machinery (or his EU/EFTA representative) to document conformity with the requirements of Machinery regulations; cf. Norwegian Labour Inspection order no. 522.

Declaration of Incorporation: Declaration issued by the manufacturer of sub-assembly (or his EU/EFTA representative) to document conformity with the requirements of Machinery regulations; cf. Norwegian Labour Inspection order no. 522.

Design review: A systematic and documented examination of a design to evaluate its capability to fulfil specific requirements.

Machinery: As defined in Machinery regulations, the term machinery comprises various types of individual machines and assembly of machines, distinguished by the ability to perform a specific application, as well as interchangeable equipment; cf. Norwegian Labour Inspection order no. 522 §2 (with explanatory notes):

- An assembly of linked parts or components, at least one of which moves, with (i.e. fitted with or intended to be fitted with) the appropriate actuators, control and power circuits,

etc., joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material.

- An assembly of machines which in order to achieve the same end, are arranged and controlled so that they function as an integral whole.
- Interchangeable equipment modifying the function of a machine.

Risk assessment: A documented and systematic process of identification and assessment of hazards related to specified work tasks, including estimation of frequency and consequence of accidents / harmful effects for the personnel involved. Risk assessments are used as a basis for evaluation of the need for and selection of safety measures.

Safety data sheet: Documentation of the safety, health and environment hazards of a chemical product according to the regulations relating to 'Compilation and distribution of safety data sheets for dangerous chemicals'; cf. Norwegian Labour Inspection order no. 548.

Shall: Verbal form used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted, unless accepted by all involved parties.

Should: Verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.

Sub-assembly: A machine that cannot function independently, and that is intended for incorporation into machinery.

Working environment: As defined in NORSOK S-002:

- The totality of all physical, chemical, biological and psychological factors at work that may affect the employees' health and well being through acute trauma or lasting exposure. The influences from lasting exposure may be positive and negative.

3.2 Abbreviations

PO	Purchase Order
WE	Working environment

4 RESPONSIBILITIES

The following responsibilities apply with respect to execution of analyses and delivery of working environment (WE) documentation for machinery:

4.1 Contractors

The responsibilities of a company working for Client according to contract are described below. Various contract strategies may apply, including engineering, procurement, construction, installation, and/or commissioning. Typical deliveries from principal contractors are offshore platforms, pipelines, and sub-sea installations. A principal contractor may use

various sub-contractors. Typical deliveries from sub-contractors are living quarters, drilling modules, and process modules.

For each subject machinery within Contractor's scope of work, the Contractor shall ensure that the boundaries of machinery and sub-assemblies and the responsibilities for issue of statutory declarations and indicators (e.g. instructions, CE-marking) are defined. Further, the Contractor shall ensure that the requirements for WE documentation are determined and specified in sub-contract and/or Purchase Orders (POs); cf. clause 5.

The Contractor shall also:

- provide the interface information necessary for execution of risk assessments (e.g. informations regarding control systems, utility systems, energy supply) to sub-contractors and/or Suppliers;
- specify risk estimation criteria other than the criteria in clause 6.7, if necessary to meet the risk acceptance criteria for the overall occupational accident risk in the area;
- specify noise level limits on noise data sheets, request the procedures for verification of Supplier guaranteed noise levels, and request necessary vibration data; cf. clause 5.5;
- ensure that working environment documentation of adequate quality are received from sub-contractors and/or Suppliers;
- forward aggregated WE documentation to Client.

4.2 Suppliers

4.2.1 Supplier of Machinery

Supplier of machinery is responsible for the safety of the machine and for providing the 'Declaration of Conformity' and the 'Instructions' issued according to machinery regulations; cf. clause 5.1. Further, the Supplier shall ensure that the necessary WE analyses of subject machinery are executed and documented.

The Supplier shall also:

- identify the interface information necessary for execution of risk assessments (e.g. information regarding control systems, energy supply), and request any lacking information from Contractor;
- identify and implement all WE requirements applicable to design, construction and documentation of subject delivery; cf. NS-EN 292, NORSOK S-002 and normative references hereto, and the basic concepts outlined in Annex A2;
- define sub-suppliers' responsibilities for WE documentation in POs;
- ensure that documentation of adequate quality is received from sub-suppliers.

As specified in sub-contract or PO, the Supplier shall compile and provide the required technical WE documentation; cf. clause 5.

4.2.2 Supplier of Sub-assembly

Supplier of sub-assembly is responsible for the safety of the sub-assembly and for providing the 'Declaration of Incorporation' issued according to machinery regulations.

As specified in PO, the Supplier shall provide the documentation necessary to demonstrate conformity with machinery regulations, normative standards, and other WE requirements.

5 WORKING ENVIRONMENT DOCUMENTATION

5.1 General

As stipulated in the Machinery regulations, subject machinery shall bear CE marking and the following documentation shall be provided:

- ‘Declaration of Conformity’.
- ‘Instructions’ for safe use, etc. Instructions for regular use and maintenance by operators shall be in the Norwegian language.

Additional technical WE documentation is required according to the regulations and normative standards applicable to offshore machinery. Requirements and responsibilities for provision of WE documentation shall be determined and documented. If not otherwise agreed in sub-contract or PO, the aggregated WE documentation for subject machinery shall include:

- Risk assessment report; cf. clause 5.2.
- WE design reviews checklists; cf. clause 5.3.
- Inventory and safety data sheets for chemicals; cf. clause 5.4.
- Noise data sheets and vibration data; cf. clause 5.5.

Basic concepts regarding WE requirements, analyses and documentation are elaborated in Annex A2. A typical form for documenting the requirements for WE documentation and responsibility determinations is included in Annex C.

5.2 Risk Assessments

The technical documentation to the ‘Declaration of Conformity’ shall include a description of the methods chosen to remove hazards of the machinery. Risk assessments to examine the hazards and specify necessary safety measures are an integral part of these methods; cf. Annex A3. Risk assessments shall be executed during development of the design, to ensure integration of safety and conformity with the functional WE requirements applicable to subject machinery.

A method for risk assessments during design of machinery, based on the principles of NS-EN 292-1 and NS-EN 1050, is described in more detail in clause 6 of this standard.

The risk assessments of machinery shall be documented in risk assessment reports, providing information about any:

- dangerous manual tasks / interactions; cf. clause 6.5
- hazards and hazardous situations / events; cf. clause 6.6
- risk estimates; cf. clause 6.7
- safety measures in design and/or operations; cf. clause 6.7

A typical form for documenting risk assessments is included in Annex E.

In addition to the risk assessment method described in clause 6, there may be needs for special methods to analyse hazards and estimate risks of complex and/or safety critical machinery. Methods outlined in NS-EN 1050 and NORSOK S-002 are referred to, e.g.:

- Failure Mode and Effects Analysis (FMEA) or Fault Tree Analysis (FTA), to document reliability of control and safety systems; cf. NS-EN 1050 Annex B;
- Ergonomic job / task analysis, to document risks of muscle-skeletal injuries; cf. NORSOK S-002 clause 4.9.4 and Annex I.
- Crisis Intervention in Offshore Production (CRIOP) analysis, to document man-machine interface of control rooms; cf. NORSOK S-002 clause 4.9.5 and Annex I;
- Chemical handling analysis, to document risks of exposure to hazardous chemicals; cf. NORSOK S-002 clause 4.9.6 and Annex I.

5.3 Working Environment Design Reviews

Design reviews are required to verify conformity with the specific WE requirements applicable to subject machinery and to identify any needs for corrective measures. Such WE design reviews shall be executed during development of the design, and shall be documented by completion of checklists.

To provide input to the design, a first design review should be performed as part of early engineering, and this checklist should at least be updated prior to construction.

The personnel/team performing WE design reviews shall have adequate working environment qualifications, and shall be familiar with operation and maintenance activities associated with the machinery.

A typical WE design review checklist for offshore machinery, based on specific WE requirements in the normative references, is included in Annex G.

- The checklist covers a broad specter of specific WE requirements. Thus, some requirements may be not applicable for certain deliveries.
- Completion of this checklist does not exempt Suppliers from the responsibility to identify and verify other specific requirements applicable to subject delivery, e.g. requirements in relevant type B European standards (to be identified by Supplier).
- Typical users of the checklist are the suppliers and sub-suppliers of machinery, and also contractors with an overall responsibility for the design, e.g. engineering companies.
- The checklist may also be used for WE inspections during construction and mechanical completion; cf. NORSOK S-002 clause 4.11.

5.4 Chemical Inventory and Safety Data Sheets

All chemical substances and preparations that are contained within machinery boundaries and/or are planned to be used in connection the machinery shall be identified and documented in an inventory. Typical chemicals to be included are lube oils, grease, and preservation chemicals. Information regarding intended use, location and quantities shall be listed, along with reference to the safety data sheet. Also, the potential for personnel exposure, as identified in risk assessments or WE design reviews, shall be documented.

A typical chemical inventory form is included in Annex F.

Chemicals that follow the installation offshore or are included in instructions for operation and maintenance shall be documented on safety data sheets; cf. NORSOK S-002 clause 5.4.2.

The safety data sheets shall be in the Norwegian language and approved through the Norwegian Oil Industry Association's quality assurance scheme for such data sheets.

5.5 Noise and Vibration Data

5.5.1 Noise Data Sheets

For all potentially noisy machinery, noise data sheets with 'Company specified data' (noise level limits) are included in the inquiries; cf. NORSOK S-002 clause 4.8.2. A typical noise data sheet is included in NORSOK S-002 Annex H.

One or more of the following noise data may be required:

- Sound power level;
- Sound pressure level at 1 m distance, free field condition;
- Sound pressure level at operators position, free field condition.

During engineering, the noise data sheet for subject machinery shall be completed with all the information required:

- Equipment design data;
- Guaranteed 'Supplier data' (noise levels), in the same format as the 'Company specified data';
- Method for planned noise level test during fabrication (see below);
- Description of all noise control measures that have been implemented in order to achieve a low noise design and meet the specified data. The recommended practice for the design of low noise machinery and equipment in standard ISO 11688 is referred to.
- It should be stated whether the specified / guaranteed noise data applies to the complete machinery or to specific components or sub-assemblies.

During fabrication, measurements to verify the guaranteed noise levels are required, unless data from previous tests on standard machinery can be accepted. The verification measurements shall be performed according to a documented test procedure, and should be executed or witnessed by a qualified noise control engineer. Recommended methods for noise level tests are described in Annex B1. The measurement results, incl. correction for measurement uncertainty, shall be documented in the noise data sheet.

5.5.2 Vibration Data

Maximum limits for continuous whole body vibration from machinery are given in NORSOK S-002 Annex E. The limits cover the range 1 - 80 Hz.

When input data for structural vibration analysis are required, the following vibration data shall be provided:

- Frequency of revolution (rpm).
- Unbalance force and direction (N).
- Weight of rotor (kg).
- Total weight of machinery, including frame (kg).

For vibration isolated machinery the following data shall also be provided: