

Qualification of manufacturers of special materials

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Foreword	4
Introduction	4
1 Scope	5
2 Normative and informative references	5
2.1 Normative references	5
2.2 Informative references	5
3 Terms, definitions and abbreviations	5
3.1 Terms and definitions	5
3.2 Abbreviations	7
4 Responsibilities	8
4.1 Purchasers responsibility	8
4.2 Manufacturers responsibility	8
4.3 Responsibilities of Qualifying Company	8
5 Qualification of manufacturers	8
5.1 Basis for qualification of manufacturers	8
5.2 Evaluation for acceptance	8
5.3 Acceptance of qualification	8
5.4 Proof of acceptance	8
6 Validity of qualification	9
6.1 Term of validity	9
6.2 Renewal of qualification	9
6.3 Transitional arrangements	9
7 General requirements	9
7.1 Knowledge and relevant experience	9
7.2 Manufacturing facilities and equipment	10
7.3 Sub-contractors	10
7.4 Quality requirements for test laboratories and manufacturers of welded products	10
8 Manufacturing Summary	10
8.1 Requirements for Manufacturing Summary	10
8.2 Content of the Manufacturing Summary	10
9 Heat treatment	12
9.1 Heat treatment facilities and equipment	12
9.2 Heat treatment procedure	13
9.3 Verification of heat treatment procedure	14
10 Qualification of the manufacturing process	15
10.1 Objective of qualification testing	15
10.2 Essential variables	15
10.3 Qualification testing	17
10.4 Welding procedure qualifications	20
11 Qualification test record (QTR)	20
11.1 General	20
11.2 Content of qualification test record (QTR)	20
11.3 Required copies and distribution of qualification test record (QTR)	21
Annex A (Informative) Manufacturing Summary front page and example	22
Annex B (Normative) Additional requirements to API Spec 6A:2010/ISO 10423:2009 , Annex M, and ASTM A 991	27
Annex C (Informative) Verification of heat treatment procedure – Example	28
Annex D (Normative) Form for Qualification Test Record (QTR) Front Page	29

Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable for most standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with support by The Norwegian Oil Industry Association (OLF), The Federation of Norwegian Industry, Norwegian Shipowners' Association and The Petroleum Safety Authority Norway.

NORSOK standards are administered and published by Standards Norway.

Introduction

This edition replaces NORSOK M-650, Rev. 3.

The main changes in Edition 4 are related to the following items:

- clarification of scope;
- definitions included or changed for Company, equalization time, heat sink, holding time, main contractor, manufacturer, Qualifying Company, soak time and test directions;
- clarification of responsibilities;
- clarification of transitional arrangements between Revision 3 and Edition 4 of this NORSOK standard;
- more stringent requirements to manufacturers knowledge;
- requirements to test laboratories and manufacturers of welded products included;
- type of etchants to be used and preparation of samples for micro examination, as applicable, shall be stated in the Manufacturing Summary;
- new clause about heat treatment with requirements to equipment, heat treatment procedure and verification of heat treatment procedure;
- changes in essential variables of the qualification tests especially regarding manufacturing equipment, heat treatment, hiped products and start material;
- changes in test requirements for flanges, other type of forgings, plates, rolled bars and valves machined from forgings;
- changes in extent and requirements to additional testing at mid-thickness for bars, forgings and hiped (HIP) products;
- otherwise editorial changes for clarification.

1 Scope

This NORSOK standard establishes a set of qualification requirements to verify that the manufacturer has sufficient competence and experience of the relevant material grades, and necessary facilities and equipment to manufacture these in the required shapes and sizes with acceptable properties.

This standard is applicable to the following material grades and product forms:

- | | |
|--------------------------------|--|
| a) Duplex SS: | all grades, product forms and dimensions |
| b) High alloyed austenitic SS: | all grades, product forms and dimensions |
| c) Nickel base alloys: | castings |
| d) Titanium and its alloys: | castings |

This NORSOK standard is also applicable to critical components or product forms in other materials and for special manufacturing/fabrication processes, e.g. titanium and nickel alloys in other product forms than casting, carbon steel and low alloy steel products and induction/cold bending.

2 Normative and informative references

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

2.1 Normative references

API Spec 6A:2010/ ISO 10423:2009,	Specification for Wellhead and Christmas Tree Equipment/Petroleum and natural gas industries – Drilling and production equipment – Wellhead and christmas tree equipment
ASTM A370-11, ASTM A 703, ASTM A 991,	Standard Test Methods and Definitions for Mechanical Testing of Steel Products Steel Castings, General Requirements, for Pressure-Containing Parts Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
EN 10204, ISO 3834-2,	Metallic products – Types of Inspection Documents Quality Requirements for Fusion Welding of Metallic Materials – Part 2: Comprehensive quality requirements
ISO 9001, ISO/IEC 17025, NORSOK M-630, PED 97/23/EC,	Quality Management Systems – Requirements General requirements for the competence of testing and calibration laboratories Material Data Sheet for Piping Pressure Equipment Directive

2.2 Informative references

API 6HT,	Heat Treatment and Testing of Large Cross Section and Critical Section Components
ASTM E407,	Standard Practice for Microetching Metals and Alloys

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.2

company

owner or organization that is responsible for development of and/or operation of an installation/facility

NOTE For the purpose of this standard this is normally an oil company.

3.1.3

equalization time

the time used to ensure a uniform pre-set temperature throughout a heat treatment load and/or throughout all section thicknesses of a component (see also figure in Annex C)

3.1.4

heat sink

separate block of material made from the same generic type of material as the parts being heat treated to monitor temperature during heat treatment

3.1.5

high alloyed austenitic SS

austenitic SS with $PREN \geq 40$ or $Ni + 2 \times Mo > 30$ ($Mo > 2$)

EXAMPLES SS type 6Mo, UNS S31266, UNS S32654, UNS S34565, UNS J95370.

3.1.6

holding time

time from the controlling thermocouple (normally furnace thermocouple) has reached set temperature until the specified soaking time is completed.

NOTE Holding time consist of equalization time + soaking time. (see also figure in Annex C).

3.1.7

main contractor

party, which carry out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility on a contract awarded by Company

3.1.8

manufacturer

party, including sub-contractors, which carry out operations affecting the material properties of the finished product

NOTE These operations can include forming, heat treatment, etc.

3.1.9

may

verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.10

pitting resistance equivalent PREN

$PREN = \%Cr + 3.3 \times \%Mo + 16 \times \%N$

3.1.11

purchaser

party that purchase a product from a manufacturer

3.1.12

Qualifying Company

party which monitor the qualification exercise and in the end accept the resulting qualification test record (QTR) by signing and stamping the QTR front page

The Qualifying Company can be the Company, the main contractor, the purchaser or a party authorised to act on their behalf. Qualifying Company shall be independent of the manufacturer.

3.1.13

shall

verbal form used to indicate requirements strictly to be followed in order to conform to this NORSOK standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.14**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

3.1.15**soaking time**

time that the entire part being heat treated (throughout its cross sections) remains at the specified set temperature

3.1.16**type 22Cr duplex**

ferritic/austenitic stainless steel alloys with 22 % Cr

EXAMPLES UNS S31803 and UNS S32205.

3.1.17**type 25Cr duplex**

ferritic/austenitic stainless steel alloys with 25 % Cr and PREN $\geq$ 40

NOTE Often referred to as "super duplex".

EXAMPLES UNS S 32505, UNS S32550, UNS S32750, UNS S32760 and UNS S39274.

3.1.18**type 6Mo**

austenitic stainless steel alloys with 6 % Mo and PREN $\geq$ 40

EXAMPLES UNS S31254, UNS N08367 and UNS N08926.

3.1.19**test directions**

test directions are defined relative to the geometry of the component to be tested

For the purpose of this NORSOK standard the definitions in ASTM A370-11, sect. 4, apply with axial defined as the longitudinal axis of test specimen located parallel to the main axis of the component.

3.2 Abbreviations

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
CD	compact disc
EN	European Standard
HIP	hot isostatic pressed
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
MDS	material data sheet
MOM	minutes of meeting
NDE	non-destructive examination
PREN	pitting resistance equivalent
PWHT	post weld heat treatment
QTR	qualification test record
SS	stainless steel
UNS	unified numbering system
WPQR	welding procedure qualification record
WPS	welding procedure specification

4 Responsibilities

4.1 Purchasers responsibility

The purchaser is responsible for ensuring that the manufacturers engaged are qualified within the essential variables of this NORSOK standard.

Acceptance of a manufacturer is at the discretion and determination of the purchaser.

4.2 Manufacturers responsibility

The manufacturer is responsible for establishing and maintaining required documentation and carry out verifications and testing in accordance with this NORSOK standard.

A manufacturer acquiring a "NORSOK M-650 qualification" assumes an obligation to carry out manufacturing in accordance with the qualified Manufacturing Summary including its referred procedures. If an order requiring "NORSOK M-650 qualification" is outside the qualified range, as defined in 10.2, the purchaser shall be informed.

4.3 Responsibilities of Qualifying Company

The qualification exercise itself shall be carried out in co-operation with and verified by a Qualifying Company.

The Qualifying Company shall monitor the qualification exercise, review and in the end accept the resulting qualification test record (QTR) and as proof of the acceptance sign and stamp the QTR front page.

It is important for acceptance of the QTR by other customers that the verification exercise is carried out by a recognized Qualifying Company.

5 Qualification of manufacturers

5.1 Basis for qualification of manufacturers

Basis for qualification of manufacturers including their nominated sub-contractors shall be as follows:

- a) knowledge and relevant manufacturing experience with the type of material to be qualified (see Clause 7);
- b) acceptable manufacturing facilities and equipment (see Clause 7 and Clause 9);
- c) established Manufacturing Summary (procedure) covering all manufacturing steps from melting or semi product to finished products (see Clause 8);
- d) an established heat treatment procedure (see Clause 9);
- e) manufacturers quality system, which shall fulfil the requirements of ISO 9001;
- f) results of testing in compliance with this NORSOK standard (see Clause 10).

5.2 Evaluation for acceptance

The Qualifying Company shall carry out a review of the manufacturers facilities, equipment, implementation of procedures and documentation as required by this NORSOK standard at the manufacturers and sub-suppliers premises. The evaluation for acceptance shall concentrate on facilities and equipment for melting, refining, forming, welding, heat treatment, etc.

The review shall be carried out by technical competent personnel, with knowledge of metallurgical aspects of the applicable alloys, including precipitation diagrams, effect of hot forming, welding, heat treatment, etc., and who has experience relevant for the manufacturing process to be evaluated.

The result of the evaluation shall be documented in an evaluation report or a MOM.

5.3 Acceptance of qualification

A complete QTR with content in compliance with Clause 11 shall be established for possible acceptance.

5.4 Proof of acceptance

The original signed and filled in QTR front page is the only valid proof of being accepted according to this NORSOK standard.

NOTE There is no official listing in the name of NORSOK of accepted manufacturers according to this NORSOK standard.

6 Validity of qualification

6.1 Term of validity

The validity of a qualification is 5 years from the date of acceptance (signing) of the QTR front page.

The qualification is valid within the parameters specified in 10.2.

6.2 Renewal of qualification

Renewal of the qualification shall be carried out as follows:

- a) a manufacturer with regular production of the originally qualified products and alloys is considered re-qualified and additional testing is normally not required. It is a pre-requisite that all test requirements in the current revision of this NORSOK standard are complied with;
- b) evaluation and review at the manufacturers and sub-suppliers premises according to 5.2 shall be carried out by the Qualifying Company;
- c) the Manufacturing Summary and referred procedures shall be reviewed, updated and a decision made whether retesting is required;
- d) the heat treatment procedure and its corresponding verification, see 9.3, shall be reviewed, and a decision made whether a new verification is required;
- e) a minutes of meeting (MOM) listing actual parts of the QTR which shall be updated and with conclusions for renewal of the qualification shall be included in the re-qualified QTR;
- f) a new QTR front page shall be established and properly signed.

6.3 Transitional arrangements

Subject to purchasers acceptance, Revision 3 qualifications are considered to fulfil the Edition 4 requirements of this NORSOK standard until the validity of the Revision 3 qualification expires on the conditions stated below. There are no transitional arrangements for flanges or valves machined from forgings. For these products it is presupposed that the qualification shall be in accordance with Edition 4 of this NORSOK standard.

Transitional conditions are as follows:

- a) the Manufacturing Summary, see 8.2, is updated, and a heat treatment procedure, see 9.2, is established/updated;
- b) verification of the heat treatment procedure, as specified in 9.3, has been carried out;
- c) the additional test requirements in 10.3.3, as specified for selected product forms in Table 2, are fulfilled.

In such case a statement shall be included in the box "Other information" on the original Revision 3 QTR front page and signed off by the Qualifying Company. The original Revision 3 validity date shall be maintained.

7 General requirements

7.1 Knowledge and relevant experience

7.1.1 Knowledge

The manufacturer shall have in-house knowledge of relevant metallurgical aspects of the applicable alloys including precipitation diagrams, effects of hot forming, welding, and heat treatment parameters, etc. as applicable for his manufacturing process.

7.1.2 Relevant experience

The manufacturer shall have relevant experience with manufacture of the type of material to be qualified.

Relevant experience should be supported by statistical data presented in the form of a histogram for key parameters, e.g. tensile strength, impact toughness, corrosion resistance, etc. In addition a relevant reference list from the last 2 years production for the products, materials and the range of sizes to be qualified shall be included.