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Entwurf

**Erdöl- und Erdgasindustrie –
Bohr- und Fördereinrichtungen –
Hebeeinrichtungen (ISO/DIS 13535:2008);
Englische Fassung prEN ISO 13535:2008)**

Petroleum and natural gas industries –
Drilling and production equipment –
Hoisting equipment (ISO/DIS 13535:2008);
English version prEN ISO 13535:2008

Industries du pétrole et du gaz naturel –
Équipements de forage et de production –
Équipement de levage (ISO/DIS 13535:2008);
Version anglaise prEN ISO 13535:2008

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2008-06-02 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise als Datei per E-Mail an noeg@din.de in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter www.din.de/stellungnahme abgerufen werden;
- oder in Papierform an den Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN, 10772 Berlin (Hausanschrift: Burggrafenstr. 6, 10787 Berlin).

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Gesamtumfang 57 Seiten

Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN

Nationales Vorwort

Dieser europäische Norm-Entwurf wurde vom Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ (Sekretariat: AFNOR, Frankreich) erstellt. Es handelt sich dabei um die unveränderte Übernahme von ISO/DIS 13535:2008, erarbeitet von ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“; Subcommittee SC 4 „Drilling and production equipment“ ausgearbeitet.

Für Deutschland hat hieran der Arbeitskreis NA 109-00-01-04 AK „Bohr- und Fördereinrichtungen“ im Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) mitgearbeitet.

Dieser europäische Norm-Entwurf enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung des ISO-Normentwurfs.

Änderungen

Gegenüber DIN EN ISO 13535:2002-11 wurden folgende Änderungen vorgenommen:

- die Norm wurde dem Stand der Technik angepasst

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ICS

Will supersede EN ISO 13535:2000

English Version

Petroleum and natural gas industries – Drilling and production
equipment – Hoisting equipment
(ISO/DIS 13535:2008)

Industries du pétrole et du gaz naturel – Équipements de
forage et de production – Équipement de levage
(ISO/DIS 13535:2008)

Erdöl- und Erdgasindustrie – Bohr- und
Fördereinrichtungen – Hebeeinrichtungen
(ISO/DIS 13535:2008)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 12.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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Foreword

This document (prEN ISO 13535:2008) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" the secretariat of which is held by AFNOR.

This document is currently submitted to the parallel Enquiry.

This document will supersede EN ISO 13535:2000.

Endorsement notice

The text of ISO/DIS 13535:2008 has been approved by CEN as a prEN ISO 13535:2008 without any modification.

Introduction

This International Standard is based upon API Spec 8C, Fourth Edition, February 2003.

Users of this International Standard should be aware that further or differing requirements may be needed for individual applications. This International Standard is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

1 Scope

This International Standard provides requirements for the design, manufacture and testing of hoisting equipment suitable for use in drilling and production operations.

This International Standard is applicable to the following drilling and production hoisting equipment:

- a) hoisting sheaves;
- b) travelling blocks and hook blocks;
- c) block-to-hook adapters;
- d) connectors and link adapters;
- e) drilling hooks;
- f) tubing hooks and sucker-rod hooks;
- g) elevator links;
- h) casing elevators, tubing elevators, drill-pipe elevators and drill-collar elevators;
- i) sucker-rod elevators;
- j) rotary swivel-bail adapters;
- k) rotary swivels;
- l) power swivels;
- m) power subs;
- n) spiders, if capable of being used as elevators;
- o) wire-line anchors;
- p) drill-string motion compensators;
- q) kelly spinners, if capable of being used as hoisting equipment;
- r) pressure vessels and piping mounted onto hoisting equipment;
- s) safety clamps, if capable of being used as hoisting equipment;
- t) guide dollies.

This International Standard establishes requirements for two product specification levels (PSLs). These two PSL designations define different levels of technical requirements. All the requirements of Clause 4 through Clause 11 are applicable to PSL 1 unless specifically identified as PSL 2. PSL 2 includes all the requirements of PSL 1 plus the additional practices as stated herein.

Supplementary requirements apply only when specified. Annex A gives a number of standardized supplementary requirements.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11960, *Petroleum and natural gas industries – Steel pipes for use as casing or tubing for wells*

API RP 9B, *Application, Care, and Use of Wire Rope for Oil Field Service*¹⁾

API Spec 5B, *Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads*

API Spec 7, *Rotary Drill Stem Elements*

ASME B31.3, *Process Piping*²⁾

ASME V, *Non-destructive Examination*

ASME VIII, DIV 1, *Rules for Construction of Pressure Vessels*

ASME IX, *Welding and Brazing specification*

ASTM A 370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*³⁾

ASTM A 388, *Standard Practice for Ultrasonic Examination of Heavy Steel Forgings*

ASTM A 488, *Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel*

ASTM A 770, *Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications*

ASTM E 4, *Standard Practices for Force Verification of Testing Machines*

ASTM E 125, *Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings*

ASTM E 165, *Standard Test Method for Liquid Penetrant Examination*

ASTM E 186, *Standard Reference Radiographs for Heavy-Walled (2 to 4 1/2-in. (51 to 114-mm)) Steel Castings*

ASTM E 280, *Standard Reference Radiographs for Heavy-Walled (4 1/2 to 12-in. (114 to 305-mm)) Steel Castings*

1) American Petroleum Institute; 1220 L St. N.W.; Washington, DC 20005; USA.

2) American Society of Mechanical Engineers; 345 East 47th St; New York, NY 10017; USA.

3) American Society for Testing and Materials; 100 Barr Harbor Dr.; West Conshohocken, PA 19428; USA.

ASTM E 428, *Standard Practice for Fabrication and Control of Steel Reference Blocks Used in Ultrasonic Inspection*

ASTM E 446, *Standard Reference Radiographs for Steel Castings Up to 2 in. (51 mm) in Thickness*

ASTM E 709, *Standard Guide for Magnetic Particle Examination*

ASNT SNT-TC-1A, *Recommended practice for personnel qualification and certification in non-destructive testing*⁴⁾

AWS D1.1, *Structural welding code*⁵⁾

AWS QC1, *Standard for AWS Certification of Welding Inspectors*

EN 287 (all parts), *Approval testing of welders – Fusion welding*

EN 288 (all parts), *Specification and qualification of welding procedures for metallic materials*

MSS SP-55, *Quality standard for steel castings for valves, flanges and fittings and other piping components – Visual method for evaluation of surface irregularities*⁶⁾

3 Terms and definitions

For the purposes of this document, the following terms, definitions, and abbreviated terms apply.

3.1 Terms and definitions

3.1.1

bearing-load rating

calculated maximum load for bearings subjected to the primary load

3.1.2

design load

sum of static and dynamic loads that would induce the maximum allowable stress in an item

3.1.3

design safety factor

factor to account for a certain safety margin between the maximum allowable stress and the specified minimum yield strength of a material

3.1.4

design verification test

test performed to validate the integrity of the design calculations used

3.1.5

dynamic load

load applied to the equipment due to acceleration effects

4) American Society for Nondestructive Testing; 4153 Arlingate Plaza; Box 28518, Columbus, OH 43228; USA.

5) American Welding Society; 550 N.W. LeJeune Road, Miami, Florida 33126; USA.

6) Manufacturers' Standardization Society of the Valve and Fittings Industry; 127 Park St. N.E.; Vienna, VA 22180; USA.

3.1.6
equivalent-round

standard for comparing various shaped sections to round bars, used for determining the response to hardening characteristics when heat-treating low-alloy and martensitic corrosion-resistant steels

3.1.7
identical design concept

property of a family units whereby all units of the family have similar geometry in the primary load carrying areas

3.1.8
linear indication

indication revealed by NDE, having a length of at least three times the width

3.1.9
load rating

maximum operating load, both static and dynamic, to be applied to the equipment

NOTE The load rating is numerically equivalent to the design load.

3.1.10
maximum allowable stress

specified minimum yield strength divided by the design safety factor

3.1.11
primary load

axial load which equipment is subjected to in operations

3.1.12
primary-load-carrying component

component of the equipment through which the primary load is carried

3.1.13
product specification level

degree of controls applied on materials and processes for the primary-load-carrying components of the equipment

NOTE The two product specification levels are identified by the code PSL 1 or PSL 2.

3.1.14
proof load test

production load test performed to validate the load rating of a unit

3.1.15
repair

removal of defects from, and refurbishment of, a component or assembly by welding, during the manufacture of new equipment

NOTE The term "repair", as referred to in this International Standard, applies only to the repair of defects in materials during the manufacture of new equipment.

3.1.16
rounded indication

indication revealed by NDE, with a circular shape or with an elliptical shape having a length of less than three times the width

3.1.17
safe working load

the design load minus the dynamic load

3.1.18

size class

designation by which dimensionally-interchangeable equipment of the same maximum load rating is identified

3.1.19

size range

range of tubular diameters covered by an assembly

3.1.20

special process

operation which may change or affect the mechanical properties, including toughness, of the materials used in the equipment

3.1.21

test unit

prototype unit upon which a design verification test is conducted

3.2 Abbreviated terms and symbols

3.2.1 Abbreviated terms

ER	equivalent-round
HAZ	heat-affected zone
PSL	product specification level
NDE	non-destructive examination
PLC	principal loading condition
PWHT	post-weld heat-treatment

3.2.2 Symbols

$AS_{\max}$	maximum allowable stress
B_B	bottom bore
B_T	top bore
D	diameter
D_R	nominal rope diameter
D_{SE}	square shoulder neck diameter
D_t	tread diameter
D_{TE}	taper shoulder neck diameter
G	total groove depth
l	length
l_o	gauge length

L_B	breaking load
L_{DVT}	design verification test load
N	number of sheaves in the block
r	radius
$r_{\max}$	maximum new groove radius
$r_{\min}$	minimum new groove radius
r_{rope}	nominal rope radius
R	load rating
SF_D	design safety factor
t	maximum thickness
T_R	yield-to-ultimate strength ratio
TS_a	actual ultimate tensile strength
$TS_{\min}$	minimum specified ultimate tensile strength
W_B	calculated block bearing rating
W_R	individual sheave bearing rating
W_S	calculated main bearing thrust rating
$YS_{\min}$	minimum specified yield strength

4 Design

4.1 General

Hoisting equipment shall be designed, manufactured and tested so that it is in every respect fit for its intended purpose. The equipment shall safely transfer the load for which it is intended. The equipment shall be designed for simple and safe operation.

4.2 Design conditions

The following design conditions shall apply:

- the operator of the equipment shall be responsible for determination of the safe working load for any hoisting operation;
- the design and minimum operating temperature shall be -20 °C (-4 °F), unless supplementary requirement SR 2 has been applied (see Clause A.3).

CAUTION — The equipment should not be used at the full load rating at temperatures below $-20\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$) unless appropriate materials with the required toughness properties at lower design temperatures have been used (see Clause A.3).

4.3 Strength analysis

4.3.1 General

The equipment design analysis shall address excessive yielding, fatigue and buckling as possible modes of failure.

The strength analysis shall be generally based on the elastic theory. An ultimate strength (plastic) analysis may, however, be used where appropriate. Finite-element mesh analysis, in conjunction with analytical methods, may be used.

All forces that may govern the design shall be taken into account. For each cross-section to be considered, the most unfavourable combination, position and direction of forces shall be used.

4.3.2 Simplified assumptions

Simplified assumptions regarding stress distribution and stress concentration may be used, provided that the assumptions are made in accordance with generally accepted practice or based on sufficiently comprehensive experience or tests.

4.3.3 Empirical relationships

Empirical relationships may be used in lieu of analysis, provided such relationships are supported by documented strain gauge test results that verify the stresses within the component. Equipment or components which, by their design, do not permit the attachment of strain gauges to verify the design shall be qualified by testing in accordance with 5.5.

4.3.4 Equivalent stress

The strength analysis shall be based on elastic theory. The nominal equivalent stress, according to the Von Mises-Hencky theory, caused by the design load shall not exceed the maximum allowable stress $AS_{\max}$ as calculated by Equation 1.

$$AS_{\max} = \frac{YS_{\min}}{SF_D} \quad (1)$$

where

$YS_{\min}$ is the specified minimum yield strength;

SF_D is the design safety factor.

4.3.5 Ultimate strength (plastic) analysis

An ultimate strength (plastic) analysis may be performed under any one of the following conditions:

- a) for contact areas;
- b) for areas of highly localized stress concentrations caused by part geometry, and other areas of high stress gradients where the average stress in the section is less than or equal to the maximum allowable stress as defined in 4.3.4.

In such areas, the elastic analysis shall govern for all values of stress below the average stress.

In the case of plastic analysis, the equivalent stress as defined in 4.3.4 shall not exceed the maximum allowable stress $AS_{\max}$ as calculated by Equation 2.

$$AS_{\max} = \frac{TS_{\min}}{SF_D} \quad (2)$$

where

$TS_{\min}$ is the specified minimum ultimate tensile strength;

SF_D is the design safety factor.

4.3.6 Stability analysis

The stability analysis shall be carried out according to generally accepted theories of buckling.

4.3.7 Fatigue analysis

The fatigue analysis shall be based on a period of time of not less than 20 years, unless otherwise agreed.

The fatigue analysis shall be carried out according to generally accepted theories. A method that may be used is defined in reference [3].

4.4 Size class

The size class shall represent the dimensional interchangeability and the load rating of equipment.

4.5 Contact surface radii

Figure 7, Figure 8, Figure 9 and Table 6 show radii of hoisting-tool contact surfaces. These contact radii are applicable to hoisting tools used in drilling (including tubing hooks), but all other work-over tools are excluded.

4.6 Rating

All hoisting equipment furnished under this International Standard shall be rated as specified herein.

Such ratings shall consist of a load rating for all equipment and a bearing-load rating for all equipment containing bearings within the primary load path.

The bearing-load rating is intended primarily to achieve consistency of ratings, but is also intended to provide a reasonable service life for bearings when used at loads within the equipment-load rating.

The load rating shall be based on the design safety factor as specified in 4.7, the specified minimum yield strength of the material used in the primary-load-carrying components and the stress distribution as determined by design calculations and/or data developed in a design verification load test as specified in 5.5.

The load rating shall be marked on the equipment (refer to Clause 10).

4.7 Design safety factor

The design safety factor shall be established from Table 1 as follows.

Table 1 — Design safety factor

Load rating R kN (ton)	Design safety factor SF_D
1 334 kN (150 short tons) and less	3,00
1 334 kN (150 short tons) to 4 448 kN (500 short tons) inclusive	$3,00 - [0,75 \times (R - 1\,334)/3\,114]^a$
Over 4 448 kN (500 short tons)	2,25
^a In this formula, the value of R shall be in kilonewtons.	

The design safety factor is intended as a design criterion and shall not under any circumstances be construed as allowing loads on the equipment in excess of the load rating.

4.8 Shear strength

For purposes of design calculations involving shear, the ratio of yield strength in shear to yield strength in tension shall be 0,58.

4.9 Specific equipment

Refer to Clause 9 for all additional equipment-specific design requirements.

4.10 Design documentation

Documentation of the design shall include methods, assumptions, calculations and design requirements. Design requirements shall include, but not be limited to, those criteria for size, test and operating pressures, material, environmental and specification requirements, and pertinent requirements upon which the design is to be based.

The requirements shall also apply to design change documentation.

5 Design verification test

5.1 General

To assure the integrity of equipment design, design verification testing shall be performed as specified below.

Design verification testing of equipment shall be carried out and/or certified by a department or organization independent of the design function.

Equipment which, by virtue of its simple geometric form, permits accurate stress analysis through calculation only shall be exempted from design verification testing.

5.2 Sampling of test units

To qualify design calculations applied to a family of units with an identical design concept but of varying sizes and ratings, the following sampling options apply.

- A minimum of three units of the design shall be subjected to design verification testing. The test units shall be selected from the lower end, middle and upper end of the size/rating range.

— Alternatively, the required number of test units shall be established on the basis that each test unit also qualifies one size or rating above and below that of the selected test unit.

NOTE The second option generally applies to limited product size/rating ranges.

5.3 Test procedures

5.3.1 Functional test

Load the test unit to the design load. After this load has been released, check the unit to verify that the functions of the equipment and its components have not been impaired by this loading.

5.3.2 Design verification test

Apply strain gauges to the test unit at all places where high stresses are anticipated, provided that the configuration of the units permits such techniques. Tools such as finite-element analysis, models, brittle lacquer, etc. should be used to confirm the proper location of the strain gauges. Three element strain gauges should be applied in critical areas to permit determination of the shear stresses and to eliminate the need for exact orientation of the strain gauges.

The design verification test load, L_{DVT} , to be applied to the test unit shall be determined in Equation 3.

$$L_{DVT} = 0,8 \times R \cdot SF_D, \text{ but not less than } 2R \quad (3)$$

where

R is the load rating, expressed in kilonewtons;

SF_D is the design safety factor as defined in 3.1.3 and 4.7.

Load the unit to the design verification test load. This test load should be applied carefully, reading the strain gauge values and observing the yield. The test unit should be loaded as many times as necessary to obtain adequate data.

The stress values computed from the strain gauge readings shall not exceed the values obtained from design calculations (based on the design verification test load) by more than the uncertainty of the testing apparatus specified in 5.6. Failure to meet this requirement or premature failure of any test unit shall be cause for a complete reassessment of the design followed by additional testing of an identical number of test units as originally required, including a test unit of the same size and rating as the one that failed.

Upon completion of the design verification test, disassemble the unit and check the dimensions of each part for evidence of yielding.

Individual parts of a unit may be tested separately if the holding fixtures simulate the load conditions applicable to the part in the assembled unit.

5.4 Determination of load rating

Determine the load rating from the results of the design verification test and/or the design and stress-distribution calculations required by Clause 4. The stresses at that rating shall not exceed the values allowed in 4.3. Localized yielding is permitted at areas of contact. In a test unit that has been design-verification tested, the critical permanent deformation determined by strain gauges or other suitable means shall not exceed 0,2 %, except in contact areas. If the stresses exceed the allowable values, redesign the affected part or parts to obtain the desired rating. Stress-distribution calculations may be used to establish the load rating of equipment only if the results of the analysis are shown to be within acceptable engineering allowances as verified by the design verification test prescribed by Clause 5.

5.5 Alternative design verification test procedure and rating

Destructive testing of the test unit may be used, provided an accurate yield and tensile strength of the material used in the equipment has been determined. Each component of an assembly shall be qualified under the most unfavourable loading configuration. Components may be qualified using either of the following methods.

- The ratio T_R shall be computed (see Equation 5) for each component in the assembly. The smallest of these ratios shall be used in the equations.
- Each component may be load tested separately if the holding fixtures duplicate the loading conditions applicable.

This may be accomplished by using tensile-test specimens of the actual material in the part destructively tested and determining the yield-to-ultimate strength ratio. The ratio is then used to rate the equipment by Equation 4:

$$R = L_B \frac{T_R}{SF_D} \quad (4)$$

$$T_R = \frac{YS_{\min}}{TS_a} \quad (5)$$

where

SF_D is the design safety factor (see 4.7);

$YS_{\min}$ is the minimum specified yield strength;

TS_a is the actual ultimate tensile strength;

L_B is the breaking load;

R is the load rating.

Since this method of design qualification is not derived from stress calculations, qualification shall be limited to the specific model, size, size range and rating tested.

5.6 Load test apparatus

Calibrate the loading apparatus used to simulate the working load on the test unit in accordance with ASTM E 4 so as to ensure that the prescribed test load is obtained. For loads exceeding 3 600 kN (400 short tons), verify the load-testing apparatus with calibration devices traceable to a Class A calibration device and having an uncertainty of less than 2,5 %.

Test fixtures shall load the test unit (or part) in essentially the same manner as in actual service and with essentially the same areas of contact on the load-bearing surface. All equipment used to load the test unit (or part) shall be verified as to its capability to perform the test.

5.7 Design changes

When any change in design or manufacturing method changes the load rating, a supportive design verification test in conformance with Clause 5 shall be carried out. The manufacturer shall evaluate all changes in design or manufacturing methods to determine whether the load rating is affected. This evaluation shall be documented.

5.8 Records

All design verification records and supporting data shall be subject to the same controls as specified for design documentation in 11.2.

6 Materials requirements

6.1 General

All materials shall be suitable for the intended service.

Clause 6 describes the various material qualification, property and processing requirements for primary-load-carrying components and pressure-containing components unless otherwise specified.

6.2 Written specifications

Materials shall be produced to a written material specification which shall, as a minimum, define the following parameters and limitations:

- mechanical property requirements;
- material qualification;
- processing requirements, including permitted melting, working and heat treatment;
- chemical composition and tolerances;
- repair-welding requirements.

The description of the working practice shall include the forging reduction-ratio.

6.3 Mechanical properties

Materials shall meet the property requirements specified in the manufacturer's material specification.

The impact toughness shall be determined from the average of three tests, using full-size test pieces if the size of the component permits. If it is necessary for sub-size impact test pieces to be used, the acceptance criteria for impact values shall be those stated below but multiplied by the appropriate adjustment factor listed in Table 3. Sub-size test pieces of width less than 5 mm shall not be used.

For materials of a specified minimum yield strength of at least 310 MPa (45 ksi), the average impact toughness shall be at least 42 J (31 ft-lb) at $-20\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$), with no individual value less than 32 J (24 ft-lb).

For materials with a minimum specified minimum yield strength of less than 310 MPa (45 ksi), the average impact toughness shall be 27 J (20 ft-lb) at $-20\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$), with no individual value less than 20 J (15 ft-lb).

For design temperatures below $-20\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$) (e.g. arctic service), supplementary impact to ughness requirements shall apply, see A.3, SR2.

Where the design requires through-thickness properties, materials shall be tested for reduction of area in the through-thickness direction in accordance with ASTM A770. The minimum reduction shall be 25 %.

PSL 2 components shall be fabricated from materials meeting the applicable requirements for ductility specified in Table 2.