PD ISO/TS 12835:2022



BSI Standards Publication

Qualification of casing connections for thermal wells

bsi.

National foreword

This Published Document is the UK implementation of ISO/TS 12835:2022. It supersedes PD ISO/PAS 12835:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PSE/17/-/5, Casing, tubing and drill pipe.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication is not to be regarded as a British Standard.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 16483 1

ICS 75.180.10; 75.200

Compliance with a Published Document cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2022.

Amendments/corrigenda issued since publication

Date	Text affected

PD ISO/TS 12835:2022

TECHNICAL SPECIFICATION

ISO/TS 12835

First edition
2022-03

Qualification of casing connections for thermal wells

Qualification des raccordements de boîtiers pour les puits thermométriques

Reference number
ISO/TS 12835:2022(E)

© ISO 2022



COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2022 – All rights reserved

Contents

Page

Foreword ... **vi**
Introduction ... **vii**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Abbreviated terms and symbols ... **5**
4.1 Abbreviated terms ... 5
4.2 Symbols ... 6
5 Program overview ... **7**
5.1 Illustrations of selected definitions ... 7
5.2 Program flowchart ... 7
6 Overview and fundamental assumptions ... **8**
6.1 General ... 8
6.2 Main features ... 8
6.2.1 Purpose ... 8
6.2.2 Applicability to service conditions ... 9
6.2.3 Rationale for development ... 9
6.2.4 Subject of evaluation ... 9
6.2.5 Application severity levels ... 9
6.3 Assessment philosophy and principles ... 10
6.3.1 Fundamental principles ... 10
6.3.2 Conservative evaluation procedure ... 11
6.3.3 Mandatory and optional tasks ... 11
6.3.4 Use of analysis and physical testing ... 12
6.3.5 Performance measures ... 12
6.3.6 Assessment criteria ... 12
6.3.7 Task outcomes — data categories ... 13
6.3.8 Prior evaluation data ... 13
6.3.9 Treatment of confidential design information ... 13
6.3.10 Interpretation of evaluation results ... 14
6.3.11 Avoiding perception of conflict of interest ... 14
6.4 Evaluation variables ... 14
6.4.1 Connection loading ... 14
6.4.2 Impacts of contributing variables ... 14
6.4.3 Pin-box interferences and tapers ... 16
6.4.4 Material yield strength ... 16
6.5 Evaluation procedure ... 17
6.5.1 Safety standards ... 17
6.5.2 Seepage assessment — random variations ... 17
6.5.3 Seepage rate thresholds ... 17
6.5.4 Seal isolation ... 18
6.5.5 Dope entrapment ... 18
6.5.6 Thermal cycle test — bake-out and hold durations ... 18
6.5.7 Pressure and temperature loading in thermal cycle test and analysis ... 19
6.5.8 Dependence of material strength on temperature ... 19
6.6 Scope of reporting ... 20
7 Program roles and proprietary design information ... **20**
7.1 Program execution roles ... 20
7.2 Proprietary connection design information ... 20
8 Conformance requirements ... **21**
8.1 Conformant evaluation program ... 21

© ISO 2022 – All rights reserved

8.2 Program non-conformances 21
8.3 Performance acceptance 22
8.4 Conformance of results from previous evaluations 22
8.5 Use of data from previous evaluations 22
8.6 Conformance to lower ASLs 23

9 Application severity levels 23
9.1 Thermal well load path 23
9.2 Temperature as controlling parameter 25
9.3 Specifications for application severity levels 26
9.4 Selection of application severity level 27

10 Program blocks and tasks 27
10.1 Evaluation procedure overview 27
10.2 Critical path tasks 31

11 Program specifications 32
11.1 Task overview 32
11.2 Identification of program roles 32
11.3 Identification of candidate connection 33
11.4 Program options 34
11.5 Data from prior evaluations 35

12 Determination of biased test population 35
12.1 Task overview 35
12.2 Initial material property characterization 36
12.2.1 Task description, definitions, methods 36
12.2.2 Testing conditions and scope 37
12.2.3 Procedure for tensile tests 39
12.2.4 Interpretation and processing of tensile test results 40
12.3 Specimen configuration analysis 45
12.3.1 Task description 45
12.3.2 Modelling and reporting requirements 46
12.3.3 Nominal reference case 47
12.3.4 Worst-case geometry configurations 48
12.3.5 Seal taper analysis 50
12.3.6 Impacts of material property variations 51
12.3.7 Make-up torque for sealability tests 54
12.3.8 Test versus production specimens 56

13 Specimen procurement 56
13.1 Task overview 56
13.2 Specimen pipe procurement 57
13.3 Material property verification 57
13.3.1 Task description 57
13.3.2 Specimens for tensile verification tests 57
13.3.3 Scope of tensile verification tests 58
13.3.4 Coefficient of thermal expansion verification test 59
13.4 Test specimen machining and gauging 60
13.4.1 General requirements 60
13.4.2 Specimen naming convention 60
13.4.3 Specimen length and length-reference requirements 61
13.4.4 Geometrical configurations 62
13.4.5 Mother pipe for specimens 62
13.4.6 Specimen machining tolerances 63
13.5 Markings 65
13.6 Specimen geometry verification 65
13.6.1 Gauging inspection scope 65
13.6.2 Inspection extent – example cases 66
13.6.3 Geometry inspection guidelines 66
13.7 Procurement and quality control of connection interfacial components 67

© ISO 2022 – All rights reserved

13.8 Specimen handling and storage ... 67
13.8.1 Handling recommendations ... 67
13.8.2 Treatment of damaged specimens ... 68

14 Full-scale physical tests and supplementary analyses ... 68
14.1 Task overview ... 68
14.2 Full-scale tests - general requirements ... 69
14.2.1 Ambient temperature at test site ... 69
14.2.2 Calibration of instrumentation ... 69
14.2.3 Disabling of secondary seals ... 70
14.2.4 Seepage measurement and rate definitions ... 70
14.2.5 Load application rates ... 72
14.2.6 Excluded connections ... 72
14.3 Galling resistance test ... 73
14.3.1 Task description ... 73
14.3.2 Rationale and objectives ... 74
14.3.3 Make-break specimens ... 74
14.3.4 Scope of galling resistance test ... 74
14.3.5 Set-up and instrumentation ... 75
14.3.6 Test procedure ... 76
14.3.7 Performance assessment ... 77
14.3.8 Reporting ... 78
14.4 Thermal cycle test ... 78
14.4.1 Task description ... 78
14.4.2 Rationale and objectives ... 78
14.4.3 Thermal cycle specimens ... 79
14.4.4 Scope of thermal cycle test ... 79
14.4.5 Mechanical strain compensations ... 82
14.4.6 Set-up and instrumentation ... 85
14.4.7 Test procedure ... 91
14.4.8 Performance assessment ... 96
14.4.9 Selection of cycled specimens for bend test and limit-strain test ... 97
14.4.10 Reporting ... 97
14.5 Bending evaluation ... 97
14.6 Limit-strain test ... 98
14.6.1 Task description ... 98
14.6.2 Rationale and objectives ... 98
14.6.3 Limit-strain specimens ... 99
14.6.4 Mandatory test description ... 99
14.6.5 Set-up and instrumentation ... 101
14.6.6 Mandatory test procedure ... 103
14.6.7 Performance assessment ... 108
14.6.8 Reporting ... 108
14.7 As-tested configuration analysis ... 108

15 Evaluation and inspection reports ... 108
15.1 Reporting deliverables ... 108
15.2 Reporting scope and contents ... 109
15.3 Reporting templates ... 113

Annex A (informative) **FEA modelling guidelines ... 114**

Annex B (informative) **Derivations of formulae - Strain compensation factors ... 124**

Annex C (informative) **Program role assignments and responsibilities ... 133**

Annex D (informative) **Optional program selections, tasks, and procedures ... 140**

Bibliography ... 163

© ISO 2022 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 5, *Casing, tubing and drill pipe*.

This first edition of ISO/TS 12835 cancels and replaces ISO/PAS 12835:2013, which has been technically revised.

The main changes are as follows:

— all optional tasks moved to Annex D;

— added option to perform thermal cycle test with cooling to intermediate temperatures;

— changed specification for to-failure portions of bend test and limit-strain test, allowing them to be performed with water only.

A list of all parts in the ISO 12835 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2022 – All rights reserved

Introduction

This document, also known to industry users as Thermal Well Casing Connection Evaluation Protocol (TWCCEP), is intended to facilitate assessment and qualification of threaded casing connections for service in intermediate or production casing strings in thermal recovery wells and in other wells experiencing significant temperature excursions such as in geothermal applications.

The extensive effort involved in replicating thermal well field conditions in a laboratory environment limits the extent of physical testing that can reasonably be undertaken in an evaluation program. The evaluation procedure adopted in this document balances technical rigor and practicality to provide a baseline level of confidence in the candidate connection's performance. Connection users should consider the scope of this evaluation and appropriate additions to address operation-specific conditions. Successful field use of a connection meeting the requirements of this protocol does not preclude an operator's need to employ appropriate product quality assurance measures and field operating practices.

Only outcomes of the performed full-scale tests are compared with assessment criteria to determine suitability of the candidate connection for the intended field service. While this document aims to enable a statistically significant full-scale test, it does not demand a rigorous check of a true statistical placement of the tested sample responses relative to field connection performance, and thus inherently assumes that the test specimens are representative of subsequent field connections. For this reason, only connections with the same design parameters as the candidate connection should be considered representative of the connection assessed under this protocol.

This document is the culmination of a thorough review of factors contributing to performance of casing connections in thermal well applications. The evaluation procedure adopted in this document has been developed using input from operators' descriptions of field practices, manufacturers' feedback on connection design and production, available literature, knowledge of past connection qualification programs, and additional analytical and experimental work performed in support of the protocol development.

© ISO 2022 – All rights reserved

Qualification of casing connections for thermal wells

1 Scope

This document provides procedures for assessment of casing connections for those field applications in which the operating temperatures cyclically vary between minimum values appreciably below 180 °C and maximum values that range from 180 °C to 350 °C or above, and in which the primary axial loading on the casing-connection system is strain-based and driven by constrained thermal expansion and leads to a stress state that exceeds the casing-connection system's yield envelope.

NOTE This document can be considered complementary to ISO 13679 (and its core content per API Specification 5C5), which applies to classic elastic-design applications.

This document contains an evaluation procedure for a candidate connection comprising of uniquely defined pin, box and interfacial components. The evaluation procedure includes:

— Material property tests to assess relevant properties of the candidate connection pin and box components;

— Analytical tasks to determine configuration of connection samples for physical tests, which are chosen based on worst-case combinations of the connection geometry and material properties;

— Full-scale testing tasks to measure the candidate connection galling resistance, structural integrity and sealability under loading representative of connection assembly and thermal well service.

This document does not address impacts of external pressure, incomplete lateral pipe support, rotational fatigue, formation-induced shear, or environmentally-induced corrosion or cracking.

Clause 6 describes fundamental assumptions adopted in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM E8, *Standard Test Methods for Tension Testing of Metallic Materials*

ASTM E21, *Standard Test Methods for Elevated-Temperature Tension Tests of Metallic Materials*

ASTM E831-06, *Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis*

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

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

© ISO 2022 – All rights reserved