DRAFT INTERNATIONAL STANDARD

ISO/DIS 16440

ISO/TC **67**/SC **2**	Secretariat: **UNI**
Voting begins on: **2014-06-05**	Voting terminates on: **2014-11-05**

Petroleum and natural gas industries — Pipeline transportation systems — Design, construction and maintenance of steel cased pipelines

Industries du pétrole et du gaz naturel — Systèmes de transport par conduite — Conception, construction et maintenance de conduites en acier moulé

ICS: 77.140.75;75.200

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Reference number
ISO/DIS 16440:2014(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 16440 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

Introduction

Users of this International Standard are advised that further or differing requirements might 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 might be particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is advisable that the vendor identify any variations from this International Standard and provide details.

Petroleum and natural gas industries - Pipeline transportation systems — Design, construction and maintenance of steel cased pipelines

1 Scope

This International Standard specifies requirements for the design, fabrication, installation, and maintenance of steel-cased pipelines for pipeline transportation systems in the petroleum and natural gas industries in accordance with ISO 13623.

Steel casings can be used for protection of pipelines at crossings such as at roads and railways.

NOTE 1 This International Standard does not imply that utilization of casings is mandatory or necessary.

NOTE 2 This International Standard does not imply that cased crossings, whether electrically isolated or electrically shorted, contribute to corrosion of a carrier pipe within a cased crossing. However, cased crossings can adversely affect the integrity of the carrier pipe by shielding cathodic protection (CP) current to the carrier pipe or reducing the CP effectiveness on the carrier pipe in the vicinity of the casing. Their use is not recommended unless required by load considerations, unstable soil conditions, or when their use is dictated by sound engineering practices.

NOTE 3 Installation of a casing at a highway, railway, or other crossing can be required by the permitting agency or pipeline operator.

2 Normative reference

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

ISO 13623, *Petroleum and natural gas industries — Pipeline transportation systems*

ISO 13847, *Petroleum and natural gas industries — Pipeline transportation systems — Welding of pipelines*

ISO 15589-1, *Petroleum and natural gas industries — Cathodic protection of pipeline transportation systems — Part 1: On-land pipelines*

EN 12954 [1], *Cathodic protection of buried or immersed metallic structures — General principles and application for pipelines*

NACE SP0169[2] *Control of External Corrosion on Underground or Submerged Metallic Piping Systems*

NACE SP0274, *High-Voltage Electrical Inspection of Pipeline Coatings*

NACE SP0490, *Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 μm (10 to 30 mils)*

[1] CEN, European Committee for Standardization, Central Secretariat, Rue de Stassart 36, B-1050, Brussels, Belgium.

[2] NACE, 1440 South Creek Drive, Houston, Texas 77084-4906 USA

NACE SPO200,*Steel cased Pipeline Practices*

3 Terms and definitions

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

3.1
carrier pipe
pipe that conveys the fluid

3.2
casing
metallic pipe (normally steel) installed around a carrier pipe for protection

3.3
electrolyte
chemical substrate containing ions that migrate in an electric field and the medium in which electric current is transported by ions

3.4
electrolytic contact
ionic contact between the carrier pipe and the casing pipe through an electrolyte

3.5
end seal
device installed over or within the end of a casing to keep deleterious materials out of the casing or provide a water tight seal between the casing and the carrier pipe

3.6
holiday
unintentional discontinuity in a protective coating that exposes the steel surface to the environment

3.7
isolator
spacer
dielectric device designed to electrically isolate a carrier pipe from a casing and provide support for the carrier pipe

3.8
metallic short
contact between two metallic structures

3.9
P/S potential
pipe-to-electrolyte potential
structure-to-electrolyte potential
potential difference between the surface of a buried or submerged metallic structure and the electrolyte that is measured with respect to a reference electrode in contact with the electrolyte

3.10
split sleeve
method of in situ casing installation by welding two halves of the casing together around the carrier pipe

3.11
tunnel liner plate
steel plate used when microtunnelling

3.12
C/S potential
Casing – to – electrolyte potential

Potential difference between the surface of a buried or submerged metallic casing and the electrolyte that is measured with respect to a reference electrode in contact with the electrolyte

4 Design

4.1 General

The purpose of a casing is to provide additional mechanical protection to the carrier pipe.

A carrier pipe within a casing is not cathodically protected because it is either electrically isolated from the casing, or the annulus of the casing is filled with a dielectric filler material.

4.2 Carrier pipe design

The carrier pipe shall be coated for corrosion protection. The application of an abrasion resistant coating over the corrosion coating should be considered.

NOTE 1 See NACE SP0169 for details of abrasion resistant coatings.

The carrier pipe shall be supported inside and outside the casing to prevent sagging which can lead to metallic contact between the casing and the carrier pipe, and carrier pipe stress.

NOTE 2 See NACE SP0286 for details of isolation techniques.

4.3 Casing design

The casing should be kept as short in length as possible to minimise the risk of electrical shorting.

The casing internal diameter shall be selected based on the outside diameter of the carrier pipe, the thickness of any abrasion resistant coating, such as concrete or epoxy polymer, and the design of the isolators between carrier pipe and casing.

For carrier pipes with outside diameter of 200 mm (8.0 in) or greater, the outer diameter of the casing should be a minimum of 100 mm (4.0 in) larger than that of the carrier pipe.

For carrier pipes with outside diameter less than 200 mm (8.0 in), the diameter of the casing should be a minimum of 50 mm (2.0 in) larger than that of the carrier pipe.

Uncoated casing should be used.

NOTE The use of coated or nonconductive casing pipe is not recommended due to potential shielding problems when cathodic protection is applied. If coated casings (either internally coated or externally coated or both) are used, external cathodic protection will not provide protection to the carrier pipe in the event that the annulus is filled with a conductive electrolyte.

Vent pipes shall be installed on both ends of the casing, unless there are valid design reasons to the contrary. Vents should be positioned so that they are not directly over any isolation spacer or end seal. If concrete coated pipe is used and no isolating spacers are used then the vent pipes should only be installed on the top of the casing.

The casing vent hole should be at least one-half the diameter of the vent pipe, with a minimum of 25 mm (1.0 in). The vent pipe should be a minimum of 50 mm (2.0 in) in diameter.

Vent pipes shall be designed to prevent intrusion of water and debris.

Casing end seals shall be installed to prevent ingress of water and debris. End seals shall be designed in accordance with NACE SP0-200.

4.4 Metallic isolation

Sufficient isolators shall be specified to prevent metallic contact between the carrier pipe and the casing provide adequate support. Isolators shall be designed to minimize coating damage.

Isolators shall be selected to ensure they have the mechanical strength required to withstand installation, considering all conditions including pipe weight, length of casing, conditions of weld beads, deflections in the casing and other field conditions. Selection should confirm the ability of the isolators to provide electrical isolation after installation, and to position the carrier pipe properly for end seal application/installation.

Test leads shall be installed on the carrier pipe before entering the casing and on the end of the casing to permit verification of metallic isolation.

Metallic shorts between the vent pipe, test leads and carrier pipe shall be prevented.

4.5 Corrosion Mitigation

Consideration may be given to applying cathodic protection to the casing as required by conditions or regulations. Cathodic protection design shall be in accordance with ISO 15589-1 or NACE SP0169.

Consideration may be given to placing inhibited dielectric filler, inert filler or conductive grout in the annular space, or injecting a vapour phase inhibitor. Annex A gives guidance on filling and the filling procedure.

5 Installation

5.1 General

This Clause provides requirements for the installation of new cased pipeline crossings, casing extensions and new casing installation on existing pipelines.

5.2 Handling and storage

The carrier pipe and casing or tunnel liner plate shall be handled and stored in a manner that minimizes coating and pipe end damage. Lifting shall be accomplished utilizing slings, wide belts, or appropriate end hooks. If skids are utilized to support the carrier pipe or casing, padding material shall be used to prevent coating damage. Skids shall be removed upon completion of the installation.

5.3 New casing

5.3.1 General

Cased crossings are installed using various techniques including boring, directional drilling, tunnelling, and open cutting.

NOTE 1 Filling of the annular space between the casing and excavation is sometimes required by the permitting agency.

Welding of steel casings should be performed in accordance with the pipeline operator's linepipe welding specifications and in accordance with ISO 13847.

NOTE 2 Radiographic inspection of casing welds is normally not required.

Butt-weld alignment shall be maintained to prevent casing, isolator or spacer damage during push/pull operations.

Slag and bows shall be removed from inside the casing to prevent damage to the carrier pipe, coating, isolator, or spacer.

The casing vent pipe should be installed before the carrier pipe to avoid coating damage. If the carrier pipe is already in place when the vent hole is cut, measures shall be taken to prevent coating damage.

NOTE 3 The use of non-flammable insulating material to protect the carrier pipe coating is often required by the pipeline operator.

If two vent pipes are used, the one at the lower elevation should be installed on the bottom of the casing to facilitate possible filling of the casing at a later date. If the vent pipe is doglegged, adequate separation and non-metallic support between the vent pipe and carrier pipe shall be provided.

If spiral welded pipe is used for the casing, internal weld beads should be removed by grinding to allow pulling or sliding of the carrier pipe without damage to the isolators and coating.

5.3.2 Carrier pipe installation

Before the installation of isolators, the carrier pipe coating shall be inspected for coating holidays using an electrical holiday detector. This should be performed in accordance with NACE SP0274 or NACE SP0490.

Isolators shall be installed according to the manufacturer's instructions and in a manner that does not damage the carrier pipe coating. Isolator runners (skids) shall be oriented to avoid a shorted condition. Bolts, if present, should not remain at the bottom (6 o'clock) position. Clearance between isolator extremities and casing should be a minimum of 25 mm (1.0 in).

NOTE 1 Additional information is given in NACE SP0286.

End caps should be installed on the carrier pipe to aid in smooth push/pull operations.

The casing shall be visually inspected and, if necessary, cleaned immediately prior to installation of the carrier pipe to remove any debris or foreign material.

All coating damage on the carrier pipe shall be repaired prior to insertion into the casing in accordance with the applicable specifications and manufacturer's recommendations.

NOTE 2 The requirements on handling pipe are also applicable to the installation of uncoated carrier pipe.

The carrier pipe shall be installed by the boring sled, a crane, or side-boom tractor using slings or belts that do not interfere with the isolators or damage the coating. The push/pull operation shall continue in a smooth motion until the carrier pipe is properly positioned.

The pull cable shall be fed through the casing in a manner that does not damage the casing.

The alignment of the carrier pipe and casing shall be ensured both prior to and during insertion of the carrier pipe into the casing. During the installation operation, it shall be ensured that there is no isolator or spacer displacement or damage to the carrier pipe coating.

NOTE 3 Isolators can slide along the carrier pipe during installation if not installed properly, if the casing is bent, or if the installation is out of line. Inadequate support of the carrier pipe allows the carrier pipe to sag and make metallic contact with the casing.

The cased crossing shall be inspected in accordance with Clause 6 to confirm that the casing and carrier pipe are electrically isolated.

The carrier pipe and casing or tunnel liner plate shall be cleaned as necessary for the installation of the end seals in accordance with design specifications and manufacturer's recommendations.

5.3.3 Casing end seals

Isolating end seals shall be installed on both ends of casing.

The end seal may be a pressure and water tight seal or a simple seal to prevent backfill from entering the annular space between the casing and carrier pipe. The selection of the seal should consider:

— the position of the carrier pipe at the end of the casing;

— operating temperature;

— end seal materials;

— pressure rating.

NOTE 1 Annex A gives additional guidance on casing end seal selection.

NOTE 2 Most water tight seals such as modular mechanical seals require that the carrier pipe be positioned in the centre of the casing (centralized), whereas most simple end seals allow for some amount of off-centered position.

5.3.4 Test leads

Test leads shall be installed on the carrier pipe and should be installed at both ends of the casing. The leads shall be attached using a thermite weld or other approved process in accordance with ISO 13847.

Two test leads should be installed at each position in order to confirm the integrity of the leads and as a contingency in case of test lead damage.

The test lead connection to the carrier pipe shall be coated. The coating shall be compatible with the carrier pipe coating, the test lead insulation, and the thermite or pin brazed connection. Damage to the carrier pipe or coating shall be repaired.

Test leads shall not be wrapped around the vent pipe, to prevent electrical shorting.

Test leads shall be installed on the casing if:

— required by the design; or

— no vent pipes are installed; or

— non-metallic vent pipes are installed; or

— metallic vent pipes are installed using mechanical couplings/fittings.

— Test leads shall be labelled or colour coded as per the design and pipeline operator requirements.

5.3.5 Backfilling

The carrier pipe and casing shall be supported to prevent settlement during the backfilling operation. The method of support, for example earth filled bags or compacted earth, shall be approved by the pipeline operator.