SLOVENSKI STANDARD
SIST EN ISO 14692-3:2004

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Industrija za predelavo nafte in zemeljskega plina - S steklenimi vlakni ojačeni polimerni cevovodi (GRP) - 3. del: Načrtovanje sistema (ISO 14692-3:2002)

Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 3: System design (ISO 14692-3:2002)

Erdöl- und Erdgasindustrie - Glasfaserverstärkte Kunstoffrohrleitungen (GFK) - Teil 3: Systemauslegung (ISO 14692-3:2002)

Industries du pétrole et du gaz naturel - Canalisations en plastique renforcé de verre (PRV) - Partie 3: Conception des systemes (ISO 14692-3:2002)

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83.140.30	Cevi, fitingi in ventili iz polimernih materialov	Plastics pipes, fittings and valves

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Petroleum and natural gas industries - Glass-reinforced plastics (GRP) piping - Part 3: System design (ISO 14692-3:2002)

Industries du pétrole et du gaz naturel - Canalisations en plastique renforcé de verre (PRV) - Partie 3: Conception des systèmes (ISO 14692-3:2002)

This European Standard was approved by CEN on 2 December 2002.

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Foreword

This document (EN ISO 14692-3:2002) 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 and natural gas industries", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2003, and conflicting national standards shall be withdrawn at the latest by June 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

NOTE FROM CMC The foreword is susceptible to be amended on reception of the German language version. The confirmed or amended foreword, and when appropriate, the normative annex ZA for the references to international publications with their relevant European publications will be circulated with the German version.

Endorsement notice

The text of ISO 14692-3:2002 has been approved by CEN as EN ISO 14692-3:2002 without any modifications.

INTERNATIONAL STANDARD

ISO 14692-3

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Petroleum and natural gas industries — Glass-reinforced plastics (GRP) piping —

Part 3: System design

Industries du pétrole et du gaz naturel — Canalisations en plastique renforcé de verre (PRV) —
Partie 3: Conception des systèmes

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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 14692-3 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

ISO 14692 consists of the following parts, under the general title *Petroleum and natural gas industries — Glass-reinforced plastics (GRP) piping*:

— *Part 1: Vocabulary, symbols, applications and materials*

— *Part 2: Qualification and manufacture*

— *Part 3: System design*

— *Part 4: Fabrication, installation and operation*

Introduction

The objective of this part of ISO 14692 is to ensure that piping systems, when designed using the components qualified in ISO 14692-2, will meet the specified performance requirements. These piping systems are designed for use in oil and natural gas industry processing and utility service applications. The main users of the document will be the principal, design contractors, suppliers contracted to do the design, certifying authorities and government agencies.

An explanation of the pressure terminology used in this part of ISO 14692 is given in ISO 14692-1.

Petroleum and natural gas industries — Glass-reinforced plastics (GRP) piping —

Part 3: System design

1 Scope

This part of ISO 14692 gives guidelines for the design of GRP piping systems. The requirements and recommendations apply to layout dimensions, hydraulic design, structural design, detailing, fire endurance, spread of fire and emissions and control of electrostatic discharge.

This part of ISO 14692 is intended to be read in conjunction with ISO 14692-1.

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 14692-1:2002, *Petroleum and natural gas industries — Glass-reinforced plastics (GRP) piping — Part 1: Vocabulary, symbols, applications and materials*

ISO 14692-2:2002, *Petroleum and natural gas industries — Glass-reinforced plastics (GRP) piping — Part 2: Qualification and manufacture*

ISO 14692-4:2002, *Petroleum and natural gas industries — Glass-reinforced plastics (GRP) piping — Part 4: Fabrication, installation and operation*

BS 7159:1989 *Code of practice for design and construction of glass-reinforced plastics (GRP) piping systems for individual plants or sites*

ASTM E1118, *Standard practice for acoustic emission examination of reinforced thermosetting resin pipe (RTRP)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14692-1 apply.

4 Symbols and abbreviated terms

For the purposes of this part of ISO 14692, the symbols and abbreviated terms given in ISO 14692-1 apply.

5 Layout requirements

5.1 General

GRP products are proprietary, and the choice of component sizes, fittings and material types may be limited depending on the supplier. Potential vendors should be identified early in design to determine possible limitations of component availability. The level of engineering support that can be provided by the supplier should also be a key consideration during vendor selection.

Where possible, piping systems should maximize the use of prefabricated spoolpieces to minimize the amount of site work. Overall spool dimensions should be sized taking the following into consideration:

— limitations of site transport and handling equipment;

— installation and erection limitations;

— limitations caused by the necessity to allow a fitting tolerance for installation (“cut to fit” requirements).

The designer shall evaluate system layout requirements in relation to the properties of proprietary pipe systems available from manufacturers, including but not limited to:

a) axial thermal expansion requirements;

b) ultraviolet radiation and weathering resistance requirements;

c) component dimensions;

d) jointing system requirements;

e) support requirements;

f) provision for isolation for maintenance purposes;

g) connections between modules and decks;

h) flexing during lifting of modules;

i) ease of possible future repair and tie-ins;

j) vulnerability to risk of damage during installation and service;

k) fire performance;

l) control of electrostatic charge.

The hydrotest provides the most reliable means of assessing component quality and system integrity. Whenever possible, the system should be designed to enable pressure testing to be performed on limited parts of the system as soon as installation of those parts is complete. This is to avoid a final pressure test late in the construction work of a large GRP pipe system, when problems discovered at a late stage would have a negative effect on the overall project schedule.

Further guidance about GRP piping system layout is given in Annex A.

5.2 Space requirements

The designer shall take account of the larger space envelope of some GRP components compared to steel. Guidance on fitting sizes is given in Clause 7 of ISO 14692-2:2002. GRP fittings generally have longer lay lengths and are proportionally more bulky than the equivalent metal component and may be difficult to

accommodate within confined spaces. If appropriate, the problem can be reduced by fabricating the pipework as an integral spoolpiece in the factory rather than assembling it from the individual pipe fittings.

If space is limited, consideration should be given to designing the system to optimize the attributes of both GRP and metal components.

5.3 System supports

5.3.1 General

GRP piping systems can be supported using the same principles as those for metallic piping systems. However, due to the proprietary nature of piping systems, standard-size supports will not necessarily match the pipe outside diameters. The use of saddles and elastomeric pads may allow the use of standard-size supports.

The following requirements and recommendations apply to the use of system supports.

a) Supports shall be spaced to avoid sag (excessive displacement over time) and/or excessive vibration for the design life of the piping system.

b) In all cases, support design should be in accordance with the manufacturer's guidelines.

c) Where there are long runs, it is possible to use the low modulus of the material to accommodate axial expansion and eliminate the need for expansion joints, provided the system is well anchored and guided.

d) Valves or other heavy attached equipment shall be independently supported.

NOTE Valves are often equipped with heavy control mechanisms located far from the pipe centreline and can cause large bending and torsional loads.

e) GRP pipe shall not be used to support other piping, unless agreed with the principal.

f) GRP piping should be adequately supported to ensure that the attachment of hoses at locations such as utility or loading stations does not result in the pipe being pulled in a manner that could overstress the material.

g) Consideration shall be given to the possible design requirements of the support to provide electrical earthing in accordance with the requirements of 5.8 and clause 10.

Pipe supports can be categorized into those that permit movement and those that anchor the pipe.

5.3.2 Pipe-support contact surface

5.3.2.1 Guidelines

The following guidelines to GRP piping support should be followed.

a) Supports in all cases should have sufficient width to support the piping without causing damage and should be lined with an elastomer or other suitable soft material. The minimum saddle width, in millimetres, should be $\sqrt{30D}$, where D is the mean diameter of the pipe, in millimetres.

b) Clamping forces, where applied, should be such that crushing of the pipe does not occur. Local crushing can result from a poor fit and all-round crushing can result from over-tightening.

c) Supports should be preferably located on plain-pipe sections rather than at fittings or joints.

d) Consideration shall be given to the support conditions of fire-protected GRP piping. Supports placed on the outside of fire protection could result in loads irregularly transmitted through the coating, which could result in shear/crushing damage and consequent loss of support integrity.

5.3.2.2 Supports permitting pipe movement

Pipe resting in fixed supports that permit pipe movement shall have abrasion protection in the form of saddles, elastomeric materials or sheet metal.

5.3.2.3 Supports anchoring pipe

The anchor support shall be capable of transferring the required axial loads to the pipe without causing overstress of the GRP pipe material. Anchor clamps are recommended to be placed between two double 180° saddles, adhesive-bonded to the outer surface of the pipe. The manufacturer's standard saddles are recommended and shall be bonded using standard procedures.

5.3.3 Support and guide spacing

The spanning capability of GRP piping spans is generally less than that for steel pipe, due to the lower modulus of the material. Supports shall be spaced to avoid sag (excessive displacement over time) and/or excessive vibration for the design life of the piping system.

GRP pipes, when filled with water, should be capable of spanning at least the distances specified in Table 1 while meeting the deflection criterion of 0,5 % of span or 12,5 mm centre, whichever is smaller. Spans are assumed to be simply supported. In some cases, bending stresses or support contact stresses may become a limiting factor (see 8.6), and the support spacing may have to be reduced.

Table 1 — Guidance to span lengths (simply supported)

Pipe nominal diameter mm	Span m
25	2,0
40	2,4
50	2,6
80	2,9
100	3,1
150	3,5
200	3,7
250	4,0
300	4,2
350	4,8
400	4,8
450	4,8
500	5,5
600 ⩾	6,0

Larger spans are possible, and the designer should verify that stresses are within allowable limits according to 8.6. The designer shall take into consideration the effect of buckling (8.7). The effect of temperature on the axial modulus of the GRP material shall also be considered.

5.4 Isolation and access for cleaning

The designer should make provision for isolation and easy access for maintenance purposes, for example for removal of scale and blockages in drains. The joint to be used for isolation or access should be shown at the design stage and should be located in a position where the flanges can in practice be jacked apart, e.g. it should not be in a short run of pipe between two anchors.

5.5 Vulnerability

5.5.1 Point loads

Point loads should be minimized and the GRP piping locally reinforced where necessary.

5.5.2 Abuse

The designer should give consideration to the risk of abuse to GRP piping during installation and service and the need for permanent impact shielding.

Sources of possible abuse include:

a) any area where the piping can be stepped on or used for personnel support;

b) impact from dropped objects;

c) any area where piping can be damaged by adjacent crane activity, e.g. booms, loads, cables, ropes or chains;

d) weld splatter from nearby or overhead welding activities.

Small pipe branches (e.g. instrument and venting lines), which are susceptible to shear damage, should be designed with reinforcing gussets to reduce vulnerability. Impact shielding, if required, should be designed to protect the piping together with any fire-protective coating.

NOTE Further guidance on the design of gussets can be found in BS 4994 [1].

5.5.3 Dynamic excitation and interaction with adjacent equipment and piping

The designer should give consideration to the relative movement of fittings, which could cause the GRP piping to become overstressed. Where required, consideration shall be given to the use of flexible fittings.

The designer should ensure that vibration due to the different dynamic response of GRP (as compared with carbon steel piping systems) does not cause wear at supports or overstress in branch lines. The designer should ensure that the GRP piping is adequately supported to resist shock loads that may be caused by transient pressure pulses, e.g. operation of pressure safety valves, valve closure etc.

5.5.4 Effect of external environment

5.5.4.1 Exposure to light and ultraviolet radiation (UV)

Where GRP pipe is exposed to the sun, the designer should consider whether additional UV protection is required to prevent surface degradation of the resin. If the GRP is a translucent material, the designer should consider the need to paint the outside to prevent possible algae growth in slow-moving water within the pipe.

5.5.4.2 Low temperatures and requirements for insulation

The designer shall consider the effects of low temperatures on the properties of the pipe material, for example the effect of freeze/thaw. For liquid service, the designer should pay particular attention to the freezing point of

