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Entwurf

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Berichtigung 1:2007-02

**Erdöl- und Erdgasindustrie –
Glasfaserverstärkte Kunststoffrohrleitungen (GFK) –
Teil 3: Systemauslegung (ISO/DIS 14692-3:2015);
Englische Fassung prEN ISO 14692-3:2015**

Petroleum and natural gas industries –
Glass-reinforced plastics (GRP) piping –
Part 3: System design (ISO/DIS 14692-3:2015);
English version prEN ISO 14692-3:2015

Industries du pétrole et du gaz naturel –
Canalisations en plastique renforcé de verre (PRV) –
Partie 3: Conception des systèmes (ISO/DIS 14692-3:2015);
Version anglaise prEN ISO 14692-3:2015

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Dieser Norm-Entwurf mit Erscheinungsdatum 2015-08-14 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.

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Gesamtumfang 43 Seiten

DIN-Normenausschuss Erdöl- und Erdgasgewinnung (NÖG)

Nationales Vorwort

Dieses Dokument (prEN ISO 14692-3:2015) wurde vom Technischen Komitee ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“ Subkomitee SC 6 „Processing equipment and systems“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ (Sekretariat AFNOR, Frankreich) erarbeitet.

Für Deutschland hat hieran der Arbeitskreis NA 109-00-01-06 AK „Verfahrenstechnische Anlagen und Ausrüstungen“ im DIN-Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) mitgearbeitet.

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

Das Ausgabedatum des Europäischen Norm-Entwurfs stand zum Zeitpunkt der Veröffentlichung dieses DIN-EN-ISO-Entwurfs noch nicht fest; der prEN ISO wird jedoch vom CMC unter der angegebenen prEN-Nummer demnächst zur CEN-Umfrage verteilt. Um der deutschen Öffentlichkeit eine möglichst lange Einspruchsfrist einzuräumen, wurde dieser Norm-Entwurf bereits vorab veröffentlicht.

Änderungen

Gegenüber DIN EN ISO 14692-3:2005-07 und DIN EN ISO 14692-3 Berichtigung 1:2007-02 wurden folgende Änderungen vorgenommen:

- a) neuer Abschnitt 5 „Generation of design envelopes“;
- b) Reduzierung der Anhänge auf Annex A „Flexibility factors and stress intensification factors“ und Annex B „A3“.

Nationaler Anhang NA (informativ)

Begriffe, Symbole und Abkürzungen

Die Benummerung der folgenden Begriffe ist identisch mit der Benummerung in der englischen Fassung.

2 Begriffe, Symbole und Abkürzungen

Für die Anwendung dieses Teils der ISO 14692 gelten die Begriffe nach ISO 14692-1.

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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*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

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

- *Part 3: System design*
- *Part [n]:*
- *Part [n+1]:*
- *Part 1: Vocabulary, symbols, applications and materials*
- *Part 2: Qualification and manufacture*
- *Part 3: System design*
- *Part 4: Fabrication, installation, inspection and maintenance*

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.

— *Entwurf* —

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.

Guidance on the use of Part 3 can be found in Figure 1 which is a more detailed flowchart of steps 5 and 6 in Figure 1 of Part 1.

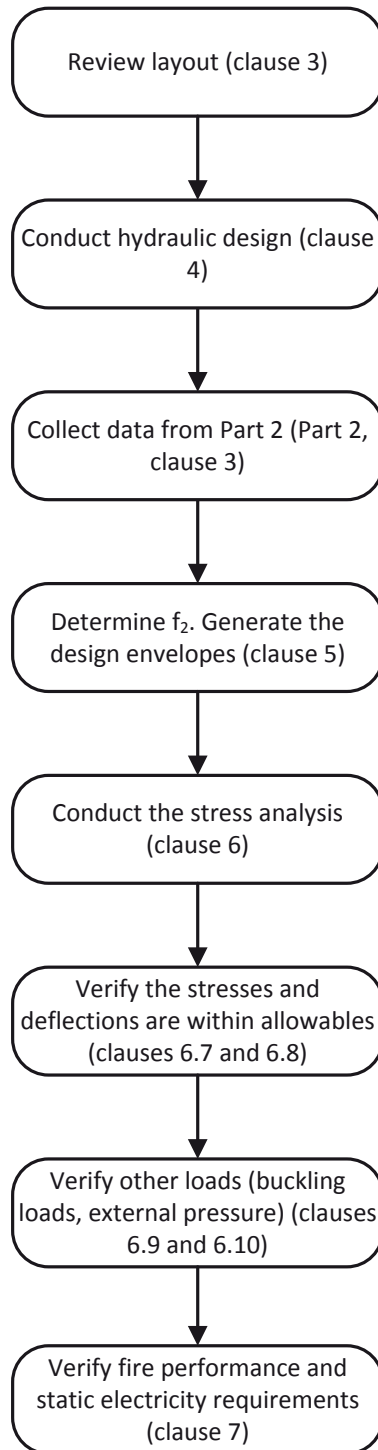


Figure 1 – Guidance on the use of Part 3

2 Terms, definitions, symbols and abbreviated terms

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

3 Layout requirements

3.1 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 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.

3.2 Space requirements

The designer shall take account of the larger space envelope of some GRP components compared to steel. Some GRP fittings 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.

3.3 System supports

3.3.1 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 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. In this case, the designer should recognize that the axial expansion due to internal pressure is now restrained and the corresponding thrust loads are partly transferred to the anchors.
- d) Valves or other heavy attached equipment shall be adequately and, if necessary, independently supported. When evaluating valve weight, valve actuation torque shall also be considered.

NOTE Some valves are 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.

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

3.3.2 Pipe-support contact surface

The following guidelines to GRP piping support should be followed.

- a) Supports in all cases should have sufficient length to support the piping without causing damage and should be lined with an elastomer or other suitable soft material.
- b) Point loads should be avoided. This can be accomplished by using supports with at least 60 degrees of contact.
- c) 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.
- d) Supports should be preferably located on plain-pipe sections rather than at fittings or joints. One exception to this is the use of a "dummy leg" support directly on an elbow or tee (or piece of pipe).

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. Supports in direct contact with intumescent coatings may also alter the performance of the coating (i.e. prevent expansion of the coating under fire). This may require application of intumescent coatings to the pipe support itself in order to protect the pipe at the hanger or pipe support.

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

Anchor supports 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 either a) a thrust collar laminated to the outer surface of the pipe or b) 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.

3.4 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.

3.5 Vulnerability

3.5.1 Point loads

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

3.5.2 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.

3.5.3 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.

NOTE One reference of interest is "Guidelines for the avoidance of vibration induced fatigue failure in process pipework", 2nd edition, 2008 by the Energy Institute. While not written for plastics, the methodology may be effective in reducing the risk of pipe failure.

3.5.4 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.

3.5.5 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 the internal liquid. For completely filled lines, solidification of the internal fluid may cause an expansion of the liquid volume, which could cause the GRP pipe to crack or fail. For water service, the volumetric expansion during solidification or freezing is more than sufficient to cause the GRP pipe to fail.

The pipe may require to be insulated and/or fitted with electrical surface heating to prevent freezing in cold weather or to maintain the flow of viscous fluids. The designer shall give consideration to:

- a) additional loading due to mass and increased cross-sectional area of the insulation;
- b) ensuring that electrical surface heating does not raise the pipe temperature above its rated temperature.

Heat tracing should be spirally wound onto GRP pipe in order to distribute the heat evenly round the pipe wall. Heat distribution can be improved if aluminium foil is first wrapped around the pipe.

3.6 Fire and blast

The effect of a fire event (including blast) on the layout requirements should be considered. The possible events to be considered in the layout design of a GRP piping system intended to function in a fire include:

- a) blast overpressure, drag forces and projectile impacts;
- b) fire protection of joints and supports;
- c) interface with metal fixtures;
- d) formation of steam traps in pipes containing stagnant water, which would reduce the conduction of heat away by water;
- e) jet fire;
- f) heat release and spread of fire for those pipes in manned spaces, escape routes or areas where personnel are at risk;
- g) smoke emission, visibility and toxicity for those pipes in manned spaces, escape routes or areas where personnel are at risk.

Penetrations (wall, bulkhead, deck) shall not weaken the division that they penetrate. The main requirements are to prevent passage of smoke and flames, to maintain structural integrity and to limit the temperature rise on the unexposed side. Penetrations shall therefore comply with the same requirements that apply to the relevant hazardous divisions. This requires the penetration to have been fire-tested and approved for use with the specific type of GRP pipework under consideration.

4 Hydraulic design

4.1 General

The aim of hydraulic design is to ensure that GRP piping systems are capable of transporting the specified fluid at the specified rate, pressure and temperature throughout their intended service life. The selection of nominal pipe diameter depends on the internal diameter required to attain the necessary fluid flow consistent with the fluid and hydraulic characteristics of the system.

4.2 Flow characteristics

Fluid velocity, density of fluid, interior surface roughness of pipes and fittings, length of pipes, inside diameter of pipes, as well as resistance from valves and fittings shall be taken into account when estimating pressure losses. The smooth surface of the GRP may result in lower pressure losses compared to metal pipe. Conversely the presence of excessive protruding adhesive beads will increase pressure losses.

4.3 General velocity limitations

Concerns that limit velocities in piping systems include:

- a) unacceptable pressure losses;
- b) prevention of cavitation at pumps and valves;
- c) prevention of transient overloads (water hammer);
- d) reduction of erosion;
- e) reduction of noise;
- f) reduction of wear in components such as valves;
- g) pipe diameter and geometry (inertia loading).

The designer shall take into account these concerns when selecting the flow velocity for the GRP piping system. For typical GRP installations, the mean linear velocity for continuous service of liquids is between 1 m/s and 5 m/s with intermittent excursions up to 10 m/s. For gas, the mean linear velocity for continuous service is between 1 m/s and 10 m/s with intermittent excursions up to 20 m/s. Higher velocities are acceptable if factors that limit velocities are eliminated or controlled, e.g. vent systems that discharge into the atmosphere.

4.4 Erosion

4.4.1 General

The following factors influence the susceptibility of GRP piping to erosion damage:

- a) fluid velocity;
- b) piping configuration;
- c) particle size, density and shape;
- d) particulate/fluid ratio;
- e) onset of cavitation.