BS EN ISO 28721-1:2011

BSI Standards Publication

Vitreous and porcelain enamels — Glass-lined apparatus for process plants

Part 1: Quality requirements for apparatus, components, appliances and accessories (ISO 28721-1:2008)

National foreword

This British Standard is the UK implementation of EN ISO 28721-1:2011. It is identical to ISO 28721-1:2008. It supersedes BS EN 15159-1:2006, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee STI/36, Vitreous enamel coatings.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Émaux vitrifiés - Appareils émaillés pour les installations industrielles - Partie 1: Exigences de qualité relatives aux appareillages, composants, appareils et accessoires (ISO 28721-1:2008)

Emails und Emaillierungen - Emaillierte Apparate für verfahrenstechnische Anlagen - Teil 1: Qualitätsanforderungen für Apparate, Apparateteile, Einbau- und Zubehörteile (ISO 28721-1:2008)

This European Standard was approved by CEN on 17 March 2011.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of ISO 28721-1:2008 has been prepared by Technical Committee ISO/TC 107 “Metallic and other inorganic coatings” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 28721-1:2011 by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings” the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by October 2011, and conflicting national standards shall be withdrawn at the latest by October 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15159-1:2006.

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

Endorsement notice

The text of ISO 28721-1:2008 has been approved by CEN as a EN ISO 28721-1:2011 without any modification.

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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 28721-1 was prepared by the European Committee for Standardization (CEN) (as EN 15159-1) and was adopted, under a special “fast-track procedure”, by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, in parallel with its approval by the ISO member bodies.

ISO 28721-1 consists of the following parts, under the general title *Vitreous and porcelain enamels — Glass-lined apparatus for process plants*:

— *Part 1: Quality requirements for apparatus, components, appliances and accessories*

— *Part 2: Designation and specification of resistance to chemical attack and thermal shock*

— *Part 3: Thermal shock resistance*

INTERNATIONAL STANDARD **ISO 28721-1:2008(E)**

Vitreous and porcelain enamels — Glass-lined apparatus for process plants —

Part 1: Quality requirements for apparatus, components, appliances and accessories

1 Scope

This part of ISO 28721 specifies the quality requirements for apparatus, components, appliances and accessories of glass-lined steel (including semi-crystallized enamel coatings) and glass-lined steel castings used for process plants. It specifies the quality requirements and the tests to be carried out by the manufacturer as well as the action to be taken to repair defects.

It is also applicable to glass-lined pumps, pump components and fittings.

It is not applicable to glass-lined flanged steel pipes or glass-lined flanged steel fittings.

NOTE 1 Provisions for glass-lined flanged steel pipes and glass-lined flanged steel fittings are given in DIN 2876 [1].

The test methods specified cover checking the enamel, the dimensional accuracy and the performance of apparatus and components.

This part of ISO 28721 applies to new apparatus and components as well as used items that have been re-enamelled.

It does not contain requirements regarding the chemical or physical properties of vitreous and porcelain enamels.

NOTE 2 Examples of test reports are given in Annex A.

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 780, *Packaging — Pictorial marking for handling of goods*

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 28721-2, *Vitreous and porcelain enamels — Glass-lined apparatus for process plants — Part 2: Designation and specification of resistance to chemical attack and thermal shock*

ISO 28721-3, *Vitreous and porcelain enamels — Glass-lined apparatus for process plants — Part 3: Thermal shock resistance*

EN 14430, *Vitreous and porcelain enamels — High voltage test*

3 Requirements

3.1 General

If the requirements given in this part of ISO 28721 are to be applied to glass-lined apparatus and components, this shall be stated as follows when ordering:

Prepared in accordance with ISO 28721-1.

Requirements differing from those stated in this part of ISO 28721 may be agreed upon between the parties at the time of ordering.

3.2 Design and quality of enamel finish

The manufacturer shall be responsible for the appropriate design and construction.

The enamel quality (i.e. the type of enamel and, where relevant, the colour) shall be agreed upon between the interested parties at the time of ordering.

The characteristic composition of individual enamel layers shall correspond to that of specimens submitted for laboratory testing. The quality of the enamel shall meet the requirements specified in ISO 28721-2 and ISO 28721-3.

3.3 Surface

The enamel coating shall have a uniform, smooth, fully-fused surface free from impurities.

3.4 Defects

3.4.1 General

Defects shall be examined visually (see 4.2).

3.4.2 Defects unacceptable in the finished product

Defects unacceptable in the finished product are those which would render a component unusable. Such defects are typically as follows:

a) defects which cannot be repaired by the means described in Clause 6, such as:

- defects extending over an area with a diameter $>$ 8 mm,
- defects on inaccessible spots,
- defects concerning vessels and columns as described in 3.4.4;

b) collapsed lines in the cover coat;

c) bubble lines, i.e. fused-in bubbles arranged in a distinct line;

d) fused strain lines (recognizable as lines with colours different from that of the surrounding enamel);

e) areas not properly fused (a rough surface similar to a sandblasted one);

f) devitrified areas in vitreous enamel or over crystallized areas in semi-crystallized enamel (recognizable as a dull or a rough surface);

g) pull-through of ground coat (recognizable as e.g. spot-like discolorations);

h) cracks detectable by e.g. a statiflux test;

i) spots with a diameter > 30 mm caused by grinding and polishing during the removal of impurities (see also 3.4.3 and 6.2).

3.4.3 Repairable defects

Repairable defects are imperfections in the enamel coating which allow, under certain circumstances (see below), further use of glass-lined equipment after repair. Common repairable defects are:

a) depressions with a depth exceeding 25 % of the coating thickness;

b) blisters, such as circular holes in the coating exposing the ground coat;

c) areas with weak spots or defects detectable by high-voltage testing in accordance with 4.3;

d) impurities in the enamel coating.

Isolated impurities, such as fire clay particles, shall be removed. Dust-like impurities on the surface may be accepted. Scale fused into the surface shall be removed where it extends parallel to the surface over a distance of more than 3 mm and/or is not a flat particle or is not fused parallel to the surface.

The maximum permissible number of defects repaired by plugging shall be as given in Tables 1 and 2.

Further requirements, such as the maximum level of pores or use without plugging, shall be agreed upon between the interested parties at the time of ordering.

Defects as defined in 3.4.3 a) and 3.4.3 b) shall be repaired as described in 6.1.

Specifications regarding defects in various types of apparatus and components are given in 3.4.4 to 3.4.6.

Table 1 — Maximum permissible number of plugged enamel defects in vessels

Nominal volume m^3	Maximum permissible number of defects			
	Agitator vessels			Other vessels
	Type AE		Types BE and CE [a]	
	Lower part of vessel	Main cover		
up to 4	0	0	0	0
over 4 to 10	1	1	1	1
over 10 to 20	—	—	2	3
over 20 to 32	—	—	3	4
over 32 to 40	—	—	4	5
over 40 to 80	—	—	—	6
over 80	—	—	—	7

[a] Assembly covers shall be delivered without any plugs.

Table 2 — Maximum permissible number of plugged enamel defects in columns

Nominal diameter of column mm	Maximum permissible number of defects for unit lengths		
	up to 2 000 mm	over 2 000 mm up to 5 000 mm	over 5 000 mm
up to 600	0	0	0
over 600 to 1 200	0	1	2
over 1 200	1	2	3

3.4.4 Vessels and columns

Table 1 and Table 2 list the number of repairable defects to be covered with plugs. Exceptions apply in the following cases:

a) outlet nozzles and agitator nozzles, including the complete neck area around the nozzle, shall not be repaired by plugging (this also applies to other nozzles with a nominal diameter of 150 mm or less, including the neck area which extends out 30 mm beyond the inner nozzle diameter);

b) convex and concave surfaces with a radius of 75 mm or less shall not be repaired by plugging;

c) seal areas (gasket bearing surfaces) shall not be repaired by plugging.

3.4.5 Accessories

Accessories such as agitators, baffles, thermo pipes, probes, inlet pipes, washers, manhole covers and dip-pipes shall not be repaired by plugging (see 6.1).

3.4.6 Fittings and pump components

Fittings and pump components shall not be repaired by plugging (see 6.1).

3.5 Coating thickness

The thickness of enamel coatings on steel substrates shall range from 1,0 mm to 2,2 mm, with the following exceptions:

a) maximum values may be exceeded by 0,2 mm on concave surfaces;

b) the enamel coating may be 0,2 mm thinner than the specified minimum value in limited areas and on convex surfaces;

c) coatings on small parts with very small radii $\leqslant$ 5 mm, such as valve stems or rotors of pumps, may have a minimum thickness of 0,6 mm.

Any changes in thickness shall be smooth.

3.6 General tolerances

General tolerances and tests for the concentricity of agitators (see 4.7.1 and 4.7.2) shall be agreed upon between the interested parties.

NOTE Examples of tolerances for vessels other than agitator vessels, agitator vessels and columns are given in DIN 28005-2 [2], DIN 28006-2 [3] and DIN 28007-2 [4], respectively. DIN 28159 [5] gives tolerances for agitator ends and DIN 2873 [6] gives permissible angular misalignments for flange surfaces.

3.7 Finish

Unless otherwise agreed, non-enamelled surfaces, except for those which are not to be coated, such as fitting surfaces, shall be protected by a primer.

Details shall be agreed upon between the interested parties at the time of ordering.

Corrosion protection of parts without a primer coating, e.g. connecting elements, shall be agreed upon between the interested parties at the time of ordering.

4 Testing

4.1 General

Tests carried out in accordance with this part of ISO 28721 shall be conducted only by skilled personnel and shall be documented.

NOTE Examples of test report formats are given in Annex A.

The surfaces to be tested shall be clean, dry, sufficiently illuminated and easily accessible.

The components tested and the test reports shall be marked to allow proper identification. It is at the customer's discretion to have his/her own inspectors verify the test results by repeating the tests at the manufacturing site as described below.

Details of testing shall be agreed upon between the interested parties at the time of ordering.

4.2 Visual examination

The surfaces of glass-lined apparatus and components shall be checked visually. Optical instruments, such as magnifying glasses, may be used for closer examination.

4.3 High-voltage test

High-voltage tests shall be conducted in accordance with EN 14430. When the enamelling of a component is complete, the manufacturer shall run a high-voltage test at 20 kV. For subsequent tests, a voltage of 12 kV may be used.

By customer request, and with the agreement of the manufacturer, particular areas may be re-checked with a higher voltage. Totally glass-lined components shall be tested with a.c. or pulsed d.c. voltage.

Exceptions apply in the following cases:

a) enamelled probes shall be tested with a d.c. voltage of 7 kV;

b) components coated with conductive or dissipative enamel shall only be checked visually; they shall be appropriately marked by the manufacturer.

4.4 Testing for cracks

Areas where cracks are presumed to have formed shall be sprayed with electrostatically charged talcum powder to make cracks more visible. Even fine cracks will then be clearly revealed.

4.5 Coating thickness measurement

Measurement of the coating thickness shall be carried out in accordance with ISO 2178, using a measuring instrument accurate to 5 % of the actual value. The thickness shall be measured using spot checks. Extra measurements shall, however, be taken at critical spots such as small radii, uneven surfaces and localized increases in thickness.

4.6 Measurement of dimensions

The following dimensions shall be measured and recorded:

a) the inside diameter and any out-of-roundness of the vessel;

b) the diameter and any out-of-roundness of the assembly flange and main flange;

c) any wavelike distortion of the sealing surfaces of the assembly flange and main flange;

d) the out-of-plane angle of the sealing surfaces of the nozzles;

e) the compensation thickness of the gaskets;

f) the distances between the support ring, the brackets and the legs and a reference plane in each case;

g) any variations in the distances between points on the support ring circumference, individual brackets and individual legs and a reference plane in each case;

h) agreement of the support element dimensions (i.e. the thickness and outer diameter of the support ring) with the drawing;

i) the ground clearance of the agitator;

j) agreement of the jacket nozzle dimensions with the drawing.

Additional measurements may be made at the discretion of the customer.

The manufacturer shall measure and document the actual dimensions. The forms included in Annex A may be used for this purpose.

4.7 Determination of the concentricity of agitators and pump rotors

4.7.1 General

Details of the determination of the concentricity of impellers and pump rotors after assembly shall be agreed upon between the interested parties.

NOTE A method for determining the concentricity of impellers and pump rotors is given in DIN 28161 [7].

4.7.2 Agitators

The maximum eccentricity of agitators that are supplied separately shall be documented; the measurements shall be performed by the manufacturer after machining and with the impellers still in the lathe.

4.7.3 Pump rotors

The concentricity of pump rotors shall be determined by the manufacturer and, if requested, the manufacturer shall document the results.

4.8 Performance testing

The manufacturer shall check the performance of the glass-lined components after assembly. Particular attention shall be paid to the proper performance of moving components (see also 4.7.1).

Further tests covering the performance of mechanical seals or test runs with power measurement may be agreed upon between the interested parties at the time of ordering.

4.9 Completeness check

A completeness check, including the outside coating, shall be carried out to ensure compliance with the order.

5 Manufacturing stages and inspections

Inspections shall be conducted when the glass-lined components are at the manufacturing stages shown in Table 3.

If the customer requests that the tests be carried out by his/her representative, the manufacturer shall give sufficient notice of the times at which the components concerned will be at the manufacturing stages at which they are to be inspected.

Table 3 — Stages at which testing is to be carried out

<table>
<tr><th rowspan="3">Glass-lined component</th><th colspan="8">Tests in accordance with subclauses</th></tr>
<tr><th>4.2</th><th>4.3</th><th>4.4</th><th>4.5</th><th>4.6</th><th>4.7</th><th>4.8</th><th>4.9</th></tr>
<tr><th>Visual examination</th><th>High-voltage test</th><th>Testing for cracks</th><th>Coating thickness measurement</th><th>Measure-ment of dimensions</th><th>Concen-tricity of agitators and pump rotors</th><th>Performance testing</th><th>Completeness check, including outside coating</th></tr>
<tr><td rowspan="2">Agitator vessels</td><td colspan="4">First test after enamelling, if possible prior to welding of elements such as jacket or support structure</td><td rowspan="2">Measure roundness and dimensions possibly altered by firing after enamelling. Measure other dimensions after assembly.</td><td rowspan="2">—</td><td rowspan="2">After installation</td><td rowspan="6">Before delivery</td></tr>
<tr><td colspan="3">Second test after assembly, together with performance testing</td><td>—</td></tr>
<tr><td>Components and agitator ordered together with the agitator vessel</td><td colspan="5">After enamelling and machining</td><td>Agitators: after installation</td><td>After installation</td></tr>
<tr><td>Accessories and agitators ordered separately</td><td colspan="5">After enamelling and machining</td><td>Agitators: after enamelling and machining</td><td>—</td></tr>
<tr><td>Storage vessels, columns and other apparatus</td><td colspan="5">After enamelling</td><td>—</td><td>—</td></tr>
<tr><td>Pumps and pump components</td><td colspan="4">Casing and components: after enamelling, prior to assembly</td><td>After assembly</td><td>Pump rotors: after assembly</td><td>After assembly</td></tr>
<tr><td>Fittings</td><td colspan="6">Casing and components: after enamelling, prior to assembly</td><td>—</td><td>After assembly</td></tr>
</table>

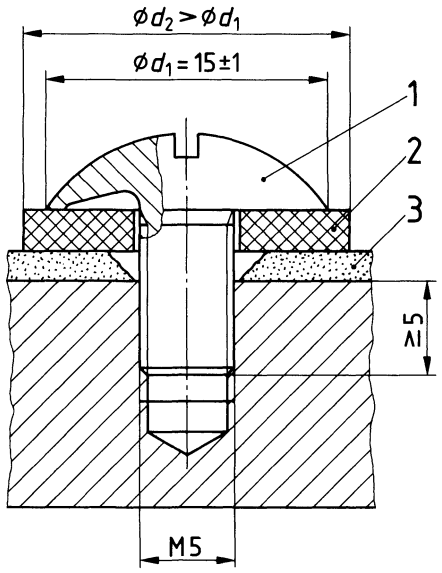
6 Repairing defects

6.1 Repairing with plugs

Defects in the enamel shall be repaired with tantalum plugs and polytetrafluoroethylene (PTFE) gaskets. Examples of plugs are given in Figure 1 and Figure 2.

The type of plug and the use of other plug or gasket materials shall be agreed upon between the interested parties at the time of ordering.

Dimensions in millimetres

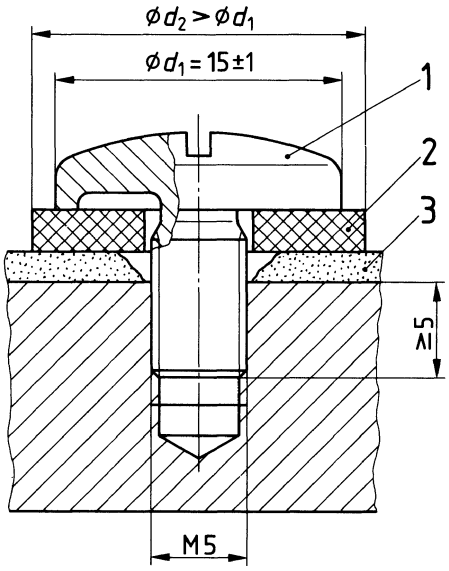


Key

1 plug
2 gasket
3 enamel coating

Figure 1 — Repair of enamel defect with type A plug

Dimensions in millimetres



Key

1 plug
2 gasket
3 enamel coating

Figure 2 — Repair of enamel defect with type B plug

Plugs shall be set at right angles to the surface. Their bearing surface shall be in full contact with the gasket. The length of the plug thread shall be chosen to ensure proper seating. The centreline distance between two plugs shall not be less than 100 mm.

The maximum permissible number of defects which may be repaired by plugging is given in Tables 1 and 2.

The manufacturer shall provide the customer with a sketch indicating the locations of repairs.

6.2 Removing impurities

Impurities (see 3.4.3) shall be removed by grinding and polishing, taking the following requirements into account:

a) the enamel thickness remaining shall be at least 0,9 mm for vitreous enamel and 1,1 mm for semi-crystallized enamel;

b) the grinding depth shall not exceed 0,5 mm;

c) following the removal of impurities, no coarse bubble structure shall be present.

If these requirements cannot be met, the enamel defects shall be repaired as described in 6.1.

7 Test report

The test report shall include the following information, depending on the scope of testing:

a) all information necessary to identify the sample tested, including:

   1) the name of the manufacturer,

   2) the product and its size,

   3) details of the order (e.g. the order date and number),

   4) the drawing number,

   5) the enamel quality;

b) a reference to this part of ISO 28721 (ISO 28721-1:2008);

c) the type and scope of testing (e.g. enamel quality testing, dimensional check, performance testing);

d) the results of the tests, including the results of the individual determinations, and:

   1) where relevant, the general state of the components at the time of testing (e.g. clean, dry, hardly accessible, partly dirty),

   2) the results of the visual examination,

   3) the voltage used in the high-voltage test and the results obtained,

   4) where relevant, the results of the crack detection test,

   5) the coating thickness,

   6) a sketch or description indicating the location and the number of defects repaired with plugs,

   7) the results of the dimensional measurements,

8) the eccentricity of agitators and pump rotors,

9) the results of performance testing,

10) the results of the completeness check, including details of the surface protection of non-enamelled surfaces;

e) any deviations from the procedures specified;

f) any unusual features (anomalies) observed during the tests;

g) the date of testing and the signature of the manufacturer's or the customer's representative.

The forms shown in Annex A may be used for the test report.

8 Packaging and transportation

The vessel shall be clean and dry inside.

Due to the brittleness of the enamel, glass-lined apparatus and components are very sensitive to mechanical shock, e.g. impact or local deformation. The type of packaging shall be chosen by the manufacturer to ensure that glass-lined products withstand the expected transport conditions. The packaging shall take into account the size and mass of the glass-lined products, the rigidity of glass-lined components, the way in which they will be loaded and unloaded, the means of transport, the nature of any transfers and, if necessary, the storage conditions once the products have reached their destination.

Accessories inside the vessels shall be secured in such a way that direct contact with other components is avoided.

Nozzles shall be covered with rubber or plastic lids that are thick enough to ensure sufficient protection of flange faces.

When transporting individual components of vessels, the flange faces shall be protected by a soft material covered by wooden discs.

Small components should preferably be packed in separate wooden boxes.

Bare metal surfaces, such as fitting surfaces machined to particularly close tolerances, shall be protected against atmospheric corrosion.

The packed products shall bear clearly visible information, or a pictogram in accordance with ISO 780, indicating the care with which they should be handled during transport.

Each package shall bear a visible and durable tag, tightly attached, indicating at least the manufacturer's name and the the order number.

Vessels shall be wedged in place and held on square timber frames. Care shall be taken that the nameplate, affixed to the side or top of the vessel, is visible and legible from above or from the side and that manholes are positioned to allow easy access.

Details regarding packaging may be agreed upon between the parties at the time of ordering.

9 Inspection at delivery

The delivered components shall be tested at delivery in accordance with the tests described in 4.2, 4.3 (test voltage up to 8 kV) and 4.4 to detect any defects or damage resulting from transportation.

Annex A
(informative)

Examples of test reports

Manufacturer	**Test report**	**Form 1** Page 1

Customer _____ Type of apparatus _____

Customer's order No. _____ Manufacturer's order _____

Date of order _____ No. of manufacturer _____

Customer's identification _____

The items listed below were tested for enamel defects in accordance with the following methods:

- Visual inspection;
- Coating thickness in accordance with ISO 2808;
- High-voltage test in accordance with EN 14430.

The item complies with ISO 28721-1 as well as with the other, optional, agreements made at the time of order.

For deviations, see remarks.

Test results

Item No.	**Description**	**Main dimensions or drawing No.**	**Type of enamel**	**Enamel thickness, min./max.** mm	**Result**
1	Vessel				
2	Cover/assembly cover				
3	Manhole cover				
4	Protective ring				
5	Agitator impeller/anchor				
6	Agitator shaft				
7	Agitator hub and blades				
8	Baffle				
9	Baffle				
10	Thermo pipe				
11	Dip pipe				
12					
13					
14					

Remarks _____

_____

_____

For positions of defects, see form 1, page 2.

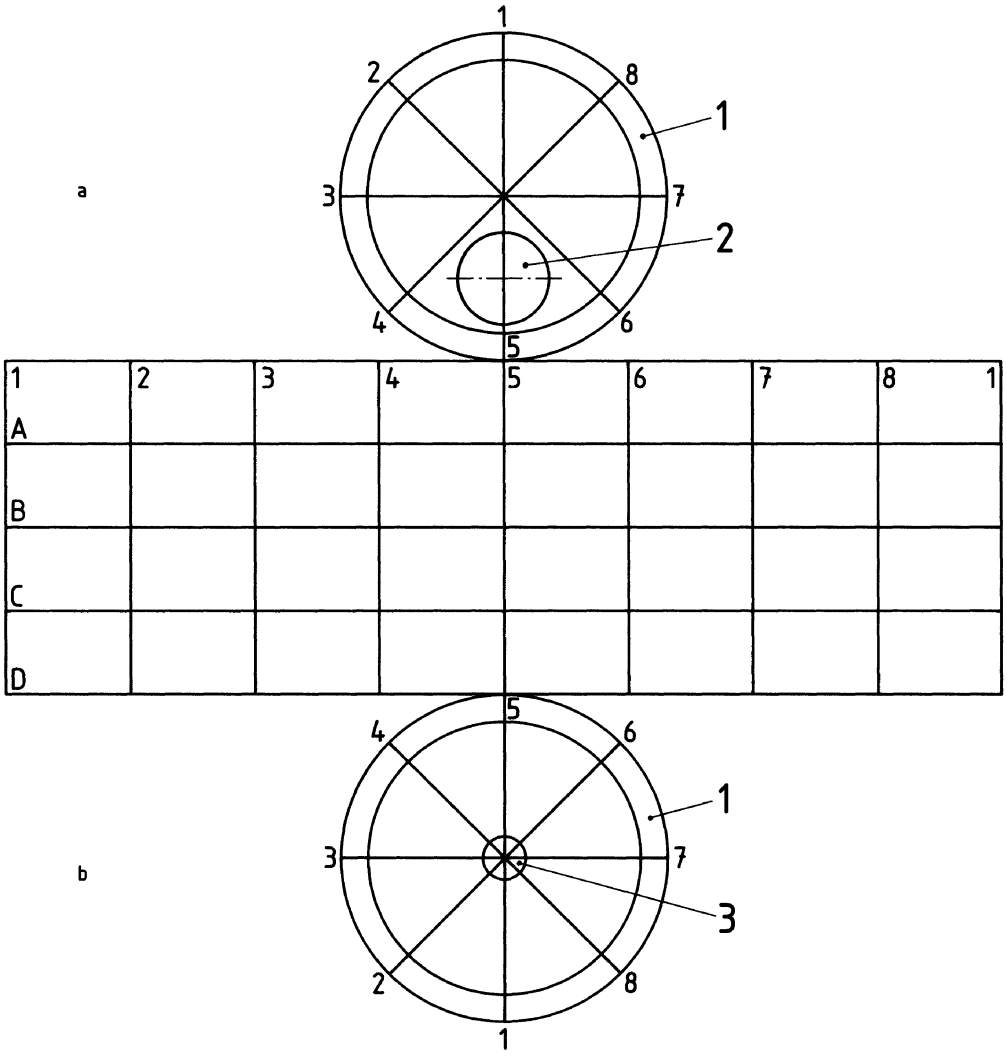
Approved for assembly/delivery: ☐ yes ☐ no ☐ see remarks

Manufacturer's inspector	Customer's inspector
Signature: _____ Date:_____	Signature: _____ Date_____

Form 1
Page 2

Positions of defects

Inside view



1 bottom rim
2 manhole
3 outlet nozzle
a top head
b bottom head

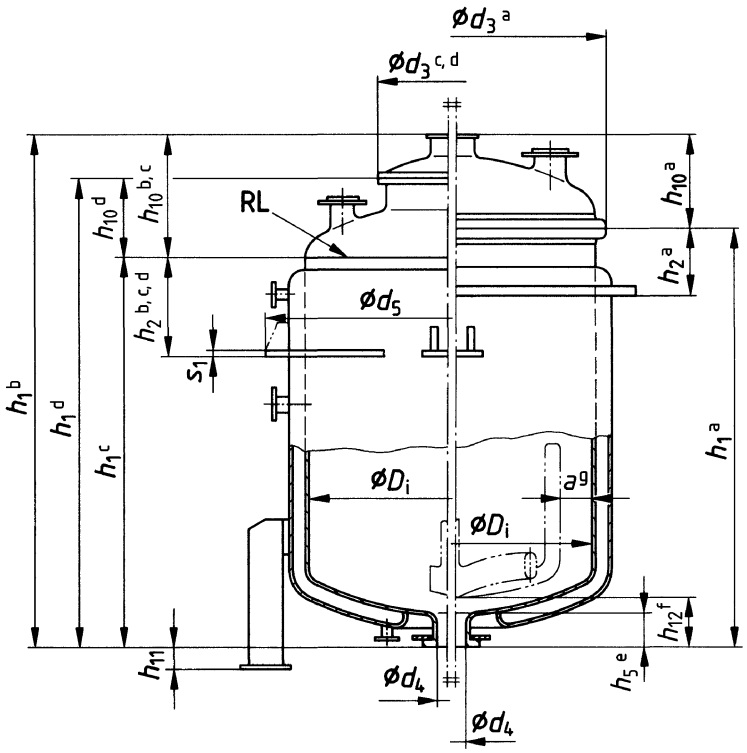
Remarks

Manufacturer	**Test report for glass-lined agitator vessels — Dimensions, performance and completeness**	**Form 2** Page 1

Customer _____ Type of apparatus _____
Customer's order No. _____ Manufacturer's order _____
Date of order _____ No. of manufacturer _____
Customer's identification _____ No. of drawing _____

a) Dimensions

Dimensions as agreed between the interested parties.
Dimensions in millimetres

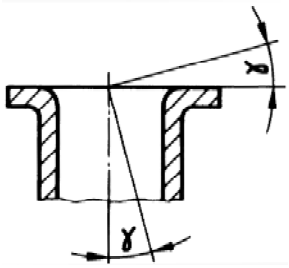


	Set value	Actual value, min.	Actual value, max.
D_i			
d_3			
d_4			
d_5			
s_1			
h_1			
h_2			
h_5			
h_{10}			
h_{11}			
h_{12}			
a			

[a] to [g] Dimension applicable, i.e. measured in the following cases:

[a] for type AE (two-piece construction);
[b] for type BE (one-piece construction without assembly cover);
[c] for type CE $\leqslant$ 4 000 l (one piece construction with assembly cover);
[d] for type CE $>$ 4 000 l (one-piece construction with assembly cover);
[e] when supplied without agitator;
[f] when agitator installed;
[g] for anchor agitator only.
RL reference line

Check of out-of-plane-angle of sealing surface of nozzles:



	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
γ										

Checklist for inspector — Checked for:

☐ Same dimensions as in drawing
☐ Flatness of flange sealing surfaces
☐ Make of agitator flange
☐ Positions of support elements
☐ Position of power-supply connection

Thickness of gasket:

— assembly opening, max. = _____ mm
— manhole opening, max. = _____ mm

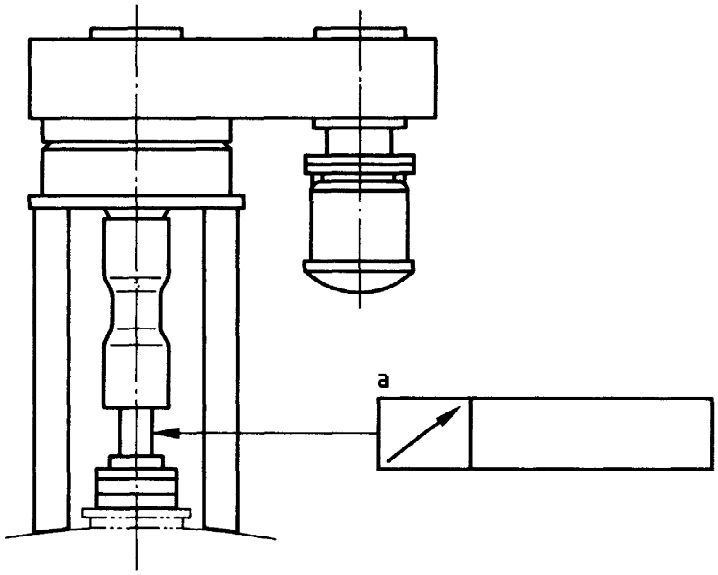
Remarks _____

Manufacturer's inspector Signature: _____ Date: _____	Customer's inspector Signature: _____ Date:_____

	Form 2 Page 2

b) Test run — Drive unit: Vessel empty ☐ full ☐

Eccentricity of agitator shaft as agreed between the interested parties



Speed of agitator shaft (revs/min): _____

Type of gear _____

Type of mechanical seal _____

Type of back-pressure unit _____

☐ Drive data
☐ Sealing liquid system
☐ Sound pressure level
comply with the order.

Key

a Eccentricity — actual value in mm

Remarks _____

_____

_____

c) Completeness check

The apparatus complies with the order: ☐ yes ☐ no

Exterior coating: ☐ Primer ☐ Final coat

The vessel/component is approved for delivery/customer's inspection: ☐ yes ☐ no

Remarks _____

_____

_____

Manufacturer's inspector	Customer's inspector
Signature: _____ Date: _____	Signature: _____ Date: _____

Manufacturer	**Test report for glass-lined vessels in vertical position — Dimensions and completeness**	**Form 3**

Customer _____ Type of apparatus _____

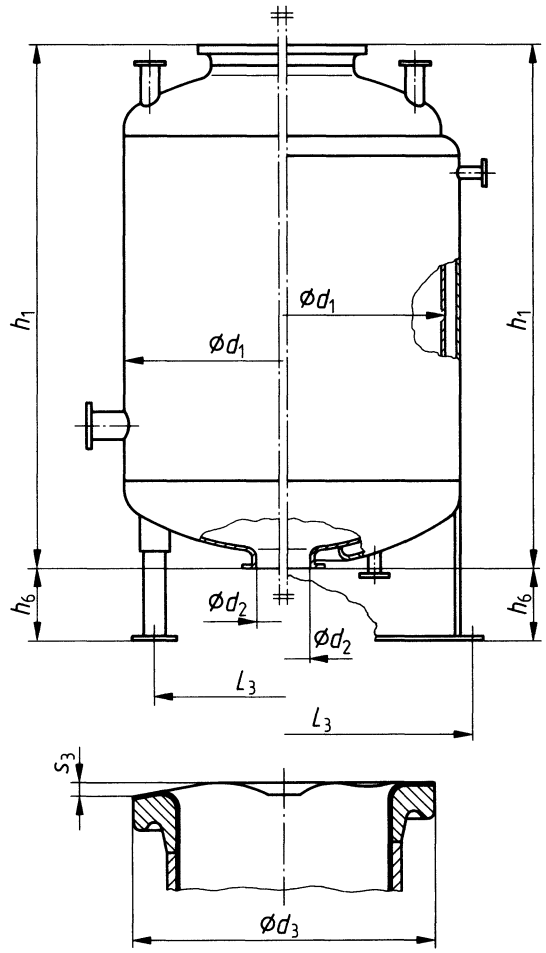
Customer's order No. _____ Manufacturer's order _____

Date of order _____ No. of manufacturer _____

Customer's identification _____ No. of drawing _____

a) Dimensions

Dimensions as agreed between the interested parties.
Dimensions in millimetres



	Set value	Actual value, min.	Actual value, max.
d_1			
h_1			
d_2			
h_6			
L_3			

Checked for:

- ☐ Dimensions
- ☐ Flatness of flange sealing surfaces
- ☐ Positions of support elements
- ☐ Position of power-supply connection

Manhole

	Set value	Actual value, min.	Actual value, max.
d_3			
s_3			

b) Completeness check

The apparatus complies with the order: ☐ yes ☐ no

Exterior coating: ☐ Primer ☐ Final coat

The vessel is approved for delivery/customer's inspection: ☐ yes ☐ no

Remarks _____

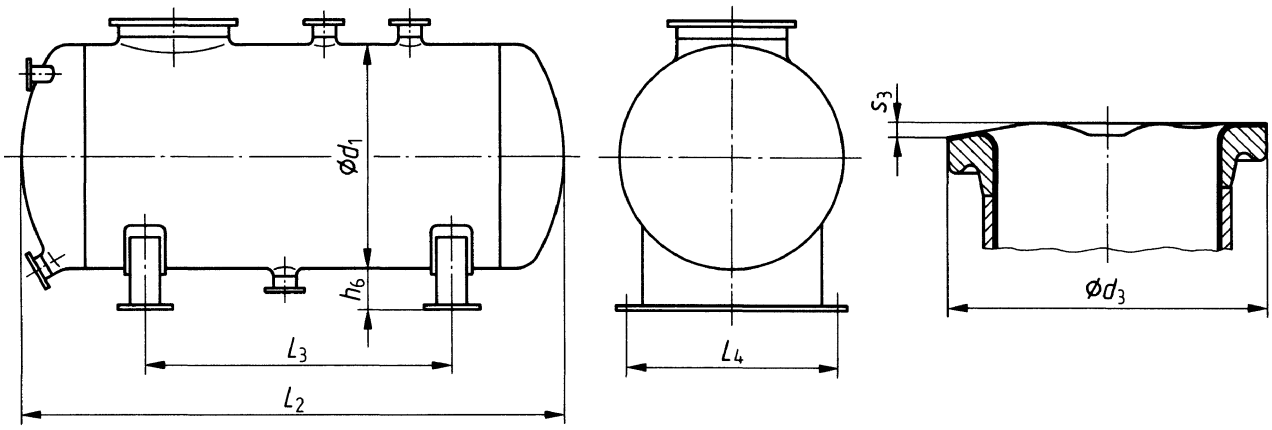
Manufacturer's inspector	Customer's inspector
Signature: _____ Date: _____	Signature:_____ Date: _____

Manufacturer	**Test report for glass-lined vessels in horizontal position — Dimensions and completeness**	**Form 4**

Customer _____ Type of apparatus _____
Customer's order No. _____ Manufacturer's order _____
Date of order _____ No. of manufacturer _____
tomer's identification _____ No. of drawing _____

a) Dimensions

Dimensions as agreed between the interested parties.
Dimensions in millimetres



	Set value	Actual value, min.	Actual value, max.
d_1			
L_2			
h_6			
L_3			
L_4			

Manhole 1

	Set value	Actual value, min.	Actual value, max.
d_3			
s_3			

Manhole 2

	Set value	Actual value min.	Actual value max.
d_3			
s_3			

Checked for:
☐ Dimensions
☐ Flatness of flange sealing surfaces
☐ Positions of support elements

b) Completeness check

The apparatus complies with the order: ☐ yes ☐ no
Exterior coating: ☐ Primer ☐ Final coat
The vessel is approved for delivery/customer's inspection: ☐ yes ☐ no
Remarks _____

Manufacturer's inspector	Customer's inspector
Signature: _____ Date: _____	Signature: _____ Date:_____

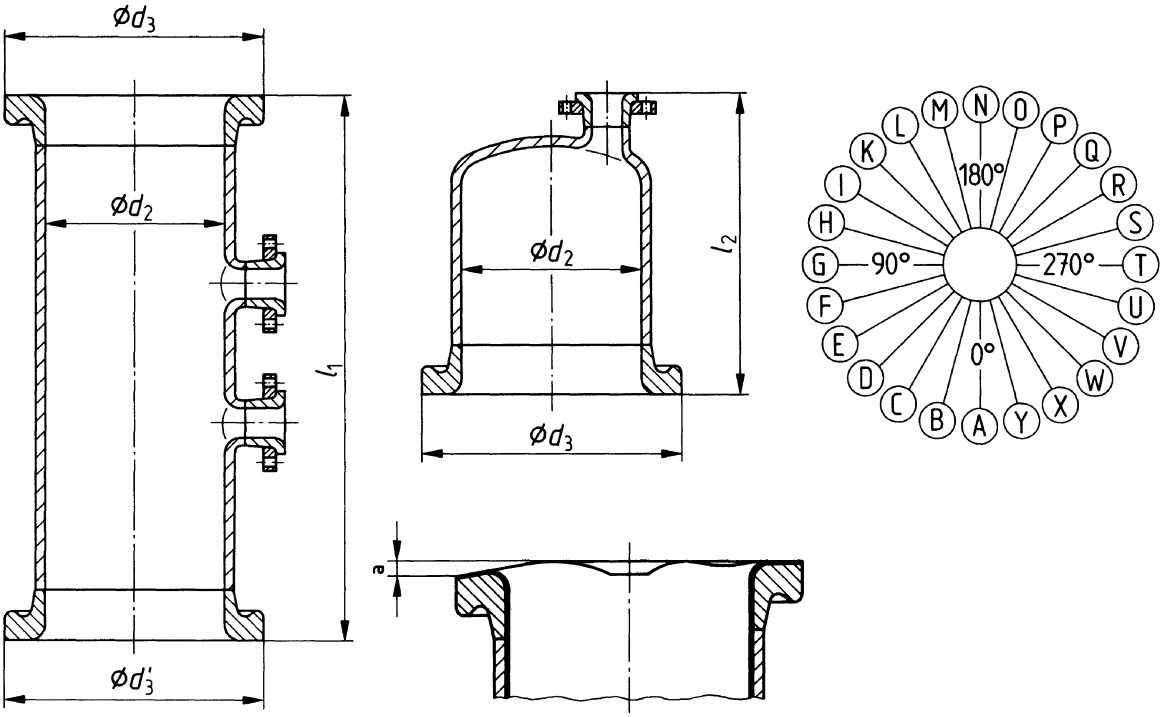
Manufacturer	**Test report for glass-lined columns — Dimensions and completeness**	**Form 5**

Customer _____ Type of apparatus _____
Customer's order No. _____ Manufacturer's order _____
Date of order _____ No. of manufacturer _____
Customer's identification _____ No. of drawing _____

a) Dimensions

Dimensions as agreed between the interested parties.
Dimensions in millimetres

Check exact positions of nozzles according to drawing. Record the nominal diameter, e.g.
Ⓐ N_1 = DN 200 Ⓗ N_2 = DN 80



Checked for:
- ☐ Dimensions
- ☐ Flatness of flange sealing surfaces
- ☐ Positions of support elements
- ☐ Position of power-supply connection

	Set value	Actual value, min.	Actual value, max.
d_2			
l_1			
l_2			
d_3			
d_3'			
a			

b) Completeness check

The apparatus complies with the order: ☐ yes ☐ no
Exterior coating: ☐ Primer ☐ Final coat
The column/component is approved for delivery/customer's inspection: ☐ yes ☐ no
Remarks _____

Manufacturer's inspector	Customer's inspector
Signature: _____ Date: _____	Signature: _____ Date: _____

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[1] DIN 2876, *Flanged steel pipes and flanged steel fittings glass lined — Technical specifications*

[2] DIN 28005-2, *General tolerances for vessels — Part 2: Glass lined vessels*

[3] DIN 28006-2, *General tolerances for agitator vessels — Part 2: Glass lined agitator vessels*

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[5] DIN 28159, *Shaft end for externally coupled glass lined steel agitators — Dimensions*

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[7] DIN 28161, *Requirements on agitator drives — Agitator speed and direction, bearing application running accuracy, dis-mounting space for shaft seal*

[8] ISO 2808, *Paints and varnishes — Determination of film thickness*

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