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ISO 21898

Second edition
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Packaging — Flexible intermediate bulk containers (FIBCs) for non-dangerous goods

Emballages — Grands récipients pour vrac souples (GRVS) pour matières non dangereuses

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Foreword

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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 document 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).

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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 122, *Packaging*, Subcommittee SC 3, *Performance requirements and tests for means of packaging, packages and unit loads (as required by ISO/TC 122)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 261, *Packaging,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 21898:2004), which has been technically revised.

The main changes are as follows:

— in 5.2.1, a new note on non-standard filling material has been added;

— a new subclause 4.4 on the use of and requirement for recycled materials has been added;

— a new subclause 4.5 on electrostatic protective FIBC has been added;

— in Clause 7, the label has been modified;

— Annex A has been revised;

— Annex C has been revised;

— a new Annex F, Optional methods for UV resistance test, has been added;

— IEC 61340-4-4 has been incorporated in the document through a series of cross-references.

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.

Packaging — Flexible intermediate bulk containers (FIBCs) for non-dangerous goods

1 Scope

This document specifies materials, construction and design requirements, type test and marking requirements for flexible intermediate bulk containers (FIBCs) intended to contain non-dangerous solid materials in powder, granular or paste form, and designed to be lifted from above by integral or detachable devices.

This document also provides guidance on the selection and safe usage of FIBCs.

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.

ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 12048, *Packaging — Complete, filled transport packages — Compression and stacking tests using a compression tester*

ISO 13934-1, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method*

IEC 61340-4-4, *Electrostatics — Part 4-4: Standard test methods for specific applications — Electrostatic classification of flexible intermediate bulk containers (FIBC)*

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/

3.1 General

3.1.1
flexible intermediate bulk container
FIBC
intermediate bulk container having the body made of flexible material such as woven plastic fabric or plastics film, designed to be in contact with the contents, either directly or through an inner liner, and collapsible when empty

3.1.2
heavy-duty reusable flexible intermediate bulk container
FIBC designed and intended to be used for a multitude of fillings and discharges, and both factory and field repairable in such a way that the tensile strength across a repair is at least as great as that of the original

3.1.3
standard-duty reusable flexible intermediate bulk container
FIBC designed and intended to be used for a limited number of fillings and discharges

Note 1 to entry: An FIBC of this category cannot be reused if damaged, i.e. it is not repairable.

Note 2 to entry: The replacement of a removable inner liner is not considered a repair.

3.1.4
single-trip flexible intermediate bulk container
FIBC designed and intended to be used for one filling only

Note 1 to entry: An FIBC of this category cannot be reused. Neither replacement of an inner liner nor repair of the FIBC is relevant to this category.

3.1.5
FIBC type
FIBCs of like design, manufactured using like materials and methods of construction (giving at least equal performance) to the same nominal cross-sectional dimensions

Note 1 to entry: Within a type, the circumference may be increased by up to 10 % by comparison with samples passing a type test, provided the same geometry is maintained. Where the type has a base discharge spout, smaller diameter discharge spouts of like design may be used.

Note 2 to entry: The presence or absence of an inner liner does not constitute a change of type.

3.1.6
safe working load
SWL
maximum load which the FIBC may carry in service, as certified

3.1.7
safety factor
SF
integer quotient between the final test load in the cyclic top lift test and the SWL value rounded down

Note 1 to entry: Safety factors can be illustrated as follows (see also B.3.3):

	Example 1	**Example 2**
Designated SWL	500 kg	500 kg
Final load, cyclic test	2 400 kg	2 600 kg
Quotient	4,8	5,2
Integer quotient, rounded down	4	5

Note 2 to entry: The results in Example 1 indicate a single-trip FIBC which does not meet the requirements of this document, whilst those in Example 2 indicate a single-trip FIBC which meets the requirements.

3.1.8
lifting device
integral and/or fixed lifting devices which form part of the FIBC and are tested with it

Note 1 to entry: Detachable lifting devices are regarded as lifting tools.

3.2 FIBC parts

3.2.1
walls
tube of one or more layers, seamless or made out of one or more panels joined together

3.2.2
base
part of the FIBC which is connected to or integral with the walls and forms the base of the standing FIBC

3.2.3
plain base
base without an opening

3.2.4
full open base
extensions to the wall(s), forming the base of the FIBC after closing

3.2.5
top
part of the FIBC, excluding handling devices, forming the upper end of the FIBC after closing

3.2.6
body
walls and base of the FIBC

3.2.7
inner liner
integral or removable container which fits into the FIBC

3.3 Operating devices

3.3.1
filling spout
tube-shaped part at the top for filling the FIBC

3.3.2
filling slit
slit-shaped opening at the top for filling the FIBC

3.3.3
discharging spout
tube-shaped part at the base for discharging the FIBC

3.4 Handling devices

3.4.1
lifting devices
webbings, loops, ropes, eyes, frames or other devices formed from a continuation of the walls of the FIBC, which are integral or detachable, and are used to support or lift the FIBC

3.4.2
four-point lifting
four lifting devices used simultaneously to lift the FIBC

3.4.3
two-point lifting
two lifting devices used simultaneously to lift the FIBC

3.4.4
one-point lifting
one lifting device, or one or more lifting devices brought to one point for lifting

3.5
coated and laminated materials
materials having a surface coating or comprising two or more layers laminated together to protect the contents of the filled FIBC or to protect the environment against the effects of leakage of the contents

3.6 Special treatments

3.6.1
stabilization
modification of the FIBC materials to give better resistance against weathering and ageing

EXAMPLE The addition of an ultraviolet (UV) absorber and/or an antioxidant.

3.6.2
electrostatic protective treatment
treatment for modifying the electrostatic behaviour of the FIBC

3.6.3
insect-repellent treatment
treatment for increasing the ability of the FIBC to protect itself and/or its contents against insect attack

3.6.4
flame-retardant treatment
treatment to impart flame resistance to the FIBC

4 Materials, construction and design

4.1 Materials

All categories of FIBC shall be manufactured from flexible materials covered by a written specification. The FIBC manufacturer shall have an authorized statement of conformity for each separate batch of materials.

The materials can have a surface coating or consist of two or more layers laminated together to protect the contents of the filled FIBC or to protect the environment from the effects of leakage of the contents.

The properties of the materials can be modified by additives to improve the resistance of the materials against, for example, degradation by heat and sunlight, and to reduce the effect of static electricity.

NOTE IEC 61340-4-4 specifies a test method for the electrostatic classification of FIBCs.

All load-bearing materials of the FIBC shall be tested in accordance with the test method specified in Annex A and shall retain at least 50 % of their initial values of the force at rupture and elongation at rupture.

Other light sources than the one specified in Annex A can be used. Details of these other light sources are given in Annex F.

In case of dispute, the light source specified in Annex A shall be used.

Materials should be chosen and joined together in such a way that recovery is promoted.

4.2 Construction

All stitched seams and joints shall be locked off and/or back sewn, or provided with a minimum 20 mm tail. All stitched seam-ends shall be secured. The surfaces to be joined by welding, gluing or heat-sealing shall be clean.

NOTE Annex E shows some design examples of FIBCs illustrated in Figures E.1 to E.13.

4.3 Design filling height

The designed filling height of the FIBC should be 2,0 times maximum of the shortest horizontal dimension of the FIBC.

NOTE 1 For FIBCs with a circular cross-section, the shortest horizontal dimension is normally the diameter of the FIBC base, even if the base has square dimensions. For FIBCs with a rectangular base, the shortest horizontal dimension is normally the shortest side.

NOTE 2 Detailed guidance on the selection and use of FIBCs is given in Annex D.

4.4 Recycled materials

Recycled mono-materials (RM), consisting of 95 % or more of the same polymer, can be used for all components of the FIBC.

As long as the following point is observed, there is no percentage restriction on the use of recycled materials.

— FIBCs from recycled material shall fulfil the same test criteria as FIBCs made of virgin material.

— If the application allows the use of liners from recycled materials, it shall fulfil the same test criteria as liners made of virgin material.

4.5 Electrostatic protective FIBC

Electrostatic discharges from FIBC can ignite explosive atmospheres formed by combustible dusts, gases or solvent vapours. To minimize the risk of explosion, FIBC intended for use in hazardous explosive atmospheres shall meet the requirements specified in IEC 61340-4-4.

NOTE 1 Detailed guidance on the selection and use of FIBCs is given in Annex D.

NOTE 2 Annex E shows some design examples of FIBCs illustrated in Figures E.1 to E.13.

5 Performance

5.1 Type-testing

All FIBC types shall be subjected to the following tests:

a) cyclic top lift;

b) compression/stacking test.

At least three specimens of each FIBC type shall be submitted for testing leading to certification. The specimens shall be tested as follows.

— Specimen 1: cyclic top lift test using the FIBC having the shortest vertical dimension.

— Specimen 2: cyclic top lift test using the FIBC having the greatest vertical dimension.

— Specimen 3: compression test using the FIBC having the greatest vertical dimension.

To conform with this document, the three specimens shall all withstand the tests.

When the FIBC type has only one fixed vertical dimension, only Specimens 1 and 3 need to be submitted and tested to withstand the tests.

One tested sample shall be durably identified and retained for reference in any later complaint or arbitration.

Tests shall be carried out at a testing facility with suitable calibration and operation.

5.2 Preparation of FIBC for test

5.2.1 Filling

For both the top lift and compression/stacking test, the FIBC shall be filled to the level specified in accordance with 4.3 by the manufacturer/supplier with a tolerance of between 0 % to +5 % of that height. The FIBC shall be filled with either:

a) a material, for example plastics granules, having the following mechanical properties:

- bulk density, 400 kg/m^3 to 900 kg/m^3,
- mesh size 3 mm to 12 mm,
- angle of repose 30° to 35°, or

b) the actual contents to be carried, when these are known, and where their use will not itself be a hazard.

NOTE 1 When option b) is chosen, the FIBC type is certified in relation to that specific product only.

NOTE 2 The transport of coarse sharp-edged materials in FIBCs is a non-standard use (see Clause 1). Such materials may only be transported in FIBCs that are marked with a special label. The special label is issued when the FIBCs have been tested with the intended filling material.

5.2.2 Conditioning

The filled FIBC shall be conditioned before testing at ambient temperature and relative humidity. However, in the event of dispute, testing shall be carried out after conditioning under standard conditions of (23 ± 2) °C and (50 ± 5) % relative humidity.

5.3 Test requirements

5.3.1 Cyclic top lift test(s)

Cyclic top lift test(s) shall be carried out in accordance with Annex B and the following criteria shall apply:

a) there shall be no breakage of any lifting devices to the extent that any of the lifting devices ceases to support its load;

b) when tested with an inner liner, there shall be no protrusion of the latter beyond the outer surface of the FIBC, except through the closure(s), where this is a design feature;

c) there shall be no loss of contents;

d) no deterioration of the body which renders the FIBC unsafe for transport or storage.

A slight discharge during the test (e.g. from closures or stitch holes) should not be considered to be a failure of the FIBC, provided that no further leakage occurs after the FIBC has been raised clear of the ground.

5.3.2 Compression/stacking test

The compression/stacking test shall be carried out in accordance with Annex C and the following criteria shall apply:

a) there shall be no loss of contents;

b) no deterioration of the body which renders the FIBC unsafe for transport or storage.

A slight discharge during the test (e.g. from closures or stitch holes) should not be considered to be a failure of the FIBC, provided that no further leakage occurs after the FIBC has been raised clear of the ground.

6 Statement of conformity

The statement of conformity to this document shall contain the data shown for the marking specified in Clause 7 a) to i) and Clause 7 k) to m).

And if available, together with;

a) the name(s) and address(es) of the conformity assessment body, together with the reference(s) and date(s) of the relevant test report(s), and

b) the material used as contents in the cyclic top lift and compression/stacking tests.

A document for an FIBC type should be valid for a period of three years from the date of issue.

An FIBC documented and marked as a single-trip FIBC in conformity with this document shall not be reused.

An FIBC documented and marked as a reusable (heavy- or standard-duty) FIBC in conformity with this document shall be reused only with the same type of contents as in the first use.

Reuse of FIBCs with contents differing from those of the first use is not in accordance with this document.

7 Marking

All FIBCs shall be durably marked by means of a permanently attached and easily visible and readable label, or durably printed on the body so that it is easily visible and read after the FIBC has been filled. The following data shall be included:

a) name and address of the manufacturer;

b) manufacturer's reference, which shall be unique to any one FIBC type;

c) safe working load (SWL) in kilograms (see Figure 1 as example);

d) safety factor (SF), i.e. 5:1, 6:1 or 8:1 as appropriate (see Figure 1 as example);

e) maximum number of the FIBCs permitted to be stacked on the bottom FIBC (see Figure 1 as example);

f) test number (which shall be unique to any one type);

g) test date: the month and year in which the type test was issued;

h) name of the approved laboratory;

i) a reference to this document, i.e. ISO 21898:2024;

j) class of FIBC, i.e. "heavy-duty reusable", "standard-duty reusable" or "single-trip";

k) date of manufacture of the FIBC, i.e. month and year;

l) handling recommendations/pictograms;

m) details of any special treatments including stabilization, electrostatic protective treatment, insect-repellent treatment and flame-retardant treatment as defined in 3.6 or coated and laminated materials described in 4.1;

n) where the FIBC is certified in relation to a specific product, the description of that product shall be added;

o) name and address of the supplier, if required;

The layout of the label shall be as in Figure 1. Additions of calendars or lists of safe working loads and safety factors to be ticked to are not permitted.

The label description should be contained in Figure 1.

<table>
<tr><td colspan="2">MANUFACTURER’S NAME & ADDRESS:</td></tr>
<tr><td colspan="2">MANUFACTURER’S REFERENCE:</td></tr>
<tr><td colspan="2"><EXAMPLE>

SWL= 1 000 kg
SF= 5 : 1

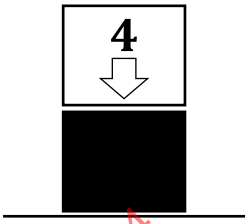
MAX
PERMITTED
STACKING
1 + 4 BAGS
  </td></tr>
<tr><td rowspan="8">MATERIAL DETAILS IF ANY SPECIAL TREATMENT, COAT, OR LAMINATE</td><td>TEST No:</td></tr>
<tr><td>TEST Date:</td></tr>
<tr><td>APPROVED LABORATORY:</td></tr>
<tr><td>TEST STANDARD: ISO 21898:20xx</td></tr>
<tr><td>FIBC CLASS:</td></tr>
<tr><td>DATE OF MANUFACTURE OF FIBC:</td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td colspan="2">Handling recommendations/Pictograms:</td></tr>
<tr><td colspan="2">Supplier’s name and address (if required):</td></tr>
</table>

Figure 1 — Example of an FIBC label

Annex A
(normative)

Evaluation of the UV resistance

A.1 General

FIBCs shall provide adequate resistance to ageing and to degradation caused by ultraviolet radiation or the climatic conditions, or by the substances contained, thereby rendering them appropriate to their intended use. For plastics where protection against ultraviolet radiation is required, it shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the lifetime of the body. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the tested design type, re-testing can be waived if changes in the carbon black content, the pigment content or the inhibitor content do not adversely affect the physical properties of the material of construction. Certain types of UV stabilizing additives are rapidly leached out, especially in an alkaline environment. This should be taken into consideration in applicable situations.

The performance of UV stabilizing additives can be affected by colour and the type of pigment used. Therefore, each combination of UV stabilizing additive and pigment should be tested separately.

A.2 Principle

The test shall be carried out by exposing specimens to an artificial light source, alternating repetitively with condensation or atomization. Specimens cut from the load-bearing materials of the FIBC (e.g. fabric, webbing, rope, sewing thread, glues) are subjected for a specified time period to irradiation from a type of fluorescent UV lamps with specified spectral distribution.

A.3 Test methods

A.3.1 Apparatus

The apparatus shall be in accordance with ISO 4892-3, using a UVB-313 lamp with an irradiance of 0,71 W/m^2/nm at 310 nm.

A.3.2 Test procedure

A.3.2.1 FIBCs for general use

a) Expose the test specimen to the UV lamp irradiation for 8 h at a black-panel temperature of (60 ± 3) °C.

b) Turn off the UV lamp and keep the test specimens for 4 h at (50 ± 3) °C of black-panel temperature with condensation.

c) a) and b) constitutes one cycle. Repeat a) and b) for a total duration of at least 300 h.

A.3.2.2 FIBCs for long term outside storage

If the FIBCs are expected or designed for long term outside storage, the following procedure may be applied with the agreement of the stakeholders.

a) Expose the test specimens to the UV lamp irradiation for 8 h at a black-panel temperature of (60 ± 3) °C.

b) Turn off the UV lamp and keep the test specimens for 4 h at (50 ± 3) °C of black-panel temperature with condensation.

c) a) and b) constitutes one cycle. Repeat a) and b) for a total duration of at least 1 500 h.

A.4 Measurement of the residual force at rupture and residual elongation at rupture

Once the total duration of the exposure is performed, condition the exposed test specimens according to 5.2.2 and determine the force at rupture and elongation at rupture in accordance with ISO 13934-1.

Condition a set of unexposed test specimens that have been stored under dark and cool conditions according to 5.2.2 and determine the force at rupture and elongation at rupture in accordance with ISO 13934-1.

Calculate the arithmetic mean value of the measurements performed on the exposed test specimens and the arithmetic mean value of the measurements performed on the unexposed specimens. Compare these two values.

The test is considered successful when the arithmetic mean values of force at rupture and elongation at rupture calculated for exposed test specimens are equal or greater than 50 % of the values calculated for unexposed specimens.

NOTE Deterioration due to UV irradiation and rainwater in the actual environment and deterioration due to the testing apparatus differs depending on the region and natural environment. It is very difficult to determine what period of time the results of this test correspond to in the actual environment.

A.5 Test report

The test report shall include the following information.

a) The arithmetic mean of the force at rupture, in newtons, of the exposed and unexposed specimens.

b) The ratio of the arithmetic mean of the force at rupture after exposure to the arithmetic mean of force at rupture of unexposed specimens, in percent.

c) The arithmetic mean of the elongation at rupture, in percent, of the exposed and unexposed specimens.

d) The ratio of the arithmetic mean of the elongation at rupture after exposure to the arithmetic mean of elongation at rupture of unexposed specimens, in per cent.

Annex B
(normative)

Cyclic top lift test

B.1 Principle

The filled FIBC is suspended by its lifting devices with a flat pressure plate positioned on top of the contents. This is done in one of two alternative ways:

a) the pressure plate is restrained either from above or below; the FIBC is suspended from a frame to which an upward force is applied progressively against the resistance of the pressure plate;

b) the FIBC is suspended from a frame fixed at the time of test, then a downward force is applied progressively to the pressure plate.

The filled FIBC is subjected to a repeated loading, unloading and dwell cycle. The force is recorded and the FIBC is observed for breakage of any lifting device, other damage or leakage of contents.

B.2 Requirements for apparatus

B.2.1 General

B.2.1.1 The pressure plate shall be flat except that flanges can be fitted to its underside to prevent lateral displacement. The plate shall be of such a size that it covers between 60 % and 80 % of the surface area of the contents.

B.2.1.2 The suspension frame shall be such that, during the test, the filled FIBC can be suspended clear of the ground with its lifting devices positioned as recommended by the manufacturer. For FIBCs designed for four-point lifting, the suspension frame shall have the cross section shown in Figure B.1. For FIBCs designed for single-point lifting, the suspension frame shall have the cross section shown in Figure B.2. For FIBCs designed for two-point lifting, the suspension frame shall have the cross section shown in Figure B.1 or B.2.

B.2.1.3 The means of applying the force (upwards or downwards) shall be

a) capable of at least the required test load,

b) capable of a rate of (70 ± 20) kN/min,

c) fitted with a means of registering the applied force.

B.2.1.4 The suspension frame, the pressure plate (and any restraint used for the latter) shall be capable of resisting the forces applied during the test with minimal deformation.

B.2.2 Apparatus for use when an upward force is applied

B.2.2.1 Apparatus of the appropriate type illustrated in one of Figures B.3 to B.9 shall be used for FIBCs being subjected to top lift testing using top or base restraint and an upward force as in B.1 a). The figures are as follows.

— Figure B.3: Perspective view of an FIBC with four lifting devices using top restraint.

— Figure B.4: Elevation of an FIBC with two lifting devices using top restraint.

— Figure B.5: Elevation of an FIBC with the lifting devices formed by extensions of the body and using top restraint.

— Figure B.6: Elevation of a single-point lift FIBC with base restraint using one member restraining the pressure plate.

— Figure B.7: Similar to Figure B.6 but with two members restraining the pressure plate.

— Figure B.8: Elevation of an FIBC with two lifting devices using base restraint and one member restraining the pressure plate.

— Figure B.9: As Figure B.8 but with two members restraining the pressure plate.

B.2.2.2 Use of the apparatus illustrated in Figures B.6 to B.9 with base restraint involves connections passing through the body of the FIBC and its test contents. Rods are a suitable method of making such connections.

Considerable care shall be taken

a) that the threads shall be separated with woven fabrics rather than be cut to permit passage of a rod,

b) to ensure that any rod passes through the base no closer than 20 mm to any base seams or joins. When, as with an FIBC having a seam or join running across the centre of the base, a single rod would need to pass within 20 mm of a seam or join, then two rods should be used as shown in Figures B.7 and B.9.

It is recommended that

— a conical adaptor be screwed to the top of any restraining rod and removed once the FIBC is in position for test,

— nuts be used to connect the rod(s) to the pressure plate and to a restraint.

B.2.3 Apparatus for use when a downward force is used

Apparatus of the type illustrated in Figure B.10 shall be used for FIBCs being subjected to top lift testing using a downward force as in B.1 b).

B.3 Procedure

B.3.1 Select, fill and condition each FIBC for cyclic top lift testing in accordance with 5.1, 5.2 and 5.3.

Any top panel not designed to contribute to the overall strength of the FIBC may be removed to allow the entry of the test apparatus. The area removed should be the minimum commensurate with efficient operation of the test apparatus.

B.3.2 Select any appropriate size of pressure plate in accordance with B.2.1.1 and position it above the contents. This size shall be sufficiently small and the positioning such that there will be no contact between the edge of the plate and the material of the FIBC during the test.

B.3.3 Apply an upwards or downwards force as appropriate. Increase the force at the rate of (70 ± 20) kN/min until the total force equivalent to the specified test load is registered. Remove the applied force.

Allow a dwell period of not more than 30 s before repeating the cycle. Repeat the test cycle until the specified number of cycles has been completed. Carry out a further test cycle to the appropriate load specified for the final test cycle.

Use the appropriate cycle from the following:

— heavy-duty reusable FIBC types: 70 cycles at a test load of 6 × SWL and a final cycle at a test load of 8 × SWL

— standard-duty reusable FIBC types: 70 cycles at a test load of 4 × SWL and a final cycle at a test load of 6 × SWL

— single-trip FIBC types: 30 cycles at a test load of 2 × SWL and a final cycle at a test load of 5 × SWL.

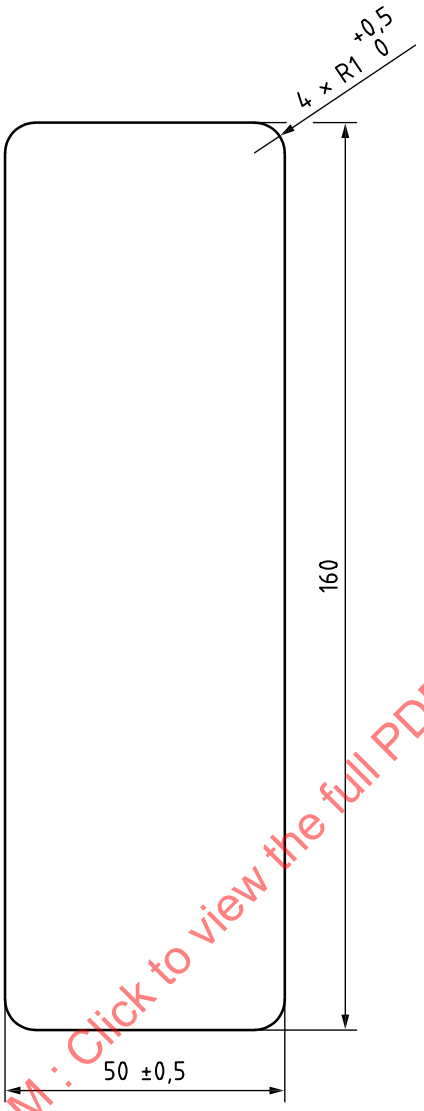
After this test is complete, further loading may be applied until failure of the FIBC, to provide additional information. When this is done, the load at failure should, together with other relevant test observations, be recorded in a test report. There is no requirement, however, for the load at failure, if it is greater than the specified test load, to be noted in the certificate or reflected in the marking of the FIBC.

B.4 Expression of results

Express the results of the test, including whether leakage of contents, breakage or loosening of lifting devices, or protrusion of the inner liner, if fitted, took place.

In Figures B.1 and B.2, all dimensions are nominal where they are not toleranced.

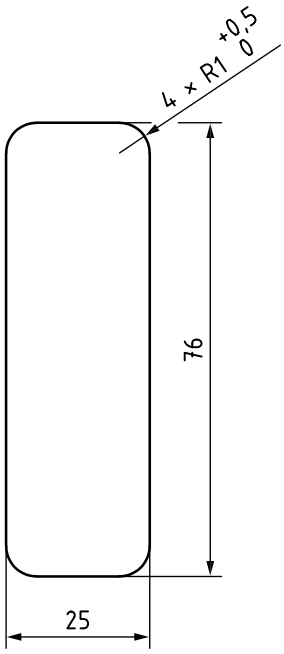
Dimensions in millimetres



All radii marked shall be 1,0 mm with a tolerance of 0 mm to +0,5 mm. The horizontal dimension shall be 50 mm ± 0,5 mm.

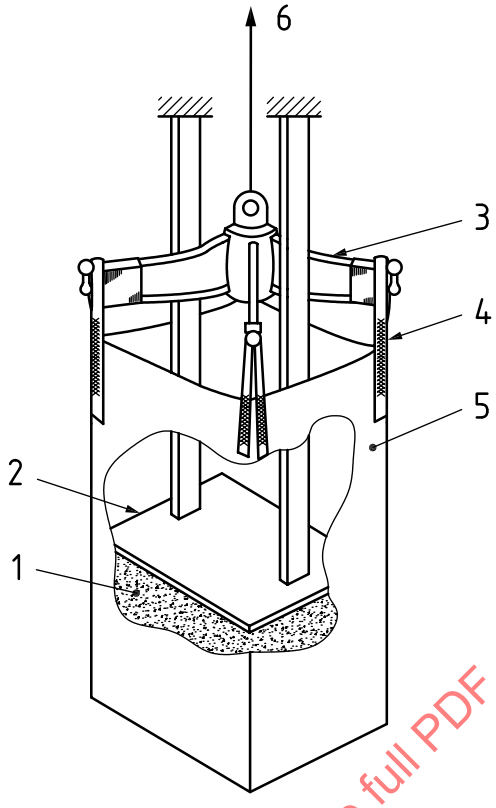
Figure B.1 — Cross section of suspension frame — Top lift test, FIBCs for four- and two-point lifting

Dimensions in millimetres



All radii marked shall be 1 mm with a tolerance of 0 mm to +0,5 mm.

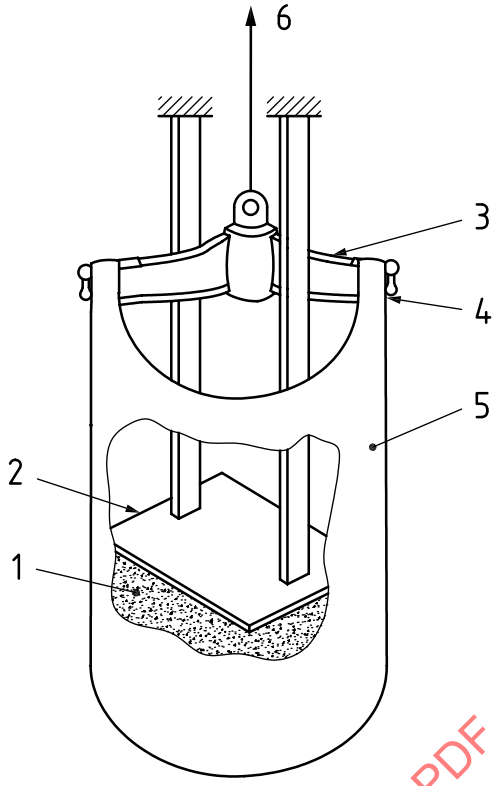
Figure B.2 — Cross section of suspension frame — Top lift test, FIBCs for single- and two-point lifting



Key

1 filler material
2 pressure plate
3 suspension frame
4 FIBC lifting device
5 FIBC
6 hoisting device

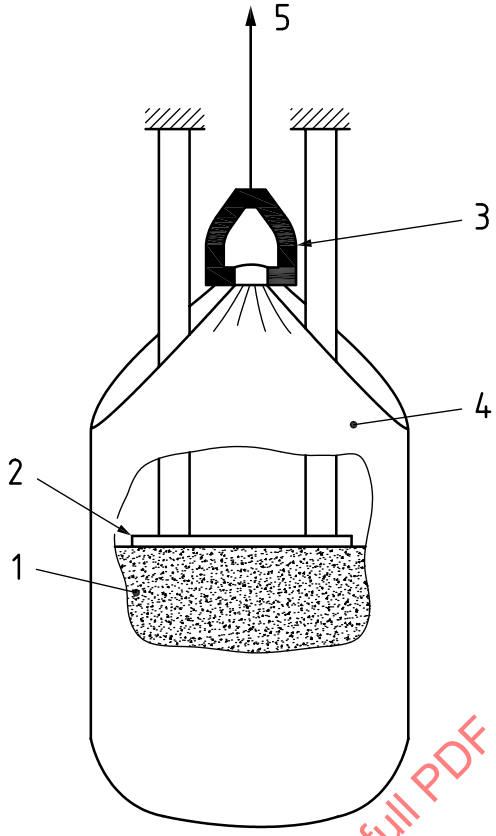
Figure B.3 — Perspective view of an FIBC with four lifting devices being tested using top restraint



Key

1 filler material
2 pressure plate
3 suspension frame
4 FIBC lifting device
5 FIBC
6 hoisting device

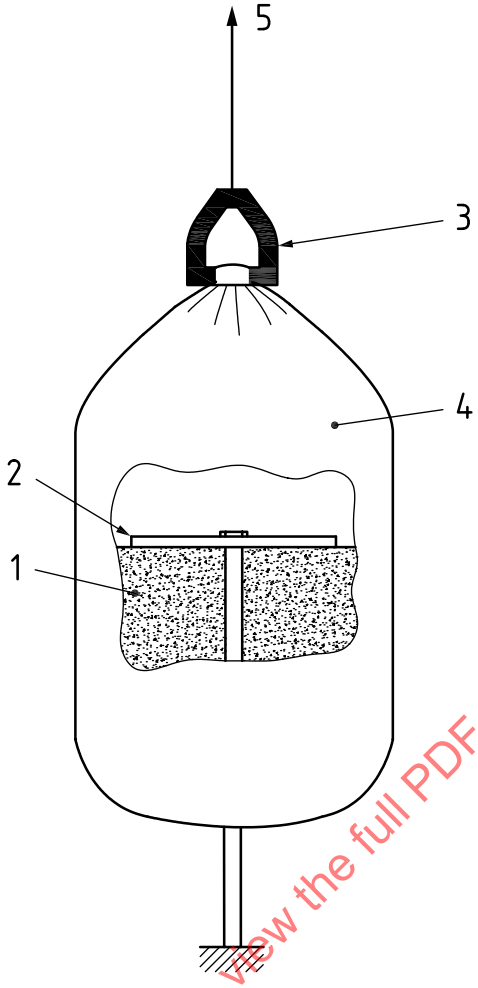
Figure B.4 — Perspective view of an FIBC (with cut-out) with two lifting devices using top restraint



Key

1 filler material
2 pressure plate
3 suspension frame
4 FIBC
5 hoisting device

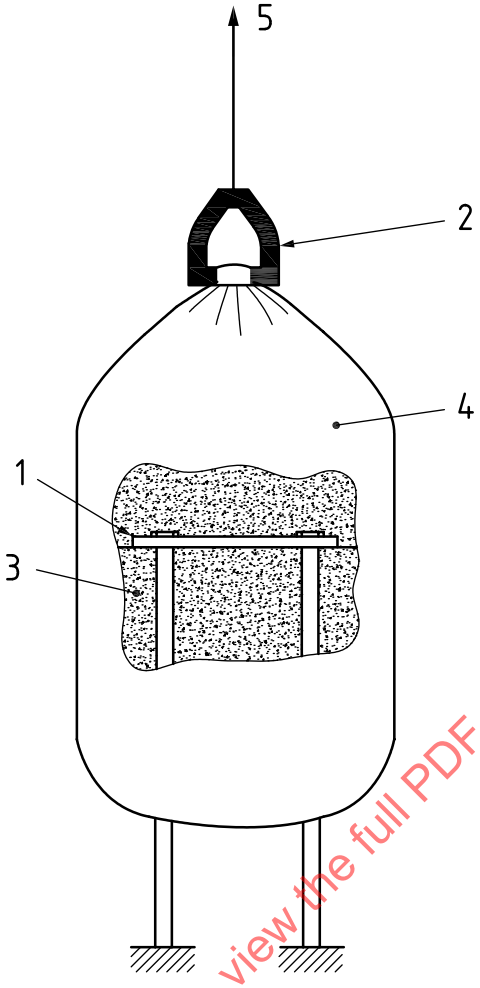
Figure B.5 — Elevation of an FIBC with the lifting devices formed by extensions of the body and using top restraint



Key

1 filler material
2 pressure plate
3 suspension frame
4 FIBC
5 hoisting device

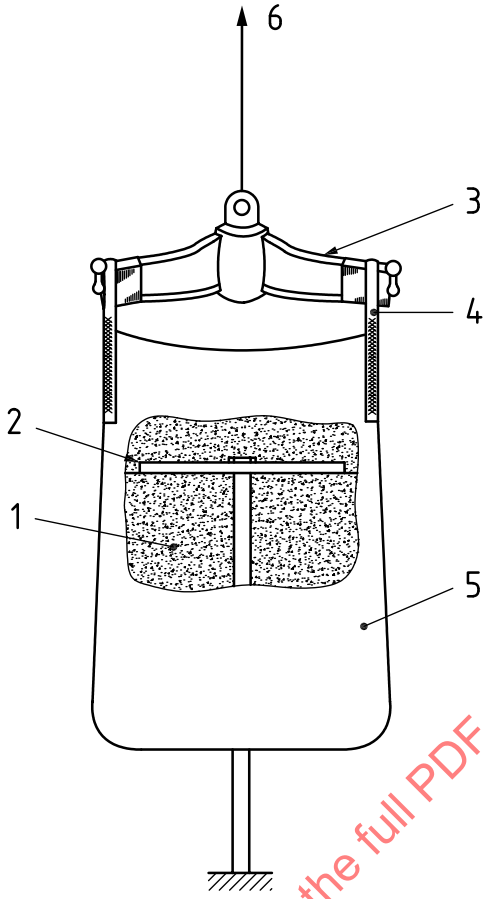
Figure B.6 — Elevation of a single-point lift FIBC with base restraint using one member restraining the pressure plate



Key

1 pressure plate
2 suspension frame
3 filler material
4 FIBC
5 hoisting device

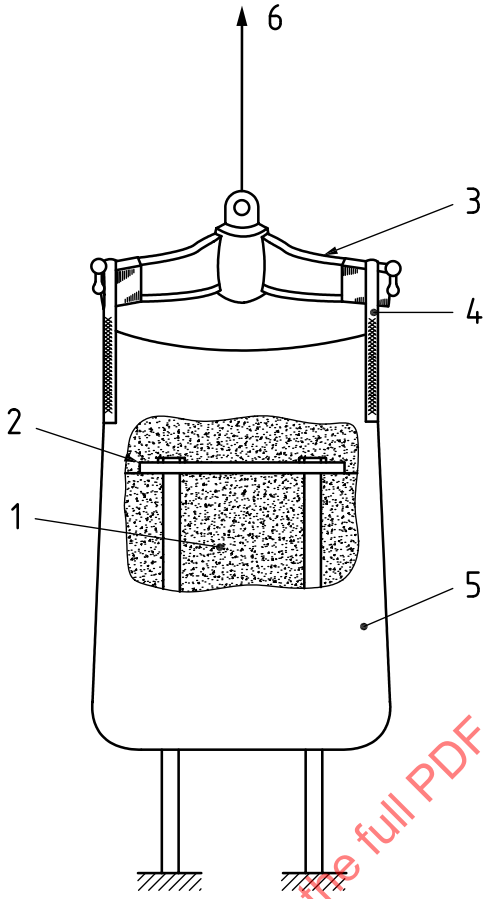
Figure B.7 — As Figure B.6 but with two members restraining the pressure plate



Key

1 filler material
2 pressure plate
3 suspension frame
4 FIBC lifting device
5 FIBC
6 hoisting device

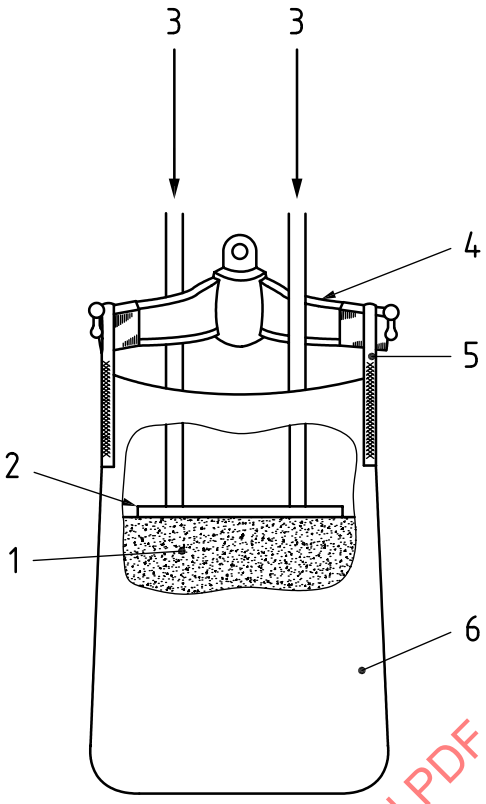
Figure B.8 — Elevation of an FIBC with two lifting devices using base restraint and one member restraining the pressure plate



Key

1 filler material
2 pressure plate
3 suspension frame
4 FIBC lifting device
5 FIBC
6 hoisting device

Figure B.9 — As Figure B.8 but with two members restraining the pressure plate



Key

1 filler material
2 pressure plate
3 download force
4 suspension frame
5 FIBC lifting device
6 FIBC

Figure B.10 — Elevation of an FIBC with two lifting devices being top lift tested using a downward force

Annex C
(normative)

Compression/stacking test

C.1 Principle

The filled FIBC is loaded to the specified test load using either a compression tester or a dead load. At the end of the test period, the FIBC is checked for loss of contents and for deterioration of the body which would render it unsafe for transport and storage.

C.2 Apparatus

Use apparatus as described in ISO 12048, or a flat plate with the appropriate dead load.

C.3 Procedure

Fill and condition the FIBC under test in accordance with 5.2.1 and 5.2.2. Use one of the methods described in ISO 12048, or apply the load by appropriate weights loaded to a flat plate placed on top of the FIBC.

C.4 Calculation of the load to be applied

The test load to be applied to the FIBC depends on the intended stack height. This load shall be calculated as shown in Formula (C.1):

$$L_C = L_{SW} \times n \times 2 \quad \text{(C.1)}$$

where

L_C is the compression load;

L_{SW} is the safe working load;

n is the number of FIBCs to be stacked on the bottom FIBC;

2 is the safety factor (SF).

If "n" is not specified, a compression load for n = 2 is mandatory.

The maximum number of the FIBCs permitted to be stacked on the bottom FIBC shall be indicated on the label as shown in Figure 1.

C.5 Duration of the test

The duration of loading shall be 6 h.

C.6 Expression of results

Express the results of the test, including whether loss of contents or deterioration of the body of the FIBC occurred.

Annex D
(informative)

Guidance on selection and use of FIBCs

D.1 General

There are many different designs of FIBCs in common use, but these can be divided into three main categories:

a) heavy-duty reusable flexible intermediate bulk container, made, for example, of polymeric fabric continuously coated on one or both sides with a plastics material such as polyvinyl chloride;

b) standard-duty reusable flexible intermediate bulk container, made, for example, of polyolefin fabric, coated or uncoated, with or without an inner liner of plastics film, and used mainly in closed loop between filler and discharge of the FIBC;

c) single-trip flexible intermediate bulk container, made, for example, of polyolefin fabrics or paper, coated or uncoated, with or without an inner liner of plastics film.

Seaming or joining of the materials is usually by means of stitching, glueing and/or welding, although other means can be used.

An FIBC may be so designed that, when filled and raised by its top lift device(s), the resultant forces may be either

— absorbed by the body and the lifting devices, where the walls are extended to form lifting loop(s), or where other lifting devices are attached to the upper part of the walls, or

— partially absorbed by separate or integral lifting devices which pass the bag to form the support.

Table D.1 gives an essential checklist to be undertaken before selecting an FIBC for use.

Table D.1 — How to use FIBCs

Do	Do not
Do select the right FIBC for the job in consultation with the manufacturer or supplier	Do not choose FIBCs without consulting the manufacturer or supplier
Do read the instruction label on the FIBC	Do not exceed the SWL in any circumstances
Do inspect reusable FIBCs before refilling	Do not fill the FIBCs unevenly
Do check that the discharge spout is closed off before filling	Do not stop or start suddenly during transportation
Do ensure that the filled FIBC is stable	Do not subject FIBCs to snatchlift and/or jerk stops
Do close the top inlet correctly	Do not drag FIBCs
Do use lifting gear of sufficient capacity to take the suspended load	Do not allow personnel under suspended FIBCs
Do adjust the distance between fork-lift arms to the correct width for the FIBC being handled	Do not allow FIBCs to project over the side of a vehicle or pallet
Do tilt the mast of the fork-lift truck rearwards to an appropriate angle	Do not tilt the mast of the fork lift forward
Do ensure that crane hooks, bars or fork-lift arms used for lifting are of adequate size and are rounded to at least the thickness of the sling, belt or rope suspension, with a minimum radius of 5 mm	Do not withdraw the fork-lift arms prior to relieving all the load on the lifting devices

Table D.1 *(continued)*

Do	Do not
Do take appropriate measures with regard to dust control	Do not stack FIBCs unless sure of their stability
Do consider the possibility of static electricity hazards	Do not use FIBCs in new conditions without consulting the manufacturer or supplier
Do protect the FIBCs from rain and/or prolonged sunlight	Do not reuse single-trip FIBCs
Do ensure the FIBCs are adequately secured in transportation	Do not repair heavy-duty reusable FIBCs unless the as-new requirements can be met

D.2 Selection of FIBCs

When selecting an FIBC for use, consideration should be given to the following:

a) the physical and chemical properties of the intended contents of the FIBC, such as
   1) bulk density,
   2) flow characteristics,
   3) degree of aeration,
   4) particle size and shape,
   5) compatibility with the materials used for the construction of the FIBC,
   6) fill temperature,
   7) whether the intended contents are foodstuffs, when special conditions normally apply;

b) the methods to be used for filling, handling, transporting, storing and emptying the FIBC;

c) the number of trips required, the number of times the bag is lifted on each trip, and the environmental conditions likely to be encountered;

d) general environmental considerations;

e) static electricity hazards: the different types of FIBC and inner liners required for protection against static electricity hazards are specified in IEC 61340-4-4.

NOTE 1 IEC/TS 60079-32-1 explains static electricity hazards and provides guidance for hazard avoidance, including the safe use of the different types of FIBC and inner liners in hazardous zones.

NOTE 2 If FIBCs are highly electrostatically charged, it is advisable that the operators wear electrostatic dissipative garments, gloves and shoes to mitigate electrostatic shocks due to discharges associated with the charged FIBCs.

D.3 Storage of empty FIBCs

Empty FIBCs and liners should be stored in such a manner that accidental damage, exposure to sunlight or extreme climatic conditions, and contact with substances likely to degrade the materials are avoided.

Where liners are supplied with the FIBCs, they can be delivered either fitted inside the FIBCs or separately. In both cases, care should be taken to avoid contamination.

Liners are vulnerable to damage which cannot always be visibly obvious, and therefore should be given particularly careful handling and storage.

D.4 Filling FIBCs

FIBCs are normally filled suspended using the lifting device(s) and with the base of the bag on or near the ground or a pallet. Other methods may be acceptable in consultation with the manufacturer or supplier.

If the FIBC has a discharge spout or other discharging device, this should be tied off or closed before filling.

Before filling with material at temperatures above 60 °C, the manufacturer or supplier should be consulted.

D.5 Stability of filled FIBCs

The FIBCs should be filled so that the ratio of filled height to base is maximum 2,0 times, using as base dimension:

a) the diameter of FIBCs with a circular cross-section, or

b) the length of the shorter side for FIBCs with a rectangular cross-section.

NOTE 1 Other major factors which affect the stability of filled FIBCs are the flow characteristics of the contents, free space and air entrapment.

NOTE 2 Stability can be often improved by vibration during or after filling to remove entrapped air and cause compaction.

c) In exceptional cases, depending on the customer's request, the manufacturer can produce FIBC with filled height as customer required, but it shall always be between the agreement of the stakeholders.

D.6 Lifting of filled FIBCs

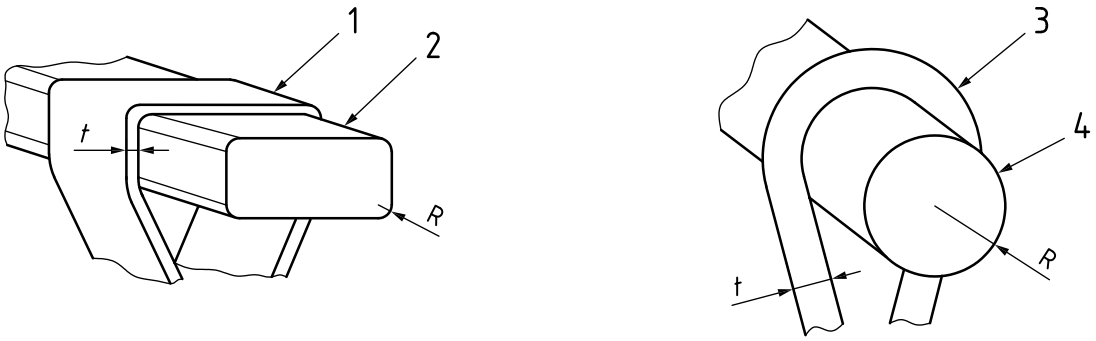
Before lifting any FIBC

a) it should be inspected for any damage which can render it unsafe,

b) the lifting loops or other lifting devices should be positioned according to the manufacturer's or supplier's instructions,

c) the hooks, bars or fork-lift arms employed for lifting should be inspected to ensure that they have rounded edges with a radius greater than the diameter or thickness of the suspension of the FIBC and/or be protected by wrapping. The rounded edges should have a minimum radius of 5 mm. The necessary characteristics are shown in Figure D.1.

d) When the FIBC is suspended, personnel should be excluded from the area under the FIBC.



Key

1 FIBC suspension (e.g. webbing loop)
2 lifting device (e.g. fork-lift arm)
3 FIBC suspension (e.g. rope)
4 lifting device (e.g. fork-lift arm or crane)

NOTE The value of R should be greater than *t*. The minimum value of R is 5 mm.

Figure D.1 — Lifting of FIBCs

D.7 Storage of filled FIBCs

Storage of filled FIBCs at temperatures above 50 °C should be avoided, except with the approval of the manufacturer or supplier.

Filled FIBCs should have any top closures properly closed before storage.

All FIBCs when stored in the outdoors:

a) should be sheeted over to prevent water collection on the tops of FIBCs;

b) should not be stored in standing water;

c) should be protected against rays of sunshine;

d) should be protected against snow;

e) should be stacked in pyramid shape.

D.8 Emptying of filled FIBCs

FIBCs can be emptied by suction and by certain types of blowing, but they are usually emptied by gravity. The flow characteristics of the contents and the cost of ancillary equipment will generally dictate which method is chosen.

When emptying by gravity, personnel should not stand under the FIBC, nor put their arms between the base of the FIBC and a receiving vessel, or similar, except where the FIBC is supported.

D.9 Inspection of heavy-duty and standard-duty FIBCs

Before reuse of FIBCs, consideration should be given to the possibility of contamination from previous contents.