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AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM CONDITIONS OF APPROVAL AND RECIPROCAL RECOGNITION OF APPROVAL FOR MOTOR VEHICLE EQUIPMENT AND PARTS

done at Geneva on 20 March 1958

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UNIFORM PROVISIONS CONCERNING THE APPROVAL OF SPECIFIC EQUIPMENT OF MOTOR VEHICLES USING LIQUEFIED PETROLEUM GASES IN THEIR PROPULSION SYSTEM

UNITED NATIONS

Regulation No.67

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF SPECIFIC EQUIPMENT OF MOTOR VEHICLES USING LIQUEFIED PETROLEUM GASES IN THEIR PROPULSION SYSTEM

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ANNEXES

Regulation No. 67

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF SPECIFIC EQUIPMENT OF MOTOR VEHICLES USING LIQUEFIED PETROLEUM GASES IN THEIR PROPULSION SYSTEM

1. SCOPE

This Regulation applies to the specific equipment of motor vehicles using liquefied petroleum gases in their propulsion system.

2. DEFINITIONS

For the purpose of this Regulation,

2.1. "Specific equipment" means:

the container,

the accessories fitted to the container,

the vaporizer, either separate or combined with a pressure regulator, the shut-off valve,

flexible hoses,

remote filling point;

2.2. "Container" means any vessel used for the storage of liquefied petroleum gas;

2.2.1. A container can either be class "A" or class "B".

2.2.2. The characteristics that distinguish the classes "A" and "B" are indicated in paragraph 8;

2.3. "Type of container" means containers which do not differ significantly in respect of the following characteristics: diameter, volume, thickness, shape, material and class;

2.4. "Accessories fitted to the container" means the following equipment which may be either separate or combined:

2.4.1. filling unit with non-return device(s),

2.4.2. level indicator,

2.4.3. device to limit the filling of the container,

2.4.4. pressure relief valve (discharge valve),

2.4.5. service valve,

2.4.6. excess flow valve(s),

2.4.7. multivalve,

2.4.8. gas-tight housing;

2.5. "Service valve" means a device which allows the establishment and interruption of LPG supply to the evaporator/pressure regulator;

2.6. "Multivalve" means a device consisting of all or part of the accessories mentioned in paragraphs 2.4.1. to 2.4.6.;

2.7. "Type of accessories fitted to the container" means accessories which do not differ significantly in respect of the material and the technology;

2.8. "Vaporizer" means a device which enables the conversion of liquefied petroleum gas from a liquid to a gaseous state to be achieved;

2.9. "Type of vaporizer" means vaporizers which do not differ significantly in respect of the material and the technology;

2.10. "Pressure regulator" means a device intended for reducing the pressure of liquefied petroleum gas to the service pressure of the vaporizer or the mixer;

The vaporizer and the pressure regulator may be combined or separate.

2.11. "Type of pressure regulator" means pressure regulators which do not differ significantly in respect of the material and the technology;

2.12. "Shut-off valve" means a device to establish or cut off the flow of LPG;

2.13. "Type of shut-off valve" means shut-off valves which do not differ significantly in respect of material and technology;

2.14. "Flexible hoses" means hoses for conveying liquefied petroleum gas in either a liquid or vapour state at various pressures from one point to another;

2.15. "Type of flexible hose" means hoses which do not differ significantly in respect of the following characteristics:

diameter, thickness, material and technology;

2.16. "Remote filling point" means a device to allow remote filling of the container i.e. from outside the vehicle;

2.17. "Type of remote filling point" means remote filling points which do not differ significantly in respect of the material and technology;

2.18. "Liquefied petroleum gas (LPG)" means any product essentially composed of the following hydrocarbons:

propane, propene (propylene), normal butane, isobutane, isobutylene and butene (butylene).

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a type of container, of accessories fitted to the container, of vaporizer, of pressure regulator, of shut-off valve, of flexible hoses of remote filling points shall be submitted by the holder of the trade name or mark or by his duly accredited representative.

3.2. It shall be accompanied by the undermentioned documents in triplicate and by the following particulars:

3.2.1. for a type of container

3.2.1.1. a detailed description of the type of container,

3.2.1.2. a drawing of the container, sufficiently detailed and on an appropriate scale,

3.2.1.3. verification of compliance with the specifications prescribed in paragraph 6 of this Regulation;

3.2.2. for a type of accessories fitted to the container

3.2.2.1. a detailed description of the type of accessories fitted to the container,

3.2.2.2. a drawing of these accessories, sufficiently detailed and on an appropriate scale,

3.2.2.3. verification of compliance with the specifications prescribed in paragraph 6 of this Regulation;

3.2.3. for a type of vaporizer and/or a type of pressure regulator

3.2.3.1. a detailed description of the type of vaporizer and/or of pressure regulator,

3.2.3.2. a drawing of the type of vaporizer and/or of the pressure regulator, sufficiently detailed and on an appropriate scale,

3.2.3.3. verification of compliance with the specifications prescribed in paragraph 6 of this Regulation;

3.2.4. for a type of shut-off valve

3.2.4.1. a detailed description of the type of shut-off valve,

3.2.4.2. a drawing of the shut-off valve sufficiently detailed and on an appropriate scale,

3.2.4.3. verification of compliance with the specifications prescribed in paragraph 6 of this Regulation;

3.2.5. for a type of flexible hose

3.2.5.1. a detailed description of the type of flexible hose,

3.2.5.2. a drawing of the flexible hose, sufficiently detailed and on an appropriate scale,

3.2.5.3. verification of compliance with the specifications prescribed in paragraph 6 of this Regulation;

3.2.6. for a type of remote filling point

3.2.6.1. a detailed description of the type of remote filling point,

3.2.6.2. a drawing of the remote filling point, sufficiently detailed and on an appropriate scale,

3.2.6.3. verification of compliance with the specifications prescribed in paragraph 6 of this Regulation.

3.3. At the request of the technical service responsible for conducting approval tests, a sample of the type of container, of accessories fitted to the container, of vaporizer and/or pressure regulator or of shut-off valve, of flexible hoses and remote filling point shall be provided.

Supplementary samples shall be supplied upon request.

3.4. The competent authority shall verify the existence of satisfactory arrangements for ensuring effective control of conformity of production before type approval is granted.

4. MARKINGS

4.1. The samples of accessories fitted to the container, vaporizer, pressure regulator, shut-off valve, flexible hoses and remote filling point submitted for approval shall bear the trade name or mark of the manufacturer and the type; and for flexible hoses also the manufacturing date; this marking shall be clearly legible and be indelible.

4.2. All equipment shall have a space large enough to accommodate the approval mark; this space shall be shown on the drawings referred to in paragraphs 3.2.1.2., 3.2.2.2., 3.2.3.2., 3.2.4.2., 3.2.5.2. and 3.2.6.2. above.

4.3. Every container shall bear a marking plate, welded to it, with the following data clearly legible:

a serial number;

the capacity in litres;

the marking "LPG";

working pressure/test pressure (e.g. 25/30);

the wording: "maximum degree of filling: 80%";

year and month of approval (e.g. 83/09);

approval mark according to paragraph 5.4.

5. APPROVAL

5.1. If the equipment samples submitted for approval meet the requirements of paragraphs 6.1. to 6.5. of this Regulation, as the case may be, approval of the type of equipment shall be granted.

5.2. An approval number shall be assigned to each type of equipment approved. Its first two digits (at present 00 for the Regulation in its original form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. In case of approval of a container, a third character (letter A or B) shall indicate the class. The same Contracting Party shall not assign this alphanumeric code to another type of equipment.

5.3. Notice of approval or of refusal or of extension of approval of an LPG equipment type/part pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in annex 1 to this Regulation.

5.4. There shall be affixed, conspicuously and in the space referred to in paragraph 4.2. above, to all equipment conforming to a type approved under this Regulation, in addition to the mark prescribed in paragraphs 4.1. and 4.3., an international approval mark consisting of:

5.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval 1/.

5.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 5.4.1. This approval number consists of the component type approval number which appears on the certificate completed for this type (see paragraphs 5.2. and 11 and annex 1) preceded by two figures indicating the sequence of the latest series of amendments to this Regulation.

5.5. The approval mark shall be clearly legible and be indelible.

5.6. Annex 2 to this Regulation gives examples of the arrangement of the aforesaid approval mark.

6. SPECIFICATIONS REGARDING THE VARIOUS LPG EQUIPMENT

6.1. General provisions

6.1.1. The specific equipment of vehicles using LPG in their propulsion system shall function in a correct and safe way.

The materials of the equipment which are in contact with LPG shall be compatible with it.

Those parts of equipment whose correct and safe functioning is liable to be influenced by LPG, high pressure or vibrations has to be submitted to relevant test procedures described in the annexes of this Regulation. In particular the provisions of paragraphs 6.2.-6.7. are to be fulfilled.

6.2. Provisions regarding containers

6.2.1. The LPG containers shall be type-approved pursuant to the provisions laid down in annex 8 to this Regulation.

6.3. Provisions regarding accessories fitted to the container

6.3.1. The container shall be equipped with the following accessories, which may be either separate or combined within a multivalve including all or part of these accessories:

6.3.1.1. filling unit with non-return device(s),

6.3.1.2. level indicator,

6.3.1.3. automatic device which limits the degree of filling of the container to 80 per cent of its capacity,

6.3.1.4. pressure relief valve (optional for class B containers),

6.3.1.5. service valve,

6.3.1.6. excess flow valve(s).

6.3.2. The container may be equipped with a gas-tight housing, if necessary.

6.3.3. The accessories mentioned in paragraph 2.4. above shall be type-approved pursuant to the provision laid down in annex 3 to this Regulation.

6.4. Provisions regarding the vaporizer and the pressure regulator

The vaporizer and the pressure regulator, either combined or separate, shall be type-approved pursuant to the provisions laid down in annex 4 to this Regulation.

6.5. Provision regarding shut-off valves

Shut-off valves shall be type-approved pursuant to the provisions laid down in annex 5 to this Regulation.

6.6. Provision regarding flexible hoses

The flexible hoses shall be type-approved pursuant to the provisions laid down in annex 6 to this Regulation.

6.7. Provision regarding remote filling points

The remote filling point shall be type-approved pursuant to the provision laid down in annex 7 of this Regulation.

7. MODIFICATIONS OF A TYPE OF LPG EQUIPMENT AND EXTENSION OF APPROVAL

7.1. Every modification of a type of LPG equipment shall be notified to the administrative department which granted the type approval. The department may then either:

7.1.1. consider that the modifications made are unlikely to have an appreciable adverse effect, and that, in any case, the equipment still complies with the requirements; or

7.1.2. require a further test report from the technical service responsible for conducting the tests.

7.2. Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 5.3. above to the Parties to the Agreement which apply this Regulation.

7.3. The competent authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension.

8. CONTAINER CLASS CHARACTERISTICS

8.1. Class A

8.1.1. A class A container is a container designed to be used with a "pressure relief valve" or "discharge valve".

8.2. Class B

8.2.1. A class B container is a container designed to be used without a "pressure relief valve" or "discharge valve".

8.2.2. It may however be provided with a possibility to mount a "pressure relief valve" or "discharge valve".

8.2.3. If a class B container is equipped with a hole to contain a "pressure relief valve" or "discharge valve", this hole shall be mentioned on the type approval documents. If the pressure relief valve (discharge valve) is not installed, this hole must be closed with a soldered screw plug.

9. CONFORMITY OF PRODUCTION

9.1. All equipment bearing an approval mark as prescribed under this Regulation shall conform to the type approval and shall comply with the requirements of paragraph 6 above.

9.2. In order to verify that the requirements of paragraph 9.1. are met, suitable controls of the production shall be carried out.

9.3. The holder of the approval shall in particular:

9.3.1. Ensure existence of procedures for the effective control of the quality of products,

9.3.2. Have access to the control equipment necessary for checking the conformity to each approved type,

9.3.3. Ensure that data of test results are recorded and that annexed documents shall remain available for a period to be determined in accordance with the administrative service,

9.3.4. Analyse the results of each type of test, in order to verify and ensure the stability of the product characteristics making allowance for variation of an industrial production,

9.3.5. Ensure that for each type of product at least the tests prescribed in annexes 6, 8, 9 and 10 of this Regulation are carried out,

9.3.6. Ensure that any samples or test pieces giving evidence of non-conformity with the type of test considered shall give rise to another sampling and another test. All the necessary steps shall be taken to re-establish the conformity of the corresponding production.

9.4. The competent authority which has granted type-approval may at any time verify the conformity control methods applicable to each production unit.

9.4.1. In every inspection, the test books and production survey records shall be presented to the visiting inspector.

9.4.2. The inspector may take samples at random which will be tested in the manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own verification.

9.4.3. When the quality level appears unsatisfactory or when it seems necessary to verify the validity of the test carried out in application of paragraph 9.4.2. the inspector shall select samples to be sent to the technical service which has conducted the type approval tests.

9.4.4. The competent authority may carry out any test prescribed in this Regulation.

9.4.5. The normal frequency of inspections authorized by the competent authority shall be one every year. In the case where negative results are recorded during one of these visits, the competent authority shall ensure that all necessary steps are taken to re-establish the conformity of production as rapidly as possible.

9.5. Moreover, each container shall be tested at a minimum pressure of:

3,000 kPa for class A,
4,500 kPa for class B,

in conformity with the prescriptions of annex 8, paragraph 3.3. of this Regulation.

9.6. Every hose assembly shall, during half a minute, be subjected to a test with gas under a pressure of 4,500 kPa.

9.7. For welded containers 1 per 200 containers and one of the remaining number has to be subjected to the radiographic examination according to annex 8, paragraph 3.4.1.

9.8. Burst testing under hydraulic pressure according to paragraph 3.2. of annex 8 shall be carried out for each lot consisting of 100 (or fewer) containers of Class B.

10. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

10.1. The approval granted in respect of a type of equipment pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 9 above are not complied with.

10.2 If a Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "APPROVAL WITHDRAWN".

11. OBSERVATION CONCERNING CONTAINER CLASS

Every approval of a container type under this Regulation is granted, pursuant to paragraph 6.2. above, for either a class A or a class B container; article 3 of the Agreement to which this Regulation is annexed shall not prevent the Contracting Parties from prohibiting on vehicles registered by them, containers being either of:

Class A (with "pressure relief valve" or "discharge valve") and class B if provided with a "pressure relieve valve" or "discharge valve".

or

Class B containers, if not provided with a "pressure relief valve" or "discharge valve".

12. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of equipment approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the Agreement applying this Regulation by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "PRODUCTION DISCONTINUED".

13. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

The Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or extension or refusal or withdrawl of approval, issued in other countries, are to be sent.

Note

1/ 1 for the Federal Republic of Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for Czechoslovakia, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 for the German Democratic Republic, 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal and 22 for the Union of Soviet Socialist Republics. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

Annex 1

Maximum format: A4 (210 x 297 mm)

1/

Communication concerning: approval
refusal of approval
extension of approval
withdrawal of approval
production definitely discontinued 2/

of a type of LPG equipment pursuant to Regulation No. 67

Approval No. ..... Extension No. .....

1. LPG equipment considered:

Container 2/ Class A/B 2/

Accessories fitted to the container 2/

filling unit with non-return device(s)

level indicator

device to limit the filling

pressure relief valve

service valve

excess flow valve(s)

multivalve, including the following accessories: .....

.....

gas-tight housing

Vaporizer/pressure regulator 2/

Shut-off valve 2/

Flexible hose 2/

Remote filling point 2/

2. Trade name or mark .....

3. Manufacturer's name and address .....

4. If applicable, name and address of manufacturer's representative .....
.....

5. Submitted for approval on .....

6. Technical service responsible for conducting approval tests .....
.....

7. Date of report issued by that service .....

8. No. of report issued by that service .....

9. Approval granted/refused/extended/withdrawn 2/ .....

10. Reason(s) of extension (if applicable) .....

11. Place .....

12. Date .....

13. Signature .....

14. The documents filed with the application or extension of approval can be obtained upon request.

1/ Name of Administration.

2/ Strike out what does not apply.

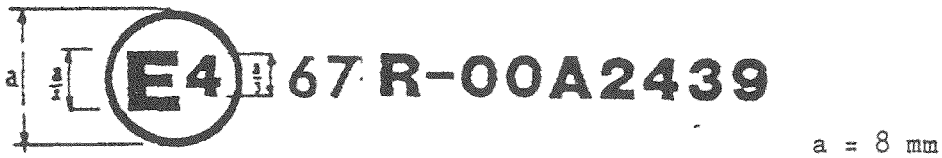
Annex 2

ARRANGEMENT OF THE LPG EQUIPMENT
TYPE-APPROVAL MARK

(See paragraph 5.6 of this Regulation)

a = 8 mm

The above approval mark affixed to the LPG equipment shows that this equipment has been approved in the Netherlands (E4), pursuant to Regulation No.67 under approval number 002439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 67 in its original form.



a = 8 mm

The above approval mark affixed to the LPG container shows that this container is of class A and has been approved in the Netherlands (E4), pursuant to Regulation No. 67 under approval number 00A2439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 67 in its original form.

a = 8 mm

The above approval mark affixed to the LPG container shows that this container is of class B and has been approved in the Netherlands (E4), pursuant to Regulation No.67 under approval number 00B2439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No.67 in its original form.

Annex 3

PROVISIONS REGARDING THE APPROVAL OF LPG CONTAINER ACCESSORIES

1. The materials used in the LPG container accessories which are in contact with LPG when the accessories are in service, shall be compatible with this gas. To verify this compatibility the provisions laid down in annex 9, paragraphs 2, 3 and 4 shall be fulfilled.

2. Filling unit */

2.1. The filling unit shall withstand a pressure of 5,000 kPa.

2.2. The filling unit shall be equipped either with two non-return devices, one of which at least is gas-tight, or with a combination of a gas-tight non-return device and a shut-off valve.

At least one of the non-return devices shall be mounted inside the container.

2.3. Gas-tight non-return devices shall be gas-tight down to a pressure of 50 kPa.

2.4. The shut-off valve shall comply with the provisions laid down in paragraph 2.6. of this annex.

2.5. The filling unit shall be equipped with a cap to prevent contamination.

2.6. The device shall comply with the test procedures laid down in annex 9, paragraphs 5, 6, 7 and 8.

3. Level indicator

3.1. The device to verify the level of liquid of the container shall be of an indirect type (for example magnetic) between the inside and outside of the container.

3.2. The level indicator shall be designed to withstand a pressure of 5,000 kPa.

3.3. The device has to comply with the test procedure laid down in annex 9, paragraph 5.

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*/ The design requirements of the filling unit should be harmonized at the international level.

4. Device to limit filling of the container

4.1. If a device limiting filling of the container comprises a float, the latter shall withstand a pressure of 5,000 kPa.

The connection between the float and the closing unit of the device shall be undeformable under normal conditions of use.

4.2. The closing unit of the device limiting filling shall withstand a pressure of 5,000 kPa and shall not, at the cut-off position, allow filling at a rate exceeding 1 litre/minute.

4.3. When the device does not comprise any float, it shall not be possible to continue filling, after closing-off, at a rate exceeding 1 litre/minute.

4.4. The device shall comply with the test procedures laid down in annex 9, paragraphs 5, 6, 7, 11 and 12 and, in the case of a device operated by a float, with the vibration test procedure of annex 10.

5. Pressure relief valve (discharge valve)

5.1. The pressure relief valve shall be so designed as to open at a pressure of 2,500 $\pm$ 200 kPa.

5.2. The outflow capacity of the pressure relief valve, determined with compressed air at a pressure which is 20 per cent higher than the normal working-pressure must be at least:

$Q = 10.66\ A^{0.82}$, in which

$Q = m^3/min.$ (air at 100 kPa absolute and 15°C).

A = exterior surface of the container in m^2.

5.3. The pressure relief valve shall be mounted inside the container in the gaseous zone.

5.4. The device has to comply with the test procedure laid down in annex 9, paragraph 9.

6. Service valve

6.1. The service valve shall be designed to withstand a pressure of 5,000 kPa in the open and closed positions.

6.2. The device shall comply with the test procedures laid down in annex 9, paragraphs 5, 6, 7 and 8.

7. Excess flow valve

7.1. Limiting the flow of LPG at the outlet of the container must be obtained by an excess flow valve.

7.2. The excess flow valve shall withstand a pressure of 5,000 kPa.

7.3. The excess flow valve shall cut off at a pressure difference over the value of 100 kPa.

7.4. The excess flow valve shall be designed with a bypass to allow for equalization of pressures. When the excess flow valve is at cut-off position, there shall be no leakage exceeding one litre/min. through the by-pass.

7.5. The excess flow valve shall be mounted inside the container.

7.6. The device has to comply with the test procedure(s) laid down in annex 9, paragraphs 5 and 10.

8. Gas-tight housing

8.1. The gas-tight housing shall be leak-proof at a pressure of 10 kPa with the aperture(s) closed off.

8.2. The minimum cross-section of the outlet of the gas-tight housing shall be 500 mm^2.

Annex 4

PROVISIONS REGARDING THE APPROVAL OF THE PRESSURE REGULATOR AND THE VAPORIZER

1. The purpose of this annex is to determine the provisions regarding the approval of the pressure regulator and of the vaporizer.

2. Pressure regulator

2.1. The material constituting the regulator which is in contact with the liquefied petroleum gas when the device is in service shall be compatible with the test LPG. In order to verify this compatibility n-hexane may be used as test liquid.

2.2. The materials constituting the regulator which are in contact with the heat exchange medium of the regulator when the device is in service, shall be compatible with that fluid.

2.3. The regulator shall be leak-proof at a pressure equal to twice the regulating pressure of the regulator prescribed by the manufacturer, with the outlets to the evaporator closed off.

3. Vaporizer

3.1. The materials constituting the vaporizer which are in contact with the liquefied petroleum gas when the device is in service, shall be compatible with the test LPG. In order to verify this compatibility n-hexane may be used as test liquid.

3.2. The materials constituting the vaporizer which are in contact with the heat exchange medium when the device is in service, shall be compatible with that fluid.

3.3. The vaporizer shall be so designed as to prevent any gas flow when the regulator/vaporizer unit is supplied with LPG under a pressure of 5,000 kPA.

3.4. The compartment containing the heat exchange medium of the vaporizer shall be leak-proof.

Annex 5

PROVISIONS REGARDING THE APPROVAL
OF THE SHUT-OFF VALVE

1. The materials constituting the shut-off valve which are in contact with the liquefield petroleum gas when the device is in service, shall be compatible with the test LPG. In order to verify this compatibility n-hexane may be used as test liquid.

2. Tightness and resistance tests

2.1. The shut-off valve shall be so designed as to withstand a pressure of 5,000 kPa.

2.2. The shut-off valve shall be so designed as to be leak-proof at a pressure of 5,000 kPa.

2.3. The shut-off valve, being in the normal position of use specified by the manufacturer, is submitted to 20 operations; then it is deactivated. The shut-off valve shall remain leak-proof at a pressure of 5,000 kPa.

3. The electrical system, if existing, shall be isolated from the body of the shut-off valve.

4. In the case of shut-off valves activated by an electric current those valves shall be in a "closed" position when their current is switched off.

Annex 6

PROVISIONS REGARDING THE APPROVAL OF FLEXIBLE HOSES WITH COUPLINGS

Scope

The purpose of this annex is to determine the provisions regarding the approval of flexible hoses for use with LPG, having an inside diameter up to 20 mm.

1. General specifications

1.1. The hose shall be so designed as to withstand a maximum working pressure of 4,500 kPa.

1.2. The hose shall be so designed as to withstand temperatures between -25°C and +80°C. 1/

1.3. The inside diameter shall be in compliance with table 1 of ISO standard 1307-1975.

2. Hose construction

2.1. The hose must embody a smooth-bore tube and cover of suitable synthetic material, reinforced with one or more interlayer(s).

2.2. The reinforcing interlayer(s) has (have) to be protected by a cover against corrosion.

If for the reinforcing interlayer(s) corrosion-resistant-material is used (i.e. stainless-steel) a cover is not required.

2.3. The lining and the cover must be smooth and free from pores, holes and strange elements.

An intentional provided puncture in the cover shall not be considered as an imperfection.

2.4. The cover has to be perforated to avoid the forming of bubbles.

3. Specifications and tests for the lining

3.1. Tensile strength and elongation

3.1.1. The hose, from which the samples are to be taken, shall be filled with liquid propane or N-pentane having a temperature of 23° ± 2°C and shall be kept in this state during 3 x 24 hours.

3.1.2. The test has to be performed in compliance with ISO-standard 37-1977.

3.1.3. The tensile-strength shall not be less than 7 N/mm^2 and the elongation at rupture shall be at least 150 per cent.

3.2. Resistance to dry-heat

3.2.1. The test has to be performed in compliance with the international standard ISO 188-1982. The test piece has to be exposed to air of a temperature of 70° ± 1°C during 7 x 24 hours.

3.3.3. The allowable change in tensile-strength shall not exceed ± 25 per cent.

3.2.3. The allowable change in elongation at rupture shall not exceed the following values:

increase maximum 10 per cent

decrease maximum 30 per cent

3.3. Resistance to N-pentane

3.3.1 The test-piece shall be immersed in liquid pentane, having a temperature of 23° ± 2°C, during 3 x 24 hours.

3.3.2. The allowable change in mass shall not exceed the following values:

maximum increase: 10 per cent

maximum decrease: 5 per cent

4. Specifications and test-method for the cover

4.1. Tensile strength and elongation

See paragraph 3.1.

4.2. Resistance to dry-heat

See paragraph 3.2.

4.3. Resistance to N-hexane

4.3.1. The test-piece shall be immersed in N-hexane, having a temperature of 23 ± 2°C, during 3 x 24 hours.

4.3.2. The allowable decrease in tensile-strength shall be less than 35 per cent.

4.3.3. The allowable decrease in elongation at rupture shall be less than 35 per cent.

4.3.4. The allowable increase in volume shall be less than 30 per cent.

4.4. Resistance to Ozone

4.4.1. The test has to be performed in compliance with ISO standard 1431/1-1980.

4.4.2. The test-piece, which has to be stretched to an elongation of 20 per cent shall have to be exposed to air of 40°C with an ozone-concentration of 50 parts per hundred million during 5 x 24 hours.

4.4.3. No cracking of the test piece is allowed.

5. Specifications for uncoupled hose

5.1. Gas-tightness (permeability)

5.1.1. A hose at a free length of 1 m has to be connected to a container filled with liquid propane, having a temperature of 23° ± 2°C.

5.1.2. The test has to be carried out in compliance with the method described in ISO-standard 4080-1978.

5.1.3. The leakage through the wall of the hose shall not exceed 95 cm^3 per metre of hose per 24 h.

5.2. Resistance at low temperature

5.2.1. The test has to be carried out in compliance with the method described in ISO-standard 4672-1978 method B.

5.2.2. Test-temperature: -25° ±3°C.

5.2.3. No cracking or rupture is allowed.

5.3. Extraction

5.3.1. A hose at a length of 2 m filled with liquid propane or N-pentane shall have to be stored during six weeks at a room temperature of 23° ± 2°C.

5.3.2. The extraction from the hose shall not exceed 30 gr/m^2 of inside tube surface.

5.4. Bending test

5.4.1. An empty hose, at a length of approximately 3.5 m must be able to withstand 3,000 times the hereafter prescribed alternating-bending-test without breaking. After the test the hose must be capable to withstand the test-pressure as mentioned in paragraph 5.5.2.

5.4.2.

Inside diameter in mm	Bending radius in mm	Distance between centres Vertical-mm-Horizontal	
up to 13	102	241	102
from 13 to 16	153	356	153
from 16 to 20	178	419	178

5.4.3. The testing-machine shall consist of a steel frame, provided with two wooden wheels, with a rim-width of c.a. 130 mm.

The circumference of the wheels must be grooved for the guidance of the hose.

The radius of the wheels, measured to the bottom of the groove, must be as indicated in paragraph 5.4.2.

The longitudinal median planes of both wheels must be in the same vertical plane and the distance between the wheel-centres must be in accordance with paragraph 5.4.2.

Each wheel must be able to rotate freely round its pivot-centre.

A propulsion-mechanism pulls the hose over the wheels at a speed of four complete motions per minute.

5.4.4. The hose shall be S-shape-like installed over the wheels.

The end, that runs over the upper wheel shall be furnished with a sufficient mass as to achieve a complete snuggling of the hose against the wheels. The part that runs over the lower wheel is attached to the propulsion-mechanism.

The mechanism must be so adjusted, that the hose travels a total distance of 1.2 m in both directions.

5.5. Hydraulic-test-pressure and appointment of the minimum burst-pressure

5.5.1. The test has to be carried out in compliance with the method described in ISO-standard 1402-1974.

5.5.2. The test-pressure of 5,000 kPa shall be applied during 10 minutes, without any leakage.

5.5.3. The burst pressure shall not be less than 10,000 kPa.

6. Couplings

6.1. The couplings shall be made from steel or brass and the surface must be corrosion-resistant.

6.2. The couplings must be of the crimp-fitting type.

6.2.1. The swivel-nut must be provided with U.N.F.-thread.

6.2.2. The sealing-cone must be of the type with a half vertical angle of 45°.

7. Assembly of hose and couplings

7.1. The construction of the couplings must be such, that it is not necessary to peel the cover unless the reinforcement of the hose consists of corrosion-resistant material.

7.2. The hose assembly has to be subjected to an impulse test in compliance with ISO-standard 1436-1978.

7.2.1. The test has to be completed with circulating oil having a temperature of 93°C, and a minimum pressure of 2,500 kPa.

7.2.2. The hose has to be subjected to 150,000 impulses.

7.2.3. After the impulse-test the hose has to withstand the test-pressure as mentioned in paragraph 5.5.2.

7.3. Gas-tightness

7.3.1. The hose assembly (hose with couplings) has to withstand during five minutes a gas pressure of 4,500 kPa without any leakage.

8. Markings

8.1. Every hose must bear, at intervals of not greater than 0.5 m, the following clearly legible and indelible identification markings consisting of characters, figures or symbols.

8.1.1. The trade name or mark of the manufacturer.

8.1.2. The year of fabrication.

8.1.3. The size and type-marking.

8.1.4. The identification-marking "L.P.G.".

8.2. Every coupling shall bear the trade name or mark of the assembling manufacturer.

1/ If hoses are used at higher temperatures than 80°C, i.e. in the engine-compartment and/or connecting hoses with exhaust-pins (used by air-cooled engines for the evaporation of the liquid gas) it shall be demonstrated that they can withstand the higher temperatures.

Annex 7

PROVISIONS REGARDING THE APPROVAL OF THE REMOTE FILLING POINT

1. The remote filling point */

1.1. The remote filling point shall withstand a pressure of 5,000 kPa.

1.2. The remote filling point shall be equipped with at least one gas-tight non-return device.

1.2.1. The gas-tight non-return device shall be gas-tight down to a pressure of 50 kPa.

1.2.2. The remote filling point shall be equipped with a cap to prevent contamination.

1.2.3. The device has to comply with the test procedure laid down in annex 9, paragraphs 5, 6, 7 and 8.

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*/ The design requirements of the remote filling point should be harmonized at the international level.

Annex 8

PROVISIONS REGARDING THE APPROVAL OF LPG CONTAINERS

1. Symbols and terms used in this annex

The symbols used in this annex have the following meanings:

P_h = hydraulic test pressure (design pressure) in kPa;

P_r = container bursting pressure measured in the bursting test, in kPa;

P_{rt} = calculated minimum theoretical bursting pressure, in kPa;

R_e = minimum yield stress in N/mm^2 guaranteed by the material standard;

R_m = minimum tensile strength in N/mm^2 guaranteed by the material standard;

R_{mt} = actual tensile strength, in N/mm^2;

a = calculated minimum thickness of the cylindrical shell wall, in mm;

b = calculated minimum thickness of barrelled ends, in mm;

D = nominal outside diameter of the container, in mm;

R = inside radius of curvature of convex base;

r = inside radius of junction of convex base;

H = outside height of dished part of container end;

h = height of cylindrical part of dished end;

L = length of container's stress-resistant shell;

A = elongation value (per cent) of parent metal;

V_o = initial volume of the container at the moment when the pressure is increased in the burst test;

V = final volume of the container on bursting;

Z = stress reduction factor.

1.1. The containers representative of the type of container submitted for approval (without accessories but with the outlets closed off) shall withstand an inner hydraulic pressure of:

3,000 kPa for Class A
4,500 kPa for Class B

without leakages or becoming permanently distorted, according to paragraph 3.3. of this annex.

1.2. A reference mark shall be affixed on the containers to ensure their correct installation.

1.3. The container shall have provisions to mount a gas-tight housing over the container accessories.

1.4. Every container shall bear a marking plate according to paragraph 4.3. of this regulation.

1.5. In those countries where the use of a pressure relief valve is not installed, the pressure relief valve hole must be closed by a soldered screw plug.

2. TECHNICAL REQUIREMENTS

2.1. Materials

2.1.1. The material used for the manufacture of the stress-resistant container shells must be steel as specified in Euronorm 120-83 (however, other materials than steel may be used provided that the container has the same safety characteristics, to be certified by the authorities granting type approval).

2.1.2. All components of the container body and all the parts welded thereto must be made of mutually compatible materials.

2.1.3. The filler materials must be compatible with the steel so as to form welds with properties equivalent to those specified for the parent metal.

2.1.4 The container manufacturer must obtain and provide chemical cast analysis certificates in respect of the steels or other materials supplied for the manufacture of the parts subject to pressure.

2.1.5. The inspection authority must have the opportunity to make independent analyses. These analyses must be carried out either on specimens taken from the materials as supplied to the container manufacturer or on the finished containers.

2.1.6. The manufacturer must make available to the inspection authority the results of metallurgical and mechanical tests and analyses carried

out on welds and must also provide it with a description of the welding methods and processes which can be regarded as representative of the welds made during production.

2.2. Heat treatment

2.2.1. Those parts of a container having been deformed by more than 5 per cent must be submitted to the following heat treatment: normalize.

2.2.2. Containers with a wall thickness equal or more than 5 mm must be submitted to the following heat treatment:

2.2.2.1. hot-rolled and normalized material: stress relieve or normalize;

2.2.2.2. material of a different kind: normalize.

2.2.3. The manufacturer must certify the heat treatment used.

2.2.4. Localized heat treatment of a completed container is not permitted.

2.3. Calculation of the parts under pressure

2.3.1. The thickness of the cylindrical shell wall at any point on the stress-resistant shell of the containers must not be less than that calculated by the formula:

2.3.1.1. Containers without longitudinal welds:

$$a = \frac{P_h \cdot D}{2000 \frac{Re}{4/3} + P_h} = \frac{P_h \cdot D}{1500\ Re + P_h}$$

2.3.1.2. Containers with longitudinal welds:

$$a = \frac{P_h \cdot D}{2000 \frac{Re}{4/3} \cdot z + P_h} = \frac{P_h \cdot D}{1500\ Re \cdot z\ P_h}$$

z equals:

either 0.85 where the manufacturer radiographs each weld intersection and 100 mm of the adjacent longitudinal weld and 50 mm (25 mm each side of the intersection) of the adjacent circumferential weld.

This test has to be performed at the beginning and end of each shift period from continuous production and per machine;

or 1 where each weld intersection and 100 mm of the adjacent longitudinal weld and 50 mm (25 each side of the interesection) of the adjacent circumferential weld is spot radiographed.

This test has to be performed at 10 per cent of the container production: the containers to be tested are chosen voluntarily. Should these radiograph tests reveal unacceptable defects, as defined in paragraph 3.4.1.4., all the necessary steps must be taken to examine the production run in question and eliminate the defects.

2.3.2. Dimensions and calculations of ends (see figures in appendix 4 to this annex)

2.3.2.1. The container ends must fulfil the following conditions:

Torispherical ends

simultaneous limits:

$0.003\ D \leqslant b \leqslant 0.08\ D$
$r \geqslant 0.1\ D$
$R \leqslant D$
$H \geqslant 0.18\ D$
$r \geqslant 2\ b$
$h \geqslant 4\ b$

Elliptical ends

simultaneous limits:

$0.003\ D \leqslant b \leqslant 0.08\ D$
$H \geqslant 0.18\ D$
$h \geqslant 4\ b$

2.3.2.2. The thickness of these barrelled ends must not in toto be less than the figure calculated by means of the following formula:

$$b = \frac{P_h \cdot D}{1500\ R_e}\ C$$

The coefficient of form C to be used for full ends is given in the table and in the graph contained in appendix 4 to this annex.

However, the nominal thickness of the cylindrical edge of the ends must not be less than the nominal thickness of the cylindrical part.

2.3.3. The nominal wall thickness of the cylindrical part and of the barrelled end may not, under any circumstances, be less than:

$$\frac{D}{250} + 1\ \text{mm}$$

with a minimum of 1.5 mm.

2.3.4. The container body may be made up of two or three parts. The ends must be in one piece and convex.

2.4. Construction and workmanship

2.4.1. General requirements

2.4.1.1. The manufacturer guarantees on his own responsibility that he has the manufacturing facilities and processes to ensure that containers produced satisfy the requirements of this annex.

2.4.1.2. The manufacturer must ensure through adequate supervision that the parent plates and pressed parts used to manufacture the containers are free from any defects likely to jeopardize the safe use of the containers.

2.4.2. Parts subjected to pressure

2.4.2.1. The manufacturer must describe the welding methods and processes used and indicate the inspections carried out during production.

2.4.2.2. Technical welding requirements

The butt welds must be executed by an automatic welding process.

The butt welds on the stress-resistant shell may not be located in any area where there are changes of profile.

Angle welds may not be superimposed on butt welds and must be at least 10 mm away from them.

Welds joining parts making up the shell of the container must satisfy the following conditions (see figures given as examples in appendix 1 of this annex):

longitudinal weld: this weld is executed in the form of a butt weld on the full section of the metal of the wall;

circumferential weld other than those fixing the collar to the upper end:

this weld is executed in the form of a butt weld on the full section of the metal to the wall. A seam weld is considered to be a special type of butt weld;

circumferential weld fixing the collar to the upper end:

this weld may be either a butt or an angle weld. If it is a butt weld, it must be applied on the full section of the metal of the wall. A seam weld is regarded as a special type of butt weld.

Note: The requirements of this indent are not applicable where the upper end has a seat within the container and where this

seat is fixed to the end by a weld which is unrelated to the leak-tightness of the container (see appendix 1, figure 2 of this annex).

In this case of butt welds, the misalignment of the joint faces may not exceed one-fifth of the thickness of the walls (1/5 a).

2.4.2.3. Inspection of welds

The manufacturer must ensure that the welds show continuous penetration without any deviation of the weld seam, and that they are free of defects likely to jeopardize the safe use of the container.

For containers in two pieces, a radiographical test has to be performed on the circumferential butt welds over 100 mm, with the exception of the welds in conformity with fig. 2A of appendix 1 of this annex. On one container selected at the beginning and end of each shift period from continuous production and, in the event of production being interrupted for a period of more than 12 hours, the first container welded should also be radiographed.

2.4.2.4. Out-of-roundness

The out-of-roundness of the cylindrical shell of the container must be limited so that the difference between the maximum and minimum outside diameter of the same cross-section is not more than 1 per cent of the average of those diameters.

2.4.3. Fittings

2.4.3.1. The carrying handles and protective collars must be manufactured and welded to the container body in such a way as not to cause dangerous concentrations of stresses or be conducive to the collection of water.

2.4.3.2. The base of the container must be sufficiently strong and made of metal compatible with the type of steel used for the container; the form of the base must give the container sufficient stability.

The top edge of the base must be welded to the container in such a way as not to be conducive to the collection of water nor to allow water to penetrate between the base and the container.

2.4.3.3. Where fitted, identification plates must be fixed on to the stress resistant shell and not be removable; all the necessary corrosion prevention measures must be taken.

2.4.3.4. Any other material, however, may be used for the manufacture of the bases, carrying handles or protective collars, provided that their strength is assured and that all risk of the container end corroding is eliminated.

3. TESTS

3.1. Mechanical tests

3.1.1. General requirements

3.1.1.1. Where not covered by the requirements contained in this annex, the mechanical tests are to be carried out in accordance with Euronorms Nos:

(a) 2-80 or 11-80 respectively in the case of the tensile test according to whether the thickness of the testpiece is 3 mm or above, or less than 3 mm.

(b) 6-55 or 12-55 respectively in the case of the bend test, according to whether the thickness of the testpiece is 3 mm or above, or less than 3 mm.

3.1.1.2. All the mechanical tests for checking the properties of the parent metal and welds of the stress-resistant shells of the container are carried out on testpieces taken from finished containers.

3.1.2. Types of test and evaluation of test results

3.1.2.1. Each sample container is subjected to the following tests:

For containers with longitudinal and circumferential welds (three sections), on test-pieces taken from the places shown in Figure 1 of appendix 2 of this annex: 1 tensile test: parent metal of cylindrical part (a), if this is not possible in a circumferential direction;

1 tensile test: parent metal from bottom (b);
1 tensile test: perpendicular to the longitudinal weld (c);
1 tensile test: perpendicular to the circumferential weld (d);
1 bend test: back of longitudinal weld (e);
1 bend test: front of longitudinal weld (f);
1 bend test: back of circumferential weld (g);
1 bend test: front of circumferential weld (h);
1 macroscopic test: of the welded section.

3.1.2.1.1. Test-pieces which are not sufficiently flat must be flattened by cold pressing.

3.1.2.1.2. In all test pieces containing a weld, the weld is machined to trim the surplus.

3.1.2.2. Tensile test

3.1.2.2.1. Tensile test on parent metal

3.1.2.2.1.1. The procedure for carrying out the tensile test is that given in the appropriate Euronorm in accordance with paragraph 3.1.1.1.

The two faces of the test-piece representing the inside and outside walls of the container respectively must not be machined.

3.1.2.2.1.2. The values determined for yield stress, tensile strength and elongation after the parent metal bursts must comply with Euronorm 120-83 (Table II).

3.1.2.2.2. Tensile test on welds

3.1.2.2.2.1. This tensile test perpendicular to the weld must be carried out on a test-piece having a reduced cross-section 25 mm in width for a length extending up to 15 mm beyond the edges of the weld, as shown in figure 2 of appendix 3 to this annex.

Beyond this central part the width of the test-piece must increase progressively.

3.1.2.2.2.2. The tensile strength value obtained must be at least equal to that guaranteed for the parent metal irrespective of where the burst occurs in the cross-section of the central part of the test-piece.

3.1.2.3. Bend test

3.1.2.3.1. The procedure for carrying out the bend test is that given in the appropriate Euronorm in accordance with paragraph 3.1.1.1. The bend test must, however, be carried out transversely to the weld on a test-piece 25 mm in width. The mandrel must be placed in the centre of the weld while the test is being performed.

3.1.2.3.2. Cracks must not appear in the test-piece when it is bent round a mandrel as long as the inside edges are separated by a distance not greater than the diameter of the mandrel (see figure 1 in appendix 3 of this annex).

3.1.2.3.3. The ratio (n) between the diameter of the mandrel and the thickness of the test piece must not exceed the values given in the following table:

Actual tensile strength R_t in (N/mm^2)	Value of (n)
up to 440 inclusive	2
above 440 to 520 inclusive	3
above 520	4

3.2. Burst test under hydraulic pressure

3.2.1. Test conditions

Containers subjected to this test must bear the inscriptions which it is proposed to affix on the section of the container subjected to pressure,

3.2.1.1. The burst test under hydraulic pressure must be carried out with equipment which enables the pressure to be increased at an even rate until the container bursts and the change in pressure over time to be recorded.

3.2.2. Interpretation of test

3.2.2.1. The criteria adopted for the interpretation of the burst test are as follows:

3.2.2.1.1. Volumetric expansion of the container; it equals:

volume of water used between the time when the pressure starts to rise and the time of bursting for containers having a capacity $\geqslant$ 6.5 litre.

the volumetric difference of the container between the beginning and end of the test for containers having a capacity $<$ 6.5 litre.

3.2.2.1.2. Examination of the tear and the shape of its edges.

bursting pressure;

volume of water used between the time when the pressure starts to rise and the time of bursting, which shows the volumetric expansion of the container;

examination of the tear and the shape of its edges.

3.2.3. Test acceptance conditions

3.2.3.1. The measured bursting pressure (P_r) must not under any circumstances be less than 9/4 of the test pressure (P_h).

3.2.3.2. The specific change in the volume of the container at the time of bursting must not be less than:

20 per cent if the length of the container is greater than the diameter;

17 per cent if the length of the container is equal to or less than the diameter.

3.2.3.3. The burst test must not cause any fragmentation of the container.

3.2.3.3.1. The main fracture must not show any brittleness, i.e. the edges of the fracture must not be radial but must be at an angle to a diametrical plane and display a reduction of area throughout their thickness.

3.2.3.3.2. The fracture must not reveal a clear defect in the metal.

3.3. Hydraulic test

3.3.1. The water pressure in the container must increase at an even rate until the test pressure is reached.

3.3.2. The container must remain under the test pressure long enough to make it possible to establish that the pressure is not falling off and that the container can be guaranteed leak-proof.

3.3.3. After the test the container must show no signs of permanent deformation.

3.3.4. Any container tested which does not pass the test must be rejected.

3.4. Non-destructive examination

3.4.1. Radiographic examination

3.4.1.1. Welds must be radiographed in compliance with ISO specification R 1106-1969, using classification B.

3.4.1.2. When a wire-type indicator is used, the smallest diameter of the wire visible may not exceed the value of 0.10 mm.

When a stepped and holed type indicator is used, the diameter of the smallest hole visible may not exceed 0.25 mm.

3.4.1.3. Assessment of the weld radiographs must be based on the original films in compliance with the practice recommended in ISO standard 2504-1973, paragraph 6.

3.4.1.4. The following defects are not acceptable

Cracks, inadequate welds or inadequate penetration of the weld.

The inclusions listed below are regarded as acceptable:

Any elongated inclusion or any group of rounded inclusions in a row where the length represented (over a weld length of 12a) is greater than 6 mm;

Any gas inclusion measuring more than $\frac{a}{3}$ mm which is more than 25 mm away from other gas inclusion;

Any other gas inclusion measuring more than $\frac{a}{4}$ mm;

Gas inclusions over any 100 mm weld length, where the total area of all the figures is greater than 2 a mm^2.

3.4.2. Macroscopic examination

The macroscopic examination of a full transverse section of the weld must show a complete fusion on the surface treated with any acid from the macro-preparation and must not show any assembly fault or a significant inclusion or other defects.

In case of doubt, a microscopic examination should be made of the suspect area.

3.5. Examination of the outside of the weld

3.5.1. This examination is carried out when the weld has been completed.

The welded surface examined must be well illuminated, and must be free from grease, dust, scale residue or protective coating of any kind.

3.5.2. The fusion of the welded metal with the parent metal must be smooth and free from etching. There must be no cracks, notching or porous patches in the welded surface and the surface adjacent to the wall. The welded surface must be regular and even. Where a butt weld has been used, the excess thickness must not exceed 1/4 of the width of the weld.

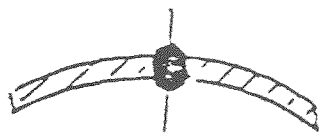


FIGURE 1:
Longitudinal weld

FIGURE 2:
Circumferential weld

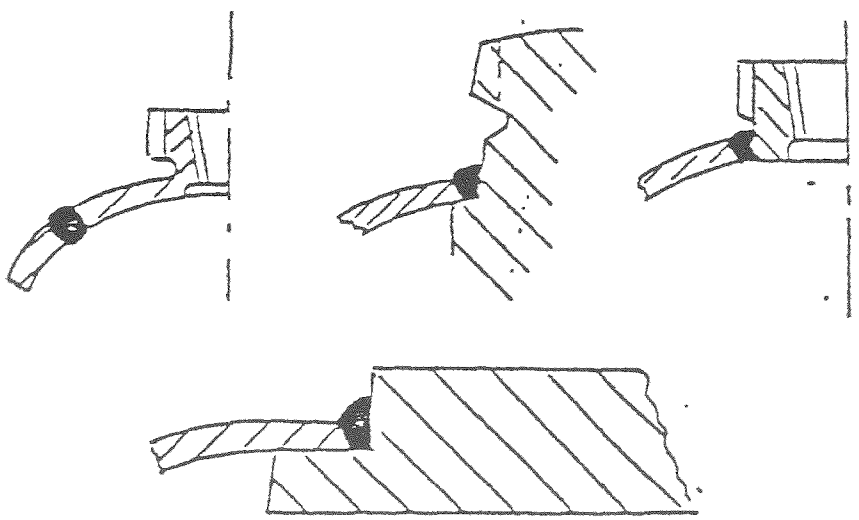


FIGURE 3

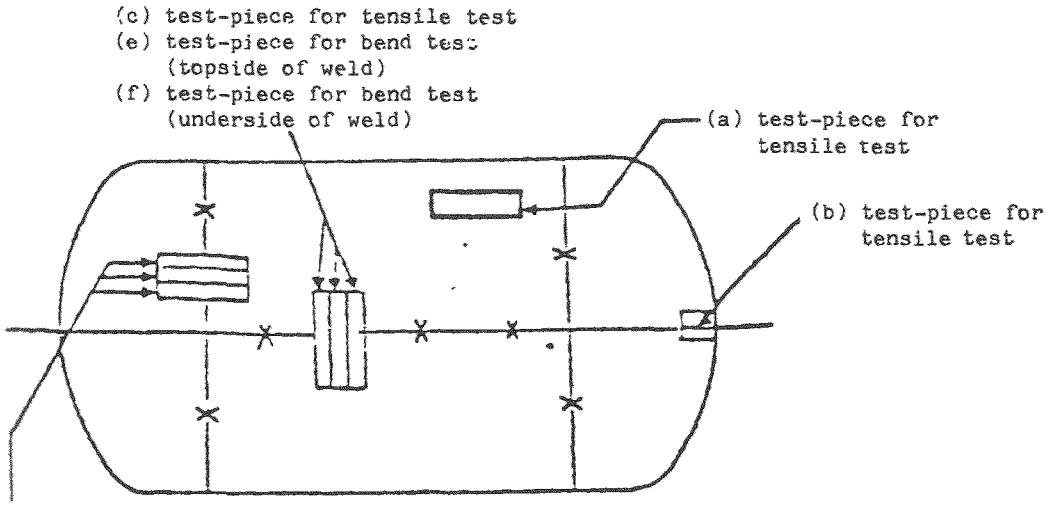


FIGURE 1:

Test-pieces taken from 3-section containers

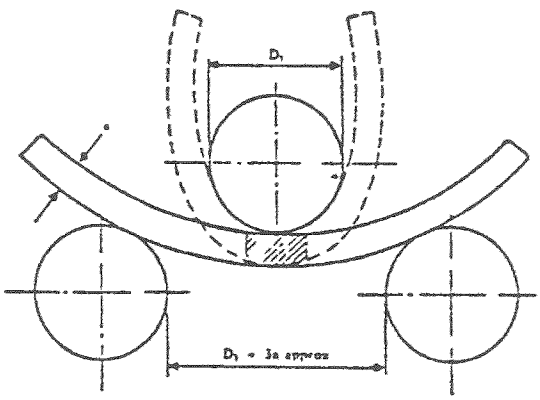


Figure 1

ILLUSTRATION OF BEND TEST

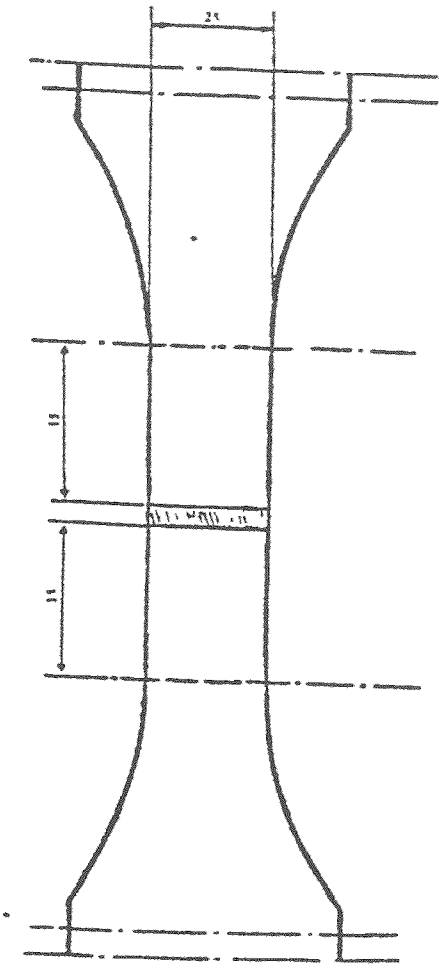
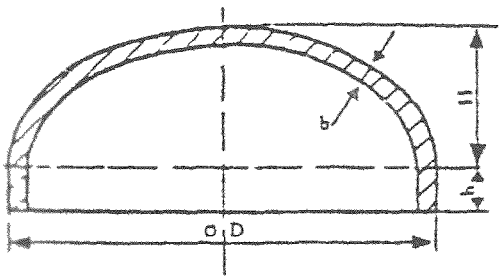
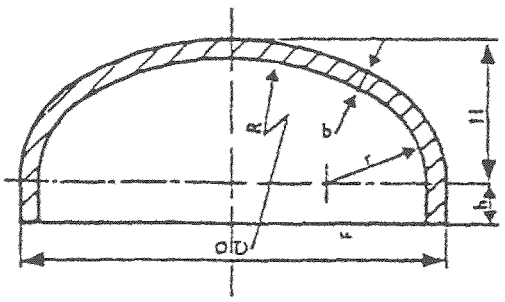


Figure 2

TEST PIECE FOR TENSILE TEST
PERPENDICULAR TO THE WELD



Elliptical ends



Torispherical ends

COEFFICIENT OF FORM C FOR DISHED ENDS

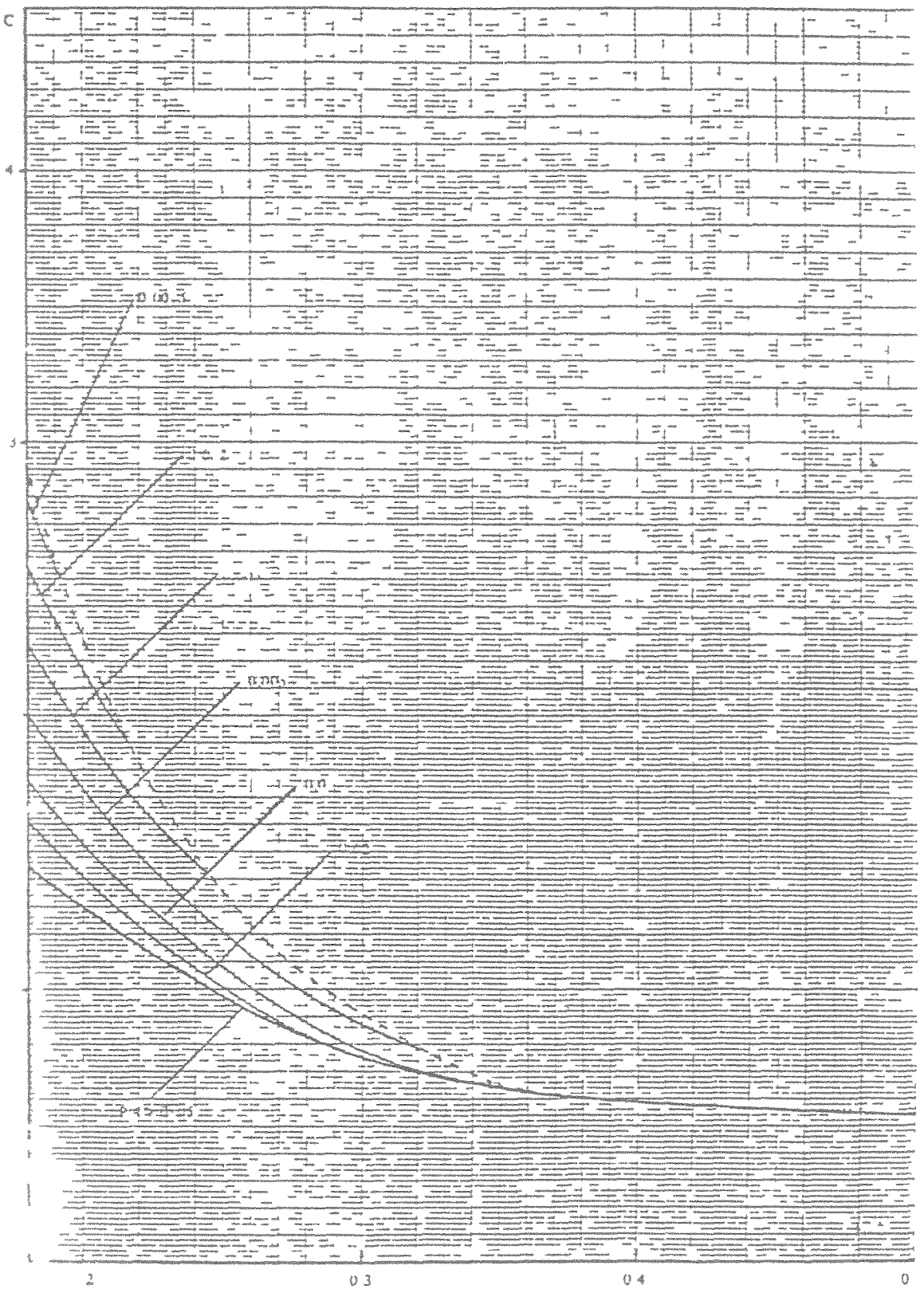
H/D	$P_h/10f = 0{,}001$ a/D	C	$P_h/10f = 0{,}0012$ a/D	C	$P_h/10f = 0{,}0015$ a/D	C	$P_h/10f = 0{,}002$ a/D	C
0,180					0 00211	2,81	0,00255	2,55
0,200							0,00218	2,18

H/D	$P_h/10f = 0{,}003$ a/D	C	$P_h/10f = 0{,}004$ a/D	C	$P_h/10f = 0\,005$ a D	C	$P_h/10f = 0{,}01$ a/D	C
0,180	0,00340	2,27	0,00423	2,12	0,00500	2,00	0,0088	1,76
0,190	0,00316	2,11	0 00395	1,98				
0,200	0 00290	1,93	0,00364	1,82	0 00433	1,73	0,0077	1,54
0,210	0,00273	1,82	0,00342	1,71				
0,220	0,00256	1,71	0,00320	1,60	0,00382	1,53	0,0068	1,36
0,230	0,00236	1,57	0,00295	1,48				
0,240	0,00220	1,47	0,00278	1,38				
0,250					0,00307	1,23	0,0055	1,10
0,300					0,00220	0,88	0,00395	0,79
0,350							0,00325	0,65
0,400							0,0030	0,60
0,450							0,0028	0,56
0,500							0,0027	0,54

H/D	$P_h/10f = 0{,}02$ a/D	C	$P_h/10f = 0{,}05$ a/D	C	$P_h/10f = 0{,}1$ a/D	C	$P_h/10f = 0{,}2$ a/D	C
0,180	0,0160	1,60	0,0366	1,46	0,0730	1 46	0,147	1,47
0,200	0,0141	1,41	0,0330	1,32	0 0650	1,30	0,130	1,30
0,220	0,0125	1,25	0,0292	1,17	0,0585	1,17	0,118	1,18
0,250	0,0102	1 02	0,0250	1,00	0,0500	1,00	0,101	1,01
0,300	0,0077	0,77	0,0193	0,77	0,0385	0,77	0,077	0,77
0,350	0,0065	0,65	0,0162	0,65	0,0325	0,65	0,065	0,65
0,400	0,0059	0,59	0,0149	0,60	0,0295	0,59	0,059	0,59
0,450	0,0056	0,56	0,0140	0,56	0,0280	0,56	0,056	0,56
0,500	0,0054	0,54	0,0136	0,54	0,0270	0,54	0,054	0,54

H/D	$P_h/10f = 0{,}5$ a/D	C
0,350	0,163	0,65
0,400	0,150	0,60
0 450	0,140	0,56
0,500	0,136	0,54

$f = \frac{R_r}{4/3}$ in N/mm²



Annex 9 1/

LEAKAGE TEST PROCEDURES

1. General requirements

1.1. Leakage tests shall have to be conducted with pressurized gas like air or nitrogen.

1.2. Water or another fluid may be used to obtain the required pressure for the hydrostatic strength test.

1.3. The test period for leakage- and hydrostatic strength-tests shall be not less than 1 minute.

2. Durability tests for synthetic materials

2.1. A synthetic part in contact with LPG-liquid shall not show excessive volume change or loss of weight, following immersion for 70 hours at a temperature of 23 ± 2°C in n-Hexane liquid.

2.2. A change in volume of not more than 25 per cent swelling or a 1 per cent shrinkage, and a weight loss (extraction) of not more than 10 per cent is considered as indicating compliance with the preceding paragraphs.

3. Aging-test

3.1 A part made of synthetic material which may be affected by aging shall not crack or show visible evidence of deterioration following exposure for 96 hours to oxygen at an effective pressure of 2,100 kPa and a temperature of 70°C.

4. Materials

4.1. A material (except a valve disc or soft seat, a seal ring or a gasket) is to have the following characteristics

(a) A melting point of not less than 500°C.

(b) A tensile strength of not less than 210 N/mm^2.

(c) An elongation of not less than 10 per cent in 50 mm.

5. Hydrostatic strength test

A filling unit, level indicator, shutoff valve and service valve, shall be capable of withstanding without rupture or permanent distortion a hydrostatic pressure of 5,000 kPa.

The samples, previously subjected to the durability test of paragraph 2 are to be connected to a source of hydrostatic pressure. A positive shutoff valve and a pressure gauge, having a

pressure of not less than 1 1/2 times nor more than 2 times the test pressure, are to be installed in the hydrostatic pressure supply piping.

The pressure gauge is to be installed in the piping between the positive shutoff valve and the sample under test.

6. External leakage test

6.1 A service valve or filling unit, shall be free from leakage through stem or body seals or other joints, and shall not show evidence of porosity in casting when tested as described in paragraph 6.2. at any aerostatic pressure between O and 4,500 kPa.

6.2. During this test the sample valve is to be connected to a source of aerostatic pressure. A positive shutoff valve and a pressure gauge having a pressure range of not less than 1 1/2 times nor more than 2 times the test pressure are to be installed in the pressure supply piping. The pressure gauge is to be installed between the positive shutoff valve and the sample under test. While under the applied test pressure, the sample should be submerged in water to detect leakage, or all joints and body casting surfaces are to be brushed with a soap and water or other leak detection solution.

7. Seat leakage test

7.1. The following tests for seat leakage are to be conducted on samples of service valve or filling unit which have previously been subjected to the external leak test of paragraph 6 above.

7.2. The seat of a shutoff valve, when in the closed position, shall be free from leakage at any aerostatic pressure between 0 to 4,500 kPa.

7.3. A non-return valve provided with a resilient seat, when in the closed position, shall not leak when subjected to any aerostatic pressure between 50 and 4,500 kPa.

7.4. A non-return valve provided with a metal-to-metal seat, when in the closed position, shall not leak at a rate exceeding 0.47 dm^3/s when subjected to an aerostatic pressure difference of 138 kPa effective pressure.

7.5. The seat of the upper non-return valve used in the assembly of a filling unit, when in the closed position, shall be free from leakage at any aerostatic pressure between 50 and 4,500 kPa.

7.6. Seat leakage tests are conducted with the inlet of the sample valve connected to a source of aerostatic pressure, the valve in the closed position, and with the outlet open. A positive shutoff valve and a pressure gauge having a pressure range of not less than 1 1/2 times nor more than 2 times the test pressure are to be installed in the pressure supply piping. The pressure gauge is to be installed between the positive shutoff valve and the sample under

test. While under the applied test pressure, observations for leakage are to be made with the open outlet submerged in water unless otherwise indicated.

7.7. Conformance with paragraphs 7.2. and 7.3. is to be determined by connecting a length of tubing to the valve outlet. The open end of this outlet tube is to be located within an inverted graduated cylinder which is calibrated in cubic centimeters. The inverted cylinder is to be closed by a water seal. The apparatus is to be adjusted so that: (1) the end of the outlet tube is located approximately 13 mm above the water level within the inverted graduated cylinder, and (2) the water within and exterior to the graduated cylinder is at the same level. With these adjustments made, the water level within the graduated cylinder is to be recorded. With the valve in the closed position assumed as the result of normal operation, air or nitrogen at the specified test pressure is to be applied to the valve inlet for a test period of not less than 2 minutes. During this time, the vertical position of the graduated cylinder is to be adjusted, if necessary, to maintain the same water level within and exterior to it.

At the end of the test period and with the water within and exterior to the graduated cylinder at the same level, the level of water within the graduated cylinder is again recorded. From the change of volume within the graduated cylinder, the leakage rate is to be calculated according to the following formula:

$$V_l = V_t \cdot \frac{60}{t} \cdot \left(\frac{273}{T} \cdot \frac{P}{1016}\right)$$

Where:

V_l = leakage rate, cubic centimetres of air or nitrogen per hour.

V_t = increase in volume within graduated cylinder during test.

t = time of test, minutes.

P = barometric pressure during test, in millibar.

T = ambient temperature during test, in K.

7.8. Instead of the method described above, leakage may be measured by a flowmeter installed on the inlet side of the valve under test. The flowmeter shall be capable of indicating accurately, for the test fluid employed, the maximum leakage flow rates permitted.

8. Endurance test:

8.1. A filling unit or service valve shall be capable of conforming to the applicable leakage test requirements of paragraphs 6.1 and 7.2, or 6.1 and 7.4, after being subjected to 6,000 cycles of opening and closing.

8.2. A shutoff valve is to be tested with the valve outlet plugged. The valve body filled with n-hexane, and the valve inlet subjected to a pressure of 4,500 kPa.

8.3. An endurance test is to be conducted at a rate not faster than 10 times per minute. For a shutoff valve, the closing torque is to be consistent with the size of handwheel, wrench, or other means employed to operate the valve.

8.4. The appropriate tests for external and seat leakage, as described under external leakage test under paragraph 6 and seat leakage test under paragraph 7 are to be conducted immediately following the endurance test.

9. Operation test of the pressure relief valve

9.1. In the case of pressure relief valves, three samples of each size, design, and setting are to be used for start-to-discharge and resealing pressure tests. This same set of three valves is to be used for flow capacity tests for other observations indicated in the following paragraphs.

Not less than two successive start-to-discharge and resealing pressure observations are to be made on each of the three test valves under test No. 1 and 3 of paragraphs 9.2. and 9.4.

9.2. Start-to-discharge and resealing pressures of pressure relief valves - test No. 1

9.2.1. Before being subjected to a flow capacity test, the start-to-discharge pressure of each of three samples of a pressure relief valve of a specific size, design, and setting shall be within ± 3 per cent of the average of the pressures, but the start-to-discharge pressure of any one of the three valves shall be not less than 95 per cent, not more than 105 per cent, of the set pressure marked on the valve.

9.2.2. The resealing pressure of a pressure relief valve before being subjected to a flow capacity test shall be not less than 90 per cent of the initially observed start-to-discharge pressure.

9.2.3. A pressure relief is to be connected to an air or other aerostatic supply source capable of being maintained at a pressure of at least 500 kPa effective pressure above the marked set pressure of the valve being tested. A positive shutoff valve and a pressure gauge having a pressure range such that the test pressure will be between 1 1/2 and 2 times the maximum scale reading of the gauge, are to be installed in the pressure supply piping. The pressure gauge is to be installed in the piping between the valve being tested and the positive shutoff valve. Start-to-discharge and resealing pressure are to be observed through a water seal not over 100 mm in depth.

9.2.4. After recording the start-to-discharge pressure of the valve, the pressure is to be increased sufficiently above the start-to-discharge pressure to ensure unseating of the valve. The shutoff valve is then to be closed tightly and the water seal, as well as the pressure gauge, are to be observed closely. The pressure at which bubbles through the water seal cease is to be recorded as the resealing pressure of the valve.

9.3. Flow capacity of pressure relief valves - test No. 2

9.3.1. The flow capacity of each of three samples of a pressure relief valve of a specific size, design, and setting shall fall within a range of 10 per cent of the highest observed capacity.

9.3.2. During flow capacity tests on each valve, there shall be no evidence of chattering or other abnormal operating condition.

9.3.3. The blow-down pressure of each valve shall be not less than 65 per cent of the initially recorded start-to-discharge pressure.

9.3.4. A flow capacity test on a pressure relief valve is to be conducted at a flow rating pressure of 120 per cent of the maximum set pressure.

9.3.5. A flow capacity test on a pressure relief valve is to be conducted by utilizing a properly designed and calibrated orifice flowmeter of the flange type connected to a source of air supply of adequate capacity and pressure. Modifications of the flowmeter from that described herein, and an aerostatic flow medium other than air, may be used provided the end results are the same.

9.3.6. The flowmeter is to be arranged with sufficiently long lengths of pipe both preceding and following the orifice, or other arrangements including straightening vanes, to assure no disturbance at the orifice place for the ratios of orifice to pipe diameters to be employed.

Flanges between which the orifice plate is located and clamped are to be provided with pressure take-off lines connected to a manometer. This instrument indicates the pressure differential across the orifice plate and the reading is used in the flow calculation. A calibrated pressure gauge is to be installed in that portion of the meter pipe downstream of the orifice plate. This gauge indicates the flow pressure and the reading is also used in the flow calculation.

9.3.7. A temperature-indicating instrument is to be connected to the meter pipe downstream of the orifice plate to indicate the temperature of the air flowing to the safety valve. The reading of this instrument is to be integrated in the calculation to correct the temperature of the air flow to a 15°C base temperature. A barometer is to be available for indicating the prevailing atmospheric pressure.

The reading of the barometer is to be added to the indicated air-flow gauge pressure. This absolute pressure is similarly to be integrated in the flow calculation. The air pressure to the flowmeter is to be controlled by a suitable valve installed in the air-supply piping ahead of the flowmeter. The pressure relief valve under test is to be connected to the discharge end of the flowmeter.

9.3.8. After all preparations for flow capacity tests have been made, the valve in the air-supply line is to be opened slowly and the pressure to the valve under test is to be increased to the appropriate flow rating pressure. During this interval, the pressure at which the valve "pops" open is to be recorded as the popping pressure.

9.3.9. The predetermined flow rating pressure is to be maintained constant for a brief interval until the readings of the instruments become stabilized. Readings of the flow pressure gauge, pressure differential manometer, and the flowing air temperature indicator are to be recorded simultaneously. The pressure is then to be decreased until there is no further discharge from the valve.

The pressure at which this occurs is to be recorded as the blow-down pressure of the valve.

9.3.10. From the recorded data and the known orifice coefficient of the flowmeter, the air-flow capacity of the pressure relief valve tested is to be calculated using the following formula:

$$Q = \frac{F_b \cdot F_t \sqrt{0.1\ h.p}}{60}$$

where

Q = Flow capacity of pressure relief valve - in m^3 per minute of air at 100 kPa absolute and 15°C.

F_b = Basic orifice factor of flowmeter at 100 kPa absolute and 15°C.

F_t = Flowing air temperature factor to convert recorded temperature to base of 15°C.

h = Differential pressure across orifice of meter in kPa.

p = Flowing air pressure to pressure relief valve - in kPa absolute (recorded gauge pressure plus recorded barometric pressure).

60 = Divisor to convert equation from m^3 per hour to m^3 per minute.

9.3.11. The average flow capacity of the three pressure relief valves rounded off to the nearest five units is to be taken as the flow capacity of the valve of that specific size, design, and setting.

9.4 Recheck start-to-discharge and resealing pressures of pressure-relief-valves test No. 3

9.4.1. Subsequent to flow capacity tests, the start-to-discharge pressure of a pressure relief valve shall be not less than 85 per cent, and the resealing pressure shall be not less than 80 per cent of the initial start-to-discharge and resealing pressures recorded under test No. 1 of paragraph 9.2.

9.4.2. These tests are to be conducted approximately 1 hour after the flow capacity test, and the test procedure is to be the same as described under test No. 1 of paragraph 9.2.

10. Operation test excess flow valve

10.1 An excess flow valve shall operate at not more than 10 per cent above, nor less than 20 per cent below the rated closing flow capacity specified by the manufacturer, and shall close automatically at a pressure differential across the valve of not more than 100 kPa during the operation tests described below.

10.2. Three samples of each size and style of valve are to be subjected to these tests. A valve intended for use only with liquid is to be tested with water, otherwise the tests are to be made both with air and with water. Except as indicated in paragraph 10.3., separate tests are to be run with each sample installed in vertical, horizontal and inverted positions. The tests with air to be made without piping or other restriction connected to the outlet of the tests sample.

10.3. A valve intended for installation in one position only may be tested only in that position.

10.4. The test with air is to be conducted by utilizing a properly designed and calibrated orifice flowmeter of the flange type, connected to a source of air supply of adequate capacity and pressure.

10.5. The test sample is to be connected to the outlet of the flowmeter. A manometer or calibrated pressure-gauge reading in increments of not more than 3 kPa is to be installed on the upstream side of the test sample to indicate the closing pressure.

10.6. The test is conducted by slowly increasing the flow of air through the flowmeter until the check valve closes. At the instant of closing, the pressure differential across the flowmeter orifice and the closing pressure indicated by the gauge are to be recorded. The rate of flow at closing is then to be calculated.

10.7. Other types of flowmeters and a gas, other than air, may be used.

10.8. The test with water is to be conducted using a liquid flowmeter (or equivalent) installed in a piping system having sufficient pressure to provide the required flow. The system is to include an inlet piezometer or pipe at least one pipe size larger than the valve to be tested, with a flow control valve connected between the flowmeter and piezometer. A hose or hydrostatic relief valve, or both, may be used to reduce the effect of the pressure shock when the excess flow valve closes.

10.9. The test sample is to be connected to the outlet end of the piezometer. A manometer or calibrated pressure gauge of the retard type, which will permit readings in the range of 0 to 1,440 kPa is to be connected to a pressure take-off on the upstream side of the test sample to indicate the closing pressure. The connection is to be made using a length of rubber hose between the pressure gauge and the pressure take-off, with a valve installed at the gauge inlet to permit bleeding air from the system.

10.10. Prior to the test, the flow control valve is to be opened slightly, with the bleed valve at the pressure gauge open, to eliminate air from the system. The bleed valve is then to be closed and the test is conducted by slowly increasing the flow until the check valve closes. During the test the pressure gauge is to be positioned at the same level as the test sample. At the instant of closing, the rate of flow and closing pressure are to be recorded. When the excess flow valve is at cut-off position, the leakage or by-pass rate of flow is to be recorded.

10.11. An excess flow valve used in the assembly of a filling unit shall close automatically at a pressure differential of not more than 138 kPa when tested as described below.

10.12. Three samples of each size of valve are to be subjected to these tests. The tests are to be made with air, and separate tests are to be run with each sample mounted vertically and horizontally. The tests are to be conducted as described in paragraphs 10.4-10.7., with a filling unit hose coupling connected to the test sample and with the upper non-return valve held in the open position.

11. Charging-speed-test

11.1. The good function of the device limiting the filling degree of the container has to be performed by filling speeds of 20, 50 and 80 l/min.

12. Endurance-test for the filling limiter

The device limiting the filling degree of the container shall be capable of withstanding 6,000 complete filling cycles to the maximum filling degree.

Note:

1/ Many of the technical requirements on valves given in this annex find their origin in standards of the Underwriters' Laboratories (UL).

For the purpose of reference, this footnote contains a conversion list of all requirements adopted from UL-standards.

Paragraphs of annex 9	Corresponding paragraph of UL-standard and year of publication		
	Paragraphs	UL-standards	Year
2	4	UL 565	1973
3	4	UL 565	1973
4	5	UL 125	1974
	and 4	UL 565	1973
5	18	UL 125	1974
6	15	UL 125	1974
7	16	UL 125	1974
8	17	UL 125	1974
9.1	10	UL 132	1973
9.2	11	UL 132	1973
9.3	12	UL 132	1973
9.4	13	UL 132	1973
10	19	UL 125	1974

Annex 10

VIBRATION TEST PROCEDURE

1. Scope

Any device limiting the filling degree of the container and operating by a float, after having been subjected to the tests verifying that:

It limits the degree of filling of the container to 80 per cent or less of its capacity;

It does not allow - at the cut-off position - any filling of the container at a rate exceeding 1 litre/minute,

shall be subjected to one of the test procedures laid down in paragraph 5 or 6 below to ensure that the device is constructed to withstand expected dynamic vibrational stresses and to ensure that performance degradations or malfunctions will not be produced by the service vibration environment.

2. Equipment and mounting techniques

The test item shall be attached to the vibration equipment by its normal mounting means, either directly to the vibration exiter or transition table, or by means of a rigid fixture capable of transmitting the specified vibration conditions. Equipment used to measure and/or record the acceleration level or amplitude level and the frequency shall have an accuracy of at least 10 per cent of the measured value.

3. Choice of procedure

At the choice of the authority granting type-approval the tests shall be performed according to either procedure A described in paragraph 5 or procedure B described in paragraph 6.

4. General

The following tests shall be carried out along each of the three orthogonal axes of the test item.

5. Procedure A

5.1. Resonance search

Resonant frequencies of the filling limiter shall be determined by varying the frequency of applied vibration slowly through the specified range at reduced test levels but with sufficient amplitude to excite the item. Sinusoidal resonance search may be performed using the test level and cycling time specified for the cycling test, provided the resonance search time is included in the required cycling test time of paragraph 5.3.

5.2. Resonance dwell test

The test item shall be vibrated for 30 minutes along each axis at the most severe resonant frequencies determined in paragraph 5.1. The test level shall be 1.5 g (14.7 m/sec^2). If more than four significant resonant frequencies are found for any one axis, the four most severe resonant frequencies shall be chosen for this test. If a change in the resonant frequency occurs during the test, its time of occurrence shall be recorded and immediately the frequency shall be adjusted to maintain the peak resonance condition. The final resonant frequency shall be recorded. The total dwell test time shall be included in the required cycling test time of paragraph 5.3.

5.3. Sinusoidal cycling test

The test item shall be sinusoidally vibrated for three hours along each of its orthogonal axes in accordance with:

An acceleration level of 1.5 g. (14.7 m/sec^2)

a frequency range of 5 to 200 Hz,

a sweep time of 12 minutes.

The frequency of applied vibration shall be swept over the specified range logarithmically.

The specified sweep time is that of an ascending plus a descending sweep.

6. Procedure B

6.1. The test shall be performed on a sinusoidal vibrating bench, at a constant acceleration of 1.5 g and at frequencies ranging between 5 and 200 Hz. The test shall last for 5 hours for each of the axes specified in paragraph 4. The frequency band 5-200 Hz shall be covered in each of the two senses in 15 minutes.

6.2. Alternatively, in case the test is not conducted by utilizing a constant acceleration bench, the frequency band from 5 to 200 Hz has to be subdivided in 11 semi-octave bands, each of them covered by a constant amplitude, so that the theoretical acceleration is included between 1 and 2 g (g = 9.8 m/sec^2).

Vibration amplitudes for each band are as follows:

Amplitude in mm (crest value)	Frequency in Hz (for accel.= 1g)	Frequency in Hz (for accel.= 2g)
10	5	7
5	7	10
2.5	10	14
1.25	14	20
0.6	20	29
0.3	29	41
0.15	41	57
0.08	57	79
0.04	79	111
0.02	111	157
0.01	157	222

Each band shall be covered in both directions in 2 minutes, 30 minutes totally for each band.

7. Specification

After having been subjected to one of the vibration test procedures described above the device shall show no mechanical failures and is deemed to conform to the vibration test requirements only in the case the values of its characteristic parameters:

filling degree at the cut-off position,

filling rate allowed at the cut-off position,

do not exceed the prescribed limits and are not exceeding by more than 10 per cent the values preceding the vibration test procedure.