No. 8940. EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR). DONE AT GENEVA ON 30 SEPTEMBER 1957[1]

ENTRY INTO FORCE of amendments to annex B, as amended,[2] of the above-mentioned Agreement

The amendments, proposed by the United Kingdom of Great Britain and Northern Ireland, were circulated by the Secretary-General to all States parties to the Agreement on 1 October 1973. They came into force on 1 April 1974, in accordance with article 14 (3) of the Agreement.

[TRANSLATION — TRADUCTION]

Contents (page iv)	Insert: "Appendix B.lc Provisions concerning fixed tanks and demountable tanks in reinforced plastics 213 000-219 999".
10 100 (1) (c)	Insert: "— Appendix B.lc concerning fixed tanks and demountable tanks in reinforced plastics.".
10 121 (1)	Add the following sentence: "Reinforced-plastics tanks may be used only if their use is expressly authorized in chapter II. The temperature of the substance carried shall not exceed 50°C at the time of filling.".
31 121	Add the following new paragraph: "(3) Heating oils and diesel oils of 4° may be carried in reinforced-plastics tanks conforming to the provisions of appendix B.lc.".
33 121	Add the following new paragraph: "(3) Solutions of 4° (a) may be carried in reinforced-plastics tanks conforming to the provisions of appendix B.lc.".
51 121	Add the following new paragraph: "(3) The following may be carried in reinforced-plastics tanks conforming to the provisions of appendix B.lc: substance of 1° (b), (c) and (d) and 2° (b) and (c), solutions of hydrochloric acid of 5°, and substances of 32°, 37° and 41°.".
	Add Appendix B.lc:

APPENDIX B.lc

PROVISIONS CONCERNING FIXED TANKS AND DEMOUNTABLE TANKS IN REINFORCED PLASTICS

NOTES

This appendix applies to fixed tanks and demountable tanks; it does not apply to batteries or receptacles, to tank-containers, or to receptacles.

For receptacles, see the requirements concerning them in annex A (packages).

[1] United Nations, *Treaty Series*, vol. 619, p. 77; for subsequent actions, see references in Cumulative Indexes Nos. 9 and 11, as well as annex A in volumes 774, 779, 827, 828, 848, 883, 892, 905, 907, 920 and 921.

[2] *Ibid.*, vol. 619, p. 77; vol. 731, p. 363; vol. 774, p. 368; and vol. 828, p. 518.

It is recalled that marginal 10 121 (1) prohibits the carriage of dangerous substances in tanks except where such carriage is expressly authorized. This appendix is therefore confined to provisions applicable to fixed tanks and demountable tanks in reinforced plastics used for transport operations which are expressly authorized.

Section 1. GENERAL PROVISIONS CONCERNING THE CONSTRUCTION OF FIXED TANKS AND DEMOUNTABLE TANKS

213 000 The tanks must satisfy the following requirements of appendix B.1 of annex B of the European agreement concerning the international carriage of dangerous goods by road (ADR):[1]

(1) General provisions applicable to tanks used for carriage of all classes of substances: marginal 210 000, 210 001, 210 002 (2) and (3), 210 003 (1), 210 004, 210 005, 210 006, 210 021 (1), fourth sentence and (2). The leakproofness test and the internal inspection shall be performed every three years.

(2) Special provisions applicable to tanks used for carriage of substances of class IIIa: marginals 210 310 (2) (a) 1, (b), 3 (a), (4) — except for the provisions applicable to tanks of types b and c — 210 312, 210 313 (f).

(3) Special provisions applicable to tanks used for carriage of substances of class V: marginals 210 510 (8), (9) (b) and (c).

213 001 The walls of the tank must present no material defect causing a reduction in safety.

213 002 The walls of the tank must have a lasting resistance to the mechanical, thermal and chemical stresses to which they are subjected.

213 003 *Tank openings*

(1) Where the tank has one or more discharge openings below the level of the liquid, any pipe or valve fitted to such opening or openings shall be protected either by being recessed into the tank shell or by any other means approved by the competent authority and providing equivalent protection.

(2) The use of screwed plugs is strictly prohibited. Valves shall be of a model approved by the competent authority.

(3) Filling apertures shall be closed by a hermetic device. If the device projects outwards from the tank shell it shall be protected by a cap capable of withstanding wrenching stresses occurring through accidental overturning of the tank.

213 004-
213 199

Section 2. MATERIALS USED FOR THE WALLS OF THE TANK

213 200 The walls of tanks may be made of the following materials:

(1) Synthetic resin
- — non-saturated polyester resins;
- — epoxide resins;
- — other resins with similar characteristics, provided that the safety of the wall is demonstrated.

(2) Fibre reinforcements

Glass fibres (glass of types E and C)* with an appropriate coating, for example with a silane base or similar products. The glass fibres may be used

* Glass of types E and C is defined in table 1.

[1] United Nations, *Treaty Series*, vol. 619, p. 77.

in the form of cut or uncut rovings including prestressed continuous rovings or filaments, mats, surface mats or woven fabric.

(3) Additives

(*a*) Additives necessary for the treatment of resins, for example catalysts, accelerators, monomers, hardeners, thixotropic substances, in accordance with instructions by the manufacturer of the resin.

(*b*) Extenders, pigments, colorants and other products enabling the required properties to be obtained, for example, the increase of fire-resistant properties, provided that they cause no reduction in the safety of use of the walls of the tank.

213 201 - 213 299

Section 3. STRUCTURE OF THE WALLS OF THE TANK

213 300 The external surface layer of the walls of the tank must be resistant to atmospheric effects and also to brief contact with the substance to be carried.

213 301 The walls of the tank and the sealed joints must satisfy the mechanical resistance requirements listed in section 4.

213 302 The internal surface layer of the walls must be resistant to the lasting effects of the substance to be carried. This layer must be made of reinforced resin having a minimum thickness of 1 mm. The fibres used must not reduce the chemical resistance of the layer. The inner part of the layer must be rich in resins and must have a minimum thickness of 0.2 mm.

The requirements detailed in marginals 213 400 (6) and 213 402 (2) of section 4 must be satisfied.

213 303 The finished walls must satisfy the requirements detailed in marginal 213 400 (3) of section 4.

213 304 The minimum thickness of the wall shall be

— 3.5 mm if the capacity of the tank does not exceed 3000 litres;

— 5.0 mm if the capacity of the tank is more than 3000 litres.

213 305 - 213 399

Section 4. TEST METHODS AND QUALITIES REQUIRED

213 400 *Tests and qualities required for materials for the prototype tank*

(1) Taking of specimens

The specimens required for the test must wherever possible be taken from the walls of the tank. For this purpose cut-out parts resulting from the making of apertures etc. may be used.

(2) Percentage of glass fibre

The test must be conducted in accordance with the methods prescribed in ISO Recommendation R1172 1970.

The glass content of the specimen must be higher than 25 per cent and lower than 75 per cent by weight.

(3) Degree of polymerization

(*a*) *Wall in polyester resins.* The residual styrene content may not be higher than 2 per cent, calculated on the total quantity of resins. The test shall be conducted in accordance with a suitable method.*

* The method prescribed in standard DIN 16945 of June 1969, paragraph 6.4.3, is regarded as suitable.

(*b*) *Wall in epoxide resins.* The acetone extract may not be higher than 2 per cent calculated on the total quantity of resins. The test shall be conducted in accordance with a suitable method.*

(4) Bending and tensile strength

The mechanical properties must be determined:

— for the shell, in the axial and circumferential directions;

— for the ends and walls of compartments, in any direction.

If the principal directions of the reinforcement do not coincide with the axial and circumferential directions (for example in the case of biaxial winding), the strength must be determined in the principal directions of the reinforcement and calculated for the axial and circumferential directions by applying the following formulae:

Tensile

σ T,c = 2σT,H $\sin^2 \alpha$

σ T,a = 2σT,H $\cos^2 \alpha$

Bending

σ F,c = 2σF,H $\sin^2 \alpha$

σ F,a = 2σF,H $\cos^2 \alpha$

T = tensile

c = circumferential

a = axial

H = helicoidal

F = bending

α = preferential winding angle

The tensile strength must be tested in accordance with the methods prescribed in document ISO/TC61/WG 2/TG "Tests of glass reinforced plastics" No. 4 of February 1971.

The bending strength must be tested in accordance with the methods prescribed in Recommendation ISO/TC61 No. 1540 of April 1970.

Requirements:

New tanks must meet the following safety factors against rupture:

Safety factor for static loading : 7.5

Safety factor for dynamic loading : 5.5

The acceleration values to be applied in computing the dynamic load are as follows:

2 g in direction of travel;

1 g at right angles to direction of travel;

1 g vertically upwards; and

2 g vertically downwards.

As the characteristics of a reinforced plastics laminate may vary according to its structure, minimum values are not prescribed for bending and tensile strength but for loads:

$A = e\,\sigma_T$ where σ_T is the tensile strength at break;

$B = e^2\,\sigma_F$ where σ_F is the bending strength at break;

where e is the thickness of the wall

* The method prescribed in standard DIN 16945 of June 1969, paragraph 6.4.2, is regarded as suitable.

The minimum values for forces A and B are:

For bending:

Capacity of tank ⩽ 3,000 litres	
— circumferential direction	B = 600 daN
— axial direction	B = 300 daN
Capacity of tank > 3,000 litres	
— circumferential direction	B = 600 daN
— axial direction	B = 600 daN

For tensile:

— circumferential direction	A = 100 daN/mm
— axial direction	A = 70 daN/mm

Module E on bending is measured at −40°C and at +60°C. The two values may not differ by more than 30 per cent from the value obtained at 20°C. Behaviour of wall material during a tensile test lasting more than 1,000 hours.

The test tension is $\frac{\sigma T}{7.5}$

During the test the factor $K = \frac{\epsilon\ 1000}{\epsilon^{0}}$ may not be higher than 1.6

ϵ^{0} = elongation of loaded specimen at beginning of test

ϵ 1000 = elongation of loaded specimen at end of test

(5) Impact behaviour

(*a*) *Nature of test.* Impact behaviour is determined on a sample of laminate corresponding to the structural material used for the construction of the tank. The test is carried out by dropping a 5 kg steel weight onto the surface of the laminate corresponding to the external surface of the tank.

(*b*) *Apparatus.* The apparatus consists of a 5 kg steel weight, a guidance device for this weight and a specimen-bearing chassis. A general diagram of the apparatus is given in diagram 1. The weight is in the form of a steel cylinder provided with two guide channels, the lower extremity being spherically shaped, 90 mm diameter.

The guidance device is fitted vertically to a wall.

The specimen-bearer is composed of two angle-bars of 100 × 100 × 25 mm and 300 mm long, welded to a 400 × 400 mm metal support. The gap between the two bars is 175 mm. The specimen-bearer, fixed to the ground, is provided with a 50 mm deep cavity to allow flexion of the specimen.

(*c*) *Preparation of specimens.* From the sample, three specimens are taken, each measuring 200 × 200 mm × thickness of the sample.

(*d*) *Operating method.* The specimen is placed symmetrically on the specimen-bearer; if possible it rests on the support following two basic straight lines of the surface, in such a way that the weight strikes the centre of the face of the specimen corresponding to the external surface of the tank.

The weight is allowed to fall from a determined height, care being taken to ensure that it does not rebound and strike the specimen a second time. The test must be conducted at ambient temperature.

The height to which the weight is raised in the guidance device is noted.

The other two specimens are tested in the same way.

(*e*) *Requirement.* The drop height for a 5 kg weight shall be 1 metre: the specimen must not allow leakage of more than 1 litre per 24 hours when subjected to a column of water of 1 m.

(6) Resistance to chemical agents

Flat reinforced plastics test plates, prepared in the laboratory, are subjected to attack by the dangerous substance at a temperature of 50°C for 30 days in accordance with the following procedure:

(*a*) *Description of the test apparatus (and shown in diagram 2).* The test apparatus comprises a glass cylinder, diameter 140 × 150 mm, 150 mm high with two nozzles positioned at 135° one fitted with an NS 29 joint to take an intermediate pipe for a reflux condenser (1), the other nozzle fitted with an NS 14.5 joint to take a thermometer (2), an intermediate pipe for a reflux condenser and a reflux condenser not shown in the diagram. The glass part of the apparatus shall be in glass resistant to changes of temperature.

The specimens taken from the test plates form the base and the top of the glass cylinder. They are sealed to the sides of the cylinder by a PTFE collar. The cylinder with the two specimens is clamped between two pressure plates in corrosion-resistant steel with six threaded bolts tightened by means of wing nuts. An asbestos washer must be placed between the pressure plates and the specimens. These washers are not shown in diagram 2.

Heating is effected from outside by means of an automatically controlled sleeve heater. The temperature is measured in the chamber containing the liquid.

(*b*) *Operation of the test apparatus.* The test apparatus allows only flat plates of uniform thickness to be tested. The test plates should, if possible be 4 mm thick. Should these plates be covered with a gel coating, they must be tested in condition as for practical use. Six hexagonal specimens, each side measuring 100 mm are cut from the test plate.

For each test, three specimens are prepared per apparatus. One of these samples is used as a reference and the other two are used for checking in the liquid zone, and vapour zone of the device respectively.

(*c*) *Test procedure.* The specimens to be tested are placed on the apparatus with the surface which may be gel-coated facing inwards. 1,200 ml of test liquid is poured into the glass cylinder. The apparatus is then heated to the test temperature. A constant temperature is maintained during the test. After the test the apparatus is cooled to the ambient temperature and the test liquid removed.

The speciments tested are immediately washed with distilled water. Liquids which are not soluble in water are removed with a solvent which does not attack the specimens. Mechanical cleaning of the plates cannot be performed because of the danger of damaging the surface of the specimens.

(*d*) *Evaluation.* A visual examination is made:

— if the visual examination reveals excessive attack (cracks, bubbles, pores, peeling off, swelling, or roughness), the test is conclusive negatively;

— if the visual examination is favourable, tensile and bending tests are conducted in accordance with the methods defined in marginal 213 400 (4) on the two specimens subjected to chemical attack and on the reference specimen.

The percentage change in strength must not be more than 20 per cent from that obtained by submitting to tensile and bending tests two specimens of the same pure resin submitted to the same chemical attack and a pure resin specimen not submitted to this test.

213 401 *Test and quality required for the prototype unit*

The prototype tank shall be subjected to a hydraulic pressure test conducted by an expert approved by the competent authorities of a Contracting Party.

If the prototype tank is divided into compartements either by bulkheads or by baffle plates, the test shall be conducted on a unit made for this purpose with the same external ends as the entire tank and which represents the part of the tank subjected, under normal conditions of use, to the greatest stresses.

This test should not be conducted if there has already been a successful test on another prototype unit of the same section or a section with larger dimensions, geometrically similar to that of the prototype unit in question, even if that unit has a different internal surface layer.

This test must demonstrate that the prototype unit has, under normal conditions of use, a factor of not less than 7.5 so far as rupture is concerned.

It must be proved, e.g. by calculation, that safety factors against fracture given in marginal 213 400 (4) are complied with for each section of the tank.

Rupture occurs when the test liquid escapes from the tank in the form of jets. Consequently, before this rupture, the presence of delaminations and losses of liquid through these delaminations in the form of droplets is permitted.

The prototype unit shall be submitted to a hydraulic pressure

$$H = 7.5 \times d \times h$$

where H is the height of the column of water
h is the height of the tank
d is the density of the substance to be carried.

If a rupture occurs with a water-column height H_1 less than H, there must still be

$$H_1 \geqslant 7.5 \times d \times (h-h_1)$$

where h_1 is the height of the highest point where the first jet of liquid appears.

Should the flow of liquid at point h_1 be too great, it is essential to make a temporary repair and temporary local strengthening to enable the test to continue to height H.

213 402 *Conformity check on tanks produced in series*

(1) A conformity check on tanks produced in series shall be carried out by conducting one or more of the tests listed in marginal 213 400. However the measurement of the degree of polymerization is replaced by Barcol hardness measurement.

(2) *Barcol hardness.* The test must be conducted in accordance with suitable procedures.* Barcol hardness measured on the internal surface of the finished tank shall not be less than 75 per cent of the value obtained in the laboratory on pure hardened resin.

213 403 *Tests and qualities required for all tanks before being put into service*

Leakproofness test. The leakproofness test shall be conducted in accordance with the provisions of marginal 210 021 paragraph 2 (e) of ADR and the expert's stamp shall be applied to the tank.

* The procedures prescribed in standard ASTM-D 2583-67 are regarded as suitable.

TABLE I

COMPOSITION OF GLASS

Glass E. Composition by weight			
Silica	(SiO_2)	52 to 55	per cent
Alumina	(Al_2O_3)	14 to 15.5	per cent
Lime	(CaO)	16.5 to 18	per cent
Magnesia	(MgO)	4 to 5.5	per cent
Boric Oxide	(B_2O_3)	6.5 to 21	per cent
Fluorine	(F)	0.2 to 0.6	per cent
Ferric Oxide	(Fe_2O_3)		
Titanium Oxide	(TiO_2)	< 1	per cent
Alkaline Oxides	($Na_2O + K_2O$)	< 1	per cent
Glass C. Composition be weight			
Silica	(SiO_2)	63.5 to 65	per cent
Alumina	(Al_2O_3)	4 to 4.5	per cent
Lime	(CaO)	14 to 14.5	per cent
Magnesia	(MgO)	2.5 to 3	per cent
Boric Oxide	(B_2O_3)	5 to 6.5	per cent
Iron	($\approx Fe_2O_3$)	0.3	per cent
Sodium Oxide	(Na_2O)	7 to 9	per cent
Potassium Oxide	(K_2O)	0.7 to 1	per cent

DIAGRAM 1

DEVICE FOR MEASURING IMPACT RESISTANCE BY MEANS OF A SPHERICALLY-ENDED FALLING WEIGHT

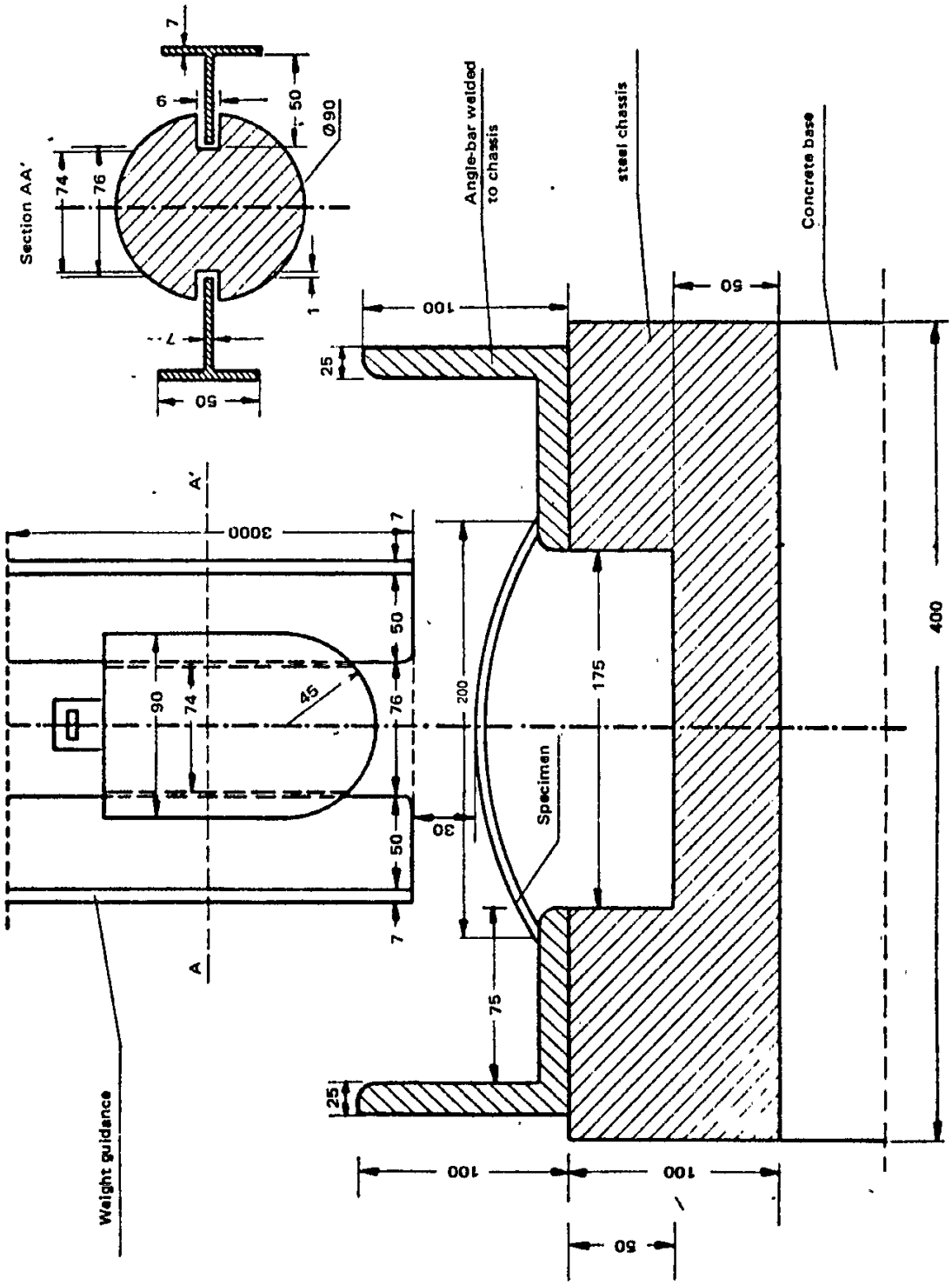
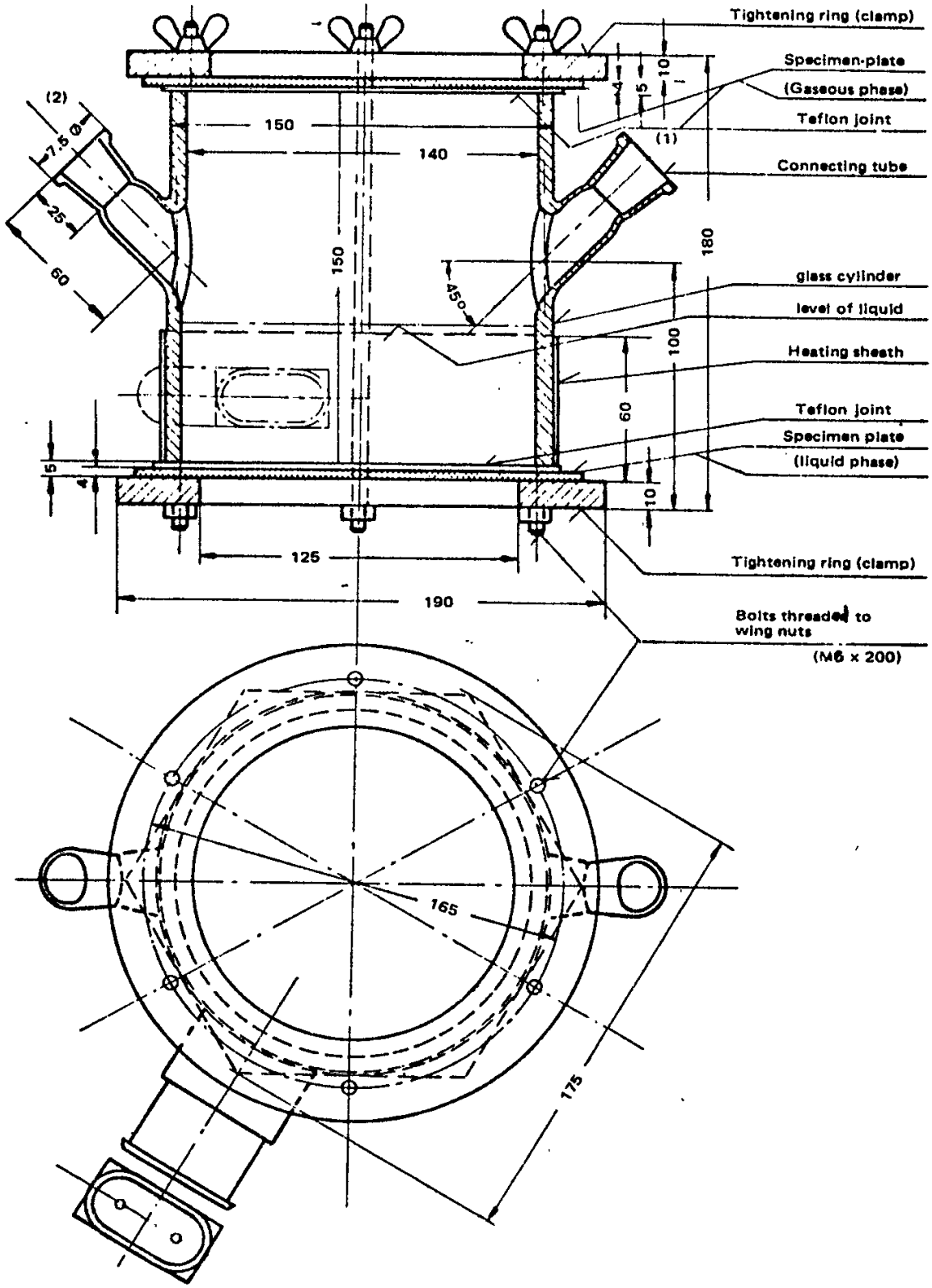


DIAGRAM 2

DEVICE TO TEST RESISTANCE TO CHEMICAL AGENTS



Authentic text of the amendments: French.
Registered ex officio *on 1 April 1974.*