SPECIFICATION FOR HOOP-WRAPPED COMPOSITE ALUMINIUM GAS CYLINDERS

HSE-AL-HW1

See Notes concerning Appendix 1, paragraph 2, on page 13

Application

This specification applies to composite gas cylinders in the range 0.5 to 50 litres water capacity for the storage and transport of compressed or liquefiable gases. Constructed in the form of a seamless aluminium alloy cylinder, the liner, over-wrapped with filament wound reinforced plastic to provide hoop reinforcement. The composite cylinder is pre-stressed by autofrettage to achieve a required level of stress distribution.

The composite cylinders shall be used for containing gases as defined in Table 1, BS 5045 Part 3.

The composite cylinder shall be certified by a Verification Body approved by the Health and Safety Executive.

1 DESIGN

1.1. Design Criteria

1.1.1 The test pressure of the cylinder shall be 1.5 times the design pressure. After autofrettage the following shall not exceed 85% of the calculated plastic (yield) stress of the liner material at autofrettage;

(a) the compressive stress in the liner at atmospheric pressure, and
(b) the tensile stress in the liner at design pressure

1.1.2. After autofrettage the calculated stress in the overwrap reinforcement filaments at test pressure shall not exceed 50% of that stress calculated at the design burst pressure (2.5 x filling pressure) of the composite cylinder.

1.1.3 The design pressure of the liner shall not be less than 50% of the design test pressure of the composite cylinder.

1.1.4 The minimum burst pressure of the liner shall be not less than 85% of the design test pressure for the composite cylinder.

1.1.5 The test pressure of the composite cylinder shall not be less than the greater of:

(a) 1.5 times the specified filling pressure, or
(b) 1.18 times the intended maximum service pressure

1.1.6 The maximum service pressure, p, is the pressure developed by the contents of a container at the reference temperature, tp.

For design purposes the reference temperature for UK use shall be:

60°C for permanent gases,
52.5°C for high pressure, liquifiable gases,
50°C for carbon dioxide in containers fitted with safety devices.

1.1.7 The filling pressure for permanent gases at the reference filling temperature of 15°C resulting in a maximum service pressure as specified above, shall be obtained by reference to British Standard 5355.

1.2. Information Required for Design Approval

1.2.1 General Information

Three copies of detailed drawings shall be prepared for design approval and submitted to the Verification Body showing each new design of composite cylinder including dimensional details of valve threads and any other

permanent features, together with the method of manufacture of both the liner and the composite cylinder.

The following information shall be made available to the independent verification body:

a) Fibre strength
b.i) Ratio of fibre to matrix by volume or
b.ii) Composite strength for a specified fibre ratio
c) Tensile strength of the metal
d) Yield strength of the metal
e) Modulus of elasticity of composite
f) Modulus of elasticity of metal

1.2.2 No alteration shall be made to the design or the method of manufacture after approval unless such alteration has received prior agreement of the Verification Body. A cylinder shall be considered to be of a new design compared with an existing approved design, when

(a) it is manufactured by a different factory, or
(b) it is manufactured by a different process, or
(c) there is change in the material of the liner or in one of the materials of the overwrap, or
(d) the liner is given different heat-treatment, or
(e) the overwrap is given different curing, or
(f) the diameter has changed by more than 10%, or
(g) the length of the container has increased by more than 50%, or
(h) the water capacity has changed by 30% or more, or
(i) a change in hydraulic test pressure of more than 10% requires a change in design wall thickness

1.2.3 Design Particulars

The design and other particulars listed under 1.2.3 and 1.2.4 below shall be shown on or attached to the drawing.

(a) water capacity in litres (to three significant figures)
(b) list of intended contents
(c) maximum filling pressure at 15°C
(d) composite cylinder maximum service pressure
(e) composite cylinder design test pressure
(f) liner design pressure
(g) liner minimum design thickness
(h) liner minimum calculated burst pressure
(i) calculated tensile hoop stress in the liner at test pressure
(j) calculated fibre stress in the filament at test pressure

1.2.4 Manufacturing, Inspection and Test particulars - Liner.

(a) materials, including limits of chemical analysis
(b) thickness and tolerance

(c) process and specification of manufacture
(d) heat-treatment
(e) inspection (minimum requirements)
(f) materials tests (specifications and minimum requirements)

1.2.5. Manufacturing, Inspection and Test particulars - Overwrap

(a) filament material, specification and strength test requirements
(b) filament construction, strand-geometry and treatment
(c) resin system - main components, materials and specifications where applicable
(d) resin system - curing agent, materials and specifications where applicable
(e) resin system - accelerator, materials and specifications where applicable
(f) overwrap construction
(g) curing process, approximate temperatures and minimum duration
(h) materials tests, specifications and minimum requirements

1.2.6 Manufacturing, Inspection and Test particulars - Complete Cylinder.

(a) autofrettage pressure and approximate duration.
(b) identity mark of the Verification Body.
(c) proposed marking and labelling.
(d) proposed periodic inspection and test procedures and rejection. criteria for the type of composite cylinder.

2. MATERIALS OF CONSTRUCTION

2.1 Liner

2.1.1 The material composition of the aluminium alloy for the liner shall be within the limits shown below:

	6061 A		7060 ***	
Element	**Min %**	**Max %**	**Min %**	**Max %**
Silicon	0.40	0.80	-	0.15
Iron	-	0.70	-	0.20
Copper	0.15	0.40	1.8	2.6
Manganese	-	0.15	-	0.20
Magnesium	0.80	1.20	1.3	2.1
Chromium	0.04	0.35	0.15	0.25
Zinc	-	0.25	6.1	7.5
Titanium	-	0.15	-	0.05
Lead	-	0.003	-	0.003
Zirconium	-	-	-	0.05
Others each	-	0.05	-	0.05
Others total	-	0.15	-	0.15
Aluminium	The remainder		The remainder	

2.1.2 A cast analysis certificate supplied by the manufacture of the liner material shall be kept at the cylinder manufacturer's premises.

2.1.3 The cast shall be defined to the satisfaction of the Verification Body.

2.2. Overwrap

2.2.1 The filament material shall be glass fibre type S2, E or aramid fibre.

2.2.2 The resin system shall be epoxy or modified epoxy with amine or anhydride curing agent.

2.2.3 The supplier of the filament material and of the resin system component materials shall provide sufficient documentation for the composite cylinder manufacturer to be able to identify fully the batch of materials used in the manufacture of each cylinder.

2.2.4 The materials used shall be of uniform and consistent quality. The composite cylinder manufacturer shall verify that each new batch of materials has the correct properties and is of satisfactory quality, and maintain records from which the batch of materials used for the manufacture of each cylinder can be identified.

2.2.5 Batches of material shall be identified and documented to the satisfaction of the Verification Body.

2.2.6 The filament material shall be subjected to an impregnated strand test in accordance with American Society for Testing and Material Standard ASTM D2343 or an identified equivalent specification accepted by the Verification Body.

The strength of acceptable fibre shall not be less than the following:-
Glass type

S2	2780 N/mm^2
E	1380 N/mm^2
Aramid	3000 N/mm^2

Alternative methods, equivalent to ASTM D2343 are acceptable to establish fibre strength.

3. MANUFACTURE, HEAT-TREATMENT AND MATERIALS TESTS

3.1. Liner

3.1.1 The liner shall be manufactured by a process as set out in Paragraph 14 of BS 5045 Part 3, or a comparable specification approved by the Health and Safety Executive for the liners of hoop-wrapped aluminium composite gas cylinders. The liner shall not be subjected to a hydraulic test before the overwrap is applied.

3.1.2 Finished liners in 6061A material shall be solution heat treated at a temperature within the range 515°C to 545°C followed by water quenching at or below 30°C and then artificially aged (precipitation treatment) at a temperature within the range 150°C to 200°C, in each case for an appropriate duration.
Finished liners in 7060 material shall be solution heat treated at a temperature within the range 4720 C to 4820 C, followed by water quenching at or below 300 C and then artificially aged (precipitation treatment) using a thermal cycle comprising two steps:-

- a first step at a temperature within the range 100^0 C to 110^0 C for a duration of 5h to 7h followed by
- a second step at a temperature within the range 167^0 C to 177^0 C for a duration of 12h to 15 h.

3.1.3 After heat treatment each liner shall be checked for hardness and shall achieve not less than 90 Brinell or equivalent for 6061A material and 120 Brinell or equivalent for 7060 material

3.1.4. Materials tests shall be performed on specimens cut from one fully heat treated liner in every batch, or where the number in a batch exceeds 200, from one liner in every 201 or part thereof. A batch refers to liners of the same material cast that have undergone identical heat treatment.

3.1.5. Tensile test specimens shall be made from a strip cut longitudinally from the liner, and its form and dimensions shall be in accordance with British Standard BS 18:

Part 1. Only the edges shall be machined, the face and the back of the test pieces shall represent the surface of the container as manufactured.

3.1.6. The results of the tensile tests shall meet the following requirements:-

Ultimate tensile strength: not less than 325 N/mm^2 for 6061A and 440N/mm^2 for 7060
0.2% proof stress: not less than 280 N/mm^2 for 6061A and 372N/mm^2 for 7060
Elongation (% on 5.65/Area): Not less than 12%.

3.1.7. Cold bend tests shall be made on four strips prepared from two rings cut from the same liner as that used to provide the tensile test pieces. The width of each strip shall not be less than 25 mm. In preparing the test piece, the face and back shall not be machined except that the edges may be rounded off.

3.1.8 The test pieces shall remain uncracked when bent inwards round a former of diameter not more than six times the actual thickness of the test strip for 6061A and 8 times for 7060, until the interior edges at the ends of the strip are at a distance apart not greater than the diameter of the former.

3.1.9. A record of all the tests carried out shall be kept at the premises of the cylinder manufacturer. Suitable forms of test certificate are shown in Appendix III.

3.1.10 If any of the test results are not satisfactory, then if the Verification Body is satisfied that this was due to an error in carrying out the test, a re-test may be authorised using the same liner otherwise, at the discretion of the manufacturer either.

(a) the test in question shall be repeated on two specimens, one from the same liner or test ring as for the first test and another one from a liner or test ring from the same batch, and if both results are satisfactory the batch may accepted.

or

(b) the batch may be re-heat treated in accordance with 3.1.2 and re-tested as specified under 3.1.3 through to 3.1.8 and if the results are satisfactory the batch may be accepted.

3.1.11 Where solution heat treatment has been shown to be inadequate, liners may be subjected to re-solution treatment, followed by artificial ageing.

3.1.12 Where heat treatment furnace records show artificial ageing has been inadequate, additional time at the ageing temperature shall be given.

3.1.13 If the test results, having allowed for re-testing or re-heat treatment, are not satisfactory, liners in the batch shall be rendered unserviceable for holding gas under pressure by one of the following methods:-

(a) crushing by mechanical means;
(b) producing an irregular hole in the top dome equivalent at least to 10% of the area of the top dome, or in the case of a thin walled liner piercing it in at least three places.
(c) cutting up

Drilling a hole is not considered to be satisfactory for this purpose.

3.2. Overwrap

3.2.1 Fibre reinforced plastic overwrap shall be applied to the entire cylindrical portion of the liner by winding resin impregnated continuous filament around it in a 'hoop wrap' pattern under controlled tension until the specified composite thickness is obtained.

Note: Liners may be stripped and re-wound provided that the overwrap has not been cured. The liner must not be re-wound if it has been damaged or scored by the removal of the overwrap.

3.2.2. After winding is completed the composite shall be cured using a controlled temperature profile as specified for the system used. The maximum temperature shall be such that the mechanical properties of the liner material are not adversely affected.

3.2.3. The composite cylinder shall be subjected to an autofrettage pressure of not less than 115% and not more than 135% of the prescribed minimum test pressure, maintained sufficiently long for further expansion to substantially cease.

4. COMPLETED CYLINDER.

4.1. Hydraulic Pressure Test.

4.1.1. Each completed cylinder shall be subjected to a volumetric expansion test as laid down in British Standard BS 5045 Part 3 at the pressure specified below. The test pressure of the composite cylinder shall not be less than the greater of:

(a) 1.5 times the specified filling pressure, or
(b) 1.18 times the intended maximum service pressure

4.1.2 The cylinder is acceptable if the total volumetric expansion at test pressure is not more than 5% and the permanent volumetric expansion expressed as a proportion of the total expansion is also not more than 5%.

4.2. Pressure Cycle and Burst.

4.2.1 One completed cylinder per batch of 201 (or less) shall be subjected to a pressure cycle test of 10,000 cycles from less than 0.10 test pressure to 2/3 test pressure, followed by 30 cycles up to test pressure.

4.2.2. If there are no signs of leakage or failure, the outcome is satisfactory and the cylinder shall be hydraulically tested to destruction in accordance with Clause 4.2.3.

4.2.3. The results of the burst test shall be acceptable if the minimum burst pressures obtained are not less than 2.5 times the filling pressure *(see Clause 1.7)*. Failure must initiate in the cylinder wall. Cylinders with maximum filling pressure not exceeding 150 bar must remain in one piece.

4.2.4. If the results of the pressure cycle and burst test (Clauses 4.2.1. to 4,2,3) are not satisfactory, the cylinders in the batch shall be rendered unserviceable for holding gas under pressure by one of the methods under 3.1.13.

4.3.5 If a cylinder fails the hydraulic pressure test (Clause 4.1.) or the pressure cycle and burst test (Clauses 4.2.1 to 4.2.3) the cause shall be investigated to the satisfaction of the Verification Body. If failure is not due to an error in the manufacturing or test procedure a specimen from the overwrap material shall be prepared and tested in accordance with Clause 2.2.6. If the tensile strength is less than required, a further specimen may be prepared and tested in the same manner. If this specimen also fails to pass the test the batch of material shall be rejected and any cylinders over-wrapped using this batch of material shall be rendered unserviceable by one of the methods under 3.1.13.

5. DESIGN QUALIFICATION TESTS

5.1. Liners.

5.1.1 Four completed liners shall be chosen at random by the Verification Body from the first production run of a new design, one liner hydraulically tested to destruction and three liners subjected to either of the pressure cycle tests in section 5.1.3.

5.1.2 One or two completed liners (depending on size) shall be chosen at random by the Verification Body from the first production run of a new design and tested for resistance to corrosion (intercrystalline corrosion and stress corrosion) in accordance with annex II of EEC Directive 84-526 of 17 September 1984.

5.1.3 The minimum burst pressure of the liner shall be not less than 85% of the design test pressure for the composite cylinder.

The liners shall attain the number of cycles shown without developing a leak:

50% composite test pressure 12,000
33% composite test pressure 80,000

5.2. Complete Cylinders

5.2.1 Three completed cylinders shall be chosen at random by the Verification Body from the first production run of a new design and subjected to pressure cycle tests as shown in Clauses 5.2.2 to 5.2.5.

5.2.2 The results are satisfactory if the cylinder attains the number of cycles shown without developing a leak.

Number of Cylinders	Upper Cyclic Pressure	Number of Cycles
1 Cylinder	90% Test Pressure	7,000
1 Cylinder	85% Test Pressure	10,000
1 Cylinder	66% Test Pressure	60,000

5.2.3 Pressure cycling tests shall be carried out using a non-corrosive fluid. The minimum (lower cyclic) pressure shall not be more than 10% of the maximum (upper cyclic) pressure and the frequency of reversals shall not exceed 15 cycles per minute. The temperature measured on the outside surface of the liner shall not exceed 50°C during the test.

5.2.4 If the cylinders subjected to pressure cycle tests are satisfactory the same cylinders shall be hydraulically tested to destruction. The results of the burst test shall be acceptable if the minimum burst pressures obtained are not less than 2.5 times the filling pressure. Failure must initiate in the cylinder wall. Cylinders with maximum filling pressure not exceeding 150 bar must remain in one piece.

5.2.5 If the burst requirements obtained in the tests specified in section 5.2.4 are below the required level, two cylinders shall be chosen at random by the Verification Body from the first production run and these shall be subjected to the pressure cycle and burst tests specified in sections 4.2.1 and 4.2.2. If these meet the requirements of section 4.2.3 the results are acceptable.

5.2.6 Liners or composite cylinders manufactured in a production run for which the design qualification tests do not give satisfactory results shall be rendered unserviceable for holding gas under pressure, by one of the methods listed in 3.1.13. The Verification Body shall verify whether the cylinders were manufactured in accordance with the design drawings and in the absence of manufacturing errors shall notify the Health & Safety Executive of the circumstances.

6. MARKING

6.1. Label.

6.1.1 Each finished composite cylinder which satisfies the requirement of this specification shall be permanently and legibly marked with a label incorporated in the reinforcing wrap on the side near the outlet end of the cylinder for fibre glass wrapped cylinders, showing the following:-

(a) the mark of this specification: HSE-AL-HW1
(b) filling pressure in bar units at 15°C (permanent gases);
(c) test pressure in bar units;
(d) manufacturer's mark;
(e) mark of the Verification Body;
(f) date (month and year) of the first hydraulic pressure test;
(g) minimum water capacity in litres (liquefiable gases)
(h) Serial Number.

For aramid fibres the above information shall be stamped on the formed neck of the liner in a low stressed area agreed with the Verification Body

6.1.2 The layout of the label and marking shall be part of the approved design. Stamping in the formed neck of the liner in a low stressed area agreed with the Verification Body, in a manner that will not create distortions of the cylinder profile or harmful stress concentrations.

6.2. Liner.

6.2.1 The following shall also be marked by stamped on the formed neck of the liner in a low stress area agreed with the Verification Body, in a manner that will not create distortions of the cylinder profile or harmful stress concentrations:

(i) the mark of this specification: HSE-AL-HW1
(ii) manufacturer's mark and type number for the cylinder;
(iii) the mass in Kg of the composite cylinder only, if it is intended for the conveyance of permanent gases;
(iv) the tare in Kg, i.e. the mass of the cylinder and valve but excluding the valve cover, if it is intended for the conveyance of liquefiable gases

6.3 Additional markings, e.g. re-test dates, may be stamped on a low stress area of the formed neck, and the base may also be marked, e.g. with the manufacturer's symbol, provided the markings are of a size and depth that will not create harmful stress concentrations

APPENDIX I

PERIODIC EXAMINATION AND TESTING

1. Composite cylinders to this specification shall be examined for defects externally by visual inspection at each cylinder fill, by a person having appropriate training, experience and facilities

2. Within the period of 5 years from the date of the last hydraulic pressure test every composite cylinder to this specification shall be examined for defects externally and internally, and before continuing in service, subjected to a hydraulic pressure test in accordance with Clause 4, by the manufacturer or a station authorised to test composite cylinders on behalf of the manufacturer.

NOTE 1 to paragraph 2
It is acceptable that the hydraulic test pressure referred to in paragraph 2 should be interpreted as 'a proof test pressure test', when the reference to 'Clause 4' shall no longer apply. All other parts of Appendix 1, and in particular paragraph 5, remain unchanged. Cylinders may continue to be tested in accordance with Clause 4 if the manufacturer wishes.

NOTE 2 to paragraph 2

The period between the initial hydraulic test and the first periodic hydraulic test can be increased to 10 years for cylinders intended for use with UN1072 Oxygen, compressed or UN3156 Compressed Gas, Oxidising, N.O.S only and where all of the conditions below have been met.

(1) At least 1000 cylinders from the first year of production covered by the design type approval have been tested at a 5-year period and found to be suitable for a further 5 years service.
(2) At least 3 of the cylinders in (1) above have been burst tested in accordance with this specification and fully met the burst test criteria.
(3) At least 3 of the cylinders in (1) above have been subjected to the full cyclic loading test in accordance with this specification and fully met cyclic loading test criteria.
(4) The cylinders are fitted with a residue pressure valve that is checked for correct operation before each fill.
(5) The cylinders are inspected at the time of fill in accordance with EN1920:2000 - *Transportable Gas Cylinders. Cylinders for compressed gas (excluding acetylene). Inspection at time of fill.*
(6) All operatives involved in the inspection at time of fill and the periodic examination have been trained and given a certificate of acceptance by the cylinder manufacturer

3. The procedure for external and internal inspection shall be specified by the manufacturer, including the appropriate damage identification criteria for the acceptance or rejection of cylinders for further service. This procedure may refer to relevant guidance published by the Compressed Gas Association in

the USA (CGA Pamphlet C-6.2) and the relevant sections of BS 5430 : Part 3: in respect of non-wrapped and internal surfaces, excluding any method of cleaning or surface preparation that might damage the composite.

4. A cylinder with superficial damage only that has no adverse effect on its safety and integrity may continue in service.

5. Cylinders with minor damage below the rejection level in accordance with the criteria specified under par. 3 including minor flaws in the reinforcement shall be returned to the manufacturer for examination and, if deemed suitable for further service, subjected to a hydraulic pressure test in accordance with Clause 4.

6. Cylinders shall be rejected if they do not meet the volumetric expansion criteria or if any flaw has grown following testing.

7. Rejected cylinders shall be rendered unserviceable from holding gas under pressure by one of the methods listed in Clause 3.2.11.

8. In the event of doubt or dispute in connection with Clauses 4 to 7, the manufacturer, and if necessary the Inspecting Authority, shall be consulted.

9. 15 years from the date of the first hydraulic pressure test each composite cylinder shall be returned to the manufacturer for re-assessment of its suitability for further service. They may continue in service for a further period of up to 15 years only with the written consent of the manufacturer and the Competent Authority.

10. Records of all periodic examinations and testing shall be held by the manufacturer together with materials and test certificates and inspection reports relating to the manufacturer of the cylinders, for the lifetime of the cylinder.

APPENDIX II

CERTIFICATE REQUIREMENTS

An example layout is shown which includes all the required information.

VERIFICATION BODY'S REPORT ON:

THE MANUFACTURE OF FIBRE-REINFORCED HOOP WRAPPED SEAMLESS ALUMINIUM ALLOY COMPOSITE GAS CYLINDERS TO SPECIFICATION HSE-AL-HW1.

Verification Body _____

Verification Body's Mark _____

Certificate _____

Place _____Date_____

Cylinders Manufactured by _____

Manufacturers Mark _____

Manufactured for _____

Consigned to _____

Quantity _____Overall size _____
Outside Diameter by _____long

Serial Numbers _____to _____ inclusive

Specification HSE-AL-HW1

Drawing No _____

Date of Hydraulic Pressure Test _____

Test Pressure _____

Water Capacity _____

Gas _____

Filling Pressure (Permanent) _____

Filling Ratio (Liquefiable) _____

Mass of Container (in Kg) Minimum _____ Maximum _____ Without valve

Minimum _____ Maximum _____ With valve

(Note: Items in brackets below refer to the Clauses of specification HSE-AL-HW1)

Each cylinder was made by over-wrapping a seamless aluminium alloy liner with resin impregnated filament reinforcement.

Liner material designated as _____ was supplied by

_____

and the cast analysis was within the required limits. Each liner was produced by an approved process in accordance with BS 5045 Part 3, heat treated by solution treatment followed by water quenching with artificial ageing (3.1.2) and checked for hardness (3.1.3.). The results of the tensile tests (3.1. 6.), and cold bend tests (3.1.8.) have been found satisfactory.

Overwrap was applied by winding under controlled tension filament

designated _____

supplied by _____

Impregnated with resin

designated _____

manufactured by _____

Identified by package number and cured after wrapping to the manufacturer's specification. Filaments strand strength (2.2.6) was verified and found satisfactory.

Calculated stress levels on the aluminium liner and the reinforcement filaments satisfy design requirements (1.1.1 and 1.1.2).

Each cylinder was subjected to an

autofrettage pressure of _____.for approximately _____

Each cylinder was subjected to a hydraulic pressure test (4.1.1) at the test pressure stated above and volumetric expansion was found to be satisfactory (4.1.2).

The results of pressure cycle test (4.2.1) and the burst test (4.2.2) on cylinders representative of the batch of which the above cylinders are a part have been satisfactory.

Each cylinder has been marked as required by the Specification (6.1, 6.2).

WE HEREBY CERTIFY that each of the above cylinders meet in full the requirements of the Specification.

For and on behalf of the manufacturer _____

For and on behalf of the Verification Body _____

APPENDIX III

SPECIMEN TEST CERTIFICATES

1) Mechanical tests on Seamless Aluminium Alloy Liners for HSE-AL-HW1 cylinders.

Batch No	Code	Test Piece Dimensions mm	0.2% yield strength N/mm^2	Tensile strength N/mm^2	Elongation %

Bend tests satisfactory at

For and on behalf of
the Manufacturer _____

For and on behalf of
the Verification Body _____

2. Hydraulic volumetric expansion test certificate for composite cylinders.

Customer Order No._____ Tested to a pressure of _____ and complying with HSE-AL-HW1

Manufacturers No. _____

Serial No.	Cast No.	Total Expan-sion	Perman-ent Expan-sion	Perman-ent/ Total Expan-sion Ratio	Mass Full	Mass Empty	Water Capacity	Date Tested
		mL	mL	%	KG	KG	L	

Certified by _____ on behalf _____ Date_____

(for manufacturer)

Accepted by _____ Date

Verification Body