



Transport
Canada
Safety and Security

Transport Dangerous
Goods Directorate
330 Sparks Street
Ottawa, Ontario K1A 0N5

Transports
Canada
Sécurité et sûreté

Direction générale du
transport des marchandises dangereuses
330, rue Sparks
Ottawa (Ontario) K1A 0N5

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FOR INFORMATION ONLY**

Equivalency Certificate

Certificate No.: SU 9686 (Ren. 3)

Certificate Holder: Structural Composites Industries,
a Worthington Cylinders Company

Mode of Transport: Road, Rail, Marine

Issue Date: NOV 10 2009

Expiry Date: September 30, 2013

CONDITIONS

This Equivalency Certificate authorises Structural Composites Industries, a Worthington Cylinders Company to sell, offer for sale, distribute, or deliver in Canada and authorises any person to handle, offer for transport, transport, or import into Canada, by road or railway vehicle, or by ship, cylinders, in a manner that does not comply with subsections 5.1(1) and (2), section 5.2, subparagraphs 5.10(1)(a)(i), 5.10(1)(b)(i), and 5.10(1)(d)(i), and subsection 5.10(2) of the *Transportation of Dangerous Goods Regulations*, if:

Selection and Use

(a) subject to paragraphs (b) to (g), the requirements applicable to Specification TC-3FCM cylinders in National Standard of Canada CAN/CSA B340-02, "Selection and Use of Cylinders, Spheres, Tubes, and Other Containers for the Transportation of Dangerous Goods, Class 2", October 2002, as amended in January 2004 and February 2005, cited in the rest of this Certificate as CAN/CSA B340-02, are complied with;

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(b) each cylinder contains one of the following dangerous goods, as specified in the design qualification test reports:

<u>Dangerous Goods</u>	<u>PIN</u>
AIR, COMPRESSED with not more than 23.5 per cent oxygen, by volume	UN1002
ARGON, COMPRESSED	UN1006
HELIUM, COMPRESSED	UN1046
HYDROGEN, COMPRESSED	UN1049
NITROGEN, COMPRESSED	UN1066
OXYGEN, COMPRESSED	UN1072
COMPRESSED GAS, N.O.S.	UN1956
METHANE, COMPRESSED; or NATURAL GAS, COMPRESSED with high methane content	UN1971
COMPRESSED GAS, OXIDIZING, N.O.S.	UN3156

(c) cylinders that have been subjected to fire are not returned to service;

(d) cylinders involved in an accident or collision are subjected to requalification before being returned to service;

(e) the cylinders are manifolded in accordance with clause 4.4 of CAN/CSA B340-02 and permanently mounted within a high strength structural framework that safely secures the cylinders, components, and manifolding. The frame is designed:

- (i) to secure the cylinders while withstanding, without permanent deformation, a static force of eight times the weight of the assembly, in the three principal axes, applied individually,
- (ii) in such a manner that no cylinder or component extends beyond the envelope defined by the frame, and
- (iii) to protect the cylinders from localized impact and from road debris through adequate shielding;

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- (f) the requirements of clause 4.5 of CAN/CSA B340-02 are complied with;
- (g) no more than 15 years has elapsed since the original manufacturing test date for each cylinder;

Manufacture and Requalification

- (h) the cylinders are manufactured at 325 Enterprise Place, Pomona, CA, U.S.A., in accordance with the specific procedures, the design qualification test report, and model number ALT 962 or ALT 962L, filed by Structural Composites Industries LLC with the Transport Dangerous Goods Directorate;
- (i) subject to paragraphs (j) to (ac), the cylinders are in compliance with the requirements applicable to Specification TC-3FCM set out in National Standard of Canada CAN/CSA B339-02, *"Cylinders, Spheres, and Tubes for the Transportation of Dangerous Goods"*, October 2002, as amended in November 2003 and February 2005, cited in the rest of this Certificate as CAN/CSA B339-02;
- (j) the cylinders are seamless aluminum liners wound with a layer of carbon fibre reinforced composite material and an outer layer of fibreglass reinforced composite material;
- (k) despite clause 9.1.1 of CAN/CSA B339-02, the nominal water capacity of each cylinder is 298.5 litres;
- (l) despite clause 9.1.1 of CAN/CSA B339-02, the service pressure of each cylinder is 43.1 MPa;
- (m) the chemical composition of the aluminum alloy complies with clause 9.2.1 of CAN/CSA B339-02, except that the maximum mass percent of lead is 0.005 and that of bismuth is 0.005;

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- (n) the filament material is composed of:
- (i) polyacrylonitrile (PAN) based carbon fibre, tested in accordance with ASTM D4018-99 (2004), "*Standard Test Methods for Properties of Continuous Filament Carbon and Graphite Fiber Tows*" and having a minimum strand strength and other mechanical properties as specified for each cylinder design by the cylinder manufacturer. In all cases, the tensile strength does not exceed 5172 MPa, the modulus of elasticity does not exceed 290 GPa, and the strain to failure is not less than 1 percent; and
 - (ii) commercial Type-S or Type-E fibreglass in accordance with the requirements of Clause 9.2.2 of CAN/CSA B339-02;
- (o) the outer surface of each liner is protected from galvanic corrosion by a fibreglass-epoxy composite layer or by a suitable polymer coating;
- (p) the net load sharing capability of the fibreglass in the outer composite layer and in the galvanic corrosion protection layer does not exceed 15 percent of the total pressure load in the cylinder at burst pressure;
- (q) the autofrettage pressure requirements specified in clause 9.5.1.2 of CAN/CSA B339-02 do not apply. However, the autofrettage pressure and duration are specified by the cylinder manufacturer for each cylinder design;
- (r) despite clause 9.9.1 of CAN/CSA B339-02, the specimens are cut from a test ring that has been heat-treated in the same furnace load as the liners it represents. The test ring is of the same nominal diameter and thickness as the liners it represents and is taken from a heat of aluminum tubing material that is represented in the load. The ring is at least 60 cm long and has its ends covered during the heat-treatment process;
- (s) for all cycling tests (lot acceptance and design qualification), the cycling rate does not exceed 10 cycles per minute;
- (t) the minimum burst pressure is 3.4 times the service pressure;

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(u) when a cylinder fails the lot acceptance cycling test or the burst test, specified in clause 9.10 or 9.11 of CAN/CSA B339-02 respectively, five additional cylinders taken at random may be subjected to the same test. If one or more of the five cylinders fails the test, the lot is rejected;

(v) in addition to the design qualification test requirements specified in clause 9.13 of CAN/CSA B339-02;

(i) the ambient temperature cycling test specified in clause 9.13.3 of CAN/CSA B339-02 is performed on at least two cylinders, and the environmental cycling test specified in clause 9.13.3 of CAN/CSA B339-02 is performed on at least two cylinders. After cycling, each cylinder is then pressurised hydrostatically to destruction, and the burst pressure is not less than 3.06 times the service pressure,

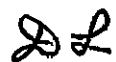
(ii) the burst test specified in Clause 9.13.4 of CAN/CSA B339-02 is performed on at least three cylinders,

(iii) it is not required that each test cylinder be subjected to a vertical bonfire test, as specified in clause 9.13.6 of CAN/CSA B339-02. However, at least two cylinders, representative of each new design, are subjected to the horizontal bonfire test except that the fire for tests is generated by propane and the cylinders may vent through the pressure-relief device and the cylinder-to-valve connection, and

(iv) at least one cylinder representative of each new design is subjected to a drop test in accordance with clause 8.5.8 of International Standard ISO 11119-2:2002(E), "*Gas Cylinders of composite construction - Specifications and test methods - Part 2: Fully wrapped fibre reinforced composite gas cylinders with load-sharing metal liners*";

(w) the representative cylinder that is subjected to the gunfire test prescribed in clause 9.13.5 of CAN/CSA B339-02 may be impacted by a 12.7 mm calibre armour-piercing projectile;

(x) the reports are retained by the manufacturer and by the independent inspector for the service life of the cylinders;


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(y) the Transport Canada mark, the specification designation, and the service pressure marked on each cylinder is: "TC-SU 9686" followed by the service pressure expressed in bar;

(z) each cylinder is marked "DO NOT USE AFTER MM/YYYY", where "MM" is the month and "YYYY" is the year representing the service life limitation of the cylinder which does not exceed 15 years from the original manufacturing test date;

(aa) the requalification period is 5 years;

(ab) subject to paragraph (ac), despite clause 2 of CAN/CSA B339-02, every reference to CGA Publication C-6.2 in that standard is read as a reference to CGA Publication C-6.2-2005, "Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders";

(ac) the acceptance criteria for level 2 cuts and abrasions in the fibre are:

(i) for depth: is not to penetrate completely through the outer glass fibre layers, such that the carbon fibre has been exposed, cut or abraded. The maximum measurable depth is 0.889 mm for cylinder diameters up to 190.5 mm and is 1.143 mm for cylinder diameters greater than 190.5 mm,

(ii) for length: is not to exceed 20% of the full straight sidewall length of the cylinder. The straight sidewall length is measured between those two points where ends begin to curve;

(ad) the Certificate holder reports any incident involving loss of contents or failure of the cylinders to the Director, Regulatory Affairs Branch, Transport Dangerous Goods Directorate, Transport Canada; and

(ae) prior to applying for renewal of this Certificate, the Certificate holder reports a summary of the cylinder manufacturing and performance experience to the Director, Regulatory Affairs Branch, Transport Dangerous Goods Directorate, Transport Canada.

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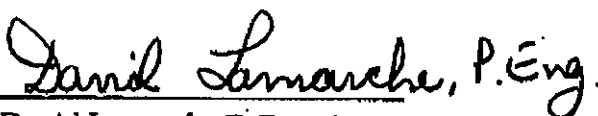
This Equivalency Certificate serves as the registration of Structural Composites Industries, a Worthington Cylinders Company pursuant to clause 25.2 of CAN/CSA B339-02, to manufacture cylinders of the designs specified herein. Structural Composites Industries, a Worthington Cylinders Company's registered mark pursuant to CAN/CSA B339-02 is

ALT

Note:

The issuance of this Equivalency Certificate in no way reduces the Certificate holder's responsibility to comply with any other requirements of the *Transportation of Dangerous Goods Regulations* not specifically addressed in this Certificate.

Signature of Issuing Authority



David Lamarche P. Eng., ing.

Chief

Permits and Approvals Division

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(The following is for information purposes only and is not part of the certificate)

Contact Person: Robert L. Beck
Director of Quality Assurance
Structural Composites Industries
a Worthington Cylinders Company
325 Enterprise Place
Pomona, CA 91768 U.S.A.

Telephone: 909-376-8101
Facsimile: 909-594-3939
E-Mail : Rbeck@scicomposites.com

Explanatory Note

This Certificate allows for the manufacture and use of fully-wrapped carbon-fibre reinforced aluminum-lined cylinders which are manifolded and permanently mounted within a protective framework for the transport of compressed gases. The Certificate holder has demonstrated that the substitution of polyacrylonitrile (PAN) based carbon fibre for fibreglass results in a cylinder which could be used with equivalent safety to that of a TC-3FCM specification cylinder.

Legend for Certificate Number

SH - Highway, SR - Rail, SA - Air, SM - Marine
SU - More than one Mode of Transport
Ren. - Renewal

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NOTE

Under Canadian Law, a foreign manufacturer of non-specification cylinders cannot be charged with an offence under the *Transportation of Dangerous Goods Act, 1992* for failure to comply with the conditions of a Certificate. However, certain remedies under the Act are available to Transport Canada in this eventuality.

These include:

1. detention of dangerous goods and consequently the cylinder containing them (subsection 17(1));
2. detention of the cylinders whether full or empty (subsection 17(1));
3. directions not to import the cylinders or to return them to origin (subsection 17(3));
4. inspectors' directions (section 19);
5. directions to importers of the cylinders to issue notices of defective construction or recall (subsection 9(2)); and
6. revocation of the Certificate, thereby making any use of the cylinders an offence; (subsection 31(6)).

If none of the foregoing are adequate, Protective Directions may be issued to prohibit or to control the use of the cylinders. (section 32).