



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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Equivalency Certificate


Certificate No.: SU 5141 (Ren. 14)
Certificate Holder: Structural Composites Industries
a Worthington Cylinders Company
Mode of Transport: Road, Rail, Air, Marine
Issue Date: FEB 23 2010
Expiry Date: March 31, 2014

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, by aircraft or by ship, cylinders in a manner that does not comply with sections 5.1 and 5.2, subparagraphs 5.10(1)(a)(i) and 5.10(1)(b)(i), paragraph 5.10(1)(c), subparagraph 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 (e), 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;


2010/02/23
Page 1 of 8

Issue Date: FEB 23 2010

**Equivalency Certificate
SU 5141 (Ren. 14)**

CONDITIONS

(b) each cylinder contains one of the following Class 2.2 or Class 2.2(5.1) dangerous goods as specified in the design qualification test report:

<u>DANGEROUS GOODS</u>	<u>PIN</u>
AIR, COMPRESSED, with no more than 23.5 per cent oxygen, by volume	UN1002
ARGON, COMPRESSED	UN1006
CARBON DIOXIDE	UN1013
HELIUM, COMPRESSED	UN1046
HYDROGEN, COMPRESSED	UN1049
NITROGEN, COMPRESSED	UN1066
NITROUS OXIDE	UN1070
OXYGEN, COMPRESSED	UN1072
COMPRESSED GAS, N.O.S.	UN1956
COMPRESSED GAS, OXIDIZING, N.O.S.	UN3156

(c) when used in nitrous oxide service, the cylinders comply with Clause 4.6.1.1 of CAN/CSA B340-02;

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

(e) no more than 15 years has elapsed since the original manufacturing test date for each cylinder;

Manufacture and Requalification

(f) the cylinders are manufactured at 325 Enterprise Place, Pomona, CA, in accordance with the specific procedures, the design qualification test reports, and model numbers ALT 602, ALT 603, ALT 604, ALT 639, ALT 687, ALT 695, ALT 715, ALT 736, ALT 737, ALT 741, ALT 742, ALT 802, ALT 833, ALT 836, ALT 838, ALT 840, ALT 842, ALT 848, ALT 848A, ALT 876, or ALT 969 filed by Structural Composites Industries, a Worthington Cylinders Company;

Issue Date: FEB 23 2010

**Equivalency Certificate
SU 5141 (Ren. 14)**

CONDITIONS

- (g) subject to paragraphs (h) to (w), 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 the Certificate as CAN/CSA B339-02;
- (h) 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;
- (i) 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 of bismuth is 0.005;
- (j) the filament materials are 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 shall not exceed 5172 MPa, the modulus of elasticity shall not exceed 290 GPa, and the strain to failure shall not be 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;
- (k) the outer surface of each liner is protected from galvanic corrosion by a fibreglass-epoxy composite layer or by a suitable polymer coating;
- (l) 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;
- (m) 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 shall be specified by the cylinder manufacturer for each cylinder design;

Issue Date: FEB 23 2010

**Equivalency Certificate
SU 5141 (Ren. 14)**

CONDITIONS

(n) for all cycling tests (lot acceptance and design qualification), the cycling rate does not exceed 10 cycles per minute;

(o) the minimum burst pressure is 3.4 times the service pressure;

(p) 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 shall be rejected;

(q) 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 shall not be 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 cylinder subjected to a bonfire test, as specified in Clause 9.13.6 of CAN/CSA B339-02, be pressurised hydrostatically to destruction. However, the certificate holder has submitted a report characterising the cylinder burst performance after being subjected to a bonfire, with the initial application for this certificate, and

(iv) at least one cylinder, representative of each new design, complete with valve, is subjected to a drop test as follows:

(A) from a height of 3 m, the cylinder is dropped onto a concrete surface three times as follows:

(1) once vertically onto the end,

(2) once horizontally onto the sidewall, and

Issue Date: **FEB 23 2010**

**Equivalency Certificate
SU 5141 (Ren. 14)**

CONDITIONS

- (3) once horizontally onto a 3.8 cm by 0.5 cm piece of angle iron, with the included angle in the downward position. The cylinder lands at right angles to and on the heel edge of the angle iron, impacting approximately at the centre of the sidewall;
- (B) the cylinder is pressurised to the service pressure for 1000 cycles in accordance with the requirements of Clause 4.13.4 of CAN/CSA B339-02,
- (C) the cylinder is subjected to a burst test as specified in Clause 9.13.4 of CAN/CSA B339-02, and the cylinder fails at a pressure not less than 3.06 times the service pressure,
- (D) if one cylinder is dropped in accordance with (A) above, it shall meet the requirements of both (B) and (C), and
- (E) if two cylinders are dropped in accordance with (A) above, one shall meet the requirements of (C), and the other shall meet the requirements of (B) and then be hydrostatically pressurised to destruction and have its burst pressure recorded;
- (r) the reports are retained by the manufacturer and by the independent inspector for the service life of the cylinders;
- (s) the Transport Canada mark, the specification designation, and the service pressure marked on each cylinder is: "TC-SU 5141" followed by the service pressure expressed in bar;
- (t) the requalification period is 5 years;
- (u) subject to paragraphs (v) and (w), the acceptance criteria specified in section 10 of CGA Publication C-6.2 for level 1 and level 2 abrasions and cuts in the fibre do not apply;
- (v) despite Clause 3 of CAN/CSA B339-02, the reference in CAN/CSA B339-02 to CGA Publication C-6.2 is read as a reference to CGA C-6.2-2005, "*Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders*", Fifth Edition, published by the Compressed Gas Association;

Issue Date: FEB 23 2010

**Equivalency Certificate
SU 5141 (Ren. 14)**

CONDITIONS

(w) the acceptance criteria for level 1 and level 2 abrasions and cuts in the fibre are:

- (i) for Level 1: minor abrasions, scuffs, cuts or scratches to the surface resin or to the exterior coating are acceptable. The outer glass fibre layers may have been exposed but shall not have been damaged, and
- (ii) for Level 2: shall not penetrate completely through the outer glass fibre layers, such that the carbon fibre has been exposed, cut, or abraded;

(x) 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

(y) 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.

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.

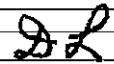
Signature of Issuing Authority



David Lamarche P. Eng., ing.

Chief,

Permits and Approvals Division


2010/02/23
Page 6 of 8

Issue Date: FEB 23 2010

**Equivalency Certificate
SU 5141 (Ren. 14)**

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

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Explanatory Note

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. The Certificate holder has also demonstrated that cylinders with a requalification cycle of five years were equivalent in safety to cylinders with a requalification cycle of 3 years. This certificate authorises the manufacture and the use of these cylinders under the *Transportation of Dangerous Goods Regulations*.

An extension of the cylinder service life up to a maximum of 30 years might be considered upon the submission by the certificate holder, (i.e. the cylinder manufacturer) of supporting data and test reports pertaining to these cylinders from the time of manufacture and from the time in service.

Legend for Certificate Number

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

Issue Date: FEB 23 2010

**Equivalency Certificate
SU 5141 (Ren. 14)**

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).