



Transportation of Dangerous Goods Directorate
L'Esplanade Laurier
300 Laurier Avenue West
Ottawa, Ontario
K1A 0N5

Direction générale du transport des marchandises dangereuses
L'Esplanade Laurier
300, avenue Laurier Ouest
Ottawa (Ontario)
K1A 0N5



Equivalency Certificate (Approval issued by the competent authority of Canada)

Certificate Number: SU 13583
Template Number: N/A
Certificate Holder: Hexagon Digital Wave, LLC
Mode of Transport: Road, Rail, Marine, Air
Effective Date: June 13, 2022
Expiry Date: June 30, 2027

LEGEND

For the purposes of this equivalency certificate, documents referred to by an abbreviation have the following meaning:

TDG Act: *Transportation of Dangerous Goods Act, 1992*

TDG Regulations: *Transportation of Dangerous Goods Regulations*

CGA C-6.2-2019: CGA C-6.2-2019, "Standard for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders", eighth edition, published by the Compressed Gas Association Inc. (CGA)

CSA B339-18: CSA Standard B339-18, "Cylinders, spheres, and tubes for the transportation of dangerous goods", published by the Canadian Standards Association (CSA), June 2018

CSA B340-18: CSA Standard B340-18, "Selection and use of cylinders, spheres, tubes, and other containers for the transportation of dangerous goods, Class 2", published by the Canadian Standards Association (CSA), June 2018

ISO 11119-2:2020: 11119-2:2020, "Gas cylinders — Design, construction and testing of refillable composite gas cylinders and tubes — Part 2: Fully wrapped fibre reinforced"

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composite gas cylinders and tubes up to 450 L with load-sharing metal liners", published by the International Standards Organization (ISO), November 2020

CAN/CGSB-48.9712-2014 / (ISO 9712:2012, IDT): CAN/CGSB-48.9712-2014 / (ISO 9712:2012, IDT), "*Non-destructive Testing – Qualification and Certification of Personnel*", dated 2014

ANSI/ASNT CP-189-2011: ANSI/ASNT CP-189-2011, "*ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel*", dated 2011

SNT-TC-1A-2016: SNT-TC-1A-2016, "*Recommended Practice No. SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing*", dated 2016

NOTES

Note 1: Subsection 31(4) of the *TDG Act* stipulates that any non-compliance with the conditions of this equivalency certificate will result in the provisions of the *TDG Act* and *TDG Regulations* to apply as though this equivalency certificate did not exist.

Note 2: This equivalency certificate provides no regulatory relief other than specifically stated herein. Therefore, all other requirements of the *TDG Act* and the *TDG Regulations* apply.

PURPOSE

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

The equivalency certificate holder has demonstrated that the use of TC-3CCM specification cylinders can be extended past the 15-year service life limitation, if they are successfully tested and requalified by the modal acoustic emission test method described in Appendix A of this equivalency certificate and subjected to the conditions listed in this equivalency certificate. The cylinders can be used up to a total life of 30 years with a level of safety at least equivalent to those cylinders currently permitted by the *TDG Regulations*.

CONDITIONS

1. This equivalency certificate authorizes **Hexagon Digital Wave, LLC** to display the marks prescribed in respect of cylinder requalification in a manner that does not comply with:

- section 6 of the *TDG Act*, and

authorizes any person to handle, offer for transport, or transport, by road or railway vehicle, by aircraft or by vessel, dangerous goods that are:

UN Number	Shipping Name and Description	Class	Packing Group
UN1002	Air, compressed (breathing air containing up to 23.5% oxygen, by volume)	2.2	N/A

in cylinders in a manner that does not comply with the following requirements:

- subsection 5.1.1(2) of the *TDG Regulations*,
- section 5.2 of the *TDG Regulations*,
- subparagraphs 5.10(1)(a)(ii), 5.10(1)(b)(iii), 5.10(1)(c)(ii) and 5.10(1)(d)(iii) of the *TDG Regulations*, but only as it relates to clauses 4.6.2(d) and 5.1.4 of *CSA B340-18*,

if the following conditions are met:

- (a) Each cylinder has been manufactured in accordance with:
 - (i) specification TC-3CCM set out in the edition of *CSA B339* in force under the *TDG Regulations* at the time of manufacture,
 - (ii) one of the following equivalency certificates issued by the Transportation of Dangerous Goods Directorate of Transport Canada: SU 5134, SU 5141 or SU 5303;
- (b) Despite Clause 24.2.7 of *CSA B339-18*, cylinders may be considered for an extended service life not exceeding 30 years after the original manufacturing test date of the cylinder and shall be condemned at the termination of the 30-year period following the date of the original test marked on the cylinder;

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- (c) For each cylinder considered for extended service life, requalification is performed by **Hexagon Digital Wave, LLC**, hereinafter referred to as the equivalency certificate holder, and is performed in accordance with the documentation filed by the equivalency certificate holder with the Regulatory Frameworks and International Engagement Branch, Transportation of Dangerous Goods Directorate, Transport Canada and in accordance with Appendix A to this equivalency certificate;
- (d) Cylinders passing the requalification and marked with “**TC-SU 13583**” are authorized for an additional 5 years of service, despite clause 24.2.7 of *CSA B339-18* and clause 4.6.2 (d) of *CSA B340-18*. Cylinders with the TC-SU 13583 marking shall be successfully requalified once every 5 years using the requalification method as per condition (c) of this equivalency certificate in order to remain in service for a maximum service life of 30 years from the date of manufacture;
- (e) Each cylinder that has passed the requalification described in this equivalency certificate for extended service life shall be marked “**TC-SU 13583**”. The original TC-SU or TC-3CCM specification shall remain visible. The marking shall be applied on a tamper resistant label securely affixed to the shoulder of the cylinder and protected with a damage resistant cover. Stamping of any part of the cylinder is prohibited;
- (f) Each cylinder requalified according to this equivalency certificate shall be marked in accordance with Clause 24.6 of *CSA B339-18*. The procedure symbol shall be “**MAE**”. The marking shall be applied on a tamper resistant label securely affixed to the shoulder of the cylinder and protected with a damage resistant cover. Stamping of any part of the cylinder is prohibited;

When a cylinder is required to be condemned, a label with the word “**CONDEMNED**” overcoated with epoxy shall be securely affixed to the cylinder;

- (g) Each cylinder covered by the terms of this equivalency certificate must have a prominent warning label on the external surface of the cylinder that indicates “**The cylinder must be externally inspected per CGA C-6.2 prior to every fill.**”;
- (h) Cylinders with evidence of having been subjected to the action of fire shall not be requalified under this equivalency certificate nor returned to service;
- (i) All cylinders marked with TC-SU 13583 are subject to the in-service life extension revalidation plan which must be submitted to Transport Canada within 12 months of the issuance of this equivalency certificate and include:
 - (i) A detailed procedure for obtaining the TC-3CCM or TC-SU 5134, SU 5141 or SU 5303 from the field and design qualification testing of each design type,

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- (ii) A procedure for the random selection of a minimum of 5 cylinders which have been in service for 18, 21, 24 and 27 years,
 - (iii) All randomly selected cylinders from the field must be tested in accordance with Sections 8.5.4, 8.5.5, 8.5.7 and 8.5.8 of *ISO 11119-2:2020*. Acceptance criteria must be as defined in *ISO 11119-2*; and
 - (iv) The complete MAE test report, including the original test data, must be submitted to Transport Canada within 30 days of completion of the test. Failure to meet the acceptance criteria in this equivalency certificate may result in the design being restricted to a maximum life of 15 years;
- (j) The equivalency certificate holder reports to the Regulatory Frameworks and International Engagement Branch, Transportation of Dangerous Goods Directorate, Transport Canada:
- (i) the name and qualifications of each Senior Review Technologist (SRT), qualified tester, and qualified operator, as defined in Appendix A to this equivalency certificate,
 - (ii) once per 12 calendar months, a summary of the test results at each facility, including the total number of cylinders tested under this equivalency certificate grouped by type, size and age. The summary must include the number of cylinders accepted, rejected or condemned. For any rejected or condemned cylinders, the defect causing the rejection/condemnation must be fully characterized and profiled (ie. Cuts, abrasions, impacts, fiber failures, chemical damage, heat damage, etc.) and the specific size of the defect be determined (i.e. length, depth, width, etc.). The cylinders that were condemned at visual inspection prior to modal acoustic emission testing must also be included in the report.
2. This equivalency certificate serves as the registration of **Hexagon Digital Wave, LLC** in accordance with Clause 25.3 of *CSA B339-18*, to requalify cylinders as specified herein. **Hexagon Digital Wave, LLC**'s registered mark is:

“628”

Signature of Issuing Authority



David Lamarche, P. Eng., ing.
Chief, Approvals and Special Regulatory Projects

Appendix A

1. REQUALIFICATION METHOD

Each cylinder shall be visually inspected internally and externally and be subjected to modal acoustic emission (MAE) examination in accordance with the following.

2. VISUAL INSPECTION

Prior to MAE examination, the cylinder shall be visually inspected externally and internally in accordance with *CGA C-6.2-2019* and with Hexagon Digital Wave, LLC's documentation entitled "Internal and External Visual Inspection of Fiber Reinforced High Pressure Cylinders" dated January 10, 2019 on file with the Transportation of Dangerous Goods Directorate.

3. MODAL ACOUSTIC EMISSION TEST

- 3.1 The entire cylinder under test shall be tested using equipment, procedures and rejection criteria in accordance with the United States Department of Transportation (U.S. DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) technical report "Modal acoustic emission (MAE) Examination Specification for Requalification of Composite Overwrapped Pressure Vessels (Cylinders and tubes)", dated May 3, 2018, and supporting documents on file with the Transportation of Dangerous Goods Directorate.
- 3.2 For the pressurization of the cylinders during the modal acoustic emission testing as per 3.1, if a cylinder is dual marked with DOT-CFFC and TC-3CCM or TC-SU marking, the test pressure shall be the higher of the DOT-CFFC service pressure times $5/3$ and the TC-3CCM or TC-SU service pressure times 1.5. For cylinders marked only with TC-3CCM or TC-SU marking, the test pressure shall be 1.5 times the marked service pressure.

4. MODAL ACOUSTIC EMISSION EXAMINATION PERSONNEL

- 4.1 Each person who performs testing or who evaluates or certifies results shall meet the requirements in this equivalency certificate.
- 4.2 A Project Manager is a senior manager of Hexagon Digital Wave, LLC responsible for compliance with the *TDG Regulations* including this equivalency certificate. Additionally, the Project Manager shall ensure that each operator and Senior Review Technologist (SRT) maintain the required certifications described herein.
- 4.3 The personnel responsible for performing modal acoustic emission testing in accordance with this equivalency certificate shall be qualified to an appropriate level (Level I, Level II or Level III) in modal acoustic emission (MAE) testing in accordance with the *CAN/CGSB-48.9712-2014 / (ISO 9712:2012, IDT)*,

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ANSI/ASNT CP-189-2011, or *SNT-TC-1A-2016* depending on the assigned responsibility as described below:

- (a) System start up, system calibration, review, and certification of the test results shall be performed by a SRT or by a qualified tester when written acceptance and rejection criteria has been provided by a SRT. Based upon the written criteria, the qualified tester may authorize cylinders that pass the requalification to be marked in accordance with this equivalency certificate;
 - (b) A person with Level I certification may perform system start up, check calibration and perform MAE under the direct guidance and supervision of a SRT or a qualified tester, either of whom shall be physically present at the test site to be able to observe examinations conducted under this equivalency certificate.
- 4.4 A SRT shall be a person who provides written MAE procedure, supervisory training, examinations (Level I and II), and technical guidance to operators, reviews and verifies the examination results. An SRT shall have a thorough understanding of the *TDG Regulations* pertaining to the manufacture and requalification of cylinders that are authorized under this equivalency certificate and shall possess:
- (a) a Level III certification in accordance with *CAN/CGSB-48.9712-2014 / (ISO 9712:2012, IDT)*, *ANSI/ASNT CP-189-2011*, or *SNT-TC-1A-2016* in modal acoustic emission examination;
 - (b) a Professional Engineer (PE) License with a documented experience for a minimum of 2 years in Non-Destructive Evaluation (NDE) of pressure vessels or pipelines using the modal acoustic examination technique; or
 - (c) a PhD degree in a discipline of engineering or physics with documented evidence of experience in non-destructive examination (NDE) of pressure vessels or pipelines using the modal acoustic examination technique or research/thesis work and authoring/co-authoring of technical papers published, in recognized technical journals, in the fields of modal acoustic examination methods.
- 4.5 A qualified tester shall be certified to Level II in accordance with *CAN/CGSB-48.9712-2014 / (ISO 9712:2012, IDT)*, *ANSI/ASNT CP-189-2011*, or *SNT-TC-1A-2016*, and shall be a person who has at least:
- (a) two years continuous experience of a technical nature involving cylinders or tubes;
 - (b) 40 hours of training or instruction in modal acoustic examination of cylinders or other pressure vessels; and

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- (c) 40 hours of experience in modal acoustic examination of cylinders or tubes under the supervision of an SRT.
- 4.6 The MAE operator shall be capable of examining waveforms event by event and the waveforms for each event shall precisely correspond with the pressure and time data during the test.
- 4.7 The SRT shall prepare and submit the records required in section 5 of Appendix A of this equivalency certificate and annually verify that the MAE program is being operated in accordance with the requirements of the equivalency certificate.
- 4.8 The most recent copies of certification (e.g. ASNT Level or PE license) shall be available for inspection at each requalification facility.

5. RECORDS

A record shall be prepared documenting the examination conditions and requalification results including:

- (a) a reference to this equivalency certificate number;
- (b) the name of cylinder owner or operator;
- (c) the name of the qualified SRT who performed or supervised the modal acoustic examination, as well as the MAE operator's name and certification level and the identification of the persons who performed the external visual inspection, as applicable;
- (d) the cylinder serial number;
- (e) the name or registered mark of the manufacturer;
- (f) the MAE test pressure;
- (g) the sensor configuration;
- (h) the pressurization medium;
- (i) the specification or equivalency certificate to which the cylinder was manufactured and its marked service pressure;
- (j) the cylinder water capacity;
- (k) the event energies exceeding the fiber tow fracture failure criteria (if applicable);
- (l) the event energies exceeding the fretting emission energy allowable criteria (if applicable);
- (m) the background energy oscillation pressure (if applicable);
- (n) the background energy rise (if applicable);
- (o) the requalification facility location;
- (p) the requalification date;
- (q) the external and internal visual inspection results (pass/fail);
- (r) the MAE requalification results (pass/fail);
- (s) the previous examination date and previous test pressure;
- (t) a record of system calibration before and after cylinder acoustic examination.

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

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Legend for Certificate Number	
SH - Road, SR - Rail, SA - Air, SM - Marine SU - More than one Mode of Transport Ren - Renewal	

For more information:	
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