



HWY.3.A: Evaluation of American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section XII and National Board Inspection Code requirements for the manufacture and continued service of highway tanks in Canada.

Final Report

Submitted to:

Transportation of Dangerous Goods Directorate
Transport Canada

Prepared by:

Giulia Brutesco, P.Eng.
Stratesco Group Inc.
9 Fielding Court
Ottawa, ON, K1V7H2

March 29, 2023

TP 15589
ISBN: 978-0-660-70661-0
Catalogue no.: T44-3/43-2024E-PDF

Table of Contents

Objective	3
Background	3
Limitations/Caveats.....	4
Methodology.....	4
Observations	7
Recommendations for future work.....	7
References.....	8
Appendix A.....	9

Table of Figures

Figure 1: Comparison table headings.....	4
Figure 2: Tab organization for each 3-digit clause.....	5
Figure 3: Breakdown of subclauses within each tab.....	5
Figure 4: Coloured text comparison to highlight similar language	6

HWY.3.A: Evaluation of American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section XII and National Board Inspection Code requirements for the manufacture and continued service of highway tanks in Canada.

Objective

The TDG Directorate as part of the Safety and Security Group at Transport Canada (TC) requires information to determine if adopting the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME) Section XII and National Board Inspection Code (NBIC) requirements in Canada, for highway tanks specifically, would provide an equivalent level of safety.

As part of that evaluation, TDG is looking for a requirement-by-requirement comparison of ASME Section XII and NBIC, including Supplement 6 with the Canadian Standards Association B620 National Standard of Canada: *Highway tanks and TC portable tanks for the transportation of dangerous goods* (CSA B620). The comparison will only include highway tanks and exclude cryogenic portable tanks and ton tanks. The purpose of this analysis is to identify differences in the standards to inform discussions of equivalent level of safety.

Background

Within North America, there are several different standards that govern motor vehicles that incorporate a pressure vessel (i.e. highway tanks).

The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME) Section XII specifies the requirements for construction and continued service of pressure vessels with volumes greater than 120 gallons for the transportation of dangerous goods by various modes of transport at pressures appropriate for the transportation mode.

The U.S. Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) has published a notice of proposed rulemaking ([NPRM 2016-09919](#)) to incorporate by reference ASME Section XII in their U.S. 49 CFR, *Hazardous Materials Regulations* (HMR), for the construction and continued service of cargo tank motor vehicles (CTMVs), cryogenic portable tanks, and multi-unit car tanks ("ton tanks"). PHMSA also proposed to incorporate by reference the National Board of Boiler and Pressure Vessel Inspectors' *National Board Inspection Code* (NBIC), as it applies to the continued service of CTMVs, cryogenic portable tanks and ton tanks constructed in accordance with ASME Section XII, and existing CTMVs constructed in accordance with the current HMR.

PHMSA proposed to include ASME Section XII in the HMR. Though this change is ongoing, special permits have been issued allowing the use of this section for construction. Given that PHMSA may be adopting ASME Section XII and NBIC requirements, and there is a large volume of dangerous goods being transported by road between Canada and the U.S., the Transportation of Dangerous Goods Directorate (TDG) has a need to evaluate the recognition and acceptability of ASME Section XII and NBIC requirements in Canada, specifically for highway tanks.

In Canada, the *TDG Regulations* adopt the CSA B620, which sets out the requirements for the design, construction, certification, assembly, modification, repair, testing, inspection, periodic retesting, maintenance, and marking of highway tanks and TC portable tanks for the transportation of dangerous

goods. Currently, CSA B620 already references ASME Section VIII Division 1 which specifies requirements for the design and construction of stationary pressure vessels only.

Limitations/Caveats

The report is intended to provide clarity on the similarities and differences between CSA B620, ASME Section XII, and NBIC requirements. The analysis includes a verification of language and interpretation for the purposes of evaluating equivalency, but the report will not conclude whether the standards offer an equivalent level of safety in Canada.

Best efforts were made to ensure that the language of the CSA B620, ASME Section XII, NBIC, and 49 CFR regulation (in some comparisons) are reflected accurately in the comparison tables, however, errors and typos (in some cases corrections) may have been made in the transfer to the tables. As such, all text and language should be taken from the respective Standard/Code/regulatory language directly. The text in the version of the CSA B620 Standard, ASME Section XII Code, NBIC Code, and 49 CFR regulation used in the comparison shall supersede the language and text found in the comparison tables.

Methodology

This project compares the clauses and subclauses of the 2020 published version of the CSA B620-20 to the appropriation clauses in ASME Section XII (2021 version), NBIC Part 2 (2021 version, Inspections) or NBIC Part 3 (2021 version - Repair and Alterations). The following CSA B620-20 clauses were compared as per the project scope:

- Clause 4.4
- Clauses 5.1-5.10
- Clauses 7.1-7.7
- Clauses 8.1-8.4

The comparison of the clause language found in the tables begin with the CSA B620 language and compares adjacently to the other codes. In some instances, references to 49 CFR were made to provide insights to references beyond AMSE Section XII and NBIC especially in cases where no references were found in these codes. Since 49 CFR comparisons are beyond the scope of the project, some citations were included to help map references. The table headings are as follows:

B620			ASME XII			49 CFR			NBIC			Notes/Observations
Section	Title	Requirement	Section	Title	Requirement	Section	Title	Requirement	Section	Title	Requirement	

Figure 1: Comparison table headings

The comparison tables are organized by CSA B620 clause which is found in separate tables (excel spreadsheet) and are named accordingly: ‘CSA B620 Comparison x.x’ where x.x represents the clause number (ex: 5.1). A list of comparison tables included in this project can be found in Appendix A. The subclauses (3 digits) each have their own tab where additional subclauses are included within each tab. Example:

14					
15				TS - 100	Required Markings
16				TS - 100.2	Location of Markings
17					
18	5.1.6.1.2		If the metal identification plate described in	TS - 100.2	Location of Markings
19			Clause 5.1.6.1.1 is not readily visible, a second		
20			metal identification plate marked "Duplicate" shall		
21			be permanently affixed, in a visible position,		

< > Tab and Colour Legend 4.4 5.1.1 5.1.2 5.1.3 5.1.4 5.1.5 5.1.6 5.1.7 5.1.8 +

Figure 2: Tab organization for each 3-digit clause

	A	B	C	D	E	
1	B620	B620		ASME XII		
2	Section	Title	Requirement	Section	Title	Req
3	5.1.6	Inspection, testing and Marking		Part TS	Stamping, Marking, Certification, Reports and Records	
4	5.1.6.1	Metal Identification Plates		Article TS-1	Content and Method of stamping Transport	
5				TS -130	Nameplates	
6	5.1.6.1.1		Each tank shall have one or more corrosion-resistant metal identification plates permanently affixed to the tank or its supporting structure by brazing or welding around its perimeter or by means of tamper-resistant fasteners. The plates shall be affixed on the left side of the tank, near the front, in a place readily accessible for inspection. The plates may be attached to a mounting pad welded directly to the tank, but not to bodywork or skirting.	TS 130.1	Nameplate attachment	The sepa of th requ attar (a) v (b) t (c) a
7						
8						
9						
10						
11						
12						
13						
14				TS - 100	Required Markings	
15				TS - 100.2	Location of Markings	(a) T on a
16						
17	5.1.6.1.2		If the metal identification plate described in Clause 5.1.6.1.1 is not readily visible, a second metal identification plate marked "Duplicate" shall be permanently affixed, in a visible position, directly to the tank or tank structure in a readily accessible location near the front of the tank.	TS - 100.2	Location of Markings	(b) A may attar addi the i this. Insp
18						
19						
20						
21						
22						
23						

Figure 3: Breakdown of subclauses within each tab

Some clauses will have coloured text. The coloured text indicates a direct comparison of text from the CSA B620 to text in the compared Codes (ASME Section XII, NBIC or 49 CFR). Different colours used within the same section may indicate direct comparisons in instances where multiple comparisons are taking place. Example:

B620		
Section	Title	Requirement
5.1.6	Inspection, testing and Marking	
5.1.6.1	Metal Identification Plates	
5.1.6.1.1		Each tank shall have one or more corrosion-resistant metal identification plates permanently affixed to the tank or its supporting structure by brazing or welding around its perimeter or by means of tamper-resistant fasteners. The plates shall be affixed on the left side of the tank, near the front, in a place readily accessible for inspection. The plates may be attached to a mounting pad welded directly to the tank, but not to bodywork or skirting.

ASME XII		
Section	Title	Requirement
TS -130	Nameplates	
TS 130.1	Nameplate attachment	The markings required in TS-100 shall be applied to a separate nameplate permanently attached to the tank. Removal of the nameplate or its attachment hardware shall require the willful destruction of it. Nameplates may be attached by: (a) welding, brazing, or soldering (b) tamper-resistant mechanical fasteners (c) adhesive attachments (see Mandatory Appendix XI)
TS - 100	Required Markings	
TS - 100.2	Location of Markings	(a) The markings required by TS-100 shall be stamped on a nameplate attached in a readily accessible location.

49 CFR		
Section	Title	Requirement
178.337	MC331	
178.337-17 (a)	Marking	(a) General. Each cargo tank certified after October 1, 2004 must have a corrosion-resistant metal name plate (ASME Plate); and each cargo tank motor vehicle certified after October 1, 2004 must have a specification plate, permanently attached to the cargo tank by brazing, welding, or other suitable means on the left side near the front, in a place accessible for inspection. If the specification plate is attached directly to the cargo tank wall by welding, it must be welded to the tank before the cargo tank is postweld heat treated.

Figure 4: Coloured text comparison to highlight similar language

Observations

In general, the CSA B620 aligns the majority of its requirements with ASME Section XII, NBIC, and/or 49 CFR. While there were a number of requirements that were specific to CSA B620, i.e. similar requirements were not found in ASME Section XII, NBIC and/or 49 CFR, a small number of differences were noted. These differences have been highlighted in green in the table and can be found in the following CSA B620 clauses:

- 5.1.6
- 5.2.2, 5.2.4, 5.2.6, 5.2.8
- 5.3.6, 5.3.10
- 5.4.7
- 5.5.6, 5.5.7, 5.5.14, 5.5.15
- 5.6.3, 5.6.4, 5.6.6, 5.6.9, 5.6.10
- 5.7.2, 5.7.4, 5.7.5
- 5.8.3
- 7.2.7
- 8.1.6

Notes and observations are made throughout the comparison table focused on specific clauses or subclauses. In addition, the following are general observations from the analysis process:

- ASME Section XII offers simplified language in some instances compared to CSA B620 language and organization. For example, ASME Section XII will include several requirements in a clause or subclause whereas CSA B620 will include one requirement per clause. There may be value in consolidating some subclauses to better align with ASME Section XII and the NBIC codes.
- Section XII presents metric units first and brackets imperial units. This is different from ASME Section VIII Div. 1.
- Any references to fibre-reinforced plastic (FRP) pressure vessels were not found in ASME Section XII. Information on FRP pressure vessels is likely found in ASME Section X – Fiber-Reinforced Plastic Pressure Vessels.
- NBIC Codes refer to DOT vessels constructed to both the ASME Section VIII Div. 1 and ASME Section XII codes. The NBIC recognizes ASME Section VII Div. 1 as the old vessel construction standard.
- Section XII does not provide much guidance on hose assembly requirements. Section XII also seems to only offer guidance on insulating jacket design in the nonmandatory appendices.

Recommendations for future work

To better determine equivalency between the CSA B620 and Section XII and NBIC Part 2 and 3, further analysis may be required in detailing the references to Section VIII Div. 1 found in CSA B620 and comparing those details to ASME Section XII. There may also be value in mapping in detail, the language found in 49 CFR to the CSA B620 requirements that were not found in Section XII or NBIC Part 2 and Part 3.

Section XII does not speak to any requirements regarding FRP pressure vessels and a comparison of the requirements in ASME Section X – Fiber-Reinforced Plastic Pressure Vessels to CSA B620 would also assist in evaluating equivalency to ASME requirements.

The CSA B620 organization appears to be more piecemeal than ASME Section XII with requirements dispersed over multiple clauses which was difficult to evaluate in some instances. There was a sense of disorganization as compared to the way ASME Section XII organized the requirements. There may be value in better aligning the structure of the ASME Section XII to the CSA B620 to enhance usability and comprehension of the Standard.

References

- 1) Canadian Standards Association B620 National Standard of Canada: *Highway tanks and TC portable tanks for the transportation of dangerous goods*
- 2) American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME) Section XII
- 3) American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME) Section VIII Div. 1
- 4) National Board of Boiler and Pressure Vessel Inspectors' *National Board Inspection Code (NBIC) – Part 2 – Inspections*
- 5) National Board of Boiler and Pressure Vessel Inspectors' *National Board Inspection Code (NBIC) – Part 3 – Repair and Alterations*
- 6) Code of Federal Regulations (CFR), Title 49 – Transportation,

Appendix A

List of attachments

CSA B620 comparison Clauses 4 & 5:

CSA B620 Comparison 4.4, 5.1.xls
CSA B620 Comparison 5.2.xls
CSA B620 Comparison 5.3.xls
CSA B620 Comparison 5.4.xls
CSA B620 Comparison 5.5.xls
CSA B620 Comparison 5.6.xls
CSA B620 Comparison 5.7.xls
CSA B620 Comparison 5.9.xls
CSA B620 Comparison 5.10.xls

CSA B620 Comparison Clause 7:

CSA B620 Comparison 7.1.xls
CSA B620 Comparison 7.2.xls
CSA B620 Comparison 7.3.xls
CSA B620 Comparison 7.4.xls
CSA B620 Comparison 7.5.xls
CSA B620 Comparison 7.6.xls
CSA B620 Comparison 7.7.xls

CSA B620 Comparison Clause 8:

CSA B620 Comparison 8.1.xls
CSA B620 Comparison 8.2.xls
CSA B620 Comparison 8.3.xls
CSA B620 Comparison 8.4.xls

CSA B620 Comparison Differences.xls