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BRENNER TANK LLC
450 Arlington Ave.
P.O. Box 670
Fond du Lac, WI 54936-0670
920-922-5020
Toll Free 800-558-9750
Fax 920-922-0122

DEPT. OF TRANSPORTATION DOCKETS DOT/RSPA/OHMS
2009 JAN -6 P 1:14
08 DEC 30 PM 3:51

SP-14467
ex 4/3/09

MW 2007 011341
MW 2009 010007

Transmitted by Certified Mail (7005 3110 0003 0785 6189) and email to Exemptions@dot.gov

December 17, 2008

Associate Administrator for Hazardous Materials Safety
Attention: Exemptions, PHH-31
Pipeline and Hazardous Materials Safety Administration
United States Department of Transportation
400 Seventh Street, S.W.
Washington, DC 20590-0001

Subject: Request for Revision to Special Permit SP-14467 – Relief From Minimum Thickness Tables for Duplex Stainless Steels used in the Construction of DOT 400 Series Specification Cargo Tanks

Dear Associate Administrator:

Brenner Tank LLC, hereinafter Brenner, is a US DOT registered manufacturer of cargo tanks, CT-0195, and respectfully requests the consideration of your office towards the end of revising special permit SP-14467 for our company.

In accordance with Title 49 CFR § 107.105 Brenner provides the required information, below…

Applicant/Manufacture Address

Brenner Tank LLC
c/o: Tom Hitchcock
450 Arlington Avenue
P.O. Box 670
Fond du Lac, WI 54936
tjhitchcock@brennertank.com
920.922.4530x3141

Confidentiality

Applicant does not seek confidentiality, and recognizes other industry entities may become aware of this request and similarly petition the US DOT.

Citation of Regulations

Applicant's request is most related to Title 49 CFR §178.345-2. However, Brenner seeks relief from Parts 178 and 180, wherever applicable.

Description of Special Permit Revision

Applicant seeks relief from 49 CFR §178.320(a)(1)(ii) minimum thickness found in Tables I and II of the applicable specification(s). The higher strengths of some materials, such as the duplex stainless steels of SP-14467 (UNS S32003, S32101) and Section II ASME materials (UNS N08020, N08367, and S31803/S32205) are not considered in these tables in the construction of DOT 400-series specification cargo tanks. Brenner requests to calculate minimum thickness using the equivalent thickness method of 49 CFR §178.274 as has been precedented in SP-14710. Further, Brenner requests permission to mark and fully certify these units to the applicable DOT specification, typically DOT 407.

By way of background, SP-14467 authorizes the controlled use of duplex stainless steels, UNS S32003 and UNS S32101, in the construction of cargo tanks and pressure vessels. As referenced above, SP-14710 allows for the construction of DOT 400-series cargo tanks utilizing titanium (UNS R50400 and R50550), a material not addressed in the minimum thickness tables. The applicable "table" minimums are determined by calculating the equivalent minimum thickness for alternate materials per the portable tank regulations (49 CFR §178.274). It is requested that this same process be used to calculate an appropriate minimum thickness for the materials identified in paragraph one of this section, but in no case will the minimum thickness be less than 0.090".

Please see the attached support document, describing the proposed methodology for revising these "table" minimum thicknesses. Should the US DOT require more details on this matter, or factual information from metallurgists, or other experts, applicant is prepared to so facilitate.

Duration

Applicant requests relief under this special permit for thirty-six (36) months. Further, Brenner seeks enduring relief for all initial and subsequent owners of subject cargo tanks to regard them as authorized packagings (DOT 407, et. al.), subject to continuing compliance with Part 180, and other applicable Hazardous Materials Regulations.

Bases

Applicant's bases in proposing the use minimum thickness calculations for duplex stainless steel are that it offers ...

- Current economic advantages,
- More efficient cargo tanks by way of weight and material reductions, and
- Utilization of pre-existing 49 CFR regulations for direct determination of minimum thickness relative to material properties.

Because materials such as duplex stainless steels have higher strengths than the reference mild steel used in §178.274, requiring the same "table" minimum thickness for these materials results in unnecessarily thick and heavy cargo tanks. Utilizing the §178.274 calculation for minimum thickness rather than the tables for these materials may provide for lighter and more efficient cargo tanks, thereby yielding economic advantages, Brenner expects more cargo tank users will continue to purchase new cargo tank vehicles and retire old equipment no longer suitable for hazardous materials transportation.

Applicable Hazardous Materials

This request involves all hazardous materials currently authorized for carriage in DOT specification cargo tanks.

Applicable Packagings

This request pertains to DOT 406, DOT 407 and DOT 412 cargo tanks. However, applicant expects over 90% of the subject units would be built in accordance with the DOT 407 specification.

Quality Control, Design, Manufacture, Performance, Service Life and Safety

Quality control, design and manufacturing practices by the applicant would be essentially the same as those employed with Brenner's other DOT specification products: Applicant has designed and manufactured DOT specification cargo tanks using the specialty materials; UNS N08367, S31803, S32003, S32205, et. al.. Furthermore, Brenner suggests the calculation of minimum thickness for duplex stainless steel will provide betterment in terms of performance, service life and public safety. This betterment is the result of the improved material strength, corrosion resistance and temperature tolerance relative to type 316.

DOT 400-series cargo tanks are designed in accordance with the 1998 edition of the ASME Boiler and Pressure Vessel Code, as incorporated by reference in Title 49 CFR § 171.7. The 1998 edition uses a 4:1 design margin for determining allowable design stresses. The code cases published for similar materials are based on ASME's current methodology of using a 3.5:1 design margin. Therefore, the allowable design stresses for use in designing DOT 400-series cargo tanks shall be reduced to maintain the 4:1 margin currently in practice for other materials.

Mild steel (MS), high strength low alloy steel (HSLA), austenitic stainless steel (SS), and aluminum (AL) are the only materials accounted for in the DOT 400 series cargo tank minimum thickness tables. The portable tank equivalent minimum thickness calculations of 49 CFR §178.274(d)(5) shall be used to determine minimum thickness values for materials covered by this special permit however an absolute minimum thickness of 0.090" shall be maintained.

Respectfully submitted,

Tom Hitchcock
Design Certifying Engineer

:TJH

Enc.: Minimum Thickness Correction Factor Calculation

c.: Chief, Hazardous Materials Division
Federal Motor Carrier Safety Administration
United States Department of Transportation
400 Seventh Street, S.W.
Washington, DC 20590-0001

BRENNER

Minimum Thickness Correction Factor Calculation

DATE:	12/17/2008
FROM:	Tom Hitchcock
SUBJECT:	Determination of material specific correction factors to be applied to DOT minimum thickness tables for DOT 400 Series tanks.

This document outlines the method used to determine material specific minimum thicknesses for use in conjunction with the DOT 406, DOT 407, and DOT 412 minimum thickness tables I and II.

The 49 CFR §178.320(a) *Minimum thickness* (ii) requires that DOT specification specific minimum thickness Tables I and II are used. These tables have three groups of materials that are very loosely defined by mild steel (MS), high strength low alloy steel or austenitic stainless steel (HSLA SS), and aluminum (AL). Section §178.345-2 of the 49 CFR allows for vessel construction using all Section II ASME Code materials. These materials do not all fit within the definitions set forth by the DOT minimum thickness table groups. Nor do the tables account for the vast difference in mechanical properties that materials of the same group often have.

Section §178.274(d)(5) for portable tanks acknowledges that materials other than those directly referenced in the 49 CFR may be desired for vessel construction. The following formula is supplied to calculate an accepted minimum thickness for the metal to be used.

$$e_1 = \frac{21.4 e_0 d_1}{1.8\sqrt[3]{Rm_1(A_1)}}$$

Where, e_1 = undefined metal minimum thickness (mm)
Rm_1 = minimum tensile strength of undefined metal (N/mm^2)
A_1 = minimum elongation at fracture of undefined metal (%)
d_1 = 1.8 unless required otherwise. Diameter of vessel being designed (m)
e_0 = reference steel minimum thickness (mm)

Section §178.274(c)(10) requires that steels used for the construction of shells have an elongation at fracture, in percentage, of not less that 10,000/Rm with an absolute minimum of 16% for fine grain steels and 20% for others.

$$A_1 = \frac{10{,}000}{Rm_1} \quad \text{or} \quad A_1 Rm_1 = 10{,}000$$

Given that Section §178.274(a)(3) defines the portable reference tank to have a tensile strength of 370 MPa and an elongation at failure of 27% it can be reasoned that the constant 21.4 is equal to the third root of the reference metal tensile strength times the elongation at failure.

$$A_0 Rm_0 = 27(370) = 9{,}990 \approx 10{,}000$$

$$\sqrt[3]{A_0 Rm_0} = \sqrt[3]{9{,}990} = 21.5 \approx 21.4$$

$$\sqrt[3]{\frac{10{,}000 Rm_0}{Rm_0}} = \sqrt[3]{10{,}000} = 21.5$$

Replacing the constant with its variable counter parts the formula for minimum thickness becomes:

$$\frac{e_1\sqrt[3]{Rm_1(A_1)}}{d_1} = \frac{e_0\sqrt[3]{Rm_0(A_0)}}{d_0}$$

Considering only like diameter vessels the formula is reduced to:

$$e_1\sqrt[3]{Rm_1(A_1)} = e_0\sqrt[3]{Rm_0(A_0)}$$

To develop the correction factor that directly relates the undefined metal thickness to the reference steel the formula is rearranged and the constant is reinserted as the third root of 10,000.

$$e_1 = e_{ms}\sqrt[3]{\frac{10{,}000}{Rm_1(A_2)}}$$

Where, e_1 = undefined metal minimum thickness (mm)
e_{ms} = Table I or II minimum thickness (mm)
Rm_1 = minimum tensile strength of undefined metal (N/mm^2)
A_2 = minimum elongation in 2" of undefined metal (%). This is a conservative value and is used because the elongation at failure is not a commonly documented value.

Therefore the correction factor for any undefined metal is equal to the third root of 10,000 over the product of the metals minimum tensile strength and elongation percentage in 2"

$$C_f = \sqrt[3]{\frac{10{,}000}{Rm_1(A_2)}}$$

Where, C_f = the correction factor for a given material

The simplest form of the minimum thickness formula is now:

$$e_1 = C_f(e_{ms})$$

The following table shows the minimum thickness correction factor for few materials of interest. Mild steel is included in this table to show that the correction factor is appropriate for cargo tanks as well as portable tanks.

Common Name	UNS Number	Correction Factor
Portable Tank Reference Steel	**Unknown**	1.00
Mild Steel	K03101	0.99
Mild Steel	K02403	0.99
Alloy 20	N08020	0.80
AL 6XN	N08367	0.69
Titanium, Grade 2	R50400	1.13
Titanium, CC2497-2	R50400	1.08
Titanium, Grade 3	R50550	1.07
AL 2003	S32003	0.73
LDX 2101	S32101	0.80
AL 2205	S31803/S32205	0.81