

DOT-113 Tank Cars for LNG

9/20/2021



Progress Made / History

- Chart Active in Several Past and Present LNG By Rail Projects
 - 1961-present: AAR-204W and DOT-113 Tank Cars
 - Liquid Ethylene (flammable) in DOT-113 tank cars
 - Argon, Oxygen, Nitrogen (non-flammable) in AAR-204W and 113 cars
 - 1994: Union Pacific LNG Fuel Tender
 - 2012-2013: Canadian National LNG Fuel Tender
 - 2012-2017: Burlington Northern LNG Fuel Tenders
 - 2014: Chart 28,000 gallon tank car style tender
 - 2014: Transport Canada approves LNG by Rail – tank car and ISO
 - 2015-present: Chart ISO container style LNG Fuel Tenders in service
 - 2015: Alaska RR receives SP to carry LNG by Rail in ISO containers
 - 2016: Alaska RR runs demonstration loads of LNG by rail
 - AAR Petition for Rulemaking - LNG in DOT-113C120W tank cars
 - 2017: Extensive Use of tenders at FECR
 - AAR NGFT Standards Published
 - Special Permit Requests to PHMSA – DOT-113C120W tank cars
 - 2019: FECR LNG fuel tenders continue
 - HM-264 and Special Permit process moving forward
 - 2020: US DOT / PHMSA Rule Making allows the DOT-113C120W9 Car
 - 2021: Chart building single demo DOT-113C120W9 for TTCl; DOT-113A90W for liquid argon continues; 2nd generation LNG Fuel Tenders

Chart Cryogenic Tank Cars

Progress Made / History

- Chart Active in Several Past and Present Cryogenic Tank Car Projects
 - 1961-present: AAR-204W and DOT-113 Tank Cars



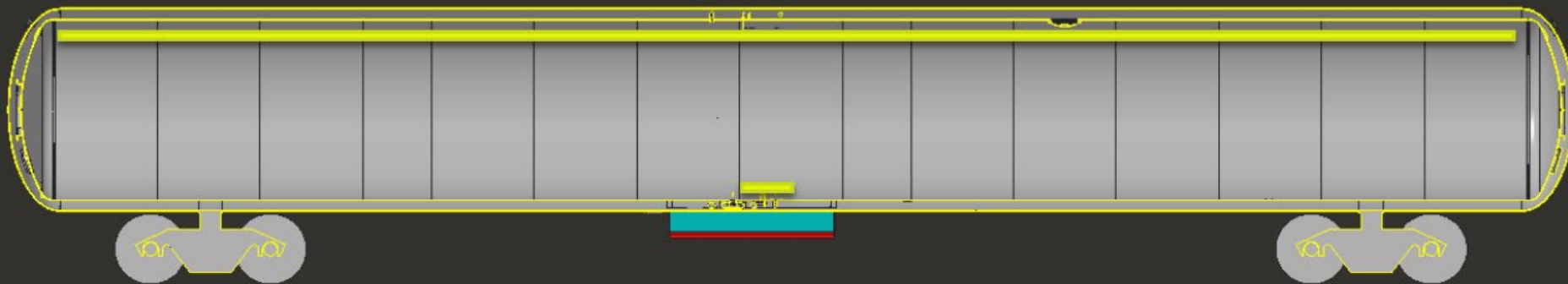
← 34,500 Gallon (130.6 M3) DOT-113C120W Tank Cars for LNG, Liquid Ethylene or Liquid Ethane

DOT-113A90W Tank Cars for Liquid Argon, Liquid Oxygen and Liquid Nitrogen →



DOT-113C120W9 Tank Car

- Ref 49 CFR 179.400
- Outer Tank – 9/16” thick TC-128 Gr B heads / shells (incr. from 71/6” shells and 1/2” heads)
- Inner tank – A little over 1/4” thick shells; 3/8” to 7/16” heads; T-304 SS



- Excellent puncture resistance in testing to date
- DOT-113 obviously includes an additional inner tank - made from 304 SS:
 - 304SS has excellent puncture resistance and tear resistance
 - 304SS is stronger at cryogenic temperatures than at ambient temps
- Outer tank has several stiffening rings – for the external pressure (vac)(179.400-9)
- Inner tank support system can vary, but is governed by:
 - 179.400-13 (7g, 3g, 3g)
 - Thermal movement considerations
 - other structural considerations (bending)

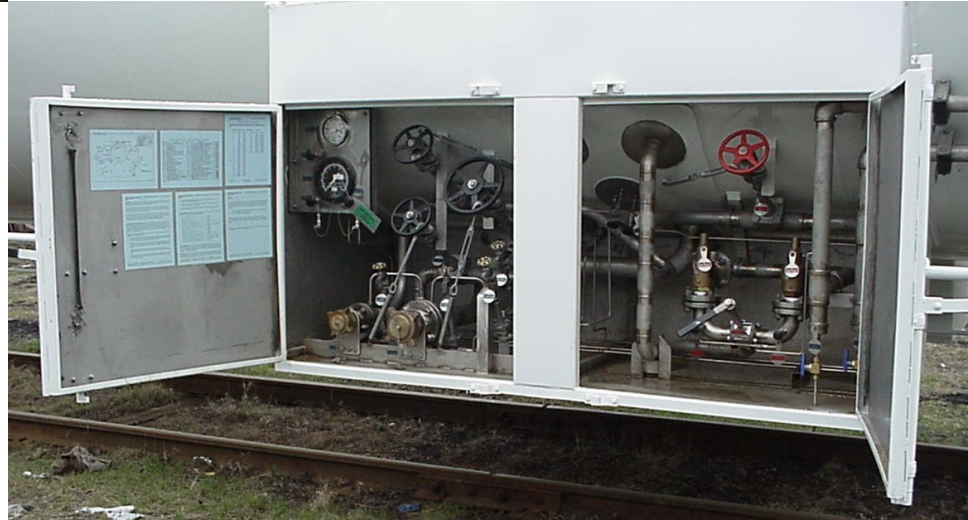
DOT-113C120W Piping



DOT-113A90W Piping

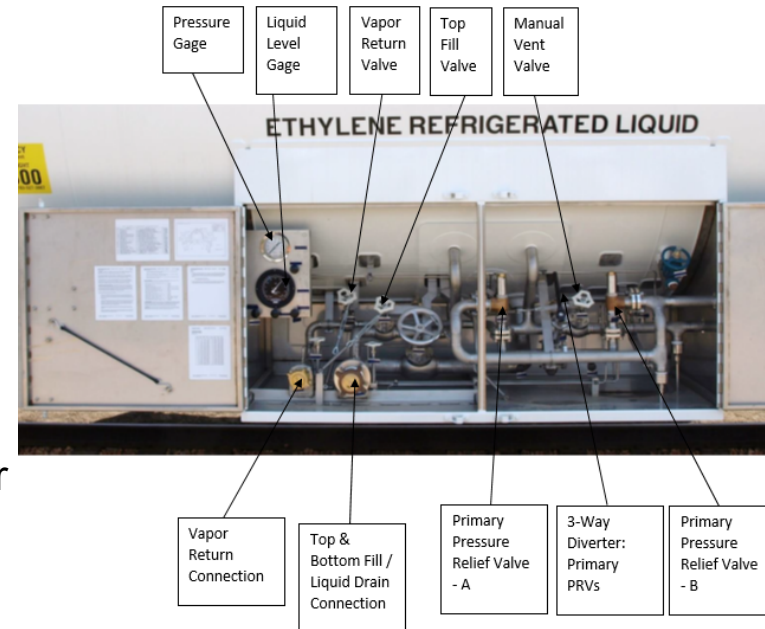


DOT-113A90W piping



DOT-113C120W9 Tank Car Piping

- Ref 49 CFR 179.400
- Addresses loading / unloading; Pressure Relief Devices; gages; etc.
 - Very well understood and straight forward for cryogenic liquids
 - Common to all modes of transport – highway, ocean, rail
 - SS valves and hoses
 - ‘ACME’ Threaded hose connections per CGA or other recognized standards
 - Manual valve and pressure tight hose connection cap provide primary and secondary closure (179.400-17)



Other:

Pressure build liquid and vapor valves – not included in the above design

Rupture Discs are located in the opposite side cabinet; the PRVs above have flanges (optional) on the inlet and outlet for maintenance purposes

P&ID, Legend, Contents and basic Operating Instructions are shown on the inside door panel

- Piping Cabinet (Protective Housing) is currently a weather enclosure per 49 CFR 179.400-22.
- An AAR TCC docket has recommended a skid plate structure (3:1) be added to the cabinet requirements along with strength requirements.
- Transport Canada – who approved LNG By Rail in 2014 – is also considering this TCC recommendation
- US industry supports these as well

Chart Cryogenic Tank Cars



Chart teamed up with VTG, a leading rail logistic company, to develop cryogenic tank cars for the European network

- <https://www.uniper.energy/news/pipeline-to-go-liqvis-and-vtg-test-rail-based-Ing-transport-in-cooperation-with-brunsbuettel-ports>
- <https://lngjournal.com/index.php/latest-news-mainmenu-47/item/103874-european-Ing-fuel-companies-successfully-test-an-Ing-delivery-by-rail-in-germany-to-uniper-plant>



Chart Vacuum Technology® provides the best insulation system to protect product loss and is at the core of why Chart is recognised as the premier supplier of cryogenic equipment solutions

Thank you for your attention.

If you have further questions or comments, please contact me directly:

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