design pressure must be provided out-
board of such valve.

[Amdt. 178-77, 48 FR 27704, June 16, 1983]

§ 178.338–8 Pressure relief devices,
piping, valves, and fittings.

(a) Pressure relief devices. Each tank
pressure relief device must be designed,
constructed, and marked in accordance
with §173.318(b) of this subchapter.

(b) Piping, valves, and fittings. (1) The
burst pressure of all piping, pipe fit-
tings, hoses and other pressure parts,
except for pump seals and pressure re-
lief devices, must be at least 4 times
the design pressure of the tank. Addi-
tionally, the burst pressure may not be
less than 4 times any higher pressure
to which each pipe, pipe fitting, hose or
other pressure part may be subjected
to in service.

(2) Pipe joints must be threaded,
welded or flanged. If threaded pipe is
used, the pipe and fittings must be
Schedule 80 weight or heavier. Malle-
able metals must be used in the con-
struction of valves and fittings. Where
copper tubing is permitted, joints shall
be brazed or be of equally strong metal
union type. The melting point of the
brazing materials may not be lower
than 1000 °F. The method of joining
tubing may not reduce the strength of
the tubing, such as by the cutting of
threads.

(3) Each hose coupling must be de-
signed for a pressure of at least 120 per-
cent of the hose design pressure and so
that there will be no leakage when con-
ected.

(4) Piping must be protected from
damage due to thermal expansion and
contraction, jarring, and vibration. Slip joints are not authorized for this
purpose.

(5) All piping, valves and fittings on a
cargo tank must be proved free from
leaks. This requirement is met when
such piping, valves, and fittings have
been tested after installation with gas
or air and proved leak tight at not less
than the design pressure marked on the
cargo tank. This requirement is applic-
able to all hoses used in a cargo tank,
except that hose may be tested before
or after installation on the tank.

(6) Each valve must be suitable for
the tank design pressure at the tank
design service temperature.

(7) All fittings must be rated for the
maximum tank pressure and suitable
for the coldest temperature to which
they will be subjected in actual serv-
vice.

(8) All piping, valves, and fittings
must be grouped in the smallest prac-
ticable space and protected from dam-
age as required by §178.338–10.

(9) When a pressure-building coil is
used on a tank designed to handle oxy-
gen or flammable ladings, the vapor
connection to that coil must be pro-
vided with a valve or check valve as
close to the tank shell as practicable to
prevent the loss of vapor from the tank
in case of damage to the coil. The liq-
uid connection to that coil must also
be provided with a valve.

[Amdt. 178-77, 48 FR 27704, June 16, 1983, as
amended by Amdt. 178–89, 54 FR 25019, June
12, 1989]

§ 178.338–9 Holding time.

(a) "Holding time" is the time, as de-
termined by testing, that will elapse
from loading until the pressure of the
contents, under equilibrium conditions,
reaches the level of the lowest pressure
control valve or pressure relief valve
setting.

(b) Holding time test. (1) The test to
determine holding time must be per-
formed by charging the tank with a
cryogenic liquid having a boiling point,
at a pressure of one atmosphere, abso-
lute, no lower than the design service
temperature of the tank. The tank
must be charged to its maximum per-
mitted filling density with that liquid
and stabilized to the lowest practical
pressure, which must be equal to or
less than the pressure to be used for
loading. The cargo tank together with
its contents must then be exposed to
ambient temperature.

(2) The tank pressure and ambient
temperature must be recorded at 3-
hour intervals until the pressure level
of the contents reaches the set-to-dis-
charge pressure of the pressure control
valve or pressure relief valve with the
lowest setting. This total time lapse in
hours represents the measured holding
time at the actual average ambient
temperature. This measured holding
time for the test cryogenic liquid must
be adjusted to an equivalent holding
time for each cryogenic liquid that is

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to be identified on or adjacent to the specification plate, at an average ambient temperature of 85 °F. This is the rated holding time (RHT). The marked rated holding time (MRHT) displayed on or adjacent to the specification plate (see §178.338-18(c)(10)) may not exceed this RHT.

(c) Optional test regimen. (1) If more than one cargo tank is made to the same design, only one cargo tank must be subjected to the full holding time test at the time of manufacture. However, each subsequent cargo tank made to the same design must be performance tested during its first trip. The holding time determined in this test may not be less than 90 percent of the marked rated holding time. This test must be performed in accordance with §§173.318(g)(3) and 177.840(h) of this subchapter, regardless of the classification of the cryogenic liquid.

(2) Same design. The term “same design” as used in this section means cargo tanks made to the same design type. See §178.320(a) for definition of “design type”.

(3) For a cargo tank used in nonflammable cryogenic liquid service, in place of the holding time tests prescribed in paragraph (b) of this section, the marked rated holding time (MRHT) may be determined as follows:

(i) While the cargo tank is stationary, the heat transfer rate must be determined by measuring the normal evaporation rate (NER) of the test cryogenic liquid (preferably the lading, where feasible) maintained at approximately one atmosphere. The calculated heat transfer rate must be determined from:

\[ q = \frac{n(\Delta h)(85-t_1)}{t_s-t_f} \]

Where:
q = calculated heat transfer rate to cargo tank with lading, Btu/hr.
\( n \) = normal evaporation rate (NER), which is the rate of evaporation, determined by the test of a test cryogenic liquid in a cargo tank maintained at a pressure of approximately one atmosphere, absolute, lb/hr.
\( \Delta h \) = latent heat of vaporization of test fluid at test pressure, Btu/lb.
\( t_s \) = average temperature of outer shell during test, °F.
\( t_1 \) = equilibrium temperature of lading at maximum loading pressure, °F.
\( t_f \) = equilibrium temperature of test fluid at one atmosphere, °F.

(ii) The rated holding time (RHT) must be calculated as follows:

\[ RHT = \frac{[(U_2 - U_1) W]}{q} \]

Where:
RHT = rated holding time, in hours
\( U_1 \) and \( U_2 \) = internal energy for the combined liquid and vapor lading at the pressure offered for transportation, and the set pressure of the applicable pressure control valve or pressure relief valve, respectively, Btu/lb.
W = total weight of the combined liquid and vapor lading in the cargo tank, pounds.
q = calculated heat transfer rate to cargo tank with lading, Btu/hr.

(iii) The MRHT (see §178.338-18(b)(9) of this subchapter) may not exceed the RHT.


§178.338-10 Accident damage protection.

(a) All valves, fittings, pressure relief devices and other accessories to the tank proper, which are not isolated from the tank by closed intervening shut-off valves or check valves, must be installed within the motor vehicle framework or within a suitable collision resistant guard or housing, and appropriate ventilation must be provided. Each pressure relief device must be protected so that in the event of the upset of the vehicle onto a hard surface, the device’s opening will not be prevented and its discharge will not be restricted.

(b) Each protective device or housing, and its attachment to the vehicle structure, must be designed to withstand static loading in any direction that it may be loaded as a result of front, rear, side, or sideswipe collision, or the overturn of the vehicle. The static loading shall equal twice the loaded weight of the tank and attachments. A safety factor of four, based on the tensile strength of the material, shall be used. The protective device or the housing must be made of steel at least %16-inch thick, or other material of equivalent strength.

(c) Rear-end tank protection. Rear-end tank protections devices must: