

hour (18 mph). Tank-head puncture-resistance is a function of one or more of the following: Head thickness, jacket thickness, insulation thickness, and material of construction.

2. *Tank-head puncture-resistance test.* A tank-head puncture-resistance system must be tested under the following conditions:

a. The ram car used must weigh at least 119,295 kg (263,000 pounds), be equipped with a coupler, and duplicate the condition of a conventional draft sill including the draft yoke and draft gear. The coupler must protrude from the end of the ram car so that it is the leading location of perpendicular contact with the impacted test car.

b. The impacted test car must be loaded with water at six percent outage with internal pressure of at least 6.9 Bar (100 psig) and coupled to one or more “backup” cars which have a total weight of 217,724 kg (480,000 pounds) with hand brakes applied on the last “backup” car.

c. At least two separate tests must be conducted with the coupler on the vertical centerline of the ram car. One test must be conducted with the coupler at a height of 53.3 cm (21 inches), plus-or-minus 2.5 cm (1 inch), above the top of the sill; the other test must be conducted with the coupler height at 79 cm (31 inches), plus-or-minus 2.5 cm (1 inch), above the top of the sill. If the combined thickness of the tank head and any additional shielding material is less than the combined thickness on the vertical centerline of the car, a third test must be conducted with the coupler positioned so as to strike the thinnest point of the tank head.

3. One of the following test conditions must be applied:

Minimum weight of attached ram cars in kg (pounds)	Minimum velocity of impact in km/hour (mph)	Restrictions
119,295 (263,000) ... 155,582 (343,000) ...	29 (18) ..... 25.5 (16) .....	One ram car only. One ram car or one car plus one rigidly attached car.
311,164 (686,000) ...	22.5 (14) .....	One ram car plus one or more rigidly attached cars.

4. A test is successful if there is no visible leak from the standing tank car for at least one hour after impact.

[Amdt. 179–50, 60 FR 49078, Sept. 21, 1995, as amended by Amdt. 179–50, 61 FR 33256, June 26, 1996; 66 FR 45390–45391, Aug. 28, 2001]

APPENDIX B TO PART 179—PROCEDURES FOR SIMULATED POOL AND TORCH-FIRE TESTING

1. This test procedure is designed to measure the thermal effects of new or untried thermal protection systems and to test for

system survivability when exposed to a 100-minute pool fire and a 30-minute torch fire.

2. *Simulated pool fire test.*

a. A pool-fire environment must be simulated in the following manner:

(1) The source of the simulated pool fire must be hydrocarbon fuel with a flame temperature of 871 °C (1600 °F) plus-or-minus 55.6 °C (132.08 °F), throughout the duration of the test.

(2) A square bare plate with thermal properties equivalent to the material of construction of the tank car must be used. The plate dimensions must be not less than one foot by one foot by nominal 1.6 cm (0.625 inch) thick. The bare plate must be instrumented with not less than nine thermocouples to record the thermal response of the bare plate. The thermocouples must be attached to the surface not exposed to the simulated pool fire and must be divided into nine equal squares with a thermocouple placed in the center of each square.

(3) The pool-fire simulator must be constructed in a manner that results in total flame engulfment of the front surface of the bare plate. The apex of the flame must be directed at the center of the plate.

(4) The bare plate holder must be constructed in such a manner that the only heat transfer to the back side of the bare plate is by heat conduction through the plate and not by other heat paths.

(5) Before the bare plate is exposed to the simulated pool fire, none of the temperature recording devices may indicate a plate temperature in excess of 37.8 °C (100 °F) nor less than 0 °C (32 °F).

(6) A minimum of two thermocouple devices must indicate 427 °C (800 °F) after 13 minutes, plus-or-minus one minute, of simulated pool-fire exposure.

b. A thermal protection system must be tested in the simulated pool-fire environment described in paragraph 2a of this appendix in the following manner:

(1) The thermal protection system must cover one side of a bare plate as described in paragraph 2a(2) of this appendix.

(2) The non-protected side of the bare plate must be instrumented with not less than nine thermocouples placed as described in paragraph 2a(2) of this appendix to record the thermal response of the plate.

(3) Before exposure to the pool-fire simulation, none of the thermocouples on the thermal protection system configuration may indicate a plate temperature in excess of 37.8 °C (100 °F) nor less than 0 °C (32 °F).

(4) The entire surface of the thermal protection system must be exposed to the simulated pool fire.

(5) A pool-fire simulation test must run for a minimum of 100 minutes. The thermal protection system must retard the heat flow to the plate so that none of the thermocouples

on the non-protected side of the plate indicate a plate temperature in excess of 427 °C (800 °F).

(6) A minimum of three consecutive successful simulation fire tests must be performed for each thermal protection system.

**3. Simulated torch fire test.**

a. A torch-fire environment must be simulated in the following manner:

(1) The source of the simulated torch must be a hydrocarbon fuel with a flame temperature of 1,204 °C (2,200 °F), plus-or-minus 37.8 °C (100 °F), throughout the duration of the test. Furthermore, torch velocities must be 64.4 km/h ±16 km/h (40 mph ±10 mph) throughout the duration of the test.

(2) A square bare plate with thermal properties equivalent to the material of construction of the tank car must be used. The plate dimensions must be at least four feet by four feet by nominal 1.6 cm (0.625 inch) thick. The bare plate must be instrumented with not less than nine thermocouples to record the thermal response of the plate. The thermocouples must be attached to the surface not exposed to the simulated torch and must be divided into nine equal squares with a thermocouple placed in the center of each square.

(3) The bare plate holder must be constructed in such a manner that the only heat transfer to the back side of the plate is by heat conduction through the plate and not by other heat paths. The apex of the flame must be directed at the center of the plate.

(4) Before exposure to the simulated torch, none of the temperature recording devices may indicate a plate temperature in excess of 37.8 °C (100 °F) or less than 0 °C (32 °F).

(5) A minimum of two thermocouples must indicate 427 °C (800 °F) in four minutes, plus-or-minus 30 seconds, of torch simulation exposure.

b. A thermal protection system must be tested in the simulated torch-fire environment described in paragraph 3a of this appendix in the following manner:

(1) The thermal protection system must cover one side of the bare plate identical to that used to simulate a torch fire under paragraph 3a(2) of this appendix.

(2) The back of the bare plate must be instrumented with not less than nine thermocouples placed as described in paragraph 3a(2) of this appendix to record the thermal response of the material.

(3) Before exposure to the simulated torch, none of the thermocouples on the back side of the thermal protection system configuration may indicate a plate temperature in excess of 37.8 °C (100 °F) nor less than 0 °C (32 °F).

(4) The entire outside surface of the thermal protection system must be exposed to the simulated torch-fire environment.

(5) A torch-simulation test must be run for a minimum of 30 minutes. The thermal pro-

tection system must retard the heat flow to the plate so that none of the thermocouples on the backside of the bare plate indicate a plate temperature in excess of 427 °C (800 °F).

(6) A minimum of two consecutive successful torch-simulation tests must be performed for each thermal protection system.

[Amdt. 179-50, 60 FR 49078, Sept. 21, 1995, as amended at 75 FR 53597, Sept. 1, 2010]

## PART 180—CONTINUING QUALIFICATION AND MAINTENANCE OF PACKAGINGS

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