HA-405 RATING OF PRODUCTION BOILERS BASED ON TESTS

All boilers or boiler parts of the same material, design, and construction, whose design pressures are based on a test to destruction of a sample boiler or boiler part in accordance with HA-402, shall be considered to have design pressures equal to the maximum allowable working pressure thus determined and shall be subjected to a hydrostatic test pressure in conformity with rules of HA-406.

HA-406 HYDROSTATIC TEST

All completed boilers or boiler parts shall satisfactorily pass the hydrostatic test prescribed in this paragraph.

HA-406.1 Hot Water Boilers.

(a) Hot water heating boilers marked for maximum allowable working pressures not over 30 psi (200 kPa) shall have each individual section or boiler part subjected to a hydrostatic test of not less than 60 psi (400 kPa) at the shop where made.

(b) Hot water heating boilers marked for maximum allowable working pressures over 30 psi (200 kPa) shall have each individual section or boiler part subjected to a hydrostatic test of 2 1/2 times the maximum allowable working pressure at the shop where made.

(c) The assembled boiler shall be subjected to a hydrostatic test pressure not less than 1 1/2 times the maximum allowable working pressure.

1. Cast aluminum monoblock boilers, boilers with a single section design that do not require additional machining or assembly, do not require a second hydrostatic test at 1 1/2 times the maximum allowable working pressure.

2. Any additional machining, shot blasting, or grinding after the hydrostatic test will require testing at 1 1/2 times the maximum allowable working pressure.

HA-406.2 Required Test Pressure. In making hydrostatic pressure tests, the pressure shall be under such control that in no case shall the required test pressure be exceeded by more than 10 psi (70 kPa).

HA-407 PNEUMATIC TESTS

As an alternative to the hydrostatic test required in HA-406.1(c), cast aluminum boilers or boiler sections may be pneumatically tested, provided the following requirements are met:

(a) The use of pneumatic testing in lieu of hydrostatic testing shall be documented in the quality control system.

(b) Maximum material thickness of any component part shall not exceed 1/2 in. (12.7 mm).

(c) When the boiler is under pneumatic pressure testing, its calculated potential energy, \( E \), shall be less than 1,000 ft-lb (1 356 J).

\[ E = C \times P_{at} \times V \left[ 1 - \left( \frac{P_{at}}{P_{at}} \right)^{0.286} \right] \]

where

- \( C = \text{constant, 360 in.}^{2/ft^2} (2 500 \text{ Pa/kPa}) \)
- \( E = \text{stored energy, ft-lb (J)} \)
- \( P_{at} = \text{absolute atmospheric pressure, 14.7 psia (101 kPa)} \)
- \( P_{at} = \text{absolute test pressure, psia (kPa)} \)
- \( V = \text{total volume under test pressure, ft}^3 \text{ (m}^3) \)

NOTE: \( V \) includes the volume of the vessel and any connected volume to the pressure supply pump or valve.

(d) Nitrogen or clean, dry, oil-free air shall be used.

(e) The boiler shall be visually inspected for evidence of damage before pressurization.

(f) The boiler should be tested in such a manner as to ensure personnel safety from a release of the total internal energy of the vessel.

(g) The required test pressure shall be the greater of 38 psi (262 kPa) or 1.1 times the MAWP.

(h) Overpressure relief protection shall be provided. The set pressure of a pressure relief device shall not exceed the greater of the following:

1. The test pressure plus 10 psi (70 kPa)

2. 110% of the test pressure

(i) A minimum hold time of 5 min shall be maintained on the boiler at the required test pressure.

(j) The pneumatic test method shall be immersed visual inspection.

1. The boiler shall be externally cleaned to prevent air bubble adherence while being tested to prevent leaks from being masked.

2. The uppermost portion of the boiler, as oriented in the test tank, shall be a minimum of 6 in. (150 mm) below the surface of the water, and the water shall have a minimum temperature of 60°F (16°C).

3. Before the holding period, the immersed boiler shall be rotated a minimum of 180 deg around a lateral axis to release any trapped air.

4. After the holding period, the pressure may be reduced to the MAWP, but not less than 38 psi (262 kPa), and maintained at this pressure while a thorough visual inspection for leakage is made with the boiler submerged in water.

5. After the holding period, and during the visual inspection, the immersed boiler shall be rotated a minimum of 180 deg around a lateral axis to permit easy visual detection of any leakage.

6. Any evidence of air leaking from the vessel will indicate failure of the pneumatic pressure test.