

Testing Standards

Test Overview

1. Unenclosed Chimney installations

- a. The chimney is to terminate 18 feet above the floor of the test structure. The chimney is to be placed in a test structure with a horizontal clearance specified by the manufacturer and the walls must be made of $\frac{3}{4}$ inch thick plywood.

The corner formed by the walls is covered by a flat roof. The roof is constructed using 2 by 8 inch joists covered at the ceiling and roof lines by $\frac{3}{4}$ inch plywood. The joists and headers are to be utilized such that they create a box section around the chimney where it penetrates the roof.

2. Temperature Measurement

- a. Flue-gas temperatures are to be determined by thermocouple. The thermocouple is to be placed into an insulated outlet of the flue-gas generator. Other thermocouples are placed along the length of chimney at regular intervals to measure the temperature of the outside wall of the chimney. These thermocouples allow for a more accurate temperature measurement and make it easy to determine when the chimney reaches equilibrium which is critical in certain tests.

3. Thermal Shock Test

- a. At the conclusion of the test the chimney must be free of cracks, distortions, and any other damage. This test is to be conducted and passed prior to any other tests. The test is started at room temperature and then the chimney flue-gas temperature is brought up to 1630° F above room temperature. Once this is accomplished the chimney is kept at this temperature for 10 minutes regardless of the time taken to reach 1630° F above room temperature. After the 10 minute wait time has passed the burner is shut off. The chimney is allowed to cool to room temperature or to cool for 4 hours whichever comes first. The test is performed three times letting the chimney cool in between each trial. After 3 tests have been conducted the interior of the chimney is visually inspected by lowering a light down the chimney for its entire length. The chimney is inspected for cracks, distortions, or any other possible damage.

4. Positive Pressure Applications Test

- a. Chimney sections with joints are assembled in a manner that creates a straight assembly that has a minimum ratio of 50 inches of seal per cubic foot of sealed chimney. The diameter of the assembly needs to be at least 40% of the maximum diameter of the chimney to be tested. The assembly is sealed by capping the ends and then pressurized to a pressure of 60 inch water column (14934Pa) or the manufacturer's rated pressure whichever is greater. If any leakage occurs the leakage rate needs to be noted. After the first pressure test is completed the chimney section is uncapped and put through the thermal shock test and then a temperature test. After these two tests are conducted the assembly is capped again and subjected to a 60 inch water column pressure and the length of time for the pressure to drop 10 inches of water column is noted. If leakages occur at the end of this test the following formula is used to evaluate whether the assembly passed or failed.

Where:

$$426.7 \left(\frac{L}{V} \right) < 50 \text{ppm}$$

$$L = \text{Leakage rate determined in } \frac{\text{lb}}{\text{hr}}$$

$$V = \text{Volume of test sample in } \text{ft}^3$$

5. Draft Test

- a. In a draft test a chimney cannot produce a draft of less than .006 inch water column per foot of vertical chimney. In this test the draft of a chimney is tested within 15 minutes of the start of firing under the same conditions as a temperature test. The draft must be measured using a gauge with an accuracy of $\pm .0025$ inch and that reads directly to .005 inch water column.

6. Vertical Support Test

- a. An assembly for the support of a chimney must not be damaged nor should the attachment to the building structure lose its security for the assembly to pass this test. In this test a section of the chimney is placed on a framework simulating a typical installation. The chimney is then weighted down with a static load that is four times the load imposed by the heaviest chimney that the support is to sustain. The load is applied for 60 minutes and no damage is to be incurred by the chimney support for this test to be passed.

7. Strength Test

- a. Impact Test
Once three separate sandbag impacts have been applied to the chimney and the chimney or its parts have not broken or become damaged to the extent that they are incapable of being further used the chimney has passed the strength test.
- b. Longitudinal Test
A longitudinal force of 100 pounds shall be applied to the chimney and no damage, breaks, or any other damage will be incurred by the chimney.
- c. Load Test for chimney elbows
The support for an elbow must survive a load equivalent of four times the weight of the vertical portion of the chimney length between the chimney supports.
- d. Chimney Joint Load Test
In this test a chimney joint to an offset chimney must survive a load that is equivalent to four times the weight of the chimney section that is in between supports in the vertical direction.
- e. Chimney Joint torsion Test
Chimney parts must not separate under the torsional forces that can be exerted by chimney cleaning brushes.

7. Wind Load Test

- a. The wind load test is conducted by applying a load equivalent to 30 pounds per square foot of exposed area to any surface extending above the roof. Under this test lateral supports like a wall band are also tested and they must resist a load that is equivalent to 30 pounds per square foot of exposed area to any surface. The lateral support must resist without damage or displacement.

8. Rain Test

- a. In this test the quantity of water entering the flue-gas conduit's ventilation openings shall not exceed 2 percent of that which enters the ventilation opening where they are unprotected by a cap or other means

9. Cemented Joint Test

- a. Cement used for joining sections of flue-gas conduits cannot show evidence of softening or leaching after the test is conducted. Four samples that include the complete joint are used to seal a chimney section whose bottom of which is sealed to retain liquid. The section is then filled with a 1/50 normal sulfuric acid to a point that is one inch above the cement seal. The solution level is to be maintained for 72 hours. Once 72 hours is up the sulfuric acid solution is emptied and then replaced by water whose level is also one inch above the cement seal. The water level is then maintained for another 72 hours. No leaching or softening of the cement joint may occur for it to pass this test.
- b. Another portion of this test is leaving two samples of the cement sealed conduit, whose weight has been recorded, completely immersed in a solution containing 20 percent sulfuric acid by weight. These samples are left for a period of 44 hours completely immersed and then removed, dried, and cleaned and the loss of weight recorded. The loss of weight by the sample shall not exceed .30 percent.

Temperature Ratings

1. Temperature Test - 1000°F

- a. The temperature of the surfaces of the chimney parts that have zero clearance to the test structure cannot be more than 90°F above the ambient temperature during this test and no more than 117°F above room temperature for any period when the flue-gas temperature is maintained. The test structure like ceilings enclosures and joists are also not allowed to exceed 90°F above ambient temperature when they have zero clearance between themselves and the test chimney. The test is conducted by starting with a chimney and test structure at room temperature and then producing flue gases at a maintained 930° that are vented through the test chimney. The testing lasts until equilibrium temperatures are attained on the surfaces of the test chimney parts and test enclosure.

2. Temperature Test - 1400°F

- a. The surface temperatures of the chimney and test structure shall not exceed 140°F above ambient temperature when the flue-gas temperature is maintained for one hour. The flue-gas temperature is maintained at 1330°F for one hour during this test and this is done after equilibrium has been achieved in the previous 1000°F test.

Temperature Rating Table

Material	Maximum Rise Above Room Temperature			
	Maximum Chimney Temperatures		Flue Gas Temperature during Testing	
	°F	°C	°F	°C
Aluminum 11100(2S)	330	183	430	239
Aluminum 3003 (3S)	430	239	530	294
Aluminum 2014, 2017, 2024, 2052 ^a	530	294	630	350
Aluminum-coated Steel heat resistant type	1030	572	1275	708
Carbon Steel-coated with Type A19 Ceramic	1030	572	1130	628
Galvanized Steel	480	267	630	350
Low-carbon Steel, Cast Iron	830	461	930	517
Stainless Steel 302, 303, 304, 321, 347	1235	686	1380	767
Stainless Steel 316	1200	667	1345	748
Stainless Steel 309S	1560	867	1705	950
Stainless Steel 310, 310B	1610	894	1755	975
Stainless Steel 430	1310	728	1455	808
Stainless Steel 446	1730	961	1875	1042

Applicable NFPA Standards

NFPA standards 211 and 96 are applicable to these tests. NFPA 211 is a standard for chimneys, fireplaces, vents and solid fuel burning appliances. NFPA 96 is a standard for ventilation control and fire protection of commercial cooking operations. Both of these standards use similar temperatures and test rig construction for their tests.

Other Applicable Standards (ASHRAE, International Standards)

ASHRAE standards are also applicable to this testing. The standard requirements put forth by ASHRAE are much the same as the UL standards. ASHRAE standards for chimney, vent, and fireplace systems prescribe the same steady state flue-gas temperature of 930°F above ambient and allow for all fuel types like the UL 103 standard.

Notes or Uses (Example: Any non-categorized appliance, which means any appliance that has a burner that can be changed in the field.)