

(f) *Pendulum-friction test.* The explosive shall show no perceptible reaction in the pendulum-friction test with the hard fiber-faced shoe. Ten trials of the test are conducted by releasing the steel shoe from a height of 59 inches. If there is evidence of sensitivity, the test is repeated with the hard fiber-faced shoe.

(g) *Toxic gases.* The total volume equivalent to carbon monoxide (CO) of toxic gases produced by detonation of the explosive shall not exceed 2.5 cubic feet per pound of explosive as determined in the large chamber test. The explosive shall propagate completely.

(1) The large chamber test is conducted with a one-pound explosive charge, including wrapper and seal, primed with a test detonator. The explosive charge is loaded into the borehole of a steel cannon, then tamped and stemmed with one pound of dry-milled fire clay. The cannon is fired into the large chamber and the gaseous products resulting from detonation of the explosive are collected and analyzed for toxic gases. At least two trials are conducted.

(2) The equivalent volume of each toxic gas produced, relative to CO, is determined by multiplying the measured volume of the gas by a conversion factor. The conversion factor is equal to the threshold limit value, time weighted average (TLV-TWA) in parts-per-million for CO divided by the TLV-TWA for the toxic gas. The TLV-TWA conversion factor for each gas for which MSHA shall test is specified in Table I of this subpart. The total volume equivalent to CO of the toxic gases produced by detonation of the explosive is the sum of the equivalent volumes of the individual toxic gases.

TABLE I—CONVERSION FACTORS FOR TOXIC GASES
[For Equivalent Volume Relative to Carbon Monoxide]

	Toxic Gas	
	Conversion Factor	TLV-TWA (PPM)
Ammonia	2	25
Carbon Dioxide	0.01	5000
Carbon Monoxide	1	50
Hydrogen Sulfide	5	10
Nitric Oxide	2	25
Nitrogen Dioxide	17	3
Sulfur Dioxide	25	2

(h) *Cartridge diameter and length changes.* (1) For proposed changes to an approved explosive involving only cartridge diameter or length, MSHA will determine what tests, if any, will be required.

(2) When a proposed change to an approved explosive involves a smaller diameter than that specified in the approval, the rate-of-detonation and air-gap sensitivity tests will be conducted.

(3) No test will be conducted on cartridges with diameters the same as or smaller than those that previously failed to detonate in the rate-of-detonation test.

(i) *New technology.* MSHA may approve an explosive that incorporates technology for which the requirements of this subpart are not applicable if MSHA determines that the explosive is as safe as those which meet the requirements of this subpart.

§ 15.21 Tolerances for ingredients.

Tolerances for each ingredient in an explosive, which are expressed as a percentage of the total explosive, shall not exceed the following:

- (a) Physical sensitizers: The tolerances established by the applicant;
- (b) Aluminum: ±0.7 percent;
- (c) Carbonaceous materials: ±3 percent; and
- (d) Moisture and ingredients other than specified in paragraphs (a), (b), and (c) of this section: The tolerances specified in Table II.

TABLE II—TOLERANCES FOR MOISTURE AND OTHER INGREDIENTS

Quantity of ingredients (as percent of total explosive or sheath)	Tolerance percent
0 to 5.0	1.2
5.1 to 10.0	1.5
10.1 to 20.0	1.7
20.1 to 30.0	2.0
30.1 to 40.0	2.3
40.1 to 50.0	2.5
50.1 to 55.0	2.8
55.1 to 100.0	3.0

§ 15.22 Tolerances for performance, wrapper, and specific gravity.

(a) The rate of detonation of the explosive shall be within ±15 percent of that specified in the approval.

(b) The weight of wrapper per 100 grams of explosive shall be within ±2 grams of that specified in the approval.

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(c) The apparent specific gravity of the explosive shall be within ± 7.5 percent of that specified in the approval.

Subpart C—Requirements for Approval of Sheathed Explosive Units or Other Explosive Units Designed to be Fired Outside the Confines of a Borehole

§ 15.30 Technical requirements.

(a) *Quantity of explosive.* The sheathed explosive unit shall contain not more than $1\frac{1}{2}$ pounds of an approved or permissible explosive.

(b) *Chemical composition.* The chemical composition of the sheath shall be within the tolerances furnished by the applicant.

(c) *Detonator well.* The sheathed explosive unit shall have a detonator well that—

(1) Is protected by a sealed covering;
(2) Permits an instantaneous detonator to be inserted in the unit with the detonator completely embedded in the well;

(3) Is provided with a means of securing the detonator in the well; and
(4) Is clearly marked.

(d) *Drop test.* The outer covering of the sheathed explosive unit shall not tear or rupture and the internal components shall not shift position or be damaged in the drop test.

(1) The drop test is conducted on at least 10 sheathed explosive units. Each unit is dropped on its top, bottom, and edge from a height of 6 feet onto a concrete surface. For units with explosives approved with a minimum product firing temperature, the drop test is performed with the unit at the minimum product firing temperature established for the explosive in the unit. For units with explosives approved under regulations in effect prior to January 17, 1989, the drop test is performed with the unit at 41 °F.

(2) At least four units which have been drop-tested shall be cut-open and examined.

(3) At least six units which have been drop-tested shall be subjected to gallery tests 9 and 10 as provided in paragraphs (e)(1) and (e)(2) of this section.

(e) *Gallery tests.* No sheathed explosive unit shall cause an ignition in gallery tests 9, 10, 11, or 12. Ten trials in

each gallery test shall be conducted and each sheathed explosive unit shall propagate completely in all tests.

(1) Gallery test 9 is conducted in each trial with three sheathed explosive units placed in a row 2 feet apart. One of the trials is conducted with sheathed explosive units which have been subjected to the drop test as provided in paragraph (d)(3) of this section. The units are placed on a concrete slab, primed with test detonators and fired in air containing 7.7 to 8.3 percent natural gas or 8.7 to 9.3 percent methane. The air temperature is between 41 and 86 °F.

(2) Gallery test 10 is conducted in each trial with three sheathed explosive units placed in a row 2 feet apart. One of the trials is conducted with sheathed explosive units which have been subjected to the drop test as provided in paragraph (d)(3) of this section. The units are placed on a concrete slab, primed with test detonators and fired in air containing 3.8 to 4.2 percent natural gas, or 4.3 to 4.7 percent methane, mixed with 0.2 ounces per cubic foot of predispersed bituminous coal dust. The air temperature is between 41 and 86 °F.

(3) Gallery test 11 is conducted in each trial with three sheathed explosive units arranged in a triangular pattern with the units in contact with each other. The units are placed in a simulated crevice formed between two square concrete slabs, each measuring 24 inches on a side and 2 inches in thickness. The crevice is formed by placing one slab on top of the other and raising the edge of the upper slab at least 4 inches. The sheathed explosive units are primed with test detonators and fired in air containing 7.7 to 8.3 percent natural gas or 8.7 to 9.3 percent methane. The air temperature is between 41 and 86 °F.

(4) Gallery test 12 is conducted in each trial with three sheathed explosive units arranged in a triangular pattern with the units in contact with each other. The units are placed in a corner formed by three square steel plates, each measuring 24 inches on a side and one inch in thickness. The sheathed explosive units are primed with test detonators and fired in air containing 7.7 to 8.3 percent natural