

ASTM C150

Five types of Portland cements exist, with variations of the first three according to ASTM C150.[12][18]

Type I Portland cement is known as common or general-purpose cement. It is generally assumed unless another type is specified. It is commonly used for general construction, especially when making precast, and precast-prestressed concrete that is not to be in contact with soils or ground water. The typical compound compositions of this type are:

55% (C3S), 19% (C2S), 10% (C3A), 7% (C4AF), 2.8% MgO, 2.9% (SO₃), 1.0% ignition loss, and 1.0% free CaO (utilizing cement chemist notation).

A limitation on the composition is that the (C3A) shall not exceed 15%.

Type II provides moderate sulfate resistance and gives off less heat during hydration. This type of cement costs about the same as type I. Its typical compound composition is:

51% (C3S), 24% (C2S), 6% (C3A), 11% (C4AF), 2.9% MgO, 2.5% (SO₃), 0.8% ignition loss, and 1.0% free CaO.

A limitation on the composition is that the (C3A) shall not exceed 8%, which reduces its vulnerability to sulfates. This type is for general construction exposed to moderate sulfate attack and is meant for use when concrete is in contact with soils and ground water, especially in the western United States due to the high sulfur content of the soils. Because of similar price to that of type I, type II is much used as a general-purpose cement, and the majority of Portland cement sold in North America meets this specification.

Note: Cement meeting (among others) the specifications for types I and II has become commonly available on the world market.

Type III has relatively high early strength. Its typical compound composition is:

57% (C3S), 19% (C2S), 10% (C3A), 7% (C4AF), 3.0% MgO, 3.1% (SO₃), 0.9% ignition loss, and 1.3% free CaO.

This cement is similar to type I, but ground finer. Some manufacturers make a separate clinker with higher C3S and/or C3A content, but this is increasingly rare, and the general purpose clinker is usually used, ground to a specific surface area typically 50–80% higher. The gypsum level may also be increased a small amount. This gives the concrete using this type of cement a three-day compressive strength equal to the seven-day compressive strength of types I and II. Its seven-day compressive strength is almost equal to 28-day compressive strengths of types I and II. The only downside is that the six-month strength of type III is the same or slightly less than that of types I and II. Therefore, the long-term strength is sacrificed. It is usually used for precast concrete manufacture, where high one-day strength allows fast turnover of molds. It may also be used in emergency construction and repairs, and construction of machine bases and gate installations.

Type IV Portland cement is generally known for its low heat of hydration. Its typical compound composition is:

28% (C3S), 49% (C2S), 4% (C3A), 12% (C4AF), 1.8% MgO, 1.9% (SO₃), 0.9% ignition loss, and 0.8% free CaO.

The percentages of (C2S) and (C4AF) are relatively high and (C3S) and (C3A) are relatively low. A limitation on this type is that the maximum percentage of (C3A) is seven, and the maximum percentage

of (C3S) is thirty-five. This causes the heat given off by the hydration reaction to develop at a slower rate. Consequently, the strength of the concrete develops slowly. After one or two years the strength is higher than the other types after full curing. This cement is used for very large concrete structures, such as dams, which have a low surface to volume ratio. This type of cement is generally not stocked by manufacturers, but some might consider a large special order. This type of cement has not been made for many years, because Portland-pozzolan cements and ground granulated blast furnace slag addition offer a cheaper and more reliable alternative.

Type V is used where sulfate resistance is important. Its typical compound composition is:

38% (C3S), 43% (C2S), 4% (C3A), 9% (C4AF), 1.9% MgO, 1.8% (SO₃), 0.9% ignition loss, and 0.8% free CaO.

This cement has a very low (C3A) composition which accounts for its high sulfate resistance. The maximum content of (C3A) allowed is 5% for type V Portland cement. Another limitation is that the (C4AF) + 2(C3A) composition cannot exceed 20%. This type is used in concrete to be exposed to alkali soil and ground water sulfates which react with (C3A) causing disruptive expansion. It is unavailable in many places, although its use is common in the western United States and Canada. As with type IV, type V portland cement has mainly been supplanted by the use of ordinary cement with added ground granulated blast furnace slag or tertiary blended cements containing slag and fly ash.

Types Ia, IIa, and IIIa have the same composition as types I, II, and III. The only difference is that in Ia, IIa, and IIIa, an air-entraining agent is ground into the mix. The air-entrainment must meet the minimum and maximum optional specification found in the ASTM manual. These types are only available in the eastern United States and Canada, only on a limited basis. They are a poor approach[clarification needed] to air-entrainment which improves resistance to freezing under low temperatures.

Types II(MH) and II(MH)a have a similar composition as types II and IIa, but with a mild heat.