Characteristics of Common Blue Pigments

Pigment	Composition	CI numbers	Usage	Density	Refractive Index	Microscopic characteristics	Other characteristics	Health
aniline blue	triarylmethane dye	CI 42780; Solvent Blue 3	patented in January 1861			reacts with collagen to produce a blue-green fluorescence	water soluble; used for inks and for dying wool, nylon, leather, wood, and paper	toxic by ingestion
azurite	natural basic copper carbonate, 2CuCO3-Cu(OH)2	Pigment Blue 30; CI 77420	since antiquity	3.77-3.80	1.730; 1.838; 1.758	strong birefringence; highly refracting; particles are irregular in size with fractured edges; pleochroic from pale blue to deep blue	decomposes in acids evolving CO2; turns black with warm alkalis, hydrogen sulfide or sulfur fumes	chronic exposure may cause anemia
blue verditer	synthetic blue copper carbonate, 2CuCO3-Cu(OH)2	Pigment Blue 30; CI 77420	European recipes date to medieval times	3.8	1.730; 1.838; 1.758	strong birefringence; highly refracting; fine grain spheres occur as aggregates; pleochroic from pale blue to deep blue	decomposes in acids evolving CO2; turns black with warm alkalis, hydrogen sulfide or sulfur fumes	chronic exposure may cause anemia
cerulean blue	cobalt tin oxide, CoO-nSnO2	Pigment Blue 35; CI 77346; CI 77368	developed in 1805, first sold in 1860		1.78 - 1.84	very fine, rounded, isotropic, greenish-blue particles; no birefringence; no pleochroism; appears deep red through Chelsea filter	ASTM lightfastness=1 (excellent); Inert to acids and bases.	chronic inhalation may cause asthma and possible fibrosis
chrysocolla	copper silicate, CuSiO3-nH2O		naturally occurring blue mineral	2.4	1.575, 1.598, 1.597	variable ground particles are anisotropic with high birefringence, straight extinction and are pleochroic changing from pale green to colorless	appears green when ground as powder	no significant hazards
cobalt blue	cobaltous aluminate, CoO.Al2O3	Pigment Blue 28; CI 77346	developed in 1802, sold as artist pigment c. 1820	3.83	1.662-1.74	irregular to rounded blue particles, no birefringence, no pleochroism; appears red through Chelsea filter	unaffected by acids, alkalis, light and heat; ASTM lightfastness=1 (excellent)	skin contact may cause allergies.
Egyptian blue	double silicate of calcium and copper, CaCuSi4O10	Pigment Blue 31; CI 77437	used by Egyptians; later manufactured in Italy		e =1.59, w =1.63	irregular particle shapes; pleochroic from deep blue to colorless; strong birefringence; appears red with Chelsea filter	very stable; insoluble in acids; unaffected by light or heat; ancient Egyptian blue may contain quartz and calcite as impurities	no significant hazards
indigo	natural dye from Indigofera tinctoria, C16H10N2O2	Natural Blue 1; CI 75780 (natural); Pigment Blue 66; CI 73000 (synthetic)	natural indigo used by 4th century; synthetic produced in 1880.		>1.662	fine, translucent dark blue, rounded particles that are weakly birefringent and appear dark red under Chelsea filter	insoluble in water; discolored by reducing agents & bleaches; ISO R105 Lightfastness Classification = 3-4	no significant hazards
manganese blue	BaMnO4-BaSO4	Pigment Blue 33; CI 77112	discovered in 1907; marketed as pigment in 1935; production discontinued in 1970s	4.85	~1.65	rectangular particles with rounded edges; strongly pleochroic from dark to pale turquoise; strong birefringence under crossed polars	ASTM lightfastness=1 (excellent)	toxic by inhalation or ingestion
Maya blue	palygorskite clay dyed with indigo		used in Mesoamerica since ancient times		1.522-1.548	fibrous or platy particles are pleochroic (turquoise blue to yellow-green). Weak birefringence under crossed polars.	unaffected by alkalis; soluble in hot concentrated acids	
phthalocyanine blue	copper phthalocyanine, C32H16N8Cu	Pigment Blue 15; CI 74160	developed in 1933; sold as paint pigment in 1935	1.6	1.38	fine grain translucent to opaque particles with moderate to strong birefringence; crystal type I appears deep red through Chelsea filter and crystal type II appears black	slowly turns yellow then dissolves in concentrated sulfuric acid; ASTM lightfastness=2 (very good)	suspected carcinogen, teratogen

Pigment	Composition	CI numbers	Usage	Density	Refractive Index	Microscopic characteristics	Other characteristics	Health
Prussian blue	ferric ferrocyanide, Fe4[Fe(CN)6]3	CI Pigment Blue 27; CI 77510	developed in 1704; first sold as artists' pigment c. 1730	1.83	1.56	cubic crystal system; isotropic; very fine particles (0.01 - 0.2 micrometers) appear black under Chelsea filter	ASTM lightfastness=1 (excellent: but often varies with manufacturer). Soluble in acids, decomposes in alkali.	can emit hydrogen cyanide gas if exposed to acids, heat or UV radiation
smalt	ground potassium glass, K, Al, Co silicate				1.46-1.55	conchoidal fracture, with sharp edges and splinter; no birefringence, no pleochroism; transparent pale blue to deep purple particles	lightfastness is variable; poor covering power; unaffected by acids, alkalis; may have quartz impurities	no significant hazards
ultramarine blue, natural	powdered lazurite	Pigment blue 29; CI 77007	extracted from lapis lazuli as early as the 13th century	2.4 - 2.5	about 1.5	irregular particles, no birefringence, no pleochroism, extinction under crossed polars; naturally mixed with silicates, calcite and pyrite	discolors when exposed to weak acids or sulfur fumes; ASTM lightfastness=1 (excellent)	no significant hazards
ultramarine blue, synthetic	3Na2O.3Al2O3.6SiO2.2Na2S	Pigment Blue 29; CI 77007	developed in 1826, sold as artist pigment in 1828	2.34	1.51; 1.63	small, round uniform particles, no birefringence, no pleochroism, extinct in crossed polars	discolors when exposed to weak acids or sulfur fumes; ASTM lightfastness=1 (excellent)	no significant hazards
vivianite	ferrous phosphate, Fe3(PO4)2 - 8H2O		naturally occurring mineral used as pigment in 13th/14th c.	2.58-2.68	1.60; 1.63; 1.65	lath-shaped crystals and fragments with strong birefringence; appears blue-green under Chelsea filter	slowly decomposes and darkens in light and air	