28.41 - Salts of oxometallic or peroxometallic acids.

2841.30 - Sodium dichromate

2841.50 - Other chromates and dichromates; peroxochromates

- Manganites, manganates and permanganates :

2841.61 - - Potassium permanganate

2841.69 - - Other

2841.70 - Molybdates

2841.80 - Tungstates (wolframates)

2841.90 - Other

This heading covers the salts of oxometallic and peroxometallic acids (corresponding to metal oxides which constitute anhydrides).

The main groups of compounds covered by this heading are :

(1) **Aluminates**. Derivatives of aluminium hydroxide.

(a) **Sodium aluminate**. Obtained by treating bauxite with sodium hydroxide solution. Occurs as a white powder soluble in water, in aqueous solutions or in paste form. Used as a mordant in dyeing (alkaline mordant); in the preparation of lakes; for sizing paper; as a filler for soap; for hardening plaster; for manufacturing opaque glass; for purifying industrial water, etc.

(b) **Potassium aluminate**. Prepared by dissolving bauxite in potassium hydroxide. White, micro-crystalline masses, hygroscopic and soluble in water. Same uses as sodium aluminate.

(c) **Calcium aluminate**. Obtained by the fusion of bauxite and calcium oxide in an electric furnace; white powder, insoluble in water. Used in dyeing (mordant); for purifying industrial water (ion exchanger); in paper-making (sizing); in the manufacture of glass, soap, special cements, polishing preparations and other aluminates.

(d) **Chromium aluminate**. Obtained by heating a mixture of aluminium oxide, calcium fluoride and ammonium dichromate. Ceramic colour.

(e) **Cobalt aluminate**. Prepared from sodium aluminate and a cobalt salt. It constitutes, either pure or mixed with aluminium oxide, cobalt blue (Thenard's blue). Used in the preparation of cerulean blue (with zinc aluminate), azure blue, smalt blue, Saxony blue, Sèvres blue, etc.

(f) **Zinc aluminate**. White powder used for similar purposes to sodium aluminate.

(g) **Barium aluminate**. Prepared from bauxite, barytes and coal; white or brown masses. Used for purifying industrial water and as an anti-scale compound.

(h) **Lead aluminate**. Obtained by heating a mixture of lead oxide and aluminium oxide. Solid, not easily melted, used as a white pigment and for manufacturing refractory bricks and linings.

The heading **excludes** natural beryllium aluminate (chrysoberyl) (**heading 25.30**, **71.03** or **71.05** as the case may be).

(2) **Chromates**. Neutral or acid chromates (dichromates), tri-, tetra- and perchromates derive from the various chromic acids, in particular the normal acid (H_2CrO_4) or from the dichromic acid ($H_2Cr_2O_7$) not isolated in the pure state.

The principal of these mostly toxic salts are :

(a) **Zinc chromate**. The treatment of zinc salts with potassium dichromate gives hydrated or basic zinc chromate. Powder, insoluble in water. Pigment which, alone or in mixture, constitutes zinc yellow. Mixed with Prussian blue, it forms zinc green.

(b) **Lead chromate**.

Neutral artificial lead chromate results from the action of lead acetate on sodium dichromate. Yellow or sometimes orange-coloured or red powder according to the method of precipitation. Alone or mixed, this pigment constitutes chrome yellow, used in enamelling, in ceramics, in the manufacture of paints or varnishes, etc.

Basic chromate, alone or mixed, constitutes chrome red or Persian red.

(c) **Sodium chromates**. Sodium chromate ($Na_2CrO_4.10H_2O$) is obtained during the manufacture of chromium by roasting natural iron chromium oxide (chromite) mixed with coal and sodium carbonate. Large yellow crystals, deliquescent and very soluble in water. Used in dyeing (mordant); in tanning; for preparing inks, pigments or other chromates or dichromates. Used in mixture with antimony sulphide for preparing photographic flashlight powders.

Sodium dichromate ($Na_2Cr_2O_7.2H_2O$), prepared from sodium chromate, forms deliquescent red crystals, soluble in water. Transformed by heat into the anhydrous and less deliquescent dichromate (i.e., melted or cast chromate) often containing a small quantity of sodium sulphate. Used in tanning (chrome-tanning); in dyeing (mordant and oxidiser); as an oxidising agent in organic synthesis; in photography; in printing; in pyrotechnics; for purifying or decolourising fats; for preparing dichromate batteries and dichromate gelatins (which, under the influence of light, are converted into products insoluble in hot water); in flotation processes (to reduce buoyancy); in petroleum refineries; as an antiseptic.

(d) **Potassium chromates**. Potassium chromate (K_2CrO_4) (yellow potassium chromate) is prepared from chromite. Yellow crystals, soluble in water and poisonous.

Potassium dichromate ($K_2Cr_2O_7$) (red potassium chromate) is also obtained from chromite. Orange-coloured crystals, soluble in water and very toxic. Dichromate dust and vapours attack the nasal bone and cartilages; its solutions infect scratches.

Potassium chromate and dichromate are used for similar purposes to sodium chromate and dichromate.

(e) **Ammonium chromates**. Ammonium chromate ($(NH_4)_2CrO_4$), prepared by saturating a solution of chromium trioxide with ammonia. Yellow crystals, soluble in water. Used in photography and in dyeing.

Ammonium dichromate ($(NH_4)_2Cr_2O_7$), obtained from natural iron chromium oxide (chromite); red crystals, soluble in water. Used in photography; in dyeing (mordant); in tanning; for purifying fats or oils; in organic synthesis, etc.

(f) **Calcium chromate** ($CaCrO_4.2H_2O$). Prepared from sodium dichromate and chalk; becomes anhydrous and turns yellow when heated. Used in the preparation of yellow colours such as " yellow ultramarine ", a name also applied to calcium chromate alone.

(g) **Manganese chromate**. Neutral chromate ($MnCrO_4$), prepared from manganous oxide and chromic anhydride. Brownish crystals, soluble in water. Used as a mordant in dyeing.

Basic chromate, brown powder, insoluble in water, is used in water paints.

(h) **Iron chromates**. Ferric chromate ($Fe_2(CrO_4)_3$), (prepared from solutions of ferric chloride and potassium chromate, is a yellow powder, insoluble in water.

There is also a basic iron chromate which, alone or as a mixture, is used in painting under the name of siderine yellow. Associated with Prussian blue it gives greens imitating zinc green. Also used in metallurgy.

(ij) **Strontium chromate** ($SrCrO_4$). Analogous to calcium chromate; alone or in mixture constitutes strontium yellow. Employed in the preparation of artists' paints.

(k) **Barium chromate** ($BaCrO_4$). Obtained by precipitating solutions of barium chloride and sodium chromate; bright yellow powder, insoluble in water and poisonous. Alone or mixed, it constitutes barium yellow which, like the similar product obtained from calcium chromate, is sometimes known as " yellow ultramarine ". Used for artists' paints and in the enamel and glass industries; also in the manufacture of matches and as a mordant in dyeing.

This heading **excludes** :

(a) Natural lead chromate (crocoisite) (**heading 25.30**).

(b) Pigments prepared with chromates (**heading 32.06**).

(3) **Manganates, permanganates**. These salts correspond to manganic acid (H_2MnO_4) (not isolated), permanganic acid ($HMnO_4$) existing only in aqueous solution).

(a) **Manganates**. Sodium manganate (Na_2MnO_4), prepared by fusion of a mixture of natural manganese dioxide (heading 26.02 - pyrolusite) and sodium hydroxide; green crystals, soluble in cold water, decomposed by hot water; used in gold metallurgy.

Potassium manganate (K_2MnO_4), in small greenish-black crystals. Used for preparing the permanganate.

Barium manganate ($BaMnO_4$), obtained by heating manganese dioxide mixed with barium nitrate. Emerald green powder. Mixed with barium sulphate, it constitutes manganese blue. Used for artists' paints.

(b) **Permanganates**. Sodium permanganate ($NaMnO_4.3H_2O$), prepared from the manganate; reddish-black crystals, deliquescent and soluble in water. Used as a disinfectant, in organic synthesis and for bleaching wool.

Potassium permanganate ($KMnO_4$), prepared from the manganate, or by oxidising a mixture of manganese dioxide and potassium hydroxide. Purple crystals with a metallic sheen, soluble in water, colouring the skin; also in purplish-red aqueous solutions or in tablets. Powerful oxidising agent, used in chemistry as a reagent, in organic synthesis (manufacture of saccharin); in metallurgy (nickel refining); for bleaching fatty substances, resins, silk yarn or fabrics or straw; for purifying water; as an antiseptic; as a dye (for wool, wood and in hair-dyes); in gas masks; in medicine.

Calcium permanganate ($Ca(MnO_4)_2.5H_2O$), prepared by electrolysing solutions of alkali manganates and calcium chloride; forms dark purple crystals, soluble in water. Oxidising agent and disinfectant, used in dyeing, in organic synthesis, for purifying water, for bleaching paper pulp.

(4) **Molybdates**. Molybdates, paramolybdates and polymolybdates (di-, tri-, tetra-) are derived from normal molybdic acid (H_2MoO_4) or from the other molybdic acids. Similar in some respects to chromates.

The principal of these salts are :

(a) **Ammonium molybdate**. Obtained in the metallurgy of molybdenum. Hydrated crystals, slightly tinted with green or yellow and decomposed by heat. Used as a chemical reagent, in the preparation of pigments or fire-proofing materials, in the glass industry, etc.

(b) **Sodium molybdate**. Hydrated crystals, shiny and soluble in water. Used as a reagent, in the manufacture of pigments and in medicine.

(c) **Calcium molybdate**. White powder, insoluble in water; used in metallurgy.

(d) **Lead molybdate**. Artificial lead molybdate co-precipitated with lead chromate gives the scarlet chrome pigments.

Natural lead molybdate (wulfenite) is **excluded** (**heading 26.13**).

(5) **Tungstates (wolframates)**. Tungstates, paratungstates and pertungstates are derived from the normal tungstic acid (H_2WO_4) and other tungstic acids.

The principal of these salts are :

(a) **Ammonium tungstate**. Obtained by dissolving tungstic acid in ammonia; white crystalline powder, hydrated, soluble in water; used for fire-proofing fabrics and in the preparation of other tungstates.

(b) **Sodium tungstate**. Obtained in tungsten metallurgy, from wolframite (heading 26.11) and sodium carbonate; white leaflets or crystals, hydrated, with a pearly sheen, soluble in water. Same uses as ammonium tungstate; also used as a mordant in textile printing, for preparing lakes and catalysts and in organic synthesis.

(c) **Calcium tungstate**. White, glossy scales, insoluble in water; used for preparing X-ray screens or fluorescent tubes.

(d) **Barium tungstate**. White powder, used in artists' paints, alone or mixed, under the name of tungsten white or tungstate white.

(e) **Other tungstates**. These include tungstates of potassium (for fire-proofing fabrics), magnesium (for X-ray screens), chromium (green pigment), or lead (pigment).

The heading **excludes** :

(a) Native calcium tungstate (scheelite), an ore (**heading 26.11**).

(b) Natural tungstates of manganese (hubnerite) or of iron (ferberite) (**heading 26.11**).

(c) Luminescent tungstates (e.g., of calcium or magnesium), classified as inorganic luminophores (**heading 32.06**).

(6) **Titanates** (ortho-, meta- and peroxotitanates, neutral or acid) are derived from the various titanic acids and hydroxides, based on titanium dioxide (TiO_2).

Barium and lead titanates are white powders used as pigments.

The heading **excludes** natural iron titanate (ilmenite) (**heading 26.14**), and inorganic fluorotitanates (**heading 28.26**).

(7) **Vanadates** (ortho-, meta-, pyro-, hypovanadates, neutral or acid) are obtained from the various vanadic acids derived from vanadium pentaoxide (V_2O_5) or from other vanadium oxides.

(a) **Ammonium vanadate** (metavanadate) (NH_4VO_3). Yellowish-white crystalline powder, sparingly soluble in cold water, very soluble in hot water and giving a yellow solution. Used as a catalyst; as a mordant in textile dyeing or printing; as a drier in paints or varnishes; as a colouring matter in pottery, and in the preparation of writing or printing inks, etc.

(b) **Sodium vanadates** (ortho- and meta-). Hydrated white powders, crystalline and soluble in water. Used in aniline-black dyeing and printing.

(8) **Ferrates and ferrites**. Ferrates and ferrites are derived from ferric hydroxide ($Fe(OH)_3$) and from ferrous hydroxide ($Fe(OH)_2$), respectively. Potassium ferrate is a black powder, dissolving in water to give a red liquid.

The name " ferrates " is erroneously given to simple mixtures of iron oxides and other metal oxides constituting ceramic colours and classified in **heading 32.07**.

The heading also **excludes** ferrous ferrite which is in fact magnetic iron oxide (Fe_3O_4) (**heading 26.01**), and hammer scale (**heading 26.19**).

(9) **Zincates**. Compounds derived from amphoteric zinc hydroxide ($Zn(OH)_2$).

(a) **Sodium zincate**. Results from the action of sodium carbonate on zinc oxide, or of sodium hydroxide on zinc. Used in the preparation of zinc sulphide employed in paints.

(b) **Iron zincate**. Used as a ceramic colour.

(c) **Cobalt zincate**, pure or mixed with cobalt oxide or other salts, constitutes cobalt green or Rinmann's green.

(d) **Barium zincate**. Prepared by precipitating an aqueous solution of barium hydroxide with an ammoniacal solution of zinc sulphate; white powder, soluble in water. Used in the manufacture of zinc sulphide employed in paints.

(10) **Stannates** (ortho- and meta-) are derived from stannic acids.

(a) **Sodium stannate** ($Na_2SnO_3.3H_2O$). Obtained by fusion of a mixture of tin, sodium hydroxide, chloride and nitrate; hard masses or irregular lumps, soluble in water, white or coloured according to the proportion of impurities (sodium or iron salts). Used in textile dyeing or printing (mordant); in the glass or ceramic industries; in the separation of lead from arsenic; in tin sizes for silk and in organic synthesis.

(b) **Aluminium stannate**. Prepared by heating a mixture of tin sulphate and aluminium sulphate; white powder. Used as an opacifier in the enamel or ceramic industries.

(c) **Chromium stannate**. Main component of pink colours for ceramics or artists' paints. Also used in tin sizes for silk.

(d) **Cobalt stannate**. Alone or mixed, constitutes a sky-blue pigment, used in paints.

(e) **Copper stannate**, alone or mixed, it is known as " tin green ".

(11) **Antimonates**. Salts of the various acids corresponding to antimonic oxide (Sb_2O_5); somewhat similar to arsenates.

(a) **Sodium meta-antimonate** (leuconine). Prepared from sodium hydroxide and antimony pentaoxide; a white crystalline powder, sparingly soluble in water. Opacifier for the enamel or glass industries; used in the preparation of sodium thioantimonate (Schlippe's salt) (**heading 28.42**).

(b) **Potassium antimonates**. The most important is potassium hydrogen antimonate, prepared by calcining the metal mixed with potassium nitrate; a white, crystalline powder. Used in medicine (as a purgative) and as a ceramic pigment.

(c) **Lead antimonate**. Obtained by the fusion of antimony pentaoxide with red lead; yellow powder, insoluble in water. Alone or mixed with lead oxychloride, it constitutes Naples yellow (antimony yellow), a pigment for ceramics, glass or artists' paints.

Antimonides are **excluded** (**heading 28.53**).

(12) **Plumbates**. Derived from amphoteric lead dioxide (PbO_2).

Sodium plumbate is used as a colouring matter. Plumbates of calcium (yellow), strontium (chestnut) or barium (black) are used in the manufacture of matches and in pyrotechnics.

(13) **Other salts of oxometallic acids or peroxometallic acids**. These include :

(a) **Tantalates and niobates**.

(b) **Germanates**.

(c) **Rhenates and perrhenates**.

(d) **Zirconates**.

(e) **Bismuthates**.

The heading **excludes**, however, compounds of :

(a) Precious metals (**heading 28.43**).

(b) Radioactive chemical elements or radioactive isotopes (**heading 28.44**).

(c) Yttrium, scandium or rare-earth metals (**heading 28.46**).

(d) Mercury (**heading 28.52**).

Complex fluorine salts, such as fluorotitanates fall in **heading 28.26**.