Chapter 1-4

NON-FERROUS GROUP OF METALS AND ALLOYS

CONTENTS

Introduction

1 In this group, defined as any alloy based mainly on metals other than iron, are included the light alloys which are of special interest in connection with aircraft and other service equipment.

2 A general indication is given of the alloys by means of typical chemical compositions and characteristics, together with references to the properties and behaviour of the metals when subjected to heat.

3 The chief metals and alloys used in aircraft components are detailed in para. 26 to 34.

4 Details of other non-ferrous metals and alloys are given in para. 35 to 57.

5 It should be noted that different specification(s)/numbers may be given to one alloy in various states of hardness, or of different formation, as in sheet or tubular form etc. The relevant specification (or its direct equivalent if applicable), is to be used in the processing and application of the material in question.

6 Generally speaking, only materials supplied to B.S. or D.T.D. specifications are permissible for aircraft repairs, except in certain circumstances. Materials drawn from stores will normally be in the fully heat-treated condition. In cases where, due to the severity of bending or forming, such material cannot be used, full heat treatment is to be carried out on completion of the required operations.

7 Such materials comprise alloys of three main groups, viz:

7.1 Heat-treatable alloys which are solution-treated (often erroneously called 'normalising') and which are age hardened at room temperature.

7.2 Heat-treatable alloys which are solution-treated and which need to be aged at slightly elevated temperature to develop their optimum properties.

7.3 Alloys which are not heat-treatable and which rely for their physical properties on the degree of cold work imparted during manufacture.

Note ...

Heat treatment details must be obtained for each type from the relevant specification.

ALUMINIUM

8 Aluminium is a silver white metallic element forming a protective film of oxide. Obtained from bauxite, pure aluminium is very soft and ductile, and is the basis for light alloys.

9 It is rarely used in the pure state owing to its low maximum strength but is often alloyed with copper, tin, nickel, manganese, zinc and silicon. An alloy may contain one of these metals only, added to the aluminium to form a simple alloy, or it may contain various combinations of several metals added in varying amounts to form complex alloys. In its pure form, the metal is used as a window in X-ray tubes, reactor fuel rod sheathing and, as foil, in capacitors.

Heat treatment glossary

10 Para. 11 to 22 detail the appropriate terms for the heat treatment of aluminium type alloys.

Annealing

11 This operation is only required where severe bending or forming is necessary. It may be applied both to heat-treatable, and rarely, non-heat-treatable alloys which have been partially hardened in manufacture by cold working, e.g. cold rolling.

11.1 In the case of cold rolling, the material, once annealed and formed, cannot be re-hardened by heat treatment. Once formed, it is usually impracticable to re-harden by cold working.

11.2 Where severe forming operations are involved, intermediate stage re-annealing may be necessary.

11.3 Materials should not be annealed as a matter of routine.

CAUTION ...

Under no circumstances whatever are heat-treatable alloy components or parts to be put into service following annealing without full re-heat treatment being carried out.

11.4 The operation is carried out in the temperature range 380-400°C, the material being cooled either in air or water

Artificial ageing

12 Also known as artificial age-hardening or precipitation hardening, produced by accelerating the natural age-hardening process.

13 The solution-treated material is heated in an air-circulating oven, at a temperature between 100 - 200°C (dependent on specification) for a recommended time.

14 After heating, the material is normally allowed to cool in air.

Note ...

The maintenance of exact conditions during heat treatment is crucial. In order to prove the batch quality, it is necessary for a test piece of the same material (which can be tested to destruction) to be processed at the same time and in the same manner as the production items. Such testing is to be carried out in accordance with BS.3L 100: 1971.

Natural ageing

15 Also known as natural age-hardening. After quenching from the solution heat-treatment (see para. 21), the material, if allowed to remain at room temperature, starts to increase rapidly in hardness during the first few hours, then at a decreasing rate until maximum hardness is reached, usually in two to five days.

16 This natural hardening is accompanied by a similar increase in the physical strength of the alloy.

17 The process may be retarded by refrigeration; certain rivets for example, are often stored in the soft condition for a period of 24 hours by this method.

Solution treatment

18 This is a heat-treatment process applied to the alloys detailed in para. 7.1 and 7.2. The term 'normalising' is often used, erroneously, to describe this process.

19 The process consists of heating the material for an appropriate soak period (dependent on the material specification) at a closely controlled temperature, followed by quenching (para. 21).

20 The heating temperatures are extremely critical. For this reason, the heating should be carried out either in a salt bath or air-circulating furnace.

WARNINGS ...

(1) THE APPEARANCE OF MOLTEN SALTS GIVES NO INDICATION OF ITS HIGH TEMPERATURE. PERSONNEL MUST AVOID PHYSICAL CONTACT.

(2) SALT MATERIALS HAVE A HIGH FIRE RISK AND MUST BE STORED IN THE SPECIAL BINS PROVIDED.

(3) IN THE EVENT OF A FIRE IN A WORKSHOP CONTAINING A SALT BATH, THE BUILDING IS TO BE EVACUATED. THE FIRE IS TO BE DEALT WITH FROM OUTSIDE THE BUILDING.

(4) SUPERVISORS ARE TO ENSURE THAT DRY SALTS ONLY ARE TO BE USED IN SALT BATHS. SALTS DAMPENED FROM ABSORBING MOISTURE FROM ATMOSPHERE MAY CAUSE AN EXPLOSIVE REACTION IF ADDED.

CAUTIONS ...

(1) Solution treatment at a temperature lower than that specified, or delay in quenching, will result in failure to develop the full physical properties of the material.

(2) Solution treatment at a temperature higher than that specified, will cause overheating, burning or blistering, with a resultant reduction of mechanical properties, notably ductibility; these cannot be restored by any subsequent treatment.

21 Following heating, the material is to be immediately quenched, usually in cold water. For some alloys warm water is used. The material specification should always be consulted.

22 Straightening, bending and other normal manipulations, e.g. small to medium forming operations, are to be performed within two hours of quenching, when the material is relatively soft (although slightly harder than in the annealed condition).

23 Aluminium can be worked by most of the usual processes, e.g. rolling, spinning, drawing, extruding, forging, casting and welding. It has a high conductivity of heat and a high coefficient of expansion, although in some alloys the latter characteristic is reduced considerably.

24 Aluminium is electro-positive to copper, iron, lead, tin, nickel and zinc, and contact with these metals, particularly when moisture or salt spray is present, will cause rapid deterioration of the aluminium due to corrosion.

Aluminium alloys

25 Defined as those in which aluminium is the predominant element; they are termed 'light-alloys' e.g.:

25.1 Aluminium-copper

25.2 Aluminium-silicon (Alpax)

25.3 Duralumin

25.4 'Y' alloy etc.

25.5 Descriptions of the most important of the aluminium alloys are given in para. 26 to 34.

Alpax (silumin)

26 An alloy containing 13.0% Si with excellent casting qualities and good corrosion resistance. It has low specific-gravity (2.66) with satisfactory mechanical properties. Tensile strength 15.75 - 19.9 kg/mm^2 (10 - 12 ton f/in^2).

Aluminium-copper

27 This alloy is relatively hard and is suitable for the production of die-cast pistons, carburettor bodies etc. The composition is about 88 per cent aluminium and 12% copper, the copper acting as a hardening element serves to maintain the original properties of the alloy at relatively high temperatures. The alloy is susceptible to corrosion, due to the effect of the copper content; therefore its uses are limited to parts which are not exposed to corrosive influences.

Aluminium-magnesium

28 Aluminium magnesium alloy has a high resistance to fatigue and surface corrosion and is suitable for casting. Aluminium is the basic constituent of the alloy which contains also between 3 and 6% magnesium and 0.25 to 0.75% manganese. A suitable alloy for the production of sheet metal has a magnesium content of 3.0 to 6.0% and a maximum strength of 31.5 kgf/mm^2 (20 tons/sq in), which is approximately twice that of pure aluminium sheet. There are several similar alloys in this class having slight variations in the chemical composition to which small additions of chromium, manganese or silicon, are made. It is now widely used in aircraft construction.

Aluminium-silicon

29 Several different aluminium-silicon alloys are used to produce castings which are malleable and which have a low coefficient of expansion. The silicon content of such alloys is usually between 8 to 13% with small additions of copper, manganese and other hardening and modifying agents. More complex alloys containing smaller amounts of silicon are used for the production of sheets, tubes and extruded bars. The addition of titanium to some of these silicon alloys gives a fine grain structure which is present in both the cast and wrought alloy.

Duralumin

30 An aluminium based alloy, containing 3.5 to 4.5% Cu, 0.4 to 0.7% Mg, 0.4 to 0.7% Mn, and up to 0.7% Si. It is capable of age-hardening at room temperature after solution-treating.

31 The material is annealed by heating to a temperature of 380 to 400°C, then cooled in air or water.

31.1 In the fully annealed condition, the material is particularly susceptible to corrosion. It must not, therefore, be left for long periods in this condition.

31.2 Duralumin is subject to corrosion particularly when exposed to sea water spray.

31.3 A measure of protection can be given by anodic treatment, consisting of the electrical deposition of aluminium oxide on both sides of the heated duralumin sheet. The material is then known as 'Alclad'.

Hiduminium (RR alloys)

32 A series of aluminium alloys of the Duralumin type, typically composed as follows: 0.8 to 3.0% Cu, up to 4.0% Mg, 0.6 to 2.8% Si, 0.5 to 2.0% Ni, 0.6 to 1.5% Fe, 0.02 to 0.3% Ti.

Other aluminium alloys

Aluminium brass

33 Brass to which aluminium has been added. It is highly corrosion-resistant and is used particularly in condenser tubes. A typical composition would be 1.0 to 6.0% Al, 24-0 to 42.0% Zn, and 55.0 to 71.0% Cu.

Aluminium bronze

34 An alloy containing from 4.0 to 11.0% AP, it may also contain up to 50% each Fe and Ni or 0.5% Sn. This form of alloy has high tensile strength and may be cast or cold-worked. It is highly corrosion-resistant.

Antimony

35 This is an extremely brittle, readily powdered metal which is a poor conductor of heat and electricity. Occasionally used in its pure form in the standardisation of pyrometers, it is most frequently alloyed in bearing metals, shrapnel bullets and in cable sheathing. The antimony alloys have the usual feature of expansion at freezing temperatures.

Beryllium

WARNINGS ...

THESE MATERIALS ARE ESPECIALLY HAZARDOUS IF:

(1) BERYLLIUM MATERIALS ARE ABSORBED INTO THE BODY TISSUES THROUGH THE SKIN, MOUTH OR A WOUND.

(2) THE DUST CREATED BY BREAKAGE OF BERYLLIA (OXIDE OF BERYLLIUM) IS INHALED.

(3) TOXIC FUMES ARE INHALED FROM BERYLLIUM/BERYLLIA INVOLVED IN A FIRE.

Note ...

Further information on the handling of Beryllium/Beryllia is given in: AP 3158 Vol 2 (2nd Edn) Leaflet H37.

36 This is one of the lightest metals, with a specific gravity of 1.82 compared to aluminium (2.70), and is capable of being hot-worked. In its pure form it is used in X-ray work, as electrodes for neon-signs, and as a deoxidiser for molten copper.

37 Some beryllium alloys, e.g. copper and nickel, yield unusually high hardness and tensile strength values. Ferro-beryllium is used in the case hardening of steel and a Brinell hardness-value of more than 1000 has been obtained.

Caesium

38 A soft metal, with a very low melting point (28.6°C), caesium reacts explosively and readily with water and oxygen.

39 When alloyed with antimony, gallium and thorium, it is generally photo-sensitive, and is extensively used in the manufacture of photo-electric cells.

Cadmium

WARNING ...

THE INSTRUCTIONS GIVEN IN AP 100B-01 ORDER 1703 AND ITS ANNEX A MUST BE FULLY COMPLIED WITH

40 As a pure metal, cadmium has few industrial applications other than electro-deposition and metal-spraying for anti-corrosive purposes (Chap.1-6 para. 11). It is also used as a constituent of special solders for some of the aluminium alloys.

41 Alloyed with copper, it is used for overhead wires, and with lead it is used for bearings.

Chromium

42 Due to its ability to stay bright, even under laboratory conditions, chromium is widely used in the production of heat-resisting and stainless steels, and as an electro-deposited anti-corrosion plating on other finished metal surfaces, to resist wear and abrasion (Chap. 1-6, para. 16).

Copper

43 Copper is produced commercially as a 99.95% pure alloy, which can be used either in its pure state or alloyed with other metals.

44 It is manufactured in a large variety of forms, and is obtainable in bars, ingots, sheets, wires and tubes.

45 The material is ductile, malleable and tough, with the property of good conductivity of heat and electricity. It may be freely worked and can be work-hardened, electro-deposited or annealed. Copper is annealed by being evenly heated to 650°C, then quenched in water or cooled in still air.

46 There are eleven grades of raw copper, for which the British Standards Institute has formulated specifications. Full details are given in BS 1035-1040 (inclusive), 1172 - 1174 (inclusive), 1861 and 1954.

47 Hot-wrought forms of copper and its alloys are produced in large quantities, with the composition of such materials being adjusted to improve the existing machining qualities. Copper based alloys meet almost every requirement in terms of mechanical properties; certain of these materials are similar to tool steel in performance.

48 Copper can be joined by all the normal brazing, soldering and welding techniques, the latter usually by the gas shielded arc-welding process.

Note ...

Phosphorous-deoxidised grades are preferred to the touch-pitch oxygen-bearing types, since hydrogen diffuses rapidly through copper at elevated temperatures to react with cuprous oxides causing embrittlement, also known as 'gassing'.

49 The chief alloys of copper are briefly described in para. 50 to 63.

The brasses

50 Industrial brasses comprise a wide range of alloys with up to 50 per cent Zinc (Zn). They may, additionally, have other trace elements, mainly Tin (Sn), Lead (Pb), Iron (Fe), Manganese (Mn), Nickel (Ni), Aluminium (Al) and Silicon (Si).

51 There are three main groups of brasses, viz:

51.1 'Alpha' brasses, containing up to 37 per cent Zinc. At this level the brass is akin to copper and can be cold worked and softened by annealing.

51.2 'Alpha-beta' brasses, with up to 45 per cent Zinc, cannot be cold-formed to any extent without breaking. At elevated temperatures, they become very plastic, and can be easily hot-rolled, forged and extended.

51.2.1 Lead may be added to the composition to enhance machinability.

51.2.2 The addition of aluminium, iron, manganese and tin, gives a wide range of 'high-tensile' brasses, often erroneously termed as 'manganese-bronze'.

51.3 'Gamma' brasses, where the Zinc content is up to 50 per cent, is, due to embrittlement, industrially useless.

Tin bronzes

52 These are alloys of copper and tin. Additional elements, particularly lead, nickel, phosphorous and zinc are often added. Tin bronzes containing zinc are referred to as gunmetals.

53 Tin bronzes are produced in two main types, viz:

53.1 Wrought alloys, in strip or wire form, for gauze and springs.

53.2 Complex bronzes and castings, for bearings and general application.

54 Tin bronzes, containing up to 8 per cent of tin, can be cold-rolled or drawn, being spring hardened in the process. With the addition of 0.40% phosphorous, such alloys then become known as phosphor-bronzes.

55 Ordinarily, 8% tin is the highest amount found in bronzes for sheet, strip and wire. However, the solubility limit may be as high as 15.8% at 550°C. If soaked at 700°C, such bronzes can then be formed into rod, sheet, strip, tube or wire by cold working, with good corrosion-resistance characteristics.

Aluminium bronzes

56 Based on copper and aluminium, this range of alloys is highly resistant to corrosion and scaling. With the use of special fluxes, they may be brazed or soldered, and are easily welded.

57 Alloys containing up to 9.4% of aluminium may be cold-worked. The normal limiting level of aluminium for this practice is, however, about 8%, more usually containing between 4 to 7 per cent.

58 In plate and tube form, such bronzes are suitable for heat exchangers and for similar uses in chemical engineering. Some loss of strength and hardness may be found in heavily, cold worked material in the temperature range 250 - 300°C. If fully annealed, this value may increase to the safe limit of 400°C.

Copper-nickel (cupro-nickel) alloys

59 These alloys are characterised by their excellent corrosion-resistant and free-working characteristics. These are enhanced as the nickel content is progressively increased, particularly when small amounts of iron and manganese are added.

60 Details of the copper-nickel ratios of the most common alloys of this type, together with brief notes as to their uses, are contained in para. 61 to 64.

61 55/45. This type is particularly well suited for electrical instrument resistances, the resistivity being of the order of 55 μΩ/cm, the temperature coefficient of resistance being virtually nil.

62 70/30. With the addition of small amounts of iron and manganese, this type has outstanding resistance to impingement attack. It is widely used in ships and power stations using sea water for cooling purposes, especially where erosion by sand or high water velocity is liable to occur. It is also widely used in desalination and chemical plants.

63 75/25, 80/20, 85/15. These types have excellent cold deep-drawing formability. The 75/25 is the standard material for U.K. 'silver' coinage. The 80/20, being extremely ductile, is the usual material for cartridge cases.

63 90/10. This type, in tube form, is particularly suited for use in ships, heat exchangers, and desalination plants. In strip or sheet, it is ideal for sheathing wooden piles in sea water, preventing attack by marine borers.

Copper-lead alloys

65 These alloys have been developed for heavy duty bearing applications, as in diesel and aircraft engines. They comprise of up to 30 per cent lead and frequently have small amounts of tin or silver added. They may be applied as thin coatings on steel shells.

Gold

66 Gold is traditionally the most sought after metal. Industrially, it is occasionally used in electro-plating processes (Chap. 1-6, para. 20) and may be alloyed with platinum or palladium.

Lead

67 Lead is a very soft white metal and because of its low mechanical strength and high specific gravity, its use on aircraft is very limited. Lead is resistant to atmosphere corrosion and to the corrosive effects of most acids, but it is attacked by both soft water and nitric acid.

68 Combinations of lead alloy and lead oxides are used for the manufacture of the plates of accumulators of the lead-acid type. Lead is also included in the formation of solders of a low working temperature and in certain grades of white-metal bearing alloys.

69 Lead pipes can be joined by means of a process known as 'wiping', the metal being worked whilst it is in a plastic state during the operation. Sheet lead is usually welded by means of a process known as lead-burning.

Magnesium and its alloys

70 Pure magnesium, with a specific gravity of 1.74, is not used for engineering purposes, but is extensively used as an important constituent in the production of a wide range of complex alloys.

71 Magnesium is available in two forms, one being the familiar powder or strip, which burns in air, giving an intense white light, rich in ultra-violet rays. The other is that, used in the production of castings, forgings, extruded rod and sheet.

72 These alloys all have a density of 1.8 to 1.9, i.e. 66% of that of aluminium and 25% of that of steel, possessing a strength/weight ratio superior to that of many other engineering materials.

73 All magnesium alloys have excellent machining characteristics, machining speeds often being limited by the capacity of the machine tool involved. Depending on the operation, the horse power required is about one-sixth of that required for steel and approximately one half of that needed for aluminium and its alloys.

74 Magnesium alloy sheet can be worked cold for simple operations. If heated to a temperature of 300°C it becomes more amenable to bending. In this condition, it is suitable only for the formation of non-acute bends.

75 Most of the wrought-alloys are readily weldable, the argon-arc method being preferred.

76 Magnesium alloys are generally susceptible to notch embrittlement effects, and suitable design allowances must be made to cater for these, e.g. ample fillets, generous radii etc.

77 Details of magnesium alloys will be found in B.S. and D.T.D. specifications. For aircraft, vehicle and reciprocating components, magnesium is principally alloyed with:

77.1 Aluminium

77.2 Copper

77.3 Manganese

77.4 Nickel

77.5 Thorium

77.6 Zinc

77.7 Zirconium

78 When magnesium is used as the basis of a complex alloy using some, or all, of the elements detailed in para. 77, the resultant metal is known as an elektron-alloy.

79 Magnesium alloys have low impact strength as compared with mild steel or bronze etc., and are generally comparable to aluminium based alloys and certain heated alloys. They have good fatigue-resistant and damping characteristics as compared with cast-iron.

Molybdenum

80 Molybdenum is a dense metal which oxidises and becomes volatile when heated to 600°C. Made ductile by high temperature swaging and heat-treatment, it can be formed into sheets or drawn into wire. As wire, it is used for thermo-couples at very high temperatures.

81 The metal is mainly used as an alloy with steels and iron, in order to reduce temper-brittleness and to give increased strength at elevated temperatures, particularly when used as an additive in 'high-speed' cutting steels.

Nickel and its alloys

82 The majority of nickel alloys are classified as ferrous metals (Chap. 1-3, para. 20). Where a high-strength, non-ferrous heat-treatable nickel based material is required, it is usual to specify Monel Alloy K500.

Note ...

> This material is not to be confused with that detailed in Chap. 1-3, para. 22.

83 Monel alloy K500 has good corrosion resistance with non-magnetic and high mechanical properties, and is particularly used for pump rods, propeller shafts and highly stressed fasteners.

Rhodium

84 A noble metal, with a higher melting point (approx. 2000°C) than that of platinum (1755°C) which it resembles.

85 It is frequently alloyed with platinum to form the positive wire of the Pt-Rh-Pt high temperature thermo-couple, for low resistance electrical contacts, and for catalytic purposes.

86 Rhodium may be specified for electro-plating purposes (Chap.1- 6, para. 31).

Silver

87 A very malleable and ductile metal, silver is the best conductor of heat and electricity known.

88 It finds considerable application in industry, due to its acid and alkali resistance characteristics, and is widely used as an electro-plating material (Chap.1-6, para. 34).

Tin

89 This is a very ductile, soft white metal. Whilst rarely used in its pure state, it forms an important constituent of various other alloys.

90 It is obtainable, mainly in ingot form, in two classes (London Metal Exchange grades) viz:

90.1 Class 'A' - tin assaying not less than 99.75 per cent of pure metal.

90.2 Class 'B' - tin assaying not less than 99.00 per cent of pure metal.

91 Tin possesses the property of amalgamating with various other metals at relatively low temperatures, and advantage is taken of this in the production of bearing metals and solder alloys. Tin may be electro-deposited (Chap.1-6, para. 37) to cast-iron and aluminium alloy pistons in internal combustion engines.

92 Tin is highly resistant to corrosion under many conditions, and for this reason is widely used in the canned food and drink industries.

93 An indication of the nature of two of the more important alloys with a large tin content is given in para. 94 and 95.

Solders, grades A and B

92 Those solders listed in A.P.1086 are alloys of tin, lead and antimony, and are employed for different classes of work.

94.1 Grade A solder contains 65 per cent tin, antimony up to 1% and 34% lead, and has a melting point of 180°C.

94.2 Grade B solder is composed of 50% tin, antimony between 2.50 and 3% and the remainder lead, and this solder has a melting point at about 225°C.

94.3 The total impurities in both are limited to 0.25%. Grade B solder is used for general work, radiator and tank repairs etc., whilst Grade A solder is used only for specified work where lower working temperatures are necessary.

94.4 Other grades of solder with special properties are included in B.S. and D.T.D. Specifications.

White metal

95 White metal, sometimes classified as copper-tin alloy, is used as a bearing metal because of its anti-friction properties, its toughness and its capacity for melting at a temperature low enough to prevent seizing in the event of a bearing overheating. A typical composition of one of these alloys

is copper from 5.50 to 7.50%, antimony 6 to 7%, nickel not more than 0.60%, and the remainder tin. There are various other grades which are included in B.S. and D.T.D. Specifications.

Titanium

96 A metal characterised by its strength, lightness and corrosion resistance, titanium is frequently added to light aluminium alloys to improve their properties.

97 It is also added to austenitic stainless steels to improve their corrosion resistance.

98 Certain titanium alloys have been developed particularly for aircraft applications, especially in sheet metal form for engine casings. It is widely used in the compressor blades and rotor discs of jet engines, where the temperature does not exceed 400°C.

99 The three most promising groups of titanium alloys are:

99.1 Those relying on chromium and iron additions, taking advantage of the fact that iron is a normal impurity in processed titanium.

99.2 Those alloyed with manganese, increasing ductility and therefore favoured as sheet.

99.3 Those alloys including chromium, aluminium, iron and manganese, particularly favoured for high temperature applications.

100 Two further alloys under development are:

100.1 An addition of molybdenum to improve ductility.

100.2 Vanadium-iron with a similar objective.

101 For alloying, titanium is always added in the form of ferro-titanium.

Zinc and its alloys

102 Zinc in its pure state is a soft, ductile metal, with a low tensile strength, which may be readily worked into either sheet or wire form.

103 Its most important property is its resistance to atmospheric corrosion, and for this reason is most widely used in the form of zinc coatings (Chap. 1-6, para. 40).

Zinc dust and oxides

104 Zinc dust and oxides are mainly used for pigments and chemicals.

104.1 Zinc dust paints are extensively used for the protection of iron and steelwork, other grades being used in sheradizing and zinc spraying.

104.2 Zinc oxides are mainly used in the rubber industry, serving to accelerate the vulcanisation of rubber compositions. Additionally, they may be used in pigments imparting toughness to the paint, preventing 'yellowing' and helping to resist the growth of mildew.

Zinc coatings

105 Protective zinc coatings are applied in five principal techniques, viz:

105.1 Hot dip galvanising

105.2 Sherardizing

105.3 Zinc-dust spraying

105.4 Zinc-plating

105.5 Zinc-spraying

106 Such coatings form a strongly adherent corrosion-resistant barrier between the atmosphere and the parent metal, their service life being dependent on the weight of zinc/unit area, varying from five years in heavily polluted atmosphere, to 25 years in rural atmospheres.

107 Zinc alloys are widely used for castings and in the manufacture of bearings, forming and blanking tools.

107.1 Zinc die-casting alloys, as detailed in BS.1004, are based on special high grade zinc of 99.99% per cent (min.) purity.

107.2 Due to their relatively low melting point, the alloys can be used in automatic hot chamber die-casting machines.

108 Zinc alloys similar to those detailed in BS.1004, but containing 3% copper to increase their hardness, are used for dies for forming and blanking sheet metals and plastic moulds.

Zinc-aluminium

109 Copper bearing alloy, also known as Algen-305, is composed of 3% Al, 5% Cu, balance Zn, and is used for bearings. It is readily used for casting by the sand, gravity or pressure-die methods, and possesses excellent machining properties.

Superplastic zinc alloys

110 Those based on the 22 per cent eutectoid composition which display an elongation of about 1,000% at 260°C after heat-treatment to produce a very fine grain structure.

111 An alloy of 71% cadmium and 29% zinc, (both metals being 99.95% pure) is used for soldering zinc-coated metal parts.

WARNING ...

WHEN ZINC IS SUBJECTED TO EXCESSIVE HEAT, IT BECOMES VERY VOLATILE, GIVING OFF TOXIC FUMES WHICH MUST NOT BE INHALED. FOR THIS REASON ALLOYS CONTAINING ZINC ARE TO BE HEATED CAREFULLY. SUPERVISORS ARE TO ENSURE THAT OPERATORS ARE MADE AWARE OF THIS HAZARD TO HEALTH.


26