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Code for the Prevention of Dust Explosions in the MANUFACTURE OF ALUMINUM BRONZE POWDER

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Manufacture of Aluminum Bronze Powder.

This Code, prepared by the NFPA Committee on Dust Explosion Hazards, was adopted in its present form by the National Fire Protection Association at its annual meeting in June 1952. The present edition supersedes the ~~1950~~ edition and all previous editions printed by the NFPA and other organizations.

The present text is reprinted from the National Fire Codes, Vol. II, Prevention of Dust Explosions, Edition of 1952. The prior history of this Code, dating back to the initiation of this project by the NFPA in 1938, will be found in the National Fire Codes, Vol. II.

Prior editions of the Code have been approved as American Standard by the American Standards Association; at the time of this printing advices have not been received relative to action on the present edition.

CODE FOR THE PREVENTION OF DUST EXPLOSIONS IN THE MANUFACTURE OF ALUMINUM BRONZE POWDER.

Table of Contents.

Definitions.

In this code the following words are used as defined below:

"Shall" is intended to indicate requirements.

"Should" is intended to indicate recommendations, or that which is advised but not required.

"Aproved" refers to approval by the authority having jurisdiction in the enforcement of standards.

Section 1. Introduction.

11. The objective of this code is to reduce the hazards of ignition and explosions inherent in the manufacture of flake-like aluminum powder (alu-

minum bronze powder) and/or the dust of any alloy of aluminum that is explosive in air, as determined by test.

12. Where the code has reference to plant location or construction, or the installation of radically new types of equipment, the specifications are not retroactive in application.

13. All new installations should be under the supervision of engineers qualified by experience in the design, construction and operation of equipment for the purpose.

14. This code is not intended to apply as a whole to the situation where the production and removal and/or collection of a small amount of waste dust produced by an incidental operation (such as scratch-brushing aluminum utensils or sheet) may occur, but some of its provisions may be considered to be advisory for such situations.

Section 2. Location and Buildings of Aluminum Bronze Powder-making Plant.

21. LOCATION OF THE PLANT: The plant should be located on a tract of land large enough so that the buildings in which the powder is manufactured shall be at least 300 feet distant from occupied structures such as public buildings, dwellings, stores or manufacturing establishments other than those which are a part of the powder manufacturers' plant. The premises in which are located the powder-making buildings should be surrounded by high, strong fencing with suitable entrance gates under charge of a guard to the property.

22. DIFFERENT OPERATIONS IN THE MANUFACTURE of aluminum bronze powder should be located in separate buildings further subdivided into as many small units as practicable, by substantial brick or reinforced concrete division walls without openings. Separate buildings (other than the small units of a major process section) should preferably be separated by not less than 50 feet of space and in no case should they be less than 25 feet apart, unless barricades, similar to those used in explosives manufacturing plants, are built between the buildings. Where two buildings are less than 50 feet apart, only one of those shall have windows or doors in the wall facing the other building.

23. ELECTRIC OR STEAM POWER GENERATORS shall be in a separate building or buildings which should be at least 100 feet from the dust-making buildings.

24. BUILDING CONSTRUCTION: All buildings used for the manufacture, packing or loading for shipment of aluminum bronze powder shall conform with the following requirements:

a. CHARACTER OF BUILDINGS: They shall be of one-story type, with no basements, and constructed of noncombustible materials throughout, and the buildings shall be designed so that every internal surface is readily accessible to facilitate cleaning. In all building walls of rooms where dust may be produced, which are not of monolithic construction, all masonry joints shall be thoroughly slushed with mortar and troweled smooth so as to leave no interior or exterior voids for the infiltration and accumulation of aluminum bronze powder.

b. CONSTRUCTION WITH REFERENCE TO POSITION OF BUILDINGS: Where two buildings face each other at a distance of less than 50 feet, one of the facing walls shall be of reinforced concrete or brick construction without openings; the other facing wall may be of "daylight type" construction.

c. COMMUNICATIONS BETWEEN BUILDINGS: Buildings separated by not less than 50 feet of space (or small units of one major process section) may communicate through enclosed passageways of incombustible construction; provided, that such enclosed passageways are specially designed for the release of internal pressures and all openings to such passageways are protected by self-closing fire doors approved for the protection of openings in fire division walls.

d. FRAMES OF DOORS AND WINDOWS should be of metal; the doors shall be approved self-closing fire doors. There should be adequate window areas both for light and in case of an explosion to afford relief of pressure on rupturing; windows which may be opened, should be hinged at the top, open outward and if fastened with catches, these should release on moderate pressure from the inside. Each room should have at least two widely separated exits to corridors or to the outside.

e. FLOORS OF BUILDINGS in which there are dust-making operations should be of concrete, covered with non-sparking composition which provides a hard, smooth surface.

f. ROOFS OF BUILDINGS in which there are dust-making operations shall be supported on girders so designed as to minimize the area of surfaces on which dust may collect. Where these surfaces are unavoidably present, and on other more or less horizontal places, such as wide girder flanges and window ledges, they shall be covered by a steeply sloping plaster filling. The roof covering shall be as light as practicable, but fire-resistant and so arranged that it will be easily blown off by an internal explosion. Any sheet metal used in the roof covering shall be well cemented to prevent leakage and be well painted with aluminum paint, or else galvanized and well maintained to prevent corrosion, which might cause leakage.

g. GROUNDING AND LIGHTNING PROTECTION: All steel work should be well grounded to a suitable ground outside the building, in accordance with the N.F.P.A. Code for Protection Against Lightning. Lightning rods should be provided for all boiler house stacks or chimneys and high points on buildings. The power lines should be adequately protected against lightning. A lightning arrester system should be provided around or within the building area, of such a capacity as to fully protect all buildings in that area from lightning.

Section 3. Making and Conveying Powder.

31. CONSTRUCTION AND GROUNDING OF DUST-MAKING MACHINES: All dust-making machines and conveyors shall be so constructed as to minimize the escape of dust into the rooms in which they are located. All parts of the machinery and conveyors shall be thoroughly grounded to prevent static sparks (see Section 5, Control of Static Electricity).

32. CONVEYING OF ALUMINUM POWDER: When this is done pneumatically it shall be in non-ferrous conveyor ducts; if transported in movable containers these shall be constructed throughout of non-ferrous, non-sparking

material with a non-ferrous metal lining and provided with wheels or casters with non-sparking tires. When these containers have to be transported in the open, they shall be protected from the weather by covers. Pneumatic conveying is a common method of transferring the dust from place to place in a building or to an adjacent building. Preferably an inert gas mixture should be used instead of air in such a system, wherever the concentration of powder is within the explosive range, or likely to become so.

a. PREVENTION OF CONDENSATION AND DRYING IN CONVEYOR DUCTS: Provision should be made, in both the design and installation of conveyor ducts, to guard against possible condensation of moisture within the ducts, and to provide means so that it may be completely and thoroughly dried out after any period of idleness, before it is again put into service. Such drying operation should always be thoroughly carried out, preferably by the use of warm dry air, for several hours before resuming operations. All conveyor ducts, where practicable, should have a definite inclination from the horizontal to facilitate cleaning and draining.

33. RELIEF VENTS OF CONVEYOR DUCTS: Wherever, in the ducts, it is practicable to have relief vents of sufficient area extending to the outside of the building, these shall be provided.

a. WORKING PRESSURE STRENGTH OF DUCTS: Wherever damage may result from the rupture of a duct, in case the relief vent does not offer sufficient relief, the duct should be designed for a working pressure of at least 100 pounds per square inch. Where so located that no damage will result from its bursting, it should be of the lightest construction possible.

34. FAN CONSTRUCTION AND ARRANGEMENTS: Blades and housing of fans that are used to actuate movement of the air or inert gas in conveying ducts should be constructed of non-sparking material such as bronze or aluminum. The arrangements should be such that intercepting screen-cloth filters suitably grounded, or the design of the ducts, will prevent aluminum bronze dust from passing into the fan; in all cases, however, it is advisable that the fan blades or propellers should be made of non-sparking material. Wherever possible, any fans into which dust may enter should be placed outside of the dust-making building. This arrangement should be particularly followed in dealing with the finest particle size of aluminum powder or any aluminum-alloy dust that is explosive in air.

Section 4. Electricity for Light and Power.

41. ELECTRICAL WIRING AND EQUIPMENT. All electrical wiring and equipment shall be in accordance with the requirements for Class II locations (Group E, atmospheres containing metal dust), Article 500 of the National Electrical Code.

42. REQUIREMENTS OF NATIONAL ELECTRICAL CODE. Attention should be specifically directed to the requirements of the National Electrical Code for the location of transformers, type and location of motors, generators and their control equipment, cables, fuses, circuit breakers, conduits and lights of all types.

43. SPECIAL PROVISIONS. Provision should be made for remote control of the electrical circuits so that the current for light and power in any dust making building may be cut off by switches outside of the building at a distance of at least 4 feet from the nearest doorway. It should also be

arranged that the power of the whole plant can be cut off by switches located at one or more central points, such as the office, watchman's booth, etc. All electrical equipment shall be inspected and cleaned periodically. Where flash lights or storage battery lamps are used, they should be of a type approved for the purpose.

Section 5. Control of Static Electricity.

51. GROUNDING MACHINERY TO REMOVE STATIC ELECTRICITY produced in dust making and collecting is vital for safety. It should be thoroughly done according to the recommendations of the N.F.P.A. Committee on Static Electricity (see Appendix A), not only for stamp mortars or other mills, fans and conveyors in all parts of the plant where dust is made or handled, but also for all dust screens, cyclone collectors, stocking or bag collectors, and screen-cloth collectors. These several kinds of cloth collectors and screens, if not themselves metallic, should have fine non-insulated, non-ferrous wire enmeshed or woven with the cloth, or otherwise securely fastened into it at suitable intervals, and grounded.

Section 6. Prevention of Accumulation of Aluminum Powder or Dust.

61. DUST SHALL NOT BE PERMITTED TO ACCUMULATE. Good housekeeping is a factor of utmost importance. To this end an adequate vacuum sweeping system is recommended, although soft push brooms may be used. When vacuum cleaners are employed the only permissible arrangement is where the hose and tools are connected with a system of evacuating tubes to the outside of the building. Each time the stamps or other dust-making machines are charged and/or discharged all dust and other material spilled on open surfaces of the machinery or the floor of the building shall be promptly and thoroughly removed. When vacuum cleaners are employed bulk accumulation of powder and material shall be removed by soft push brooms and non-sparking scoops before the vacuum sweeping equipment is used.

62. COMPETENT SUPERVISION AND PERIODIC CLEANING should always be maintained and the foremen should be alert to prevent the accumulation of excessive dust on any portions of buildings or machinery which are not regularly cleaned in daily operations. Regular periodic cleaning, with all machinery idle and power off, should be carried out as often as local conditions require it to maintain safety, but in any case at least once a week.

63. LOCATION OF DISCHARGE RECEPTACLES OF DUST COLLECTORS: The dust collected by vacuum cleaner nozzles or brushes or otherwise and drawn through an evacuating pipe shall be discharged into a suitable receptacle located outside the dust-making building. Each piece or group of such equipment shall be surrounded with a tight, strong steel shield, preferably cylindrical, open at the top and closed at the bottom and designed to withstand an internal pressure of 200 pounds per square inch, so that if an explosion should occur in dust-collecting receptacles, its full force and flame would be diverted upwardly.

64. FANS AND OTHER EQUIPMENT for moving the air shall be so placed that the entrance of dust is minimized, or else enclosed as above specified. They should have ball or roller bearings, and when used for pneumatic conveying of dust from a machine or group of machines, they should be electrically interlocked with the power supply for such machines, so that in case the fan stops, the machine will stop making dust.

Section 7. Prevention of Ignition of Aluminum Powder.

71. GENERAL PRECAUTIONS: In the operation of the plant, every precaution shall be taken to avoid the production of sparks from electrical faults or from either static electricity or sparks caused by impact, such as that of steel or iron articles or stones upon each other or upon concrete. The leakage of water in or into any building where it can come into contact with any aluminum powder shall be prevented to avoid spontaneous heating and ignition therefrom. The electrical heating to a high temperature of any wire or resistance element in a dusty or dust-producing building and the development of serious local heating in machinery, due to friction, should likewise be prevented. The installation of thermostats connected by relays with bell or other indicators may be advisable in some parts of the plant.

72. REMOVAL OF TRAMP METAL AND STRAY PEBBLES: Approved magnetic separators of the permanent magnet or self-cleaning electro-magnetic types or approved pneumatic separators should be installed in an approved manner ahead of all mills, stamps or pulverizers to remove tramp metal from the pieces of aluminum going to the mills or stamps and these pieces should also be carefully examined to remove pebbles or other foreign material which might in subsequent operations produce frictional sparks of sufficient intensity to ignite the aluminum powder.

73. BALL OR ROLLER BEARINGS properly sealed against dust shall be used generally for line shafts or other high-speed equipment, instead of plain bearings, because of the difficulty of maintaining proper lubrication of the latter for preventing their heating. Any open bearings which have to be used should be protected as thoroughly as possible against the ingress of aluminum dust, and on high speed equipment should be equipped with automatic hot journal alarms.

74. CYCLONE AND BAG COLLECTORS should be equipped with suitable instruments for recording the temperature therein, and with an indicating device to give warning when a dangerous degree of heating is reached. Polishing equipment should also be equipped with temperature recording instruments, to indicate to the operators any tendency toward excessive heating. All such temperature recording instruments should preferably give their indications and make their record at easily observed central locations, so the men in responsible charge may receive warning and take action to remedy the hazardous conditions.

75. No open flames nor electric or gas cutting or welding equipment shall be permitted within the buildings housing the powder producing or handling machinery during operation. If it becomes absolutely necessary to use such equipment for making repairs all machinery in the room or section of the building where the repairs are to be made shall be shut down and the entire room or section with its machinery shall be thoroughly cleaned to remove all accumulations of aluminum powder. Operators of cutting or welding torches should be required to obtain a permit from the safety or fire protection officer of the plant before using their equipment under any condition around aluminum powder plants. Attention is called to the hazardous conditions that may exist either inside or outside of the plant if cutting torches are used in dismantling dust collectors or powder producing machinery before all dust accumulations have been removed.

76. ALUMINUM, COPPER OR BRONZE METAL TOOLS, INCLUDING SHOVELS, and not iron or other spark-producing tools, should be used in any dust-making building except when that part of the plant is stopped, and then only after thorough removal of dust accumulation. This rule should also be followed in dismantling either inside or outside of the plant any discarded powder-producing equipment that may contain dust accumulations.

77. HEATING AND DRYING SHOULD BE DONE ONLY BY HOT AIR, the air to be heated by steam or hot water coils in a small off-set to the building. In buildings which may have aluminum dust in them, the heating and drying air should be forced by blower fans into each respective building through a heating unit. In the case of dusty buildings, the fans should draw in their air supply from the outside in order that no explosive dust accumulates in the heating chamber.

78. POWDER OR DUST SWEEPINGS and other materials swept from the floor, machines, or other locations must be carefully screened to remove foreign matter before being placed in any machine for additional fabrication.

79. STARTING MACHINERY AFTER SHUTDOWN: All machines should be thoroughly cleaned and be absolutely dry before they are charged with metal and placed in operation.

Section 8. Aluminum Bronze Powder Storage.

81. The aluminum powder product, the conveyance of which is referred to in Section 3, paragraph 32, and the collection of which is to be in a separate building from the dust-making building, should be packed into steel drums as soon as possible, and these drums tightly sealed and stored in a dry location until they are ready to be shipped from the plant or repacked. Open bin storage is dangerous.

Section 9. Fire Fighting Methods for Prevention of Aluminum Powder Explosions.

91. THE USE OF FINE DRY SAND, preferably that screened through a 20-mesh sieve, is at present the best known method of fighting incipient fires of aluminum powder. Water streams or liquid sprays of various kinds that vaporize quickly are highly dangerous, as shown in many instances, since the dust is thrown into the air and the ignited particles instantly cause a violent explosion of the dust. For the same reason, any mechanical agitation or distrubance of the burning powder or that adjacent thereto must be avoided. An ample supply of dry fine-screened sand or other approved powder should be kept in covered bins or covered receptacles each containing about a cubic yard. These receptacles should be placed at a sufficient number of suitable points at or in each building, convenient to reach quickly. The receptacles should be covered and arranged so that the sand can be quickly scooped up by bucket or shovel. These implements shall be made of aluminum or other non-ferrous material.

92. IN FIGHTING AN ALUMINUM POWDER FIRE AVOID STIRRING IT: All electric power should be first shut off; then if the aluminum powder is burning quietly in a place where it can be safely isolated, the sand should be carefully ringed around but not dropped on the burning powder, great care being taken to avoid fanning the dust into the air. The powder, when burning quietly forms a crust which excludes oxygen and gradually extinguishes it-