CERTIFICATE

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By the Authority Vested By Part 5 of the United States Code § 552(a) and Part 1 of the Code of Regulations § 51 the attached document has been duly INCORPORATED BY REFERENCE and shall be considered legally binding upon all citizens and residents of the United States of America. *HEED THIS NOTICE*: Criminal penalties may apply for noncompliance.

Document Name: ANSI B20.1-1957: Safety Code for Conveyors, Cableways, and Related Equipment.

CFR Section(s): 29 CFR 1926.555

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THE EXECUTIVE DIRECTOR
OFFICE OF THE FEDERAL REGISTER
WASHINGTON, D.C.

AMERICAN STANDARD

Superseded by B20.1-1972

Safety Code for

CONVEYORS

CABLEWAYS AND RELATED EQUIPMENT

B20.1-1957 UDC 621.876-783

Sponsors

Accident Prevention Department of the Association of Casualty and Surety Companies

The American Society of Mechanical Engineers

Published by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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AMERICAN NATIONAL STANDARD

This standard is one of more than 4000 approved as either a USA Standard or as an American Standard. It became an American National Standard in October 1969 when the Institute changed its name to American National Standards Institute, Inc.

Foreword

SUBSEQUENT to the publication of the 1947 edition of American Standard Safety Code for Conveyors, Cableways, and Related Equipment (ASA B20.1-1947) Sectional Committee B20 which was developed under the procedure of the American Standards Association, was reorganized in February, 1950. It then became known as Sectional Committee (B20) on Safety Code for Conveyors and Related Equipment. At that time sponsorship for the program was offered to and accepted by the Accident Prevention Department of the Association of Casualty and Surety Companies and The American Society of Mechanical Engineers.

Subcommittee No. 1 on Scope and Intent revised the scope of the newly organized project to apply to design, construction, installing, maintenance, inspection, and operation of conveyors and conveying systems in relation to accident hazards. Conveyors covered by the code include such items as power conveyors, gravity conveyors, pneumatic tube cableways, skip hoists, vertical reciprocating conveyors and power unloading scoops, except industrial power trucks, tiering machines, cranes, derricks, joints, power and hand shovels, bucket drag lines, moving stairways, dumbwaiters, manlifts, and platform elevators designed to carry passengers or the elevator operator.

Subcommittee No. 2 on Nomenclature and Definitions, Subcommittee No. 2 on Portable Conveyors, and Subcommittee No. 4 on Conveyors in General have been active in the preparation of a revision of the code, and a draft dated April, 1955, was distributed to industry for criticism and comment. It was later approved by sectional committee letter ballot vote, by the sponsors, and by the American Standards Association which designated it as an American Standard on December 4, 1957

Sectional Committee on Safety Code for Conveyors, Cableways, and Related Equipment, B20

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American Standard

Safety Code for Conveyors, Cableways, and Related Equipment

INTRODUCTION

General

The use of conveyors in industrial and commercial businesses has reduced the accident hazards resulting from the manual handling of materials. A more general agreement among both manufacturers and users of conveying equipment as to safe practice in the design, installation and operation of such equipment would undoubtedly lead to further elimination of such accident hazards.

This code is designed as a basis for safety codes and as a guide for state authorities in the formulation of state safety rules and regulations. It is also intended for voluntary use by concerns manufacturing or utilizing conveyor machinery and equipment. This code may be adopted by any such concern as a standard to be followed by its superintendents, foremen, designers, mechanics, and operators.

The design and installation of all conveyor systems should be in the hands of competent engineers, and their operation and maintenance should be in charge of reliable and experienced persons. Some installations may require individual treatment to meet unusual conditions, and such treatment is recommended in all cases where a higher safety factor than that specified in this code is necessary. This code is intended to cover all installations of the related material handling and passenger conveyors, either where the installation is of a permanent nature or is only temporary, or where installations for permanent use are arranged for portable operation.

Section 1 Scope

This code is intended as a guide for the safe construction, elements of design, installation, operation and maintenance of conveyors and conveying machinery, such as power conveyors, gravity conveyors, pneumatic tubes, cableways, etc., but not including underground mine conveyors, self-propelled, steerable industrial trucks and tiering machines.

This code shall apply (with the exceptions noted above) to all conveyor installations excepting those installations where it can be shown that adherence to the provisions of the code would nullify the usefulness of the conveyor.

Section 2 Reference to Other Codes

The following codes and standards should be referred to when designing, installing, and operating conveyors or conveying machinery.

Safety Code for Mechanical Power Transmission Apparatus (ASA B15.1–1953)

National Electrical Code (ASA C1–1953)

National Electrical Safety Code (ASA C2)

Safety Code for Elevators, Dumbwaiters, and Escalators (ASA A17.1–1955)

Safety Code for Cranes, Derricks, and Hoists (ASA B30.2–1943; reaffirmed 1952)

Specifications for Steel for Bridges and Buildings (ASA G24.1–1947) (ASTM A7–1946)

Safety Color Code for Marking Physical Hazards and the Identification of Certain Equipment (ASA Z53.1–1953)

Safety Code for Floor and Wall Openings, Railings, and Toe Boards (ASA A12–1932)

Safety Code for Portable Wood Ladders (ASA A14.1–1952)

Safety Codes for the Prevention of Dust Explosions (ASA Z12)

ASME Boiler and Pressure Vessel Code

Building Exits Code (ASA A9.1–1953)

This code shall be considered as supplementary to any law or code covering fire or health regulations in force at present.

Section 3 Intent

The purpose of this code is to provide conveying equipment with practical and adequate safety features and factors of safety and to provide for its safe operation and maintenance. In case of practical difficulty or unnecessary hardship the enforcing authority may grant exceptions from the literal requirements or permit the use of other devices or methods, but only when it is clearly evident that reasonable safety is thereby secured.

It is suggested that in cases where additional explanations are desired that such matters be referred to the Sectional Committee on Safety Code for Conveyors, Cableways and Related Equipment, B20, in care of The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y. Such consultation will tend to bring about uniform application of the code and will keep the committee informed of criticisms which will be considered when the code is revised.

Section 4 Mandatory and Advisory Rules

To carry out the provisions of this code the word "shall" is to be understood as mandatory and the word "should" as advisory. The word "approved" means approved by the authority having jurisdiction.

Section 5 Definitions

501 General Definition

Conveyor. A horizontal, inclined, or vertical device for moving or transporting bulk materials, packages, objects, or passengers in a path predetermined by the design of the device, and having points of loading or discharge fixed or selective; included are skip hoists, and vertical reciprocating conveyors; typical exceptions are those devices known as industrial trucks, tractors and trailers, tiering machines, cranes, hoists, monorails, power and hand shovels, power scoops, bucket drag lines, platform elevators designed to carry passengers or the elevator operator, moving stairways, and highway, or rail vehicles.

502 Definitions of Conveyors to which Specific Safety Provisions Apply

The following definitions are in accord with those in use by the conveyor industry and as recommended in the dictionary of terms, Conveyor Terms and Definitions, (Prepared by the Tech-

nical Committee of the Conveyor Equipment Manufacturers Association). Only commonly known and distinct types of conveyors are listed. Where variations or adaptations are concerned the rules governing related conveyors as listed shall apply.

Belt Conveyor. An endless fabric, rubber, plastic, leather, or metal belt which carries bulk materials, packages, or objects, placed directly upon it; and pulleys for changing the direction of belt travel, driving and adjusting; and rollers, troughing idlers, or wooden or metal bed supporting the belt and its load.

Bucket Conveyor. Any type of conveyor in which the material is carried in a series of buckets. See *Bucket Elevator, Gravity-Discharge Conveyor,* and *Pivoted Bucket Conveyor* under Section 503.

Cableway. A cable supported system in which the material handling carriers are not detached from the operating span and the travel is wholly within the span.

Cableway, Slack Line or Drag Line Excavator. A cable supported system in which the supporting cable is adjusted in length to provide the lifting functions of the unit.

Chain Conveyor. Any type of conveyor in which one or more chains act as the conveying element. For specific applications see, *Drag, Rolling, and Sliding Chain Conveyors* under Section 503.

Drag Line Excavator. See *Cableway, Slack Line.*

Live-Roller Conveyor. A series of rollers over which packages or objects are moved by the application of suitable power means to all or a part of the rollers.

Pneumatic Conveyor. A system of tubes or ducts through which objects or bulk materials are conveyed in a pressure and/or vacuum system.

Portable Conveyor. Any type of transportable conveyor usually mounted on mobile supports.

Power Conveyor. Any type of conveyor to which electrical, mechanical, hydraulic or pneumatic energy is applied.

Reciprocating Conveyor, Vertical. A power or gravity (counterbalanced) actuated carrier which receives packages or objects and discharges them to another or other elevations.

Roller Conveyor. A series of rollers supported in a frame over which packages or objects are moved manually, by gravity, or by power.

Screw Conveyor. A revolving pipe or shaft on which is mounted helically shaped flighting which serves to convey bulk materials along a trough or a defined path.

Slat Conveyor. One or more endless chains to which non-overlapping, non-interlocking, spaced slats are attached to form a moving support for the packages or objects being conveyed. Slat conveyors having been called apron conveyors.

Suspended Tray Conveyor. One or more endless chains with suitable pendant trays or carriers which receive and deliver packages or objects at one or more locations.

Tramway. A cable supported system in which the travel of the materials handling carriers is continuous over the supports of one or more spans.

Vertical Conveyor. Generally speaking, any conveyor which transports bulk materials, packages or objects in a vertical or substantially vertical direction. For the purposes of this code, the term applies specifically to conveyors for handling packages or objects. See *Suspended Tray Conveyor* and *Vertical Chain Conveyor (Opposed Shelf Type).*

Vertical Chain Conveyor (Opposed Shelf Type). Two or more vertical elevating-conveying units opposed to each other. Each unit consists of one or more endless chains whose adjacent facing runs operated in parallel paths so that pairs of opposing shelves or brackets receive packages or objects and deliver them at any number of elevations.

Wheel Conveyor. A series of wheels supported in a frame over which packages or objects are moved manually, by force of gravity or by power.

503 Definitions of Conveyor to Which General Safety Provisions Apply, but Which are not Mentioned Specifically.

This section is not intended to list all types of conveyors or variations thereof. For a more complete nomenclature and terminology see *Conveyor Terms and Definitions,* (a publication of the Conveyor Equipment Manufacturers Association listed as an American Standard MH4–1958.)

Apron Conveyor. One or more endless chains or other linkage to which overlapping or interlocking plates or shapes are

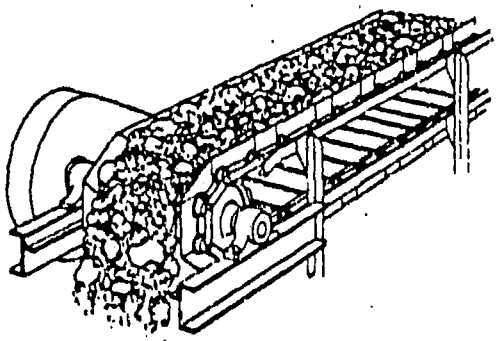

FIG. 1. APRON CONVEYOR

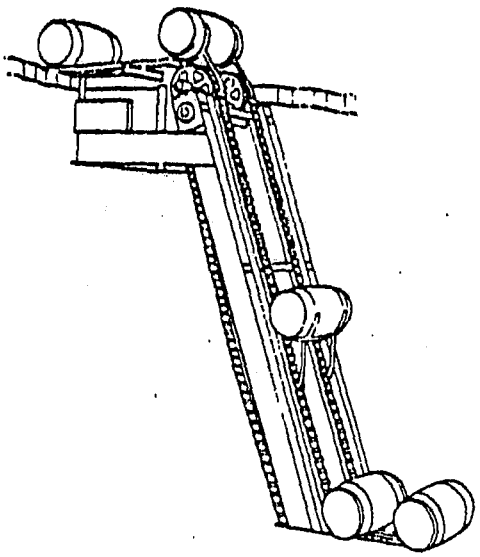

FIG. 2 ARM CONVEYOR

attached to form a continuous moving bed for bulk materials, packages or objects.

Arm Conveyor. An endless belt, one or more chains, or other linkage to which are attached projecting arms, or shelves for handling packages or objects in a vertical, inclined or horizontal path.

Assembly Conveyor. Any of several types of conveyors adapted to convey assemblies, or parts through a series of progressive assembly operations. See *Apron Conveyor, Slat Conveyor, Rolling and Sliding Chain Conveyors, Belt Conveyor,* and *Trolley Conveyor,* etc.

Barrel Elevator. See *Arm Conveyor.*

Booster Conveyor. One of several types of powered conveyors used to regain elevation lost in gravity actuated conveyor lines.

Bucket Elevator. A conveyor consisting of an endless belt, chain or chains, or other linkage, to which buckets are attached for carrying materials, and which operates in vertical or inclined paths.

Carrousel Conveyor. A continuous platform or series of spaced platforms which move in a circular path. Note: The term carrousel has been applied to other forms of conveyors such as car-type and pallet-type.

Car-Type Conveyors. A series of cars attached to and propelled by an endless chain or other linkage which operates in a defined path.

Closed Belt Conveyor. A moving, endless, flexible, tubular-shaped belt which may be opened or closed to load or discharge while the belt is in motion.

Cross-Bar Conveyor. Single or double strands of endless chain supporting spaced, removable or attached "sticks", or cross-members from which materials are hung or festooned while being processed.

Double Helical Bag Conveyor. Closely spaced parallel tubes with right and left-hand rounded helical threads rotating in opposite direction on which bags of other objects are carried while being conveyed.

Drag Chain Conveyor. One or more endless chains which drag bulk materials in a trough or along a defined path.

En Masse Conveyor. A series of skeleton or solid flights on an endless chain or other linkage which operates in hori-

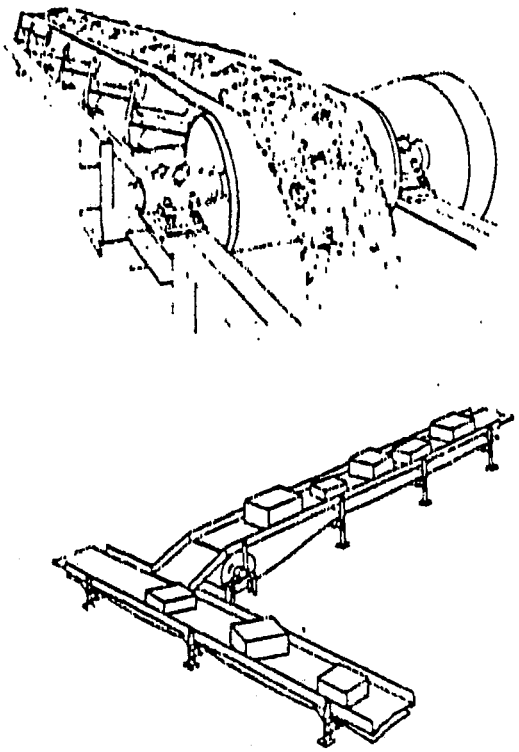

FIG. 3 BELT CONVEYOR

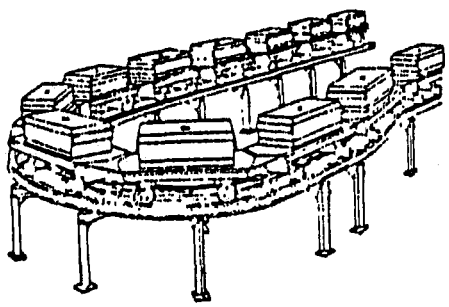

FIG. 4 CAR-TYPE CONVEYOR

zontal, inclined, or vertical paths within a closely fitted casing for the carrying run. The bulk material is conveyed and elevated "en masse" in a substantially continuous stream with a full cross-section of the casing.

Farm Elevator. A term applied to any of several types of inclined, portable or fixed conveyors adapted for use on farms to store and move grains, corn ensilage and other materials. See *Drag Chain Conveyor, Flight Conveyor, Screw Conveyor, Belt Conveyor,* etc.

Feeder. A conveying device by which the rate of delivery of bulk material, packages or objects may be controlled.

Festoon Conveyor. See *Cross-Bar Conveyor.*

Flight Conveyor. One or more endless propelling mediums such as chains, or other linkage, to which flights are attached to move bulk materials along a defined path.

Floor Conveyor. Any of several types of conveyors using chain, cable or other linkage mounted near or flush with the floor. See *Chain Conveyor, Car Conveyor, Pallet Conveyor,* and *Slat Conveyor.*

Flume Conveyor. See *Hydraulic Conveyor.*

Gravity Conveyor. See *Roller, Skate-Wheel* or *Wheel Conveyor.*

Gravity-Discharge Conveyor. Buckets attached between two endless chains which may operate in horizontal, inclined, and vertical paths. Bulk material is elevated in the buckets and moved horizontally by their acting as flights.

Hopper Car Unloader. A form of portable drag chain, belt or flight conveyor which can be placed either beneath or over the rails for the purpose of unloading bulk materials from hopper bottom cars.

Hydraulic Conveyor. A system of flumes, pipes, or troughs through which bulk material is conveyed by means of water or water jets.

Ingot Casting Conveyor. A type of pan conveyor on which the pans serve as molds for casting ingots or pigs.

Loader, Bucket. Form of portable, self-feeding, inclined bucket elevator for loading bulk materials into cars, trucks or other conveyances.

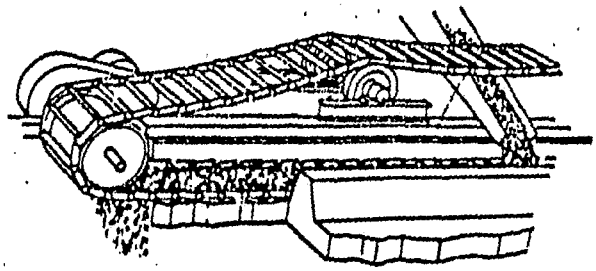

FIG. 5 DRAG CHAIN CONVEYOR

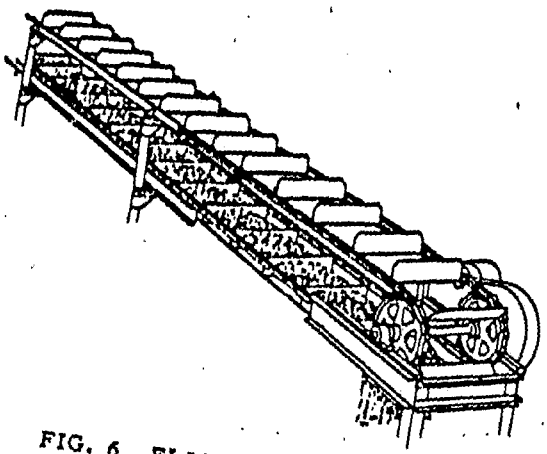

FIG. 6 FLIGHT CONVEYOR

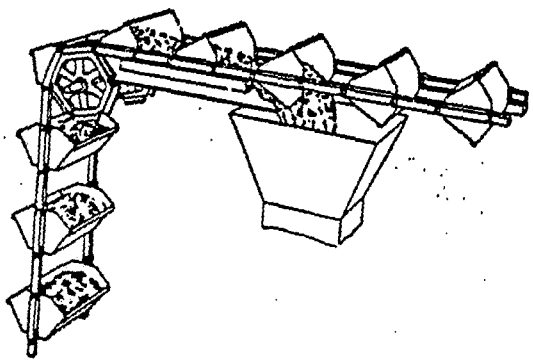

FIG. 7 GRAVITY-DISCHARGE CONVEYOR

Marine Leg. A self-feeding, self-discharging elevating conveyor with means for lowering it into and removing it from the holds of vessels.

Oscillating Conveyor. A type of vibrating conveyor having a relatively lower frequency and greater amplitude of motion. See *Vibrating Conveyor.*

Over-and-Under Conveyor. Two endless chains or other linkage between which carriers are mounted and controlled in such a manner as to remain in the original carrying position at all times.

Pallet Loader. An automatic device to receive packages, cartons, etc., from a conveyor line which loads them on pallets according to a prearranged pattern.

Pallet Type Conveyor. A series of flat or shaped wheel-less carriers propelled by and attached to one or more endless chains or other linkage.

Pan Conveyor. One or more endless chains or other linkage to which usually over-lapping or interlocking pans are attached to form a series of shallow, open topped containers. Some pan conveyors have also been known as apron conveyors.

Pivoted Bucket Conveyor. A series of buckets pivotally mounted between two endless chains which operate in horizontal, vertical, and inclined paths. The buckets remain in carrying position until they are tipped or inverted to discharge.

Pocket Conveyor. A continuous series of pockets formed of a flexible material festooned between cross-rods carried by two endless chains or other linkage which operate in horizontal, vertical, and inclined paths.

Pusher Bar Conveyor. Two endless chains or other linkage cross-connected at intervals by bars or rotatable pushers which move packages, or objects along stationary wood, metal or roller beds, or troughs.

Pusher Chain Conveyor. One or more endless chains or other linkage with attachments which move or retard the movement of packages, objects, trucks, dollies, or cars along stationary wood, metal or roller beds, troughs, rails or tracks.

Reciprocating Beam Conveyor. One or more parallel reciprocating beams with tilting dogs arranged to advance packages or objects along a defined path.

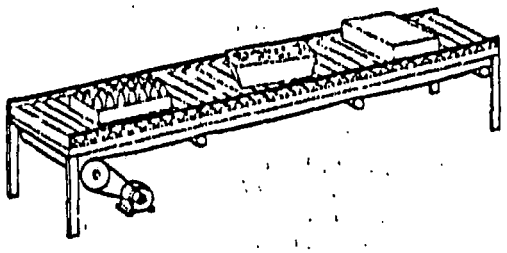

FIG. 8 LIVE-ROLLER CONVEYOR

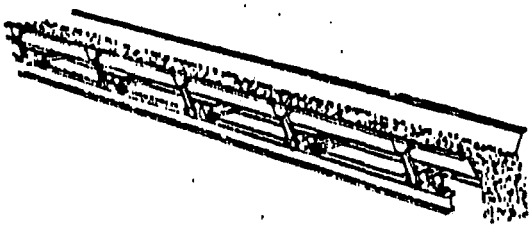

FIG. 9 OSCILLATING CONVEYOR

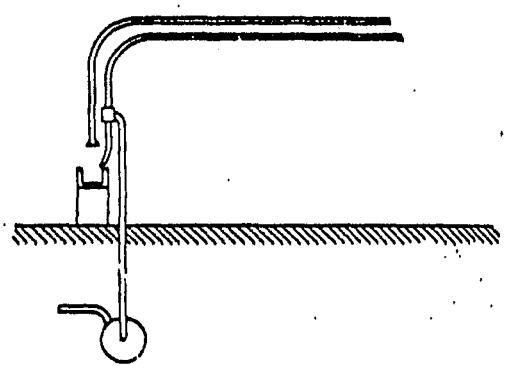

FIG. 10 PNEUMATIC CONVEYOR

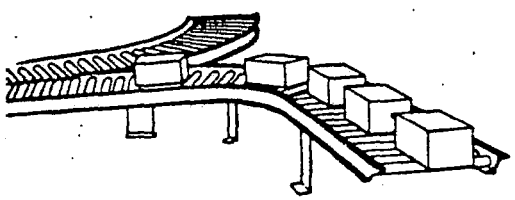

FIG. 11 ROLLER CONVEYOR

Reciprocating Flight Conveyor. A reciprocating beam or beams with hinged flights arranged to advance bulk material along a defined path.

Roller Spiral. Curved sections of roller conveyor which wind helically and over which packages and objects are lowered by gravity.

Rolling Chain Conveyor. One or more endless roller chains on which packages or objects are carried.

Rope and Button Conveyor. A series of buttons or flights attached to an endless wire rope or cable for the purpose of conveying or retarding the movement of bulk materials or objects along a stationary trough.

Ship's Conveyor — Elevator. A dock-mounted pocket or suspended tray conveyor arranged to be lowered into a ship's hold to varying depths for the purpose of loading or unloading packages and objects. Not to be confused with a Marine Leg.

Shuttle Conveyor. Any conveyor such as belt, chain, pan, apron, screw, etc., in a self-contained structure movable in a defined path parallel to the flow of the material.

Skate Wheel Conveyor. A type of gravity wheel conveyor which employs wheels similar to those used on roller skates. See *Wheel Conveyor.*

Skip Hoist. A bucket or car operating up and down a defined path, receiving, elevating, and discharging bulk materials.

Slat Conveyor, Roller Type. Two or more endless chains or other linkage to which rollers are attached to form a moving support for the packages or objects being conveyed.

Sliding Chain Conveyor. One or more endless chains (sliding on tracks) on which packages or objects are carried.

Spiral Chute. A continuous curved trough over which bulk materials, packages, or objects are lowered in a substantially helical path.

Tow Conveyor. An endless chain supported by trolleys from an overhead track, or running in a track at (above, flush with, or under) the floor with means for towing trucks, dollies, or cars.

Trimmer Conveyor. A self-contained portable conveyor usually of the belt type for use in unloading, delivering, and trimming bulk material in bins or piles.

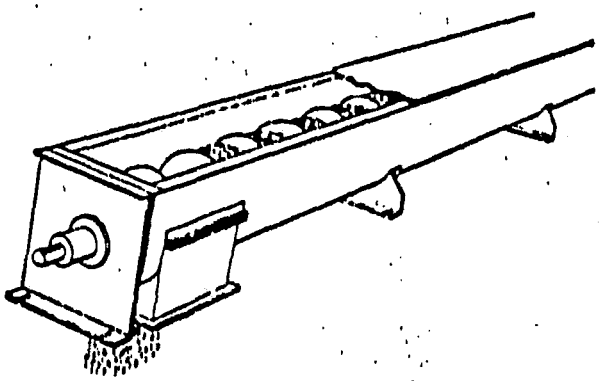

FIG. 12 SCREW CONVEYOR

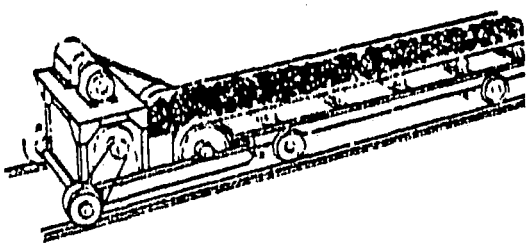

FIG. 13 SHUTTLE CONVEYOR

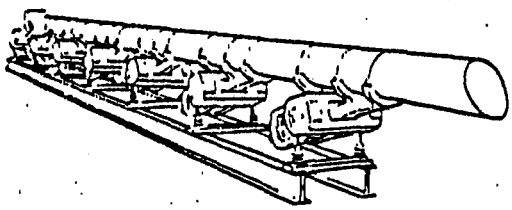

FIG. 14 VIBRATING CONVEYOR

Trolley Conveyor. A series of trolleys supported from or within an overhead track and connected by an endless propelling medium such as chain, cable, or other linkage, with loads usually suspended from the trolley. Trolley conveyors may be designed for single or multiple plane operation.

Vibrating Conveyor. A trough or tube flexibly supported and vibrated to convey bulk material or objects. Vibration may be induced electrically or mechanically.

Wheel, Spiral. Curved sections of wheel conveyor which wind helically and over which packages or objects are lowered by gravity.

PART I GENERAL SAFETY REGULATIONS

Section 6 Design Features

The following general safety regulations apply to every type or form of conveyor. They apply to horizontal, inclined, declined or vertical conveyors; they apply to conveyors supported from floors, hung from ceilings or structures, supported in bridges or trusses; and they apply to conveyors operated manually, by gravity or by power. Any regulations that apply only to a specific type of conveyor will be given in Part II – Specific Safety Regulations.

Safety guards shall be provided on all types of equipment at driving mechanisms, terminals and take-ups where the unguarded parts may constitute a hazard to the operating personnel.

Rated capacity shall mean the capacity as established by the designer of the equipment.

601 Belts, Chains, Cables

In no case shall the maximum loading exceed the working load as recommended by the manufacturer.

602 Pulleys, Sprockets, Sheaves, Drums, Blocks

All of these, when located in a working area where operators (other than maintenance men) are present, shall be arranged to prevent the possibility of injury due to hands or parts of clothing being caught between the belt and pulley, or chain and sprocket, or cable and sheave, drum or block. When these units are located in areas where authorized personnel only have access, then such arrangements of frames or guards will not be required *if* provisions are made to stop and lock out the power before work is performed on the conveyor. If cable tension varies considerably, or is subject to whipping action, all sheaves should be provided with suitable cable guards to prevent cable from jumping the sheave.

603 Bearings (Lubrication)

Where bearings are inaccessible or in hazardous locations, the fittings should be located at an accessible point and the lubricant piped to the bearings if lubrication is required while equipment is in operation.

604 Adjustments

The means provided for changing the position of pulleys, sprockets, or sheaves, to compensate for normal working stretch and wear in endless belts, chains, or cables, shall be readily accessible, and guards shall be provided to protect maintenance personnel from contact with the moving parts if adjustment is required when equipment is in operation.

605 Backstops and Brakes

a On all conveyors where reversing, or running away presents a hazard, "anti-runaway" or "backstop" devices should be provided; or the track of the conveyor designed to prevent any portion of the conveyor and load from falling or sliding down in the event of mechanical or electrical failure. When such design is not practical, suitable guards (designed to withstand the shock and confine the falling load) shall be placed to prevent access to the danger area.

b Electric machines equipped with brakes which are mechanically released and applied by the movement of operating devices shall be so designed that if the power is interrupted with the brakes in the off position, the load could descend only at a controlled speed. Electrically released brakes shall not be released until the power has been applied to the motor and shall be applied automatically if the power fails or the operating device is returned to the off or stopped position.

606 Overload Protection

In addition to overload protection customarily provided to protect electric motors, there should be an overload device to protect the conveyor and mechanical drive parts. Such devices must be designed to quickly shut off the electric power or disconnect the conveyor or drive parts from the motive power in the event of overload. Where overload conditions would create a hazard to personnel, overload protection shall be provided. Such overload devices can be of any type arranged to shut off electric power; can be shear pins; can be slip or fluid couplings; or any other type designed for the purpose of quickly disconnecting the motive power or limiting the applied torque. If a shear pin device is used, a description of the proper size and material of the shear pin should be placed at such a point on the conveyor that the operators can readily see it when replacement is being made. Where the failure of the overload device would permit overspeeding in either direction, with consequent

hazard to personnel, a centrifugal control device shall be used in addition.

607 Hinged Sections

a Manually operated hinged sections of gravity roller conveyors, chutes, belt, or other types of conveyors that require more than a minimum effort to operate should be counterbalanced.

b Power operated sections should be provided with mechanical safety devices which will prevent them from falling in case of power failure. Protection against the failure of mechanical parts of the hoisting and lowering device should be provided when practical.

c All hinged sections of power conveyors used for the purpose of clearing a passageway shall be designed so that they cannot be raised while the conveyor is in operation and shall automatically stop the conveyor when the section is raised.

608 Counterweights

When counterweights are attached to cables or chains, the weights shall be confined in a suitable enclosure having a stop designed to withstand the impact of the falling weight. If counterweights are attached to lever arms, the design shall insure that the weights cannot become detached if the device used for the adjusting of the weight becomes loose.

609 Guards

a Where a conveyor passes over working areas, aisles, or thoroughfares used by other than authorized personnel, suitable guards shall be provided to protect those areas from the hazards of dislodged materials.

b Where conveyors are installed overhead and dip down at work stations, suitable guards or handrails shall be provided to prevent accidental injury to personnel.

c All guards should be painted in colors as specified in American Standard Building Code Requirements for Light and Ventilation (ASA Z53.1–1953).

610 Interlocking Devices

On all conveyor systems where practical, electrical and/or mechanical devices should be provided to automatically stop a conveyor when the conveyor, bin, hopper, chute, etc., to which it feeds, has been stopped or has been blocked with loads so that it cannot receive additional loads or material.

611 Transfer, Loading and Discharge Points

At conveyor transfer, loading or discharge points, means shall be provided to guard against accidental injury to personnel.

612 Portable Conveyors

Where practical, portable conveyors are subject to the safety design features applied to other conveyors, but they are subject, in addition, to specific requirements as follows:

a The conveyor shall be stable within operating ranges and shall be fitted with an adequate locking device to hold the conveying unit at variable fixed elevations.

b All portable conveyors powered with electric motors shall be provided with grounded circuits.

c Where portable conveyors are exposed to outside weather conditions, weatherproof electrical equipment or its equivalent shall be provided in compliance with any applicable electrical code and pipe, conduit, BXL or similar type of protected wiring shall be used.

Section 7 Design and Installation

701 Accessibility and Clearance

a Clearances for authorized personnel shall be provided where existing conditions permit.

b Obstructions which needlessly prevent an operator from seeing oncoming loads or any parts of the conveyor mechanism over which he has control, should be removed.

702 Catwalks, Platforms, and Balconies

Catwalks, platforms, balconies, and access ladders should be provided and should be installed in accordance with American Standard Safety Code for Floor and Wall Openings, Railings, and Toe Boards (ASA A12–1932).

703 Wall and Floor Openings

Wall and floor openings should be guarded in accordance with American Standard A12–1932.

704 Inspection Doors and Openings

Inspection doors or illuminated peep holes should be provided so that maintenance men may make observations without the necessity of entering enclosures or housings. Openings

with removable doors, or panels should be provided so that maintenance personnel may clean out housings and enclosures or make minor repairs without entering housings or enclosures.

705 Crossovers, Aisles, Passages, and Stairways

a All conveyors installed within seven (7) ft of the floor or walkway surface shall be provided with crossovers or passages to comply with the requirements of the Building Exits Code A9.

b It will be permissible to allow passage under conveyors that are installed below the minimum seven (7) ft headroom, excepting at main aisles and provided such passages are equipped with telltales indicating low headroom.

c All crossovers, aisles and passages shall be indicated by suitable signs in conspicuous positions.

d No reciprocating platform conveyors shall be installed in such a manner as to block any stairway.

Section 8 Inspection and Maintenance

801 Inspection

Periodic inspection of the entire conveyor mechanism should be made.

802 Adjustment

All take-up devices provided for the purpose of adjusting for stretch in the belt, chain, or cable should be checked periodically for proper functioning.

803 Cotter Pins, Fasteners, Couplings, etc.

All cotter pins, fasteners and couplings should be checked periodically as carefully as should any type of splice or connection.

804 Worn Parts

a A supply of parts subject to wear should be kept on hand for ready replacement.

b Any part showing signs of wear shall be watched carefully and replaced as soon as there is any indication of excessive wear. A record should be made of the points of wear and reported to the supervisor to assure future inspections of the wearing parts.

805 Lubrication

All machine parts shall be properly lubricated according to manufacturers instructions.

806 Safety Devices

Particular attention should be paid to brakes, backstops, anti-runaway devices, overload releases and other safety devices to insure that all are operative and in good repair.

Section 9 Related Structures

901 Tunnels, Pits, and Foundations

a Tunnels and pits should be designed for proper drainage and, if necessary, with sump holes and pumps furnished. Pits and tunnels should also provide ample space for the accumulation of spilled material and means for readily removing such accumulation.

b Adequate, permanent lighting should be installed in tunnels and pits with a switch located outside of and convenient to the entrance. Electrical outlets for extension cords should be provided at convenient locations. If there is a likelihood of an accumulation of explosive fumes or dust, all electrical work shall meet the requirements of the underwriters for hazardous locations.

902 Hoppers and Chutes

All openings to hoppers and chutes shall be protected to prevent persons from stepping into them. If the hopper or chute is equipped with a grating to protect conveyors, such grating will be considered as sufficient protection provided that one dimension of the opening does not exceed 2 inches. If the openings in the grating are larger or if no grating is provided, suitable hand rails are to be installed around the openings. All openings to hoppers and chutes shall be protected where they present a hazard to personnel. Such protection shall consist of:

a Hand rails of standard height with toe boards;
or

b Temporary covers, where the opening is subject to frequent use; or

c Other equivalent comparable safety devices where the special conditions of the hopper preclude the standard safe guards listed above.

The sides of open chutes shall be high enough to prevent material falling into working areas below. Open chutes should be provided with front plates at the point where conveyors discharge into them to prevent material bouncing out of the chute.

Section 10 Safe Operating Provisions

The following operating rules are recommended for all conveyor installations:

a All manually loaded conveyors traveling partly or entirely in a vertical path should have a conspicuous sign designating the rated load that the conveyor is designed to raise or lower. These signs should be located at each loading point in a prominent place.

b All starting and stopping devices should be clearly marked and, if possible, painted in accordance with American Standard A53.1–1953. The area around these devices should be kept free of obstructions to permit ready access to them and a clear view of them at all times.

c The area around all loading and unloading points on the conveyors should be kept clear of obstructions at all times so that the operator working at these points has an unobstructed view of the conveyor.

d No "riding" shall be permitted on a conveyor at any time, unless it is specifically designed to convey passengers or the operator.

e Maintenance work should not be done while conveyor is in operation. If it is necessary to operate the conveyor while servicing it, special safety provisions shall be used.

f When a maintenance man stops the conveyor for servicing purposes, he shall lock out the starting device so that no one but the man working on the conveyor can restart it.

g Before restarting a conveyor that has stopped due to an overload, an inspection of the entire conveyor shall be made and the stoppage cleared before restarting.

h The starting device shall be locked out before any attempt is made to remove the cause of an overload.

i No overload or safety device shall be removed from the conveyor. Provisions should be made to prevent anyone, excepting a competent authorized person, from adjusting or tampering with the adjustment of such devices.

j All personnel working on or near a conveyor shall be instructed in the location and operation of all stopping devices.

k At no time should a conveyor be used for a purpose other than the one for which it was designed.

l Good housekeeping shall be maintained at all times.

Section 11 Prime Movers and Controls

a Motors, controls, and wiring shall conform to the National Electric Code (ASA C1–1953), or the National Electrical Safety Code (ASA C2).

b Convenient means for stopping the motor or engine shall be provided at the operator's station. If the operator's station is at a remote point, similar provisions for stopping the motor or engine shall be provided at the motor or engine location. Emergency stop switches should be provided at all points along the conveyor, where potential hazards exist, and the conveyor shall be arranged so that it cannot be started again until the actuating stop switch has been reset to running or "on" position. Overload stop switches shall *not* be arranged to automatically start the conveyor upon removal of the overload. Means shall be provided for locking the main switch or clutch to prevent accidental starting.

c Steam boilers shall conform to the ASME Boiler and Pressure Vessel Code.

d All conveyors designed to convey inflammables or explosives, or located in hazardous areas shall conform with any regulations governing such installations. Any rules set forth in this code shall not be construed as supplanting any regulation for hazardous locations. All conveyor installations in areas where there is danger of dust explosions shall be installed in accordance with this code and the applicable standard safety codes for the Prevention of Dust Explosions (ASA Z12).

PART II SPECIFIC SAFETY REGULATIONS, APPLYING TO CERTAIN CLASSES OF CONVEYING EQUIPMENT

Section 12 Aerial Cableway

1201 Cableway Carriage and Fall Rope Carriers

a Cableway carriage and fall rope carriers shall be so constructed that no adjustments are required while cableway is in operation, and that adjustments, when made, may be locked. Fall rope carriers are used to prevent the weight of the hauling rope itself causing sufficient tension to overhaul the load carrier or fall block. Even short spans may require fall rope carriers depending on the relation of the weight of fall block and its ropes, friction in the system, and the tension of the hauling rope between the carriage and the hoist tower. On spans of 600 ft or more, where the carriage works to the center of the span or beyond, slack carriers shall be provided to support the operating ropes. A button line or equivalent device shall be provided to space the carriers at appropriate intervals along the span.

b Carriages shall have approved mesh guards for the operating sheaves, hand grips throughout the full length of the carriage, footwalk and toe boards, for ready access for maintenance riggers and for inspection of the operating ropes, sheaves, beckets, and structural parts of the carriage.

c Sheaves carrying operating ropes should be as large as practical and as recommended by the rope manufacturer. In no case shall the pitch diameter of sheaves be less than 42 times rope diameter for 6 x 7 rope, 30 times rope diameter for 6 x 19 rope, 18 times rope diameter for 6 x 37 rope, and 21 times rope diameter for 8 x 19 rope. The sheaves shall have "V" grooves and the radius of the groove shall be 55 per cent of the rope diameter.

1202 Operating Ropes

Operating ropes shall be of wire rope construction suitable for the service requirements of the cableway. The working load of the rope shall never exceed one-fifth of the breaking strength.

Ropes shall be fastened with approved units capable of developing at least 80 per cent of the ultimate strength of the rope. Rope ends shall be arranged for complete and easy inspection.

1203 Track Cable System

If the design requires that track cables be carried over saddles, care must be taken to see that the saddle radius, rope lubrication and inspection provisions conform to rope manufacturer's recommendations. Track cable connections shall be properly applied sockets using only pure zinc. Clamped ends develop only about 75 per cent of the strength of the rope and therefore are not recommended. Supporting members carrying track cable tensions shall be forged steel, or rolled steel carrying stress in the direction of rolling. These members shall be arranged so that loads are carried concentrically and so that no eccentric load can be applied to them or to the track cable connections by virtue of failure or nonoperation of any joint bearing in the track system.

1204 Backstay

Backstay carrying track cable tensions shall be designed to support the entire load disregarding any load carrying help from side guys.

1205 Side Guys

Side guys shall be so proportioned that no more than two are regarded as acting at the same time, unless equipped with equalizing bar, sheave, or other approved device not subject to freezing temperatures. If hydraulic or pneumatic equalizing device is used, provisions must be made to avoid, or counteract the effect of, loss of fluid in the system.

1206 Anchorages

Anchorages for track cable tensions should be proportioned so that they are stable under the ultimate strength of the track cable or backstays. Steel rods, preferably embedded in concrete or block asphalt, should be used for the portion of the backstay where the anchorage tension is carried through earth. Wire rope guys should never be used in contact with earth but if absolutely necessary, then double the ultimate strength of the backstay should be provided, together with anticorrosion protection in the form of grease, tar, etc.

1207 Supporting Structures

Supporting structures, fixed towers, movable towers, etc.,

shall be designed to withstand full known loads plus allowance for impact with due regard for the nature of the structural elements, the type of structure, and the manner of application and release of loads; all in accordance with the American Institute of Steel Construction's Specification for Design, Fabrication, and Erection of Structural Steel for Buildings. Ladders, platforms, handholds, etc., shall be supplied to facilitate the inspection of the towers, the cableway parts attached to them, and the changing of lines and other maintenance work around them.

1208 Operation and Maintenance

a The cableway supervisor and operator shall be charged with the responsibility for allowing only authorized and properly qualified parties around the cableway rig.

b Inspection of the complete rig, track cables or carriage, operating ropes, structures, hoisting engine, electrical apparatus, and other operating parts shall be made by the supervising safety engineer or other designated qualified person each day if the rig is operating twenty-four (24) hours a day or at such other intervals as justified by lesser operating schedules for the rig. These inspections (not adjustments) shall be made while rig is in operation except, at the discretion of the supervisor, certain inspections may be made while the rig is not in operation.

c During the safety inspection, special attention should be paid to:

(1) Operating ropes at the becket ends, overwraps on the drum or hoist, and at the sheave points if pick-ups are made at the same point repeatedly.

(2) Track cable for broken wires near sockets and in the span under the pick-up or unloading point, for broken wires, and worn or faulty track cable socket bearings.

(3) Slack carriers for loose or broken parts, and to see that the carrier rollers turn freely and are well oiled.

(4) Electrical system, especially for faulty connection where the current might possibly go to ground through the earth ropes, traveling towers, tracks, wheels, journals, and tower moving apparatus.

d Operating ropes shall be re-becketed on a regular program. Re-becketing after thirty (30) operating shifts is suggested or more than thirty (30) if the rig is little used each shift. At

least four rope lay lengths shall be cut off each time. Operating ropes shall be changed when any of the following conditions are found:

(1) Evidence of lack of proper internal lubrication.

(2) Cross section of the outer wires reduced 50 per cent.

(3) Six adjacent wires broken in any one strand.

(4) Ten per cent outer wires broken in all strands in a rope lay length.

(5) Square breaks in outer wires revealing square breaks in the inner wires also.

(6) Necking or tucking indicating a loss of the hemp or wire center.

If ropes are changed before the above conditions are reached, they may be turned end-for-end, if the worn places do not fall again at a point of wear.

e Track cables shall be re-socketed when eight (8) broken wires show within a rope lay length of the socket. Regular strand track cables shall be subject to the regulations given above for operating ropes. Locked coil or other armored construction shall be changed when four (4) wires adjacent are broken, so that the locked sheath is lost or, if the broken wires reveal square breaks in the inner wires, or evidence of lack of proper internal lubrication.

f Hoist brakes and frictions shall be maintained in good condition at all times. Hoisting engine shall be located so that the operating ropes have the proper fleet angle to the nearest sheave, which shall be oriented to lead to the center of the drum in the hoist. The hoist operator should be located so that he can see the hoist and also the working area of the cableway.

g Hook tenders serving the cableway will be permitted to "ride the hook", if the ground does not permit other access. Proper foot stands and hand holds shall be provided for two men on the hook or fall block; otherwise a manskip must be used. Signals for the operation of the rig may be given to a signalman or to the operator direct. Inexperienced hook tenders shall not ride the hook alone until they have had a period of thirty (30) working shifts with an experienced cableway hook tender.

h Loads carried by cableways shall be secured by safety hooks, or shackles, in such a manner that they cannot shift or

slip while suspended by the cableway. Load hooks shall be provided with safety shields to keep the load slings on the hook. Slings must be used in pairs so that the load will not untwist the lay of a single rope.

i If the cableway is not in use for a twenty-four (24) hour period or more, an inspection of the hoist should be made before the cableway is started. The hoist should be enclosed in a separate room or building. Approved receptacles for oil, grease, waste, etc., shall be provided outside the hoist room or building.

j For use in controlling cableway operation, appropriate telephone and/or other signal system should be provided.

k Suitable lighting should be provided at critical points for night operation and repairs.

Section 13 Slat Conveyors

Where the slats are arranged having a clear space between slats of more than one (1) inch and where the conveyor is installed at floor level or in working areas, the entire space under the top or carrying run of slats should have a solid smooth bed to prevent a shearing hazard between the moving slats and the sub-structure. This bed will not be required at such places where other provisions are made to prevent personnel from coming in contact with or crossing the conveyor.

Section 14 Belt Conveyors

Where a tripper or other moving deflector is used, requiring an operator to travel on the tripper, a suitable operator's platform shall be so constructed and located that the operator is protected from the hazard of slipping or falling. The tripper should be so designed that, when the operator is on the operating platform, engaged in the normal performance of required duties, contact between operator's limbs or clothing and moving parts is impossible.

Section 15 Pneumatic Conveyor Systems

1501 Doors and Gaskets

Pneumatic conveyor systems shall be arranged so that doors to pressure vessels cannot be opened while there is a positive internal pressure. Gaskets holding line pressures shall be so shielded that a gasket leak will not project the conveyed

material against workmen or into a working space, in a hazardous manner.

1502 Receiving Chambers

Receivers or storage bins shall be equipped with full bin indicators or controls to prevent overfilling.

1503 Oxidizable Materials

When used to convey bulk oxidizable materials, the conveyor shall be designed with particular regard for possible explosion hazard and shall conform in other applicable specifications to those given in the codes dealing with explosive materials, dust explosion proofing and fire hazards, etc. Pressure systems operated by constant volume, variable pressure (positive type) blowers shall be equipped with a relief valve, on or adjacent to the blower.

1504 Contaminated Areas

Any pneumatic conveyor serving an area containing contaminated air must be arranged so that none of the contaminated air enters the conveyor tube and is then carried to other areas.

Section 16 Bucket Conveyor

Bucket conveyors should be totally enclosed in a suitable housing to protect operating personnel. If a housing is impractical, suitable guards shall be placed where a hazard might exist.

Section 17 Chain Conveyors

Chain conveyors take many forms but they all carry, pull, push, haul or tow the load either directly by the chain or with attachments, pushers, cars, etc. These conveyors should be guarded by hand rails, guard plates, etc., to minimize the possibility of operator's limbs or clothing being caught between the moving parts of the conveyor and/or the load, and stationary parts of the conveyor structure.

Section 18 Roller Conveyor and Wheel Conveyor

1801 Hinged Sections

a Vertical types of hinged sections should be hinged to that portion of the stationary conveyor from which the material

is flowing. In this manner the hinged section helps to block the oncoming material.

b The open end of all roller or wheel conveyors should be equipped with a stop that automatically projects above the level of rollers or wheels when the hinged section is opened and is automatically retracted when the hinged section is closed.

c The horizontal swinging type of hinged section should have retractable stops at both ends of the stationary portion of the conveyor line to prevent loads dropping off conveyor when the hinged section is open.

1802 Gravity Systems

Most roller and wheel conveyors are graded to permit loads to move along conveyor by the action of gravity. When such graded lines convey heavy loads, provisions shall be made to prevent loads from "running away". Devices used to control the speed of travel generally are retarders, brakes, power conveyors, etc.

Section 19 Live Roll Conveyor

Where installed at floor level or used in working areas, all live roll conveyors should be designed to eliminate hazards from pinch points or moving parts excepting at such places where other provisions are made to prevent personnel from coming in contact with or crossing the conveyor.

Section 20 Vertical Conveyors

2001 Reciprocating Conveyor, Vertical

a When the vertical reciprocating conveyor is a link in conveyor line, i.e., loads are automatically loaded to the reciprocating conveyor by another conveyor and upon being raised or lowered by the reciprocating conveyor the load is delivered automatically to still another conveyor, then no specific safety regulations are required. (The general safety regulations apply).

b When loads are manually pushed or placed on the carriage of the vertical reciprocating conveyor, or when loads are manually removed from the carriage, suitable guards shall be provided to protect operating personnel.

c The carriage shall never have a solid bed and at the same time be designed to register at a floor, balcony, gallery, or mezzanine level.

d This conveyor is not intended to convey passengers or operators.

e The car or carriage on this conveyor is not intended to be called to a station by a manually operated push-button.

f Carriages may be suspended by chain or wire ropes. The working load on chain or wire ropes shall not exceed that recommended by the manufacturer.

g When the conveyor passes through a building floor, the applicable fire laws may require a fire enclosure. Any such fire code will then govern.

2002 Suspended Tray Conveyor and Vertical Chain Conveyor (Opposed Shelf Type)

a When the conveyor is loaded and unloaded automatically, only authorized maintenance persons shall be permitted near the stations. Suitable guards shall be provided to protect personnel from contact with moving parts.

b If loads are placed manually on the moving trays or carriers and/or manually removed, safety devices shall be incorporated to protect the operator(s). Such safety devices may consist of lintle switches on the up traveling side, sill switches on the down traveling side, deflectors that will safely push operators limbs away from danger points, etc.

c When the conveyor passes through a building floor the applicable fire laws require a fire enclosure. Any such fire code will then govern.

Section 21 Screw Conveyor

Troughs or boxes should be equipped with a cover. If it is not practical to cover the troughs or boxes, other guards shall be provided.

Section 22 Aerial Tramways

2201 Track Cables

a Track cables shall be appropriate construction for the life, type and nature of the installation with a safety factor of at least four (4).

b Track cable sags should be such that lateral swinging due to wind or acceleration does not cause collision of ingoing and out-going buckets on two bucket systems.

2202 Hauling Rope

a When friction grips are used on the continuous type tramway system, the hauling rope should be 6 × 7 Lang lay, hemp center construction in sizes ¾ in. and smaller. For sizes ⅞ in. and larger use 6 × 18 Lang lay, hemp center construction. The safety factor should be at least five (5), except where reverse bending occurs; or where abrasive dust or acid fumes are encountered; when factors of six (6) to seven (7) are recommended.

b Tail ropes shall be provided to avoid jerky operation and possible derailment.

c Suitable adjustment should be provided to maintain the original design relation of hauling rope and tail rope tensions. The vertical component of rope tensions should always be such that the rope never tends to lift out of the support sheaves.

2203 Hauling Rope Grips

Carriage hauling rope grips shall be designed to supply the necessary pulling components without damage to the rope due to slippage or excessive grip pressures. Hauling rope down pull on carriers must be kept to a minimum to prevent damage to rope and to avoid damaging the bucket hangers.

2204 Tramway Drives

a Tramway drives shall be equipped with a brake on the same shaft as the drive sheave and the brake system shall be adequate for stopping and holding the load at any point. The brake shall not be used for absorbing power developed by overhauling load during normal operation. Such developed power should be dissipated electrically, hydraulically, or pneumatically. The main drive brake shall be applied automatically if electric power fails.

b The driving sheave control should be such that reduction of velocity is automatic as the bucket(s) approaches the terminal station.

2205 Wire Rope Sockets

Wire rope connections shall be properly applied sockets using only pure zinc. Clamped ends develop only about 75 per cent of the strength of the rope and therefore are not recommended.

2206 Tower Saddles

Tower saddles for track cables shall have ample radii to minimize bending stresses and thus prolong the life of the cables. Stationary curved saddles of long radius may be employed where the cable breakover angle exceeds that possible with a rocking saddle. The radius of the saddle shall be large enough to provide smooth transition of the bucket from span to span. Also, the saddle shall be long enough to reduce the bearing pressure to a value which will permit the cable to slide in the saddle groove. All saddles must be lubricated at regular intervals.

2207 Sheave Diameters

Sheave should be as large as practical and as recommended by the rope manufacturer for the particular rope being used. In no case shall the pitch diameter of sheaves be less than 42 times rope diameter for 6 × 7 rope and 30 times rope diameter for 6 × 19 rope.

2208 Supporting Structure

Supporting structures shall be designed to withstand full known loads plus allowance for impact with due regard for the nature of the structural elements, the type of structure, and the manner of application and release of loads; all in accordance with the American Institute of Steel Construction's Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings. Ladders, platforms, handholds, etc., shall be supplied to facilitate the inspection of the structures and tramway parts.

2209 Crossing Guards

Crossing guards shall be provided where the tramways cross highways, railways, or other public passageways. These guards shall be of approved construction with regard to the material being handled on the tramway.

2210 Operation and Maintenance

a The tramway supervisor shall be charged with the responsibility for allowing only authorized and properly qualified parties around the tramway rig.

b Inspection of the complete rig, track cables, buckets, structures, drives, electrical apparatus, and other operation parts shall be made at regular intervals. Only the tramway

supervisor and personnel designated by him shall be allowed to "ride" the buckets and then only in performance of a specific duty such as inspection of track cables.

c Grips on continuous tramways shall be inspected and adjusted at periodic intervals. Worn parts shall be replaced promptly.

d Lubrication of track cables, hauling rope bearings, rails and guides shall be performed at regular intervals. The lubrication of the hauling rope should, preferably be continuous by means of a controlled drop feed from an oil reservoir at one or both ends of the line. This lubrication should not occur as the rope enters the driving sheave, but rather as the rope leaves the drive sheave and passes over a support sheave.

e Where counterweighted spans are used, the counterweight shall hang free when the cable is fully loaded. The deflection of anchored spans shall be adjusted by take-up means provided to keep the cable tension within the proper limits.

2211 Traffic Control System

There should be at least three control systems, as the operation of an aerial tramway is dangerous without alternate communication systems. The recommendations are:

(1) A bell signal code and push button stations for warning of stop, start, slow speed, high speed and reverse. Portable linesman sets should be provided for tapping along the line.

(2) An all metallic aerial wire circuit telephone with instruments at certain points along the line in addition to the terminal sets.

(3) A second telephone circuit which may be grounded if desired.

(4) Condensers for static elimination and lightning arrestors should be installed to protect instruments.

(5) Protection should be provided against short-circuiting of the telephone and bell circuits by water running down the line supports and diverting current to the towers and station steel.

(6) Suitable lighting should be provided at critical points along the line for night operation and repairs. Such lighting should illuminate the operating mechanism without causing a glare in the eyes of the linesman or operator.

American Standard Safety Codes

TITLE OF STANDARD	
Aerial Passenger Tramways, 1960	B77.1
Conveyors, Cableways and Related Equipment, 1957	B20.1
Cranes, Hoists, Derricks, 1943 (Reaffirmed 1952)	B30.2
Elevators, Dumbwaiters, Escalators and Moving Walks, 1965	A17.1
Jacks, 1943 (Reaffirmed 1952)	B30.1
Manlifts, 1949 (Reaffirmed 1956)	A90.1
Mechanical Power Transmission Apparatus, 1953 (Reaffirmed 1958)	B15.1
Mechanized Parking Garage Equipment, 1964	A113.1
Powered Industrial Trucks, 1959	B56.1
Practice for Inspection of Elevators, 1960	A17.2

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