MH27.1 – 2003
(a revision of MH27.1 – 1996)

Specifications for Patented Track Underhung Cranes and Monorail Systems

An Affiliated Trade Association of
Material Handling Industry of America
A Division of Material Handling Industry
8720 Red Oak Blvd., Suite 201
Charlotte, NC 28217-3992

American National Standard

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Approved September 11, 2003
American National Standards Institute, Inc.

Disclaimer

This standard, which was developed under the ANSI Canvass method and approved by ANSI on September 11, 2003, represents suggested design practices and performance testing criteria for crane and monorail equipment. It was developed with the sole intent of offering information to parties engaged in the manufacture, marketing, purchase, or use of crane and monorail equipment. This standard is advisory only and acceptance is voluntary and the standard should be regarded as a guide that the user may or may not choose to adopt, modify, or reject. The information does not constitute a comprehensive safety program and should not be relied upon as such. Such a program should be developed and an independent safety adviser consulted to do so.

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Foreword (This foreword is not part of American National Standard MH27.1-2003)

This standard was sponsored by the Monorail Manufacturers Association, Inc. in the interest of improved uniformity of patented track underhung crane and monorail performance and enhanced public safety. Since the intention of this standard is to encourage better communication between the manufacturer and the user, it should be regarded as a guide rather than a rigid specification.

This standard was first published as a Monorail Manufacturers Association, Inc. consensus standard in 1973. Since this original publication, the member companies of MMA have recognized the need to expand user awareness of this standard. As a result, it has been subjected to the American National Standards Institute's Canvass Review procedure and approved as an ANSI Standard June 8, 1981. That standard was revised and approved on December 27, 1996 as MH27.1-1996 replacing MH27.1-1981 and now the standard has been revised and approved September 11, 2003 as MH27.1-2003.

The following organizations recognized as having an interest in the standardization of patented track underhung crane and monorail systems were contacted prior to approval of this standard. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed standard to ANSI.

Acco Chain & Lifting Products
American Fabricators & Engineers
Cincinnati Incorporated
Dupont Engineering
Fluor Federal Svcs. M/S E6-15
G.S. Safety Consultants
Meridian Engineering & Technology, Inc.
MHAM
TC/American Monorail, Inc.
Underwriters Laboratories, Inc.
Unified Industries, Inc.
United Water
U.S. Air Force
Van Dorn Demag Corporation

At the date of approval of this standard, the Monorail Manufacturers Association, Inc. consisted of the following member companies:

Acco Chain & Lifting Products
Assembly Technology & Test, Inc.
Columbus McKinnon Corporation (CM)
Demag Cranes & Components Corporation
Gorbel, Inc.
Ingersoll-Rand Co.
Siemens Dematic Material Handling Automation Division
Spanco, Inc.
TC/American Monorail Inc.
Trambeam Corporation
Unified Industries
United States Monorail, Division of American Crane and Hoist Corp.

Suggestions for improvement, and questions regarding interpretation of this standard will be welcome. They should be sent to: MH 27.1 Committee (MMA), Material Handling Industry of America, 8720 Red Oak Blvd., Suite 201, Charlotte, NC, 28217-3992 or standards@mhia.org.

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SPECIFICATIONS FOR PATENTED TRACK UNDERHUNG CRANES AND MONORAIL SYSTEMS

SECTION 1 – Scope

1.1 These specifications apply to underhung cranes whose end trucks operate on the lower flange of a patented-track runway section; and to carriers (trolleys) operating on single-track patented-track monorail systems, including all curves, switches, transfer devices, lift and drop sections, and associated equipment. Systems used for transporting personnel require special considerations and are not included in these specifications. These specifications do not apply to enclosed-track runway sections, enclosed-track monorail systems, structural-shape runway section, or structural-shape monorail systems. Refer to MMA MH27.2, Specifications for Enclosed Rack Underhung Cranes and Monorail Systems for enclosed-track runway sections and enclosed-track monorail systems.

1.2 Hoist(s) and/or carrier(s) may be supplied by the crane manufacturer, crane distributor, crane installer, or by the purchaser. In either case, the hoist(s) and carrier(s) shall comply with the applicable sections of ASME/ANSI B30.16, Safety Standard for Overhead Hoists (Underhung); ASME B30.11, Safety standard for Monorails and Underhung Cranes and appropriate ASME HST Performance Standards. If the hoist(s) and/or carrier(s) are supplied by the purchaser, the crane builder shall be provided with certified dimensional drawings with all required data including wiring diagrams, carrier collector locations and weights.

1.3 This specification includes consideration for cranes and monorail equipment only. It does not include considerations or specifications for the design of the building, the design of supporting structure, electrical power supply, or erection.

1.4 This specification applies to normal ambient temperatures and atmospheric conditions; any other conditions require special consideration.

SECTION 2 – Referenced Specifications and Standards

Reference is made to portions of other specifications within the text of these specifications. Referenced specifications and the publishers are as follows:

MMA MH27.2-1998, *Specifications for Enclosed Track Underhung Cranes and Monorail Systems*

Publisher:
Monorail Manufacturers Association, Inc.
8720 Red Oak Blvd., Suite 201
Charlotte, NC 28217-3992

ASME B30.11-1998 *Safety Standard for Monorails and Underhung Cranes*

ASME B30.16-1998 *Safety Standard for Overhead Hoists (Underhung)*

ASME B30.20-1999 *Safety Standard for Below-the Hook Lifting Devices*

ASME HST-1-1999 *Performance Standard for Electric Chain Hoists*

ASME HST-2-1999 *Performance Standard for Hand Chain Manually Operated Chain Hoists*
ASME HST-4-1999 *Performance Standard for Overhead Electric Wire Hoists*

ASME HST-5-1999 *Performance Standard for Air Chain Hoists*

ASME HST-6-1999 *Performance Standard for Air Wire Rope Hoists*

Publisher:
American Society of Mechanical Engineers (ASME)
Three Park Avenue
New York, NY 10016-5990

ASME Order Department
22 Law Drive, Box 2900
Fairfield, NJ 07007-2900

ANSI Z535.4-1991 *Product Safety Signs and Labels*

ANSI/NFPA 70-1999 *National Electric Code*

Publisher:
National Fire Protection Agency (NFPA)
Batterymarch Park
Quincy, MA 02269

LRFD Manual of Steel Construction, 2nd Edition (1993)

ASD Manual of Steel Construction, 9th Edition (1989)

Publisher:
American Institute of Steel Construction, Inc. (AISC)
One East Wacker Drive
Suite 3100
Chicago, IL 60601-2001

ANSI/NEMA Standards Publication No. ICS6-1993, *Industrial Controls and Systems: Enclosures*

Publisher:
National Electric Manufacturers Association (NEMA)
1300 North 17th Street
Rosslyn, VA 22209

ANSI/AWS D1.1098 *Structural Welding Code-Steel*

ANSI/AWS D14.1-85 *Specification for Welding of Industrial and Mill Cranes and other Material Handling Equipment*

Publisher:
American Welding Society, Inc. (AWS)
P.O. Box 351040
550 N.W. LeJeune Road
Miami, FL 33135

ANSI Z241.2-1999 *Safety Requirements for Melting and Pouring of Metals in the Metalcasting Industry*

Publisher:
American Foundrymen's Society
505 State Street
Des Plaines, IL 60016

SECTION 3 – Duty Service Classification

This specification includes consideration for cranes and monorail equipment only. It does not include considerations or specifications for the design of the building, the design of supporting structure, electrical power supply, or erection.

3.1 Duty service classifications have been established to enable the buyer to specify the most economical carrier (trolley) or crane for a particular installation. To determine proper service classification of equipment, it should be noted that there are three possible basic modes of operation to be considered. These modes are crane (bridge) travel, carrier (trolley) travel, and hoist travel. Carriers (trolleys) or cranes are affected by operating conditions. Such conditions are high ambient temperatures, dust, moisture, corrosive fumes, etc. Unless otherwise specified, carriers (trolleys) and crane shall be designed to operate in ambient temperatures between 0° and 104°F (-18° and 40°C) and in atmospheres reasonably free from dust, moisture, and corrosive fumes. Unless otherwise specified, carriers (trolleys) and cranes shall be designed for Class C service as defined in Table 1 and powered hoists shall meet Hoist Duty Class H3 as defined in *ASME HST – 4,* Performance Standard for Overhead Electric Wire Rope Hoists or *ASME HST – 1,* Performance Standard for Electric Chain Hoists.

3.2 Service conditions have an important influence on the performance of wearing parts such as gears, bearings, rope, sheaves, electrical equipment, brake linings, load and lift limit devices, wheels, etc.

Careful consideration of the duty service classifications described in this Section will enable the user to evaluate the application and to obtain a carrier (trolley) or crane designed for optimum performance and minimum maintenance. If additional assistance is required, consult with the manufacturer, supplier, or a qualified person to determine classification requirements based upon the application. Many factors enter into the selection of the proper equipment to perform a given function. Carrier (trolley) and crane equipment consists of both mechanical and electrical components and both must be considered when analyzing the service the equipment must perform.

The factors that influence the mechanical and electrical performance include:

3.2.1 Load Distribution
The actual distribution or proportion of full and partial loads to be handled by the equipment, including lifting devices, has an important effect on the life of power-transmission components. For example, ball bearing life generally varies inversely according to the cube of the load.

3.2.2 Operational Time
Operational time is the total running time per hour.

TABLE 1

Duty Service Classification

Duty Class (Col. 1)	Typical Areas of Application (Col. 2)	Operational Time Ratings at K = 0.65 Uniformly Distributed Work Periods Max. ON Time Time min/hr (Col. 3)	Max. No. Starts/hr (Col. 4)	Infrequent Work Periods Max. ON Time From Cold Start Min. (Col. 5)	Max. No. of Starts (Col. 6)
A	Powerhouse and utilities, infrequent handling. Equipment used primarily to install and service heavy equipment where loads frequently approach rated load and where the equipment is idle for 1 to 6 months between periods of operation.	7.5 (12.5%)	75	15	100
B	Light machine shop, fabricating service, and maintenance. Loads and utilization randomly distributed. Rated loads infrequently handled. Total running time not over 12.5% of the work period.	7.5 (12.5%)	75	15	100
C	General machine shop, fabricating, assembly, storage, and warehousing. Loads and utilization randomly distributed. Total running time not over 25% of the work period.	15 (25%)	150	30	200
D	High volume handling of heavy loads, frequently near rated load in steel warehousing, machine and fabricating shops, mills, and foundries, with total running time not over 50% of the work period. Manual or automatic cycling operations of lighter loads with rated loads infrequently handled such as in heat treating and plating operations, with total running time frequently over 50% of the work period.	30 (50%)	300	30	300
E	Bulk handling of material in combination with buckets, magnets, or other heavy attachments. Equipment often cab operated. Duty cycles approaching continuous operation are frequently necessary. User must specify exact details of operation, including weight of attachments.	60 (100%)	600	N/A [(Note (1)]	N/A [Note (1)]

NOTE:
(1) n/a = Not applicable since there are no infrequent work periods in Class E Service

3.2.3 Work Distribution

This is determined by whether the operation time is uniformly distributed over the work period or concentrated in a short time span. Work distribution generally does not appreciably affect mechanical wear, but does materially affect the electrical components such as motors, brakes, and controls. For example, a motor designed to operate 30 minutes out of each hour of an 8-hour shift cannot handle 4 hours of steady run an d4 hours of idle time even though either condition only requires 4 hours of operational time per 8-hour shift.

3.2.4 Number of Starts and Stops

This directly affects all electromechanical devices, such as motors, contactors, brakes, and solenoids.

3.2.5 Hazardous Locations

When equipment is used in hazardous locations as defined by the National Electrical code, ANSI/NFPA 70 or other special codes, modifications or additional precautions not covered by this Standard, may be required. In these locations, only equipment designed in a manner suitable for the conditions encountered shall be used.

3.2.6 Hot Molten Material Handling

When equipment is used to handle hot molten material, modifications or additional precautions not covered by this Standard, may be required. Refer to ANSI Z241.2, Safety Requirements for Melting and Pouring of Metals in Metalcasting Industry.

3.3 Duty Service Classification Table

While all the factors listed in paragraph 3.2 must be considered in selecting the proper duty class, most industrial applications, having randomly distributed loads or uniform loads up to 65% of rated load handled periodically throughout the work period, can be generalized according to the type of workshop or area of application. Listed in column 1 of Table 1 are the five duty classes which have been established. In column 2 are listed typical areas of application where each class can normally be applied. The majority of applications fall into one of the three duty classes A, B, or C, and the use of the generalized descriptions in column 2 of Table 1 may be used for selection.

3.3.1 Operational Time Ratings

If in doubt as to the required duty classification for an application, refer to the data in columns 3 through 6 of Table 1 that show the operational time ratings for each class.

3.3.1.1 Uniformly Distributed Work Periods

a) Maximum On Time, min/hr – The maximum running time in minutes per hour permitted for the duty class when utilization is uniformly distributed over a given work period (column 3).

b) Maximum Number of Starts Per Hour – The maximum number of motor starts per hour permitted for the duty class when utilizations are uniformly distributed over a given work period. For two-speed motors, the total number of starts is the sum of the starts made at each motor speed (column 4).

3.3.1.2 Infrequent Work Periods

a) Maximum On Time From Cold Start In Minutes – The maximum total running time for utilization for the duty class starting with equipment at ambient temperature. These values cover infrequent periods of extended use and are applicable only with the equipment at ambient temperature and cannot be repeated unless it is allowable to cool down to ambient temperature between periods (column 5).

b) Maximum Number of Starts – The maximum total number of motor starts permitted for infrequent work periods specified in column 5. For two-speed motors the total number of starts is the sum of the starts made at each motor speed (column 6).

3.4 Mean Effective Load

Mean effective load denotes a theoretical single load value which has the same effect on the equipment as various loads actually applied to the equipment over a period of time.

K is the mean effective load factor and is expressed as:

$$K = \sqrt[3]{W_1^3P_1 + W_2^3P_2 + W_3^3P_3 + \ldots + W_n^3P_n}$$

Where:

K = mean effective load factor. Mean effective load factor is the ratio of the mean effective load to the rated load.

W = Load Magnitude. Load magnitude is the ratio of the equipment operating load to the equipment rated load. Operation with no load shall be included along with the weight of any dead load such as lifting attachments or devices.

P = load probability. Load probability is the ratio of the running time under each load magnitude condition to the equipment total running time. The sum total of all load probabilities used in the above equation shall equal 1.0.

3.5 Randomly Distributed Loads

Randomly distributed implies that loads applied to the equipment are assumed to be evenly distributed within the rated load of the equipment in decreasing steps of 20% of the previous load value. Random loads are, therefore, considered as 100, 80, 64, 51, 41, 33, 26, etc., % of rated load. Operation with random loads is considered on an equal time basis for the operating time remaining after accounting for the time the equipment is operating at no load and rated load. Randomly distributed loads will result in mean effective load factor of 0.65. (See Table 1)

SECTION 4 – General Specifications

4.1 Design Criteria

4.1.1 The following limitations of stress provide a margin of strength to allow for variations in the properties of materials, manufacturing methods, operating conditions, and design assumptions; and under no condition should such limitations be used to imply authorization or protection for users loading the crane beyond its rated capacity.

4.1.2 Castings, forgings, stampings, and other mechanical load-bearing parts, with the exception of structural members shall be designed with an allowable stress not to exceed 20% of the minimum ultimate strength of the material. For Case 3 loadings (see Section 6.2.3) the allowable stress may be raised to 30% of the minimum ultimate strength of the material.

4.1.3 For the design stresses of track, runways, bridge girders, and end trucks, refer to Sections 6 and 8.

4.1.4 Structural members not specifically covered by this specification, members in compression, bracing members and compression flanges of long span bending members shall be designed in accordance with the AISC Specifications for Structural Steel for Buildings.

4.1.5 In the design of bridge girders, runway and monorail tracks, hanger rods and fasteners subject to repeated load, consideration shall be given to the number of stress cycles, the expected stress range and stress category as contained in Appendix K-4, AISC Manual of Steel Construction, (Allowable Stress Design), 9th Edition.

4.1.6 All welding shall conform to ANSI/AWS D14.1 – Specification for Welding Industrial and Mill Cranes and other Material Handling Equipment. Where field welding of equipment is required, welding shall be in accordance with the manufacturer's recommendations. Where field welding to the building is required, it shall be done with the owner's permission and in accordance with ANSI/AWS D1.1 – Structural Welding Code-Steel.

4.1.7 Where two or more cranes operate on one runway or two or more carriers (trolleys) operate on a crane, monorail or a combination of transfer cranes, the maximum loading conditions on the runway, cranes, and monorail tracks shall be specified by stating the position of the loads. Means should be provided so that loads will not be positioned to exceed the design limitations set.

4.1.8 Requirements of ASME B30.11 – Safety Standards for Monorails and Underhung Cranes, shall be incorporated in equipment furnished under these specifications.

4.2 Rated Load and Rated Load Markings

4.2.1 The rated load of the carrier or crane shall be the maximum load for which the carrier or crane is designed and built by the manufacturer. In determining the rated load, all handling devices such as buckets, magnets, grabs, etc., shall be included as part of the load to be handled.

4.2.2 The rated load of the crane shall be marked in accordance with ASME B30.11 – Safety Standard for Monorails and Underhung Cranes.

4.2.3 The rated load of each hoist on a crane or monorail shall be marked in accordance with ASME B30.16 – Safety Standards for Overhead Hoists (Underhung). If a crane or monorail has more than one hoist unit, the combined load applied to all hoists on a crane or monorail shall not exceed the rated load of the crane or monorail.

4.3 Manufacturer's Identification Markings

4.3.1 The crane shall be marked with manufacturer's identification information in accordance with ASME B30.11 – Safety Standard for Monorails and Underhung Cranes.

4.3.2 Each hoist on a crane or monorail shall be marked with manufacturer's information in accordance with ASME B30.16 – Safety Standard for Overhead Hoists (Underhung).

4.4 Warnings

4.4.1 Floor-operated cranes shall have a safety label or labels affixed to the pendant station or load block and shall include cautionary language in accordance with ASME B30.16 – Safety Standard for Overhead Hoists (Underhung).

4.4.2 Cab-operated cranes shall have a safety label or labels affixed in the cab and shall include cautionary language in accordance with ASME B30.16 – Safety Standard for Overhead Hoists (Underhung).

4.5 Clearances

4.5.1 A minimum clearance of 2" (50 mm) should be provided between the crane and any lateral or overhead obstruction.

4.5.2 Where two non-interlocking cranes operate on parallel runways with no intervening walls or structures between them, the clearance between the two cranes should be no less than 2" (50 mm).

4.5.3 Where two cranes on parallel runways are designed for interlocking and transfer of the carrier, provisions shall be made for a clearance between the ends of the crane bridge girders of no more than 1/4" (6 mm).

4.5.4 Clearance shall be provided at the curves of a monorail system for swing of the load when negotiating the curve. Clearance shall be determined by giving due consideration to the carrier design; size, weight, and speed of travel of the load; and the curve radius.

4.5.5 Clearances should take into account the length of load, hoists, and carrier (trolley).

SECTION 5 – Runway and Monorail Track

5.1 Patented track shall be a specially rolled or fabricated section.

5.2 The minimum hardness of the lower load carrying (tension) flange of patented track shall be 195 Brinell.

5.3 The tread of the lower load carrying (tension) flange shall be flat.

5.4 Track shall be designed to limit deflection under rated load to no more than 1/450 of the crane span or unsupported length, or 1 1/4" (32 mm), whichever is less. Impact need not be included in calculating deflections.

5.5 On crane spans or unsupported lengths over 16' – 0" (4.9 m) the ratio of crane span or unsupported length to top flange width shall not exceed 60 to 1.

5.6 Web type or other suitable couplings (splices) shall be provided at all track joints. The maximum gap between ends of the load carrying flange shall not exceed 1/16" (1.5 mm).

5.7 Stops shall be provided at the ends of the carrier and crane travel. Stops or forks shall be provided at open ends of tracks; such as interlocking cranes, track openers and track switches. Stops shall be provided to resist impact forces of a fully loaded carrier or crane traveling at a normal walking speed or at 50% of the rated full load speed, if the carrier or crane is motor driven.

5.8 Monorail curves shall be of such radius as to permit operation of the carrier without binding (refer to Section 8.3).

5.9 Where track systems cross building expansion joints, provisions shall be made to accommodate for differential expansion of building and track. Expansion compensated for by appropriate hanger-rod swing is one possible provision.

5.10 Track straightness, center-to-center distance, and elevation shall be within the tolerance given in Figure 1, unless the system is operable with other tolerances as established by the manufacturer. Track running-surface misalignment at joints, following installation and adjustment, shall not exceed 1/32" (1 mm).

SECTION 6 – Track Loadings and Design

6.1 Runway and monorail track shall be a specially rolled or fabricated section and shall be considered as a simple beam in determining capacity. In determining the capacity of the tracks, the load on the load-carrying (tension) flange shall be assumed to be at the point central within the wheel tread. Allowable wheel loads shall take into account the stress imposed on the lower load-carrying flange when a carrier transfers from one track to another. Where track sections are diagonally cut at transfers, the wheel loads shall be limited by the stress imposed on the lower load-carrying flange. When considering horizontal forces on the track, they should be applied through the shear center of the track section, unless track is restrained torsionally.

6.2 Track is subjected to different loading conditions that vary with the application of the equipment and track. These loading conditions are divided into three different cases. Standard designs shall be based on Case 1. Designs that include considerations of Cases 2 and 3 shall be specified by the purchaser.

6.2.1 Case 1 – Principal Loads

Case 1 loadings shall consist of applicable loads as follows:

a) track dead load,

b) carrier dead load,

c) crane dead load,

d) lifted or live load, and

e) lifted or live load impact factor.

6.2.1.1 Track dead load

The weight of the track and the weight of any fixed machinery or structure supported by the track.

6.2.1.2 Carrier dead load

The weight of the carrier unit including the hoist or other components that are part of the carrier unit.

6.2.1.3 Crane dead load

The weight of the crane unit including all components that are part of the crane unit.

6.2.1.4 Lifted or live load

The lifted or live load consists of the rated or working load and the weight of any lifting devices used for handling and holding the working load such as the load block, lifting beam, bucket, magnet, grab, or other supplemental devices.

6.2.1.5 Lifted or live load impact factor

This factor applies to powered hoists only and shall be included in the design of all components of the crane or monorail system. The impact factor shall be 1/2% of the hoist rated or working load for each foot per minute (1.6% of rated or working load for each meter per minute) of hoisting speed with minimum factor value of 15% and a maximum factor value of 50%. For bucket and magnet applications, a factor value of 50% shall be used.

6.2.2 Case 2 – Principal plus additional Loads

Case 2 loading shall include Case 1 loadings plus applicable loadings such as:

a) operating wind load

b) Skewing load, and

c) operating lateral load

6.2.2.1 Operating wind load

Lateral load due to wind, when applicable or specified, shall be considered as an operating load of 5 pounds per square foot of projected area unless higher wind forces are specified. Where multiple surfaces are exposed to the wind force, such as crane girder and auxiliary girder, and the horizontal distance between surfaces is greater than the depth of the member on the windward side, consideration shall be given to increasing the effective area exposed to the wind. For single surfaces, such as cabs, a projected area shall be considered to be 1.2 times the projected area to account for negative pressure on the far side of the enclosure.

6.2.2.2 Skewing load

Lateral load due to skewing forces that tend to skew the tack shall be considered as an operating load. The horizontal force shall be obtained by multiplying the vertical load exerted on each wheel by the coefficient S_{sk} shown in Figure 2 for rigidly-supported track. The values shown in Figure 2 should be reduced by 50% for flexibility-supported track. The wheelbase is the distance between the outermost wheels for this calculation.

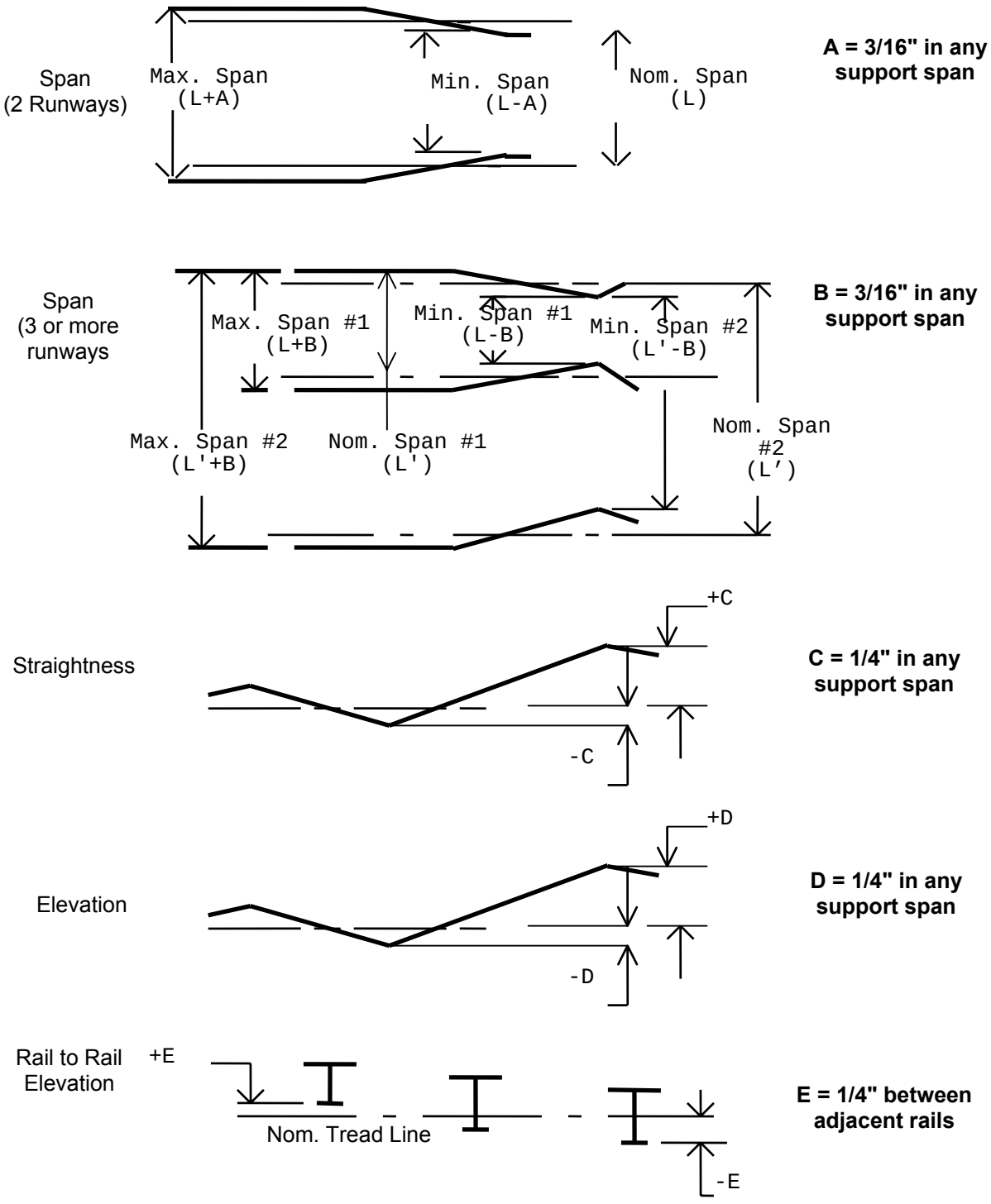
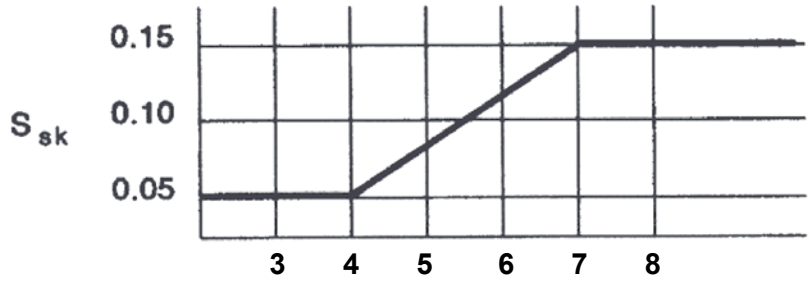


Figure 1 – Runway Alignment Tolerance



RATIO = SPAN / WHEELBASE

Figure 2 – Skewing Load

6.2.2.3 Operating lateral load
Lateral load due to any other forces as specified by the purchaser or determined by the manufacturer shall be considered as an operating load.

6.2.3 Case 3 – Case 1 or Case 2 plus Extraordinary Loads
Case 3 loading shall include Case 1 or Case 2 loading plus applicable loadings such as:

a) stored wind load,

b) collision load, and

c) seismic load.

6.2.3.1 Stored wind load
Lateral load due to the maximum wind that the track and bridge is designed to withstand during an out-of-service condition.

6.2.3.2 Collision load
Load due to the inadvertent collision of two cranes or carriers; or crane or carrier and end stops or bumpers.

6.2.3.3 Seismic load
Load due to specific seismic conditions. If required, seismic accelerations to the track shall be in accordance with section 6.1 and shall be specified by the owner.

The allowable stress levels under conditions of these loadings shall be applied in accordance with section 6.3.2.

6.3 The allowable stress in the tack shall be limited by the loading case that is considered. Case 1 and Case 2 loadings are considered operating conditions, while Case 3 loading is considered an extraordinary event. Under Case 3 conditions, the equipment is expected to withstand the loading conditions, however, may not be operational after the event occurs.

6.3.1 Allowable stress on the track for Case 1 and Case 2 loading conditions shall be as follows:

6.3.1.1 The allowable tension stress in the lower load-carrying (tension) flange of Patented Track shall be 20% of the minimum ultimate strength of the material used.

6.3.1.2 The allowable stress in the compression flange shall be determined by the formula:

$$F = \frac{12x10^6}{ld/A_f} \leq 60\% \text{ of the yield strength of the material used.}$$

Where:

l = Unbraced span between track supports in inches (mm). Cantilever lengths require special considerations.

d = Depth of track in inches (mm).

A_f = Area of compression flange in square inches (square mm).

F = Allowable stress in psi.

This formula is applicable when the compression flange is solid and approximately rectangular in cross-section and is not less than that of the tension flange. For other conditions, refer to AISC manual for steel construction. The computed stress shall not be greater than .6 of the yield strength of the material used.

6.3.2 Allowable Stress in the track for Case 3 loading conditions shall be as follows:

6.3.2.1 The allowable tension stress in the lower load-carrying (tension) flange for Patented Track shall be 30% of the minimum ultimate strength of the material used.

$$F = (1.3)\frac{12x10^6}{ld/A_f} \leq 75\% \text{ of the yield strength of the material used.}$$

Where:

l = Unbraced span between track supports in inches (mm). Cantilever lengths require special considerations.

d = Depth of track in inches (mm).

A_f = Area of compression flange in square inches (square mm).

F = Allowable stress in psi.

This formula is applicable when the compression flange is solid and approximately rectangular in cross-section and is not less than that of the tension flange. For other conditions, refer to AISC manual for steel construction. The computed stress shall not be greater than .75 of the yield strength of the material used.

SECTION 7 – Suspension Fillings

All necessary clamps, hanger rods, and other fittings from which a track is suspended shall be considered as part of the track system. Track hangers shall support the load resulting from the maximum loading condition. The allowable cross-sectional area for hanger rods shall be determined from the root area of the rod (minor diameter of threads), or from test data.

7.1 Means shall be provided to allow for the vertical adjustment of the track both before and after the system has been put in operation so that track can be erected and maintained level.

7.2 Where the track is suspended from hanger rods, the track shall be braced to restrain the track against damaging lateral and longitudinal movement.

7.3 Where the track is suspended from hanger rods, means shall be provided to prevent the hanger-rod nuts from backing off the rods.

7.4 Where multiple rods are used at a suspension point, consideration shall be given to the unequal load induced in the rods.

7.5 In the design of hanger rods, the allowable stress shall be 20% of the minimum ultimate strength of the material used.

SECTION 8 – Carriers or Trolleys

8.1 Carrier yokes shall be of the swiveling type.

8.1.1 Wheels shall have a minimum tread hardness of 375 Brinell.

8.1.2 Wheel bearings shall be anti-friction precision type bearings. Bearings shall be prelubricated and sealed or provided with fittings and seals or shields for pressure lubrication.

8.1.2.1 Bearings shall be selected to provide a minimum B-10 life of 1,250 hours for Class A service; 2,500 hours for Class B service; 5,000 hours for Class C service; 10,000 hours for Class D service; and 20,000 hours for Class E service.

8.1.2.2 Bearing life shall be based on 75% of the wheel load (impact need not be included) and the full-rated speed of motor-propelled carriers or an assumed speed of 150 FPM (46 meter per minute) for manually-propelled carriers.

8.3 The wheelbase of carriers (trolleys) that operate on monorail systems with curves shall be equal to or less than the radius of the smallest curve in the monorail system, not including curved track in switches.

SECTION 9 – Cranes, Transfer Cranes, and Interlocking Cranes

9.1 Cranes shall be manually or motor propelled, and operate on two or more runways.

9.1.1 Crane girders shall be designed in accordance with the provisions of Sections 5 and 6 except the ratio of crane span to top flange width of 60 to 1 is not applicable to girders for cranes where the top flange of the girders are laterally braced. 9.1.1 does not apply to the enclosed track systems.

9.1.2 Carrier (trolley) yokes shall be of the swiveling type. End-truck load bars shall be cradled in yokes.

9.1.3 Wheels shall be in accordance with the provisions of Section 8.1.1.

9.1.4 Wheel bearings and bearing life shall be in accordance with the provisions of Sections 8.1.2, 8.1.2.1, and 8.1.2.2.

9.1.5 Lugs shall be provided on end trucks to limit drop of the end truck to 1" (25 mm) or less in the event of wheel or axle failure. Lugs shall be located on both sides of the track load-carrying flange to provide central loading of the track about the vertical axis if failure occurs.

9.1.6 Ratio of crane span to end-truck wheelbase for patented track shall not exceed 10:1.

9.1.7 Stops shall be provided at ends of girders in accordance with the provisions of Section 5.7.

9.1.8 Motor-propelled cranes shall be driven by individual driving heads or tractor drives mounted on or attached to two or more end trucks or by squaring-shaft type drive which provides traction by pressure of the driving wheels on the underside of the track. Drives shall be in accordance with the provisions of Sections 8.2, 8.2.1, and 8.2.2.

9.1.9 On double-girder cranes, means shall be provided to maintain the gauge of the girders.

9.1.10 Interlock mechanisms for transfer and interlocking cranes shall maintain alignment of crane girder or girders with spur tracks, fixed transfer sections or crane girders of interlocking cranes operating on adjacent runways to permit the transfer of a carrier from one to the other.

9.1.10.1 Interlock mechanisms shall limit load-carrying flange misalignment to a maximum of 1/8" (3 mm).

9.1.10.2 Stops or forks shall be an integral part of the interlock mechanisms. When girders and spur tracks or transfer sections are aligned and interlock mechanisms are engaged, stops or forks shall be in the open position and permit transfer of carrier from one to the other. When girders and spur tracks of transfer sections are not aligned and/or interlock mechanisms are disengaged, stops or forks shall be in the closed position and prevent carriers from rolling off the end of spur tracks, transfer sections, or crane girders.

9.1.10.3 Transfer and interlocking cranes, spur tracks, and fixed transfer sections shall have a maximum gap of 1/4" (6 mm) between adjacent ends of the load-carrying flange.

SECTION 10 – Track Switches

10.1 Track switches shall be of the tongue, rotary, crosstrack, or sliding type. They shall maintain alignment of the incoming tracks and switch tracks, with a maximum gap of 3/16" (5 mm) for patented track and 1/16" (2 mm) for enclosed track, between adjacent ends of the load-carrying flanges. Misalignment shall not exceed 1/16" (2 mm). Switches may be operated by pull chains or ropes or by electric-, pneumatic-, or hydraulic-operated devices.

10.2 Stops shall be provided as an integral part of the switch to protect the end of an incoming track when the switch track is not aligned with the incoming track, and shall resist the impact forces of a fully loaded carrier traveling at a normal walking speed or at 50% of the full-load speed, if the carrier is motor propelled. Guards shall also be provided to prevent a carrier (or trolley) on the movable track from running off the movable track, when it is not aligned with an incoming track.

10.3 Means shall be provided to hold the movable frame during passage of carriers (or trolleys) through the track switch.

10.4 Electric baffles shall be provided on track switches and incoming tracks of systems with cab-controlled carriers or automatic-dispatch carriers. Baffles shall prevent carrier contact with the end of an incoming track when the track switch is not aligned with the incoming track. Baffles shall also prevent the load from interfering with the load path of the adjacent track.

SECTION 11 – Track Openers

11.1 Hand-operated or automatic track openers shall be provided where it is necessary to open a section of track to allow for closing of sliding or curtain-type fire doors. These devices shall open the track and allow the door to close either by hand operation or as a result of the parting of a fuse in the event of a fire. The gap between the adjacent track and track opener shall be no more than 3/16" (5 mm) for patented track and 1/8" (2 mm) for enclosed track. Forks or stops designed per paragraph 5.7 shall be provided to prevent a carrier (or trolley) from running off either of the open ends of the track when the movable section is not in alignment with the track.

11.2 Electric baffles shall be provided on stationary tracks of track openers of systems with cab-controlled carriers or automatic-dispatch carriers.

SECTION 12 – Vertical Drop or Lift Sections

12.1 Vertical drop or lift sections shall maintain alignment of the stationary track(s) and the movable tracks(s) with a maximum gap of 3/16" (5 mm) between adjacent ends of the load-carrying flanges.

12.2 When sections are operated by electric, pneumatic or hydraulic power, means shall be provided to limit the vertical travel of alignment of the movable track with the stationary track(s). Misalignment between the movable track and stationary tracks shall not exceed 1/16" (2 mm).

12.3 Stops shall be an integral part of the movable track and shall prevent a carrier from running off either end of the movable track when the movable track is not in alignment with the stationary track(s).

12.4 Stops shall be an integral part of the stationary track(s) and shall prevent a carrier from running off the open ends of the stationary track(s) when the movable track is not in alignment with the stationary track(s).

12.5 Clearances should take into account the length of the load, hoist, and carrier (or trolley).

12.6 Electric baffles shall be provided on stationary tracks of systems with automatic-dispatch carriers. Baffles shall prevent carrier contact with the stop at the end of the stationary track when the movable track is not in alignment with the stationary track. Baffles shall also prevent the load from contacting another load on the movable section.

SECTION 13 – Cab-Controlled Carriers and Cranes (when provided)

13.1 An operator's cab shall be furnished only when specifically requested by the purchaser.

13.2 The general arrangement of the cab and the location of control and protective equipment shall be such that all operating handles are within convenient reach of the operator when facing the area to be served by the load hook, or while looking in the direction of travel of the cab. The arrangement shall allow the operator the full view of the load hook in all positions in the travel path.

13.3 The cab shall be located to afford a minimum of 3" (76 mm) clearance from all fixed structures within its area of possible movement.

13.4 The clearance of the cab above the working floor or passageway should be no less than 7' (2.1 m), except when operations require dimensions that are less. In this case, precautions shall be taken during operation of the crane or carrier to keep personnel and other obstructions clear of the low overhead cab.

13.5 Where it operates on a single track, the cab should be mounted on a separate trolley and coupled to the load-carrying trolley. On double-girder cranes, the cab shall be rigidly attached to the carrier or crane to minimize swaying or vibration.

13.6 Where windows are provided, they shall meet the requirements of ASME B30.11 – Safety Standards for Monorails and Underhung Cranes.

13.7 The cab shall be provided with a roof capable of supporting without permanent distortion, the weight of a 200-pound (91 kg) person.

SECTION 14 – Brakes

14.1 Hoisting brakes shall be in accordance with ASME HST Standards and ASME B30.16 – Safety Standard for Overhead Hoists (Underhung).

14.2 Brakes supplied for carrier or crane travel may be applied by mechanical, electrical, pneumatic, or hydraulic means. Brakes shall be in conformance with ASME B30.11 – Safety Standard for Monorails and Underhung Cranes.

14.3 Travel Holding Brakes, when provided, shall have a torque rating of at least 50% of the rated motor torque and be adjustable to a minimum of 25% of the rated motor torque.

SECTION 15 – Electrical Equipment

15.1 Wiring and equipment shall comply with the provisions of Article 610, ANSI/NFPA 70 National Electric Code.

15.2 The power and control circuit voltage shall not exceed 600 volts for alternating current or direct current. The control circuit voltage in pendant push buttons shall not exceed 150 volts for A.C. or 300 volts for D.C.

15.3 Unless otherwise specified, all functions on floor-operated equipment shall be from a common pendant pushbutton station. The pushbutton station shall be suspended in a manner that will protect the electrical conductors against strain. Functions on cab-controlled equipment shall be from master switches or pushbuttons. Motion controls shall return to the off position when released by the operator. All switches, buttons and indicators shall be clearly labeled as to their purpose and function.

15.4 Motors shall be rated on no less than a 30 minute basis with temperature rise in accordance with the latest NEMA standards for the class of insulation and enclosure used, unless otherwise specified. Motors shall be of the type suitable for crane and hoist service and shall be provided with anti-friction bearings. Motor duty rating shall be suitable for the service class required.

15.4.1 Motor insulation shall be a minimum of Class B, based upon a 40°C ambient. Unless otherwise notified, manufacturer will assume a 40°C ambient.

15.4.2 Motors for use in Hazardous Locations shall conform to appropriate Class, Group and Divisions, as set forth in ANSI/NFPA 70, National Electric Code.

15.5 Control systems may be magnetic, solid state, static, or in combination as specified. Crane and carrier controls shall be plain reversing unless otherwise specified. All reversing contactors shall be mechanically and electrically interlocked. Unless otherwise specified, controls shall be mounted in NEMA type 1 general-purpose enclosures (see section 17 for special applications).

15.5.1 Magnetic control shall have contactors of sufficient size for crane and hoist duty consistent with the horsepower and voltage of the motor or motors with which they are used.

15.5.2 Solid state power components such as thyristors, diodes, etc., shall be rated in accordance with the horsepower, voltage and time ratings of the motor or motors with which they are used.

15.5.3 Static power components such as rectifiers, reactors, etc., as required, shall be in accordance with the horsepower, voltage and time ratings of the motor or motors with which they are used.

15.5.4 Carriers and cranes with squirrel cage motors and single speed control should be provided with reduced torque starting through the use of solid state devices, autotransformers, resistors, fluid couplings, or electro-mechanical means.

15.5.5 Carriers and cranes with squirrel cage motors and multi-speed control should be provided with reduced torque in starting and changing from one speed to the other. Reduced torque may be provided through the use of solid state devices, autotransformers, resistors, fluid couplings, or electro-mechanical means.

15.5.6 Carriers and cranes with squirrel cage motors that use variable frequency drives with controlled acceleration and deceleration do not need reduced torque solid state devices, autotransformers, resistors, fluid couplings, or electro-mechanical means specified in sections 15.5.5 and 15.5.4.

15.5.7 Controls for carriers and cranes with wound-rotor motors shall have a minimum of two acceleration contactors and a minimum of three speed points.

15.5.8 Carriers and cranes with D.C. motors shall have single-speed or variable-speed control in accordance with the provisions of Sections 15.5.4 and 15.5.7.

15.5.9 Where more than one motor is employed on a crane, each motor shall have individual phase overcurrent protection. Where two or more motors operate a single carrier or crane and are controlled as a unit by one controller, the motors with their leads may be protected by a single overcurrent device.

15.6 A motor-circuit switch or circuit breaker shall be provided in the leads from the runway contact conductors on all electrically-powered cranes. Where this disconnecting means is not readily accessible from the crane operating station, means shall be provided at the crane operating station to open the power circuit to the crane motors, except as specified in Article 610 of ANSI/NFPA 70 National Electric Code. The continuous ampacity of the motor-circuit switch or circuit breaker shall be no less than 50% of the combined short-time ampacities of the motors required for any single crane motion.

15.7 All cranes using a lifting magnet shall have a magnet circuit switch of the enclosed type with provisions for locking in the open position. Means for discharging the stored inductive energy of the magnet shall be provided.

SECTION 16 – Electrification

16.1 Where electrical equipment operates on a system, power shall be supplied by means of insulated or open rigid-type contact conductors mounted parallel to the track. Conductors shall comply with the provisions of Article 610, ANSI/NFPA 70 National Electrical Code. Flexible cable may be used in lieu of rigid-type contact conductors.

16.2 Conductors shall be sized to carry the required current to the crane(s), when operating with rated load.

16.3 Collectors shall be of the wheel or shoe type and shall be designed to minimize sparking between the wheel or shoe and the contact conductor.

SECTION 17 – Equipment for Special Applications

17.1 Sections 1 through 16 are for use in normal ambient temperatures and atmospheric conditions; any other conditions require special consideration.

SECTION 18 – Glossary

18.1 **Ambient Temperature** – The temperature of the atmosphere surrounding the equipment.

18.2 **Ampacity** – The current carrying capacity expressed in amperes.

18.3 **Automatic Crane** – A crane that when activated operates through a preset cycle or cycles.

18.4 **Automatic Dispatch Carrier** – A carrier that when activated operates through a preset cycle or cycles.

18.5 **Bearing Life** – B-10 Bearing Life – The B-10 bearing life of an anti-friction bearing is the minimum expected life, in hours, of 90% of a group of bearings that are operated at a given speed and loading.

18.6 **Bridge Travel** (Crane Travel) – Crane movement in a direction parallel to the crane runway.

18.7 **Bridge Girder** (Crane Girder) – Crane member on which carriers (trolleys) travel, horizontally mounted between and supported by the end trucks.

18.8 **Building Structure** – The structural members of a building that support the building loads and on which the loads of crane or monorail equipment, and the material to be moved, will be imposed.

18.9 **Brake** – A device other than a motor used for retarding or stopping motion by friction or power means.

18.10 **Cab** – An operator's compartment attached to a crane or carrier.

18.11 **Cab-controlled** – Equipment controlled from an operator's cab.

18.12 **Carrier** (trolley) – A unit that travels on the bottom flange of a monorail track or bridge girder used to support and transport a load.

18.13 **Carrier Head** – A two-wheel assembly used with load bars to form a carrier or end truck.

18.14 **Circuit Breaker** – A device to open and close a circuit by non-automatic means, and to open the circuit automatically on a predetermined overcurrent, without injury to itself when properly applied within its rating.

18.15 **Clamp** – A type of suspension fitting used to support tracks from an overhead structure, which is fastened to the structure by mechanical means rather than welding or direct bolting.

18.16 **Collectors** – Electrical contacting devices providing a path for current flow from stationary conductors to moving equipment.

18.17 **Collector, Shoe** – The portion of a collector that makes contact by sliding on the conductor bar.

18.18 **Collector, Wheel** – The portion of a collector that makes contact by rolling on the conductor bar.

18.19 Conductors, Insulated – A bar with a non-conducting cover material to minimize accidental contact with the conductor, used to transmit an electrical current.

18.20 Conductors, Open – A bare bar, or wire, used to transmit an electrical current.

18.21 Control, Single Speed – A drive control system providing one-speed operation in either direction.

18.22 Control, Multi-Speed – A drive control system providing more than one-speed operation in either direction using multi-speed squirrel cage motors.

18.23 Control, Variable Speed – A drive control system providing more than one-speed operation in either direction.

18.24 Control Voltage – The voltage impressed on the control devices.

18.25 Controller – A device by means of which the operator controls the speed, acceleration, torque and/or direction or motor-driven equipment.

18.26 Couplings (Splices) – Mechanical devices used to join the adjacent end of track sections.

18.27 Crane – A machine for lifting and lowering a load, and moving it horizontally. Drives may be manual, power, or a combination of both.

18.28 Crane, Double Girder – A crane having two bridge girders mounted between and supported from the end trucks.

18.29 Crane Girder – See Bridge Girder.

18.30 Crane, Semi-Gantry – A traveling crane with one end of the bridge supported on one or more legs running on fixed rails or other runway and the other end of the bridge supported by a track running on an elevated fixed rail or runway.

18.31 Crane Span – See Span.

18.32 Crossover (Fixed Transfer Section) – A connecting track with an interlock mechanism on both ends, mounted between two interlocking cranes, used to transfer a carrier from one bridge girder to the other.

18.33 Crosstrack Switch – A track switch containing one straight section of moving track pivoted in the center which can be rotated to align it with other crossing tracks to allow passage of a carrier through the junction without changing the direction of the carrier motion.

18.34 Curves – Formed sections of track used to change the horizontal or vertical directions of carrier travel.

18.35 Disconnecting Means – A device, or group of devices, or other means whereby the conductors of a circuit can be disconnected from their source of supply.

18.36 Double Girder Crane – A crane having two bridge girders mounted between and supported from the end trucks.

18.37 Driving Head – A motor-driven carrier head which is supported from and propelled by the load bearing wheels.

18.38 Drop Section (Lift Section) – A mechanism that will permit a section of track(s) to be lifted or lowered out of alignment with the stationary track(s).

18.39 Electric Baffles – Conductors wired to cut off electric power to approaching motor-driven equipment if track switches, drop sections, and other movable devices are not properly set for passage of equipment.

18.40 Electrically Interlocked – An electrical device that prevents a short circuit when opposite controls are operated at the same time.

18.41 Electrification – The track mounted conductor system by which the moving equipment receives its electrical power.

18.42 Enclosed Track – See Track, Enclosed.

18.43 End Stop – A device located at the end of the track or crane bridge to prevent the carrier from running off the end of the track or crane.

18.44 End Truck – An assembly consisting of the truck frame and wheels that supports the crane girder(s) and allow movements along the runway.

18.45 Equipment Supplier – The supplier of monorail and/or underhung crane systems under contract.

18.46 Fixed Cranes – Cranes that are non-mobile. Jib cranes are classified as fixed cranes.

18.47 Fixed Transfer Section - See Crossover.

18.48 Floor Controlled – Motor propelled units that are controlled by an operator on the floor by means of pushbutton station suspended from the overhead equipment.

18.49 Fork – A pivoting mechanical end stop portion of an interlock.

18.50 Gantry Crane – A traveling crane similar to an overhead crane, except that the bridge for carrying the hoisting mechanism is rigidly supported on two or more legs running on fixed rails or other runway.

18.51 Gauge – The center-to-center distance between the load-carrying flanges of the two crane girders of a double girder crane.

18.52 Guard – A portion of a switch provided to prevent carriers from running off the open ends of the switch tracks in the event the switch is moved with the carrier on the inner frame of the switch.

18.53 Hanger Rod – Steel rods that, together with other fittings, are used to suspend the track from the supporting structure.

18.54 Hoist – A suspended machinery unit that is used for lifting or lowering a freely suspended (unguided) load.

18.55 Holding Brake – A brake that automatically prevents motion when power is off.

18.56 Impact Allowance – Additional hook load assumed to result from the dynamic effect of the live load.

18.57 Interlock Mechanism – A mechanical device to lock together the adjacent ends of two cranes or a crane to a crossover or spur track to permit the transfer of carriers from one crane or track to the other.

18.58 Interlocking Crane – A crane with an interlock mechanism on one or both ends enabling it to be mechanically locked to another crane, crossover, or spur track for the purpose of transferring a carrier from one to another.

18.59 Lift Section – See Drop Section.

18.60 Load – The total weight superimposed on the loadblock, hook, or carrier.

18.61 Load Bar – A load-carrying member between carriers or carrier heads.

18.62 Load Block – The assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoist rope or load chain. This shall include any appurtenances reeved in the hoisting rope or load chain.

18.63 Load-Carrying Flange – The lower flange of the track on which the load-bearing wheels roll.

18.64 Lug – A mechanical device fixed to the end truck or carrier (trolley) yoke that will prevent the crane end truck or carrier from falling in the event of a wheel or axle failure.

18.65 Magnet – An electromagnetic device carried on a hoist hook, used to pick up and carry loads magnetically.

18.66 Master Switch – A device that controls the operation of contactors and auxiliary devices of an electric circuit.

18.67 Mechanically Interlocked – A mechanical device that prevents operation of opposite controls at the same time.

18.68 Monorail – A single run of overhead track on which carriers (trolleys) travel.

18.69 Motor Circuit Switch – A switch, rated in horsepower, capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

18.70 Normal Walking Speed – A walking speed assumed to be 150 FPM (46 meters per minute).

18.71 Overhead Traveling Crane – A crane that follows a fixed path on elevated runways.

18.72 Patented Track – See Track, Patented.

18.73 Pulpit Controlled – A unit operated from a fixed operator station not attached to the crane.

18.74 Pushbutton Station – An electrical control device consisting of pushbutton-operated contacts in an enclosure used by the operator for control of the powered motions of the crane, carrier, hoist, and other auxiliary equipment.

18.75 Qualified Person – A person, who by possession of a recognized degree in an applicable field, or certificate of professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

18.76 Radio Controlled – A unit operated from a radio transmitter located at a point not mechanically attached to the device being controlled.

18.77 Rated Load – The maximum load designated by the manufacturer or qualified person for which the crane or monorail system is designed and built.

18.78 Remote Controlled – A unit operated from a control station located at a point not mechanically attached to the device being controlled.

18.79 Residual Magnetism – The magnetic field remaining in a magnet after power has been removed.

18.80 Rotary Switch – A track switch with a movable inner frame containing straight and/or curve sections of track. The inner frame can be rotated around a vertical axis to align these tracks with other tracks for routing carriers from one track to another.

18.81 Runway – The track and support system upon which the crane travels.

18.82 Shall – Indicates that the rule is mandatory and must be followed to comply with this standard.

18.83 Should – Indicates that the rule is a recommendation, the advisability of which depends on the facts in each situation.

18.84 Simple Beam – A structural member supported and unrestrained at each end and subjected to loads acting transversely to its longitudinal axis.

18.85 Sliding Switch (Glide Switch) – A track switch with a movable inner frame containing straight and/or curved sections of track. The inner frame can be moved to align these sections of track with other tracks for routing carriers from one track to another.

18.86 Span – The horizontal distance, center-to-center, of runway tracks.

18.87 Spur Track – A fixed track arranged to interlock with an adjacent crane girder to permit passage of carriers between the spur track and the crane.

18.88 Squaring Shaft – A driven shaft that transmits torque to drive wheels operating on two or more tracks.

18.89 Stationary Track – A fixed track attached to the building or supporting structure.

18.90 Stop – A device to limit travel of a carrier (trolley) or crane.

18.91 Structural Supports – Structural members provided for the support of runways or monorail track and switches.

18.92 Supporting Structure – The structure used for the support of a monorail or crane system.

18.93 Suspension Fittings – Fittings used to attach the track to the supporting structure.

18.94 Tagline – An electrical conductor system employing flexible cables.

18.95 Tongue Switch – A switch that contains one straight section of track, pivoted at one end, which can be rotated to various positions to align with other tracks for routing carriers (trolleys) from one track to another.

18.96 Track – The structural member upon which the carrier or crane wheels operate.

18.97 Track, Enclosed – A generic term referring to track used as crane girders, crane runways, and monorails; whose related equipment operates on the internal lower operating or running flange of such track. The track section is either a rolled and/or fabricated steel shape; or a rolled or extruded and/or fabricated aluminum shape. All enclosed track incorporates a lower operating or running flange shape, in relation to track size, having proprietary shape dimensions dependent upon the individual enclosed track manufacturer.

18.98 Track, Patented – A generic term referring to track used as crane girders, crane runways, and monorails; whose related equipment operates on the external lower operating or running flange of such track. The track section is either a high-carbon, high-manganese rolled steel shape; or a composite fabricated steel section having a high-carbon, high-manganese rolled steel tee-section lower operating or running flange. All patented track, regardless of size or depth, incorporates a lower operating or running flange shape, having proprietary shape dimensions dependent upon the individual patented track manufacturer.

18.99 Track Joint – The point at which two sections of track are joined together.

18.100 Track Opener – A section of track arranged to lift or swing out of the line of the track to make an opening through which a door may pass.

18.101 Tractor Drive – A motor-driven unit supported from wheels and propelled by drive wheel or wheels bearing on the underside of the track.

18.102 Trolley – See Carrier.

18.103 Trolley Yoke – A frame on which a pair of load-carrying (trolley) wheel assemblies are mounted.

18.104 Turntable – A track device with a movable inner frame containing a straight section of track that can be rotated about its center with a loaded carrier on it to align the section of track with other tracks for routing of carriers from one track to another.

18.105 Underhung Crane – A traveling crane with a movable bridge running on the lower flanges of an overhead fixed runway structure and carrying a movable or fixed hoisting mechanism.

18.106 Wall Crane – A traveling crane having a jib with a movable or fixed hoisting mechanism and operating on a runway attached to the side walls or columns of a building.