

Door Dealer Accreditation

Section 4

Residential and Commercial Sectional Door Technical Essentials



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Section One

Introduction

This study guide has been created by the Institute of Door Dealer Education and Accreditation (IDEA) as part of its goal to establish the door systems industry as a profession, and to recognize the skilled individuals who work within the industry as professional technicians. This is the fundamental objective of the IDEA Accreditation and Certification programs, and all other professional designation courses offered by IDEA.

Although it is intended that all students will learn some valuable new concepts in studying the curriculum, it is essential that each student begin the process with a broad base of knowledge and experience in the technical aspects of commercial sectional door systems' products and accessories.

A professional can be defined as one possessing a high degree of skill or expertise. Individuals trained and experienced in installing, servicing, or repairing commercial sectional doors, operators, and accessories meet that definition. Most people engaged in the door systems industry on a full time basis would agree that they should be viewed as professionals. However, it is just as important that end users and the general public share that view.

Professionalism goes beyond the pure technical knowledge of an industry's practitioners. Professionals bring additional qualities to the industry, such as customer relations, safe work practices, leadership among colleagues, communication skills, and a comprehensive understanding of the industry and the organizations that support it.

A Brief History of Sectional Doors

The upward acting sectional garage door was introduced by C.J. Johnson in 1921, marking a major shift from the swinging and sliding doors commonly used on larger openings. Johnson's design allowed the door and counterbalance system to travel upward and store neatly between the top of the opening and the garage ceiling, creating a safer and more space efficient solution. During the same era, one-piece tilt-up doors also emerged as an alternative to side-swinging doors, giving homeowners and businesses multiple upward-acting options for the first time.



As these systems gained popularity, early sectional doors, primarily constructed of wood, became the foundation of the modern garage door industry. By the 1950s and 1960s, new materials such as fiberglass, aluminum, and steel entered the market for both residential and commercial applications. The sectional door's smooth operation, adaptability to a wide range of openings, and compatibility with emerging operator technology helped it become the dominant door type over the decades that followed.

Around 1978, the introduction of the first steel raised panel door significantly improved the appearance, durability, and affordability of residential garage doors. This was followed in the early 1980s by the insulated steel sandwich door, which offered improved thermal performance and quickly became a standard product in many climates. Both raised panel and insulated sandwich designs remain major segments of the market today.

As the industry continued to evolve, the early 2000s saw the resurgence of the carriage-house style, driven by architectural trends and advances in steel stamping, overlays, and finishing techniques. At the same time, commercial applications expanded with specialized track configurations, such as high lift and vertical lift systems, designed to maximize interior space and accommodate modern building layouts. These developments have contributed to the wide variety of designs, colors, materials, and performance options available in today's sectional door market.

Description of Sectional Doors

As the name implies, a sectional door consists of a series of sections connected by hinges. The sections are connected in such a manner that the door can open and close easily, yet provide a tight barrier against wind and rain when closed.

Although the description of a sectional door might appear obvious, there are other specialized components that require a high degree of expertise when installing and servicing sectional doors. In addition to sections and hinges, the door parts include rollers, track, counterbalance, and weather seal.

When the hardware is attached to the door, and the tracks and counterbalance system are installed, the final product is a complete upward acting sectional door. Sectional doors can be operated manually or automatically using a variety of automatic control systems.

Industry Organizations

The door and operator industry is supported by numerous organizations that shape standards, education, safety practices, and professional development. Each organization plays a distinct role in how products are designed, manufactured, installed, and maintained. The following section outlines the major organizations that influence the industry and the functions they serve.

Door & Access Systems Manufacturers' Association (DASMA) is North America's leading trade association representing manufacturers of garage doors, rolling doors, high-performance doors, garage door openers, vehicular gate openers, and access control products. DASMA's more than 100 member companies produce products sold throughout the United States, Canada, and in more than 70 countries worldwide. Collectively, DASMA members' products represent more than 95 percent of the U.S. market for the door and access systems industry. The association is organized into six divisions – five product-specific manufacturing divisions and an Associates Division for component and raw-material suppliers – and supports the industry through technical standards development, regulatory engagement, education, and safety initiatives.



dasma.com

International Door Association (IDA) is the leading trade association representing door and access systems dealers. Its mission is to advance the industry by providing advocacy, education, and collaboration that promote professionalism among dealers, installers, and suppliers. IDA serves as the primary network for professional door and operator dealers, offering programs, resources, and events that support business growth, technical competence, and ethical conduct. As a membership-driven organization, IDA relies on input from its dealer and supplier members to shape the programs, services, and industry initiatives it delivers.



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IDA Affiliate Organizations

IDA maintains an alliance with other door systems industry organizations, known as IDA Affiliates. These are individual trade associations whose missions are similar to the International Door Association. IDA recognizes them as Affiliates, and they work cooperatively to serve the garage door industry more effectively at the grassroots level.



The IDA Affiliates in the United States and Canada are:

- Central States Door Dealers Association (CSDDA)
- Michigan Door and Operator Dealers Association (MIDODA)
- Professional Door Association of New England (PDA)
- Western Access Systems Association (WASA)
- Canadian Door Institute (CDI)

See the IDA website for a complete list of other International Affiliates.

Institute of Door Dealer Education and Accreditation (IDEA) is a non-profit education foundation sponsored by DASMA and IDA. Its mission is to advance public safety and serve the public interest by promoting and recognizing professionalism in the door, gate, and access systems industry through education, accreditation, and certification. IDEA provides the educational resources necessary to develop and maintain a successful business, and to validate, certify, and accredit those door and operator dealers and industry professionals whose standards can meet IDEA's demanding criteria of business excellence and technical expertise.



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American National Standards Institute (ANSI): A



private, non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. ANSI also coordinates U.S. standards with international standards to support global use of American products. The Institute facilitates the development of American National Standards by accrediting the procedures used by organizations that work cooperatively to develop voluntary national consensus standards.

Occupational Safety and Health Administration (OSHA):



Created by the Occupational Safety and Health Act of 1970, OSHA promulgates and enforces workplace safety and health standards and provides consultative services to employers. OSHA regulations apply to most private sector workplaces in the United States and influence safety practices on virtually every job site.

Underwriters Laboratories® (UL):



UL is an independent organization involved in product safety testing, certification, and inspection. Through UL Solutions, the organization evaluates and certifies tens of thousands of products, components, materials, and systems each year. Underwriters Laboratories also develops safety standards through its nonprofit standards body, UL Standards & Engagement. UL plays a critical role in the door and access systems industry through its standard for safety, ANSI/CAN/UL 325 *Door, Drapery, Gate, Louver, and Window Operators and Systems*, which establishes safety performance requirements for door and gate operator systems. **ULC** is the Canadian division of UL Solutions and provides certification and standards development for the Canadian market.

National Fire Protection

Association (NFPA): A non-profit organization founded in 1896, NFPA's mission is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training, and education. NFPA is the world's leading advocate for fire prevention and an authoritative source on public safety. The organization is especially important to the fire door industry through NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, which governs the installation, inspection, testing, and maintenance of door systems used to protect openings in walls, floors, and ceilings against the spread of fire and smoke.



Consumer Product Safety

Commission (CPSC): A federal agency charged with protecting the public from unreasonable risks of serious injury or death associated with thousands of types of consumer products under its jurisdiction. The CPSC focuses on hazards such as fire, electrical, chemical, and mechanical risks, and works to prevent injuries to children. The agency's work is relevant to the door and access systems industry primarily through its oversight of residential garage door operators and related consumer-use products.



FM Approvals: FM

Approvals is the independent third-party testing and certification organization of FM Global, specializing in the evaluation of products and services used for property loss prevention. It conducts scientific testing to verify that products meet stringent performance, safety, and reliability standards related to fire, electrical hazards, building materials, and other loss-prevention concerns. Products that satisfy these requirements earn the FM APPROVED mark, indicating compliance with internationally recognized loss-prevention standards.



International Building Code

(IBC): A model building code developed by the International Code Council (ICC), the International Building Code establishes minimum standards to safeguard public health, safety, and general welfare in the design, construction, and operation of buildings. It has been adopted throughout most of the United States and addresses a wide range of topics, including structural design, fire and life safety, means of egress, accessibility, and building systems. Although a significant portion of the IBC focuses on fire prevention, both during construction and in the operation of completed buildings, it applies to all buildings and structures in jurisdictions where it has been adopted, except one- and two-family dwellings, which are regulated by the International Residential Code (IRC).



Canadian Standards

Association (CSA): A not-for-profit organization serving business, industry, government, and consumers. CSA develops consensus standards that address public safety and health, quality of life, environmental protection, and the facilitation of trade. Through its certification division, CSA functions as a neutral third-party in testing and certifying products to verify compliance with applicable standards.




Intertek: Intertek is a global provider of assurance, inspection, product testing, and certification services, supporting manufacturers, importers, and industries in verifying the safety, quality, and regulatory compliance of their products and systems. Headquartered in London, Intertek operates a worldwide network of laboratories and technical experts and traces its roots to the late 19th century, including early testing organizations such as the Lamp Testing Bureau founded by Thomas Edison. Today, Intertek delivers comprehensive Total Quality Assurance services across numerous sectors,



evaluating products, materials, and processes to ensure they meet applicable standards and performance requirements. Through its third-party testing and certification programs, Intertek issues widely recognized marks, most notably the ETL Listed mark, indicating that a product has been independently tested and found compliant with relevant safety standards.

Warnock Hersey (WH) Mark: As part of Intertek’s building and construction certification programs, the Warnock Hersey mark indicates that a product has been independently tested and certified for safety, performance, and compliance with applicable building codes and standards. The WH mark is widely recognized in North America, particularly for fire doors, fire rated frames, fire rated glazing, and fire rated countertops. Products bearing the Warnock Hersey label have been evaluated to meet the relevant fire, structural, and performance criteria required by code officials and authorities having jurisdiction.



Texas Department of Insurance (TDI):  Texas Department of Insurance
A state agency that regulates the Texas insurance industry and administers product evaluations for wind load performance in designated catastrophe areas along the Texas coast. Through its Windstorm Certification Program, TDI reviews and lists building products, such as exterior doors, windows, and garage doors, that meet the wind resistance requirements applicable in Texas coastal regions. Products approved by TDI are eligible for use in structures seeking windstorm insurance coverage through the Texas Windstorm Insurance Association (TWIA).

Florida Building Commission (FBC): A government body responsible for developing, maintaining, and updating the Florida Building Code. Through the Florida Product Approval System, administered by the Florida Department of Business and Professional



Regulation, the Commission oversees the process for issuing Statewide Product Approvals for wind load and other building products, indicating compliance with the provisions of the Florida Building Code.

Miami-Dade County Product Control



Division: An internationally recognized government agency responsible for evaluating and listing building products for use in the High Velocity Hurricane Zone (HVHZ) of Florida. The division issues Notices of Acceptance (NOAs), which verify that products comply with the stringent wind load, impact, and durability requirements of the Miami-Dade County Building Code. NOAs are required for many exterior building products used in Miami-Dade and Broward counties and are widely referenced by code officials and design professionals throughout Florida and other coastal regions.

United States Environmental Protection Agency (EPA): A



U.S. federal government agency created to protect human health and the environment. In the garage door industry, the EPA is most noted for its Lead-Safe Renovation, Repair and Painting (RRP) rule, which applies when painted surfaces are disturbed in homes built before 1978. The RRP program establishes requirements for lead-safe work practices, training, and certification to reduce the risk of lead exposure during renovation and repair activities.

IDEA Programs and Services

IDEA was created in 1995 as an independent credentialing and educational institute by a coalition of industry groups following more than a decade of discussions on how to advance door and access systems dealers as members of a professional industry.

The Door & Access Systems Manufacturers Association (DASMA), the International Door Association (IDA), and the American Rolling Door Institute (ARDI) agreed to establish IDEA as an independent entity with shared governance through allocated board seats. The two manufacturer organizations held six seats on the new Institute's board of directors, matched by six seats held by IDA. In 2006, ARDI merged with DASMA, maintaining the 6-6 balance of IDEA leadership positions equally divided between IDA and DASMA.

Dealer Accreditation was the first professional credentialing program launched by the organization. The first accreditation examinations were offered at the 1997 International Garage Door Exposition in Nashville, Tennessee. Since that time, IDEA has developed a series of programs designed to help dealers train new installers, develop skilled professionals, and create career paths for technicians.

The Accreditation curriculum consists of six parts:

- Accounting and General Business Principles
- Insurance and Legal
- Safety Management and OSHA Compliance
- Residential and Commercial Sectional Door Technical Essentials
- Commercial Rolling and Rolling Steel Fire Door Technical Essentials
- Sales and Marketing

Dealers must pass a written examination for each section. At least one person within each applicant company must pass all six examinations, ensuring exposure to the full spectrum of business management topics relevant to door dealers. While many additional factors contribute to running a successful door company, these six fields of study represent a broad foundation of essential knowledge.

In 2001, IDEA launched the Train-the-Trainer program. This one-day course teaches experienced installers how to train employees

and coworkers, significantly improving a dealer's ability to recruit and develop new workers. The program focuses on training skills, evaluation techniques, communication methods, and other instructional competencies that are as important as technical knowledge. IDEA created the Train-the-Trainer program in recognition of the fact that most technicians are trained on the job, and the program was designed to build a network of skilled, effective trainers.

Since the establishment of the Dealer Accreditation program, IDEA has continued to expand its educational offerings and has developed a variety of certification programs for installers, technicians, and other industry professionals. IDEA offers the following certifications:



- Residential Installer Certification (2002)
- Rolling Steel Fire Door Certification (2004)
- Commercial Sectional Door Systems Technician Certification (2006)
- Commercial Rolling Door Systems Technician Certification (2007)
- Automated Gate Operator Installer Certification (2008)
- Certified Door Dealer Consultant (2011)
- Certified Automated Gate Systems Designer (2013)
- Certified Automated Gate Systems Technician Level 1 (2022)
- Certified Automated Gate Systems Technician Level 2 (2023)
- Certified Automated Gate Systems Technician Level 3 (2024)
- Advanced Overhead Door Operator Technician Certification (2026)

A door systems technician who becomes certified in Residential Sectional, Commercial Sectional, Commercial Rolling, and Rolling Steel Fire Doors is automatically designated as an ***Automated Access Systems Master Technician***.



Similarly, a gate systems technician who becomes certified in Automated Gate Operator Installer and Gate Systems Technician Levels 1, 2, and 3 is automatically designated as an ***Automated Gate Systems Master Technician***.



While Dealer Accreditation is awarded to companies, certification credentials are issued to individuals. The intent is to build a professional community of qualified industry practitioners who can better serve the public. These credentials are voluntary – there are no federal, state, or local requirements mandating them for the sale or installation of door and access systems products.

However, as a form of voluntary self-regulation, credentials are important to consumers. Door and access systems are essential components of home and property security and safety. The industry recognizes that to provide the highest level of safety and security, the products must be installed, maintained, and serviced properly by trained professionals.

Section Two

Codes and Standards

The installation, inspection, and servicing of sectional doors are governed by a complex framework of codes, standards, and regulatory requirements that work together to ensure life safety, property protection, and reliable performance during. No single document covers every aspect of a sectional door system. Instead, technicians must understand how building codes, published standards, product listings, installation instructions, and workplace safety regulations intersect in real world applications.

This chapter provides a comprehensive overview of the primary codes and standards that shape the work of sectional door professionals, including those related to published standards, product listings, building code compliance, and annual inspection requirements.

Codes vs. Standards

A **standard** is a detailed, consensus based guide for technical specifics. Standards are typically voluntary, as they exist to establish consistency and acceptable approaches to systems, processes, and product development specifications. On their own, standards are **not** legally mandated.

A **building code** is a set of rules, regulations, or guidelines that are formally adopted into law and enforced by local, state, or federal authorities. Codes are designed to ensure public safety and maintain the integrity and functionality of buildings, structures, systems, and processes. Codes become legally mandated once adopted by a municipality, state, or federal agency. Many codes incorporate published standards by reference, which makes those standards legally enforceable.

Published Standards

Published standards play a critical role in the design, testing, installation, and maintenance of sectional doors and operators. These documents define accepted technical practices, performance criteria, and testing methods used throughout the industry. Although standards are typically voluntary, they often become enforceable when referenced by building codes, adopted by Authorities Having Jurisdiction (AHJs), incorporated into contracts, or required as part of a product's listing.

Several standards apply directly to sectional doors, including those that specify requirements for electric operation. Prominent standards development organizations include Underwriters Laboratories (UL), ASTM International, and the National Fire Protection Association (NFPA). One highly relevant UL standard is ANSI/CAN/UL 325 (door, gate, and window operator systems). One relevant NFPA standard is NFPA 5000 (Building Construction and Safety Code).



DASMA is an ANSI-accredited standards development organization that publishes voluntary standards related to sectional doors, rolling doors, door operators, and other topics. While compliance with DASMA standards is not mandated by law, many manufacturers follow them to promote consistency, safety, and industry best practices. Some DASMA standards have achieved ANSI approval, while others are still undergoing the ANSI consensus process and will receive the ANSI/DASMA designation once final approval is granted.

Building Codes

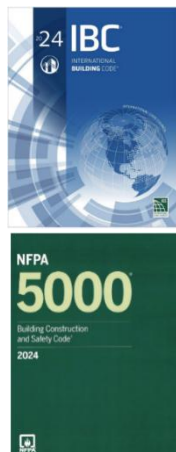
Building codes are sets of rules and regulations adopted and enforced by local, state, or federal authorities to protect public safety and ensure the proper design, construction, and performance of buildings and related systems. Once a code is formally adopted by a jurisdiction, its requirements become legally mandatory. Many codes incorporate published standards by reference, making those standards enforceable as part of the code.

For sectional doors and operators, published standards are referenced throughout various building codes, and the codes themselves often contain additional provisions that apply to electric operation. Historically, multiple **Model Building Codes** existed in the United States, each developed by different code agencies.

Model building codes are nationally developed, consensus-based documents that establish minimum requirements for building design, construction, and installation practices. They are not laws until adopted by a state or local jurisdiction. Because they reference numerous published standards, those standards also become legally enforceable once the model code is adopted.

Model codes may be adopted at the state level, with or without amendments, or at the municipal level, where local amendments may also apply. Larger cities and counties may even develop their own building codes.

The two most prominent model building codes for commercial and multifamily construction are the **International Building Code (IBC)**, published by the International Code Council (ICC), and **NFPA 5000 Building Construction and Safety Code**, published by the National Fire Protection Association (NFPA). Of these, the IBC model code is by far the most widely adopted



throughout the United States and forms the basis for most state and local building regulations.

For one- and two-family dwellings and townhouses, the ICC also publishes the **International Residential Code (IRC)**, which serves as the companion residential model building code and is adopted by most jurisdictions alongside the IBC.

One of the most important responsibilities of a sectional door technician is to verify which code is in effect in the jurisdiction where the product is being installed. Even neighboring communities may enforce different codes, and different project types may fall under different code requirements. For example, a commercial building project may have requirements that differ significantly from those of a single-family residence, and multi-family projects may fall under commercial codes rather than residential ones.

Local building codes and officials are only one source of requirements. Architects, insurance underwriters, risk-management professionals, and other stakeholders may impose additional performance criteria beyond those required by the adopted code. These requirements must be identified early in the project to ensure the door assembly meets all specified performance expectations.

Finally, both codes and standards are developed in cycles – sometimes annually, sometimes every two or three years. Even when a new edition is published, a state or local jurisdiction may not adopt it immediately, or at all. Technicians must always confirm which edition of a code or standard is legally in effect for the project at hand.

Licensing

Some states and local jurisdictions require contractors to hold a specific license to install or service sectional doors, operators, or related components of a door system. In many regions, it is illegal to perform contracting work of any kind, including sectional door installation, without first obtaining the appropriate license.



Licensing requirements vary widely, but most jurisdictions require applicants to submit an application, document a minimum amount of experience, and pass one or more examinations. These exams typically cover general construction practices, business and financial management, contracts, and state-specific laws rather than material unique to sectional doors or operators. Many areas also require licensed contractors to display their license number in advertising and include it on contracts, proposals, and invoices.

Violating licensing laws in jurisdictions that require them can result in fines, civil penalties, loss of the right to operate, and in some cases, criminal charges. It is essential to research and understand the licensing requirements in every area where you perform work to ensure your company remains compliant.

Lead Renovation, Repair, and Painting

In April 2008, the US Environmental Protection Agency (EPA) issued the Lead Renovation, Repair, and Painting (RRP) Rule. The rule became enforceable on April 22, 2010, and requires that work in homes and child-occupied facilities built before 1978 follow specific lead-safe practices when disturbing more than 6 square feet of interior painted surface per room or more than 20 square feet of exterior painted surface. The RRP Rule requires both firm certification and individual renovator certification, along with specific training and work-practice standards for everyone involved on the job site.

The first certification is for the firm or dealer contracted to do the work. The company must apply to EPA (or an authorized state program) for certification. Once approved, the firm must assign a Certified Renovator to each covered job, use only certified or properly trained workers, and comply with all recordkeeping and work-practice requirements in the rule. Firm certification is generally valid for five years under EPA's program.

The second certification is for the individual renovator. To become a Certified Renovator, an individual must complete an EPA-accredited 8 hour course that includes both classroom instruction and hands-on training, and must pass the required assessments. This certification is typically valid for five years under EPA's program (some authorized states may have different renewal periods). The Certified Renovator is responsible for training non-certified workers in lead safe work practices, posting warning signs, setting up and maintaining containment, overseeing compliance with lead safe methods, maintaining required records, and performing the final cleaning verification at the end of the job.



At the time of publication, the following states operate EPA-authorized RRP programs with their own requirements and procedures: Alabama, Delaware, Georgia, Iowa, Kansas, Massachusetts, Mississippi, North Carolina, Oklahoma, Oregon, Rhode Island, Utah, Vermont, Washington, and Wisconsin. The Minnesota Chippewa Tribe–Bois Forte (Nett Lake) also operates an authorized tribal program. Because state authorization and requirements can change, always verify current RRP rules and certification procedures in every jurisdiction where work is performed.

The International Door Association (IDA) has compiled additional information and documents on their website to help dealers and technicians with RRP compliance. Visit their website to learn more.

Insulation and Thermal Energy Transfer

Insulation is material that retards the flow of energy. Energy (heat) always flows from a high energy source to a low energy source, such as warmth flowing to cold, until the temperatures equalize. By slowing this transfer, insulation helps maintain temperature differences between spaces. Many insulating materials also reduce sound transmission, since the same physical properties that resist heat flow can dampen vibration and noise.

Heat flow is commonly measured in British Thermal Units (BTUs). One BTU is the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. To evaluate how well a slat or complete door system resists this heat flow, the industry uses several standardized thermal performance ratings.

R-Value: Used to measure a material's *resistance to heat flow* and is the most commonly used metric for determining the thermal performance of an insulating product. A product's R-value represents its ability to

retard heat flow. R-values are expressed numerically, with higher numbers indicating better insulating performance and lower numbers indicating poorer performance. Thus, a product with an R-value of 4.00 provides greater resistance to heat flow than a product with an R-value of 2.00. English (Imperial) units for R-value are $\text{ft}^2 \cdot \text{hr} \cdot ^\circ\text{F} / \text{BTU}$, and metric (SI) units are $\text{m}^2 \cdot \text{K} / \text{W}$. See DASMA TDS 163 for further information.

K-Value: Used to measure an insulation material's *thermal conductivity*. Thermal conductivity is defined as the degree to which a material facilitates the flow (conduction) of heat. K-values are expressed numerically, typically as decimals, with higher values indicating higher conductivity (which reduces insulating performance) and lower values indicating lower conductivity (which improves insulating performance). English (Imperial) units for K-value are $\text{Btu} \cdot \text{in} / (\text{ft}^2 \cdot \text{hr} \cdot ^\circ\text{F})$, and metric (SI) units are $\text{W} / (\text{m} \cdot \text{K})$.

K-value is calculated by dividing a product's insulation thickness by its R-value. An example of this calculation is as follows:

Material: 1.00 inch thick EPS with an R-value of 3.85 per inch.

K-value: $1.00 \div 3.85 = 0.259$ (K-value)

U-Factor: Used to measure the *overall thermal transmittance* of a wall system or, in this case, a sectional door assembly. It accounts for the thermal properties of all components within the system and the performance of the assembly as a whole. Like K-value, a door system's U-factor is typically expressed as a decimal, with lower values indicating better thermal performance. U-factor is determined through testing. The U-factor of an assembly cannot be derived by dividing 1 by the R-value of the curtain. English (Imperial) units for U-factor are $\text{Btu} / (\text{ft}^2 \cdot \text{hr} \cdot ^\circ\text{F})$, and metric (SI) units are $\text{W} / (\text{m}^2 \cdot \text{K})$. See DASMA TDS 163 and 196 for further information.

Method of Determining Thermal Performance

Thermal performance ratings (section R-value, insulation K-value, and assembly U-factor) can be derived either by calculation or by testing. Calculated values are typically based on the mean section profile and do not account for factors such as section joints, jamb interfaces, or building connections. Tested values are obtained from laboratory testing of a complete installed door system. It is important to understand which method was used to generate published thermal performance ratings when comparing products, because calculated and tested values measure performance under different conditions and are not directly comparable. Generally, published ratings for R-value and K-value are determined through calculation, while U-factor is determined through full assembly testing. See DASMA TDS 163 and 196 for further information on manufacturer published insulation values.

DASMA Thermal Performance Verification

To improve consistency and transparency in published thermal ratings, DASMA established the *Thermal Performance Verification (TPV)* program.



The DASMA Thermal Performance Verification (TPV) Program is a voluntary program to certify and verify the thermal performance ratings of sectional door products using third-party testing and inspection. The program represents a shift in how sectional garage door thermal performance is rated, from traditional R-value to more accurate and relevant U-factor. U-factor ratings are tested whereas R-value is calculated. U-factor tests the whole installed assembly and R-value is calculated for only a portion of section insulation.

Member companies of DASMA that manufacture sectional doors voluntarily agree

to participate in the program. Third-party tests are conducted at labs according to ANSI/DASMA 105. Tests and certifications are submitted to the program administrator, ICC-ES. Participants agree to abide by all program rules and requirements.

Doors that participate in the program provide:

- Verified thermal performance values
- Clear identification of whether values are calculated or tested
- Greater confidence for architects, builders, and consumers when comparing products

Products which have been included in this program will be identified with the DASMA TPV badge, label, or icon mark.



Referencing DASMA's program helps ensure that published values reflect reliable, industry-accepted methods rather than marketing-driven calculations. Reference DASMA TDS 196 and DASMA's website for more information.

Flame Spread and Smoke Developed

Flame Spread rating is a numerical value that compares how quickly a material burns relative to two reference materials: cement asbestos board (rating of 0) and red oak (rating of 100). These ratings are determined using the *Steiner Tunnel Test*, in which the material is mounted to the ceiling of a horizontal test tunnel and exposed to a controlled gas flame. As the material burns, observers measure how far and how quickly the flame propagates along its surface. The resulting flame spread index is a unitless value indicating how rapidly fire can travel across that material compared to the established benchmarks.

Most building codes require materials used in residential and commercial construction to have a flame spread rating of 75 or less,

placing them in Class B or better for interior finish applications.

Smoke Developed rating measures the density of smoke a material produces when burned in the *Steiner Tunnel Test*. As the material combusts, smoke is drawn through a duct where a photometric device measures its optical density. The resulting value indicates a unitless comparison of how much smoke the material generates relative to the same baseline reference materials used for flame spread.

Building codes typically require a smoke developed rating of 450 or less for materials used in residential and commercial construction. This rating is important because smoke, often more dangerous than flame, can impair visibility, hinder evacuation, and contribute to toxic inhalation hazards.

Materials with a flame spread rating (aka index) not exceeding 75 and a smoke developed rating not exceeding 450 are classified as Class B. Standard test methods for determining these ratings are ASTM E84 and UL 723.

Sound Transmission

Noise reduction for building components such as sectional doors is evaluated using **STC** (**Sound Transmission Class**) and **OITC** (**Outdoor-Indoor Transmission Class**) ratings, and both are expressed as dimensionless numerical ratings that represent how effectively a partition reduces sound transmission. STC and OITC ratings are laboratory derived indices based on how the material performs across specific ranges of sound frequencies.

STC is the most common rating for interior partitions and building components. It is based on how much a material reduces sound across a standardized range of mid to high frequency noise (speech, office noise, general indoor

sounds). A higher STC value indicates better sound reduction.

OITC is designed for exterior noise, especially low frequency sounds such as traffic, aircraft, and industrial equipment. OITC uses a broader and lower frequency range than STC, making it more relevant for doors exposed to outdoor noise sources.

In the simplest sense, you can think of a door with an STC rating of 20 as *roughly comparable* to reducing an 80 decibel sound on one side of the door to about 60 decibels on the other. In actuality, an STC 20 door does not literally mean “80 dB becomes 60 dB”. Instead, it means the door’s overall sound transmission performance matches the standardized reference contour for STC 20. Sound Transmission ratings are useful for relative comparison of products, but they are not a direct decibel subtraction measurement.

Air Infiltration

Air infiltration ratings quantify the amount of air that passes through a door system when exposed to a pressure differential. These ratings are determined through physical testing of a standard sized door, most commonly a 10 foot x 10 foot assembly, installed in a test chamber. During the test, a pressure difference is applied to the exterior face of the door to simulate wind loads typically equivalent to 15 to 25 miles per hour. As pressure is applied, a calibrated flow meter measures the volume of air that leaks through the door’s joints, perimeter interfaces, and hardware penetrations.

The resulting value is expressed in cfm (cubic feet per minute), representing the volume of air leakage at the specified pressure. Lower cfm values indicate better air leakage resistance, meaning the door provides a tighter seal and improved environmental control. Air infiltration performance is influenced by factors such as

section joint design, perimeter weather seals, and the rigidity of the door assembly.

Air leakage affects both energy efficiency and comfort in conditioned spaces. In commercial and industrial settings, excessive infiltration can increase heating and cooling loads, introduce dust or contaminants, and reduce the effectiveness of climate controlled environments.

Manufacturers often pair air infiltration ratings with U-factor data to provide a more complete picture of a door's thermal performance. A door with a high R-value but poor air seal performance may still allow significant heat loss due to uncontrolled airflow.

Seismic Qualification

Commercial sectional door installations in public safety and/or earthquake prone applications may encounter requirements for **Seismic Qualification**. This means the door requires certificates and/or calculations from the manufacturer showing the ability of the door system to endure the loads anticipated from an **earthquake**.



An example specification for this is "Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7." *Withstand* means the door will remain in place without separation of any parts from the door when subjected to the seismic forces specified. Doors meeting this specification may require

larger or more frequent wall attachment fasteners, larger shafts, heavier track, etc.

The dealer will have to supply the manufacturer information from the Architect's plans in order for the manufacturer to engineer the door properly. Examples of information needed are building height, site class (A, B, C or D), occupancy category (I, II, III or IV), building code reference, seismic design category, component importance factor, spectral response-Ss, spectral response-S1, and jamb configuration.

When installing a door subject to these requirements, the installer should verify that the components provided match that indicated on the seismic qualification documentation and are installed in accordance with the manufacturer's instructions.

Wind Load Requirements

Wind is the organized translation of large amounts of air at one time. It can shape landforms, transport dirt and debris miles away, uproot trees, and damage buildings. From a windy day to thunderstorm microbursts, tornadoes, and hurricanes, Mother Nature can produce unexpected high winds virtually anywhere in the world. This section aims to give a general understanding of wind loads and garage doors.



Studies of damage to buildings as a result of hurricanes and other high wind events found

that one common cause of catastrophic building failure was a pressure buildup within the building. Much like inflating a balloon until it pops. Researchers found that the cause of this pressure buildup was a breach somewhere in the exterior envelope of the building which allowed high winds to enter. With nowhere to exit, these high winds cause an increase in pressure that eventually can blow out windows, walls, or even blow off roofs.

A sectional door is a significant component in a building's ability to withstand high winds because it often closes the largest opening(s) on a building. An open door, or one which fails during high winds, can create a very large breach in the outer envelope. This opening can allow large amounts of wind to enter at once and rapidly increase the internal pressure until the building fails. This is just one reason why it is important for sectional doors to carry the wind load rating for the location where they will be installed.

Winds are often measured by their speeds. Meteorologists use a measuring instrument called an *anemometer* to measure the wind speed and often report the speed of the peak gusts during a given wind event. The smoother the terrain, the faster the wind speeds can become. Similarly, the more obstructions the wind encounters, the less speed can develop. Required wind load ratings are typically higher in areas near the coast of a large body of water, where there are no obstructions, than in urban areas where numerous closely spaced obstructions are present.



In building design, it's important to understand that wind speed units differ between meteorology and engineering. Meteorologists and the media typically report wind speeds using the 1-minute sustained wind, which is the average wind speed measured over a one-minute period. This is the standard used to classify hurricanes and other weather events.



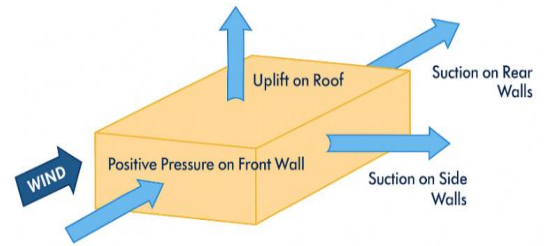
By contrast, building codes such as the International Building Code (IBC), which references ASCE/SEI 7, use the 3-second peak gust as the basis for structural design. This represents the highest wind speed averaged over a 3-second interval and is typically about 15 mph higher than the 1-minute sustained wind for the same storm event. This difference is critical when interpreting wind maps and design requirements.

In structural engineering, wind is evaluated not just by its speed but by the load it exerts on the surfaces it encounters. That load is expressed as a pressure, measured in psf (pounds per square foot), which quantifies the force applied to each square foot of exposed surface area, such as a garage door, wall panel, or roof system.

Converting wind speed to psf is a complex process governed by formulas in building codes and standards. The calculation considers multiple factors, including:

- **Exposure category**, which accounts for the terrain and surrounding obstructions that influence how quickly wind accelerates toward the building.
- **Building height and geometry**, because taller or more irregular structures experience higher pressures.
- **Importance factor (risk category)**, which increases required design loads for buildings where failure would pose greater risk to life or property.

- **Internal and external pressure coefficients**, which describe how wind interacts with surfaces – pushing, suctioning, or creating uplift depending on direction and shape.
- **Wind directionality and enclosure classification**, which adjust the load based on how wind approaches the structure and whether the building is open, partially enclosed, or fully enclosed.



Because these variables differ by jurisdiction and application, wind load ratings must be determined using the specific code adopted in your area.

To help clarify this process, DASMA has published TDS 155, which explains how wind speed relates to wind pressure and outlines wind load requirements across various standards and codes. TDS 155 includes conversion tables and formulas, regional wind speed maps, code references (IBC, ASCE/SEI 7, Florida Building Code, etc.), and guidance for specifying wind rated sectional doors. Due to its technical depth, TDS 155 is best consulted directly. You can download it from the DASMA website to ensure your designs and product selections meet local wind load requirements.

Winds can impart forces on sectional doors and buildings in two different directions. The first is called *Positive* wind load. In the positive direction, winds hit the door directly and attempt to blow the door into the building, similar to the sail on a sailboat. The second direction is called *Negative* wind load. Typically caused by crosswinds on the sides of the building, and turbulent suction on the trailing end of the building. Negative wind loading attempts to suck the door outward. Both loading directions must be accounted for in the door design to ensure proper performance.

Another wind load related performance requirement in some areas is for Impact resistance. High wind events can involve flying debris which can crash into a garage door. These impacts can cause damage to the door which lessens its wind load resistance, particularly if windows are involved. Impact rated doors have undergone special testing to ensure the wind load performance is maintained after several impacts. The testing involves firing a 2x4 out of a cannon at 50 feet per second (34 miles per hour) and impacting numerous key areas of the door. To pass this testing, the impact cannot result in a hole in the door exceeding the allowable limits. In addition, the door must then endure prescribed cyclic wind load testing to ensure the wind load resistance has not been compromised.



Impact rating is no longer limited to hurricane prone regions near the coast, and is often required outside of these regions. According to the International Building Code, the wind-borne debris region is where glazing is required to be impact rated. Increasing requirements for impact resistance has been driven in part by the insurance industry in an effort to reduce the amount of water damage caused by impact penetration in the outside envelope of the building.

There are typically two classifications for sectional doors with respect to wind protection. The first is wind load rated products that are designed to meet a specific pressure rating. These doors have pressure ratings in both the positive and negative direction. The second, in addition to an assembly being rated for pressure, it is designed and evaluated to meet enhanced protection standards that require the

complete door assembly to have been evaluated for impact-resistance, including the glazing if the door has glass.

For most of the United States, the doors must be designed in accordance with the International Building Code, but for some parts of the United States it is required that the doors have approvals from certain approval agencies. Examples of these include Florida Product Approval - required for all doors installed in Florida, Miami-Dade Notice of Acceptance - required for Dade and Broward counties in Florida, and Texas Department of Insurance Windstorm Inspection - required for areas along the Texas coast that need windstorm inspections.

No matter which level of protection that the job requires, it is critical that only the components listed on the wind load design drawing are used, and that no components are substituted or omitted unless approval has been obtained from the manufacturer.

When ordering a door, it is critical to check with the building specifications, as well as the local Authority Having Jurisdiction (AHJ), to ensure that the product ordered will be in compliance with the wind load requirements. As mentioned previously, DASMA has published a number of TDSs that can help determine the required wind load ratings in your area.

Specification of higher wind loads for sectional doors can result in many product changes which may not be obvious to the untrained eye. It is important to understand the implications of specifying higher wind loads because these changes can increase the cost of the door. First, additional and/or larger/thicker struts may be added to the door. The sections may be built utilizing thicker steels and may require special backup plates, and the hardware may interface differently to handle the added hinge loads. Additional jamb brackets and thicker gauge track may be required. Many of these items of course cause the balance weight to go up which could result in requiring larger

springs. Some doors use vertical reinforcement systems which require the user to install post(s) across the opening when a high wind event is expected. It may not be possible to convert a door to handle higher wind loads in the field if the door was not ordered with the proper rating.

Garage Doors and High Wind Events (DASMA TDS 152)

Garage doors are typically in the largest openings associated with building structures. There are several items that should be kept in mind regarding a garage door's wind load performance in high wind events.

- 1) The appropriate protection is provided with a garage door that is rated to the required design pressure. A garage door is subject to either being blown into the garage or pulled out of the opening. Therefore, both positive and negative pressure ratings are important.
- 2) Positioning a vehicle against a garage door is not recommended. This does not provide reinforcement for the door and may damage the vehicle and the door.
- 3) A garage door should be closed and secured prior to a high wind event. The door should be wind resistant to local requirements. Keeping a garage door open during a high wind event leaves the interior walls, ceilings, and roof structure vulnerable to structural damage and possible collapse of the structure. In all cases the building owner must accept responsibility for properly securing each door in the closed position in anticipation of a high wind event. Refer to the manufacturer's documentation for details.
- 4) DASMA does not recommend the operation of garage doors, grade level or loading dock, during high wind events. The increased operational force needed to manually open or close the door may cause injury to personnel and/or may damage the door.

- 5) Adding weight, particularly non-manufacturer-specified reinforcement, to a door can create a dangerous situation that may result in property damage and/or personal injury. Owners should avoid adding reinforcement to a garage door themselves. This will increase the weight of the door and may result in failure or collapse of the supporting tracks or other components that may not be suitable to carry the extra weight. Upgrading garage doors by adding reinforcement can require a package that includes appropriate springs and hardware and supporting track. Contact a trained door systems technician regarding this matter. In addition, please refer to DASMA TDS 153 for guidance concerning vertically reinforcing sectional garage doors.
- 6) In some coastal areas subject to storm surges other requirements may apply that override wind load resistance. Refer to DASMA TDS 184 for further information.
- 7) If you question your garage door's ability to resist high winds, contact a design professional to evaluate both the door and the surrounding frame of the opening. Keep in mind that the attachment of both the door track and the door jamb to the structure are just as critical as the strength of the door itself. Refer to DASMA TDS 161 for further information.
- 8) DASMA TDS 183 should be consulted for situations involving component substitution on wind load rated doors.

Vertically Reinforcing Sectional Garage Doors for Wind Load Conditions (DASMA TDS 153)

Introduction: Door manufacturers commonly specify horizontal reinforcement (i.e., struts) to make their doors wind load resistant. In some cases, horizontal reinforcement is not sufficient, and vertical reinforcement (i.e., a post system) is required.

Common Vertical Post Concept Options:

Common scenarios of the vertical post concept include:

1. *A post system integrated into the door design.* Here the homeowner is required to secure the post in accordance with the manufacturer's instruction, usually by some mechanical means such as the turning of a crank or movement of a lever.
2. *A post system supplied with the door by the manufacturer.* The door manufacturer supplies the homeowner with instructions, and the homeowner must secure the post by an established assembly procedure.
3. *A post system that a homeowner may purchase as an aftermarket product.* NOTE: A post, or any product, not purchased from or specified by the door manufacturer, may not result in a door that properly resists the wind. Contact the door manufacturer to assess the benefit of an aftermarket post system. A post system purchased aftermarket may constitute a "component substitution". More details on component substitution can be found in DASMA TDS 183.

Compliance with Relevant Standards: Doors using vertical reinforcement posts as a component of a new door system should comply with industry standards such as ANSI/DASMA 102. This standard contains specifications for garage doors. Doors using posts should have been tested in accordance with a nationally recognized uniform static air pressure testing standard and meet the acceptance criteria. DASMA has published ANSI/DASMA 108, which contains a uniform static air pressure testing method and acceptance criteria relevant to garage doors.

Support from Existing Building Structure:

Garage door reinforcement in the form of vertical posts transmits wind load forces to the garage door opening header and to the garage floor. When vertical posts are installed in a garage door, the door still transmits forces to the entire surrounding structural support,

including the header and the vertical support members where the track attaches. Because the use of vertical reinforcement may increase the force applied to the garage opening header, it is recommended that a qualified design professional perform an assessment of the building structure prior to the installation of any vertical reinforcement. It is strongly advised that the garage door manufacturer be contacted for any questions or concerns related to sectional garage doors and vertical reinforcement.

Homeowner Responsibility: In all cases the homeowner must accept responsibility for properly securing the vertical post in position in anticipation of a hurricane or other high wind event. For retrofitted doors, the door installer should explain the installation instructions. For new construction, the building contractor should explain these instructions. In most cases, if an electric door opener is installed, it should be unplugged to prevent accidental operation of the door while the vertical post is in place. Contact the door manufacturer for details.

Building Department Involvement: If a building inspector is required to inspect a vertically reinforced door as part of a door permitting process, such reinforcement should be installed and fully engaged at the time of the inspection.

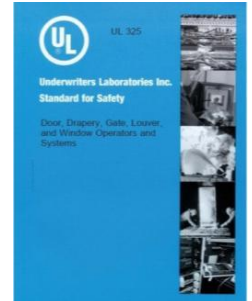
Labeling: Manufacturers may also choose to create labels. One label could be a general instructions-oriented label advising that the post system be installed/engaged when hurricane or other high wind warnings are issued. Another label could contain product specific instructions for preparing the garage door and for installing/engaging the post system.

Conclusion: Homeowner education is the key to successful use of vertical reinforcement for sectional garage doors to resist high winds. Effective education should result in the use of such reinforcement being no different than

homeowners securing doors and windows during such events. Any questions about specific products should be directed to the garage door manufacturer.

ANSI/CAN/UL 325

Underwriters Laboratories (UL) is an independent safety organization that develops standards and provides testing, certification, and evaluation services for a wide range of electrical products and systems. UL has long been involved in establishing safety requirements for door, gate, and operator equipment. The standard governing these products is now formally designated ANSI/CAN/UL 325, reflecting its harmonization across the United States and Canada. Although the official title is **ANSI/CAN/UL 325 Door, Drapery, Gate, Louver, and Window Operators and Systems**, this study guide will refer to it as UL 325 for simplicity.



UL 325 History

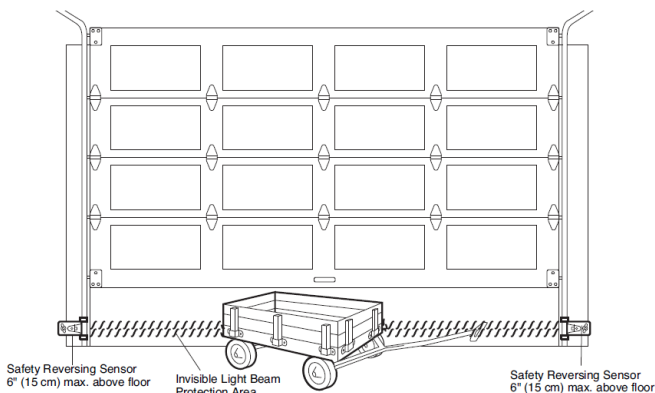
The first edition of UL 325 was published in April 1973, marking the point at which motorized door operators were formally recognized as a distinct product category rather than being treated simply as electric motors. This shift acknowledged that garage door operators required safety provisions beyond basic motor protections. Over the decades that followed, UL 325 underwent numerous revisions to address emerging technologies, evolving safety concerns, and changes in industry practice.

Today, the standard is published under the harmonized title ANSI/CAN/UL 325, reflecting joint adoption in the United States and Canada. UL itself has since separated into two organizations: UL Standards & Engagement,

the non-profit standards development body responsible for maintaining UL 325, and UL Solutions, the for-profit testing and certification organization that evaluates products for compliance.

A major early milestone occurred in 1982, when the timed-reversing requirement for residential operators became effective. This rule required an operator to automatically reverse the door to the open position if the close limit was not reached within 30 seconds of a close command. Prior to this change, contact-reversing was the only entrapment protection requirement for residential operators.

In 1990, the Consumer Product Safety Commission (CPSC) became involved in the development and enforcement of UL 325 following a grassroots effort to improve residential garage door operator safety. This involvement led to significant revisions requiring operators to use external entrapment protection devices, such as photoelectric sensors or sensing edges, and to monitor those devices to ensure they were functional before allowing a door to close from a remote control or a single press of a wall button. These requirements became effective on January 1, 1993.



The CPSC requirements were incorporated directly into UL 325, and after January 1, 1993, manufacturers could demonstrate compliance by applying the UL mark. Compliance may be shown through testing and evaluation performed by UL Solutions or by an

independent accredited laboratory certifying that the product meets the requirements of UL 325. Compliance is verified through type testing of representative samples and maintained through periodic factory audits.

In 2008, UL 325 underwent a significant update aimed at improving the consistency and reliability of inherent entrapment protection. The revision strengthened the contact-reversal requirement for residential operators by specifying a minimum reversal distance of two inches after the door encounters an obstruction. It required that if the door encounters a second obstruction during a subsequent closing attempt, the operator must drive the door fully open. Furthermore, the standard clarified that when an inherent entrapment circuit senses an obstruction during upward travel, the operator is not required to return to the full upmost position, it can simply stop. These refinements helped ensure more predictable and measurable safety performance across manufacturers.

In 2009, the standard was further revised to address unattended closing features, such as timers-to-close and smartphone based controls, by establishing rules for audible and visual warnings and other safeguards. Later editions continued to strengthen and clarify these requirements.

Revisions to UL 325 in 2010 expanded and clarified requirements for commercial and industrial door operators, particularly in the areas of entrapment protection, control functions, and environmental considerations. These updates strengthened the expectations for monitored external entrapment protection devices on commercial operators using momentary contact controls, aligning them more closely with the residential rules adopted in the 1990s. Prior to 2010, commercial and industrial operators still required external entrapment protection devices, but those devices were not required to be monitored.

This revision also refined provisions for timer-to-close functions, requiring appropriate audible and visual warnings before unattended movement, and clarified how commercial operators must respond to faults in monitored devices - typically by reverting to constant pressure to close operation. Additional updates addressed special-purpose operators, such as those used on rolling steel doors, grilles, and fire door systems, ensuring that their unique operating environments and safety needs were reflected in the standard. Collectively, the 2010 changes helped modernize commercial and industrial operator requirements and laid the groundwork for later revisions related to connectivity and advanced control systems.

Following the 2010 update, UL 325 continued to evolve in response to new technologies, expanded operator capabilities, and the growing use of network-connected controls. Revisions in the early 2010s strengthened requirements for monitored external entrapment protection devices, clarifying how operators must detect faults and how they must respond when a monitored device is disconnected, shorted, or otherwise unable to provide a valid signal. These changes ensured that both residential and commercial operators default to constant pressure to close whenever a monitored device cannot be verified as functional, reinforcing the safety principles first introduced in the 1993 revisions.

As smartphone based controls, building automation systems, and cloud connected operators became more common, UL 325 introduced additional provisions governing unattended operation. These revisions expanded the rules first established in 2009 by defining how operators must handle network initiated close commands, including requirements for audible and visual warnings, minimum warning durations, and consistent behavior across all forms of remote activation. These updates ensured that timers-to-close, app-based controls, and automation systems all meet the same safety expectations,

regardless of the technology used to initiate movement.

Later revisions also addressed the increasing complexity of commercial and industrial operator applications, refining requirements for monitored devices, force-limiting performance, and the behavior of operators used on rolling steel doors, grilles, and other specialty systems. Updates clarified how commercial operators must respond to entrapment protection faults, how monitored edges and photoelectric sensors must be supervised, and how operators must behave when integrated into larger access control or facility automation networks. These changes helped align commercial operator safety with the more stringent expectations already applied to residential systems.

In 2017, the standard transitioned to its current harmonized designation, ANSI/CAN/UL 325, marking its joint adoption in the United States and Canada. This period also aligned with UL's organizational restructuring, in which standards development moved to UL Standards & Engagement, a non-profit entity, while testing and certification activities became part of UL Solutions, a for-profit organization. Although this restructuring did not alter the technical requirements of UL 325, it is historically significant because it defines the modern framework for how the standard is maintained and published. Canada later adopted ANSI/CAN/UL 325 as its sole national standard for commercial and industrial operators in 2023.

Standards Development

UL Standards & Engagement develops standards through a consensus based process that includes participation and comment from both the affected public and the affected industry. For UL 325, the operator industry works with UL through a Technical Committee (TC), which includes representatives from

operator manufacturers, manufacturers' associations, and other interested parties.

The TC is composed of volunteers from various stakeholder groups, including manufacturers, users, regulators, and technical experts. Anyone may submit comments, proposed changes, or revisions for consideration. The TC reviews these proposals, provides feedback, and votes on whether to adopt them.

UL standards are living documents, and revisions may occur at any time. The edition number may or may not change with each revision; when it does not, updated pages are issued to the appropriate parties. A UL standard, including UL 325, is current only when it incorporates the most recently adopted revisions.

Although UL 325 is the safety standard for *Door, Drapery, Gate, Louver, and Window Operators and Systems*, it relies on and incorporates numerous other UL standards for specific test methods and performance requirements.

Some examples are:

| | |
|---------|---|
| UL 498 | Attachment Plugs and Receptacles, Electrical |
| UL 817 | Cord Sets and Power Supply Cords |
| UL 1004 | Motors, Electric |
| UL 746 | Polymeric Materials |
| UL 796 | Printed Wiring Boards, Electrical |
| UL 94 | Plastic Materials for Parts in Devices and Appliances, Tests for Flammability |
| UL 506 | Transformers, Specialty |
| UL 991 | Tests for Safety Related Controls Employing Solid State Devices |

UL 325 Standard Layout

UL 325 is organized into a series of major sections that define scope, construction requirements, safety provisions, performance

tests, and documentation obligations for door, drapery, gate, louver, and window operators and systems. The primary sections include:

- **Contents:** Introduces the standard and defines its scope, units of measure, terminology, and glossary.
- **Construction:** Covers general construction requirements, including frames, enclosures, mechanical assemblies, and component characteristics.
- **Protection Against Risk of Injury to Persons:** Addresses safety requirements related to moving parts, surface temperatures, pedestrian doors and operators, industrial and commercial door operators, residential garage door systems, and gate operator systems.
- **External Entrapment Protection Devices:** Specifies requirements for photoelectric sensors, edge sensors, and related devices, including installation and instruction requirements for residential and commercial door operators.
- **Performance:** Defines test methods and acceptance criteria, including leakage current tests (before and after humidity conditioning), input current, normal temperature, dielectric voltage withstand, insulation resistance, metallic coating thickness, gasket aging, switch and control testing, strain relief, puncture resistance, and permanence of marking.
- **Manufacturing and Production Tests:** Specifies required production-line tests such as dielectric voltage withstand and grounding continuity.
- **Instruction Manual:** Details requirements for installation instructions, user instructions, and field-installed labels.
- **Marking:** Specifies required product markings and identification details.
- **Appendix A - Standards for Components:** Lists referenced UL standards and other component-level standards used for test methods and compliance.
- **Supplements and Annexes:** Provide additional requirements, clarifications, or

alternative test methods. These may address:

- Special operator types or configurations
- Additional safety considerations
- Region specific or application specific requirements
- Informative guidance that supports the normative sections of the standard

Supplements and annexes are now a routine part of UL 325's structure and should be reviewed alongside the main body of the standard to ensure full compliance.

Impact

This standard covers the design, manufacture, and installation of the products. Even the instruction manuals are evaluated when the type testing is accomplished. Any changes made to the products during installation can void the manufacturer's warranty, and create an unreliable, or worse, an unsafe product.

Every installation should have the proper product selected. Use the correct tools for the job. Always follow the installation instructions. Always use the field-installed labels that are supplied with the product. Educate the users in the proper and safe use of the product.

Residential UL 325 Requirements

All residential garage door operators manufactured after January 1, 1993, must comply with UL 325. This requirement, mandated by the Consumer Product Safety Commission (CPSC), was established to reduce entrapment injuries and fatalities. Residential operators must include the residential requirements outlined in the history section, most notably at least one monitored external entrapment protection device and force-sensing reversal.

UL 325 specifies that photo eye sensors must be mounted no more than 6 inches above the floor. As an industry best practice, these should also be no more than 6 inches back from the plane of the door. Contact edge sensors, installed along the leading edge of the door, serve the same purpose by detecting physical contact with an obstruction.

Residential and commercial operators fall under different sections of UL 325, and those differences directly limit where each type can be used. Residential installations must meet stricter, mandatory safety requirements that most commercial operators are not designed to satisfy. Because of this, a commercial operator generally cannot be installed in any setting classified as residential, including barns, detached garages, RV storage buildings, or other auxiliary structures located on residential property. In these environments, the operator is still treated as part of a residential system and must comply fully with the residential provisions of UL 325.

Some manufacturers offer operators that are specifically engineered and listed to meet both the residential and commercial portions of UL 325. These dual-rated models can be appropriate for heavier-duty residential applications where a standard residential operator may not provide sufficient performance or durability. Technicians should understand which models carry this dual rating and when they are acceptable substitutes for traditional residential units, ensuring both safety compliance and proper system performance.

UL 325 for Commercial Operators

A revision effective in 2010 requires that all labeled and listed commercial and industrial operators manufactured on or after August 29, 2010 must comply with the 2010 revision to UL 325. The most noteworthy of which was a revision requiring that all commercial/industrial door operators monitor an external entrapment

protection device or otherwise function only in constant pressure to close mode.

An external entrapment protection device is an apparatus intended to reduce the risk of injury by preventing persons from becoming caught or held under a closing door. Common examples of these are photo eyes and sensing edges. The requirement for these to be monitored essentially means the operator must verify these are working properly prior to, and during, closing of the door. The monitored device must provide status to the operator, which is designed to receive and monitor the status. In the event that the monitored device is not present or has a fault condition, the operator must revert back to constant pressure to close, or stop and reverse a closing door. Either monitored photoelectric sensors or monitored sensing edge devices are mandatory for any momentary contact, radio control, timer-to-close, or other unattended operation closing cycle.

In industry training, external entrapment protection devices are often described as **primary** or **ancillary**, even though these terms do not appear in UL 325. A primary device is required when momentary contact to close is used and must be a monitored device, such as monitored photo eyes or a monitored sensing edge. Ancillary devices are optional and cannot replace the required primary device; examples include non-monitored electric or pneumatic sensing edges or additional photo eyes installed above the primary set.

When photo eyes are used as the primary monitored device, they must be mounted no higher than six inches above the floor. Installations that do not include a primary monitored external entrapment device must operate with constant pressure to close, regardless of any ancillary devices present.

In a constant pressure to close condition, the operator must stop the door, and may reverse the door, when pressure on the control is released before the door reaches the closed

limit. Constant pressure to close is not permitted from a portable transmitter or any unattended operation device; these controls may only initiate an opening cycle. Therefore, any remote or unattended closing command requires primary, monitored external entrapment protection.

The UL 325 listing is dependent on the testing of each operator paired with each of the acceptable entrapment protection devices, so each device must be tested and approved for each operator. All door operator manufacturers or monitored entrapment device manufacturers are required to state within their installation manuals and/or user's guides which photo sensors and sensing edges are approved by UL or other Nationally Recognized Test Laboratory (NRTL) for use with a given operator as a monitored external entrapment protection device. Included with this is to provide suitable instructions on the methods of installation, adjustment, and wiring of external controls or devices serving as required protection against entrapment.

Additional requirements of UL 325 pertaining to commercial door operators are:

- A warning placard is to be placed in the vicinity of the door.
- If a three button station is provided, at least one button must be stop.
- Controls shall be far enough from the door or positioned such that the user is prevented from coming in contact with the door while operating the controls.
- Exposed moving parts of a commercial/industrial door operator installed more than 8 feet above the floor are not required to be guarded or enclosed, provided the operator is marked to indicate the minimum acceptable installation height. If the operator is installed below 8 feet, all exposed moving parts must be guarded or enclosed to eliminate pinch points.

Prior to the revision in 2010, external entrapment protection devices were required, but they were not required to be monitored. Operators manufactured prior to August 29, 2010 can still be repaired as needed, but the technician should use this opportunity to educate the consumer on the added safety features and benefits of labeled UL 325 compliant operators.

Environmental Considerations and NEMA Standards

Architectural specifications for commercial sectional door



systems frequently reference standards published by the National Electrical Manufacturers Association (NEMA), a trade association representing manufacturers in the electrical and electromechanical industries. NEMA publishes hundreds of technical standards across many volumes, far too extensive to summarize in this guide. The standard most relevant to door operator installations is **ANSI/NEMA 250, Enclosures for Electrical Equipment**, which defines environmental protection levels for operator control boxes and related electrical components.

Commercial and industrial door operators must be housed in enclosures that meet specific environmental and safety requirements. NEMA enclosure types describe the degree of protection an enclosure provides against dust, water, corrosion, and other environmental conditions. UL 50E complements these definitions by establishing the construction and performance tests used to verify that an enclosure labeled as a specific NEMA type actually meets the protective characteristics defined by NEMA.

Most commonly referenced NEMA Enclosure Types in Operator Specifications:

- **NEMA 1 - General Purpose:** An enclosure designed for indoor use to prevent accidental contact with live electric parts. It is not dust-tight or watertight.
- **NEMA 3R - Rainproof:** Designed for outdoor use to protect against rain and sleet. It is not required to be watertight from underneath.
- **NEMA 4 - Watertight:** A sealed enclosure that excludes water spray from any direction. It is not necessarily submersible.
- **NEMA 4X - Corrosion Resistant:** This is the same as NEMA 4, with added corrosion resistance. The enclosure material is typically plastic or stainless steel.
- **NEMA 7 - Hazardous Area (Gases/Vapors):** An explosionproof enclosure for areas containing flammable vapors or gases. Classified by gas groups (A, B, C, D).
- **NEMA 9 - Hazardous Area (Dust):** An explosionproof enclosure for areas containing combustible dust particles. Classified by dust groups (E, F, G).
- **NEMA 12 – Dust-Tight:** A sealed enclosure for indoor use that protects against dust, lint, fibers, and oil.

Applying NEMA Ratings:

- All electrical controls are housed in NEMA 1 enclosures as a minimum.
- A particularly dirty or dusty environment would use a NEMA 12 Operator Modification.
- Areas with a lot of moisture or water spray should use a NEMA 4 or 4X Operator Modification.
- Hazardous areas containing explosive gases or combustible dust may require a NEMA 7/9 Operator Modification if the operator is installed within the classified location. Examples include chemical processing rooms, grain handling or milling facilities, finishing booths, and petroleum or fuel-handling areas.

Section Three

Sectional Door Construction

There are many different styles of applications for sectional doors. Each has its own requirements for the aesthetics and performance characteristics of the door. Because of this, the sectional door has evolved with many different types of door styles, construction, available finishes, and materials.

The core defining feature of a sectional door is the section. Sections are the garage door component that extends the full width of an opening, usually joined together by hinges. Multiple sections stacked upon one another make up the face of the door. Generally speaking, door sections are numbered from #1 at the bottom, continuing with section #2, #3 and so on until reaching the top section. Depending on the door height, the section sizes can vary from 18 inches up to 32 inches tall in various combinations. The most common section sizes are 18 inches, 21 inches, and 24 inches.

At first glance, all door sections may appear similar, but important differences exist that installers must recognize. The bottom section may have a larger rail or added internal reinforcement since it must support the entire weight of the door. The top section may have a larger rail than the intermediate section rails and may not have the joint contours across the top. The top section may also be internally reinforced or have an extra center stile for the operator attachment. The lock section, usually the second section up from the bottom, may have predrilled holes or an extra stile for mounting a lock assembly. *Lites*, the industry term for windows, may be installed in some or all of the sections.

There are many types of materials used to build door sections. The customer can select from steel, aluminum, wood, various plastics, and others. As years have passed, engineers

have searched for alternative materials to improve performance, lower door cost, and meet special needs or overcome the shortcomings of other materials and fluctuations in material availability and cost.

Steel has become the material of choice in most sectional door applications. Steel is strong, durable, dimensionally stable, and lower cost than many alternative materials. The paint and galvanizing systems have been developed to provide protection against rust for many years without repeated painting in most environments. The weight remains constant and consistent. Steel doors are generally lighter in weight, making them easier to handle and operate.

Section Materials

In the doors of today, the buyer has a choice of many materials. In addition to traditional wood, the buyer can select from steel, aluminum, various plastics, and fiberglass.

Wood is a renewable construction material that has been used for door manufacturing for many years. It can be easily cut, shaped, glued, painted, or stained, and it lends itself well to decorative profiling. Scrap pieces are often repurposed by gluing them edge-to-edge to form panels or end-to-end using finger joints to create rails and stiles. The species selected has a significant impact on the durability of the finished door. Hardwoods such as oak and meranti are generally the most durable and the most expensive. Cedar offers natural resistance to insects and decay. Softwoods such as pine and luan are widely available and economical, but they typically have a shorter service life. Wood composite materials are commonly used only for panel inserts because

of their lower strength and relatively poor weather resistance.

Wood *breathes* continually, absorbing moisture and drying out so that its weight is constantly fluctuating. This may make it difficult to keep a wood door well balanced. As the moisture content changes, so does the shape to a minor degree through warping, twisting, and swelling. Add microscopic organisms and the wood begins to rot. Therefore, it is necessary to maintain a good coating of paint or stain on the door to control the ill effects of moisture.

Steel addresses many of the drawbacks of wood. Steel does not breathe like wood, although it will rust if not protected. Factory finishes have been developed to provide protection against weathering for many years without frequent refinishing. The weight remains constant and consistent. Steel doors are generally lighter in weight, making them easier to handle and operate. As the cost of steel doors lowered over time, the industry shifted away from wood to steel. Today, steel is the most prevalent material used to build garage doors.

Aluminum is used as the primary material in sectional doors where large windows are needed, the appearance of aluminum is desired, or there are special corrosive needs. The usual construction is rail and stile, much like wood door panels. The rails are extruded so they are small yet strong, leaving much of the door surface available for glass. Aluminum doors are generally more expensive than their wood or steel counterparts.



Specialty engineered materials have emerged as yet another alternative section material. Plastic is one example of material which offers dent, scratch, and corrosive advantages. These sections are typically constructed of an outer plastic skin reinforced with steel or aluminum internal rails. PVC (Polyvinyl Chloride) is a low cost plastic with good properties for door construction. It is dent and water resistant and is the same color throughout so that scratches are less apparent. Forming methods allow decorative shapes and simulated wood grains to be embedded into the surface for unique and realistic finishes.

On the downside, the same flexibility that promotes its dent resistance results in a door that may sag too much if not supported by other materials. Painting plastics require special procedures which should be specified by the manufacturer when needed. PVC is a thermoplastic, meaning it softens with elevated temperatures, so dark colors in direct sunlight and use in high temperature regions should be avoided. Other plastic materials may be used to address some of these limitations, but typically come at a higher cost.

Fiberglass sections are another alternative engineered material. These sections are typically comprised of a fiberglass outer section skin combined with steel section construction. Similar to plastic sections, fiberglass is resistant to dents, cracks, splintering, and rust, but fiberglass adds higher temperature stability to resist expansion and contraction.

Residential Door Styles

One of the most common styles for residential sections is the raised panel. For steel doors, a decorative profile is stamped directly into steel sections as they are



manufactured. These can be short panels, long panels, or other stamped shapes. The raised panels are sometimes spaced to align with the attachment locations of the hinges. These sections are usually embossed with a wood grain pattern.

A newer and popular style of door that has emerged is the carriage house design. These are sectional doors with outside facing designs that mimic traditional wood construction swing door appearance. Decorative hardware can be affixed to the face of the door simulating side swing hinges and handles to accent this appearance. These come in a wide variety of vertical, horizontal, and diagonal designs to provide customized appearances.



Another section style is the overlay design. These doors are constructed by attaching a variety of materials to the face of the door to achieve a desired three dimensional appearance. These first emerged as decorative magnetic overlays applied to the face of a steel door to mimic the look of traditional wood doors. Advancements in attachments, adhesives, and materials have resulted in a wide variety of materials and attachment methods used today for overlay sections. This style is particularly useful in creating carriage house style appearances.



Wood doors are available in many varieties of appearance. The paneled door construction offers a range from plain, flat panels to raised panels. The raised panels can be basic or routed for a custom appearance. The panels can be nearly square to long rectangular in shape. Flush doors are available with finishes ranging from smooth, to plywood, to very rough cut wood grain. Higher end wood species are often overlaid on flush wood sections to give any appearance desired.



One piece garage doors, also known as tilt-up doors, are still offered by some manufacturers, although they represent a smaller and declining share of the market. Modern one piece doors are factory built rather than site cut, which eliminates much of the labor once required to custom fit and assemble them on the job.

Their primary appeal today is aesthetic: because the entire door face is a single, uninterrupted surface, one piece doors can achieve design styles that are difficult or impossible to replicate with sectional construction. Large, continuous panels allow for smooth, flush surfaces; wide, uninterrupted wood grains; deep architectural reliefs; and custom carvings or overlays without the visual breaks created by horizontal section joints.

This makes one piece doors especially attractive for mid-century, contemporary, and certain architectural styles where clean lines or large monolithic surfaces are desired. Although sectional doors dominate the industry due to performance and compatibility advantages,

one piece doors remain a viable option when a specific architectural look or continuous panel appearance is required.

Types of Door Sections

Sectional garage doors are built from individual sections, and the construction of those sections plays a major role in the door's strength, appearance, insulation value, and overall performance. This section details the most common section types used in the industry: pan sections, insulated sandwich sections, full-vision sections, and traditional wood sections. Understanding how each type is built and where it is typically used helps technicians identify existing doors in the field, select appropriate replacement parts, and recommend the right construction for new installations.

Pan Door Sections: A pan door is comprised of sheet metal pan door sections. The sheet metal starts in a coil form and is roll formed to create a pan. The pan can be roll formed with either a ribbed design or flush design. The flush design can be stamped with raised panels. The steel, in most cases, is embossed with either a wood grain or pebble grain finish prior to roll forming. End and center stiles are added for vertical reinforcement, hinge attachment, and to create a rigid garage door section.

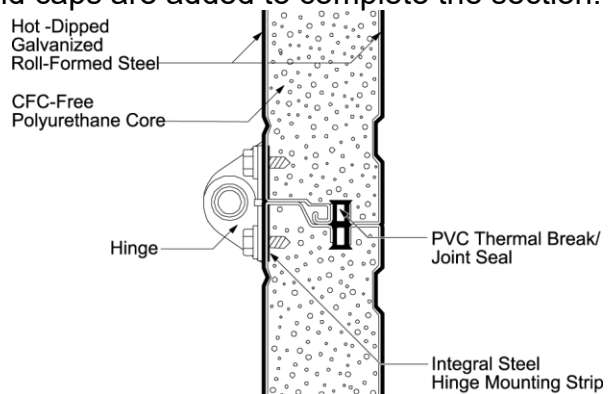
Pan door sections can be insulated for improved thermal performance. Insulated pan door sections are comprised of a standard pan door section, with insulation added to fill the voids in the pans surrounding the stiles. Various back cover materials can be used to cover and protect the inside face of the insulation. Common back covers are made from sheet metal or plastic. In addition, the foam insulation itself may have an integrated back cover material.

Pan door sections are available in a variety of standard and custom finishes and colors. The

bare steel is coated with a galvanized coating ranging from G-30 to G-90 for corrosion protection. They are then most commonly finished with a paint system which includes a primer and finish coat prior to roll forming.

Insulated Sandwich Door Sections:

Insulated Sandwich Door sections are constructed using an interior and exterior skin with an insulating foam core material. Expanded polystyrene foam can be cut to size and glued to the inner and outer skins, or polyurethane foam can be foamed-in-place between the skins to chemically bond the foam to the skins to create a rigid section. The inner and outer skins of the section may be kept separated during assembly to act as a thermal break. Steel backer plates or continuous reinforcement strips can be installed during the assembly of the section to accommodate various on-door hardware requirements and end caps are added to complete the section.



The skins of the insulated sandwich sections range in thickness from 16 to 28 gauge steel and are available in a variety of finishes and colors. The interior skin is often different thickness than the exterior skin. The bare steel is coated with a galvanized coating ranging from G-30 to G-90 for corrosion protection and they are most commonly finished with a paint system which includes a primer and finish coat prior to roll forming.

Full Vision Sections: Full vision sections are constructed from aluminum extrusions which are cut and machined to create vertical stiles and horizontal rails. The stiles and rails are fastened together to create a section frame. The open areas of the frame can be filled with

various glass or plastic glazing, or solid aluminum sheet, hardboard with aluminum laminate, insulation with aluminum laminate, or other material that will not create electrolytic corrosion. Common glazing materials are DSB Glass, tempered glass, insulated glass, polycarbonate, acrylic, and wire reinforced glass.



The aluminum frame can be finished in a number of ways. Typical finishes are anodized, primed and painted, or powder coated.

For commercial sectional doors, full vision sections can be combined with other full vision sections creating a full view door (left), or used as glazed sections in a steel door called sash sections (right):



Wood Sections: The most basic wood door construction is made by building a frame of rails and stiles. These horizontal rails and vertical stiles serve as frames for panels that make up the majority of the door face. The panels provide rigidity to the frame much like cross bracing. In addition, the panels can be made in decorative patterns to improve the appearance of the door. The horizontal rails provide a continuous

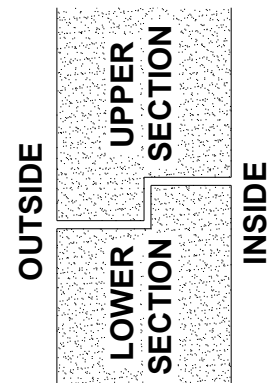
structural member to support the weight of the sections. The vertical stiles separate the rails and provide fastening points for hinges and hardware. Each assembly of rails, stiles, and panels form a section.

Another variation of the wood door section is the flush model. These doors still have the wood frame of rails and stiles, but sheets of plywood or wood composite are laminated on top of the frame on both sides, covering the entire surface. This design provides hollow cavities inside the door that can be filled with insulation or remain void.

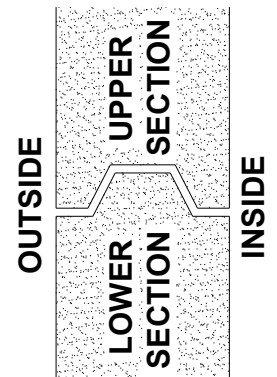
Section Joint Profiles

The mating edges of sections have special profiles for preventing the passage of light and water when the door is closed. There are four predominant section joint profiles used for this purpose.

A ***Shiplap*** section joint, sometimes called a rabbeted joint, steps up from one level to a second level from the outside of the door section to the inside. This step allows the sections to overlap, preventing light from passing through the section joint. The higher step towards the inside of the section prevents water from channeling through the section joint to the inside of the opening.

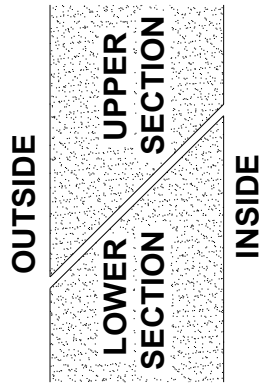


A ***Tongue and Groove*** section joint is commonly composed of a middle protrusion on a section edge mating with a middle groove on an abutting section edge. The tongue will be located on the lower section, creating the upward step to prevent

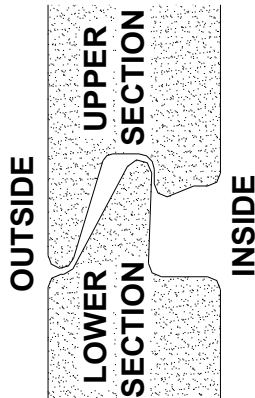


light and water passage. The groove will be located on the upper section to mate with the tongue on the lower section.

Angled section joints are commonly used on wood doors in which the entire door is assembled as one piece, and then sawed into sections. The lower section will have an upward sloping angle from the outside to the inside to prevent light and water passage and the upper section will have a corresponding angle to mate with the lower section. The overlapping sections prevent light penetration, and the upward sloping angle prevents water passage.



Pinch Resistant section joints are designed to prevent injuries to a person's finger. The lower section will have a male protrusion for blocking light and water passage, and the upper section will have a corresponding female profile for mating to the lower section. The profile of the section joint is designed to match the articulation of the section through the track radius in order to keep the section joints in close proximity to one another and prevent insertion of a person's fingers.



A weather seal, called a joint seal, may be added between the sections to further prevent the passage of air, water, and/or light and to improve the thermal performance of the section joint.

Sectional Door Lites

It is often desired for sectional garage doors to have windows to provide visibility and/or passage of light through the door.

A single window in a sectional garage door is called a *Lite*. The glass, plastic, or other material used to fill the window is called *Glazing*. A section which contains lites is called a *lited section*, or a *glazed section*. A section without lites is called a *solid section*.

Lited sections are created by cutting one or more holes through the section. Inside and outside lite frames, primarily made from plastic or aluminum, assemble to sandwich the glazing and the section together between the two frames in the section cutout. The frames can snap together or assemble with screws on the interior side of the section. Weatherseals are used on the exterior perimeters of the frame in contact with the section and the glazing to prevent water penetration.



Full vision and sash sections are created by assembling a framework of horizontal rails and vertical stiles, called a *sash*, around multiple glazing panels. Weatherseals are used on the exterior perimeter of the glazing and extruded plastic or rubber glazing strips fit against the glazing and the framework on the inside to further resist water infiltration.



Lite Materials

Sectional door lites are produced from a variety of glazing materials, typically from 3/32 inch to 1/2 inch thick, with some specialty applications using glazing up to 1 inch thick or more.

The most basic glazing material is annealed glass, which has been slowly cooled after forming to relieve internal stresses. Glass that has not been properly annealed is more prone to breakage from temperature changes or minor mechanical shock.

A stronger option is tempered (toughened) glass, a safety glass that undergoes thermal or chemical treatment to increase its strength. When tempered glass breaks, it fractures into small granular pieces rather than sharp shards, reducing the risk of injury. This is the same type of glass commonly used in automotive side windows.

Two grades of glass are widely used in the garage door industry. SSB (Single Strength Billet), often called single-strength glass, is a regular window glass typically between 0.085 and 0.100 inches thick. DSB (Double Strength Billet), or double-strength glass, is slightly thicker, generally between 0.118 and 0.133 inches, and offers improved durability compared to SSB.

Another option is wire glass, which contains an embedded wire mesh. It is produced by placing a steel mesh between layers of hot glass and rolling them together. The embedded mesh helps hold the glass in place if it breaks, providing added security and containment.

For improved thermal performance, many doors use insulated glass units (IGUs), also known as double glazing. An IGU consists of two panes of glass separated by a perimeter spacer that creates an insulating airspace. This cavity is filled with air or inert gas to reduce heat transfer, and the dual-pane construction can also improve sound attenuation.

In addition to glass options, acrylic and polycarbonate provide lightweight plastic alternatives with excellent impact resistance and good insulating properties. While these materials are far more resistant to breakage than glass, they are more susceptible to surface scratching and may require additional care to maintain clarity.

Coatings and Surface Treatments

Clear glass, as the name implies, is completely transparent. This allows light and full visibility through a window.



Obscure glass refers to any glazing that allows light to pass through while preventing clear visibility, providing privacy without eliminating daylight.



The degree of obscurity can range from lightly diffused to fully opaque, depending on how the glass is manufactured or treated. Various processes are applied to clear glass to alter its surface or internal structure in a way that scatters light and distorts images. Common methods include acid etching, which chemically roughens the surface; sandblasting, which mechanically abrades the glass; and rolling patterns into the glass during manufacture, which creates textures such as reeded, ribbed, or patterned finishes. Other forms of obscure glass are produced by applying tints, films, or coatings that darken or reflect light, resulting in appearances such as bronze, gray, mirrored, or heavily tinted surfaces. Regardless of the method, the goal is the same: to maintain light transmission while obscuring visibility from the outside.

Alternately, light filtering glass is available with films which lessen the passage of light and/or UV rays. These



windows allow visibility while reducing the passage of light.

Low-E (low-emissivity) glass is designed to improve the thermal performance of a window or door lite by reducing the amount of radiant heat that passes through the glazing. It begins as standard clear glass, and a microscopically thin metallic coating is applied to one surface of the pane. This coating reflects a significant portion of infrared radiant energy while still allowing visible light to pass through, which helps keep heat inside during cold weather and reduces heat gain during warm weather. Because the coating works by controlling radiant transfer rather than conduction or convection, it enhances overall energy efficiency without noticeably altering the appearance of the glass.

Low-E coatings can be applied to single panes of plate glass or incorporated into insulated glass units (IGUs). When used in an IGU, the coating is typically placed on one of the interior surfaces of the sealed airspace to protect it from scratching and environmental exposure while maximizing thermal performance. Depending on the type of coating, hard-coat or soft-coat, Low-E glass can also influence solar heat gain, UV transmission, and interior comfort. In sectional doors, Low-E glazing is often selected when improved energy efficiency or reduced heat transfer is desired, especially in insulated or climate-controlled garages.

Condensation

Condensation occurs when warm, humid air contacts a surface that is colder than the air's dew point, causing water vapor to change into liquid on that surface. In door systems, this is most commonly seen on windows and vision panels when outdoor temperatures are low and interior humidity is high. Single pane glass has very little thermal resistance, so its interior surface cools quickly, often becoming the coldest surface in the building envelope. As a

result, moisture readily condenses on regular glass, leading to fogging, dripping, and potential corrosion around the frame.



Insulated glass units (IGUs) reduce this effect by using two panes of glass separated by an air or gas filled space, which acts as a thermal barrier. Because the interior pane stays significantly warmer, it is less likely to fall below the dew point, greatly reducing condensation compared to single pane glazing. While IGUs cannot eliminate condensation in all high humidity environments, they substantially improve visibility, reduce moisture related damage, and help maintain thermal performance in exterior door applications.

Exhaust Ports

Exhaust ports are openings installed in a commercial sectional door to allow vehicle exhaust to be safely routed outside a building while the door remains closed. They are commonly used in service garages where vehicles idle indoors to help control fumes and maintain indoor air quality.



Exhaust ports provide a dedicated pathway for an exhaust hose to pass through the door. When connected to a vehicle tailpipe, the hose directs exhaust gases outdoors, reducing the buildup of carbon monoxide and other harmful emissions inside the building.

Exhaust ports are offered in several configurations depending on the application:

- Fixed ports – A rigid opening with a metal or reinforced polymer collar.
- Hinged or closable ports – Include a flap or cover that can be closed when not in use to reduce air infiltration.
- Latching Cover – Include a latch to secure the cover closed to help prevent intrusion of weather and pests.

Exhaust ports are typically installed by cutting an opening in the designated door section and securing the port assembly with fasteners and backing plates. The port must be positioned on the section to align with the desired hose connection point inside the building, often at the center of the door.



Ports are typically sized to match standard exhaust hose diameters and may include a protective sleeve or collar to prevent wear on the door section. They are commonly made of aluminum and are available with inside diameters suitable for 3 inch, 4 inch, and 5 inch diameter exhaust hoses.

They are also available with different barrel projections to match various section thicknesses. Common projection sizes include up to 1/4 inches for pan door and aluminum panel sections, up to 2 inches for most insulated sections, and up to 3 inches for thicker insulated sections.

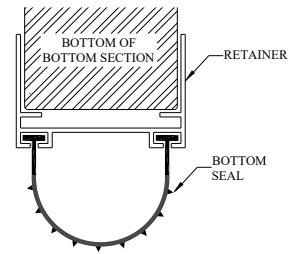
Exhaust ports can be factory installed or field installed. Proper sealing around the port is

important to minimize air leakage and prevent water intrusion into the section.

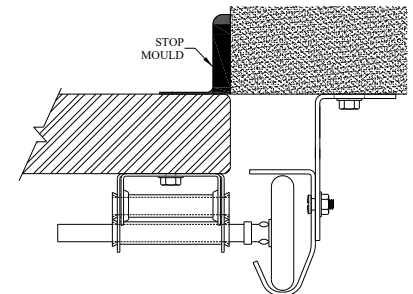
Weatherseals

Weatherseals are used to limit air and water infiltration around the perimeter of the door. Sectional doors utilize several different types of weatherseals depending upon the application and the level of protection desired.

The most common weatherseal used on sectional doors is the bottom weatherseal, often referred to as an astragal. This seal is attached to the bottom edge of the door and compresses against the floor when the door is closed to prevent air, water, and debris from entering. Bottom weatherseals are typically bulb-shaped and may fasten directly to the bottom section or slide into a separate retainer designed to hold the seal securely in place.



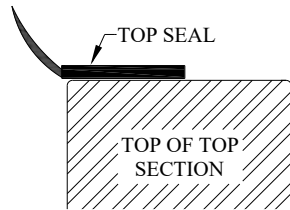
Stop mould is a perimeter weatherseal commonly used on sectional doors, especially in residential installations with wood jambs. It consists of a rigid trim piece fastened to the edges of the door opening and a flexible flap that presses against the exterior face of the door when it is closed. When properly installed, the flexible flap forms a continuous seal that helps prevent air and water from entering around the sides and top of the door. This type of weatherseal provides an effective barrier at the jambs and header and is a standard finishing component for many wood-framed openings.



Commercial installations often use perimeter seals mounted directly to the wall angle of the

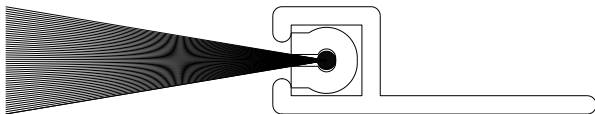
vertical track, creating a sealing method that functions much like residential stop moulding but is designed for the heavier, more industrial nature of commercial doors. These seals typically consist of rigid plastic component that clips onto the wall angle paired with a flexible vinyl or rubber flap that presses against the door's exterior surface when closed. This arrangement provides a continuous barrier along both vertical edges of the opening, helping to reduce air infiltration, dust, and weather exposure.

A top seal is also commonly installed on commercial doors to close the gap between the top section and the header. This seal



attaches to the upper edge of the top section and compresses against the building structure when the door is fully closed. Together, the vertical perimeter seals and the top seal create a more complete weather barrier, improving energy efficiency and environmental control in commercial facilities.

Another type of perimeter seal available utilizes a rigid retainer to attach a vinyl flap or a brush seal to the jambs and header. Brush seal is made from a dense bundle of fine bristles that are tightly crimped together, forming a continuous barrier that blocks air, dust, and water while remaining highly flexible. Because the bristles can maintain contact even when the door or building shifts slightly, brush seal performs well in demanding environments and is commonly used in extreme weather conditions, high-exposure locations, or facilities requiring enhanced environmental control.



Types of Insulation

Insulation plays a key role in the thermal performance, sound control, and the fire-resistance characteristics of sectional door assemblies. Manufacturers use several types of insulation depending on the door's design, required performance, and intended application. Each material has distinct properties that affect how it is installed in a section and how the finished door performs in service. The most common insulation materials used in sectional doors include Expanded Polystyrene (EPS) and Polyurethane (PUR).

Expanded Polystyrene (EPS):

Expanded polystyrene (EPS) is a widely used foam insulation material for both pan-style and sandwich-style sectional doors. It is produced from small polystyrene beads, which are derived from petroleum based chemical byproducts. During manufacturing, these beads are placed into a mold and exposed to steam. The heat causes the beads to expand significantly and fuse together, forming a uniform, closed cell block of rigid foam. This block, often called a billet, can then be cut to precise dimensions using a hot wire knife. Cut to size EPS inserts are commonly placed inside pan doors or wood doors, and sheets of EPS can also be bonded to metal skins to create insulated sandwich door sections.



EPS is available in a range of densities, typically from 1 to 2 pounds per cubic foot, with higher densities offering greater rigidity and slightly improved thermal performance. As an insulating material, EPS provides an R-value of approximately 4 per inch of thickness, making it an effective and economical choice for improving the thermal efficiency of sectional doors. Its closed cell structure helps resist moisture absorption, and its ability to be cut cleanly and consistently makes it well-suited for high volume door manufacturing.

Polyurethane (PUR):

Polyurethane foam is an insulation material widely used in the manufacture of garage door sections, especially in foamed-in-place sandwich doors. It is created through a chemical reaction between two petroleum derived components: isocyanate and polyol.



When these components mix, they react rapidly to form a rigid, closed cell foam. This reaction generates expansion, allowing the foam to fill the internal cavity of a door section and bond directly to the metal skins. This natural adhesion is one of polyurethane's defining advantages, producing a unitized, composite structure with excellent strength, rigidity, and thermal performance.

Polyurethane can also be produced as a homogeneous block or billet, which can be cut to size with a hot wire knife for use in pan doors, though this is less common than foamed-in-place manufacturing. Typical polyurethane foam densities range from 2 to 3 pounds per cubic foot, with higher densities providing increased structural strength and slightly improved insulating properties.

Both chemical and physical blowing agents are incorporated into the polyol component to control the foam's expansion, density, and thermal characteristics. Different blowing agents create different cell structures within the foam, which directly influence its insulating value. Depending on the blowing agent used, polyurethane foam typically provides R-values ranging from R-5 to R-7 per inch of thickness, making it one of the most efficient insulation materials used in sectional doors.

Polyurethane's combination of high R-value, strong adhesion to metal, and ability to create a rigid structure makes it the preferred insulation for sandwich style garage doors.

Thermal Bowing

(Reference DASHA TDS 185)

Thermal bowing is an inherent characteristic on garage doors with insulated bonded core sections and is not considered a product defect. Insulated bonded cores are associated with sandwich insulated panel construction, predominantly featuring steel facings and foam cores. This Technical Data Sheet describes the different factors where thermal bowing occurs and identifies various industry recommendations to minimize its effect.

What is Thermal Bowing? Thermal bowing is caused by thermal expansion, which is the tendency of matter to change in volume in response to a change in temperature. Most materials increase in volume when the temperature rises. Thermal bowing occurs in insulated bonded core panels, where an interior and exterior skin are bonded to an insulated core and there is a significant temperature difference between the interior and exterior skins. If one panel is significantly warmer than the other, the warmer skin will grow relative to the cooler skin and cause the door to bow in the direction of the warmer skin. It is important that end users recognize this inherent phenomenon and apply an appropriate garage door manufacturer recommended solution.

All insulated panels will exhibit some thermal bowing when subjected to a temperature difference from one side of the insulated panel to the other (see Figure 1).

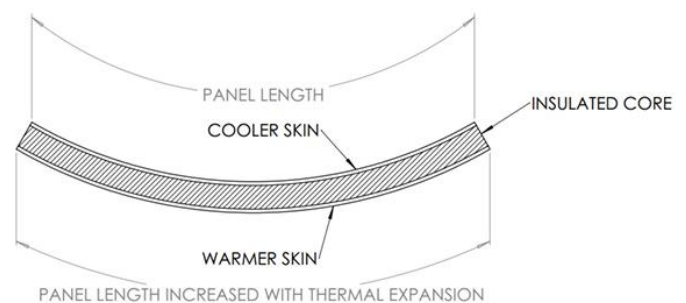


Figure 1

What are Influences That Can Create Thermal Bowing?

- Amount of temperature difference – The greater the temperature difference from the outside environment to the inside garage space, the greater the potential thermal bowing. However, thermal bowing is not restricted to outward movement. For example, in a cold winter environment a heated garage might mean that a garage door might have a tendency to bow inward.
- Door size – The larger the door width, the more potential bow. Without reinforcement, the thermal bow on 20' wide garage door could exceed several inches.
- Darker color door – A brown, insulated garage door facing the sun on a hot day with an air conditioned garage or warehouse space will have more thermal bowing than an equivalent white garage door in the same application. As with a greater outdoor temperature than indoor garage temperature, thermal bowing will be outward. The darker color, the more this tendency exists when facing the sun.
- Door design – Door designs that inhibit heat transfer from the exterior to interior, or vice versa, have the potential for greater thermal bowing than garage doors that do not inhibit this heat transfer. Insulated garage doors that are “thermally-broken” inhibit heat transfer, since the heat transfer path is ‘broken’ from one side of the door to the other.
- Construction material of door skin - Different materials have different rates of thermal expansion. Aluminum and plastics have greater thermal expansion rates than steel.
- Exposure to sun - A south facing door in direct sunlight will be more likely to experience thermal bowing than a north facing door out of direct sunlight.

What are other issues related to Thermal Bowing? Besides a measurable bow, field issues reported with thermal bowing include top section rubbing on the top of the garage

door opening header (outward thermal bow) or a gap between the top section and the top of the opening (inward thermal bow).

What Can Be Done About Thermal Bowing?

While thermal bowing cannot be eliminated when the previous influences are present, it can be minimized to where it has no appreciable effect on garage door performance. Preventive measures typically involve door reinforcement that reduces thermal bowing. This could include, but is not limited to, the application of horizontal struts across the back of the garage door. The size and number of struts across the back of the door can vary depending on the various factors listed above and the amount of thermal bow.

Extreme instances of thermal bowing might require more extensive reinforcement, including:

- Large, dark colored, thermally broken (non-thermally conductive material placed between the door's exterior and interior facings) insulated garage door
- Facing the sun on a hot day
- Air conditioned garage door space

Other techniques to address thermal bowing depend on the door system and the adjustability of either the track assembly or the jamb/header seal. Please contact the product manufacturer for their recommendations on minimizing thermal bowing.

Specialty Applications

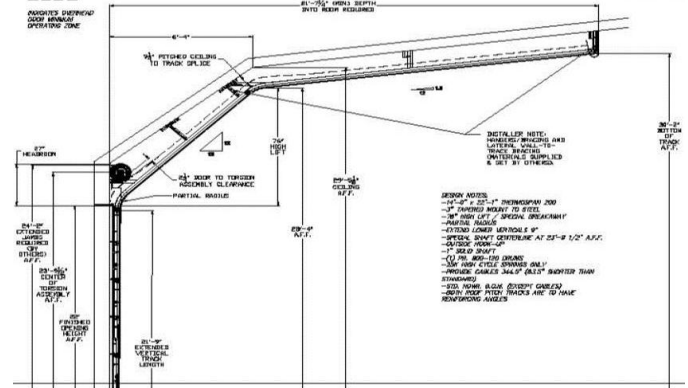
There are many specialty and custom design applications in the commercial sectional door industry. While some of these share some or all of their components in common with ordinary commercial sectional doors, many of them would require their own complete training manual. Some of these specialty applications are outlined in this section. It is important to be aware of these specialty applications, and seek

the appropriate training when they are encountered.

Pass Door: A pass door, sometimes called a wicket door, is a swinging pedestrian door integrated into a sectional door assembly. The pass door is hinged at the side to a cutout in the sectional door, as well as hinged at the intermediate section joints so the pass door bends with the sections as the sectional door is opened. This option must incorporate an interlock on motorized doors so that the sectional door is not operated when the pass door is open. Pass doors are not recognized as an egress door by model building codes.



Special Track Design: Special track designs are used when the travel of the door must clear unique building obstructions. Designers use combinations of standard and special design components to design the track system and travel path of the door to fit within the application requirements.



Mullions: Mullions are a combined track assembly joining two adjacent sectional doors. Mullions may be stationary or removable. Removable mullions may be mechanically or motor operated where the center track is hinged to lift up and out of the way, or slide to the side of the opening, to expose the full opening width when all of the doors are open. Mullions are used in very wide applications where the width of the opening may be too large for a single door. Another application they are common in is airport hangar doors, where it may be desirable for the center opening to be taller than the outer openings.



Combination Doors: Combination doors, sometimes called superimposed doors, utilize a dual track system that allows two doors to be used in the same opening. This type of system is used to combine two different door types. Typically, the exterior door utilizes a solid door construction for security, while the interior door is a full vision or screen door providing visibility or air flow.



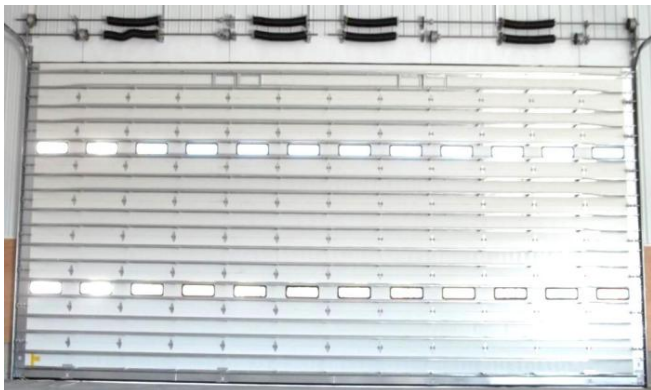
Counterweight System: A counterweight system is a special application counterbalance which replaces torsion or extension springs to balance the door. Steel counterweights are approximately equal to the weight of the door and are typically attached to a cross header shaft system by means of a drum. Some units attach by means of cables, chains, straps, or belts and run through pulleys to lift the door. Solid weights, steel plates, or a tube filled with

steel pellets or sand is used to counterbalance the weight of the door. The drum arrangements will determine the amount of weight needed. Vertical lift doors that rise straight up and down typically only require one counterweight with standard lift type cable drums. Standard lift and high lift doors are more difficult to balance with a counterweight system. Some manufacturers use standard lift drums and some use vertical lift drums. Others use a combination of drums and pulleys with chains, belts, or cables that lift a series of hinged weights to counterbalance the door.

Transom Sections: A transom section is a dummy door section above the opening that is sometimes used to allow extra lift of the horizontal tracks and/or to accommodate a trolley/drawbar type operator.



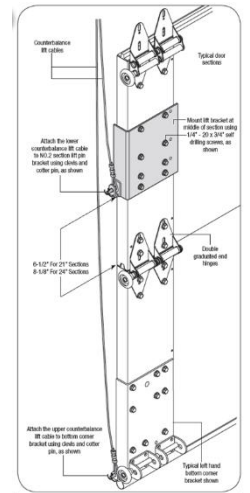
Double Shaft: Double shaft is when a door utilizes two parallel spring shafts because additional space is required to accommodate the required counterbalance spring lengths. Double shafts are required in a number of different applications. The most common are high cycle requirements and narrow by tall doors. This occurs when the lengths of the required springs are greater than the width of the door. When this happens, two pairs of shafts will be used to essentially double the width of the shaft in order to utilize additional, longer springs. Double shaft is often used in combination with center lift and dual cables.



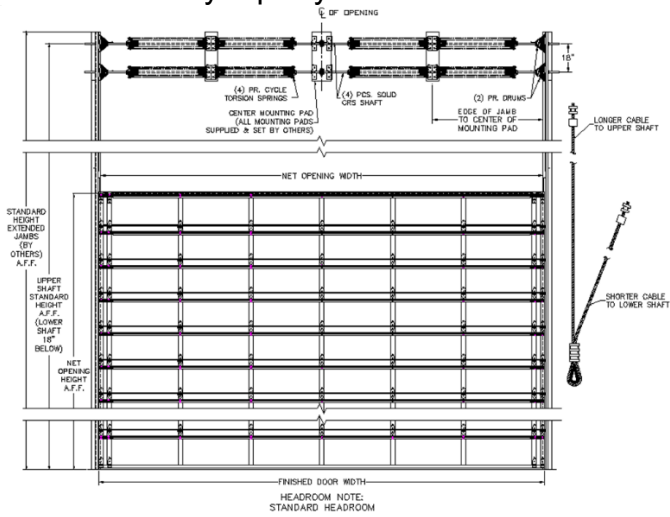
Center Lift Cables: Center lift cables are used to provide extra lifting support for extremely wide or heavy doors. One or more additional cable assemblies are secured to the outside of the door at points toward the center of the opening. Stainless steel rub plates are sometimes fastened to the face of the door to protect the area where the cables may contact the sections. Additional cable drums are used on the counterbalance shaft to accommodate the extra cables, often in a double shaft arrangement.



Dual Cables: Dual cables are used to provide extra lifting support for extremely heavy doors. Additional bottom brackets and cable assemblies attach to one or more of the intermediate sections to help disperse the required lifting force. This reduces the loads on each cable and the loads on the bottom section bottom brackets. These doors use two pairs of cable drums in a double shaft arrangement. The lower shaft line is offset further from the jambs/header than the upper shaft line, often using shims, to provide clearance for the cable on the upper drum to pass behind the lower drum.



Special Cables: Special cables with a single loop in the middle of two lengths of cables are sometimes used with double shaft when the bottom bracket weight capacity is not exceeded. One of the cable lengths is shorter for reaching the lower shaft, and the other is longer for reaching the upper shaft. The counterbalance is split evenly for the two shafts, and two pairs of cable drums load each cable assembly equally.



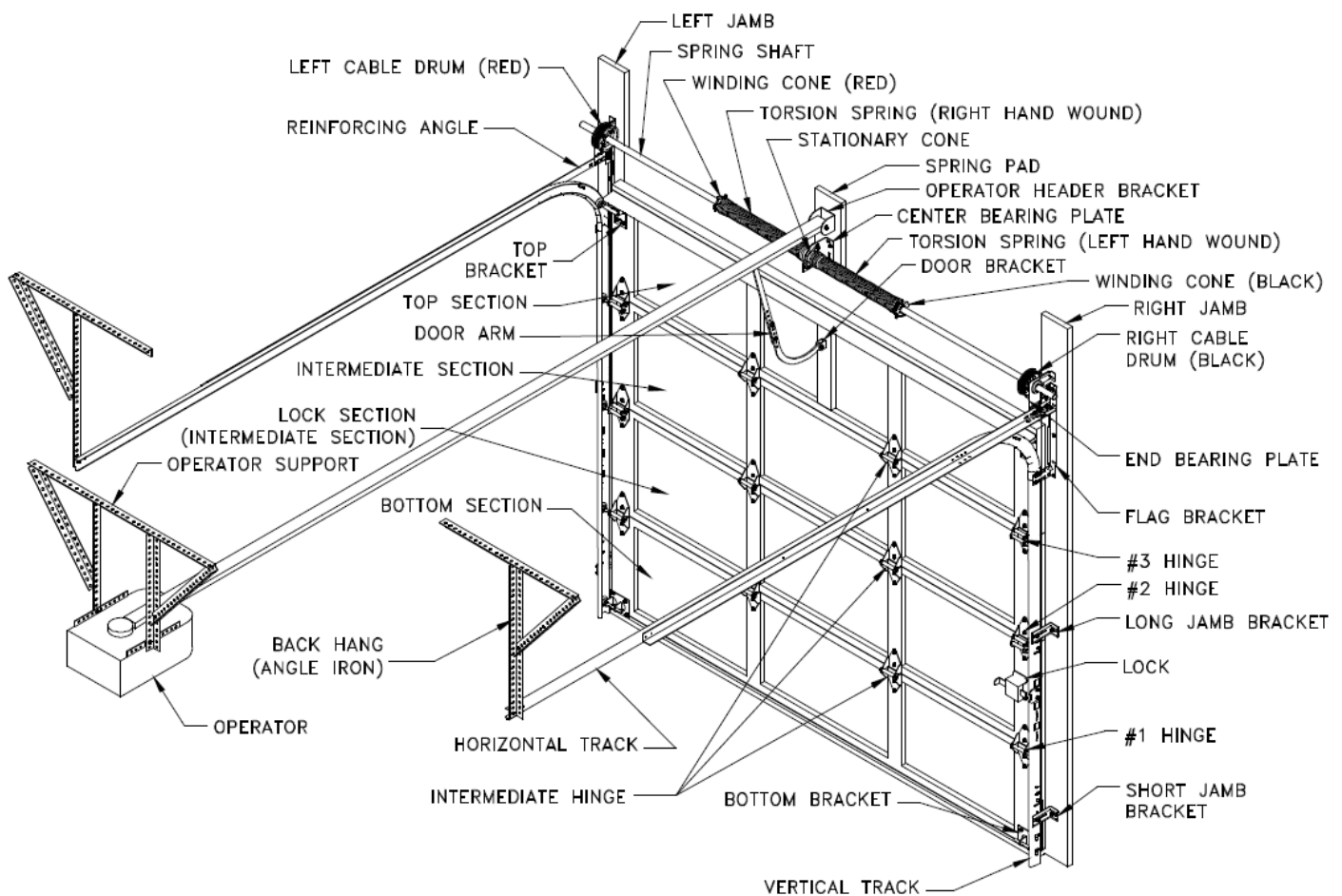
Section Four

Sectional Door Components

Throughout this Study Guide, references are made to the hand of various door components, such as right hand and left hand parts. By industry convention, all directions and points of reference for sectional doors are based on the perspective of standing inside the garage and looking out, sometimes referred to as ISLO, unless specifically noted otherwise.

This guide also assumes standard installation, with the door facing the exterior of the building and opening toward the interior. Variations exist, but the component descriptions in this chapter follow this typical configuration.

The diagram below identifies the locations of the most common sectional door components. Each component will be described in detail in the pages that follow, along with its function and relationship to the overall door system.

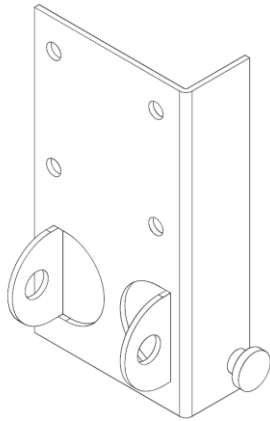


Hardware Components

Sectional garage doors rely on a coordinated set of hardware components that guide the door's movement, support its weight, and ensure safe, reliable operation. This section introduces the core hardware used across most sectional door systems including bottom brackets, hinges, track rollers, top fixtures, operator brackets, and locking devices. Understanding the purpose and interaction of these components helps technicians install doors correctly, identify wear points, diagnose operational issues, and select the correct replacement parts during service or installation.

Bottom Brackets

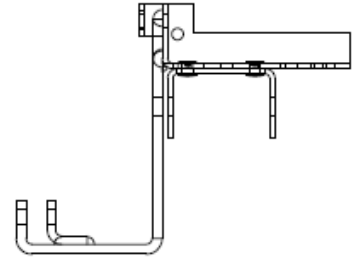
A bottom bracket, or bottom fixture, is a structural support located on the bottom of each end of the bottom section. They hold track rollers and may also provide for attachment of the lifting cables. These brackets generally support the entire weight of the door and are often designed so that a portion fits underneath the bottom of the door to reduce the load on the fasteners. Bottom brackets are typically handed for the left and right side of the door.



The cables attach to bottom brackets using two different pin types. A Milford pin is a mushroom shaped pin that is stamped into the bottom bracket. The cable loop slides over the large portion of the Milford pin and cable tension keeps the loop tight to the smaller diameter portion. Heavier duty doors utilize a clevis pin to attach the cables. A clevis pin is a steel pin with a head on one end. The pin is slid through the bottom bracket, through the cable loop, and secured in position with a cotter pin.

Most manufacturers follow ANSI/DASMA 103, a standard which requires the use of red color coded or tamper resistant fastener(s) to attach the bottom brackets to the bottom section. Other special design bottom brackets exist that prevent access to the assembly screws while tension is present on the cables. Bottom brackets often also include a safety warning label to warn of high spring tension.

Outside hookup bottom brackets are commonly used for low headroom lift doors where the cable is routed outside the tracks.



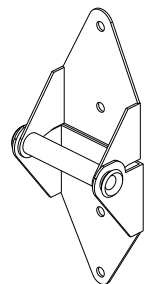
These typically have an extra strap which reaches around the track to the proper cable attachment location.

Optional Cable Tensioners can be mounted on the bottom bracket to help maintain cable tension. These are commonly used to help prevent cables from slacking on the drums in certain lift conditions. A spring is mounted to the bottom bracket and hooks over the cable to pull out a limited amount of slack that may occur during operation.

Bottom brackets can incorporate an optional Cable Safety Device, which is designed to slow or stop the descent of a door in the event of a cable breakage. These typically use a knife or knurled wheel to lock onto the vertical track and stop the door when a cable failure occurs.

Hinges

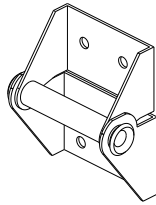
A hinge is used to join the door sections together, allowing the sections to pivot independent of one another as the door follows the track profile. They are also used to keep the outer face of abutting sections flush with one another. End hinges are mounted at the ends of the sections and



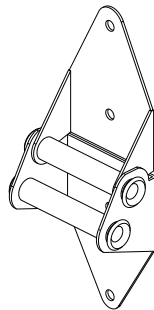
hold the track rollers while center hinges are mounted on the intermediate stiles.

There are various types of hinges depending upon the door type. The most common type of hinge is a leaf hinge. The upper and lower portions of the hinge that attach to the door are triangular shaped. They are hinged together at the pivot point with a flared tube that can also be used as the roller carrier for #1 hinges. Leaf hinges are available in several different thicknesses depending upon the size and weight of the door.

Another common type of hinge is a box hinge. These hinges are very similar to leaf hinges, but the triangular sections are removed to create a more compact hinge. These are commonly used on sections with narrow meeting rails or where the added strength of a full size leaf hinge is not required.

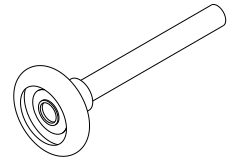


Graduated edge hinges are used at the ends of the door sections to ensure flush fit of the door against the jambs when closed. For 2 inch track, they are usually numbered starting with 1 on the first section on up. For 3 inch track, they are usually numbered starting with 3 on the first section on up. This aligns the bottom roller with the track, and the graduation of the edge hinges positions the roller at an increasing distance from the door opening in order to match up to the slope of the vertical track, approximately 1/8 inch per foot. This design assures that the door will be in close contact with the interior surface of the opening when it is completely closed providing a weathertight fit. The slope of the track assures that the door will pull away from its tight fit to the jambs, eliminating friction as the door travels.



Track Rollers

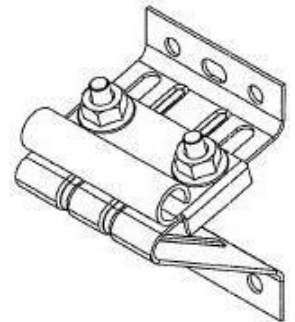
Track Rollers, often simply called Rollers, are used for guiding the door sections along the track. They consist of a tire assembled to a stem.



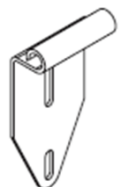
The tire is sized to match the track, usually 2 inches or 3 inches depending on the size and weight of the door, and is made from plastic or steel. The tire will contain a bearing or be made of bearing materials for ease of rotation. The stem is staked through the tire and has a cylindrical body which extends into the end hardware of the door. Wider doors will utilize long stem rollers to interface with double end hardware. The stem usually has a standoff to space the roller away from the door section and prevent the door from hitting the track during operation.

Top Fixtures

A top fixture is a bracket for positioning the top roller on the top section of the door. The bracket usually consists of two parts, a base and a slide. The base is commonly "A" shaped and provides the mounting locations for attaching the top fixture to the section. The slide contains a curl to accept the top roller stem and can be adjusted on the base for alignment of the top roller to the track.



Low Headroom Lift Top Fixture: A low headroom lift top fixture is used on doors with low headroom lift track to reduce the high arc travel of the top section as the door is opened.



These top fixtures are often flat and roller position adjustment is achieved by raising and lowering the attachment location of the top fixture on the top section.

Operator Brackets

The purpose of an operator bracket is to provide a connection point for a drawbar operator that adequately applies the lifting force to the top section of the door. They can be as simple as an angle bracket for thicker, heavy duty doors to full section height brackets that interface with the intermediate hinge and the top strut on thinner, lighter duty doors.



Operator brackets are typically supplied with the operator, but may also be supplied with the door in some instances. It is important to check with the door manufacturer for the appropriate mounting of operator brackets to verify the top section is properly reinforced for the attachment of the operator.

Locks

There are various types of locking mechanisms used on sectional doors to secure the doors to the vertical track(s) in the closed position. These locks may engage a striker plate or go directly through cutouts in the track itself. Once secured, the door cannot be opened until the lock mechanism is released.

One type of sectional door locking mechanism is an Automatic Latch. As the name suggests, the automatic latch will automatically engage a striker plate in the closed position and secure the door. The latch must be manually released each and every time the door is operated.

Another common sectional door locking mechanism is an inside lock. This is a spring loaded, sliding deadbolt lock or spring latch operable only from the interior side of the door. The inside lock deadbolt will engage the track or a striker plate. The deadbolt may have a way to padlock the door, or rely on the security of inside access only for preventing unwanted operation of the door.

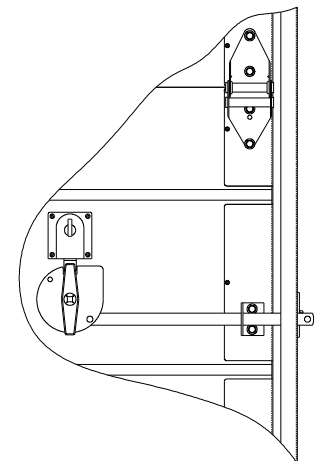


Exterior locks are available when outside access to the door is desired. A key activated handle will be located on the outside of the door and a



square shaft, called a *chill*, will penetrate through a hole in the door section connecting to the inside lock set. A decorative plate, called an *escutcheon*, will be used to surround the outside portion of the lock assembly and cover the hole through the section. A lock cylinder in the handle will accept the access key and contain the locking pins. The outside keyed handle can be aligned to the side of the door or located at the center. Depending on the section construction, the lock handle may need to align with a stile on the inside of the door for structural support. Lock sections sometimes have an extra stile at the lock end of the door for mounting the lock.

Exterior lock assemblies often utilize a lock bar with *cremone* on the inside of the door. The square shaft (*chill*) from the outside handle penetrates the door section and engages a lock bar disc (*cremone*) which is attached to one or more lock bars.



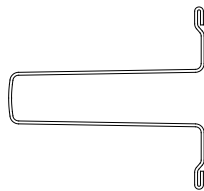
Rotating the cremone forces the lockbar(s) to slide towards the track to engage the striker plate or vertical track. Rotating the cremone in the opposite direction pulls the lockbar(s) back and provides access to operate the door. The cremone is often notched such that a night lock deadbolt can be mounted on the inside of the door. The exterior key cylinder may be separate from the handle and rely on activating the night lock dead bolt.

There are various arrangements for keying exterior locks. The simplest arrangement is for each door lock to have its own key. It can be complicated to keep track of which key goes with which door at a location where multiple doors are installed. One common solution is to have the lock cylinders keyed-alike, such that two or more lock cylinders can be opened with the same key. Another common key arrangement is Master Keying, in which each lock cylinder utilizes its own key, but all locks can be operated using one master key.

Locks should be removed or disabled on electrically operated doors to prevent the operator from attempting to lift a locked door. Failure to disable the locks can result in damage to the door and an unsafe condition if electrical operation is attempted while the locks are engaged.

Struts

A strut is a structural stiffener used to reduce deflection or sag of door sections when the door is in the horizontal position. Struts are commonly installed on the top section to provide reinforcement for drawbar operators, but they may also be added to increase a door's wind load rating or to minimize thermal bowing caused by temperature differences between the interior and exterior surfaces. In some situations, struts are also used to help equalize section weights, particularly on doors with heavy glass, decorative inserts, or other



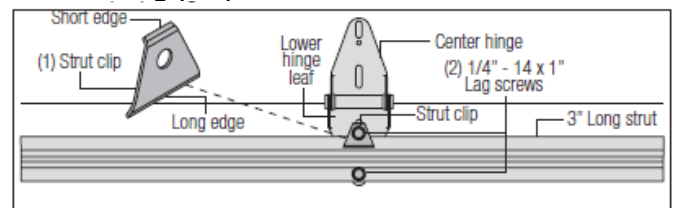
features that can create spring balance challenges. By redistributing weight and stiffening the section, a properly selected strut can improve both door balance and operator performance.

Most struts are U-shaped, which is why they are sometimes referred to as U-bars. Struts are defined by both their height and material thickness. Common heights include 2 inch, 3 inch, and 4 inch profiles, while typical thicknesses are 20 gauge and 18 gauge steel. Some manufacturers use color coding or stamped markings to help identify strut size or gauge in the field.

Very large, heavy, or high wind load rated doors may require more substantial reinforcement. In these cases, manufacturers may use C-channels, Z-purlins/girts, or even truss assemblies instead of standard U-struts.

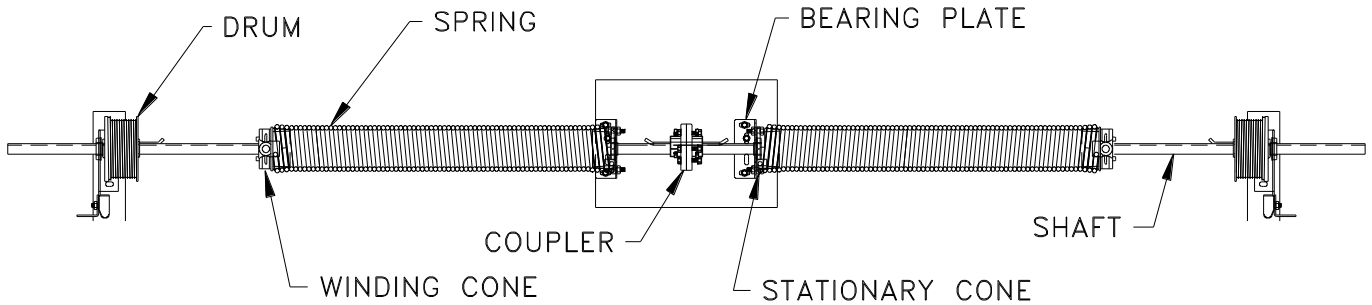
When required, struts are mounted to the inside face of the door section and may be factory or field installed. They run the full width of the section, though the ends may be notched or shortened to avoid interference with end hinges or other hardware.

Small metal plates known as strut clips are sometimes used to share strut fasteners between the struts and the hinges, reducing the number of screws required while maintaining proper strut attachment.



Full vision sections often incorporate integrated fins on the top or bottom rails that function as built-in struts. Larger or wind load rated full vision sections may include additional internal reinforcements in the rails, or bolted-on angles to increase rigidity and meet design load requirements.

Counterbalance Components

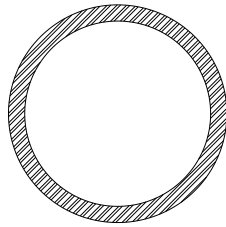


The torsion spring counterbalance system is comprised of a shaft, drums, springs, cables, coupler (when necessary) and bearing brackets. These components, when properly installed, should precisely balance the door for easy operation.

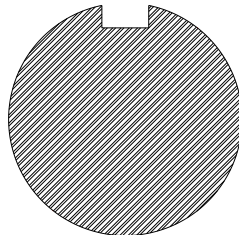
Torsion Shafts

Torsion spring doors utilize a torsion shaft that is installed parallel and level to the top edge of the door. The spring(s) required to balance the door must be attached to this shaft. All spring torque, regardless of the number of springs, is delivered equally to both ends of the shaft.

Torsion shafts can be tubular or solid. Tubular shafts are used on lighter doors that do not require a shaft mounted operator. The tube shaft length will run the full width of the door and various wall thicknesses of the tube can be used depending on the torque requirements. The most common size for tubular shafts is 1 inch diameter.



Solid shafts are used on heavier doors that exceed the capacity of tubular shafts or when a keyway is desired for attaching sprockets in chain hoist or jackshaft applications. The shaft may be keyed at the ends or along its full length to engage cable drums, spring cones, couplers, or drive sprockets. Common solid shaft diameters are 1 inch and 1-1/4 inches.



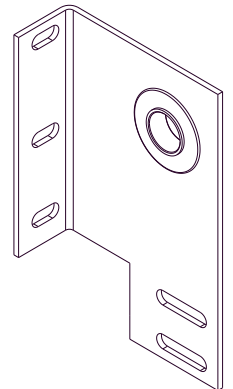
The solid shaft length may run the full width of the door, or split into two segments joined together by a coupler.

Couplers are used to join two solid shaft segments together end to end. They typically provide a way to adjust the rotation of the two shafts relative to one another in order to properly set the tension of the cables during installation and service.



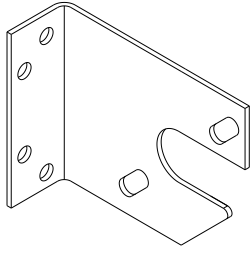
End Bearing Plates

End bearing plates, sometimes called headplates, support the counterbalance shaft at each end. They will position the shaft a fixed distance from the jambs to provide clearance for the cable drums and springs, and contain bearings so the shaft can turn freely. End bearing plates are typically attached to the horizontal track and/or the wall and are often handed for the left and right side of the door. The cable drums will assemble to the shaft tight against the end bearing plates to prevent shaft movement during operation of the door.



Center Bearing Brackets

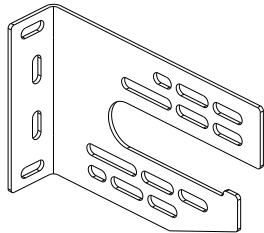
Center bearing brackets are installed at the center of the door, and sometimes at intermediate width locations, to align and support the torsion shaft.



They are also commonly used to anchor the stationary spring cone(s) to the header or other building structure. When used to anchor the springs, they are sometimes referred to as *spring anchor brackets*, or *spring anchor plates*. When used solely as a stand-alone shaft support, they are sometimes called *shaft support brackets*.

A bearing is used at each bracket to prevent shaft wear during rotation. The bearing may be assembled directly to the bracket when it serves as a shaft support, or it may be installed inside the stationary spring cone when the bracket is used as a spring anchor.

Some center bearing brackets include slotted mounting patterns to accommodate different spring sizes and to allow in-and-out adjustment of the shaft centerline relative to the header.



Center bearing brackets are available in open or closed styles. Open-style brackets allow the counterbalance shaft to be installed or removed without detaching the bracket from the spring pad. Closed-style brackets require the bracket, shaft, and spring(s) to be removed or installed as a single assembly.

Shaft Bearings

Shaft bearings are used to maintain shaft alignment and reduce friction as the shaft(s) rotate. They are typically integral to the end bearing plates and one or more mounted at the center brackets. These may be bushings on

lighter doors or ball bearings on more heavy duty doors.

The most common bearing used on sectional doors is the **Flange Bearing**.

These roller bearings are formed with a flanged housing which can be pressed or staked into end and/or center bearing plates or inserted between the spring cone and center bracket during installation. The inner race turns with the shaft as it rotates and spins on the bearing rollers to eliminate friction. Flange bearings are available with a variety of load ratings depending on the application.



Bushings or Center Bushings are sometimes used in place of flange bearings on light duty doors, mainly at the center bracket location(s). The bushing is made from a low friction material and the shaft turns on the inner race. The shape and field application is the same as flange bearings.



An **Oval Bearing**, sometimes called a football bearing, is a flange bearing pressed into an oval mounting plate. They are used to support the shaft at center brackets where there is not a spring fitting to hold the bearing. These are commonly used on rear mount center brackets when the springs are mounted to track brackets or when the spring fittings are not designed to receive a flange bearing.



Heavy Duty Cast Bearings

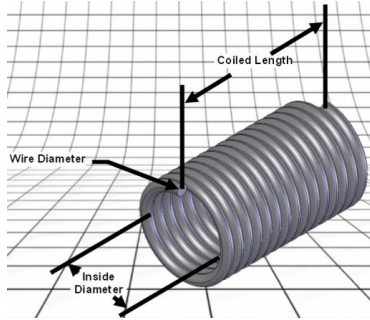
are used in high cycle commercial applications. A precision bearing is in a cast housing that bolts to the end and/or center brackets. The bearing is self-aligning to improve the endurance of the bearing and typically has grease fittings for lubricating the bearing during service. Cast



bearings will often mount on the opposite side of the end bearing plate as the drum and a spacer collar may be used to position the drum properly.

Torsion Springs

A torsion spring is defined by three characteristics. Coiled length is the distance from one end of the spring to the other. Wire diameter is the size of the wire used to coil the spring. Inside diameter is the distance across the inside of the spring. Wire diameters range from 0.1875 inches up to 0.625 inches and inside diameters range from 1-19/32 inches up to 7-5/8 inches. Common inside diameters are 1-3/4, 2, 2-5/8, 3-3/8, 3-3/4, 5-1/4, 6, and 7-5/8 inches.



The spring can be coiled in two different directions, left wound or right wound. A simple way to distinguish between these two types of springs is that a right wound spring would screw clockwise into the ground like a wood screw would rotate into the floor.

Torsion spring manufacturers buy wire, which is received in large diameter spools. These manufacturers order the wire from their vendors in the wire diameter and material necessary.

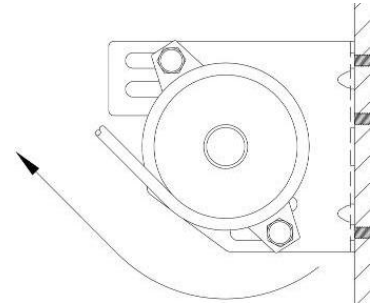


The spring manufacturer coils this wire with an initial tension which allows the wire to coil uniformly. The wire is normally coiled with a stud or arbor in an automatic coiling machine or sometimes coiled around a mandrel or spool. Most torsion springs used to counterbalance garage doors are made from oil-tempered steel, although other materials

can be used. Some spring materials are more accessible in various parts of the world.

Torsion springs develop internal stress when they are wound. This stress is removed by heating the springs after they are coiled. Stress relieving is also referred to as *baking* or *bluing*. Torsion springs are typically coated or galvanized to improve their appearance.

Torsion springs do not develop torque until the wire is wound into coils. In order to properly create torque in a torsion spring, it must be wound in the direction it was coiled. Spring turns must be applied in the direction the end coil is pointing. With standard lift sectional doors, the standard orientation is to wind springs upward. Therefore, a left wound spring must be installed on the right side of the door. A right wound spring must be installed on the left side of the door.



Some spring manufacturers color code spring ends or cones to reduce confusion. Black color-coded springs are those on the right side of the door, and red color-coded springs go to the left side of the door. Many times, only one spring will be needed. When referring to spring location, always refer to the spring anchor point as being the *center* of the installation.

Torsion springs are also often color coded to identify wire diameter using a label or splash of paint. These color codes are used by most spring suppliers and are defined in DASMA TDS 171. Some of the more common color codes for sectional door torsion springs are:

| Size | Color |
|--------|--------|
| 0.192 | Orange |
| 0.207 | Yellow |
| 0.2187 | White |
| 0.2253 | Red |

| Size | Color |
|--------|-------|
| 0.234 | Brown |
| 0.2437 | Green |
| 0.250 | Gold |
| 0.2625 | Blue |

Torsion springs develop *torque*, which is a twisting force applied around an axis. In garage door systems, that axis is the torsion tube or shaft. Torque is measured in *inch-pounds*, defined as the amount of twisting force required to lift one pound with a one inch lever arm. As wire diameter increases, a torsion spring is capable of producing greater torque. Every door requires a specific amount of inch-pounds at the cable drum's moment arm to remain balanced at any point in its travel.



The total torque required to balance a door determines how many turns must be applied to the torsion spring. Springs are wound in quarter-turn increments using winding bars. One bar is inserted into the winding cone, and the spring is rotated one-quarter revolution. This exposes the next hole in the cone, allowing the second bar to be inserted. Once the second bar is secure, the first bar is removed, and the process is repeated until the specified number of turns is reached.

Torsion springs are manufactured in specific combinations of wire diameter and inside diameter to ensure safe and efficient operation. These combinations must fall within acceptable *Index Ratios (IR)* for manufacturability. The IR is the ratio of *mean coil diameter* (inside diameter plus one wire diameter) to wire diameter. ANSI/DASMA 102 specifies that torsion springs with an IR of less than 6 to 1 should not be used. Common inside diameters range from 1-19/32 inches to 7-5/8 inches, and wire diameters typically range from 0.192 to 0.490 inches, depending on the application.

The inside diameter of a torsion spring does not *directly* determine its torque output. Torque capacity is controlled by the wire diameter and the length of the uncoiled wire used to make the spring. In practical terms, the same length and diameter of straight wire can be coiled into several different inside diameters, producing

springs of different overall lengths that all generate the same torque and therefore balance the door identically. The illustration below shows how spring length decreases as inside diameter increases, using inside diameters of 1.75 inches, 2 inches, and 2-5/8 inches from top to bottom. Although their lengths differ, all three springs use the same amount of uncoiled wire and would balance the door exactly the same.



WARNING! Torsion springs are under extreme tension and can pose serious hazards if improperly handled. Severe injuries and even deaths have resulted from improper installation, use of improper winding methods or failure to use proper safety precautions. The professional installer is the key in ensuring that installation and service procedures follow manufacturers' instructions and that all precautions are taken to minimize risk.

Cycles

A cycle is defined as one opening plus one closing of a door. The springs are engineered to last a predetermined number of operational cycles. Most sectional doors are engineered with 10,000 cycle minimum springs. Higher cycle springs are available, and are typically specified as 25,000, 50,000, 75,000 and 100,000 cycles.

Selection of higher cycle springs should be based on the anticipated usage of the door in application. A door which is expected to be opened and closed many times throughout the course of the day would require higher cycle

springs than a door which is only opened and closed once at the beginning and end of the day. It is important to assess the application's anticipated duty cycle in advance of ordering the door such that the springs can be designed for sufficient cycle life.

The result in specifying higher cycle springs is the use of larger diameter spring wire and longer springs. These larger springs are stronger and therefore last longer. In some cases, a process known as *shot peening* is used to extend the life of the springs. Shot peening corrects surface imperfections created in the manufacture of the spring by bombarding the surface of the spring with small pellet-like spheres. This extends the life of the spring providing additional operational cycles.

Commercial sectional doors with higher cycle springs specified often also utilize heavy duty support bracket bearings, as well as solid shafts, to provide longer life of components other than the springs. Refer to the manufacturer's recommended maintenance schedule to help achieve the expected life of the door.

Spring Cones

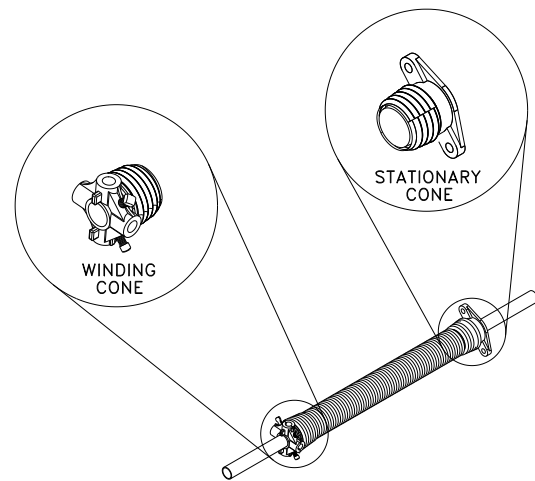
Spring cones are aluminum or steel castings which are installed at the ends of a torsion spring. They are sized to match the inside diameter of the springs.

There are generally two types of spring cone engagements with the spring; friction and mechanical. Friction spring cones have a gradually increasing tapered thread profile which screws into the torsion spring creating a compression fit. As the spring is wound, the inside diameter gets smaller and squeezes down on the spring cone. These cones rely on friction alone to maintain engagement with the spring and are mainly utilized on lower torque spring applications.

Mechanical engagement spring cones utilize various types of mechanical locking methods to

physically secure the end of the spring to the cone. The most common type of mechanical engagement is a cone that slips or threads into the end of the spring and the end of the spring wire is heated up and bent to retain the spring onto the cone. The mechanical engagement cone type is utilized on larger, high torque spring applications.

There are two types of spring cones; stationary cones and winding cones. The stationary cone is attached to the spring and anchored to the header or other support using the center bearing bracket. The inside of the stationary cone is often sized to hold a shaft bearing when the cone is installed.



The winding cone is attached to the spring and controls the spring tension as it is applied and locked to the counterbalance shaft. It has outward radiating holes to receive winding bars for applying spring tension. Winding cones are most commonly sized to attach to 1 inch and 1-1/4 inch torsion shafts.

Set screws in the winding cones are used to secure the spring tension to the torsion shaft once tension is applied. Winding cones used on solid shaft doors may also utilize a key when secured to the shaft. Most manufacturers follow ANSI/DASMA 103 by utilizing red color coded set screws to secure the winding cone to the shaft.



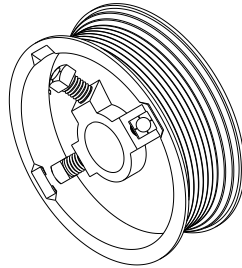
Winding cones are also often color coded for convenience to identify the installation location on the door. Black identifies a part for the right side of the door (left wound spring) and red identifies a part for the left side of the door (right wound spring).



The most common spring assembly utilizes a single spring with a cone on each end. Larger commercial doors may utilize a multiple spring assembly known as Duplex or Triplex springs. A duplex spring is a combination of two springs of different diameters with the smaller spring nested inside the larger spring. Similarly, a triplex spring utilizes three springs of increasing diameter assembled one inside the other. These combination springs utilize special spring fittings for securing each spring to the cones.

Cable Drums

Cable drums are aluminum castings and come in pairs. One end of each of the lift cables attaches to the drum. The drums convert the torque of the springs into a lifting force used to counterbalance the weight of the door. As the door is opened, the cables wrap around and collect on the drums.



Drum diameters range from 4 to 8 inches. The most common diameters are generally 4 to 6 inches. Cable drums are available to fit on 1 inch and 1-1/4 inch spring shafts. There are various types of cable drums for different track lift options.

Set screws in the cable drums are used to secure the drum to the counterbalance shaft. Cable drums used on solid shaft doors may also utilize a key when secured to the shaft. Most manufacturers follow ANSI/DASMA 103 by utilizing red color coded set screws to

secure the cable drums to the counterbalance shaft.

Cable drums are also often color coded for convenience to identify the installation location on the door. Black identifies a drum which is installed on the right side of the door and red identifies a drum which is installed on the left side of the door.

In most cases, a slot in the cable drum is used to attach the cable. The cables must have the proper length to provide the correct amount of pre-wrap on the drums in the closed position. In some cases, cable drums may utilize a third set screw for adjusting the cable length in the field.

The Relationship between Drums and Springs

To operate a door properly, the drums and springs must be engineered as a matched system to balance a door of a specific weight. The correct spring selection depends on the combined factors of drum size, door weight, and door height. Changing any one of these variables affects the others.

If the door weight is less than what the spring is designed to balance, the door may rise on its own, often rapidly, creating a risk of damage or injury. Conversely, if the door weight is greater than the spring's balancing capacity, the door will be difficult to lift and may drift downward unexpectedly, also posing a hazard.

The relationship between drum size and spring size is equally important. In most cases, a drum cannot be replaced with a different size without also selecting a spring that matches the new drum's moment arm. Ignoring this principle will result in an improperly balanced door.

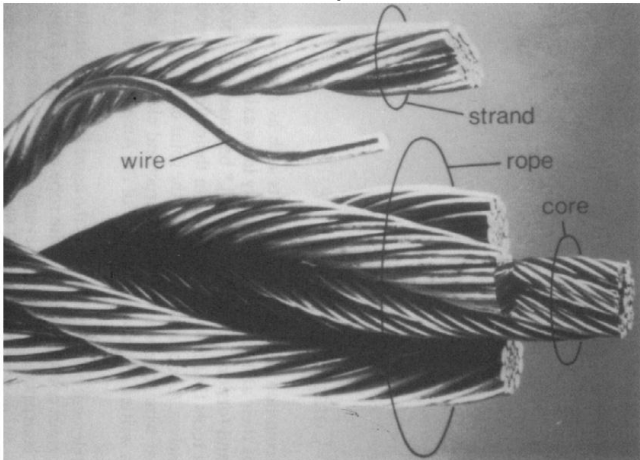
CAUTION: Professional technicians should never modify or replace any part of a counterbalance system without first consulting the door manufacturer and confirming that the

drums, springs, and door weight are properly matched. Incorrect substitutions can lead to unsafe operating conditions.

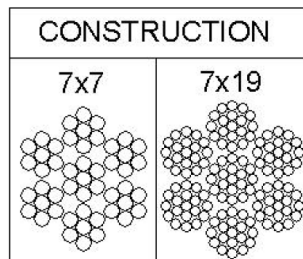
Cables

Cables are used to transfer the spring torque through the cable drums into a lifting force to balance the door. The cables lift the door from each end and must be equal length to ensure the door travels level as it is opened. The cables will attach to both the cable drum, and the bottom of the door. As the door is opened, the cables will collect onto the cable drums.

Cables are constructed of multiple steel wires woven together to make a strand. Then multiple strands are woven together around a core strand to make a rope.



Cable construction is commonly identified using a designation consisting of *number of strands x number of wires per strand*. The most common cable constructions are 7x7 and 7x19. Cables with 7x19 construction are made using 7 strands with 19 wires per strand. It is important to verify the cable construction whenever replacing cables to ensure the proper load rated cables are used.



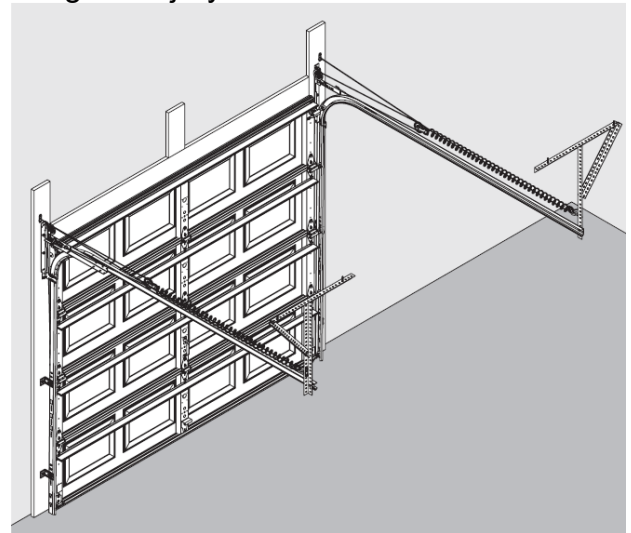
The ends of a lift cable are specially formed to interface with the door hardware and the cable drums. The door end is typically looped to fit around the lift pin at the bottom bracket. This

loop is created by passing the cable through a sleeve, often reinforced with a teardrop thimble, and crimping it securely. The loop must be correctly sized to ensure proper pin engagement and reliable operation.

The drum end of the cable assembly usually includes a cable stop that is crimped onto the cable at a precise location so it will seat correctly in the slot of the cable drum. This crimped stop establishes the exact working length of the cable. Some applications use a floating stop that can be field crimped, allowing technicians to fine tune cable length.

Extension Springs

Another type of counterbalance used on sectional doors is Extension springs. These springs typically require less headroom than torsion spring doors and can be easier to install because the shaft, end bearing brackets, cable drums, and spring fittings are eliminated. Extension springs attach directly to the door with cables that travel on sheaves, or pulleys. These springs must be safely restrained utilizing a restraint cable that runs through the center of the spring to contain the spring intact in the event of breakage and prevent potential damage or injury.



Extension springs develop pull force by being stretched. They connect to the door lift cables on one end, while the opposite end is typically anchored to the back hang angle or an

attachment point at the end of the horizontal track. As the door closes, the cable pulls the spring, causing it to stretch and generate the force needed to counterbalance the door. As the door opens, this stretch is gradually reduced.

It is important to select springs that will stretch to the proper length while providing the correct counterbalancing force. Extension springs are also manufactured with a preload, or force that holds the coils compressed together, typically ranging from 10% to 20% of the total pull. This preload helps hold the door in the open position.

Extension springs are designated using a code comprising *Length-Stretch-Pull*. Proper length of the spring is 30 percent of the door height. The amount of stretch equals half of the door's height, and the pull rating of the spring is equal to the door's weight. Hence, a pair of 25-42-200 springs is needed for a 7-foot high door weighing 200 pounds. This spring is 25 inches long and will exert 200 lbs pull per spring at 42 inches of stretch. The pulley on each spring divides the load to lift the door in half resulting in 200 pounds pull on the door for a pair of 200 pound springs. The stretch of the spring will create the balance force needed to lift the door.

There are three common end types used to connect extension springs when they are installed. The first is a single open loop. These springs have just over half a coil bent 90 degrees to create an open loop that can be hooked onto the back hang angle and connected to the sheave.



The second end type is a double closed loop. This is essentially the same as a single open loop, except two coils are bent creating a closed loop that can be used to hook the springs. The third loop style is clipped ends, in which a metal strap is connected to the end of the spring in place of the closed and open

loops. Clipped ends are most common on larger, higher load extension springs.

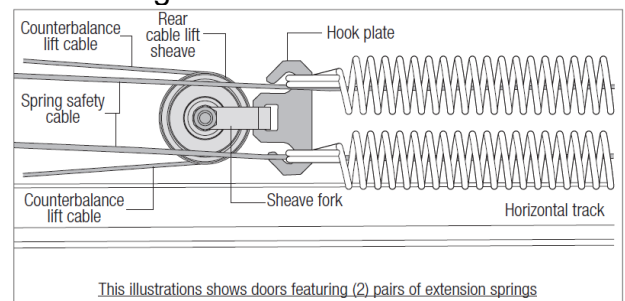
Extension springs are often color coded to identify the pull rating of the spring using a label or a splash of paint. The color codes are used by most of the industry spring suppliers and are defined in DASMA TDS 171. Some common color codes for extension springs are:



| Door Weight | Color | Door Weight | Color |
|-------------|----------|-------------|--------|
| 80 lbs | Gold | 120 lbs | Green |
| 90 lbs | Lt. Blue | 130 lbs | Yellow |
| 100 lbs | Tan | 140 lbs | Blue |
| 110 lbs | White | 150 lbs | Red |

Because a pair of extension springs mount independently, it is necessary to adjust the initial stretch on these springs to ensure equal pull force is applied to both sides of the door. Heavy gauge back hang angles are required for larger, heavier doors to hold the large pull forces of the spring(s).

Larger, heavier doors may also require Tandem Extension Springs. These utilize 2 pairs of extension springs to make up the total balance weight of the door.



For example, 2 pairs of 160 lbs extension springs may be used in a tandem arrangement to balance a 320 lbs door. A special hook plate connects the two springs at the sheave.

WARNING! Extension springs are under extreme tension and can pose serious hazards if improperly handled. Severe injuries and

deaths have resulted from improper handling and failure to use restraint cables.

Track Components

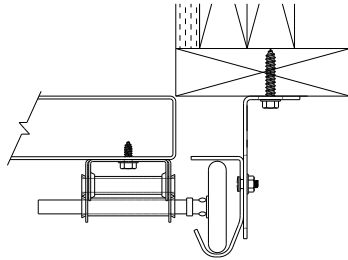
There are various different components that make up a track system depending upon the application and type of lift. Portions of the track system can be factory assembled for ease of installation. The following outlines the assembly types and key components which make up a typical sectional door track system.

Track Mounting

Bracket Mounted

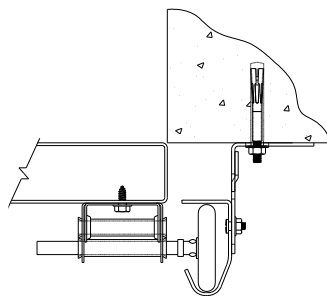
Track: Most residential and some commercial doors utilize *bracket mounted track* to attach the vertical tracks to wood

jamb. As the name describes, the track is attached to the jamb by using angle brackets, called jamb brackets. This type of mounting is commonly used on smaller doors and keeps the fasteners away from the opening edge so as not to break or split out wood jambs.



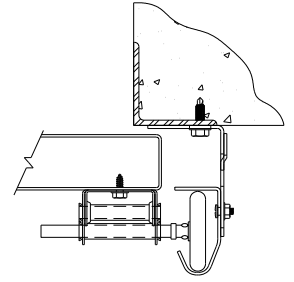
Angle Mounted Track:

Similar to bracket mounted track, angle mounted track is used to attach the vertical track to a wood or masonry jamb. The jamb brackets are replaced by a full height continuous angle that runs beyond the end of the vertical track. This provides the connection for the horizontal track and the reinforcing angle to the vertical track. The angle leg is turned away from the door opening to keep the anchor bolts away from the edge of the wood or masonry to prevent cracking and splitting.



Reverse Angle Mounted Track:

Reverse angle mounted track, also called clip mounted track, is the same as angle mounted track except that it is used when mounting the track system to steel jambs. Common steel jambs are around three inches wide and the angle leg must be turned toward the door opening in order to mount the track. In some cases, the track is welded in place when the jamb steel won't allow for bolting. Welding a track in place should always be a last resort as you lose adjustability in the track system. With reverse angle mounted track, the door is customarily ordered 2 inches wider than the actual opening, providing 1 inch lap on each jamb to properly position the vertical track.

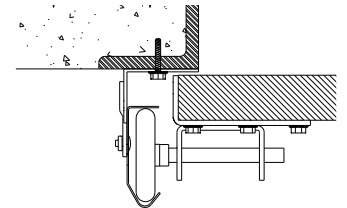


Types of Jambs

The type of jambs often determines what type of vertical track mounting is required.

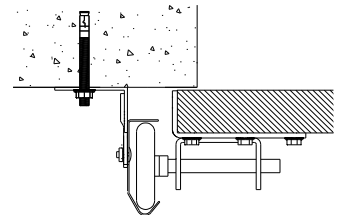
Steel or Precast Wall with Corner Angle

Jambs: Reverse angle mounted track is used for steel jambs with the angle turned in towards the sections. The track is fastened to the jambs using self-drilling or tapping screws. The wall mounted angle leg is commonly used to attach a weatherseal.



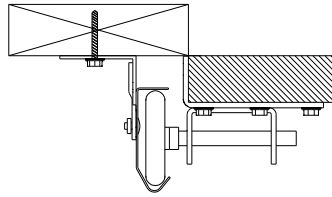
Masonry or Precast Wall without Corner Angle

Jambs: Bracket mounted or angle mounted track is used for masonry jambs. This moves the fastener away from the edge of the jamb to prevent the faster from splitting out the masonry. The center of the fastener is typically a minimum of six times the fastener diameter away from the edge.



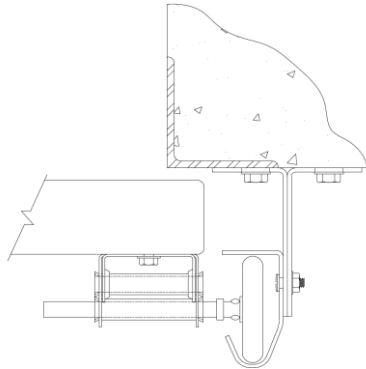
Wood Jamb:

Bracket mounted or angle mounted track is used for wood jambs. This moves the fastener away from the edge of the jamb to prevent the faster from splitting out the wood. The center of the fastener is typically a minimum of six times the fastener diameter away from the edge.



Reinforcement:

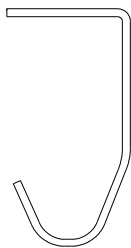
Very large or heavy wind load doors may use reverse angle mounted track (angle in) and add jamb brackets on the outside for added reinforcement.



Vertical Track

Vertical track refers to the portion of the track system that is oriented vertically and is adjacent to the jamb. This track assembly is made up of a section of track and multiple jamb brackets used to secure the track to the jambs.

The shape of the track profile provides clearance for the roller to travel up and down, but with a narrow opening to prevent the roller from unintentionally exiting the track. It is manufactured from galvanized steel coils in a variety of gauges ranging from 12 through 18. The door weight, size, and mounting method of the track assembly must be considered when choosing the proper gauge of the door track. Track is available in 2 inch and 3 inch sizes, depending on the diameter of the roller which will operate in the track.

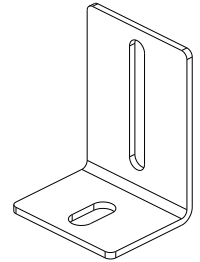


Vertical track is sloped away from the jambs at an increasing distance going up the opening. This slope is typically 1/8 inch per foot and is

used to ensure that the door will pull away from its tight fit to the jambs, eliminating friction as the door travels. The graduated edge hinges of the door are designed to mate up with this slope resulting in a tight fit to the jambs in the closed position, and smooth, frictionless motion as the door is opened.

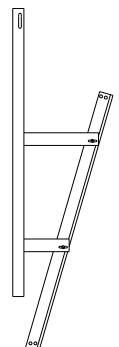
Jamb Brackets

Jamb brackets are “L” shaped angle brackets used to connect the vertical track to the door jamb when bracket mounted track is used. The small leg of the angle is used to fasten the bracket to the jambs, and the long leg is used to space the vertical track out to align with the rollers. Jamb brackets are often slotted to provide in and out adjustment of the vertical tracks to properly seal the sections to the opening. Jamb brackets are assembled to the vertical track using track bolts, or they can be welded or riveted to the vertical track at the factory. Some jamb brackets are numbered in graduation from the bottom to the top of the door to prevent the jamb bracket from sticking out past the vertical track. When field assembly is required, refer to the manufacturer’s jamb bracket schedule for proper jamb bracket locations.



Upper Vertical Track

High Lift and Vertical Lift doors will utilize an upper vertical track assembly. This is a secondary vertical track assembly that mounts above the opening. This track assembly typically has a larger pitch away from the jambs than the lower vertical track to provide clearance for the cable drums and to prevent the cables from hitting the sections as the door is opened. Similar to angle mounted track, the upper vertical track will have a series of vertical and horizontal

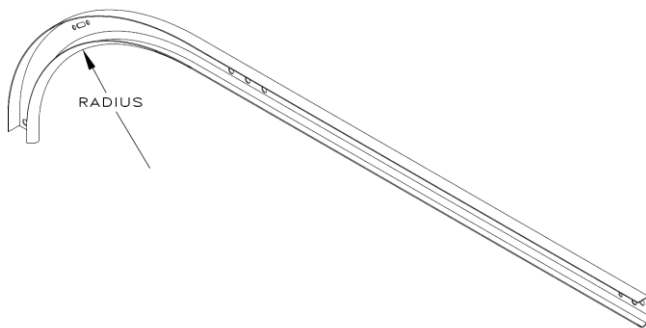
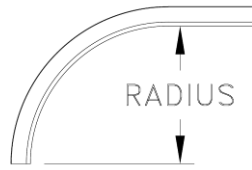


angles for mounting the track to the jambs and to provide support for the vertical track pieces.

Horizontal Track

Horizontal track is the horizontal segment of the track system that supports the weight of the sectional door in the open position. This track will utilize the same profile as the vertical track. It is used in pairs and is formed from galvanized steel in a thickness designed for the application.

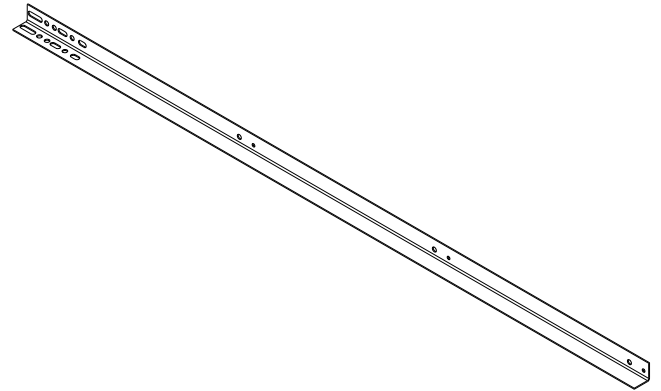
It is formed on one end with a sweeping radius to allow the rollers to transition smoothly from the vertical to the horizontal position while the door is in operation. The radius of the track is the vertical distance from the radius end of the track up to the bottom of the horizontal portion. The most common sizes are 12 inch and 15 inch radius, however various other sizes up to 32 inches are available from many manufacturers. Like vertical track, the horizontal track is made in both 2 inch and 3 inch sizes depending on the size of the roller.



Horizontal Track Angle

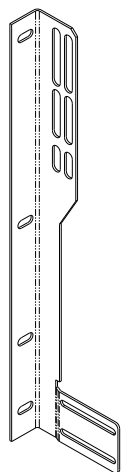
A Horizontal Track Angle is a reinforcing angle formed from galvanized steel that is attached to the horizontal track. It is sized to support the weight of the door when the door is in the open position. This angle is welded or bolted to the horizontal track and may run the entire length of the horizontal track, or may be shorter on smaller doors where extra reinforcement is not

required. The horizontal track angle typically extends beyond the radius enough to be attached to the flag bracket, header plate, or vertical angle that is attached to the jamb.



Flag Bracket

One common method of attaching the vertical and horizontal tracks is the use of a flag bracket, or flag angle. A flag bracket is a vertical wall angle with a splice plate protruding for joining the vertical and horizontal track angles. The upward extending portion of the flag bracket is used for attaching the horizontal reinforcing angle. The jamb leg of the flag bracket is used to attach the flag bracket to the jambs. Flag brackets can be made as a single stamped part, or for larger doors, a splice plate may be riveted or welded to a length of angle.

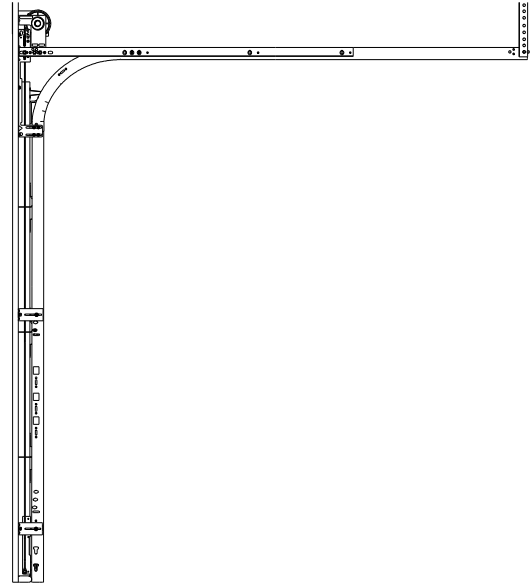


Headplate

Another common method of assembling the vertical and horizontal track is the use of a headplate. The headplate is used as the end bearing plate to support the counterbalance assembly, but it can also be used to attach the horizontal track at the radius and/or the horizontal reinforcing angle at the same time. Similar to a flag bracket, the headplate will attach to the header or vertical tracks for ease of installation of the horizontal tracks.



multiple different sizes ranging from 10 inch up to 32 inch radius. The most common track sizes are 12 inch and 15 inch radius.



Types of Sectional Door Lifts

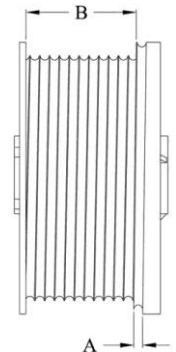
Sectional garage doors can be configured with different types of lifts to accommodate a wide range of building conditions, ceiling heights, and operator requirements. The lift configuration determines the path the door follows as it opens, the hardware needed to support that movement, and the clearances required for proper operation. This section introduces the most common lift types and explains how each configuration is selected based on the characteristics of the opening and the needs of the application. Understanding these lift types helps technicians identify existing installations, plan replacements, and ensure that new doors are specified and installed correctly.

Standard Lift

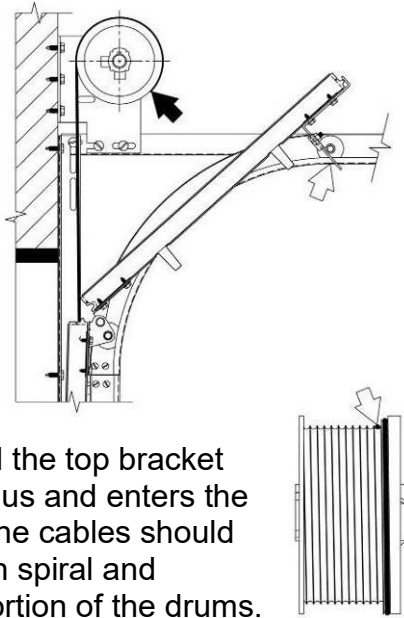
The most common type of lift for a sectional door is Standard lift. This type of track system has a single set of vertical and horizontal tracks with a smooth radius between the two. The horizontal tracks are positioned so that the door clears the opening in the open position. The radius portion of the track can utilize

The first spiral on standard lift cable drums is usually stepped slightly larger, referred to as the *High Spiral* of the drum. This region of the drum has a larger moment arm to compensate for the initial upward travel of the door in which spring turns are reducing, but the door weight is unchanged because the top section hasn't entered the horizontal tracks. When the door is in the closed position, there should be 1/2 to 3/4 turns of cable prewrapped on the cable drums. The balance of the spirals on a standard lift drum are flat.

The High Spiral Portion (A) of the drum starts the door in motion from the floor until the top roller enters the flat section of the horizontal track. Cable will begin to fill the flat portion (B) of the drum after the top rollers enter the horizontal tracks. The actual cable transfer from high spiral to flat will vary slightly depending on lift, radius, and/or shaft centerline. The height of the door determines how much of the flat portion remains unused with a door fully opened.



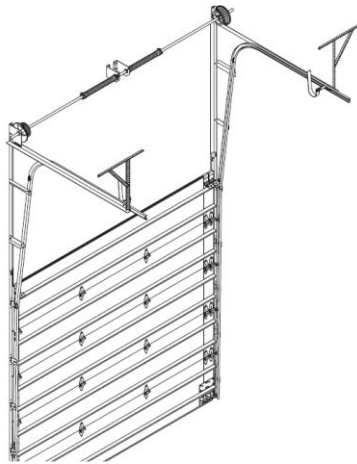
With a door in the closed position, the correct cable lengths will wrap 1/2 to 3/4 of the cable drum high spiral (solid arrow). To further verify cable length (hollow arrows), raise the door until the top bracket roller exits the radius and enters the horizontal track. The cables should be leaving the high spiral and entering the flat portion of the drums.



Cable drums for doors with larger track radius, such as 32 inch, may have more than one high spiral and require additional cable pre-wrap in the closed position.

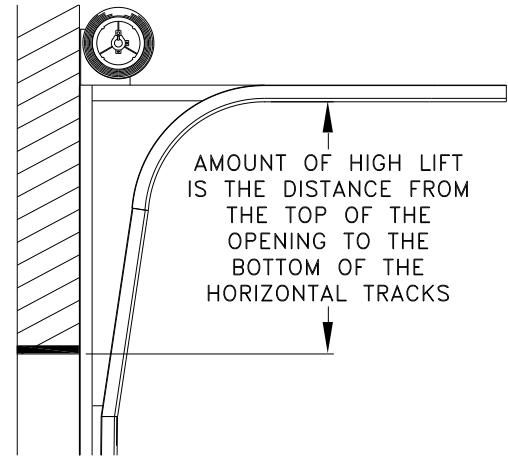
High Lift

High lift track, sometimes called lift clearance track, is used when the available ceiling height is greater than the opening height. This allows the horizontal track to be as high as possible, reducing the obstruction into the room. High lift track is also useful for raising the horizontal tracks up near the ceiling to avoid long, unstable back hangs required for support. This is accomplished by extending the vertical track in height and decreasing the horizontal track length by the same amount that the vertical track is extended.

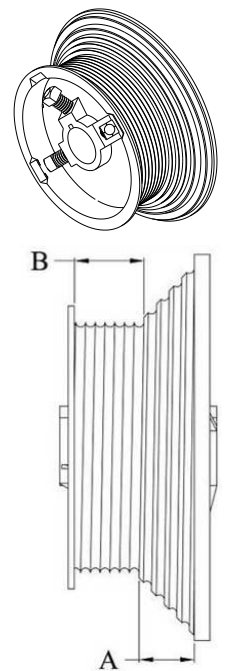


High lift is measured as the distance from the top of the opening to the bottom of the horizontal tracks. A general rule for determining the maximum amount of high lift is

to take the ceiling height and subtract the door height and then subtract another 12 inches.



High lift utilizes special cable drums that are partially spiraled and partially flat. The high spiral portion (A) starts the door in motion from the floor and keeps the door balanced as it travels through the vertical track until the top roller enters the flat section of the horizontal track. When the door is closed, the amount of high lift determines how much of the high spiral is without cable.



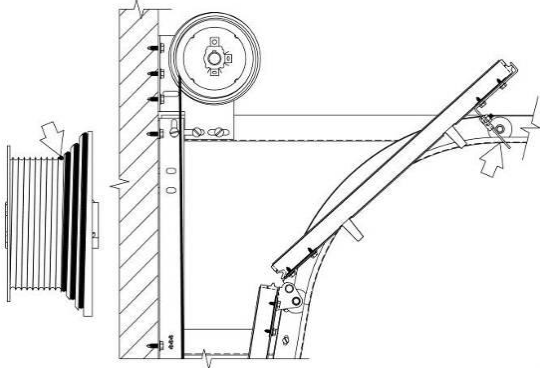
Cable begins to fill the flat portion (B) of the drum as the top roller enters the flat section of the horizontal track. The flat portion keeps the door balanced as it continues back into the horizontal tracks to the fully open position. Door height minus the high lift amount determines how much of the flat portion is unused with a door fully opened.

There are a range of drum diameters, and their part numbers typically indicate flat diameter and maximum high lift that can be achieved with the drum. For example, a 400-54 drum is 4 inch diameter at the flat portion with 54 inches of maximum high lift. The most common diameters are 4 and 6 inches.

The spirals on a high lift drum are flat to the inside and tapered on the outside. The cable

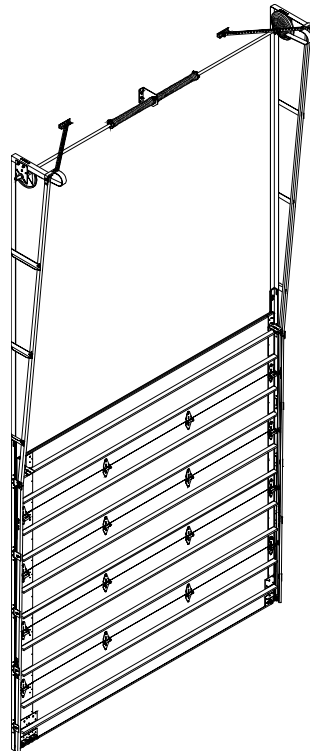
storage capacity of the tapered portions must be at least equal to the amount of high lift the door requires.

To verify correct cable length (hollow arrows), raise the door through the high lift section of the track until the top bracket roller exits the radius and enters the horizontal track. At this time the cable should be leaving the high spiral and entering the flat portion of the cable drums.

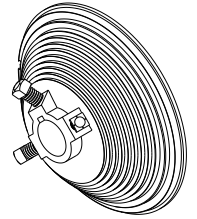


Vertical Lift

Vertical lift track can be used if the ceiling height is one foot greater than twice the door height. This allows the door to travel straight up and down and eliminates the need for the horizontal track. Vertical lift track typically pitches away from the wall above the opening to provide space for the counterbalance assembly and to prevent the cables from rubbing the sections. Vertical lift doors are common on warehouse dock doors because the track is not required to be supported from the ceiling.

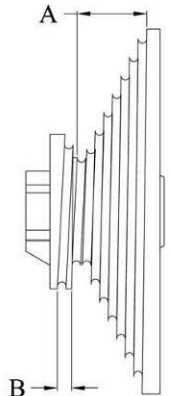


Vertical lift utilizes special cable drums that are completely spiraled. The spiral portion of the drum keeps the door balanced as it travels through the vertical lift track.



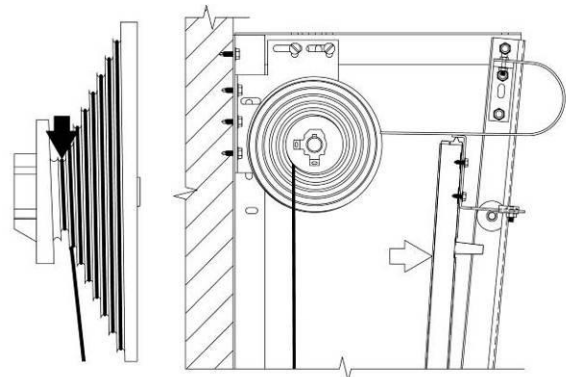
There are a range of drum diameters, and their part numbers typically indicate approximate diameter and the maximum door height the drum can accommodate. An 850-11 cable drum, for example, is about 8-1/2 inch diameter and can accommodate up to 11 foot tall doors. The spirals on a vertical lift drum are tapered.

The spiral portion (A) of the drum is used for the normal range of travel of the vertical lift door. For door heights less than the maximum for each drum, the actual door height determines how much of the spiral portion is filled with cable when the door is closed.



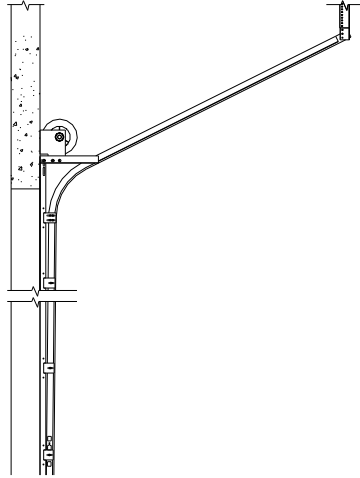
The negative spiral portion (B) reduces the door speed and controls door travel overrun when opened with excessive force. There should never be cable resting on the negative spiral portion when the door is open.

With the door in the full open position (hollow arrow) cable should be leaving the drums from the lowest point of the spiral portion (solid arrow). There should be no cable resting on the negative spiral portion when the door is open.



Contour Track (Roof Pitch)

Contour Track, often referred to as follow the slope-of-roof or roof pitch, is a horizontal track system that follows the contour of roof construction or the ceiling. The horizontal tracks pitch upward as the door travels back from the opening.



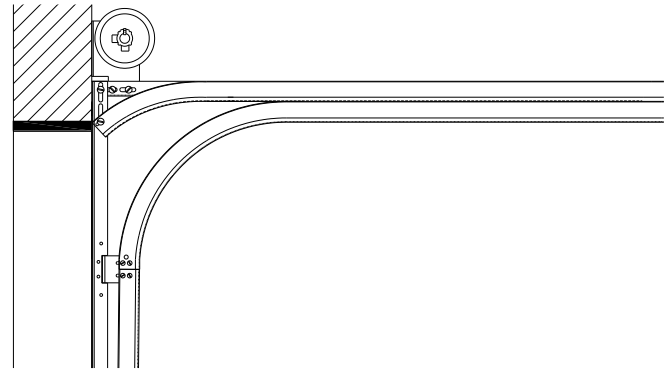
This system can be utilized in combination with low headroom lift, standard lift, or high lift track. Contour track is desired when the door is installed on a sloped roof building and the door is not located on the gable end. This allows the user to take advantage of the building height at the rear of the track, not just at the front.

Structurally, this is also a better installation due to the limited back hang length. Precise measurements must be made for this type of track design. Front and rear measurements are very important in order to figure out the pitch of the track. The method utilized for this is a rise of a given number of inches per foot. In other words, the track will slope up a certain number of inches per foot of the horizontal depth into the room.

For example, if the front headroom is 16 inches, the rear headroom is 60 inches and the track is 10 feet long, the pitch would be 4:12. This means that the track would rise up 4 inches for every 12 inches of horizontal track length. Thus, the track will rise 40 inches in the rear above the standard height in the front. Here the 40 inches of rise plus the additional 16 inches in the front for section clearance means the rear of the track would be 56 inches higher in the rear than the header height.

Low Headroom Lift

Low Headroom Lift, sometimes called Double Track Low Headroom or Low Lift Track, is used when there is reduced clearance above the door. A low headroom lift track system will incorporate a double horizontal track and a shortened vertical track. The upper horizontal track lowers the high arc travel of the top section as the door is opened which reduces the required headroom. Only the top roller on the top section will travel in the upper horizontal track.



Low headroom lift should only be used if there is not enough clearance for a standard radius track system as low headroom lift doors require more force to push the top section in place, do not balance as well as standard lift doors, and hang down into the opening several inches at the fully open position. The slight curve of the upper horizontal track pushes the top section against the jambs and header when the door is closed. Without this feature, a drawbar operator is required to push the top section against the jambs and header when the door is closed.

Low headroom lift doors use the same cable drums as standard lift. This track system typically utilizes outside hookup cables, where the cable and drums are positioned outside of the tracks, and an outside hookup bottom bracket is used. This is because the upper horizontal track interferes with the path of the cable when inside hookup cables are used.

The springs can be mounted at the front or rear of the track. Rear mounted springs are used when very limited headroom is available. By

moving the springs to the back end of the horizontal tracks, the springs can be lowered requiring less clearance. A sheave, or pulley, is mounted to the horizontal tracks near the opening and the cable is routed up and over the sheave and back to the cable drums at the rear of the track. Rear mounted springs may also utilize special track brackets for mounting the springs to avoid having to mount the springs to back hang angle.

There are a variety of other methods used to achieve low headroom lift other than using a double horizontal track system. Special low lift hardware can be used to reduce the high point of travel of the top section by pivoting the section back from the opening into standard radius track. These systems are often used to convert existing doors in the field with tight headroom to provide clearance for a trolley operator. These low lift hardware designs typically require motor operation or utilize a special double roller top bracket to close the top section against the opening. They may also require longer horizontal tracks to clear the brackets in the open position.



Track Guards

Track guards are protective devices installed around the vertical track assembly to shield it from impact damage. They are commonly used in commercial and industrial facilities where forklifts, pallet jacks, carts, or other equipment operate near the door opening. Track guards help prevent deformation of the track, which can lead to door misalignment, roller binding, or complete inoperability.

Track guards are typically constructed from steel and are designed to mount directly to the floor or wall adjacent to the track. Their shape provides a physical barrier that absorbs or deflects impacts before they reach the track. Guards are available in various heights and profiles to match the door size, traffic patterns, and facility requirements. Some models wrap partially around the track, while others stand off to the side to protect the track and jamb area.

Because track damage can compromise door operation and create safety hazards, track guards are often recommended in high-traffic environments or anywhere material-handling equipment operates close to the door. They help extend the service life of the track system and reduce the likelihood of costly repairs.



Bollards

Bollards are vertical posts installed near door openings to protect the door, track, and surrounding structure from vehicle or equipment impact. They are commonly used in warehouses, distribution centers, manufacturing facilities, and any location where forklifts or other powered equipment operate near sectional doors.



Bollards are typically anchored into the concrete floor using embedded sleeves or heavy duty anchors. Their purpose is to absorb or stop impacts that might otherwise strike the

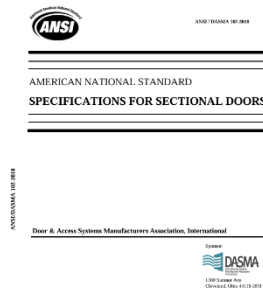
door, track, or jambs. Bollards are available in various diameters and heights, and may be filled with concrete or reinforced depending on the required level of protection. Many are finished with high visibility paint or protective sleeves to increase visibility and reduce maintenance.

Properly placed bollards help maintain the integrity of the door system by preventing accidental collisions that can bend tracks, damage sections, or compromise the building structure. They are often used in combination with track guards to provide comprehensive protection in high traffic or high risk areas.

ANSI/DASMA 102 Specifications for Sectional Doors

(Reference dasma.com for the latest edition)

Among the primary activities of DASMA is the publication of standards for the Door and Access Systems industry. ANSI/DASMA 102 *Specifications for Sectional Doors* is a voluntary standard defining minimum design and performance requirements for sectional doors. This standard is outlined below to aid in understanding the performance requirements and specifications of sectional doors and related components.



1.0 Scope

1.1 Inclusions. This specification for sectional doors, as defined in Section 2, is intended to cover residential and commercial type doors normally used on garages, warehouses, factories, service stations, and other places requiring doors generally used for vehicular traffic.

1.2 Exclusions. It is not intended to cover doors generally used for pedestrian traffic nor other types of overhead doors such as rigid, folding, multi-leaf, rolling doors, or special application doors.

- 2.0 Definitions – See DASMA publication for definitions.
- 3.0 Referenced Standards – See DASMA publication for referenced standards.
- 4.0 Installation/Operation – The door system manufacturer shall furnish standard details and instructions for proper installation and operation. Such instructions shall include warnings relative to the installation and operation of the door system.
- 5.0 Maintenance – The door system manufacturer shall furnish a listing of those components requiring regular maintenance with instructions and frequencies for such maintenance.
- 6.0 Durability - When testing is performed to determine cycle life, testing shall be conducted in accordance with ANSI/DASMA 109.
- 7.0 Identification – Each door system shall be labeled to identify the name and address of the door system manufacturer.
- 8.0 General Requirements
 - 8.1 Hand Chain Hoist Operation – Hand chain hoists shall not be used on standard lift and low headroom applications unless provisions are made to maintain adequate cable tension as specified by the door system manufacturer.
 - 8.2 Power Assisted Operation
 - 8.2.1 Motorized jackshaft operators shall not be used on standard lift and low headroom applications unless provisions are made to maintain adequate cable tension as specified by the door system manufacturer.
 - 8.2.2 If a drawbar operator is used, additional door reinforcement may be required upon installation. Reinforcement requirements for drawbar attachment shall be specified in the door system manufacturer's installation instructions.
 - 8.2.3 If an operator is listed as part of the door system, such operator shall be designed in compliance with the applicable sections of the

version of UL 325 in effect at the time of manufacture.

8.3 Counterbalance Assemblies

8.3.1 Counterbalance assemblies shall meet the requirements of ANSI/DASMA 103.

8.3.2 Torsion spring counterbalance assembly design shall be in accordance with Section 9.3.

8.3.3 Extension spring assembly design shall be in accordance with ANSI/DASMA 103.

8.4 Sectional Door Interfaces and Lift Handles. Residential doors shall meet the requirements of ANSI/DASMA 116.

8.5 Thermal Transmittance/Air Infiltration. Published thermal transmittance and air infiltration values of installed residential and commercial doors shall be in accordance with the test methods specified in ANSI/DASMA 105.

8.6 Published steel gauge numbers shall be in accordance with DASMA Technical Data Sheet 154, DASMA Steel Gauge Chart.

8.7 Foam Plastic Insulation. Foam plastics used in sectional doors shall meet requirements established by the authority having jurisdiction for flame spread and smoke development.

9.0 Loads

9.1 Wind Loads

9.1.1 Residential or Commercial Door System. A door system shall be designed to withstand a minimum wind load as required by the authority having jurisdiction over the geographic location where the door is to be installed. When required by the authority having jurisdiction, structural tests shall be in accordance with ANSI/DASMA 108 or other accepted means required by the authority having jurisdiction.

9.1.2 Where resistance to windborne debris is required by the authority having jurisdiction over the geographic location where the door is to be installed, a door system shall meet the requirements of ANSI/DASMA 115 or other accepted means as required by the authority having jurisdiction.

9.2 Dead Loads

9.2.1 Residential and Commercial Door Sections. Door sections, including their reinforcement hinges, roller assemblies, and method of attachment to the door, shall be designed to support their own weight when in the horizontal position and not deflect more than 1/120th of the door width. Deflection shall be measured after the door has been in the horizontal position for at least 24 hours.

9.2.2 Horizontal Track Assembly. The horizontal track assembly, including installation hardware, shall be designed to support a dead load equal to the door weight when in the horizontal position and not deflect more than 1/240th of the door height. Deflection shall be measured after the door has been in the horizontal position for at least 24 hours. Twist, deflection, or deformation of the track shall not interfere with the operation of the door. The manufacturer shall specify the point(s) where attachment to the horizontal track shall be made for the purpose of suspending the track from the building.

9.2.3 Bottom Brackets. Each bottom corner bracket, and its

attachment to the door panel and cable, shall support its designed portion of the static load of the door without releasing it, including a 4:1 safety factor (door weight including all on the door hardware divided by the bottom bracket designed portion of the load multiplied by a safety factor of four).

9.3 Torsion Spring Counterbalance

Assembly. The torsion spring counterbalance assembly shall be so designed and constructed to provide for a safe and durable conversion of spring torque to lifting power for balancing the weight of a sectional door as stated in paragraphs 9.3.1-9.3.6. Torsion springs shall not be used to balance sectional doors employing an index ratio of less than 6 to 1 (mean coil diameter six times wire diameter).

(Reference publication for Index Ratio formula)

9.3.1 Torsion Shafts

9.3.1.1 Tubular steel torsion shafts shall be of a sufficient wall thickness to prevent a torsional (radial) deflection of the shaft in excess of 1.5 degrees per foot (305 mm) of shaft length from the torque source to point of delivery. Linear deflection of a torque shaft shall not exceed one tenth inch (2.5 mm) per foot (305 mm) of shaft length with proper supports in position.

9.3.1.2 Solid steel torsion shafts shall be of a diameter and composition sufficient to prevent torsional (radial) deflection of not more than 2 degrees per foot (305 mm) of shaft length from the torque source to the point of delivery. Linear

deflection of the torque shaft shall not exceed one tenth inch (2.5 mm) per foot (305 mm) of shaft length with proper shaft supports in position.

(Reference publication for shaft formulas)

9.3.2 Cable drums shall be so designed to allow cable to be accumulated or dispensed in an orderly manner and to prevent lapping or cable chafing. Cable drums shall be selected with a minimum safety factor of 4, based on the maximum torque for the applied load requirements.

9.3.3 Spring Fittings

9.3.3.1 Winding device shall have a torsional safety factor of 4. The portion of the winding device interconnecting with the spring shall be of a design that properly retains a torsion spring when fully wound or unwound, and withstands the radial and lateral forces exerted by the torsion springs.

9.3.3.2 Spring retainers and stationary sleeves shall have a torsional safety factor of 4. Spring retainers, or stationary sleeves, shall be so designed to withstand the radial and lateral forces exerted by the torsion spring to properly retain the spring when fully wound or unwound and allow the application of torque.

9.3.4 Each side bearing plate shall be designed to support the weight

of the counterbalance assembly, plus the total door weight, multiplied by a safety factor of 2. They shall be adequately reinforced to resist any lateral force exerted by the torsion shaft and properly retain the shaft bearing in alignment with the torsion shaft.

9.3.5 Spring anchor plates shall be so designed as to adequately transmit torque from the stationary end of a torsion spring to the building structure and, at the same time, support the weight of the torsion shaft, multiplied by a safety factor of 2, in a level attitude. The anchor plate shall be able to withstand the lateral forces exerted by torsion spring.

9.3.6 Shaft bearings shall be of a type and design that adequately support the radial forces dictated by the weight of the counterbalance assembly and door weight, lateral forces exerted by the torsion shaft, and shall be able to tolerate minor shaft misalignment conditions.

9.4 Cable Assembly. The cable assembly that transmits door load shall be selected using a safety factor of 5. Cable shall be securely anchored at each end. Cable diameters shall not be greater than 5% of the diameter of the cable drum or cable sheave with which it will be used.

10.0 Responsibility of Others

10.1 Transmitted Loads

10.1.1 The track system shall be attached to the building at the points specified by the manufacturer (Section 9.2.2)

using a method capable of supporting the door loads at each point. In addition, the supports shall resist twisting and swaying loads imposed on them by the track system.

10.1.2 The installation instructions shall advise that it is important that forces transmitted from an installed door system to the building structure be considered in the design of building openings for doors. These forces are evident at the building jambs when a door is subjected to wind pressure, at each spring anchor pad and its connection to the building header, and at all points where the horizontal track is attached to the building. Since these forces will vary, installation instructions shall specify that load information may be obtained by contacting the door system manufacturer.

11.0 Disclaimers

11.1 Certification that a door system meets this standard does not constitute a warranty that the system will perform in accordance with the standards set forth in this standard, including but not limited to durability, thermal transmittance/air infiltration, or loads. Certification implies only that the design of the listed door system, when tested in accordance with these standards (which may be random testing, if so specified), meets the applicable tests.

11.2 Many tests required by this standard are inherently hazardous and adequate safeguards for personnel and property must be employed in conducting such tests.

Section Five

Methods of Operation

Sectional doors can be operated in several different ways, and selecting the correct method is an important part of proper door specification. The choice depends on factors such as door size, available headroom and sideroom, frequency of operation, cost, and power availability. Matching the operating method to the application helps ensure smooth performance, long service life, and customer satisfaction.

This section describes the three primary methods of operating sectional doors:

1. Manual Pushup Operation
2. Manual Chain Hoist Operation
3. Electric Operation

For any mechanically operated door, it is also necessary to determine the hand of operation before ordering. When facing the door from the inside of the building, the operating mechanism may be located on the left or right, and this choice should avoid field obstructions, align with traffic patterns, and meet appearance requirements. Properly specifying both the operating method and the hand of operation helps prevent installation challenges and ensures the door functions as intended.

Manual Pushup Operation

Manual pushup operation is the simplest method of operating a sectional door. The user manually lifts the door from the closed position and pushes it upward until it reaches the fully open position. Because doors can be very heavy, counterbalance springs are used to offset the weight of the door and allow it to be lifted safely.

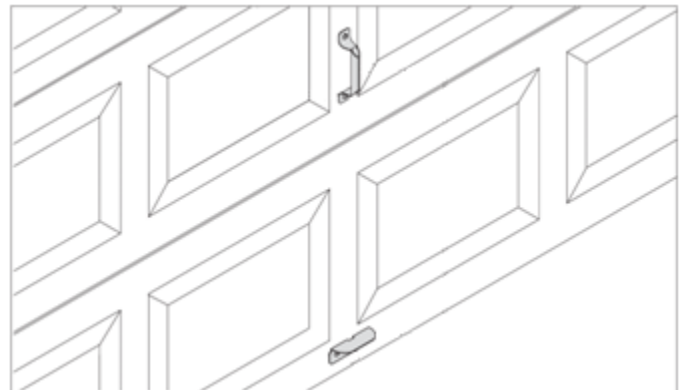
For taller doors, a pull down rope is typically attached to the bottom bracket so the user can pull the door down into reach when closing it.

Proper placement of lift handles and step plates is essential for safe manual pushup operation. Correct placement helps the user maintain a safe grip and reduces the risk of hand injuries at section joints, hinges, and other potential pinch points.

ANSI/DASMA 116, *Standard for Section Interfaces on Residential Garage Doors*, provides requirements for the location of lift handles and suitable gripping points on both the interior and exterior surfaces of the door. Key provisions include:

1. A lift handle must be installed on the bottom section within 8 inches of the bottom edge and aligned with gripping devices on other sections.
2. Additional lift handles must be installed on the second or third section from the bottom of the door.
3. Lift handles located within 4 inches of a section joint must promote vertical hand orientation.

Most manufacturers supply combination step plate/lift handle assemblies for the bottom section and separate lift handles for the second or third section, along with hardware and installation instructions designed to meet this standard.



Manual Chain Hoist Operation

Chain hoists have been developed primarily as an operating mechanism for commercial and industrial doors equipped with a shaft. High Lift or Vertical Lift doors are ideally suited for this style of operation. Standard lift doors can be equipped with manual chain hoists, provided that the door has a shaft as the driving element and has additional provisions to maintain cable tension. It is important to specify if chain hoist operation is required in advance of ordering a door, as chain hoist doors often are provided with a solid keyed shaft for assembly of the hoist sprocket.

There are two types of chain hoist operating mechanisms used for sectional doors. The first type is a *direct drive* unit, which mounts directly to the door shaft and utilizes a one-to-one reduction. This means that each revolution of the chain hoist pocket wheel results in one revolution of the door shaft. Because of this limited reduction, a direct drive chain hoist is reserved for smaller, lighter doors.



The second type is a *gear reduction* unit, also called a *reduced drive chain hoist*. This unit typically utilizes a three-to-one or four-to-one reduction between the hoist pocket wheel and the door shaft. This reduction allows the door to be operated with ease and is ideal for use on larger, heavier doors. The hoist will be mounted on the wall, track, or directly on the door shaft and sprockets and/or gears are used to achieve the reduction. It's important to remember that the larger the reduction, the lower the hoist effort will be, but this lower effort will require more revolutions of the chain to open the door.

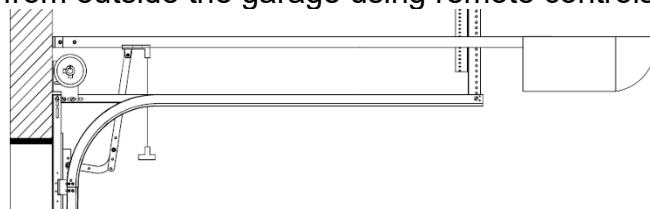


Sometimes a chain hoist is provided with an electric operator for use in case of power failure or some other mechanical breakdown.

Residential Electric Operation

Residential garage doors can use electric operators to provide safe, convenient, and reliable daily use. This section introduces the two primary types of residential operators, drawbar and jackshaft, and explains how each interacts with the door's hardware and balance system. It also covers the external entrapment-protection devices required for modern installations, including photoelectric sensors and monitored sensing edges. Understanding these components and how they work together helps technicians install, adjust, and service residential systems in compliance with current safety standards.

Residential Drawbar Operators: Also known as trolley operators, drawbar operators were created for the primary purpose of lifting to open and pushing to close the garage door. In the early stages of development, most were belt and chain driven and were activated with pushbuttons. Over time, accessories have been developed so that operation can be done from outside the garage using remote controls.



Today, there are three common types of drawbar garage door operators: chain, belt, and screw drive. Chain Drive is operated using a roller chain and sprocket system. Belt Drive operates with a cogged belt and pulley system, and Screw Drive uses a worm gear and a threaded shaft similar to that of a screw.

Products certified by a nationally recognized testing laboratory, such as UL or Intertek (ETL), are designed to have *fail safe* components in the operation of the residential operator.

It should be noted that the only reason an operator is used is for convenience purposes. If and when the operator is disconnected, the door can be operated manually because the

counterbalance system is designed to assist in operating the door.

Drawbar operators are designed for use on standard lift or low headroom residential doors and are normally mounted on the centerline of the door and parallel to the floor. Most operators require 2.5 inches (6.35cm) clearance over the high arc of the door and 48 inches (1.2m) behind the door when it is fully opened.

The drawbar operator connects to the door using an adjustable arm. Operators also have provisions to disconnect the operator so that the door can be operated manually during power failures or in an emergency if entrapment were to occur.

Residential Jackshaft Operators: A jackshaft is another type of residential garage door operator. Instead of using chains, belts, or screws with a trolley, the motor connects directly to the door's counterbalance system. The operator mounts to the side of the door and turns the counterbalance shaft to raise and lower the door. Because the operator relies on the door's torsion system for movement, proper installation requires strict adherence to the manufacturer's instructions, including the use of cable tension monitors if specified by the manufacturer to ensure safe and reliable operation.



Residential External Entrapment Devices

With the addition of the November 1990 amendment to the Consumer Product Safety Improvement Act, it became a federal

requirement that, effective January 1, 1993, all residential garage door operators sold in the United States must be constructed to comply with and be tested to UL 325.

Among the key provisions of UL 325 is the requirement that residential garage door operators include an external entrapment device. Today, two types of external entrapment protection devices are recognized for residential operators: Photoelectric Sensors and Contact Edge Sensors.

Residential Photoelectric Sensors:

Photoelectric sensors are devices that project an invisible light beam across the door opening. If the beam is interrupted a closing operator will reverse and an operator in the fully open position will not close.



The most common beam system is a through beam, constructed with a sending unit and a receiving unit, mounted on opposite sides of the door. These systems operate in the infrared band or frequency of the light spectrum. Infrared is used because it has the most tolerance to sunlight. The units are to be mounted no more than 6 inches above the floor. The set is then typically connected to the operator with wires running from the sending and receiving units to the input terminals on the operator's head unit. Some units also operate wirelessly. One should refer to the individual operator manufacturer's instructions for mounting and wiring of Photoelectric Sensors.

The sending unit sends the light beam to the receiving unit, which then sends a pulsing signal or a voltage level to the operator's motor control which monitors this information. If it does not receive the correct pulse or voltage reading because of an interruption of the beam or an electrical or mechanical failure, it will reverse the operator's travel in the down direction or will not allow the operator to close from the fully open position. It will not operate

until the obstacle or malfunction is corrected or constant pressure is applied from a wired control.

Residential Contact Edge Sensors: Contact edge sensors are devices installed along the lead edge or bottom edge of the door. The edge senses an obstruction when it comes in contact with that object and sends a change of status signal back to the operator's control board. The control board monitors the input and tells the operator system to reverse if it is moving in the down direction. If the operator is in the fully open position, it will not close.

The contact edge sensor used on residential garage door operators is a unit constructed with two electrical contact strips spaced apart and enclosed in a rubber tube or other waterproof material. The pulse or voltage signal is generated by an electronic board or component mounted at the very end of the contact edge sensor. This creates a pulse or voltage level that the motor control board monitors as the standard signal input into the board. When the two contact strips come together during contact with an object, or if the contact edge sensor has an electrical or mechanical failure, the signal changes and informs the operator that there is a problem or contact with the edge.

The signal is typically sent to the operator input through a coil cord connection from the edge to a junction box or connector. The wires then run from the junction to the operator connections. Some units also operate wirelessly.

Residential Access Controls

Residential access control devices allow homeowners to operate their garage doors safely, conveniently, and securely. This section introduces the primary control methods used in modern residential systems, including radio-frequency remote controls, keyless entry keypads, and multifunction wall stations. It also covers common accessories that expand system capability or enhance user

convenience. Understanding how these devices communicate with the operator and how they are installed, programmed, and maintained helps technicians ensure reliable performance and compliance with current safety standards.

Residential Radio (Remote) Controls: Radio systems to control garage door operators have been in use for many years. The systems have evolved from the tube radio unit as large as a loaf of bread, to mini transmitters the size of a matchbook.



The radio system is comprised of two components:

- 1) The transmitter, which is the mobile part of the system located in the car, pocket or other location, and sends the radio frequency signal out.
- 2) The receiver, which is either attached to or built into the operator and receives the coded signal from the transmitter, checks it for the proper code, and sends input to the operator to activate.

The standard transmitter/receiver set is a one button or one channel system. Manufacturers do produce systems with multiple buttons or channels for special applications and activation of two or more operators from one transmitter/receiver set.

The transmitter is comprised of two parts:

- 1) The front end or the section of the unit that generates the radio frequency and carries the code to the receiver.
- 2) The back end or the section of the unit that creates the code that the receiver accepts.

This special code is created by way of a dip or trinary switch set and/or an encoder I.C. chip or

microprocessor I.C. chip. This special code is then used to modify the carrier radio frequency that is sent to the receiver.

The receiver also has two parts:

- 1) The front end or the section of the unit that accepts the signal from the transmitter.
- 2) The back end that decodes the signal and, if it is the correct code, sends an input to the device to which it is attached.

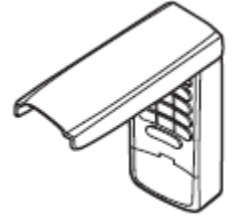
The radio frequency band, or area in which this type of system is allowed to operate, is managed by the FCC. They define the allowable output power that these units can transmit.

There are three types of signal-encoding methods that have been used in residential garage door opener transmitters and receivers:

1. **Binary or Trinary Dip Switch Sets:** Some transmitters and receivers are built with a binary or trinary dip switch set that creates the modified signal that is used. This type of coding is limited. There are a limited number of codes that can be generated by these switches; the standard binary switch with 10 switches will create 1,024 codes and the standard trinary switch with 9 switches will create 19,683 codes.
2. **Embedded Code Sets:** The transmitter uses a microprocessor type of Integrated Circuit (IC) chip and is coded by the manufacturer with one of a million or more codes. The code is built into the transmitter and cannot be changed. The receiver is a *smart* or programmable unit and is programmed with the total number of transmitters used with this one operator. This type of system is limited by the receiver and the number of transmitter codes that it will store in memory.
3. **Code-Rotating or Code Changing Sets:** A manufacturer typically now uses a code changing radio set. This system uses a microprocessor IC chip and algorithm to change the code every time it transmits. The receiver has the same IC chip

installed and is programmed to recognize each transmitter's program and accept its code signal. The advantage of this type of system is that it cannot be copied by any outside device and is considered the most secure of the three systems.

Keyless Entry System: A keypad is mounted on the exterior of the garage near the opening allowing a user to control the door by entering an access code.



These units can be wired or wireless.

For a wired keyless entry system, the keypad module is wired to the processor module and the processor module has a set of wires directed to the operator's input connections. The disadvantage of this entry type is that a hole may need to be drilled into the door jamb for mounting the wires running from the processor module to the operator input connection.

A wireless system has a radio transmitter built into the module and utilizes a radio frequency signal to send the activation command to the operator's radio receiver. The unit is self-contained and mounts anywhere without the need to run wires to the operator head, thus speeding up the installation time.

Wall Push Button: This switch device is mounted inside the building and may be hard wired to the operator's input connections or may operate wirelessly. When activated, it sends a start/stop command to the operator.

Multi-Function Wall Station: This accessory is mounted to the building and hard wired to the operator's input connections or may operate wirelessly. It allows the user to utilize built-in functions with the garage door opener. The module acts as a start/stop activation device for the operator and can turn the lights of the operator on and off. In some cases, it shuts down the control inputs to the operator so that when the user is on vacation or leaves

the building for an extended period of time, the operator will not activate.

Emergency Vault or Cable Release Lock:

This device allows the user to open the door from the exterior in case of power failure or electrical/mechanical problems. The unit is comprised of a lock cylinder with a length of cable attached. The mounting of the device requires drilling a hole through the door and attaching the release arm to the operator. When the key is inserted and turned, the cylinder comes forward and allows the user to pull the cable, release the emergency disconnect, and open the door.

Timers: A timer is an adjustable electronic device that will automatically close the door after a given or adjustable time period. UL 325 requires both visual and audible alarms prior to this operation on residential door operators.

Wireless transmitters, wireless keyless entry systems, and wireless wall stations often utilize batteries for power. When using these systems, take the time to explain to customers that these batteries require replacement periodically to avoid range issues.

Internet Connectivity: Many residential operators now support Internet connectivity through built-in Wi-Fi hardware or external communication modules. These components interface with a home router and allow the operator to be controlled through a web portal or mobile app, enabling out-of-line-of-sight operation from anywhere the user has an internet connection. This connectivity provides convenience features such as remote operation, status monitoring, and activity notifications.

Because remote operation occurs without the user physically viewing the door, UL 325 requires both audible and visual alarms to activate before the door moves. These alerts function similarly to those required for timer-to-close systems and are intended to warn anyone near the door that a remote operation is in progress.

Commercial Electric Operation

Commercial electric operation refers to the use of a powered door operator, control equipment, and safety devices to move a door safely and reliably. An automated door system includes the door, an electric operator, the controls that command the operator, and the safety equipment that protects people and property.

A wide range of operator types and control options are available to suit virtually any size or application. Because a commercial sectional door is a large, heavy object, the safety of the system depends on proper design, installation, and maintenance. The door itself must be correctly balanced, aligned, and able to move freely by hand; an operator is not intended to overcome a poorly installed or worn out door. Attempting to use the motor to compensate for mechanical defects can create hazardous conditions and significantly increase the risk of injury.

Operator Selection

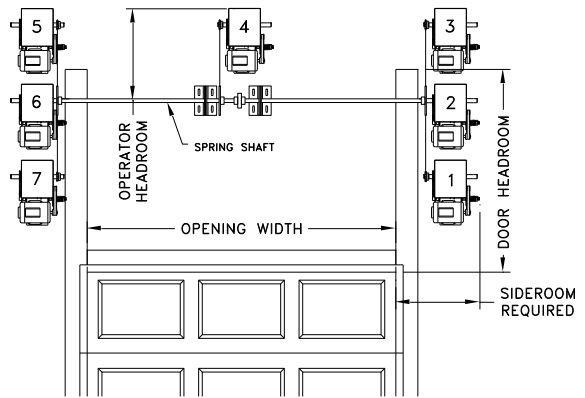
It is important to select the proper type and size of door operator for each application. Emergency manual operation, which can make the difference between life and death in an emergency, should be considered on every system. Smaller doors generally use small, light duty operators, while larger doors require heavy duty operators with features such as friction brakes and delayed start. These differences are reflected in the standard features of operators designed for each door type and size. A mismatch or improper selection between the door and operator can result in a malfunctioning or dangerous system.

A sensing device is recommended with all electrically operating units; note an approved monitored sensing device is required when activation is other than constant pressure to close. This includes any operator that utilizes momentary contact pushbuttons or that can be remotely signaled to electrically close. UL 325 also requires all moving operator components

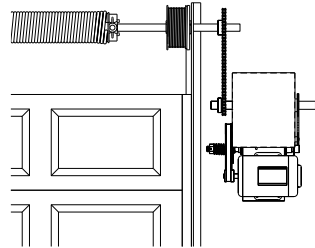
that create possible pinch points below 8 feet above floor level be guarded or covered. Refer to the *ANSI/CAN/UL 325* section for complete details on these and other requirements.

Operator selection involves considerations for operator type, usage, size and speed.

Operator Type: The following is an illustration of each of the three basic types of commercial operators:



1. *Jackshaft Operators*, sometimes called side-mount operators, are designed for use

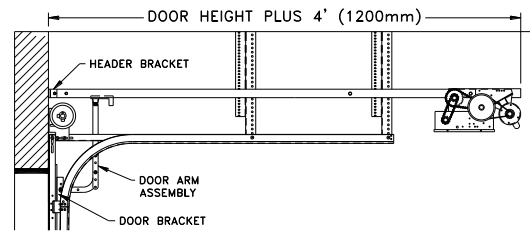


on high lift, vertical lift, and other doors that have a shaft as the basic driving element. They can be wall mounted on either side of the door or, when headroom permits, above the door shaft. The operator is designed to drive the door shaft using roller chain and sprockets. In some cases, a jackshaft operator can be mounted in line with the shaft and directly connected with couplers.

Jackshaft operators can be wall mounted on either side or at the center of the door. The operator can be coupled to the door with roller chains and sprockets, or direct coupled using shaft couplers. These units are primarily intended to be used for high lift and vertical lift applications and should not be used in standard lift and low headroom lift applications without proper provisions to maintain cable tension.

The following illustration shows the most common mounting positions.

2. *Trolley/Drawbar Operators* are designed for use on standard lift and low headroom lift doors. They are normally mounted parallel to the floor on the centerline of the door but can be offset to the right or left of center in certain field conditions. Drawbar operators require 2.5 inches clearance over the high arc of the door and 48 inches behind the door when it is fully opened. The operator connects to the door using an adjustable arm with provisions for disconnecting during power outages or if entrapment were to occur.



3. *Direct Drive Operators* connect directly to the torsion shaft of the counterbalance assembly. These operators differ from jackshaft operators in that there is a direct connection with the operator without the use of chains and sprockets or couplers. Many high performance doors use direct drive operators due to internal safeties and redundancies that allow for even springless operation. These operators typically use Variable Frequency Drive (VFD) AC motors or DC motors to provide variable speeds and reduced wear and tear on the door assembly.

Operator Usage: Operator usage must match the expected duty cycle of the door, since both the door and the operator must be capable of withstanding the frequency and intensity of operation. A system that cycles 25 times per hour, for example, cannot rely on an operator intended for limited or occasional use.

Operators that use worm gear reduction gearboxes generally tolerate higher frequency operation better than belt-reduced designs, and continuous-duty motors provide longer service life than limited-duty motors when subjected to repeated cycling.

In applications where the door will be used frequently, three-phase power is preferred when available, as three-phase motors typically outperform single-phase motors in both durability and efficiency. Three-phase operators also draw fewer amps for the same horsepower, which can reduce electrical consumption and lower operating costs over time.

Properly matching the operator to the application ensures not only reliable performance but also safer operation and reduced long-term maintenance.

Operator Size: Electric operators for commercial sectional doors are available in a wide range of power levels, from light-duty operators for smaller doors to heavy-duty operators designed for frequent cycling and larger doors.

Door size area charts can be used to aid in the proper selection of an operator. However, these charts are only estimates and can vary widely based on the door design. Always consult the door manufacturer for recommendations when issues arise with operator selection. The door size area charts can be used with caution to determine the required operator horsepower.

Oversizing an operator for sectional doors can be dangerous. Startup torques for larger operators can be too much for a door to handle if it has not been designed to accommodate it.

Selecting an operator that is too big can cause premature door failure, such as broken cables, ripping the operator bracket off the section, etc. Consult the manufacturer for operator size recommendations for specific doors.

Door Speed: Jackshaft operator selection also involves taking door speed into account. Door speed can be adjusted by changing the size of the sprockets driving the door. For example, a door with a 24 tooth sprocket on the door shaft will go twice as fast as a door with a 48 tooth door sprocket.



Adjustments to door speed must be made with caution as they directly impact the amount of torque on the operator and door components. Careless adjustment to door speed could result in premature operator failure, roller chain breakage, shaft failure, etc. Consult the manufacturers as needed to ensure the door and operator will support any desired speed modifications.

Average door speed, in inches per second, can be estimated using the formula:

$$Door\ Speed = \frac{RPM \times TT \times MT}{60 \times DT \times WR}$$

Where RPM is the revolutions per minute of the motor output shaft, TT is the total travel of the door in inches, MT is the number of teeth on the motor sprocket, DT is the number of teeth on the door sprocket, and WR is the working revolutions of the door shaft, or the total spring turns minus the remaining spring turns in the open position.

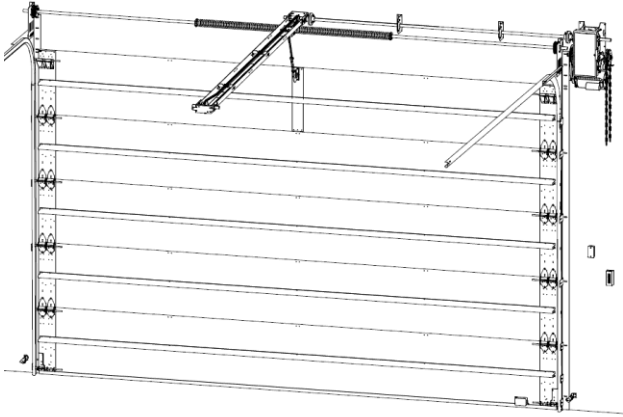
Safe door operating speeds range from 6 to 12 inches per second.

Furthermore, the speed of the door is directly related to the horsepower requirement. For example, if a certain door requires a 1 HP operator to run it at 8 inches per second, then it will only require a 1/2 HP operator to run at 4 inches per second.

Special Commercial Operator Applications

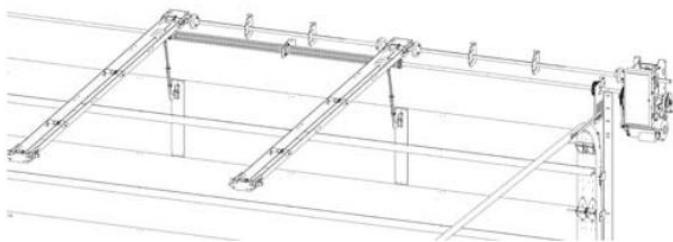
Jackshaft Operator with Auxiliary

Trolley/Drawbar: Sometimes called side mount trolley, the auxiliary trolley operator is used on standard lift and low headroom lift applications when the customer requires an auxiliary chain hoist backup. The operator and the auxiliary trolley are connected by means of a cross header shaft. The most common use is in limited backroom applications where a trolley or modified trolley cannot fit.

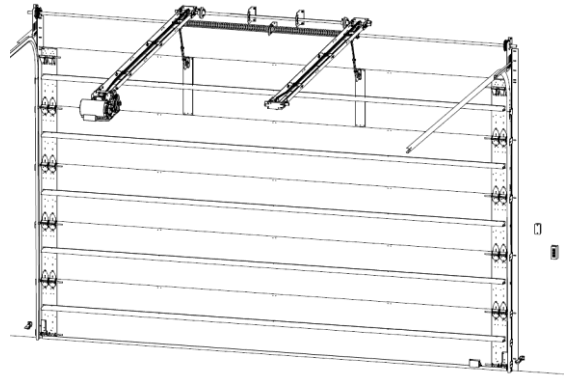


Jackshaft Operator with Dual Auxiliary

Trolley/Drawbar: The jackshaft operator with dual auxiliary trolley is required for extra wide standard lift or low headroom lift doors. A cross header shaft system is used to drive two auxiliary trolley assemblies. The door is raised with two arms in lieu of one from the top section which decreases stress on the door.



Dual Trolley/Drawbar Operators: Dual trolley operation is required for extra wide standard lift or low headroom lift doors. An auxiliary slave trolley is connected to the main drawbar operator using a cross header shaft. The door is raised with two arms in lieu of one from the top section which decreases stress on the door.



Trolley/Drawbar Operator – Minimum Depth Modification: The minimum depth modification allows the powerhead unit of a drawbar type operator to be mounted at the side of the operator track assembly instead of on the end. This modification reduces the overall length dimension of a standard drawbar operator by 18 inches.

Air Power Operator: An air powered operator uses compressed air to drive a pair of pneumatic cylinders that open and close the door. Two air powered pistons are mounted along the door track, and each piston rod connects to a chain that turns a sprocket on the door shaft. When the operator is activated, a manual or electric valve directs air into the top of one cylinder, pushing its piston downward. As the piston moves, the attached chain rotates the sprocket on the shaft to open the door while simultaneously pulling the opposite piston upward.

Air leaving the cylinders is vented through a small bleed hole on the side of the tube and through an adjustable exhaust port at the bottom. These dual exhaust paths allow the door to travel quickly through most of its cycle while slowing it smoothly at the end of both the opening and closing strokes. Because the system relies on air rather than electric motors, air powered operators are commonly used in wet, corrosive, or washdown environments



where electric equipment would be more vulnerable.

Commercial Access Controls

A wide variety of access control devices are compatible with commercial sectional door operators. Most operators are supplied with a standard Open/Close/Stop three button station, which provides full local control of the door. However, many installations require additional devices to meet specific convenience, security, or access management needs.

Most access control devices involve a balance between ease of use and the level of security required. Pushbutton stations are simple for nearly anyone to operate, but this same convenience can make the unsuitable in secure areas. Key control stations offer a higher level of security by requiring a physical key to open or close the door. Card readers function similarly in that the user must possess a credential, but they also allow administrators to issue multiple cards, track usage, and assign different access levels throughout a facility.

Digital keypads provide a comparable degree of security and flexibility without requiring the user to carry a device. Instead, the user must remember an access code to operate the door.

Doors are often operated by people in vehicles, and in these situations, devices such as overhead pull switches, loop detectors, or radio controls are commonly used. Radio controls are especially convenient because the transmitter can be mounted inside the vehicle.

Automatic controls may also be used. Auto-close timers can close the door automatically after a preset interval, while 365-day time clocks can be programmed to open and close the door at scheduled times throughout the year.

Following are some of the more common access controls used for commercial door operators:

Digital Keypads: Digital keypads provide a convenient and secure method of access control for door systems, offering users a simple numerical interface while allowing facility managers to control access to operate the door. They are available in both stand-alone versions, where the keypad directly controls the door operator, and computer managed versions that integrate with broader access control systems. Housings may be lighted or non-lighted, depending on visibility requirements and the environment.



A digital keypad functions as a numerical entry station: when an authorized access code is entered, the keypad sends a signal to open, close, or unlock the door. Modern keypads can store a large number of individual codes, allowing administrators to add, modify, or delete user credentials as needed. This flexibility makes them well suited for applications where access must be granted to multiple users while still maintaining tight control over who can operate the door. Because codes can be changed without altering hardware, digital keypads offer an efficient way to manage turnover, limit access to specific personnel, and maintain security over time.



Stand-Alone Card Access: These systems use cards with encoded credentials rather than numerical codes to control who can operate a door. They are available in swipe-card,



touch-plate, and proximity formats. These devices can be used for vehicular, pedestrian, or building access control, making them versatile for a wide range of commercial and industrial applications. Each card carries a unique identification code, giving facility managers full accountability over issued credentials and allowing them to track, restrict, or revoke access as needed.

Most stand-alone card readers allow card codes to be assigned to specific time zones, enabling access only during approved hours, or to be fully deactivated when a card is lost or no longer authorized. Touch-plate and proximity readers are especially popular because they offer fast, contact free operation and can be integrated with computer based systems for monitoring usage and maintaining access logs. This combination of convenience, security, and administrative control makes stand-alone card access a strong option for facilities that require controlled entry without relying on shared PIN codes.

Radio Receivers and Transmitters: Radio receivers and transmitters work together to provide wireless control of door operators, and this pair of devices forms one of the most common access control methods used in commercial and industrial settings. The receiver is the fixed component, wired into the door operator or integral to the control board, while the transmitter is the portable device that sends the command signal. Their capabilities, range, and security features vary depending on the system design.

Radio Receivers allow doors to be operated remotely by handheld or vehicle mounted transmitters. When the receiver detects a valid coded signal, it activates the appropriate door function. The effective operating range can be increased by using a coaxial antenna, which improves reception and allows transmitters to function reliably from greater distances or in areas with mild obstructions. Receivers may support multiple transmitters, rolling code security, and integration with broader access control systems.

Radio Transmitters are handheld pushbutton devices that send coded signals to the receiver to open, close, or stop the door.



Depending on the model, a single transmitter can control several openings by using multiple channels. Standard transmitters typically operate one to four doors, depending on the number of channels available. Multi-button transmitters allow users to assign different channels to different doors or functions.

Transmitters are easy to add or delete from a system, making them flexible for facilities with changing personnel or access needs.

Commercial/Industrial Multi-Channel Remote Access Control Systems provides significantly expanded capability for larger facilities. These systems use a transmitter capable of controlling up to 250 doors, making them suitable for warehouses, distribution centers, and industrial campuses.

Key characteristics include:

- The receiver is typically installed in the operator housing or inside the building near the controlled doors.
- The handheld transmitter is programmed to the same code as the receiver and commonly uses rolling code technology, which changes the code with each use to enhance security.
- A single receiver can store up to 250 transmitters, allowing broad but controlled access across a large facility.

These systems offer high scalability, strong security, and centralized control, making them ideal for environments where many doors must be managed efficiently.

Control Stations

Control stations provide the user interface for commanding an electric operator, and they

form a critical part of the overall access control and safety strategy. While access control devices such as keypads, card readers, and radio systems determine who may operate the door, control stations determine how the door is operated once access is granted. Their design, placement, and functionality must match the application, the operator type, and the safety requirements of the opening. Control stations range from simple open/close/stop buttons to more advanced, logic-based interfaces that integrate with fire door functions, traffic flow systems, and building automation.

Control stations must be located where the user has a clear view of the door and can operate it safely. They also must be compatible with the operator's control logic - some operators require momentary contact, others require maintained contact, and fire door operators may require dedicated test/reset stations. In larger facilities, control stations may be combined with remote access systems such as multi-channel transmitters or networked access control panels to provide both local and centralized control.

Most control stations are available in both flush mount and surface mount configurations to match the station to the wall construction and the facility's aesthetic or durability needs. Housings can be supplied in a range of NEMA ratings, ensuring the controls are properly protected for the environment, whether clean, dry interior spaces or harsher locations requiring dust-tight or weather-resistant enclosures.

Three Button Stations: The most common type, providing Open, Close, and Stop functions. These are used on most commercial operators and allow the user to stop the door at any point in travel.



Single Button Station: A single button control can either open, close, or stop/reverse the door using just one button.

Two Button Station: Typically, Open and Close only, used in applications where the operator logic automatically stops the door at limits or where a stop function is not required by code or application.



Lighted Three Button Station: Three button control Open/Close/Stop with red pilot light "on" buttons will activate the door.

Key Access Three Button Station: Similar to three button stations but require a key to activate the controls. These are used where access must be restricted to authorized personnel without relying on electronic access control.



Key Access Lighted Three Button Station: Three button control with pilot light and on/off key switch. Buttons will open, close, and stop the door when the key is in the on position. Key switch will render push buttons inactive in the off position. Key is removable in both positions.

Spring Return Key Switch: Surface or flush mounted, key activated with spring return to center offering open and close control. May or may not include a stop button.



Push Button Station Lockout: Push button control with open, close, and stop with lockable stainless steel housing, suitable for flush or surface mounting. Key-lock covers can be used to prevent the use of the door by unauthorized personnel.

Mushroom-Head Buttons: A large, highly visible actuator used where quick, positive control of a powered door is essential, offering a broad contact surface that can be pressed with a hand, elbow, or gloved fist to ensure reliable activation even in demanding industrial environments. Their distinctive shape makes them easy to locate and reduces operator error, and they are commonly used for Open, Close, Stop, or Emergency Stop functions in

applications that require clear, unmistakable control input.

Pull-Cord Switches: Provide a simple method of activating a powered door by using a ceiling or wall mounted switch connected to a hanging pull cord. When the cord is pulled, the switch sends a momentary signal to open or close the door, making this style especially useful in warehouses, loading areas, or any environment where forklift operators or personnel need quick access without leaving their equipment. Their straightforward design, durability, and ease of use make pull-cord switches a practical control option in high traffic industrial settings.

Fire & Postal Lock Boxes:

Fire and postal lock boxes provide secure, code-driven access for emergency responders and postal services. These enclosures are designed to accept padlocks or dedicated fire department and postal keys, allowing authorized personnel to gain entry without damaging the door or building. Depending on the setup, opening the lock box can either directly activate the door for automatic opening or provide access to a secured control device or key stored inside. This approach maintains day-to-day security while ensuring rapid, controlled access when emergency or postal entry is required.



Fire Door Test/Reset Stations:

Used for fire door operators that include automatic closing features. These stations allow the user to test the fire door release, reset the operator after a drop test, and verify proper operation without manually releasing the door.



Emergency Egress Release/Reset Stations:

Used with emergency egress operators that include a built-in release mechanism. These stations allow personnel to



activate the egress release, verify proper operation, and reset the operator after an emergency event or functional test.

Touchless Actuators: Can be used to allow a door activation without physical contact, using technologies such as infrared presence detection, microwave motion sensing, or hand-wave activation. These devices are especially useful in environments where cleanliness, speed, or hands free operation is important, such as food processing, healthcare, logistics, or any facility where operators may have limited ability to press a button. When a user approaches or gestures within the sensor's detection zone, the actuator sends a signal to open the door, reducing touchpoints and improving traffic flow.

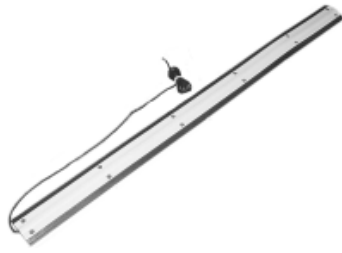
For all control stations, the open button is frequently used as an override. Pressing the open button while a door is closing will stop and reverse direction to open. Momentary contact to close can only be used in conjunction with monitored external entrapment protection as required by UL 325.

Automated Access Control

Automated access control devices manage how a door responds to approaching vehicles, equipment, or pedestrians. These components use pressure, motion, magnetic fields, or electronic sensing to command the door to open, close, or reverse, and many also function as safety inputs that prevent the door from closing on vehicles or equipment. Selection depends on traffic patterns, environmental conditions, and the level of automation required, and together these devices improve workflow efficiency, reduce operator involvement, and enhance safety around the opening.

Electric Vehicle Treadle Switch:

An electric treadle switch is a pressure activated device placed on the floor, typically about 4 feet from the door, that responds when a



vehicle tire rolls over it. The pressure pad closes an internal switch, sending a signal to open or close the door, or to reverse it if the door is descending. Because it reacts only to physical pressure, it provides a simple and reliable method of vehicle triggered control.

Loop Vehicle Detector:

A loop vehicle detector uses an inductive loop embedded in the driveway to sense the presence or movement of a vehicle. When a metal vehicle passes over or stops within the loop, the detector registers a change in inductance and sends a command to open, close, or reverse the door. These detectors are fully electronic, highly adjustable, and commonly installed by saw-cutting the loop pattern into existing pavement.



Preformed Loops:

Preformed loops function the same way as saw-cut loops but are installed before new concrete or asphalt is poured. The loop is placed, wired, and secured during construction, eliminating the need for saw-cutting and reducing installation time while providing a clean, protected installation.



Microloop Probe: A microloop probe is an alternative to traditional loop wire systems, designed for locations where saw-cutting is not possible such as heated driveways, suspended ramps, or areas with structural limitations. The probe detects changes in magnetic fields caused by nearby vehicles and can be mounted above the door, on ramp walls, or embedded in the driveway, providing flexible vehicle detection without cutting into the surface.

Approach Sensor: An approach sensor is a directional microwave motion detector that responds only to movement approaching the door. By ignoring traffic moving away from the opening, it allows the door to close sooner in two-way traffic areas and reduces unnecessary open time. This improves both security and environmental control while maintaining safe operation.



Visible Warning Devices:

Visible warning devices, such as rotating beacons or flashing lights, activate when the door is opening or closing, providing a clear visual alert to pedestrians and vehicle operators. They may also be used to signal the automatic closing of a fire door. Some models incorporate annunciator functions, combining visual indication with an integrated audible signal to enhance awareness around the opening.



Audible Warning Devices:

Audible warning devices emit a tone or alarm during door movement, offering an important alert in areas where visibility is limited or background noise is high. These devices can also be tied into fire door closing sequences to warn occupants when a drop has been initiated. When equipped with annunciator capability, an audible device can provide status indication for door motion, timed closing cycles, or fire door activation.



Horn/Strobe: A horn/strobe combines both audible and visual alerts into a single unit, providing maximum awareness during door movement or emergency closing cycles. This combination is especially effective in high traffic or high noise environments where a single type of signal may be missed. Horn/strobe units function as annunciators because they integrate audible



and visual signaling to announce door operation or an activated closing sequence.

Traffic Signal: A traffic signal uses red and green lights to indicate door status to approaching vehicles. Red typically signals that the door is closed or moving, while green indicates that the door is fully open and safe to proceed. This device is especially useful at loading docks, parking structures, automotive service entrances, and high traffic industrial openings.



Interior Solenoid Locks: Interior solenoid locks automatically engage to secure the door when it reaches the closed position. When the operator receives an open command, the solenoid retracts the locking bolt, allowing the door to move. This provides enhanced security without requiring manual locking.

Electric Interlock Switch: An electric interlock switch prevents the door from operating when certain conditions are unsafe, such as when a pass door is open, a dock leveler is deployed, or an interior lock is engaged. By interrupting the control circuit, the interlock protects the door, operator, and surrounding equipment from accidental damage.

Safety Accessories

All modern electric operators accept safety accessories to protect people and equipment where motorized doors are used. Some operators will accept more accessories than others.

UL 325 2010 introduced the requirement that all commercial and industrial motorized doors using anything other than constant pressure to close must employ a monitored external entrapment protection sensing device. The standard recognizes two categories of external entrapment protection devices: contact and non-contact sensors.

Contact Sensing Devices: Commonly referred to as sensing edges, these are

mounted on the bottom leading edge of the door and connect to the operator either through hard wiring or a wireless transmitter. When the door encounters an obstruction while closing, the sensing edge signals the operator to stop and/or reverse. Because monitored functionality is required, technicians must verify that both the operator and the sensing edge are UL 325 approved for use together before installation.

When utilizing a monitored sensing edge as a primary entrapment protection device, an interface module may be required. This module translates the device signal to interface with the operator. Reference manufacturer instructions for specific details.

Non-Contact Sensing Devices: These include photoelectric sensors and motion sensors. These devices detect a person or vehicle without requiring physical contact and will stop and/or reverse the door when the detection field is interrupted. Proper mounting height, alignment, and placement are essential for these devices to function correctly, and the final configuration depends on jobsite conditions and the type of traffic expected to use the opening.

All installations should have warning signs in place to alert pedestrians of the dangers of operating doors. These should be carefully placed according to the manufacturer's instructions. Depending on the location and surroundings of the door, consider using additional warning signs as necessary. These can be obtained through the manufacturer.

Sensing Devices

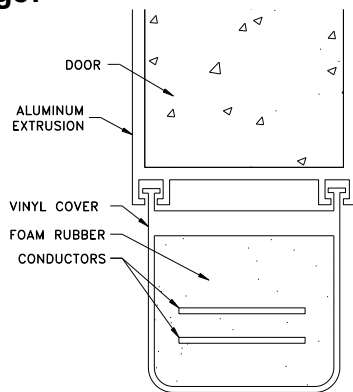
Most sensing devices supplied for door industry operators are compatible with commercial sectional door operators. This includes pneumatic edges, electric edges, through-beam photo eyes, retro-reflective photo eyes, and others. If the door does not have a bottom sensing edge or photoelectric sensors, encourage the owner to purchase one and

place the operator in constant contact mode. If not preinstalled by the door manufacturer, mount the sensing device on the door according to the instructions provided with the device. The sensing device may be electrically connected by wire, coiled cord, take-up reel, or wireless devices.

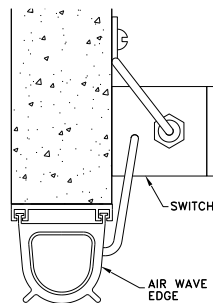
Note: Sensing devices with normally open output are not considered monitored. Therefore, the operator will require constant contact to close operation per UL 325.

Electric Sensing Edge:

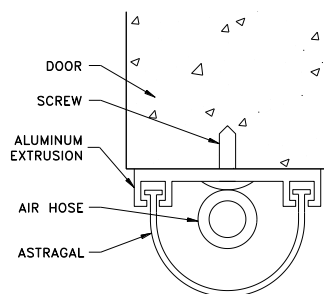
Electric sensing edges reverse and/or stop a closing door when contact is made. This edge is comprised of two metal contact strips enclosed in a hermetically sealed elastomeric extrusion. This sensing edge has a three point contact. Even lateral pressure on these edges makes contact to reverse and/or stop operation.



Air Wave Sensing Edge: As the leading edge of the door meets an obstruction, an air wave is created. This wave motion is then detected by an electrical switch which activates the door control panel and reverses and/or stops the door.



Pneumatic Sensing Edge: When the door encounters an obstruction during its downward travel, compression of a pressurized air hose in the bottom seal increases its internal pressure, which then triggers the air switch and an electric signal is sent to the operator,



causing the operator to reverse and/or stop the door.

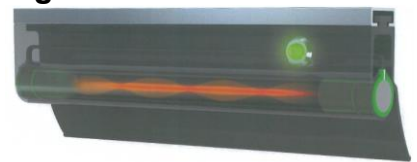
Non-Contact Sensing Edge:

As the door closes this device creates an invisible beam near the leading edge of the door. Once this invisible beam detects an obstruction, the door reverses to the open position without the door making any contact with the obstruction.



Optical Sensing Edge:

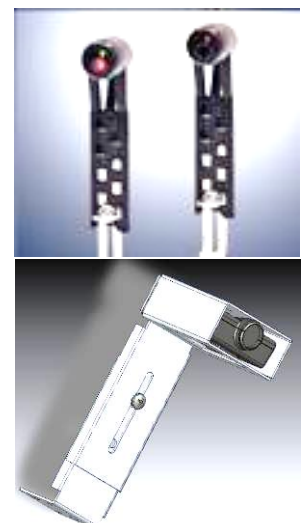
Optical sensing edges reverse and/or stop a door when contact is made.



This type of edge consists of a photo eye installed in a weather seal profile on the leading edge of the door. The light beam is interrupted when the seal profile contacts an obstruction, causing the operator to stop and/or reverse the door movement.

Photoelectric Sensors:

Photo eyes can be used for multiple applications. Photo eyes can be used as a safety device as well as to signal the operator to start a timer or other various functions. The most common is for use as a safety reversing device. Photo eyes are to be installed no more than 6 inches above the ground when used as entrapment protection. Some photo eyes can have an operating range or working distance of up to 35 feet. Additional photo eyes can be added when coverage is desired for reasons other than entrapment protection.



There are two common photo eye devices used today:

1. *Through-Beam Photo Eyes*, include one sending unit and one receiving unit. The photoelectric controls are positioned close to the door and project a light beam across the doorway path. If the beam should be interrupted while the door is closing, it will cause the door to reverse and/or stop. Depending on the device and purpose of use, these may be monitored or non-monitored.
2. *Retro-reflective Photo Eyes*, include one sending/receiving unit and a reflective component for the opposite side of the door. The photoelectric controls are positioned close to the door and the sending/receiving unit projects a light beam across the doorway path. The reflective component on the opposite side of the door sends the beam back to the sending/receiving unit. If the beam should be interrupted while the door is closing, it will cause the door to reverse and/or stop.

Sensing Device Accessories

Take-Up Reel: A take-up reel stores the electric wire used to connect a sensing device to the operator in a housing preventing it from hanging down. The wire is coiled up inside the housing, and extends and retracts as the door is operated. Take-up reels are not recommended for monitored devices. The slip coupling device breaks contact as it spins and may cause nuisance reversals.

Coil Cord: A coil cord provides a flexible method of connecting a sensing device to the operator. The coil cord attaches to a junction box mounted on the wall approximately

halfway up the door opening, and the junction box is then hardwired to the operator. The opposite end of the coil cord is connected to the bottom of the door and wired to the sensing device. The coils in the cord stretch and retract during door movement, helping to manage slack and reduce wire sag throughout operation.



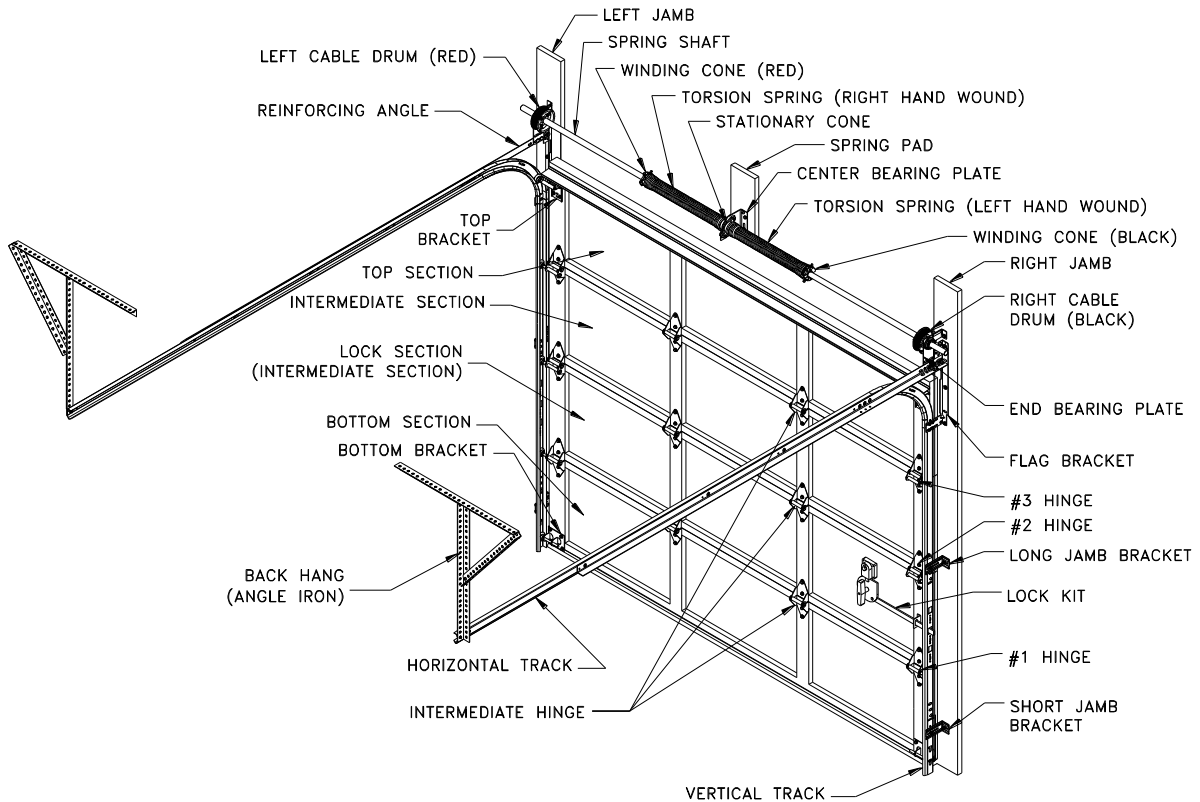
Wireless Edge Transmitter:

Provides a monitored or non-monitored wireless signal to commercial operators from a sensing edge. The transmitter mounts on the bottom of the door and the receiver is interfaced with the operator. These can be used to take the place of take-up reels and coil cords.



Verify the sensing device satisfies UL 325 requirements for the application when used as monitored external entrapment protection.

Sectional Door Installation



Quality

A professional door systems technician should always seek perfection and always provide the end user with all warning stickers, placards, and owner's manuals. Failure to do so not only leaves the job site incomplete but also exposes the company to unnecessary risk exposure.

Consumers expect high quality at a fair price. In addition to knowing the mechanical functions that cause a door system to work properly, the professional technician must be equally skilled in educating end-users regarding the safety and maintenance of the product. All mechanical aspects of the garage door must be fully functional, and all equipment must be properly installed before releasing the door for use.

Conduct an operational test with the customer while the door is in manual mode. Open and close the door several times feeling for any areas

of binding. Whether the customer plans on using an operator or decides to use the door manually, a quality installation will enable the door to operate smoothly for its full range of travel.

An effective method of ensuring the successful completion of a quality installation is to develop a systematic process of installation. Although there will be unique aspects to each job, having a standard method of installation allows the technician to work more efficiently.

Productivity

Economic reality creates advantages for those who operate at the highest levels of productivity. The overhead door industry is a perfect example of this principle. As with many mechanical objects, door systems have undergone constant technological advancements, and the means by

which they are installed has become more systematic.

Early doors were constructed of wood, which was readily available and inexpensive. Problems arose from the lack of standardization of openings. The horizontal rails, vertical stiles, and cross braces were individually cut for each installation. Over time, standards were developed to facilitate the mass production of overhead doors which significantly reduced the time required to complete a job.

Advances in tools and equipment have increased efficiency. An earlier generation of installers used hand-driven tools, such as hand crank drills, ratchets, and screwdrivers. The development of electric and cordless tools has provided the industry with the ability to increase productivity by leaps and bounds.

Many tools used today are the same type used decades ago. Hammers, open-ended wrenches, pliers, and screwdrivers look the same, but the use of lighter weight ladders, circular saws, and cordless impact drivers have replaced much of the manual force once exerted.

Another notable enhancement has been the evolution of the door systems truck. Standard pick-up and flatbed trucks have been replaced by service vehicles featuring storage, tool bins, racks, and organized work areas, which allows a technician to transport everything needed for a day on one truck.

It is important that quality not be compromised for the sake of productivity. Although productivity is an essential element in today's competitive market, the skill and expertise of technicians create the value demanded by consumers. Increased productivity should never be confused with shortcuts.

Manufacturing standards, installation methods, power tools, and service vehicles enhance productivity, but the value to the customer always begins and ends with the technician's commitment to quality.

Obtaining and Installing the Correct Commercial Door

Ensuring a commercial sectional door is properly specified, ordered, and installed is essential for safe operation, code compliance, and long term performance. This chapter guides technicians through the entire process, from interpreting bid and door specifications to ordering the correct materials, inspecting the job site, and preparing the opening. It then provides step-by-step instructions for assembling, installing, and winding the springs, along with the critical checks required before final inspection. By understanding each stage of this workflow, technicians can avoid common pitfalls, streamline installation, and deliver a door system that performs as intended.

The following is a basic installation guide for sectional doors. **This section is intended only as a general reference guide, and not as actual installation instructions.** Always refer to the manufacturer's instructions supplied for the specific door being installed.



As noted elsewhere in this study guide, it is important to follow the manufacturer's instructions when installing a sectional door. These products are well-designed and effective tools used in the protection of lives and property. However, they are intended to work under specific installation conditions. If at any time you experience a conflict between a manufacturer's instructions and an installation circumstance, contact the manufacturer for guidance prior to proceeding with installation.

The Bid Specifications

The specification section is an area to become familiar with. During installation, it is often necessary to review the project specifications before beginning the work. Knowing how to read and understand the specifications of the



installed product will allow an installer to carry out the installation efficiently and professionally. Should you discover a questionable installation issue with regards to the specification, you should first discuss the issue with your company's sales staff.

This section provides an overview of the paragraphs within a specification. While architectural formats may vary, most specifications address the same areas.

CSI *MasterFormat* is the industry standard in North America for organizing construction specifications. Often referred to as the "Dewey Decimal System" of construction, it typically follows the format shown in the following paragraphs.

Part 1.00 General

- 1.01 Material to be furnished: This paragraph will have a brief overview of what is to be supplied, i.e., sectional door, electrical operators, etc.
- 1.02 Related work: This paragraph will describe what other trades will be involved with this project involving sectional doors. Usually this will refer to such activities as opening preparation, structural metal work, access panels finish or field painting, field electrical wiring, wire, conduit, fuses, and disconnect switches which would then usually be in the Scope of Work of other divisions or trades.
- 1.03 Opening preparation: Although the specifications will establish the party responsible for preparing the opening, it is ultimately the installer's responsibility to verify that the prepared opening is acceptable for the product being installed.

Part 2.00 Product

- 2.01 Manufacturers: In this paragraph a list of approved manufacturers will be provided. Some architects will have an area and criteria for accepting a manufacturer other than those listed. These are called *or equal* suppliers. Here some will also list the model

number of a specific door that is being specified.

- 2.02. Material: Typically, the type of material to be supplied, i.e. galvanized steel.
- 2.03. Sections: This will describe the section type, gauge, insulated or non-insulated, type of insulation, etc.
- 2.04. Track: This section will describe the type of track required for the job including size and type. Hot dipped galvanized track per ASTM A526, 2" or 3" depending on door size. Tracks to have graduated incline for weather tight closing. Tracks are to be bracket mounted or continuous angle mounted and fully adjustable for sealing the door to the jamb. Continuous angle size to be not less than 2 5/16" x 4" x 3/32" on 2" and 3-1/2" x 5" x 1/8" on 3" track. Horizontal track must be adequately reinforced with continuous angle.
- 2.05. Hardware: Hardware types and material. All hinges and brackets are to be galvanized steel. 2" or 3" diameter track rollers shall have hardened steel ball bearings.
- 2.06. Counterbalance: This section will describe the type of counterbalance required. Such as torsion spring or weight counterbalance. Heavy duty, oil tempered wire, torsion springs on continuous ball bearing cross header shaft. Galvanized aircraft type lifting cables.
- 2.07. Insulation: This section describes the type of insulation to be used. Quite often the type to be utilized will be left up to the dealer based on the desired thermal performance. Other times the specific type of insulation the designer requires is specified. This could be such common types as expanded polystyrene, polyurethane or fiberglass.
- 2.08. Weatherstripping: Here the different types of weatherstripping will be spelled out. Such as brush seal or vinyl and where it is to be installed. Perimeter seal for jambs, header and between sections.
- 2.09. Lock: The type of locking feature required is described here. Exterior

- locking - Five pin tumbler cylinder with night latch and steel bar engaging track.
- 2.10. Glazing: There are a variety of window options available. This section will describe the type and size. Lite inserts to be 24" x 8" factory installed with 5/8" insulated glass.
 - 2.11. Load: Wind load ratings are dependent on the geographic location of the installation. This section will specify what rating is required. Doors may be specified to be designed to withstand a minimum load, such as 20 lbs. per sq. ft. Dead load deflection of the door in horizontal position is typically specified to be a maximum of 1/120th of the door width.
 - 2.12. Operation: This section will describe the type of operation such as manual pushup, chain hoist, or motor operation. Subsections will define related requirements, such as operator supply voltage, enclosure type, sensing devices, automation, etc.

Part 3 - Execution

- 3.01 Installation: This section will call out for the experience requirements of the installers, such as a factory trained or IDEA Certified installer is to be used. Also, the experience of the dealership will be specified, such as minimum years in business, IDEA Accredited Dealer and other requirements.
- 3.02 Quality Assurance: This area will specify certain quality assurance issues, not only with the installation but with the operation. This will include clean up at the job site, touching up the finish, testing and lubricating the door after the installation is complete, and training of personnel in maintenance and operation.

Ordering the Door

Ordering the door should be accomplished with careful planning and attention to detail. An installer may be consulted in this process and should be knowledgeable about the product

and its application. Rules governing the installation of commercial sectional doors not only follow specifications, but also laws and local building codes in many cases. Taking proper action to ensure the correct door is ordered is an important step in the installation process, whether the project is small and simple or large and complex.



Prior to ordering a door, shop drawings should be submitted to the construction manager, contractor, owner, and any other essential person involved in the project. Written approval should be obtained on the drawing from the proper authority on the job. This may be an architect, engineer, etc.

When drawings are returned "approved as corrected" or other similar wording, the drawings should be reviewed with a high degree of scrutiny. Some changes may have an impact on the originally quoted price for the installed door. When this occurs, the issue should be addressed prior to ordering the door, rather than after the installation is completed. If the drawings are not approved as submitted, new drawings should be submitted and approved.

A professional installer also will perform a site survey to verify field dimensions against the approved shop drawings including opening size, sideroom, headroom, etc. Taking the extra steps to ensure accuracy from the initial stages of the process will enhance the efficiency and profitability of the project.

When ordering the door, drawings should be sent to the manufacturer along with the order. Errors or mistakes can be prevented through this additional review stage. In some cases, manufacturers may require copies of the shop drawings at the time of ordering. Adhering to this simple rule may not only help prevent mistakes but may also provide protection in the event of a dispute. In most cases the seller of the door will remain contractually bound in accordance with the plans and specifications for the project, unless a specific request for an exception to these requirements is granted.

Receiving the Door

Once the door has been ordered and shipped the next step is properly receiving the materials. When the product is received, a proper counting and checking of the material before the truck has left the dock is required. In some cases, shipping errors involving missing items or damage may delay the start of a project. Any shortages or damage should be noted on the Bill of Lading. This is extremely important for claims involving damage or replacement from the manufacturer. An even worse scenario is to discover missing parts or specialty hardware once the installation process has begun.



When all items are received and accounted for, proper storage and handling is the next step. The door should be stored indoors, protected from outside elements. Careful attention must be given to storage of the sections as these can be heavy and can be easily damaged if dropped. Some doors may have a special finish. In this case, the final product will be expected to appear as a finished product. Damaged parts can lead to expensive replacements and additional delays in the installation process.

Safety Awareness

Before covering installation, it is of vital importance to establish that *safety* should always be the installer's primary concern. As a professional, it is the installer's responsibility to always make safety and quality a priority. These two priorities go hand in glove.

Like it or not, an installer may be held liable for an installation if an accident occurs. The industry has seen numerous incidents in which children or adults were seriously injured, or even killed, because a door system was installed improperly. These tragedies underscore the importance of following all manufacturer instructions, safety standards, and best practices on every job.

We also hear of lawsuits in which plaintiffs have been awarded substantial sums of money, often the direct result of careless or improper workmanship. To protect both the customer and the installer, it is essential to follow all required procedures. For customer safety, system reliability, and your own liability protection, ***ALWAYS FOLLOW THE MANUFACTURER'S INSTALLATION SPECIFICATIONS AND INSTRUCTIONS.***

The installer can assure their own personal safety by always wearing the correct safety equipment including a hard hat, safety glasses, and steel toed shoes. Making safety a number one concern will help keep the installer on the job for years to come and help to ensure the profitability of the business.

Preliminary Safety Precautions:

1. Wear protective gloves to avoid lacerations from sharp metal edges.
2. Always wear eye protection to avoid potential serious eye injuries.
3. Avoid installing a new door on windy days. The door could fall during installation causing severe injury or death.
4. In general, doors 12 foot wide and over or with heavier sections should be installed by two people to avoid possible injury. Reference company policies.

5. Operate the door **ONLY** when properly adjusted and free of obstructions.
6. Keep door in full view while operating it. Watch the door open or close completely before leaving the area.
7. Should the door become hard to operate or completely inoperative, a qualified door agency should correct the problem to prevent damage to the door or serious personal injury.
8. **DO NOT PERMIT** children to play with the garage door or the electrical controls. Fatal injury could result, should the child become entrapped between the door and the floor.
9. To prevent serious injury or death, avoid standing in the open doorway or walking through the doorway while the door is moving.
10. Use lift handles/step plate when manually operating the door. **DO NOT** place fingers into section joints when operating the door.
11. Pull rope must be removed and locks must be removed or disabled if door is operated by an electric opener.
12. Door is constantly under **EXTREME SPRING TENSION**. To prevent possible serious injury or death, adjustments, repairs, removal, or installation, **ESPECIALLY OF SPRING ASSEMBLIES, CABLES, OR BOTTOM BRACKETS**, should be performed **ONLY** by qualified door service people.
13. Check door and its hardware monthly for loose, worn, or broken parts. Have any repairs or adjustments made by a qualified door agency.
14. Test electric operator's safety features monthly.
15. Have the door professionally inspected once a year.

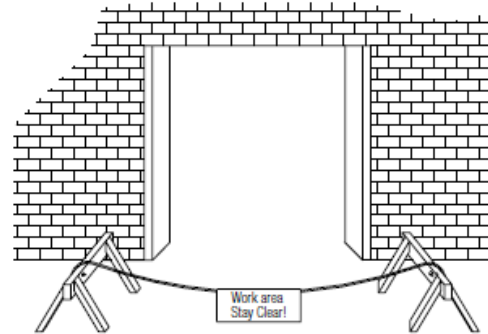
Getting Started

Prior to loading material, check that all paperwork is complete and correct. All crates and boxes must be accounted for and loaded. It is important to read all instructions carefully, checking shop drawings supplied for any special conditions. Open all crated materials and check with attached part lists prior to

installation. All parts supplied should correspond with the type of door being installed. If special devices are supplied, their individual instructions should be reviewed prior to installation.

Site Inspection

Once at the job site, check in with the appropriate person and review all paperwork and job requirements prior to proceeding. Review all conditions and areas required for the installation. For safety reasons, be sure other trades and people will remain outside the work area. In some situations, installing caution tape to rope off the area may be required.



Removing an Existing Door

Often, the installation of a new door will begin with the removal of an existing door. The technician should take special precautions when removing an existing door to avoid dangerous situations and safety risks. This is especially important when the installer encounters components which may be unfamiliar. When in question, contact the original door manufacturer for door removal instructions. Installation instructions are typically not intended to cover the removal of an existing door.

The first step in removing an existing door is to disconnect and remove any electric operator to prevent unintended door operation. Use caution to properly disconnect power before

working on an electric operator to avoid the risk of electric shock.

The next, and most important step, is removal of spring tension and the counterbalance system. Counterbalance spring tension must be relieved before removing any hardware. Do not release spring tension unless you are qualified, experienced, and familiar with the counterbalance system of the existing door. Always use properly sized winding bars when removing torsion spring tension and never cut cables as a method of removing tension. Contact the original door manufacturer for removal instructions anytime an unfamiliar component is encountered, especially if the counterbalance system is unfamiliar.

Once the spring tension and counterbalance system is removed, the door can be disassembled by removing the hardware and unstacking the sections one at a time starting with the top section. After all of the sections have been removed, remove all remaining track and hardware from the jambs and begin to prepare the opening for the new door.

Installation Preparation

The very first step of an installation begins long before one arrives at the job site. For most, it means getting the truck cleaned and ready to



load. One should double check the door being loaded to make sure it is the proper door (refer to the work order). Load the door onto a suitable rack or smooth, clean surface to prevent unnecessary scratching or denting.

Upon arriving at the job site, the installer should double check the address or lot number. The truck should be parked close to the work area, but out of the way of other contractors, allowing access for others to the property. In retrofit conditions, be conscious of the customer's property. If the truck leaks oil or other fluids, take the necessary precautions to prevent customer complaints.

Before taking the door or any tools off the truck measure the opening and check for proper headroom according to the door brought to the job. Also, make sure the opening has been correctly framed.

All jambs should be at least 1-1/2 inches thick and securely fastened to the garage framing. This ensures that the lag screws that will be used throughout the installation will have a substantial fastening surface. The use of 3/4 inch stock for a garage door jamb is not acceptable.

If the door being installed has a torsion spring, pay particular attention to the spring pad. Make sure it is securely fastened with long framing nails. Re-nail or screw if unsure.

The final preparation step is to create enough room to work inside the garage (if necessary). This may entail moving bikes, mowers, construction material, and equipment. One should ask the question, "Have I made myself a safe place to work?"

Assessing the Opening

All jambs must be plumb, level, and square. If removing an old door, ensure jambs are clean of existing welds and debris. After the door is removed and jambs are cleaned and prepared, inspect and repair the jambs and attachments as necessary before proceeding with the installation.

Part of the installer's responsibility is verifying the jamb conditions are suitable for the type of door being installed. This requires verification the wall construction is appropriate for the door that was ordered as well as sufficient to support the weight of the door and any applicable wind load or seismic jamb requirements. For instance, if a sectional door was intended to be installed on wood jambs, and the jambs are discovered to be deteriorated, this condition must be reported and addressed.

If the installer discovers a wall that is not adequate at the project site, it is their responsibility to stop prior to beginning installation and bring the conflict to the attention of the homeowner or job site Superintendent. Proceeding with the installation can result in project delays and complications, along with increased liability to the installer and the company.

Sizing the Opening

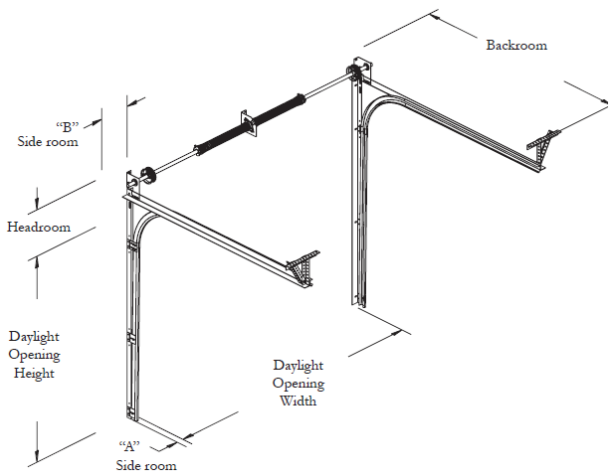
The opening dimensions and clearances must be verified and compared with the approved shop drawings and manufacturer installation instructions. Verify the opening width and height, ensure the opening surfaces are plumb, and the floors and lintels are level. If they are not, compensation for these conditions must be addressed before door installation.



Where floors are not level, always raise the low side of the tracks to gain level across the opening. Never cut a door down without first checking with the manufacturer. Cutting may cause operational issues. Also of importance, field modifications are generally not permitted on wind load rated doors.

Adequate sideroom clearances must be available. Typical installations require at least 4 inches of sideroom. If the proper clearance is not available, these conditions must be corrected before the installation can begin.

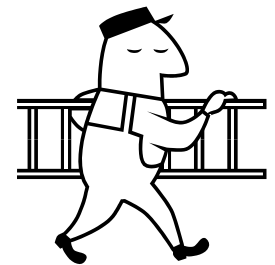
Headroom dimensions and clearances must be verified and compared with the installation instructions and the approved shop drawings if applicable.



Addition of future conduit, duct work, sprinkler systems, and other potential obstructions should be discussed with the contractor and building owner before installation begins. It is important for the owner to understand nothing should be attached to the door, and objects should not be stored, or installed, in a manner obstructing the door. If ceilings are installed after door installation, it is important to ensure ceiling construction will not interfere with the operation of the door, and access panels be provided for future service.

Job Site Organization

It is important that all materials are organized to ensure a safe and efficient installation process is achieved. Layout tracks in an area adjacent to the wall, keeping the sections, counterbalance components, and hardware clear of the opening to prevent tripping hazards during installation of the tracks. Layout and sort all hardware and fasteners to check for proper count and type. If the provided hardware cannot be used, substitute hardware must be approved by the manufacturer.



Once everything has been accounted for, and the job has been checked, installation can begin. Taking the proper steps prior to beginning installation will save time and increase efficiency by avoiding complications.

Truck, Tools, and Equipment

The following section is meant to be used as a recommendation only for minimum standards for installers. Markets will vary and require special needs. Training in the safe and proper use of each of these tools is part of a comprehensive training program provided at the dealer level.

The following tools are typically used in the installation of sectional doors:

Tool List:

- 25' tape measure
- Claw hammer
- Level – 12 inch and 4 foot
- Open/box wrenches; 3/8", 7/16", 1/2", 9/16"
- Ratchet; 3/8" and 1/2" drive
- Sockets: 3/8", 7/16", 1/2", 9/16" deep well
- Ratchet extension; 3" and 6"
- Drill Bits – 3/16" thru 1/2"
- Pry Bar
- Assorted flat and Phillip's screw drivers
- C clamps (at least two pairs)
- Locking pliers; 9" (at least two pairs)
- Assorted chisels (wood and steel)
- Flashlight
- Hacksaw with blades for wood and steel
- Wire cutters (diagonal cutter)
- Tool pouch
- Caulking gun
- Winding bars – 1/2" OD cold rolled steel
- Nut drivers (1/4" thru 7/16")
- Impact sockets (3/8", 7/16", 1/2", 9/16")
- Staple gun (round staples)
- Adjustable wrench
- Metal cutters (straight)
- Cable cutters
- Needle nose pliers
- Speed wrench
- Compass with pencil
- Uni-bit
- Smart phone
- Cable puller
- Come-along
- Angle iron cutter



- PPE: work gloves ,welding gloves, safety glasses, hard hat, etc.

Power Tools:

- 3/8" electric/cordless drill
- 1/2" electric/cordless drill
- Impact driver
- 1/2" masonry drill
- Circular saw
- Reciprocating saw
- Grinder
- Extension cords
- Extra batteries
- Battery charger
- Electrical gang box with ground fault interruption (GFI) circuit



Truck Inventory:

- Hinges - #1 through #5
- 2 inch short stem and long stem rollers
- Top Corner Brackets (one pair)
- Bottom Brackets
- Low Headroom Lift Top Brackets
- Step Plates and Lift Handles
- Cable – one pair for 7'and 8' high torsion and extension spring doors
- One pair 4 inch standard lift cable drums
- 1 inch bearings
- Universal Spring Anchor Brackets
- End Bearing Plates
- Back Hang Angle
- 5' or 6' step ladder
- Fasteners; assorted per door brand
- Pushbutton wire
- Wall pushbutton
- Stud and clevis pulleys
- Sawhorses
- Inside lock
- Complete outside keyed lock
- Bottom astragal for wood door
- Touch up paint (per door mfg.)
- Jamb brackets / flag or joint brackets



Truck Recommendations:

- 1/2 ton rated suspension
- Add-on storage box for pick-ups
- 12 foot overhead rack or longer
- Fire extinguisher



- First aid kit
- Caution tape
- Map or GPS
- Spare tire and jack
- Vehicle registration and proof of insurance

Installation Technique

There are several different common methods used for stacking sections during installation of a sectional door. The preferred method may vary for each job depending on site conditions, weather, installer preference, number of installers, type and size of door, etc. In all cases, it is imperative to select the method which provides for the safest installation. Three of the most common techniques used are described below.

Technique #1: The first common technique used to install a sectional door is to stack all of the sections in the opening prior to installing the vertical tracks. This method simplifies the installation of the vertical tracks because they can be easily spaced off the ends of the sections. The drawback is that the installer(s) must prevent the sections from falling until the vertical tracks are installed. Nails or screws are often used at the ends of each section to temporarily hold them in place until the tracks are installed. This method is not ideal in windy conditions.

Technique #2: Another common technique is to install only one side of the vertical track prior to stacking the sections. The bottom section is used to space and plumb the vertical track. The lower portion of the track is fastened to the jambs, and the remaining track fasteners are installed gradually as each section is stacked. Each of the sections being stacked is brought in at an angle to insert the roller into the vertical track. The section is then pivoted and placed on top of the lower section. Once all of the sections are installed, the second vertical track is installed. This method may be more difficult for wider or less rigid sections.

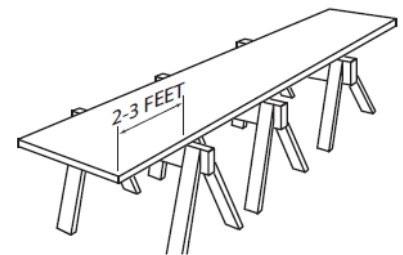
Technique #3: The third technique is similar to the second, except both vertical tracks are

installed prior to stacking the sections. The bottom section is used to space and plumb the vertical tracks. The lower portions of both tracks are fastened to the jambs, and the remaining track fasteners are installed gradually as each section is stacked. The sections can be stacked by lifting each section to the top of the vertical tracks to insert the rollers, or one end of the section hardware will be left off until after the section is stacked in place.

The example installation instructions in this study guide will follow technique #3 with one end of the hardware installed as the sections are stacked.

Installing the Hardware

A door is stacked in sections from the bottom to the top with the first section being designated as #1, or bottom.



The next section to be stacked is the #2, or intermediate section, and so on until you reach the top section. The hardware is often applied to the sections prior to stacking them in the opening to save time climbing and moving ladders once the sections are stacked. Lay each section on sawhorses and install the hardware outlined. Use appropriate support to minimize section damage and bowing.

Starting with the bottom section, attach the cables to the bottom fixtures. Now attach each bottom fixture to the bottom corner of the section. Use only the fasteners supplied by the manufacturer. Attach the bottom seal to the bottom of the section if required. It may be necessary to notch the bottom seal around the bottom brackets. Attach both sets of graduated edge hinges and all of the intermediate hinges to the section in the appropriate locations. The graduated edge hinges for 2 inch track typically start with a #1 hinge on the bottom section and graduates up for each section. 3 inch track

typically starts with a #3 hinge and graduates up. Some manufacturers start with a single barrel hinge; others may start with a double barrel hinge. Verify the appropriate edge hinge graduation with the manufacturer's instructions. The hinges should be oriented so that the number and any text stamped into the hinge are legible when the section is stacked in the opening.

If one or more struts are supplied for the bottom section, attach them at this time. Use appropriate saw horsing to ensure the section is not bowed when struts are installed. Installing a strut on a bowed section could cause the section to be bowed when stacked in the opening. Once the bottom section hardware is attached, set the section aside and proceed to the intermediate sections.

Intermediate sections are typically all the same, unless a lock, lite, or full view window section is supplied. Determine the appropriate #2 section and attach the edge hinge(s) to one end of the section only. Unless otherwise specified by the manufacturer, the #2 section will use a #2 hinge for 2 inch track or a #4 hinge for 3 inch track. Refer to the manufacturer's instructions. Attach all center hinges in the appropriate locations. If struts are supplied for the #2 section, lay them out along with hinges and attach at the same time following the guidelines above. Repeat this procedure for all intermediate sections with proper edge hinge graduation and leaving the hardware off the same side of each section.

Assemble the top section hardware to the top section of the door in the same way. Assemble the top fixture base and slide and attach them to the top ends of the section. Install the strut to the top section if applicable. If a drawbar type operator is being utilized, install the operator bracket and/or top section reinforcement kit at this time.

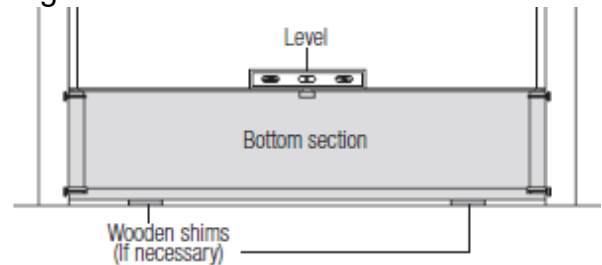
Also perform any necessary track assembly at this time. Refer to the manufacturer's installation instructions for the proper jamb bracket schedule and assemble them to the vertical track if required. Attach flag brackets to

the vertical tracks if applicable. Assemble the horizontal reinforcing angle to the horizontal track if needed.

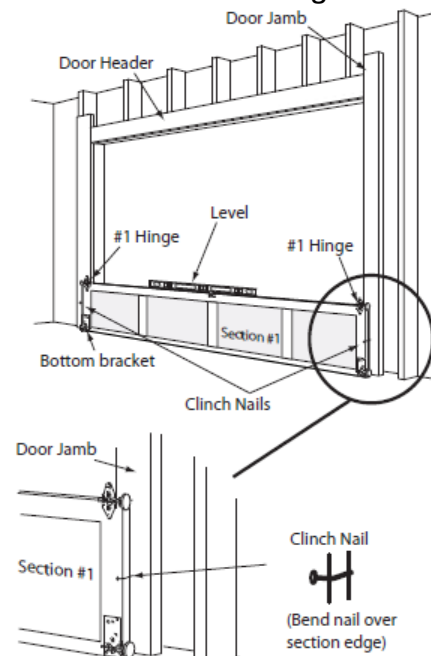
Install rollers in the graduated tube of the edge hinges, top fixtures and bottom fixtures of all sections. Reference the manufacturer's instructions to verify if roller spacers are required on the bottom rollers.

Placing the Bottom Section

Center the bottom section in the opening and level with shims if required. If a shim is used to level the bottom section, the track on that side must be raised the same amount. Allow the shim to stick out far enough for the tracks to rest on as well. Secure the bottom section from falling until the vertical tracks are installed.

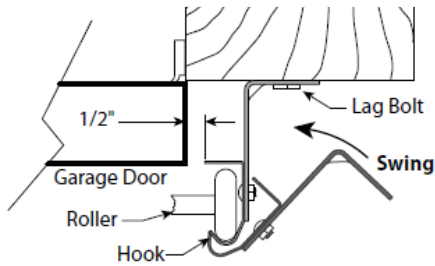


A common method of securing the bottom section from falling is to use clinch nails. Temporarily drive a nail or screw into the jambs at each end of the section and bend the nail/screw over the section edge.



Installing the Vertical Track

Stand one hand of the vertical track and twist into position, inserting the top and bottom rollers

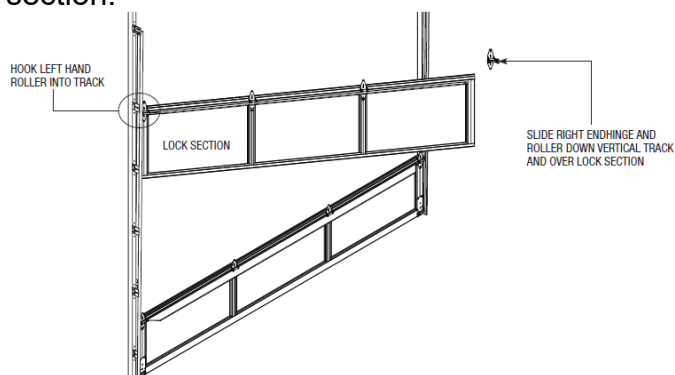


of the bottom section into the track profile. String the cables to the top of the track so they will be properly positioned once the sections and the track are in place. If a shim was used to level the bottom section, the track must rest on this same shim to raise the track the same amount. This will ensure that the tops of the left and right tracks are level with one another. Follow the manufacturer's specifications for track spacing. Typical track spacing provides 1/2 inch to 3/4 inch clearance between the end of the sections and the vertical track.

Plumb the vertical track to the bottom section while maintaining this spacing and fasten the bottom two to three mounting locations to the jambs. Repeat this step for the opposite vertical track.

Stacking the Intermediate Sections

Locate the next section to be installed. This section should have only one end hinge and roller on one end. While holding the section at an angle away from the opening, insert the roller into the vertical track. Swing the section towards the opening to lock the roller in the track and stack the section on top of the lower section.



Place a roller into the roller carrier of the appropriately numbered edge hinge(s) for the opposite end of the section. Pivoting the roller into the vertical track, position the hinge(s) on the section and fasten in place. Verify alignment of any exterior face designs, if applicable, and attach the edge and intermediate hinges from the lower section to the upper section.

Repeat these steps for each of the remaining intermediate sections. As each of the sections is installed, verify it is centered and level. Progressively fasten the vertical track and flag angle if applicable to the jambs as the sections are stacked, ensuring the tracks are plumbed to the sections and the proper spacing is maintained. Do not install the top section.

Installing the Horizontal Tracks

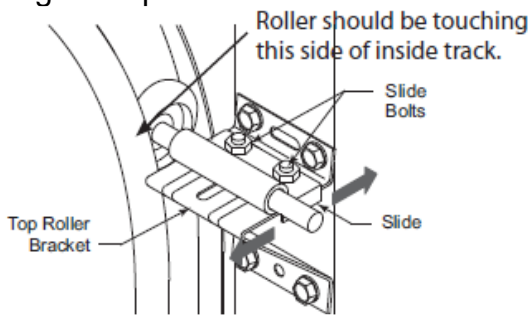
For Vertical Lift and High Lift doors, install the upper vertical tracks per the manufacturer's instructions prior to performing this step. Vertical lift doors will not have horizontal tracks to install.

Once the bottom and intermediate sections are stacked and the vertical tracks are secured to the jamb, install the horizontal track. Raise one of the horizontal tracks into position. Using track bolts and/or splice plates, connect the vertical track end to the horizontal track end. Attach the horizontal reinforcing angle to the front flag bracket, wall angle, or headplate and secure to the jambs. Temporarily support the rear of the horizontal tracks and repeat for the other side.



Installing the Top Section

Raise the top section and stack on top of the rest of the sections following the same procedure used for the intermediate sections. Use a nail or other appropriate method to temporarily secure the top section to the header until the top fixtures and rollers are installed. Fasten the top fixtures with rollers on each end of the section. Adjust the top bracket slide so that the top roller pushes against the track and seals the top section tightly across the header. Remove the temporary fastener securing the top section to the header.



Installing the Counterbalance Assembly

Assemble both end bearing brackets to the horizontal reinforcing angles and fasten to the jambs on both sides of the door. The wall mounting flange should align with the fasteners for the vertical track. When lag screws are used to secure the end brackets to the jambs, be sure to predrill the proper size to achieve proper fastening strength and to prevent splitting the wood.

The springs, bearings, support brackets, center coupler (if applicable), and cable drums must be assembled in the proper positions on the shaft(s). Most manufacturers use color coding to aid in this identification. The spring cones and drums may be color coded red or black. The red cable drum goes on the left side of the door, and the black drum goes on the right. The set screws of the drums will face the springs. The spring with red color coding is a right wound spring that is installed on the left side of the door. Similarly, the spring with the black color coding is a left wound spring that is installed on the right side of the door. Position

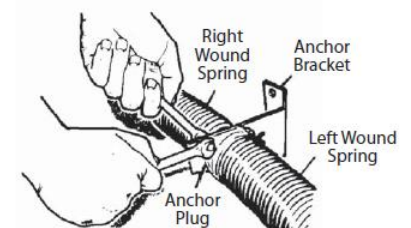
the counterbalance components on the shaft(s) in the proper location.

Lift the shaft and spring assembly and insert the shaft into one end bearing bracket. Slide the shaft in far enough to get the shaft into the opposite support and slide back into place. Repeat for the opposite shaft if two piece shaft is used and center the shaft assembly in the opening.

Measure the vertical distance from the top of the top section to the center of the shaft at the end bearing brackets. Transfer this measurement to the center bearing bracket installation locations. This marks the vertical location of the centerline of the shaft. When lag screws are used to secure the center bearing brackets to the jambs, be sure to predrill the proper size to achieve proper fastening strength and to prevent splitting the wood. Also, when installing center bearing brackets to wood spring pads mounted over masonry, be sure to utilize proper length lag screws to prevent contacting the masonry. Similarly, if installing center bearing brackets to supports covered by drywall, be sure to use the proper length lag screws to ensure adequate embedment into the structural framing. Position the center bracket such that it is plumb and will locate the shaft in line with the mark and fasten to the spring pad. Repeat if multiple center bearing brackets are required.

Warning! Failure to follow the manufacturer's instructions and safety precautions could result in sudden spring tension release, causing severe injury or death.

Assemble the stationary ends of the springs and the bearing(s) to the center bearing brackets following the

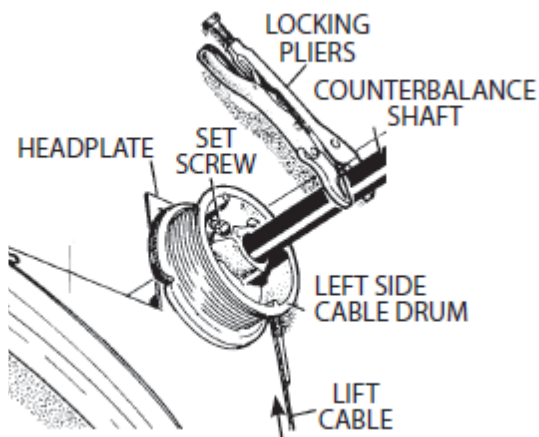


manufacturer's instructions. If slotted and/or adjustable center bearing brackets are used, be sure to position the springs such that the shaft is the same centerline distance from the jambs and spring mounting pads. If a split shaft

assembly is supplied with a coupler, do not bolt the coupler together until the cables are set.

The next step in counterbalance assembly is drum and cable installation. Cable drums should always be installed starting on the left hand side first. The cable drums tend to rotate slightly when the set screws are tightened. By installing the left hand drum first, this rotation is minimized, making it easier to get equal cable tension. Starting from the left side, slide the left hand cable drum against the left hand end bearing bracket and secure to the shaft by tightening the set screws. If solid keyed shaft is used, insert the drum key into the drum and shaft keyways prior to tightening the set screws. Do not overtighten the set screws as drum damage may occur. There must be a minimum of 1/2 pre-wrap of cable on the cable drums.

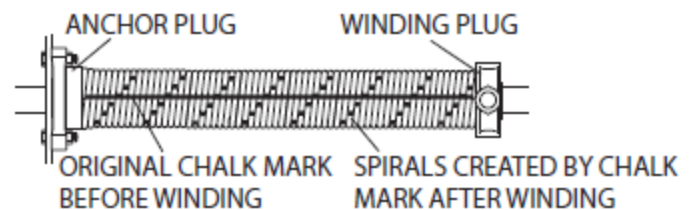
Attach the left hand cable to the drum by pulling it through the entrance slot until the stop catches. Rotate the drum and shaft around in the direction to open the door until the cable is tight. Secure the shaft into place with locking pliers. Repeat the drum installation for the right hand side. If a one piece shaft is supplied, connect and tighten the cable prior to tightening the drum set screws. If a split shaft is supplied, follow the same procedure for the right side and lock the second shaft into place with locking pliers.



Applying Spring Tension

Putting tension on springs must be done with safety in mind first. Sudden release of spring tension can create a very dangerous situation with risk of injury or death. Place clamps to secure the door closed prior to winding springs to ensure the door does not open during the spring winding process.

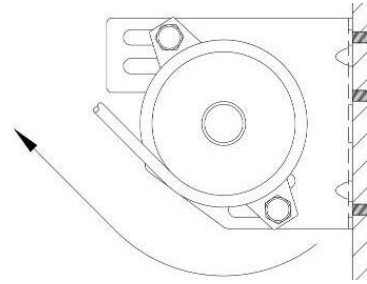
Place a straight line on the springs with soap stone, chalk, paint, etc. which can be used to count the number of turns on the spring as they are applied. Make sure the door is level and place a pair of locking pliers above one roller on each side of the door to prevent it from rising once the springs are wound. Reference the manufacturer's instructions and/or spring tag information to determine the required number of spring turns.



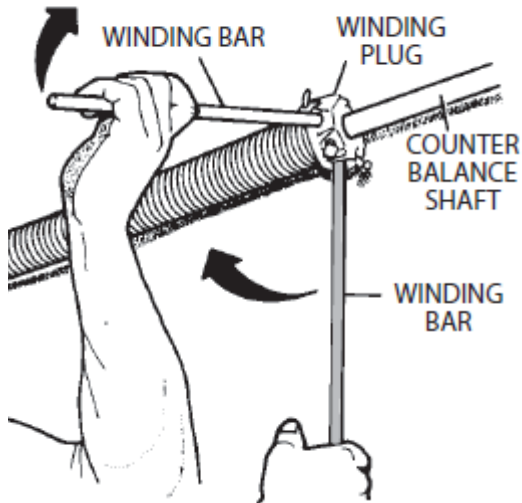
Winding bars must be of the proper size, length, and material type per the manufacturer's specifications. The winding bar should be the same diameter for its full length and should not be hardened or of a material stronger than recommended by the manufacturer. Proper winding bars are designed to bend prior to reaching torque levels sufficient to damage the spring cones.

Warning! Never use screwdrivers or incorrectly sized winding bars. Winding bars must fit snugly into the holes in the spring winding cones. Attempting to wind springs with loosely fitting rods, screwdrivers, or other improper tools can result in severe injury or death.

Determine the proper direction for winding the springs. Turns will be applied to the spring by winding the end in the direction the cable drums will turn as the door is closing. This direction should correspond to the direction the end coil of the spring is pointing. For inside hookup doors, the springs will wind upwards.



Stand to the side of the winding bars and be sure to insert the bars all the way into the hole. Utilizing the proper sized winding bars, insert one winding bar into the winding cone and rotate the spring upwards 1/4 turn until the next winding hole is accessible. Insert the second winding bar into this hole. Once the second winding bar is inserted and holding the spring tension, remove the first winding bar and apply 1/4 turn using the second winding bar. Continue applying turns using this 1/4 turn alternating pattern until the required turns are applied.



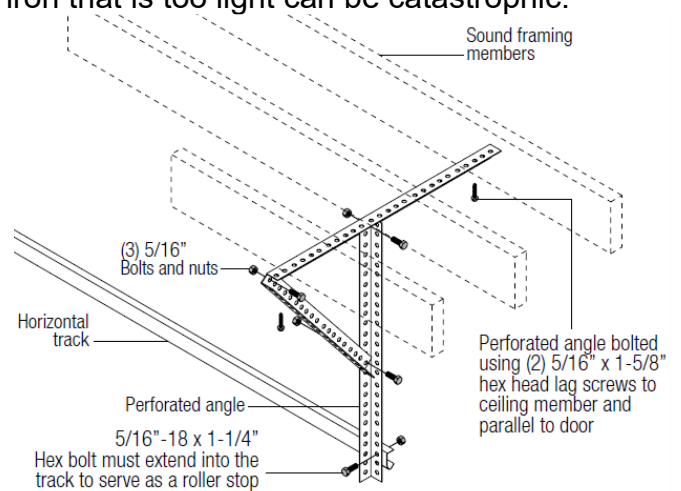
While holding spring tension, insert key stock if required and stretch the spring 1/4 inch by lightly tapping on the winding bar. Tighten the set screws in the spring winding cones to secure the spring tension to the shaft. Do not

overtighten the set screws as this could damage the spring cone. Once the set screws contact the shaft, tighten the screws one full additional turn. With setscrews tightened, apply pressure in the opposite direction with the winding bar to verify the sets screws are secure. Repeat spring winding for the remaining springs if applicable.

After winding all of the springs, install the coupler assembly bolts if the door utilizes a two piece shaft. Remove the locking pliers from the spring shaft(s). Be sure all ladders, scaffolding, etc. have been cleared from the travel area of the door.

Back Hang Installation

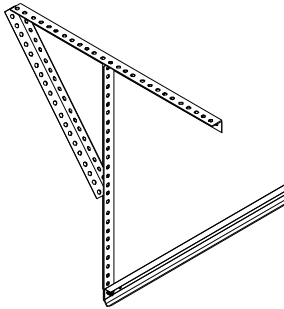
Installation of the back hang is a critical point in the installation. Verify the type and weight of the steel to be utilized. Once the proper size has been determined, locate the building's structural members for attachment. Proper size and type of fasteners must also be selected. Refer to the manufacturer's instructions for reference. An under rated fastener or angle iron that is too light can be catastrophic.



While holding the door secure, remove the clamps securing the door in the closed position. Carefully raise the door to place the top section in the horizontal portion of the horizontal tracks. Secure the door from moving in this position and use the top section as a guide for locating the horizontal tracks. With the horizontal tracks square to the top section,

determine the required location for the back hang angles.

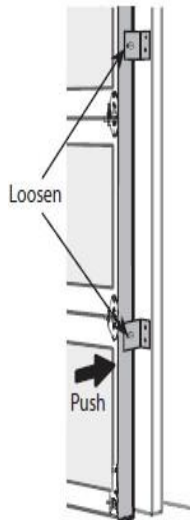
Attach a horizontal ceiling angle to the overhead structure. Install a vertical angle dropping from the ceiling angle to the end of the horizontal track. Attach an angled side support sway brace between the vertical angle and the horizontal angle to eliminate side movement of the track. Attach the rear of the horizontal track to the back hang. The rear of the track is typically raised slightly from level. Reference the manufacturer's installation instructions for proper pitch of the horizontal tracks.



Install center hangs on the horizontal track if required. Typically, doors over 12 feet tall need to have center hangs for support. Some manufacturers require center hangs for heavier doors less than 12 feet high. Always follow the manufacturer's instructions.

Test the Door for Proper Operation

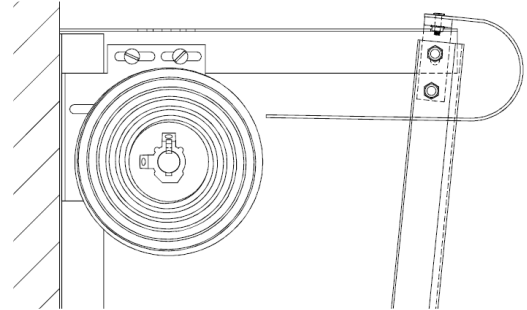
With both horizontal tracks properly hung, remove the clamps securing the door and test the door operation. Verify clearances between the door and the vertical and horizontal tracks. Adjust back hangs if needed for both horizontal tracks to have equal and proper spacing with the sections when opened. When the door is in the up position, verify that both cables are taut. When raising and lowering the door it should stop at any point and stay, except when the rollers are in the



radius of the track or if the door has heavy glazed sections. When operating the door, verify the door rolls freely throughout travel. Verify the cable properly spools onto the cable drum as the door is opened and that the cable is not rubbing against the track or sections during operation.

Verify the door seals properly to the opening in the closed position. Loosen and adjust the vertical track, if applicable, so the sections seal to the opening properly.

If supplied, install spring bumpers on vertical lift and high lift doors so that the door rests against the spring bumpers about two to three inches above the header.



Lubricate all rollers, hinges, and springs. If the door does not have outside weatherstrip, adjust the track tight to the jambs making sure the door will move with little resistance.

Once the door is operating properly, the next step is to install the weatherstrip. Adjust the vertical track of the door to create a 1/8 inch to 1/4 inch gap between the door and jamb. Position the weatherstrip so that the seal touches the face of the door and secure per the manufacturer's instructions. Install the lock components at this time if required.

Install all warning stickers, tags, and labels. Clean the door and your work area when finished. Do not leave any paper or boxes on the job site.



Demonstrate to the customer how to use the door in a proper and safe manner. Allow the customer to operate the door and verify they

are satisfied before you leave the job. Upon gaining the approval of the customer, have them sign all paperwork for their approval and give them the operation manual, warranty papers, etc.

When Installing with an Operator

To prepare a door for an operator, proper reinforcement must be installed to the top section. Improper installation of reinforcement can cause damage to the door as well as personal injury. Refer to the manufacturers' installation instructions for proper reinforcement and attachment.

Low Headroom Lift Installation

Low headroom lift track systems are used for sectional doors when the available headroom is limited. These systems utilize two different spring mounting configurations that play a role in how much headroom is required, and how the hardware is arranged. This section discusses the two spring mounting configurations used, front-mounted springs and rear-mounted springs, and explains how each configuration is different from the standard lift scenario previously covered.

Front Mounted Springs: A front mounted spring system is one of two types of low headroom lift track systems utilized when headroom is not available for a standard lift door. The track is installed the same way as standard headroom track, except the vertical track is shorter and the horizontal tracks have a double track profile arrangement. The rollers of the top fixtures will ride in the upper horizontal track and the rest of the rollers ride in the lower horizontal track.

Most front mounted low lift track systems utilize outside hookup cables. This requires special outside hookup bottom brackets and the cable drums are mounted on the outside of the vertical tracks. In this configuration, the red cable drum still goes on the left side of the door and the black cable drum on the right, but the

drum is reversed so that the cable spools onto the front of the drum, away from the jambs, instead of the back.

The springs, however, flip sides such that the black color coded spring (left wound) is installed on the left side of the door, and the red color coded spring (right wound) is installed on the right. When the spring tension is applied, the springs will be wound downward instead of upward.

Rear Mounted Springs: The second type of low headroom lift track system utilizes rear mounted springs. As the name implies, this track is installed with the spring and shaft assembly located at the rear of the horizontal tracks to allow a door to be installed in as little headroom as possible. A sheave, or pulley, will be mounted on the track near the header of the door for translating the cables back to the rear mounted drums.

The track is identical to front mount low headroom lift track, and these doors also utilize outside hookup cables and bottom brackets. The drums mount on the outside of the track with opposite orientation - the black cable drum installs on the left and the red cable drum installs on the right. The cables will wrap over the tops of the cable drums.

When the springs are mounted at the center to one or more center bearing brackets, they have the same orientation as standard lift such that the red color coded spring (right wound) installs on the left side of the door and the black color coded spring (left wound) installs on the right.

Some manufacturers mount rear mounted springs on spring plates located at the ends of the tracks. When the springs are end mounted to the tracks, the color code must be reversed such that the black color coded spring (left wound) is installed on the left side of the door and the red color coded spring (right wound) is installed on the right side of the door. When in question, reference the manufacturer's instructions for spring orientation.

When the spring tension is applied to rear mounted springs on low headroom lift systems, the springs will be wound upward the same as standard lift.

When utilizing low headroom lift track, it is very important that the vertical track length measurement is followed. Low headroom lift track is opposite of standard headroom track when raising and lowering the track in the field. If the vertical track is cut down, the high arc of the door will be increased, which can increase the amount of headroom required to operate the door.

Extension Spring Assembly

An extension spring door follows a similar installation process already reviewed with a few exceptions. Assemble the sheaves, or pulleys, to the horizontal angle previously assembled using the appropriate fasteners. Hook the clevis (fork) through one end of the extension spring and attach the sheave to the clevis. Fasten an eyebolt to the perforated back hang 6 to 8 inches above the horizontal tracks and hook the loop of the spring over the eyebolt. An eyebolt is not necessary if using open loop springs. Low headroom lift horizontal tracks may include a rear mounting plate for the eyebolt or spring hook.

To attach the springs, carefully raise the door to the fully open position and secure from closing. *You may need assistance with this procedure.* Attach the cable to the bottom bracket. Feed the cable up to the sheave, following the proper cable path keeping it between the vertical track, the end of the door, the roller shafts, and the wall. The cable should feed up over the sheave on the track, back and over the top of the sheave attached to the end of the spring, and down through the clevis. Attach an “S” hook to the cable and hook the cable to the horizontal angle. Repeat the procedure for the opposite side.

Remove the clamps and operate the door a few times to test the operation. The door is considered reasonably balanced when it will

stay (not fall or rise) in a partially open position. If the springs need adjustment, secure the door in its fully open position and move the adjusting “S” hook towards the jambs for more tension or away from the jambs for less tension. ***BE SURE TO ALWAYS MAINTAIN EQUAL SPRING TENSION ON BOTH SIDES.***

Install spring containment kit as outlined in the following instructions.

Uncoil the spring containment wires and lace them through the springs. Secure each wire by wrapping it around the back support and then winding it back upon itself. Pull the wire(s) tight and secure to the front. It may be attached to the vertical flag bracket, or to the header with screw eyes. In either method, the wire should be aligned closely with the travel of the spring to minimize the noise caused by rubbing. Attach a spring warning tag to the eyebolt at each side, where the extension springs are hooked at the back hanger.

When balance is achieved, adjust stops and/or track as well as the top fixture for proper seal at the jambs and the header. Raise the door halfway and check the side clearance between the door and the horizontal track. Both horizontal tracks must be spaced the same as the vertical tracks. If adjustment is necessary, *return the door to the closed and locked position* and adjust the hangers and add braces as necessary. Repeat procedure until spacing is correct. When correct, *make sure* all hangers are secure and adequately braced. Hangers and braces are not supplied by the manufacturer.

Lightly lubricate springs and all moving parts with oil. Install spring warning tags and post owner’s manual and/or the instruction manual adjacent to the door in a protected place to make available to the end user. The door installation is now complete.

Special Application Installation

Some sectional door installations involve conditions that fall outside standard lift and low headroom lift configurations. These special applications require additional planning, modified hardware arrangements, and careful attention to alignment and clearances. This section briefly discusses the impact on the installation process for three common scenarios, contour track systems, double shaft configurations, and center lift configurations. It's critical to reference the manufacturer's installation instructions for specific details when these are encountered to ensure proper installation and operation.

Contour Track (Roof Pitch): Contour track is used in combination with low headroom lift, standard lift, or high lift track. Contour track is desired when the door is installed on a sloped roof building and the door is not located on the gable end. This allows the user to take advantage of the building height at the rear of the track, not just at the front.

Precise measurements must be made for this type of track design. Front and rear measurements are very important in order to figure out the pitch of the track. The method utilized for specifying pitch is a rise of a given number of inches per foot. In other words, the track will slope up a certain number of inches per foot of horizontal track length. For example, if a door uses 4:12 pitch, the horizontal tracks will be raised 4 inches for each 12 inches of horizontal track length.

Contour track can be installed with any type of spring arrangement as described previously. It is important to verify that the horizontal tracks are installed at the proper pitch. Deviating from the pitch ordered with the door without making proper adjustment to the springing will cause the door to balance improperly.

Double Shafts: Double shafts are installed in a similar manner to a single shaft assembly. The distance between the two shafts will be determined by the spring and drum diameters, allowing sufficient clearance between the

shafts for the cable drums and springs. Refer to the manufacturer's instructions for this measurement.

Some arrangements require the two shafts to be connected. The most common method of connecting them is using roller chains and sprockets. Because this arrangement can generate significant roller chain pull forces, manufacturers often require additional shaft supports at the sprocket locations. It is important to follow the specified sprocket sizes, chain sizes, and mounting locations to ensure the spring forces are transferred correctly and to prevent overloading the shaft or other components. Once properly located, tighten the sprockets on the shafts and install proper keys if required. Install the roller chains on the sprockets, and secure connecting links.

Double shaft arrangements may use either a single pair of cable drums or two pairs of cable drums. In a single pair configuration, there is one drum on each side of the door, with one drum mounted on the upper shaft and the other mounted on the lower shaft. For example, if the left side of the door has the drum installed on the upper shaft, then the right side of the door would have the drum installed on the lower shaft. The longer cable must be attached to the same side of the door as the drum on the upper shaft.

In a two pair configuration, there are two drums on each side of the door – one on the upper shaft and one on the lower shaft – resulting in a total of four drums. There will be two different lengths of cable, or two different cable mounting positions, on each side of the door. The different lengths of cables must be attached to the correct locations on the door so that each cable wraps the same amount on both the upper and lower drums. This ensures the cables track evenly and the spring forces are transferred correctly between shafts.

Once the shafts, drums, cables, and roller chains and sprockets (if applicable) are installed and the springs are secure, the spring tension may be applied the same as for a single shaft.

Center Lift: Center lift cables are used to provide extra lifting support for extremely wide or heavy doors. One or more additional cable assemblies are secured to intermediate lift brackets on the outside of the door at points toward the center of the opening.



Follow the manufacturer's instructions to properly locate and assemble the intermediate lift brackets on the outside face of the bottom section. It may be necessary to assemble stainless steel rub plates to the face of the door to protect the area where the cables may rub.

Additional cable drums are used on the counterbalance shafts in a double shaft arrangement to accommodate the extra lift cables. Typically, the primary pair of cable drums aligned with the ends of the door are mounted on the upper shaft, while the additional drums for the intermediate lift points are mounted on the lower shaft. These intermediate drums must be positioned precisely so the cables align with the intermediate lift brackets on the outside face of the door. Because these drums introduce additional spring and cable forces into the system, they also require added shaft supports to ensure proper force transfer and to prevent overloading the shaft or other components.



The upper and lower shafts are often not connected using roller chains and sprockets. Depending on the design and layout, the upper/primary shaft will often have more springs than the lower shaft. This is done for two reasons. First, by placing more springs on the primary shaft, more load is applied to the primary bottom corner fixtures, consequently resulting in less load on the intermediate lift brackets. Second, having fewer springs on the lower shaft provides open shaft space for properly positioning the intermediate cable drums in alignment with the outside lift brackets. For example, in a 10 spring arrangement, the upper shaft with the primary cable drums may have 6 springs, while the lower shaft would have 4 springs.

Once the shafts, drums, cables, and intermediate lift brackets are installed and the springs are secure, the spring tension may be applied the same as for a single shaft.

Section Seven

Installation of Residential Drawbar Operators

WARNING! To reduce the risk of injury or death, always read and follow all manufacturers' instructions and safety precautions. The following general instructions are for reference only and are in no way intended to replace or supplement the instructions and safety precautions provided by the operator manufacturer.

Door operators and associated control equipment should only be installed and serviced by qualified professionals. Professional installers should observe the following safe installation procedures.

Before Installation:

1. Verify the operator is proper for the type, size of door, and frequency of use per the operator specifications.
2. Power should always be disconnected whenever installing, wiring, or servicing a door operator or automatic door system. Not only is the chance of electric shock eliminated, but the moving chains in most door operators can catch clothing or fingers and cause severe injury.
3. Installation and wiring must comply with local building and electrical codes.
4. Place controls far enough from the door so a user cannot touch the door when operating the controls.
5. Controls must be at a minimum of 5 feet above the finished floor.
6. Controls should be placed so the user has full view of the door when operating.
7. Always set the limits on the operator, even if power has not been supplied.
8. Test door and service monthly. If adjusting limit travel, retest the door opener. Failure to adjust the door may cause death or injury.
9. Keep doors properly balanced. An improperly balanced door has the potential to cause severe injury. Qualified service personnel should perform all repairs to the door if needed.
10. Use emergency manual operation mechanisms only when the door is closed. Use caution when using this release with the door open. Weak or broken springs may cause the door to fall rapidly.
11. The installer is responsible for assuring the owner of the door system understands its basic operation and safety. In particular, be sure the owner/end-user understands the location and operation of the emergency operation mechanism.
12. Point out to the owner/end user that children or pets should not be allowed to play on or near the door or any part of the system, and that the safety instructions supplied with the operator are the responsibility of the owner/end-user.
13. Leave the operation and maintenance manual for the operator as well as any additional information supplied with the operator or any other components of the door system with the owner/end user.
14. If you have any questions about the safety of the door operating system, do not install the operator.

To reduce the risk of severe injury or death, read and follow all manufacturer's safety warnings and installation instructions. Ensure the door is properly installed and working freely in both directions. Do not install the operator until all door problems have been corrected. If necessary, oil all moving parts (chains, guides, etc.). Remove any old accessories (locks, bolts, etc.) before installing the operator. Locate any pushbutton controls within sight of

the door, at a minimum height of 5 feet so small children cannot reach them, and away from all moving parts of the door.

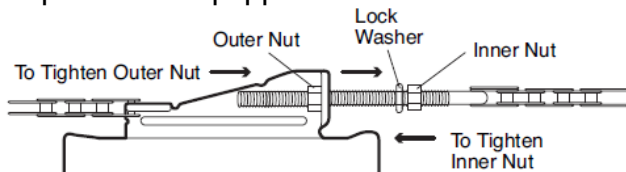
Attach Rail to Operator

To attach the rail to the operator, begin by placing the operator head on the garage floor with a piece of cardboard underneath to protect its finish. Slide the trolley onto the rail, ensuring it faces the correct direction, then secure the rail to the operator head using the provided fasteners. Finally, pull the chain from the rear of the rail and position it around the operator sprocket.

Adjust Chain Tension

There are several different types of chain adjustment systems used. Verify the correct chain tension adjustment procedures with the operator's instructions.

The chain is typically adjusted by turning an adjustment nut located either at the wall end of the rail or on the trolley. Tighten the nut until the chain sits just slightly above the bottom of the rail at its midpoint, taking care not to overtighten. If applicable, secure the adjustment by tightening the lock nut. A small amount of slack in the chain is normal, as a chain that is too tight or too loose can lead to excessive gear noise and premature wear. Once the adjustment is complete, install the sprocket cover over the sprocket and chain if the operator is equipped with one.

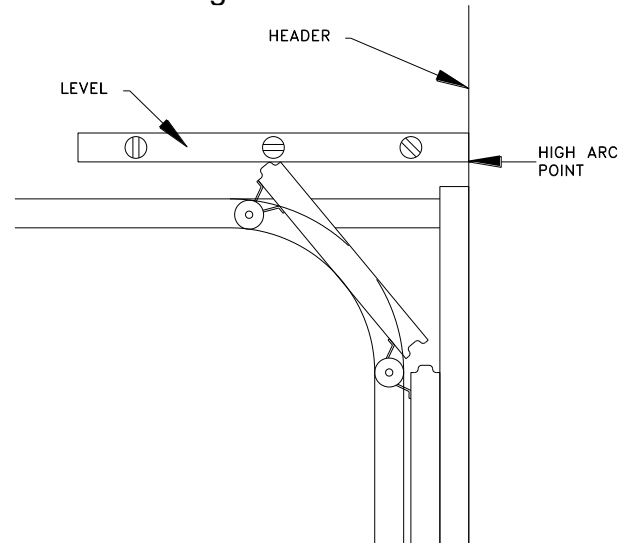


Installing Header Bracket

Begin by closing the door, then mark the vertical centerline of the door on both the header wall and the top section of the door

from inside the garage. Examine the area above this center point on the header wall to identify a suitable mounting location for the header bracket.

Next, open the door to its high arc point, or the position where the top edge of the door reaches its highest point, and use a level to transfer that height to the header.



Close the door again and mark the final mounting location: for sectional or one-piece doors with track, mark the header one inch above the high arc point; for one-piece doors without track, mark it two inches above. In some installations, the correct bracket height may fall above the existing header, requiring a 2x4 or larger crosspiece secured to the wall studs to create a proper mounting surface.

For sectional doors with low-headroom lift, the header bracket may be mounted to the ceiling up to six inches back from the header wall, following the operator manufacturer's guidance for this configuration.

Attaching Header Bracket to Wall

Hold the header bracket on the centerline above the door, aligning the bottom edge of the bracket with the marked mounting line, and the center of the bracket with the center of the top section. Use a pencil to mark the centers of the bracket's holes, then pilot drill the locations and

secure the bracket using the provided lag screws.

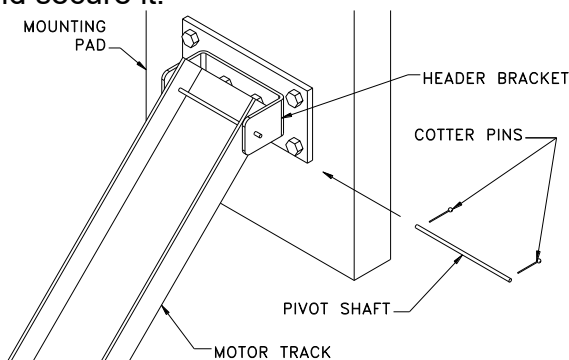
Attaching Header Bracket to Ceiling

On a finished ceiling, use a stud finder to be sure there is a joist to fasten to under the sheetrock where the header bracket will be located. If there is none, install a 2x4 cross piece between the two closest joists to fasten the header bracket onto.

Extend the centerline from the header wall onto the ceiling, then position the header bracket along this line, ensuring the edge of the bracket is no more than six inches from the header wall. Mark the centers of the bracket's mounting holes with a pencil, pilot-drill the holes, and secure the bracket using the provided lag screws.

Connecting Rail to Header Bracket

Place the assembled operator on the empty carton with the rail facing the door; if the door uses a torsion spring, you may need to set the operator head on a ladder so the rail can clear the spring. Align the holes at the end of the rail with the holes in the header mounting bracket, then insert the header mounting bracket pin and secure it.

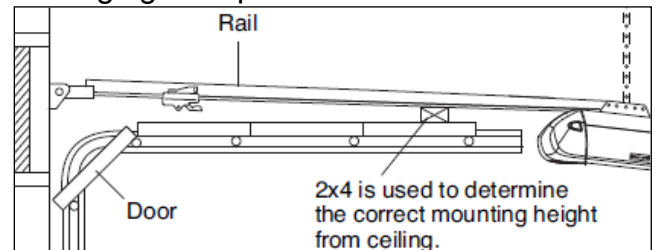


Positioning Operator

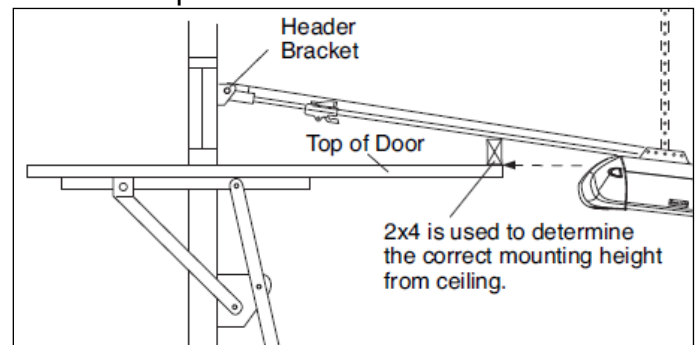
Sectional and One-piece Doors with Track: Raise the operator head and place it on top of a ladder, adding spacers if needed to ensure it

clears the door. Disconnect and slide the trolley toward the operator head to move the operator arm out of the door's path, if applicable.

Carefully open the door to the fully open position, confirming that the rail and trolley clear the door. Lay a 2x4 across the top section of the door to support the rail; this spacer protects the door and provides the necessary clearance between the door and rail for hanging the operator.



One Piece Doors without Track: Raise the operator head and place it on top of a ladder, adding spacers if needed to ensure it clears the door. Carefully open the door and note when it passes the high arc point, stopping it at that position if possible. Adjust the height of the operator head so the rail clears the top of the door by approximately two inches at the high-arc point. Keep the operator supported at this height until it can be permanently hung in the next step.



Hanging the Operator

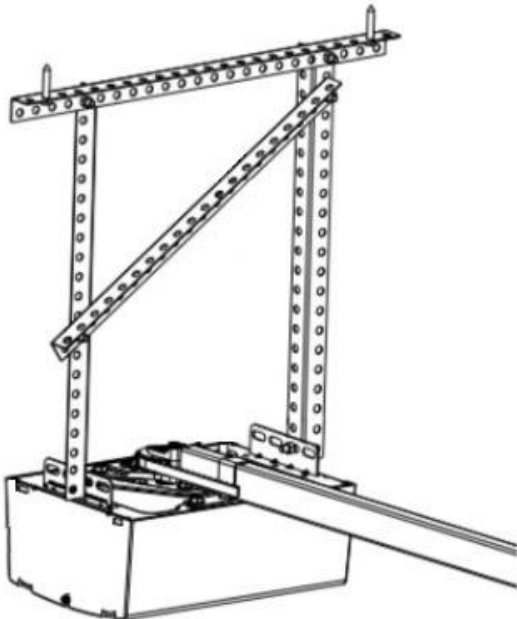
Installation methods vary depending on the garage's construction, but the operator must always be supported by a rigid, stable hanging system. Brackets should include two vertical drops and a sway brace to prevent movement during operation.

Hanging hardware is not supplied with the operator; angle iron and lag screws are the recommended materials for creating a secure support structure. The following sections outline common hanging methods, though some installations may require adapted or improvised approaches based on site conditions.

Center the operator head and rail with the centerline mark on the top of the door. Install an angle across the ceiling perpendicular to the operator rail: when the joists run parallel to the rail, fasten the angle between the two closest joists above the operator; when the joists run perpendicular, align the cross angle with the nearest joist. Mark the mounting-hole locations, pilot-drill 3/16-inch holes, and secure the angle using two 5/16-inch lag screws, ensuring proper embedment when fastening through a finished ceiling.

Measure the distance from each operator hanging tab to the cross angle and cut two drop angles to the required lengths. Position the drop angles straight down from the cross angle and loosely attach the operator to them.

Cut and install a diagonal cross brace between the two drop angles, or between one drop angle and the cross angle, then tighten all fasteners and remove the 2x4 spacer.

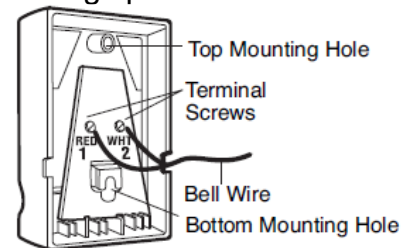


Manually open and close the door to confirm that it clears the operator rail by at least one inch throughout its travel. Note that operators installed on one piece doors without track will sit at a slight angle, with the operator head positioned lower than the header bracket.

Installing the Pushbutton

A standard wired pushbutton station is typically supplied with the operator. Optional upgraded wall controls may also be available.

Strip 1/4 to 7/16 inch of insulation from one end of the supplied 2-conductor bell wire, then connect the conductors to the two terminals on the back of the wall station, following any polarity markings provided.



Choose a convenient mounting location near an access door where the garage door is fully visible, and mount the wall station at least five feet above the floor using the provided screws, keeping it away from all moving parts.

Route the wire from the wall station to the back of the operator, securing it with staples that straddle both conductors to prevent shorts. Leave approximately six inches of slack at the operator, cut the wire, and strip each conductor 1/4 to 7/16 inch. Connect the black wire to the black pushbutton terminal and the white wire to the white terminal.

Finally, apply the warning label to the wall next to the pushbutton, using staples or tacks to ensure it remains securely in place over time.



Installing Light Bulbs and Cover

If the operator does not use traditional light bulbs or lens cover, skip this step. The plastic lens cover protects the light bulb(s) and diffuses the light from the bulb(s).

Install a light bulb in each of the lamp sockets. Do not install bulbs that exceed the wattage rating marked on the operator. Position the plastic lens cover and secure in place.



Emergency Release Handle

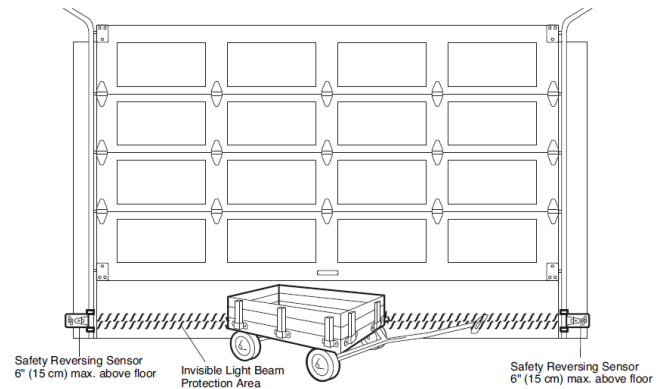
The emergency release handle allows the operator to be disengaged from the garage door so the door can be moved manually. This release must be accessible in case the door needs to be operated manually during an entrapment situation and can also be used during power outages.

Thread one end of the supplied rope through the hole in the release handle and tie an overhand knot to prevent it from slipping back through. Thread the opposite end of the rope through the hole in the trolley release lever, adjusting the length so the handle hangs approximately six feet above the floor, then tie another overhand knot to secure it. Trim any excess rope and seal the cut end with a match or lighter to prevent unraveling. Both knots should be positioned about one inch from the rope ends to ensure they hold securely.

Installing Photo Eyes

The photo eyes must be installed so the path of the light beam is not obstructed by the door during operation. They can be mounted to the track or directly to the wall, or in some cases can be mounted to the floor. It may be necessary to add a piece of wood to the wall at mounting locations to ensure proper clearance or for installation on masonry wall construction. The detector should be installed on the *shade*

side of the garage door, where sun will not shine directly into the detector lens.



Assemble the mounting brackets if required, then attach the sensors to the brackets as needed. Position both units at the same height, no more than six inches above the floor, ensuring the photo eye lenses face each other.

If mounting to a wall or floor, mark the screw locations with a pencil and pre-drill as necessary. Mount the brackets to the track, wall, or floor at the marked locations.

Wiring Photo Eyes

The photo eyes transmit signals that connect to the operator using two wires. Strip 1/4 to 7/16 inch of insulation from the wires and attach them to the terminals on the first photo eye. Route the wires up the wall, over the door, and down the opposite side to the second photo eye. Leave about six inches of slack, cut the wires, strip the ends, and connect them to the terminals, noting that some photo eyes require specific polarity for proper operation.

Strip another set of wires and attach them to the terminals on the second photo eye, then route these wires up the wall, halfway across the door opening, and back along the top of the operator rail using zip ties, or across the ceiling to the operator, leaving approximately six inches of slack at the operator head.

Strip the wire ends and connect them to the operator terminals. Secure all wiring to the wall

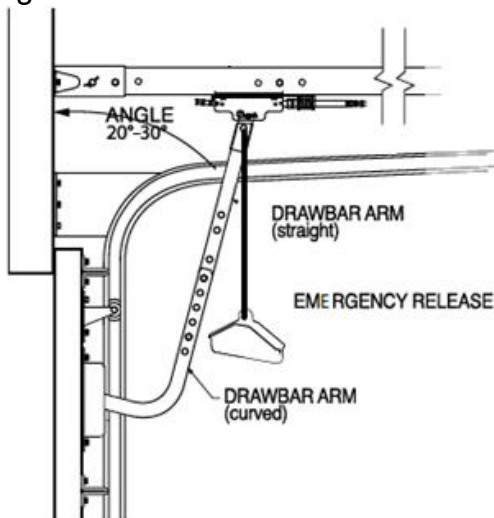
and ceiling with staples, ensuring each staple straddles both conductors to prevent shorts.

These instructions describe wiring photo eyes in parallel; follow the manufacturer's guidance when series wiring is required.

Door Arm Attachment

Pin the curved end of the drawbar arm to the door operator bracket, then disengage the trolley by pulling the release handle and move it toward the door. If needed, insert the single-hole end of the straight drawbar arm into the trolley and secure it with the pin.

Rotate the curved arm upward to meet the straight arm and align the holes in both pieces; the straight arm should angle 20 to 30 degrees toward the operator head. If the holes do not align, slide the trolley until they do. Connect the two arms using the provided fasteners, then manually raise the door until the trolley engages the traveler on the rail.

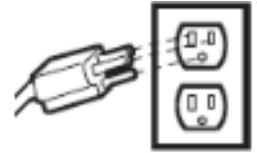


Connecting Power

Residential operator power can be supplied from a cord and grounded outlet connection, or permanent wiring by an electrician.

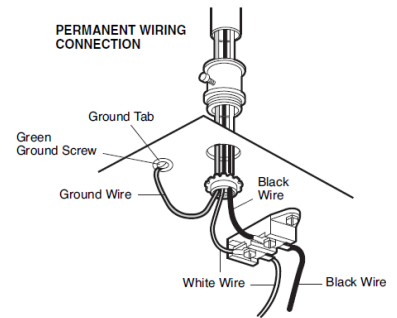
Cord and Outlet

Connection: The operator should be connected to a grounded receptacle on the ceiling or near the operator's head. If one is not available that will accept the grounded operator plug, one should be installed by a qualified electrician. **Do not use an extension cord.** Plug the operator into grounded receptacle.



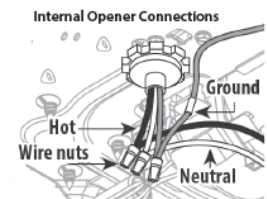
Permanent Wiring:

Some local electrical codes require permanent wiring to the power source through conduit. Follow these steps only if permanent wiring is required.



Ensure the power cord is unplugged, then cut the existing cord outside the operator chassis, leaving about one inch of length from the strain-relief bushing. Remove the operator cover, take out the strain-relief bushing, and discard it. Strip back the outer insulation of the power cord and remove insulation from the individual conductors.

Pull a suitable power cable with neutral, hot, and ground conductors through the conduit, then connect the conduit to the operator using the appropriate termination. Inside the chassis, use wire nuts to connect the new supply wires, ensuring at least six inches of conductor length remains inside and that all wiring is kept clear of gears and moving parts.



Reinstall the operator cover, then complete the installation by connecting the conduit wires to the power source at the junction box.

Aligning Photo Eyes

The photo eyes often consist of two units, a sending unit and a receiving unit. The sending unit constantly sends a narrow beam to the receiving unit. If the door is moving down and an obstruction interrupts the beam, the sensors will signal the operator to result in a reversal, causing the door to go up. If the door is up and there is an obstruction interrupting the beam, or the beams are not aligned, the remote transmitter(s) will not function. The operator will then only run the door down if constant pressure is applied to the wired wall station pushbutton.

Ensure power is applied to the operator, then loosen the mounting nuts and align the photo eye beams, using the indicator lights on the detectors for feedback. If alignment cannot be achieved, check for common issues such as dirt on the lenses, sunlight interference, wire shorts from staples or terminal connections, or incorrect wiring.

With the trolley disengaged, press the wall station button to run the traveler to the up position. Press the button again and, while the traveler moves downward, block the photo eye beam; the traveler must stop and reverse to the up position.

Place an object in the beam path and verify that constant pressure on the wall station button is required for downward travel; releasing the button before the traveler stops should cause it to return to the up position. The operator will not respond to a CLOSE command from a radio transmitter when the photo eye beam is obstructed.

Setting Limits

Limits may be factory preset or field adjustment may be required. The limit adjustments are located on the operator head. They control how far the door will open or close. In some cases, the limit travel is controlled with adjustment screws and other cases are controlled

electronically. Follow the operator manufacturer's instructions for specific limit adjustment. The limits should be set so that the door clears the opening and closes tightly to the floor without flexing the operator rail.

Programming Radio Controls

The radio receiver is located inside the operator. A small external wire serves as the antenna for the receiver. Straighten out the antenna wire so it points straight down toward the floor.

Follow the manufacturer's instructions for programming the remote(s) to the operator head. Stand clear of the door, press transmitter button and verify the operator starts. More transmitters can be added for additional users of the door operator.

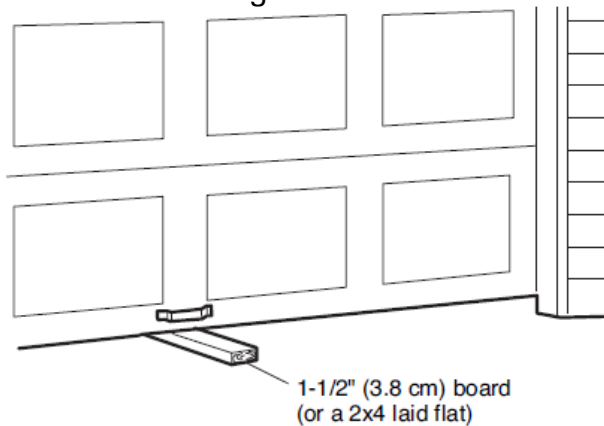
Force Adjustment

The operator force must be in proper adjustment at all times. This ensures that the garage door will reverse its direction in the event an obstruction is encountered during downward travel, and stop its motion in the event that an obstruction is encountered during upward travel. In some cases, operator force is controlled with adjustment screws and other cases are controlled electronically. Follow the operator manufacturer's instructions for force adjustment. Perform a reversal test monthly or anytime operator forces are adjusted.

Reversal Test

Start with the door in the up position. Lay a 2x4 flat on the floor as an obstacle where it will be struck by the center of the door as it closes. Activate the operator and verify the door reverses when it contacts the 2x4. The door *must* reverse its direction of travel within 2 seconds after it contacts the 2x4. If the door stops and does not reverse, then the down limit or down force require adjustment. Repeat the

reversal test until the door reverses within 2 seconds of contacting the 2x4.



Using the Garage Door Opener

Opening the Door: Press the wall station button or activate a wireless remote control transmitter to activate the operator. When the operator is activated, the courtesy lamp will light, and the door will begin to open. The door will open until the up limit is reached, unless an obstruction is encountered, which will stop the door. The courtesy lamp will typically remain lit for several minutes after the operator stops.

Closing the Door: Press the wall station button or activate a wireless remote control transmitter. When the operator is activated, the courtesy lamp will light, and the door will begin to close. The door will close until the down limit is reached, unless an obstruction is encountered or the photo eye beam is interrupted, which will stop and reverse the door. The courtesy lamp will typically remain lit for several minutes after the operator stops.

Stopping the Door Mid-Travel: Each operator has the ability to be stopped mid-travel by activating the wall station button or a wireless transmitter. Reference the operator instructions for activation sequence when using mid-travel stop.

Manual Operation: The trolley release handle is used to disengage the operator from the garage door. It can be used during emergencies or power failures to allow manual operation of the door. Only pull the trolley

release handle when the door is in the closed position.

With the door in the closed position, pull the trolley release handle to disengage the door. The door can now be raised or lowered manually. Reengage the trolley release lever to resume electric operation. It may be necessary to move the door manually until the trolley engages the traveler on the rail.

Optional Wall Station Features

Wall Station Lock: There may be a lock switch or button on the wall station that can activate a vacation lock to prevent operation. Activation of the lock will prevent operation of the door. Some systems allow the door to be closed once after the lock is activated to allow the user to exit before locking out controls.

Activating the lock will often include an indicator on the wall control. A light may flash or turn off to indicate the lock is active. Deactivate the lock to return the operator to normal operation.

Wall Station Light Control: If the operator's courtesy lamp is off, pushing the wall station's light button will turn the operator's lamp on. The lamp will remain on until the light button is pressed again, or the operator is cycled. If the operator's courtesy lamp is on, pushing the wall station's light button will turn the operator's lamp off.

Care for the Garage Door Operator

Seasonal weather changes affecting the door could require fine tuning of the operator's adjustments over time. Wooden doors can swell and gain weight during wet weather, sectional door hinges and rollers might bind during cold periods, etc.

Monthly Testing: With the door closed, pull the trolley release handle to disengage the trolley from the rail. By hand, slowly open the

door all the way, and then close it all the way. Notice if there is any binding, sticking, or rubbing caused by the hardware, track rollers, or door frame. The door should travel smoothly.

Raise the garage door about halfway up. Release your hold on the door and see if the door balances. It shouldn't go up or down on its own. Close the door. If the door is unbalanced or if the door travel isn't smooth, the door should be repaired by a qualified technician.

Verify photo eye alignment by performing the test in the Aligning Photo Eyes section. Perform limit adjustments as described in the operator's instructions, and verify force settings by performing a Reversal Test.

Bi-Annual Testing: Check the chain or belt tension (if applicable) and adjust it if necessary.

Yearly Maintenance: Lubricate door hinges, springs, rollers, and bearings. Follow the operator manufacturer's recommended annual maintenance.

Section Eight

Commercial Operator Installation

WARNING! To reduce the risk of injury or death, always read and follow all manufacturers' instructions and safety precautions. The following general instructions are for reference only and are in no way intended to replace or supplement the instructions and safety precautions provided by the operator manufacturer.

Door operators and associated control equipment should only be installed and serviced by qualified professionals. Professional installers should observe the following safe installation procedures.

Before Installation:

1. Verify the operator is proper for the type, size of door, and frequency of use per the operator specifications.
2. Power should always be disconnected when installing, wiring, or servicing a door operator or automatic door system. Not only is the chance of electric shock eliminated, but the moving chains in most door operators can catch clothing or fingers and cause severe injury.
3. Installation and wiring must comply with local building and electrical codes.
4. If the door system will be operated using momentary contact or remote operation, additional equipment such as reversing edges, photoelectric sensors, or similar devices must be installed as part of the system to prevent entrapment.
5. Outdoor or easily accessible controls must be secured to prevent unauthorized use of the system.
6. Place controls far enough from the door so a user cannot touch the door when operating the controls.
7. Controls should be placed so the user has full view of the door when operating.
8. Always set the limits on the operator, even if power has not been supplied.
9. Some manufacturers tape the cotter pin against the clutch pulley. Make sure you remove it and pin the adjusting nut as per the manufacturer's recommendations.
10. Do not overtighten the clutch to compensate for a damaged door.
11. Test door and service monthly. If adjusting limit travel, retest the door opener. Failure to adjust the door may cause death or injury.
12. Keep doors properly balanced. An improperly balanced door has the potential to cause severe injury. Qualified service personnel should perform all repairs to the door if needed.
13. Use emergency operation mechanisms only when the operator has been electrically disconnected. If possible, use them only when the door is closed. Use caution when using emergency operation mechanisms with the door open. Weak or broken springs may cause the door to fall rapidly.
14. The installer is responsible for assuring the owner of the door system understands its basic operation and safety. In particular, be sure the owner/end user understands the location and operation of the emergency operation mechanism.
15. Point out to the owner/end user of the door system children or pets should not be allowed to play on or near the door or any part of the system, and the safety instructions supplied with the operator are the responsibility of the owner/end user.
16. Leave the installation and maintenance manual for the operator as well as any additional information supplied with the operator or any other components of the door system with the owner/end-user.
17. If you have any questions about the safety of the door operating system, do not install the operator.

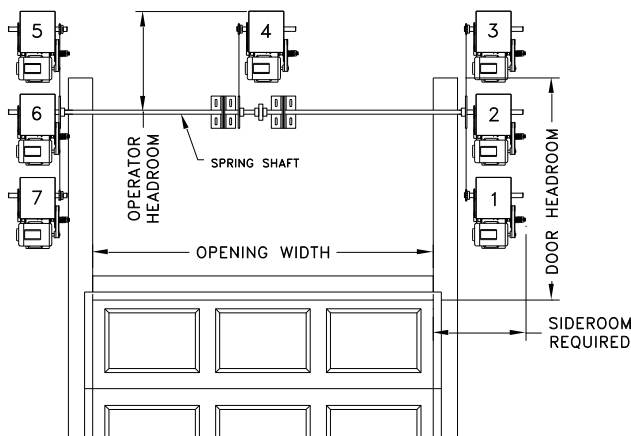
To reduce the risk of severe injury or death, read and follow all manufacturer's safety warnings and installation instructions. Ensure the door is properly installed and working freely

in both directions. Do not install the operator until all door problems have been corrected. If necessary, oil all moving parts (chains, guides, etc.). Remove any old accessories (locks, bolts, etc.) before installing the operator. Locate any pushbutton controls within sight of the door, at a minimum height of 5 feet so small children cannot reach them, and away from all moving parts of the door.

Jackshaft operators should not be used on standard lift or low headroom lift doors without taking proper precautions to maintain cable tension during operation.

Jackshaft Operator Installation

Mounting Position: Jackshaft operators have dual output shafts and may be mounted in a variety of locations. The operator may be mounted on the right hand side (positions 1, 2, and 3), on the left hand side (positions 5, 6, and 7), or at the center of the door (position 4). Place the sprockets on the shafts in the appropriate locations according to the desired mounting position.



WARNING! Electric operators can be very heavy. Exercise extreme caution while performing this step to prevent and secure the operator from falling in order to avoid severe injury or death.

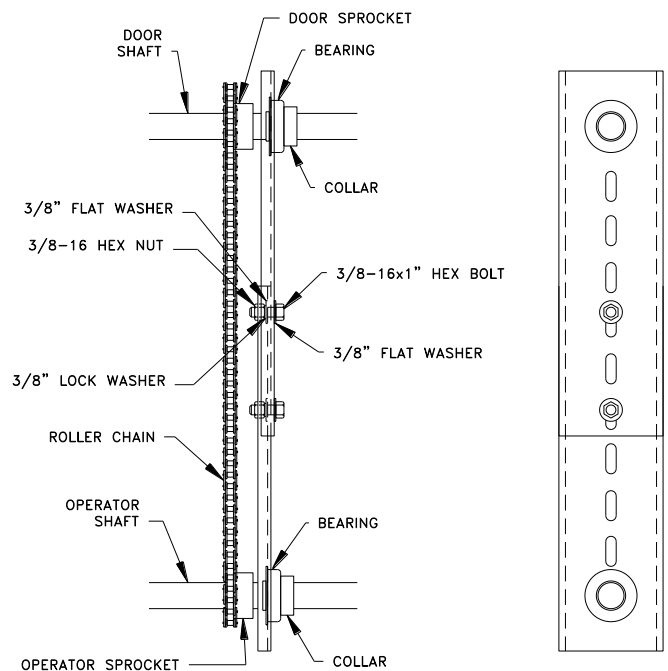
Mounting Operator: Operator should be installed a minimum of 8 feet above the floor. Installations below 8 feet require the use of an

operator cover to protect personnel from accidental contact with moving parts.

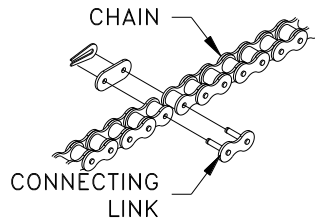
Determine the best location for the operator. The operator should mount to the wall off to the side or above the door with the operator output shaft in alignment with the door drive shaft. The mounting location should provide adequate structure for mounting the operator to the wall. Locate the operator as close to the door as reasonably possible to reduce the length of the roller chain. Optimum location is 12 to 15 inches from the operator shaft to the door shaft. Excessively long roller chains may require additional devices, such as idler sprockets and chain guides.

Mount the Jackshaft unit by fastening it to the wall with adequately sized thru bolts, or if the wall is of such construction to prevent the use of thru-bolts, lag bolts and shields of sufficient size may be used. Do not tighten. Always verify all operator mounting fasteners are of sufficient type, size, and grade for each application with the manufacturer's installation instructions.

Place the driven sprocket on the door shaft loosely and align it with the drive sprocket of the operator. Install a chain spreader as shown below.



Lock the drive and driven sprockets in place by inserting the keys and tightening their respective set screws. If no keyway exists in the door shaft, drill a 1/4 inch hole through the sprocket hub and door shaft and insert a 1/4 inch spring pin through the hole. Connect the sprockets with the drive chain, shorten to a suitable length using a chain breaker, and join together with the connecting link. To shorten the chain, punch out the pin that will leave an inside link nearest to the desired length. Connect the chain around the sprockets using the connecting link.



Slide the operator to tighten the drive chain and then firmly tighten the mounting bolts. Check the tension on the chain and the set screws on the sprockets. There should be no more than 1/4 inch slack when the chain is depressed between sprockets.

If an auxiliary chain hoist is supplied, run the hand chain through the pocket wheel and chain guide outside the frame; allow both ends to hang down towards the ground and cut hand chain, if necessary, so that both ends are approximately 2 feet from the floor. Connect both ends of the hand chain.

Attach the cable to the chain hoist engaging lever then pass it through the small pulley at the bottom of the operator frame. Allow the cable to hang down towards the ground and cut the cable, if necessary, so that the cable end is approximately 4 feet from the floor. Connect the cable end to the disconnect lever and secure it with the U-bolt. Mount the floor level disconnect lever to the wall so as to allow the cable to be slightly loose when the lever is in the engaged position (upwards).

Manual Operation of Jackshaft Operator: If the jackshaft operator is equipped with an emergency chain hoist, use the following instructions to manually operate the door.

- a. With door in the closed position, pull the disconnect cable downwards to the *disengaged* position. A positive engaging coupling disengages the initial drive mechanism from electrical operation and transfers it to manual chain hoist drive. A switch disconnects the electrical controls to prevent injuries.
- b. Operate the door manually by pulling downward on one side of the chain. Pulling the other side will cause the door to move in the opposite direction.
- c. To return to electrical operation merely release the disconnect cable to the *engaged* position.
- d. The floor level disconnect may also serve as a hand chain keeper. Insert the hand chain into the proper slot to secure during electrical operation.

Trolley/Drawbar Operator Installation

Before the operator is installed, be sure the door has been properly aligned and is working smoothly. Although each installation will vary due to particular building characteristics, refer to the following general procedures to install the operator.

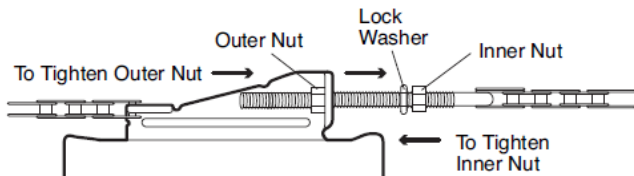
Rail Assembly: Using the bolts and nuts supplied, assemble the operator rails by installing and tightening the spacer brackets. Position the spacers evenly over the length of the rails. Using bolts and lock washers, install the front idler assembly to one end of the rails. Slide the trolley carriage onto the rails so that the take-up bolt will be towards the operator.

Powerhead Attachment: Position the rail assembly on the frame of the powerhead so that the motor side of the operator is in the back (away from door). Loosely install bolts and nuts in the holes from the end of the rails. Align the rails so that the bolts line up with the holes in the frame. Connect the rails to the powerhead by fastening bolts and nuts through the frame and the end holes in the rails. Tighten all bolts to secure the rails to the powerhead.

Trolley Carriage/Chain Attachment: Attach the take-up bolt to the trolley carriage using lock washers and nuts.

Using one of the connecting links, attach the chain to the other end of the trolley carriage. Reel the chain around the front idler shaft, over the spacer brackets, back to the drive shaft sprocket, and then to the take-up bolt on the carriage.

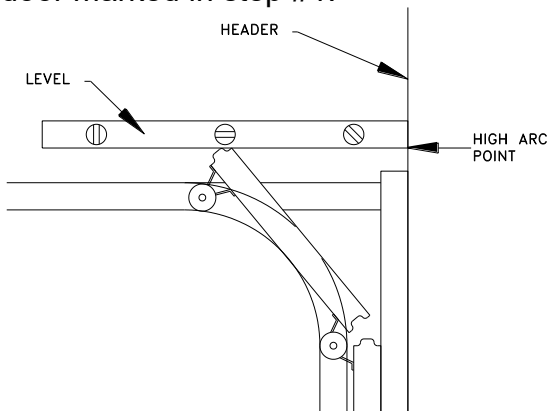
Using a connecting link, attach the chain to the take-up bolt and tighten to tension the chain. If necessary, remove links from the chain to achieve proper adjustment per the manufacturer's instructions.



Mounting the Header Bracket: The trolley/drawbar operator is generally mounted over the center of the door. However, off center mounting may be required due to specific field conditions. Extension spring doors require center mounting.

Locate the center of the door and mark a line on the wall directly above the door and on the top section. Extend this line up the wall.

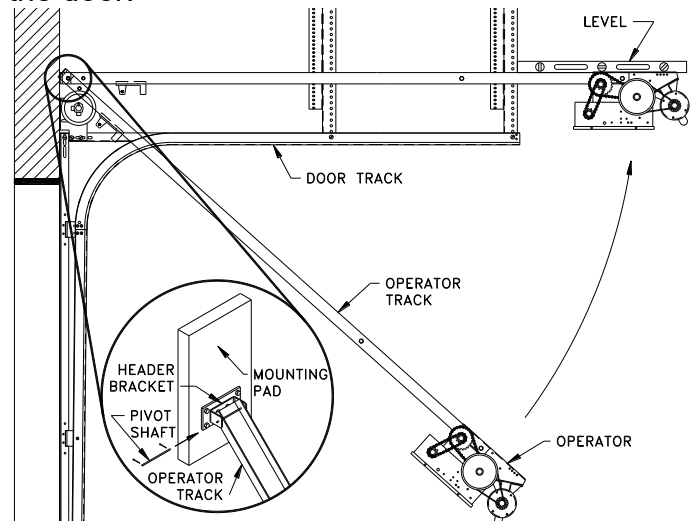
Determine the highest point of door travel by slowly raising the door and observe the action of the top section. When the top section reaches its highest point, use a level and project a line from this point to the centerline of the door marked in step #1.



Using the projected lines for location, mount a suitable wood block mounting pad or length of angle iron to the wall above the door opening. This will provide a mounting pad for the front header bracket of the operator. If necessary, reinforce the wall with suitable mounting brackets to ensure adequate support of the mounting pad. Using suitable hardware, mount the front header bracket to the mounting pad.

Mounting the Operator: With the motor resting on the floor, or a raised ladder or scaffolding if needed, raise the front end of the rail assembly to the front header bracket and fasten with the pivot pin.

Swing the operator to a horizontal position above the door track and temporarily secure with a suitable chain or support from the floor. Now open the garage door slowly, being careful not to disturb the temporary support. Place a level against the rails and adjust the operator until it is horizontal. Make sure that the operator is aligned with the centerline of the door.

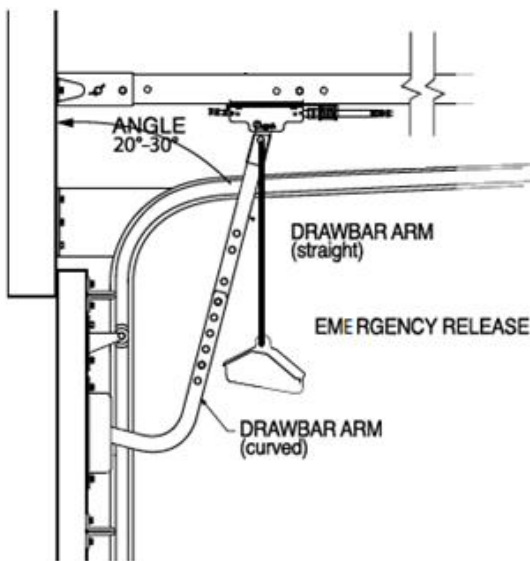


Operator Support: The operator should be supported using angle iron. A support brace is needed to mount the operator powerhead to the ceiling. If the operator is longer than 15 feet, use a center hang to support the mid-span of the operator rail assembly. Each installation may vary depending on field conditions, but in all cases side support is required for additional strength and to prevent

the operator moving from side-to-side. Be sure to suspend the operator securely to prevent injury or property damage.

Straight Door Arm Attachment: Fully close the door and move the carriage to the front of the operator rail. Attach the straight door arm to the carriage if needed, and attach the curved drawbar arm to the door bracket.

Align the straight and curved arms and bolt them together with the arm positioned 20 to 30 degrees from the door. Ensure all bolts and lag screws used in the installation of the operator are securely tightened.



Setting Operator Controls

Once the jackshaft or trolley/drawbar operator is mounted and connected to the door, the remainder of the installation is similar for both operators.

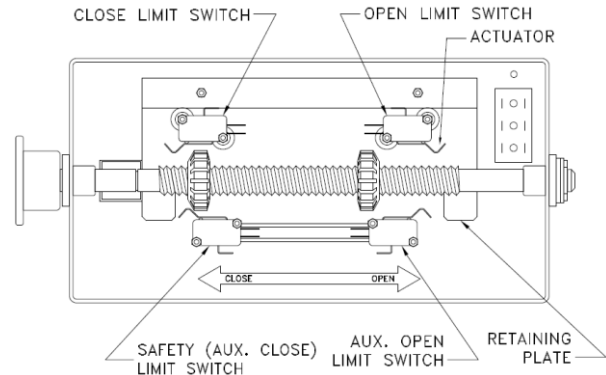
Setting the Limits

There are two main types of limit adjustment; Electronic and mechanical.

Electronic Limit Adjustment: Limits are adjusted electronically using the operator's control board. Follow the manufacturer's

instructions for proper key sequence required to set the operator travel limits.

Mechanical Limit Adjustment: Limits are adjusted mechanically using an external limit box. Follow the manufacturer's instructions for proper adjustment of mechanical limits.



There are typically up to four limit switches. Two are used as end of travel, one is for radio control or single button operation, and one is for reversing devices such as sensing edges.

Traditional mechanical limit adjustment is as follows:

- i. The open limit switch is the end of travel in the open position. Adjust the cam so the door stops in the open position at the desired location. Be sure to set the limit so the door stops clear of the opening.
- ii. The advanced open limit switch is used for radio control and single button (open/close) devices. This switch is set to be activated slightly before the open limit when opening.
- iii. The close limit switch is the end of travel in the closed position. Adjust the limit cam so the door stops in the closed position at the desired location. The limit should be set so the door contacts and seals with the floor, but does not slack the cables or bend the drawbar operator rail.
- iv. The advanced close limit switch is used in the operation of a sensing edge or other reversing devices. This limit switch deactivates reversing devices slightly before the closed position to prevent the door from reversing when the edge contacts the floor.

Control Wiring Type

Refer to the wiring diagram located on the inside cover of the electrical box to determine the type of control wiring.

Prior to 2010, standard operators were typically shipped from the factory set for C2 wiring, which required constant pressure to close the door. If momentary contact to close was desired, the operator was either rewired or an adjustment on the control board was required to achieve this wiring type known as B2 wiring.

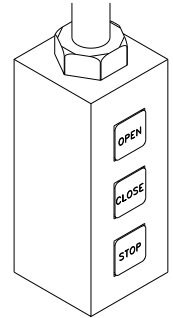
1. **Constant Pressure to Close (C2 wiring):** The operator requires constant pressure on a wired close control in order to keep the door moving in the close direction until it reaches the close limit.
2. **Momentary Contact to Close (B2 wiring):** The operator will require only momentary contact on the close control in order to close the door.

Since 2010, commercial operators have been required to include a monitored external entrapment protection device if momentary contact to close is desired. The exception to this is when a fire door operator is closing in an alarm condition. In this instance, the operator is allowed to ignore safety devices immediately, or after a number of attempts to close, and close with momentary contact even if external monitored entrapment protection is not present, for the purpose of fire containment and protection.

Special Control Wiring: If the operator was shipped from the factory with non-standard control wiring or with optional accessories requiring additional instructions, refer to the wiring diagram(s) indicated in the special control wiring data box. When a replacement wiring diagram is present, refer only to the replacement wiring diagram for all connections. If the wiring diagram is missing, or any uncertainties exist regarding the proper wiring type, contact the operator manufacturer before making any connections.

Locating the Control Station

All operators are supplied with some type of control station. Generally, a three button station (Open/Close/Stop) is provided. Alternative control stations may be used depending on the needs of the customer. The wall control(s) must be located so the door remains visible to the user and positioned either at a safe distance or in a way preventing the user from coming in contact with the door while operating the controls. UL 325 requires the control station to be mounted a minimum of five feet above the floor to prevent small children from reaching. Reference DASMA TDS 384 if you encounter a conflict between UL 325 and ADA mounting height requirements.



UL 325 requires an entrapment warning placard to be mounted next to the control station in a prominent location. The placard should be located such that it is visible when operating the door.

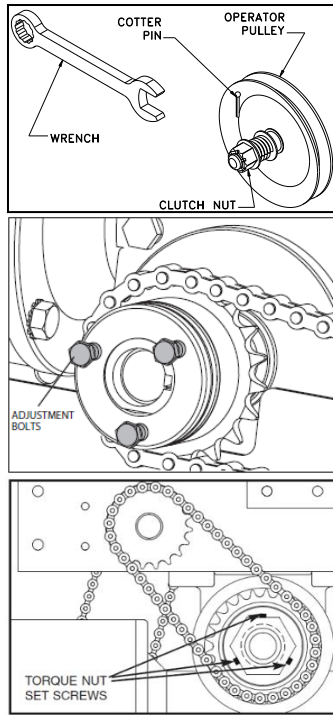


Clutch Adjustment

If the electric operator is supplied with a clutch, it is necessary to adjust the clutch to ensure proper engagement. Failure to adjust the clutch specific to each door installation will result in an unsafe door system and potential for an accident, injury, or damage to the door. A clutch is not intended to be used as an alternative to proper entrapment protection, but rather an auxiliary device to protect the door from damage.

Follow these procedures for properly adjusting the clutch. Refer to the manufacturer's instructions for specific clutch type adjustment procedures.

1. Move the door to the closed position.
2. Remove the cotter pin or loosen the set screws from the nut on the clutch shaft if needed.
3. Back off clutch adjustment until there is very little tension on the clutch.
4. Tighten the clutch gradually until there is just enough tension to permit the operator to move the door smoothly but to allow the clutch to slip if the door is obstructed.
5. Once final adjustment to the clutch is made, reinstall the cotter pin or retighten the set screws if previously loosened. End users must be instructed in clutch assembly safe operating and testing procedures.



Test the System

Once power is supplied, test all controls and safety devices for proper operation and make any necessary adjustments to the limit switches.

Do not leave the power on unless all safety and entrapment protection devices have been tested and are working properly.

Install all safety stickers and warning labels.

Conduct a thorough review of safe operating procedures with the owner or person(s) responsible for the operation of the door. Review safety instructions, emergency manual operation of the door, if provided, and explain how any safety devices operate and demonstrate how to test them.

All installations should include a thorough review to document the door system is working properly at its conclusion. As with any door system, commercial sectional doors and operators may be damaged or modified by others following completion of the installation. Checklists, digital photographs, and forms signed by the end user are methods of documentation that may be important in the future, in the event of a malfunction. The post-installation process can also reveal any undetected flaws or defects in the installation.

Brake Adjustment

When the electric operator is supplied with a brake, the brake is factory set but may require adjustment after usage. In order to obtain optimal performance and maximum life, the brake must be adjusted for proper clearance between friction pads and brake tensioning. Reference the operator manufacturer's installation instructions for detailed information on brake adjustment.

Section Nine

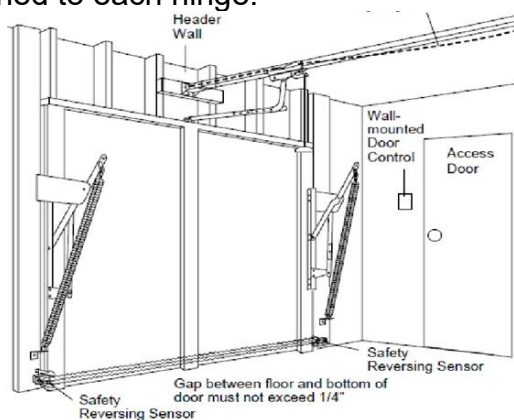
One Piece Doors

One piece, or tilt-up, doors are one of the earliest forms of overhead door construction and remain in use today for specific architectural and functional reasons. Unlike sectional doors, built from multiple hinged panels, a one piece door operates as a single rigid slab that pivots outward and upward as a single unit. This design influences everything from hardware selection and operator compatibility to clearance requirements and safety considerations. Understanding how one piece doors are built and how they move provides important context for technicians who may encounter them in both retrofit and specialty applications.



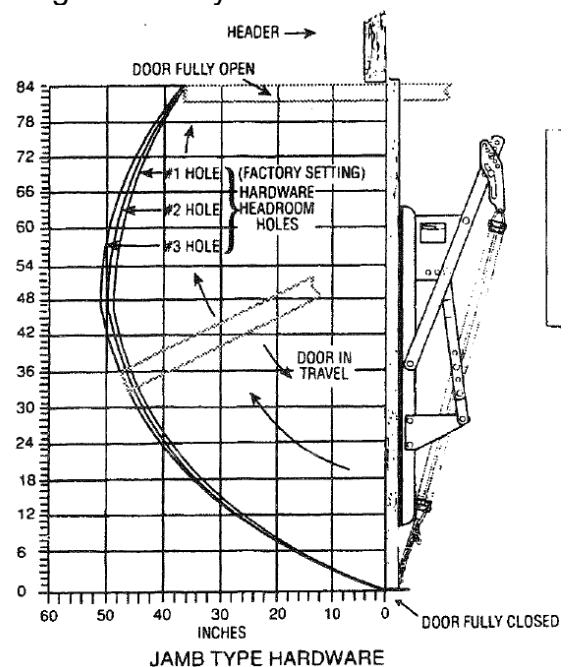
Jamb Type Hardware

Jamb type one piece door hardware is essentially a pair of hinges (four bar linkages) which mount to the door and to the door jambs. The motion of the door is controlled by the geometry of the hinges, and the weight of the door is counterbalanced by extension springs attached to each hinge.



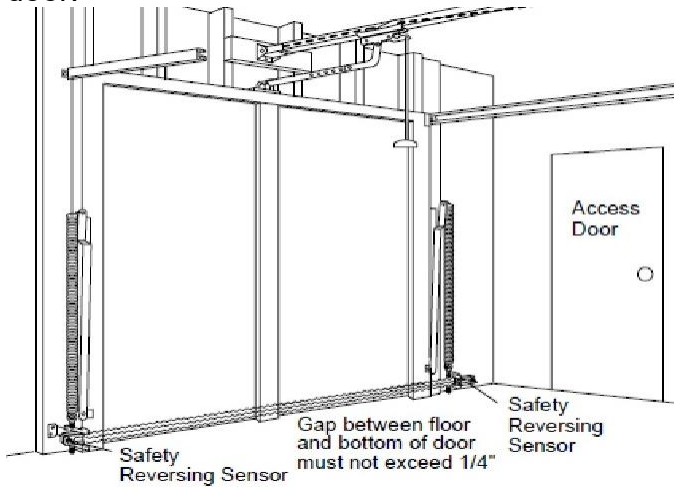
The benefits of a one piece door hung on jamb type hardware are:

- Fewer components to install compared with jamb type with track or with sectional doors. This results in less installation time.
- Less interference with beams and rafters in the garage since the door remains approximately half inside and half outside the garage in the open position.
- Less headroom is required, as little as 1-1/2 inch is available.
- Smoother operation with electric openers compared with jamb type track.
- Wide selection of jamb type hardware is available to accommodate door heights from 6 foot 6 inches to 12 foot and weights from 200 to 450 pounds. Hardware is also available for specialty applications such as electrically operated doors and flush mounted doors.
- Quieter operation than typical sectional doors.
- Less costly compared with installation using jamb type hardware with tracks or with sectional doors.
- Designer friendly.



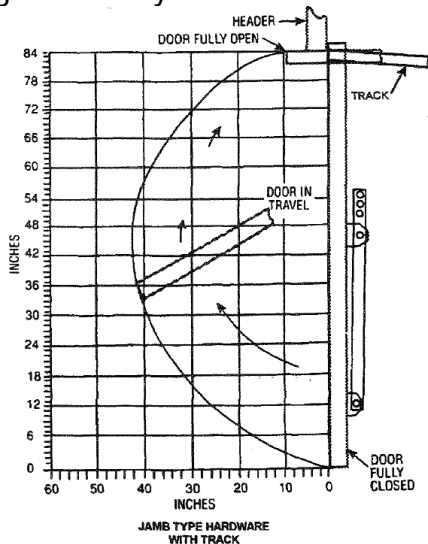
Jamb Type with Track Hardware

Jamb type one piece door hardware with tracks is comprised of two pivot arms and two horizontally mounted tracks. The pivot arms mount to each door jamb and support the lower corners of the door while rollers, which ride in the tracks, support the upper corners of the door.



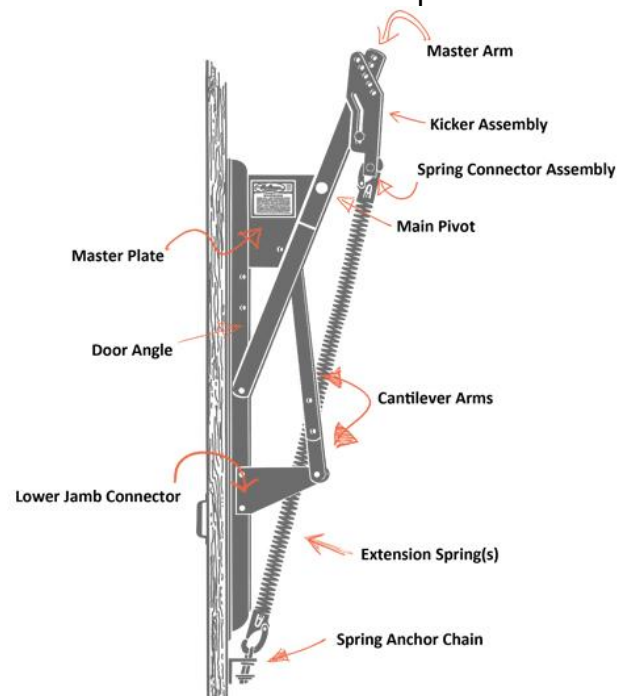
The benefits of a one piece door hung on jamb type hardware with track are:

- Fewer components to install compared with sectional doors.
- Less costly compared with installations using sectional doors.
- Typically, in the open position, the door is almost entirely inside the garage. This is beneficial if a door which extends beyond the building is undesirable or not in compliance with building codes.
- Designer friendly.



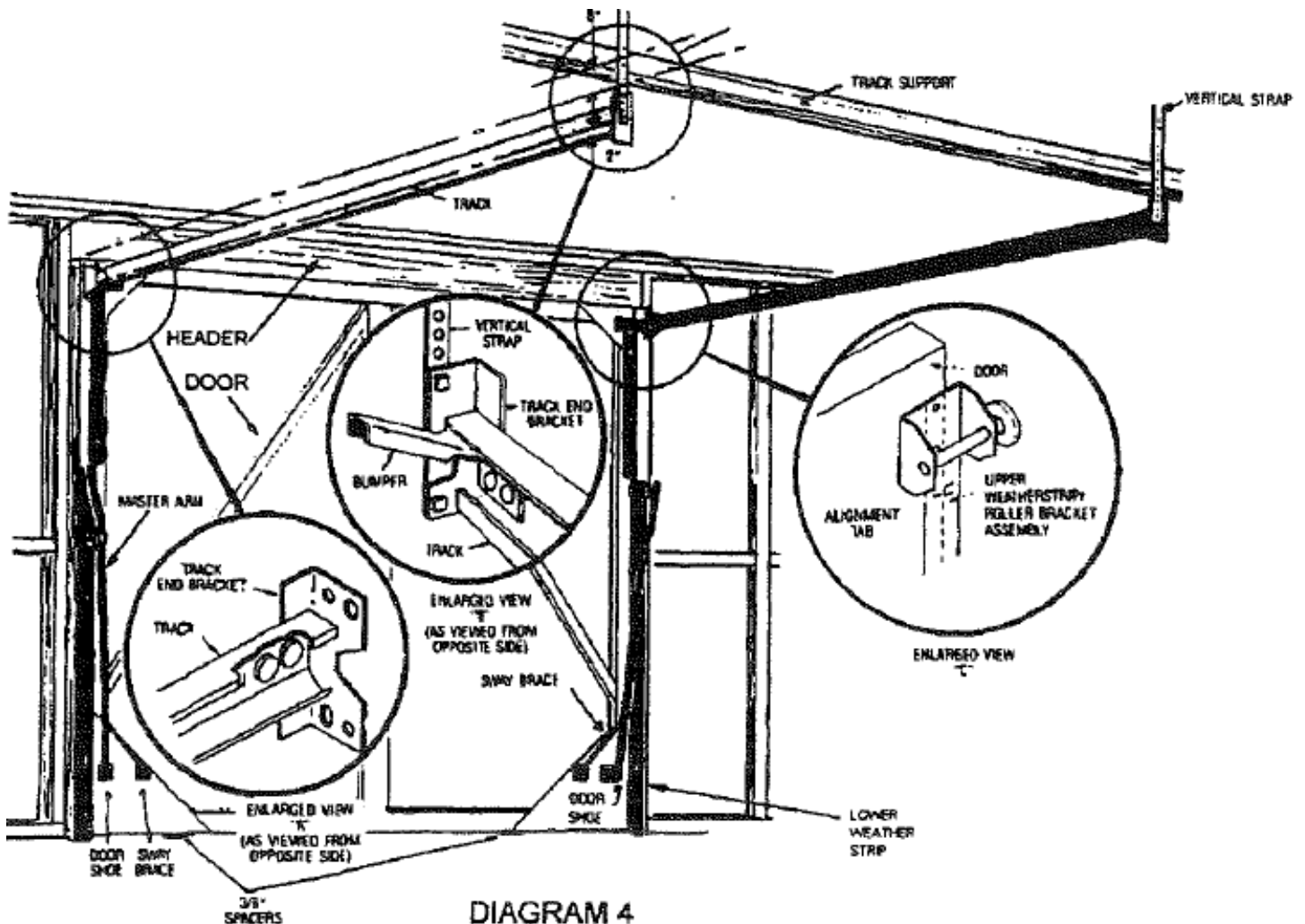
Jamb Type Hardware Components

- Master Plate: for attachment to door jamb.
- Master Arm: the main load carrying member.
- Door Angle: for attachment to the door.
- Kicker Assembly: for attachment of the springs to the master arm and adjustment of spring force during the last 1/4 of door travel.
- Spring Connector Assembly: for attachment of the springs to the kicker and to the chain or lower jamb connector. Also serves to contain the spring when the spring breaks.
- Cantilever Arms: for adjusting the vertical position and angle of the door in the closed position.
- Extension Springs: for counterbalancing the weight of the door.
- Spring Anchor Chain: for attachment of springs to the jambs.
- Lower Jamb Connector: another method for attachment of springs to the jambs which makes it easier to install and adjust the tension on the springs.
- Fasteners: including pivot points which hold hinge components together, bolts which are used to adjust headroom, spring tension and mounting hardware.
- Main Pivot: the pivot point connecting the master arm to the master plate.



Jamb Type with Track Hardware Components

- a. Master Plate: for attachment to door jamb.
- b. Master Arm: main load carrying member.
- c. Anti-sway Brace: Stiffens master arms against sway to prevent door from rubbing on jambs.
- d. Upper and Lower Weather Strip: closes air gap between door and jambs.
- e. Roller Bracket Assembly: mounts rollers to the top two corners of the door.
- f. Tracks: support the top corners of the door.
- g. Track End Bracket: attaches tracks to header or jambs.
- h. Door Shoe: attaches master arm to lower corners of door.
- i. Extension Springs: counterbalances weight of door.
- j. Spring Connector Assembly: attaches springs to master arm.
- k. Spring Anchor Assembly: attaches springs to jambs and adjusts spring tension.
- l. Main Pivot: pivot point connecting master arm to master plate.
- m. Fasteners: including pivot points which hold hinge components together, bolts that are used to adjust spring tension and mounting hardware.



Maximum Door Weights and Sizes

Light Duty Jamb Type: Designed for doors weighing up to 200 pounds and measuring between 6 foot 10 inches and 7 foot 4 inches tall. Light duty hardware is generally used on single garage doors up to 10 foot wide, but is also used on up to 16 foot wide aluminum and light weight steel doors.

Medium Duty Jamb Type: Designed for doors weighing up to 325 pounds and measuring between 6 foot 10 inches and 7 foot 4 inches tall. Medium duty hardware is generally used on double car garage doors up to 16' wide. Wood doors wider than 10' are required to have added stiffening supports, such as truss rods, to prevent the door from sagging in the open position. Medium duty hardware is also available with a heavy duty main pivot for longer cycle life.

Heavy Duty Jamb Type: Designed for doors weighing up to 350 pounds and measuring 6 foot 10 inches and 7 foot 4 inches tall. Heavy duty hardware is generally used on double car garage doors up to 16 foot wide. Wood doors wider than 10 foot are required to have added stiffening supports, such as truss rods, to prevent the door from sagging in the open position.

Jamb Type for Special Applications: Jamb type hardware is available for special residential applications such as:

- 1) Hardware designed with a smoother operation for use with electric openers.
- 2) Hardware designed for installations that require the door to be flush to the exterior surface of the garage (flush hung).
- 3) Heavy duty hardware (commercial grade) for doors exceeding the residential height and weight capacity.

Jamb Type with Track: Designed for doors weighing up to 300 pounds and measuring between 6 foot 6 inches and 7 foot 8 inches tall. This hardware is generally used on doors up to 16 foot wide. Wood doors, wider than 10 foot are required to have added stiffening

supports, such as truss rods, to prevent the door from sagging in the open position.

Safety Considerations

Minimum Specifications for Jamb: It is recommended that both jamb type hardware and jamb type hardware with track be mounted on wood door jambs which comply with the following minimum specifications: 1) National Forest Products Association, National Design Standards, Table 8.1A, Group II or better material (i.e. Douglas Fir), 2) Minimum Specific Gravity of 0.51 (32 pounds per cubic feet), and 3) Minimum Dressed Size of 1-1/2 inches x 5-1/2 inches. If the door jambs are not made from wood, one should follow the manufacturer's recommendations for jamb materials.

Safety Containment of Extension Springs:

It is recommended that all garage door springs be equipped with a device capable of restraining the spring (or spring pieces) in the event that it breaks. Usually, the springs will include an integral containment device. In the event of a spring, which is not equipped with a containment device, replace the spring with one that is properly equipped or contact the manufacturer for recommendations.



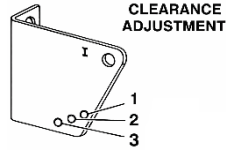
Spring Design Standard: Garage door extension springs are designed for a minimum cycle life of 10,000 cycles where one cycle is defined as one door opening and one door closing.

All of the above are required by law in California.

Adjustment of Hardware and Springs

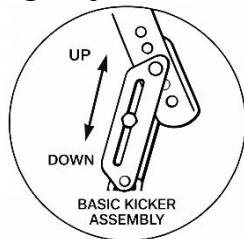
Three Headroom Adjustment Holes:

These are used to adjust the path of the door to fit within available space between the top of the door and the garage ceiling or other obstructions such as beams or ducts. The offset cantilever arm is bolted to the appropriate hole in the master plate.



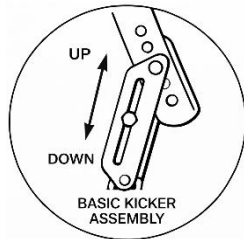
Five Power Settings for Spring Adjustment:

This is used to increase or decrease leverage in order to adjust spring tension and achieve a balanced door. The kicker is moved from hole to hole on the master arm.

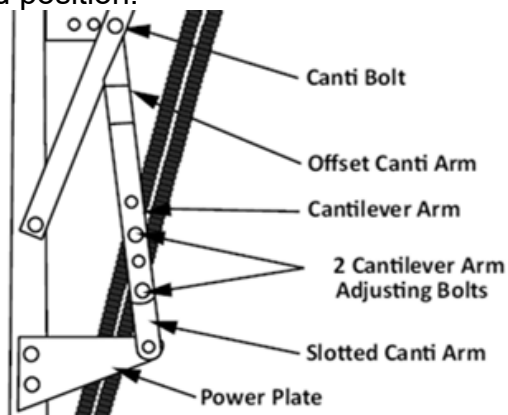


Kicker Adjustment:

Used to adjust the balance of the door in the last quarter of door travel when the door typically gets heavy and tends to fall closed. A bolt is adjusted up or down in the kicker slot to increase or decrease the *kick*, respectively.

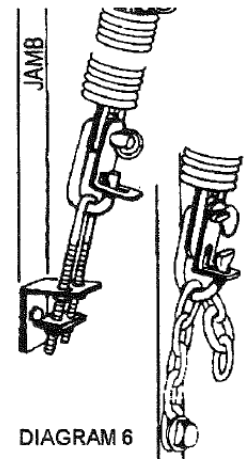


Cantilever Arm Adjustment: Used to adjust the position of the door angle. Two carriage bolts are loosened allowing the length of the arm to be increased or decreased. Adjusting the length of the arm allows the installer to position the door angle against the back of the door for mounting purposes and allows the angle of the door to be adjusted to plumb in the closed position.



Spring Pre-Stretch:

This is the amount of stretch on the spring(s) when the door is in the open position. Springs should typically have between 1 inch and 2 inches of pre-stretch. If the spring is attached to the jamb using chain, adjustment is achieved by moving up or down one link in the chain. If an adjusting bolt is used to attach the spring, adjustment is made by loosening or tightening the nut on the bolt. Refer to Diagram 6.



Adjustment of Garage Door Opener: One should refer to garage door opener manufacturer's installation instructions for attachment to one piece garage doors.

Maintenance

Lubrication: All pivot points should be lubricated monthly following the manufacturer's recommendations.

Door Balance and Spring Adjustment:

Garage doors should be inspected periodically for proper balancing. If the door is electrically operated, the operator should be disconnected per the manufacturer's instructions before testing or adjusting the balance of the door. Springs must be adjusted with the door securely propped in the open position.

- If the door is hard to pull down or goes up too fast in its upper 3/4 of travel, move the kicker up one hole at a time until the door is balanced.
- If the door comes down too fast or is hard to lift up in its upper 3/4 of travel, the kicker must be moved down one hole at a time until the door is balanced.
- In the lower quarter of travel, the kicker can be adjusted as described in the section headed *Adjustment of Hardware and Springs*.

- It is best practice to adjust the springs in the same manner on both sides of the door.

Visual Inspection: The hardware and the door should be inspected regularly for signs of rubbing and binding which can be an indication of damaged hardware or maladjusted hardware.

Repair and Replacement

Spring Replacement: When replacing a broken spring, a minimum of one spring per side should be replaced to maintain even balancing. Springs tend to lose tension after years of operation. It is best practice to replace all springs if they are more than five years old. Refer to manufacturer's instruction for spring replacement instruction.

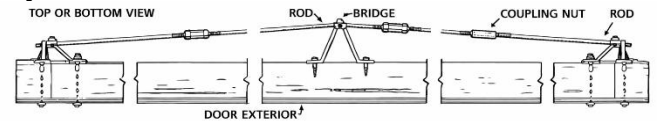
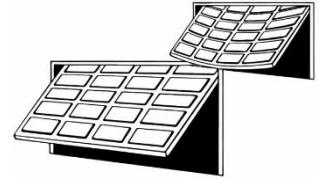
Hardware Replacement: When replacing hardware, it is very important to inspect the jambs for damage such as splits, cracks, termite damage, dry rot, or excessive numbers of drilled holes. The integrity of the jambs is of utmost importance because the weight of the door and the force of the springs are both acting on the lag screws that secure the master plate to the jamb. It is never acceptable to mount a new set of hardware using existing lag screw holes unless at least one of the following is done:

- Plug the existing holes using glue and wooden dowels.
- Drill through the entire jamb and bolt the hardware in place using grade 5 bolts and nuts.
- Add a steel support from the master plate up to the jamb.
- Replace the existing jambs with new jambs.

Refer to Safety Issues, Minimum Specifications for Garage Door Jambs for minimum jamb specifications. Refer to manufacturer's instructions for hardware replacement.

Accessories

Truss Rod Kits: These kits are used for wood garage doors exceeding 10 feet in width to prevent the door from sagging in the open position. Rods are typically mounted to the top and bottom rails of the door. Over an extended period of time, a door may tend to sag, in which case the truss rods may require tightening. Refer to manufacturer's instructions for installation adjustment of truss rods.



Slide Bolt Lock: Designed for locking the garage door with a padlock. Typically, the side bolt is mounted 2 inch to 3 inch from the floor. A slide bolt may be used on each side of the door if desired.

Center Lock: An alternative to a slide bolt lock that is operated from the center of the door can provide locking on both ends of the door. Some center locks can also be operated from the inside of the garage.

Rubber Bumpers: These devices are used to prevent damage to the face of the door as it opens against the header. Bumpers are typically mounted to both ends of the header. Extra decorations on the face of the door must be considered when mounting the rubber bumpers. Bumpers can either be positioned to engage the thickest decorations, or they can be shimmed accordingly so the decorations do not interfere with the header.

Lift Handle: The lift handle is provided for manual operation of the door. Typically, door handles are mounted 18 to 24 inches from the floor.

Weather Strip: A weather strip should be mounted to the bottom and sides of the door to close the air gap around the door. Typically, weather strip mounts to the sides of the door

before the level of the master plate, and mount to the door jambs above the level of the master plate. Refer to the manufacturer's installation instructions.

Section Ten

Service and Operation

Proper service and safe operation of sectional doors are essential to maintaining code compliance, ensuring reliable performance, and protecting building occupants. This chapter provides technicians with practical guidance for repairing and servicing existing doors and outlines required maintenance practices, troubleshooting procedures for both doors and operators, and the electrical considerations involved in servicing these systems. By following these guidelines, technicians can confidently diagnose issues, perform repairs, and keep sectional door systems functioning as intended throughout their service life.

Sectional door service and repair starts with reviewing the proper safety procedures required to complete the job without sustaining personal injury. Service work in the garage door industry exposes the technician to more potential hazards than in many other trades. This is due to the combined components of the equipment involved and the nature of both simple and complex service calls. Springs are charged with a load, and cables carry the tension of the spring and the weight of the door. Open doors constitute a potential falling hazard, and electric operators can malfunction causing entrapment or dangerous electrical conditions. Damaged sections and jammed operators can store a reflex tension that can be released once the opposing force has been removed.

Safety Checklist:

- 1) *Proceed with Caution.* Check all *live* components before attempting to move the door or operator and initiate any repairs. Check torsion and extension springs, cables and cable ends, rollers, operator chain, visually damaged equipment, obstructions, and the operator's power source. Visually assess any potential risks.
- 2) *Careful Planning.* Decide on the safest course of action before coming into contact

with any part of the door or operator. Ask the customer what happened in order to get as much information as possible.

- 3) *Check Troubleshooting Guidelines.* Refer to the manufacturer's suggested solutions for the most common symptoms and then investigate other factors that might be contributing to the problem.
- 4) *Use Your Best Judgment.* Follow a process of elimination to isolate the problem and determine the cause. Separate the door system into its individual segments and inspect each one closely. Take time to think about the possible result of what you are preparing to do. Use common sense.
- 5) *Isolate All Potential Risks.* Take action to prevent possible risks identified. Clamp off a door that may fall, lockout power to a malfunctioning operator, etc. Always disconnect operator power prior to working on a door to prevent unexpected operations.

Customer Relations

Service and repair calls are among the best opportunities to better customer relations and enhance company professionalism. When it comes to repairing a door, you may not consider customer relations to be important to the task at hand, but that couldn't be further from the truth. In many cases, your ability to relate to the customer can lead to additional sales, their willingness to cooperate with moving garage items to make your job easier, etc.

The service person is the best salesperson on the job. Keep your customers happy and you will get more work from this and other customers as well, thus job security and more profits for your company.

Here are a few things to keep in mind when dealing with customers:

- If possible talk to the person in charge prior to doing the job. This will allow you to address any questions or concerns they may have, and ensure that the work you perform addresses the reason for their call.
- Establish the customer's expectations. You don't want to do hundreds of dollars' worth of repairs if the customer only wanted minimal work done. On the other hand, you don't want to do minimal repairs when the customer wants a complete rebuild.
- Show interest in the customer's property. You don't want to take the three hour tour, but a couple of quickly answerable questions and compliments show you are interested in the customer's property.
- Show respect for their property. Ask permission before moving items in the garage. Also work with them to ensure they can access items in the garage if needed. Keep materials and tools picked up and organized and out of the way. Leave the site clean and orderly when your work is done.

Keep in mind that in many cases when you are on a job someone is always watching you and how you conduct yourself, weather you know it or not. This can weigh heavily on whether or not your company is asked to do work for that customer in the future.

Servicing an Existing Sectional Door

Although the information contained in this study guide is intended to cover a wide range of sectional doors, there are times when you will encounter doors that are not familiar to you. These may be doors that are very old or ones that have been modified with various other parts. In those cases, it is important that you follow the original manufacturer's recommendations. If you do not have those recommendations, you will need to contact the manufacturer for this information or ask the building owner if they have a copy of the door

manual on file. If none are available and the manufacturer cannot be contacted, you will need to assess the situation and make one of the following recommendations.

Do not perform service and recommend that a door be replaced, if:

- Servicing the door will result in an unsafe condition.
- The door is damaged or modified and cannot be repaired.
- The door is no longer manufactured, and the required repair parts are not available.
- The door has sustained unreparable damage.

Do not perform service and recommend that the owner obtain service from another qualified entity, if:

- The door is not functioning correctly, and you do not have the information or manuals available to correct the situation.
- You do not feel qualified to service the door properly.

Proceed with service of the door if and only if:

- After reviewing the site, you determine that you have the expertise to proceed with the service call and complete the repair.
- The door is not damaged beyond repair, it only requires routine maintenance, or all repairs can be done using available parts.

Residential Service Calls

Use this foundation of safety consciousness as a guide as you take a closer look at what you might expect to find when you show up at a customer's home in response to a call for service. This section will separate the door into its individual components and list a few of the most common things that can go wrong and then cover some specific techniques for the most typical residential service calls. Always refer to the manufacturer's installation manual for safety warnings and specific instructions.

When servicing a sectional door, begin by discussing with the customer what problems they are experiencing. Inspect the entire door system for the following common conditions:

Cables: Inspect the cables for any abnormalities such as fraying or rust, broken strands, distorted wires, cable ends rusted at the bottom bracket, catching on the door or track, unevenly threaded on the drum, or off the drum and wrapped around the shaft.

Replace both cables even if only one is damaged. This ensures that both cables will stretch evenly and maintain an even wear cycle.

Raise the door and verify the cables pivot freely on the bottom bracket when the bottom section rolls in the radius. Check that the cable is properly secured in the drum. If the cables are in good repair, apply a small amount of lubricant to the cable and the cable attachment at the bottom bracket.

Shaft: Sheared partially or completely through at the bearings or spring(s), twisted or bent, pulled out of the bearing at either end or center coupler.

Pulleys: Noise (lubrication), ball bearings worn or missing, pulley wheel separating, catching on track or sidewall/ceiling obstacle, or wear in the cable groove.

Drums: Verify that the cables are properly wrapped and that the drums do not make contact with the track, header, or end bearing brackets. Inspect for cracks, missing or loose set screws, or abnormal wear.

Bearings: Check the bearings in the end bearing brackets for excessive noise, balls worn or missing, seized with rust, or wobble and misalignment. Look for metal shavings below the bearing or if the shaft is not centered in the bearing. If either condition exists, replace the bearing, and if necessary, the torsion shaft. If the bearings are in good condition, apply grease to both sides of the bearings.

Brackets: Look for loose fasteners, brackets mounted out of plumb, bottom bracket loose, damaged, or rusted. Inspect the center bearing brackets to ensure they are securely fastened and that the spring pads are in good condition with no signs of cracking or screw pullout.

Springs: Prior to checking the balance of the springs, inspect the condition of the spring assembly. Look for broken or distorted coils, fatigued spring wire. Check the spring cones for hairline cracks, broken winding holes or flange, set screws missing, slipping on the shaft, or signs of release from the spring(s).

Open and close the door to observe the shaft, checking for bending or bowing, replacing if necessary. While operating the door, listen for squeaks or grinding noises.

In most applications, when springs are properly balanced the door should remain in place when left in a partially opened position. If the door continues to lower without force, more spring tension is required. Conversely, if the door rises without force, less spring tension is required. When adjusting the spring, maintain the same tension, or number of turns on each spring if the door has more than one spring.

When working with springs, take note of the spring stretch. Spring stretch is the gap between the coils of a wound spring. Too much stretch will cause the spring to lose its shape and snake. Too little stretch will cause the spring to bind. Adjust spring stretch by moving the winding cone out an additional 1/4 inch after the spring is wound. Springs that are correctly stretched will freely move up and down when lifted in the center, and will maintain their original shape throughout the door's cycle. Once the torsion spring assembly is inspected and balanced, lubricate each spring.

Vertical Track: Inspect the vertical track for damage, especially distortion or bending from being hit. Verify that the mounting hardware is securely attached.

Roller stems should turn with a slight amount of resistance. With the door closed, attempt to turn the roller stems. If the roller stems will not turn, the track may be set too tight to the jambs. If the roller stems turn too freely, the track may be set too loose. Readjust as needed.

Run the door by hand inspecting for binding or sticking. If the door is difficult to raise, the track may be too tight to the wall at the bottom, or the spacing may be too tight to the sections causing door binding. Check the spacing is not too wide causing excessive side to side movement or the locks to not engage or roller stems to pull out of the hinges.

If the door catches during travel, it may also be the result of a protruding track bolt, use of the wrong type of bolt in the track, misalignment between the horizontal and vertical track, or contact between the top section and the springs or center bearing brackets.

Horizontal Track: When inspecting the horizontal track, inspect for damage or wear. Verify the back hangs are secure and the drops aren't positioned out of plumb causing the track to twist, the door to bind, or the rollers to pull out of the hinges. Also check the spacing is not set too close or too wide. With the door in the open position, check for proper alignment and spacing to the door.

Track Jamb and Header Brackets: Loose or bent causing binding and erratic door travel. Jamb brackets not adjusted properly causing a gap or door binding at the jambs.

Sections: Inspect the sections for damage, distortion from impact or excessive weight causing binding as door travels through radius. Verify the stiles (if applicable) are properly secured. On insulated sandwich doors, check for separation of the interior and exterior skins, or splitting of the sections. While damaged sections may still operate they could lack structural integrity and should be replaced.

Reinforcing struts or U-bars shifted sideways past the edge of the door catching on track.

Verify the struts are straight and securely fastened.

Inspect the bottom seal for tears or shrinkage, and verify it is securely attached. Inspect glazed section lites for cracks, leaks, or deteriorating seals.

Hinges: Fasteners loose or missing causing door sections to separate and hinges to bend or break. Edge hinges positioned out of order or upside down, creating spaces or binding at the jambs. Roller in wrong tube of graduated edge hinges. Excessive noise (lubrication). Inspect the hinges for any cracks, bends, or damage to the hinge barrel. Check to make sure all the fasteners are in place and tight. If the hinge is ok, apply a small amount of lubricant to the pivot points.

Rollers: Inspect the rollers for bent or rusty stems. Check for freedom of movement in the bearings and for side movement of the stem in the hinge barrel. Replace rollers if necessary. If the rollers are in good condition, lubricate the stem and bearings.

Locks: Lock bars too long, catching on tracks (track spacing might be too narrow). Automatic latching lock cables/chains too slack – unable to turn handle far enough to unlock door. Lock bars or auto latches set too tight (too high) in track strikes making it difficult to disengage the mechanism to unlock door. Not properly disabled or removed when using electric operator.

Outside factors can also interfere with a door's ability to function properly. The main culprit is most often the electric operator that drives the door through its open/close cycle. If it has been mounted too high, it can create a hard start to close the door from the open position and even damage the top section. In this case, you will sometimes find the reversing sensitivity has been over adjusted to compensate for this hard start to a point that will not allow the door to easily reverse if it meets with an obstruction. The solution is to cut longer back hangs and remount the operator where the rail is situated

within two inches above the top section of the door.

Other problems can arise from door stop moldings that are set too tight against the closed door, causing it to bind near the fully closed position. Obstructions within the garage can also get in the way of a door's travel path such as brooms and shovels stored next to the vertical tracks or lumber, ladders, and other items hung from sidewalls and ceilings. Check the entire area around both sides of the vertical and horizontal tracks, above the open door and near the back of the door's upward travel for items that may have shifted and moved into the door's path.

Besides making a thorough investigation of all the door's components, it is also necessary to double check the manufacturer's troubleshooting guidelines and recommendations before beginning any repair work. This will ensure that the warranty has not been violated and minimize your exposure to any unforeseen hazards that might exist. On older doors with hardware and power assembly designs that are outdated and unfamiliar, it is important to take the extra time required to understand how it is designed to operate before attempting to move the door or make any adjustments or alterations.

Warning! If you are not confident about an unusual situation, do not proceed with the service work.

Relocating an Existing Sectional Door

Sectional doors have occasionally been removed from their original installation and then reinstalled on a different opening. The following information is a list of guidelines for consideration before relocating an existing door.

- Verify the door is the appropriate size for the new opening.

- Verify the door can be mounted on the wall construction of the new opening.
- Inspect and consider the condition of the door. Depending on the age of the door, how well it operates, if there is damage to be repaired, wear to the existing components, and other potential issues, it may not be worth moving.
- The door must be reinstalled at the new location per the original installation instructions.
- Consideration must be given to what will happen to the existing opening. If the existing opening is on the exterior of a building, removing the existing door may make the building itself vulnerable to high winds. Building security, accessibility to animals, etc. are also things to consider.
- Consider if the relocated door will satisfy building codes and if documentation exists to demonstrate such. Code changes or specific location requirements, particularly for wind load rated doors, may make the existing door non-compliant in the new location.

In conclusion, it is important to inspect and operate a sectional door before committing to moving it. It may also be necessary to consult with the door manufacturer to obtain any information that cannot be determined by a site inspection and to prove code compliance in the new application.

Service Techniques

Following are a few specific techniques for handling some of the more common types of service calls. Although job

conditions, equipment, and exact techniques tend to vary greatly, the objective is to review the safest and most efficient methods that are widely known and accepted as standard procedures for most overhead doors.

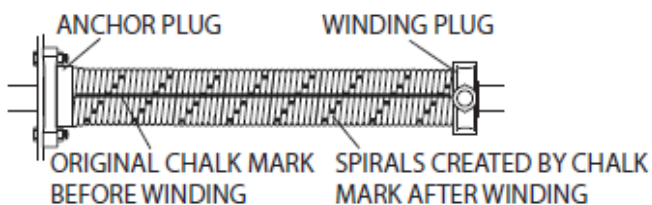


Changing a Torsion Spring

The first step in changing a broken torsion spring is to identify the existing spring's dimensions. Look for a tag or stenciling identifying the spring size. If no information is available, it will be necessary to measure the inside diameter, wire size, and length of the spring in its unwound state. You will need to determine if the spring is right or left wound, and it may also be necessary to note the type of spring ends. See the section on *Measuring a Spring*.

Measure the height and width of the door and the cable drum's diameter. If there are two springs on the door, it is good practice to measure the other spring in case there is any difference in dimensions. It is always recommended that all springs be replaced when one has failed due to the possibility of the unbroken spring failing in a short amount of time. Strongly advise the customer of this option and potential long term savings by not having to return for a second service call.

Determine how many turns are required on the springs. Look for this information indicated on the tag or by counting spirals on the spring. If the spring does not have spirals, draw a chalk line on the wound spring before unwinding so that turns can be counted when unwound. If there's no way to determine the number of spring turns, consult the manufacturer or a spring program.



The next step in replacing a broken torsion spring is to unwind the unbroken spring(s), if applicable, and make sure the full weight of the door is resting completely on the floor with no tension in the cables. To unwind a spring, start by clamping the shaft to prevent it from rotating downward as turns are removed. Insert a winding bar into the lowest accessible hole in the winding cone and hold it near the end.

Warning! The winding bars should be properly sized for the diameter of the winding cone holes and penetrating all the way to the bottom of the winding hole. Winding bars should be 18 to 36 inches in length.

Push up on the winding bar to control the spring tension and loosen the winding cone set screws.

Place the second winding bar in the next hole above it and push up slightly to release the tension off the lower bar so that you can remove it from its winding hole. Slowly lower the upper winding bar and repeat the procedure one quarter turn at a time until the spring is completely unwound.

Some springs are unwound in the opposite direction when they are mounted with the stationary end facing the cable drums, or in low headroom lift applications. In this situation, the cables are usually peeling off the opposite side of the drum, running down the outside edge of the vertical tracks and attached to an outside hookup bottom bracket.

Warning! If you are not sure about which way the spring is wound, do not attempt to unwind the spring.

If there were any problems while measuring the spring(s), it may be necessary to weigh the door in order to calculate the proper replacement spring(s). To field weigh a torsion spring door, position a scale under the center of the door with both springs completely unwound and slack in both cables. Check the door is not binding in the tracks or against the jambs and record the scale's reading.

Next, with all springs unwound, remove the bolts on the end bearing bracket on the broken spring side and slide the bracket off the end of the spring shaft. Loosen the setscrews on the cable drum, pull out the cable end and slide the drum off the shaft. Drape the cable end over the track.

Remove the bolts at the stationary end of the spring where it mounts to the spring anchor bracket at the header. Slide the two sections of broken spring off the end of the shaft. In cases where the shaft has become distorted or gouged from the cable drum and winding cone set screws, it may be necessary to file the damaged area to allow the drum, bearing bracket, and winding cone to slide freely off the end of the shaft.

Slide the new springs onto the shaft. Remount the end bearing bracket and the cable drum in their original positions, connect the cable to the drum, and use locking pliers to secure the shaft to the header to hold equal cable tension on both sides. You may have to adjust the cable length in order for the drums to be positioned exactly the same at both ends of the shaft.

Clamp the door in the closed position and rewind the spring(s) using the procedures described previously in this study guide. Make sure the winding bar is inserted fully into the winding hole before removing the second bar from its winding hole. *Position ladders for greatest stability, position yourself to the outside of the winding cone, and wind along your side, not in line with your body.*

Wind the spring(s) to the required number of turns. Unclamp the door and check its balance through the open/close cycle. Add or remove tension one-quarter turn at a time until the door is reasonably balanced. Make sure the door is operating smoothly and consistently.

Spring Repair Blocks

Spring Repair Blocks are specialized, heavy duty couplers used to provide a temporary, emergency connection between the broken ends of a torsion spring. When a torsion spring breaks, the coil separates into two pieces, preventing the spring from functioning. Spring repair blocks are designed to join the two broken ends so the spring can be re-tensioned and the door can be operated until a permanent replacement spring is installed.

These may be needed if the proper replacement spring is not readily available.



Spring repair blocks are intended strictly as a temporary emergency measure; a spring that has already failed is more likely to break again, and the repair blocks do not restore the original strength or fatigue life of the spring. They are not intended to provide extended regular daily use, and the spring has a high risk of breaking again, possibly in a very small number of cycles.

Spring repair blocks come in various sizes and are color coded to indicate the wire diameters of the springs they are designed to fit. Blue blocks typically fit wire sizes from .207 to .3065 inches, yellow blocks fit wire sizes from .3125 to .3625 inches, and red blocks fit wire sizes from .3750 to .4305 inches. Using the correct size is essential to ensure the block grips the spring securely and does not slip under load.

Before using spring repair blocks, it's important to inspect the spring and spring fittings. The spring cones must still be properly fitted to the ends of the spring with no lifting or distortion from the spring break. The cones must be intact without damage. Spring repair blocks should not be used if the spring break is close to one of the spring cones, or if the spring has broken in more than one place.

To install spring repair blocks, follow the instructions provided by the supplier. Generally, these are installed by inserting the broken spring ends into the block's machined holes and securing with set screws. Two spring repair blocks should be used per broken spring, positioned approximately 180 degrees apart. Once the blocks are in position and tightened, the spring can be rewound to provide limited, temporary emergency operation of the door.

Although spring repair blocks can allow short term operation in an emergency, they introduce significant risks. The repaired spring is still structurally compromised, and the repair block creates a rigid point in the coil that can concentrate stress. If the spring fails again, it may do so suddenly and with little warning. Installers must use these with extreme caution because in some cases the spring may break while attempting to reapply spring turns. For these reasons, spring repair blocks must never be used as a long-term repair and should only be installed by trained technicians who understand the hazards associated with re-tensioning a previously broken spring. The door should be operated minimally until the correct replacement spring is installed.

Changing Extension Springs

Extension springs are mounted in pairs at the rear of the door's horizontal tracks and are stretched forward by means of cables fed through pulleys bolted to the front end of both springs. The upper portion of cable is fed over another pulley at the front of the horizontal tracks and runs down to attach to the door's bottom brackets. The lower portion of cable is attached to one of a series of holes punched into the pulley angle where the spring's tension can be adjusted by moving the cable's S-hook either way along the angle.

The first step in changing a broken extension spring is to identify the existing spring's dimensions. Look for DASHA TDS 171 color coding. If color coding is not present, then the spring must be measured. Measure the outside diameter of the spring body, the total compressed spring length, minus the looped ends, and the wire diameter. You'll also need to measure the width and height and weight of the door.



An extension spring is rated using a three number system – compressed length, stretching capacity, and the door's total weight. For example, the springs for a 9x7 wood door weighing 150 pounds would be referred to as a 27-42-150. In other words, this particular spring is 27 inches long in its compressed state, is able to increase in length (stretch) by 42 inches, and will lift half a door's weight rated at 150 pounds. You would need a pair of 27-42-150 springs to properly balance the door.

Extension springs can vary widely in outside diameter and spring size, but you only need to be concerned with the most critical factors of spring length, stretch, and total door weight. Measuring the door's unbroken spring may help you get a more accurate figure for the closest available replacement. However, spring measurements are not required if you are able to accurately measure the door size and weight.

To weigh a double-wide (two car) extension spring door, position a counterbalance and bathroom scale under the center of the door. Attach a come-along on the live spring side of the door to relieve the spring's tension from the cable. Make sure the door is free in the tracks and not binding on the jambs and take your reading as in the method described previously for weighing a torsion spring door. In smaller doors, it may be easier to lift and clamp the door, then to lower it onto the counterbalance arm to get the weight.

The next step in replacing a broken extension spring is to lift the door into the open position. Hold it in place using locking pliers clamped to the track's radius under the bottom rollers on the broken spring side of the door. Clamp off the other side of the door in the same way with another pair of locking pliers to keep the door evenly positioned and to secure the door for replacing the unbroken spring also. Both springs should be replaced at the same time to allow even operation of the door with new, equally rated replacements.

Remove the cable from the S-hook assembly and unthread it back through the pulley.

Remove the spring from where it is mounted at the rear of the horizontal tracks. Inspect the existing pulley for wear in the cable groove or excess play in the bearing and replace if necessary. Attach the new spring and thread the cable over the top and around the bottom of the pulley. Stretch the spring forward slightly and reattach to the pulley angle. When both springs have been replaced, remove the locking pliers and check the door's operation for balance and even travel at both sides through the open and close cycle.

Warning! Restraint cables must be installed through each spring and secured near the front and at the back of both the horizontal tracks.

Resetting and Changing Cables

When resetting loose cables back into the cable drum grooves on a torsion spring door, it is necessary to first remove enough spring tension to get sufficient slack in the cable to work. If the door is closed, one quick way to get cable slack is to backwind the spring slightly. You can accomplish this by backwinding the entire spring assembly one quarter turn with a winding bar.

Warning! Backwinding more than one spring using a single winding cone can exceed the torque rating of the cone causing cone failure. When resetting or replacing cables on a torsion spring door, the best approach is to remove the spring tension by completely unwinding all springs, or using a backwinding tool designed for this situation.

Check to see that the cable is secured to the drum and refit the cable loops into the grooves one at a time. Slowly turn the locking pliers or winding bar until the cables are once again under full spring tension. Also, make sure that both cables have equal tension and that both drums are positioned exactly the same before attempting to operate the door.

On extension spring doors, you will have to open the door all the way and clamp off under the bottom rollers whether you are rethreading

jumped cables or replacing broken ones. When replacing broken cables on torsion spring doors, unwind the springs and loosen the lag screws on the bottom track brackets so that you can get at the edge of the bottom bracket on the door where the cable attaches. In some cases, you may need to totally remove the bottom bracket in order to get at the connecting pin.

Warning! When replacing broken cables, always use at least the same diameter and construction as the original cables. Do not modify the cable attachments in any way. Always use the manufacturer's prescribed method and hardware.

When making up new door cables from raw cable lengths, you will need to make new looped and fixed ends. Specially designed aluminum sleeves, or ovals (double holes for making loops) and round fittings (single hole for ends attaching to cable drums) are compressed with a swaging tool that forces the aluminum into the strands of the cable. For maximum holding strength under full spring tension, it is critical to swage fittings properly.

Fittings are made to match cable diameters and should be compressed in two places when using sleeve for looped ends and once when making fixed ends. Swaging tools have multiple sets of compressing *teeth* that allow for accurate compression of small, medium, and large fittings. Apply enough pressure to secure the fitting to the cable without too much distortion that will only cause the cable to fail under pressure. Practice on a small section of scrap cable until you are capable of making a properly swaged cable fixture before making one for use under spring tension.

Some torsion spring doors use a metal or nylon teardrop shaped insert in the looped end of the cable to protect the strands from wearing through. This is used on some residential and most commercial doors because of the more direct pressure from the spring's tension at the bottom bracket. Always install a new teardrop in the looped ends of replacement cables for these heavier doors.

Changing and Reinstalling Rollers

Changing worn rollers on graduated end hinges starts by locking or securing the door in the down position. Remove the hinge holding the worn roller and remove the roller. Slide the new roller into the track and refasten the hinge.

Warning! When several rollers have come out of the track on a door that is in the open position, first secure the door from falling.

Replacing Track

When vertical tracks have been hit and bent, they can either be straightened right on the wall, or with a track anvil when removed and laid on the floor. If the track is damaged beyond repair, it should be replaced with a completely new, full length piece. Splicing in shorter pieces is possible, but not recommended because it weakens the track and can cause roller wear.

To replace the vertical track, first close and lock or clamp the door. Unplug the operator, but leave it connected to the door. Drive a nail or screw inside the track and over the edge of each section to hold the side of the door against the opening when the old track is being removed and the new one inserted. Mark the sides of the jamb brackets with a pencil at the front edge of the track. Remove all track bolts from the jamb brackets starting at the bottom and carefully twist out the damaged track from between the rollers and jamb brackets.

Cut a new piece of track to fit and slide it into place. Line up the front edge with your pencil marks and hold it in place with clamps for drilling out the new piece for the track bolts if required. Realign the track splice where the new piece meets the radius of the horizontal track, and secure all fasteners. Remove the nails or screws holding the sections, unlock/unclamp the door, and slowly open the door.

Replacing Sections

Replacing sections can be the most confusing type of service call for the new repair personnel and installers. This is because they sometimes think they need to completely disassemble the door in order to switch out the damaged section(s). The only real obstacle is getting around the spring tension which is accomplished in different ways depending on whether it is a torsion or extension spring door and which section is being replaced.

To change the bottom section on a torsion spring door, first raise it off the floor a couple of inches. Hold the upper sections in place with locking pliers clamped to the vertical tracks above and below the #2 hinge and roller on both sides of the door. Next, remove all the fasteners from the bottom half of the hinge leaves on the bottom section. Place one pair of locking pliers on one side of the track to prevent the bottom section from falling in toward the garage. Begin to slowly backwind the springs or spring shaft as described previously to lower the bottom section to the floor.

Slowly lower the bottom section to the floor. Continue backwinding until there is enough slack in the cables to safely remove the bottom brackets. You may have to loosen the bottom jamb brackets of the track to get enough sideroom for removing the section.

Flip the hinge leaves up and swing the bottom section out of the tracks. Transfer hardware to the new section and reverse the procedure for installing the replacement section.

You can use this same technique to replace all the sections in a torsion spring door, except the top section which can be easily removed by clamping off and removing hinge fasteners and the top corner brackets.

On extension spring doors, you can use a similar method for all but the bottom section. Instead of backwinding the door to the floor, you can clamp a pair of locking pliers above the rollers on the section below the one to be

changed. In this situation, the door would have to be resting completely on the floor.

To replace the bottom section on an extension spring door, you can use a pair of come-alongs on the pulley brackets in order to take the tension off the cables.

A much simpler method is to:

- 1) Raise the door to the open position.
- 2) Clamp under the bottom rollers to prevent the door from falling.
- 3) Remove the cables from the bottom brackets to disconnect the springs.
- 4) Lower door to the floor.
- 5) From there, you can easily remove the top three or four sections to reach the bottom section for replacement.

On doublewide doors with extension springs, you will either have to use the come-along method or get someone to help you lower the door to the floor once the cables have been removed.

Warning! If you have never attempted this procedure or used this type of equipment, do not attempt the section replacement.

Measuring Springs

Throughout the course of installing and/or servicing sectional doors, the technician will encounter situations where it is necessary to measure springs. This may be to confirm spring sizes while investigating balance issues with a new installation, or to determine the appropriate replacement for a broken spring service call. The following section outlines a number of common practices used for measuring springs.

Wire Size

The diameter of the spring wire is one of the most critical measurements of a spring. It is important to measure this accurately as very small differences in wire diameter can have a

considerable impact on the spring tension produced. Wire size can be difficult to measure because the spring wire deforms slightly when coiled into a spring. There are a number of methods and tools available to aid in accurately determining the diameter of the spring wire.

The first, and perhaps most convenient method, is if the springs utilize color coding per DASMA TDS 171.



Official Color Codes for Torsion and Extension Springs

| Torsion Springs For Sectional Doors | | |
|-------------------------------------|------------|-------------------------|
| WIRE DIAMETER ENGLISH | COLOR | WIRE DIAMETER METRIC |
| .1200" | Orange | 3.05 (11817) |
| .1240" | Light Blue | 3.20 (12697) |
| .1330" | Yellow | 3.40 (13397) |
| .1370" | White | |
| .1430" | Red | 3.65 (14177) |
| .1460" | Brown | 3.80 (14967) |
| .1480" | Tan | 4.00 (15757) |
| .1520" | Green | 4.20 (16547) |
| .1700" | Gold | 4.40 (17337) |
| .1875" | Blue | 4.60 (18127) |
| .1920" | Orange | 4.80 (18917) |
| .2000" | Light Blue | 5.00 (19707) |
| .2070" | Yellow | 5.25 (20677) |
| .2187" | White | 5.50 (21647) |
| .2253" | Red | 5.75 (22617) |
| .2253" | Blue | 6.00 (23587) |

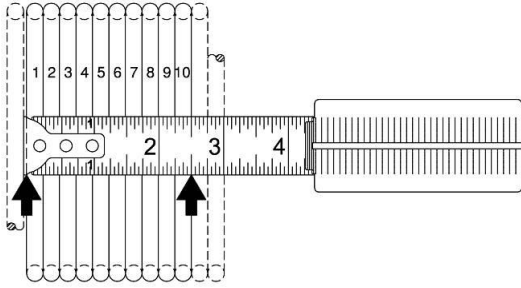
A label or splash of paint will be applied to the spring indicating the size of the spring wire. These color codes are used by most spring manufacturers, but one must use caution when dealing with very old springs as the color codes had different meanings prior to publication of the DASMA TDS. Some of the most common color codes for sectional door torsion springs are:

| Size | Color | Size | Color |
|--------|--------|--------|-------|
| 0.192 | Orange | 0.234 | Brown |
| 0.207 | Yellow | 0.2437 | Green |
| 0.2187 | White | 0.250 | Gold |
| 0.2253 | Red | 0.2625 | Blue |

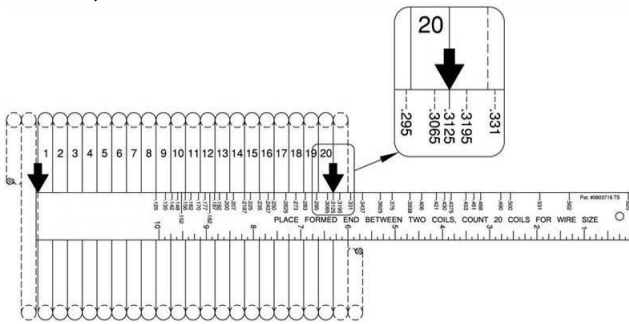
Another method of determining the spring wire size is to measure the length of 10 coils. Place the end of a tape measure between two coils and determine the length of 10 coils. Then divide this measurement by 10 to determine the size of one coil.

For example, if 10 coils measures 2.5 inches, then the wire diameter is 0.25 inches. This

method can be used with more coils for a more accurate result.



Similar to the 10 coil measurement is the use of a 20 coil ruler. This special ruler converts the length of 20 coils to a spring wire size for you. Simply place the ruler between two coils, count 20 coils, and read the wire size off the ruler.



Another tool available for measuring wire diameter is a spring wire gauge. This tool has a series of teeth cut into small metal plates. The teeth can be V shaped or curved and the pitch of the teeth is sized to match each spring wire diameter. By trial and error, each gauge is placed on the body of the spring until one is found where the teeth fit uniformly into the grooves of all of the coils. The spring wire diameter will be indicated on the matching gauge.



Important Note: Make sure there are no gaps between the coils when using multiple coils to aid in determining the spring wire diameter.

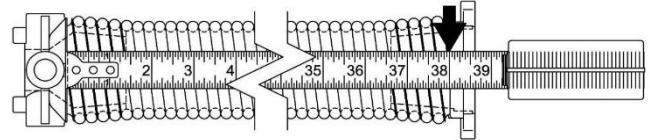
Spring Length

Length is another measurement required to determine the size of a spring. Torsion spring designs are fairly forgiving of variations in

spring length. A good measurement tolerance to target is $\pm 1/2$ inch.

It is important to remember to account for spring growth when attempting to measure spring length. A spring will grow in length by one coil for each turn applied. It is best to measure spring length when the spring is unwound because of this. If the spring cannot be unwound, then you must subtract the wire diameter times the number of turns from the length of the tensioned spring to determine the unwound spring length.

The simplest method of measuring spring length is to stretch a tape measure from one end to another. There must be no gaps between the coils, and the spring must be straight and without sag. If the spring is broken, the length of each half can be measured and added together.



Another method exists in which the total number of coils are counted and multiplied by the diameter of the wire. While this method can provide more accurate results if the wire diameter is determined accurately, it is rarely used in the field because it can be difficult and time consuming to count the coils and torsion spring length does not require this level of accuracy.

Inside Diameter

An experienced installer will become accustomed to the standard spring inside diameters used by different door manufacturers and recognize them based on appearance. However, it may be necessary to measure a spring's diameter from time to time when non-standard sizes are encountered or verification is necessary. Measuring the inside diameter directly can be difficult in some cases as the spring cones, door shaft, etc. may interfere with taking the measurement.

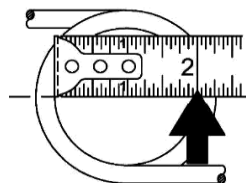
One simple, and often overlooked, method of determining the inside diameter of a spring is to look for spring cone marking indicating the size. Many spring cones used today have pattern marks indicating the cone manufacturer, spring size, and/or the code used by the cone manufacturer to identify the spring size. Inspect both the winding and stationary cones for these codes and check with the manufacturer for spring size guidance. See the picture for an example of the cone markings on a standard 2-5/8 inch ID stationary spring cone which can be utilized to determine the ID of the spring.



When it is necessary to measure the inside diameter of a spring, calipers or a tape measure can be used if there is access to the end of the spring coils. Measure the largest distance from the inside of one side of the spring coil to the other.



If the end of the spring is not accessible because of the spring cones or the torsion shaft, it is possible to determine the inside diameter of the spring by measuring the outside diameter of the coils. To do this, measure the outside diameter and subtract 2 times the wire diameter.



Important! The diameter of a spring decreases when a spring is wound. All measurements of inside and outside coil diameter must be taken with all spring turns removed.

Determining the Hand of a Spring

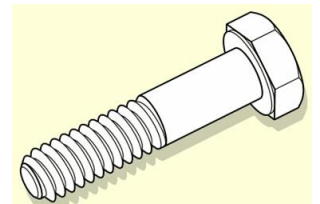
Another important feature of a spring which must be verified from time to time is the direction the spring coils are wound. The spring wire can be wound in two different directions, termed *left wound* and *right wound*. Attempting to use the wrong hand of spring for a particular application can result in performance issues and lead to premature spring failure.



The spring cones may be color coded indicating the hand of the spring. A red color coded spring cone is used on a right wound spring and is typically installed on the left side of a door. Similarly, a black color coded cone is used on a left wound spring which is typically installed on the right side of a door. Use caution when relying on the color code to identify the hand of a spring as many cones utilize universal threads and it's possible to manufacture springs with incorrectly colored cones.

Determining the hand of a spring can be difficult to explain and even more difficult to comprehend. Because of this, it's common to explain several different methods of determining the hand of a spring and allowing each person to select the method which makes the most sense to them. Regardless of which method is used, an installer should be able to effortlessly determine the hand of a spring on a regular basis.

Method #1: Compare the spring coils to the threads on a bolt. A right wound spring will screw clockwise into the ground just like a right hand threaded bolt.



Method #2: Look at the end of the spring with the end of the coil at the bottom. If the wire points to the right (counterclockwise), then you have a right wound spring. If the wire points to the left (clockwise), then you have a left wound spring. See picture for an example of a left wound spring.



Method #3: Use your left index finger and lay it over the end coil of the spring. If the end of the spring starts at the tip of your left index finger and wraps towards your palm, this is a left wound spring. Conversely, a right wound spring would start at the tip of your right index finger and wrap towards your right palm. See picture for an example of a left wound spring.



Method #4: Hold the spring in your hand with your fingers placed around the outside of the body and your thumb pointing straight up. Similar to method number 3, if the last coil ends in the same direction that your fingers are pointing, then the hand holding the spring is the direction of wind of the spring.



There are various other methods installers have used for visualizing how to determine the hand of a spring. It is not necessary for an installer to know and understand each and every one of these different methods. It is only necessary for the installer to select one method that enables them to look at a spring and assess the direction of wind quickly and reliably.

Safe Operation of Sectional Doors

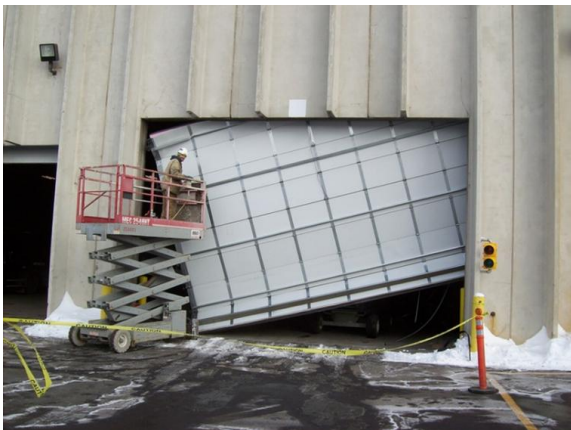
Sectional doors are large, heavy, moving assemblies. When operated safely and correctly, potential hazards can be mitigated. It is essential for professional technicians to understand safe operation of these doors, not only to follow these procedures on the job site, but also to properly educate end users. The following guidelines outline key practices for the safe operation of sectional doors. While some may seem like common sense, they should never be overlooked or taken for granted, as each plays an important role in preventing injury and ensuring safe, reliable operation.

- Visually inspect the door for damage or defective components before and during each operation.
- Release all locking devices prior to operating the door. Attempting to operate a door while locks are engaged can cause damage to the lock and/or operating mechanisms.
- Only operate the door when it is in full view. User intervention can be much more effective in avoiding dangerous situations than relying upon any safety accessories the door may have.
- Operate the door only when it is properly adjusted and free of all obstructions.
- Always operate doors with smooth, controlled movements. Jerking the hand chain, slamming doors open or closed, and rapid start/stop operator movements can cause damage and wear to the door and operator components.
- For manually operated doors, lift the door using lift handles or other suitable gripping points only to avoid potential pinch points.
- Never walk away from a closing door until it has safely reached the closed position. The door should be observed for the duration of its movement to ensure safe closing.
- Do not walk or drive under a moving door regardless of whether it is closing or opening.
- Keep people clear of the opening while the door is moving.

- Do not operate a door that is jammed, has a broken spring, or is damaged in any other way. Attempting to operate a damaged door could result in additional damage or injuries.
- Avoid stopping the door at locations other than fully open and fully closed.
- Secure all operator controls to prevent use by unauthorized personnel.
- Keep controls away from children. Do not allow children to play with, on, or around the door or operator.
- Do not pull electric operator hand chain or release during operation.
- Never disconnect the door from the operator in the open position. An underbalanced or otherwise damaged door could free fall causing injury or damage.
- Keep hands and other body parts away from a moving door.
- Should the door become difficult to operate or completely inoperable, a trained sectional door systems technician should perform immediate repairs.
- Follow proper lockout/tagout procedures to secure a malfunctioning or damaged door from operation until repaired to prevent safety risks to others.

Common Commercial Service Calls

The following sections illustrate some common troubleshooting and maintenance techniques for commercial sectional doors. These are not intended as actual procedural instructions, but rather as general practice guidelines with which a professional installer should be familiar.



Changing Cables

Raise the door 3 to 4 inches off the ground and secure into place with locking pliers, clamps, and/or support jacks.

Remove all tension from the springs noting how many turns were applied.

Remove cables from the drums taking note of how many wraps were on the drum.

Remove the cable from the bottom bracket. This may require removal of the bottom bracket.

Using one of the old cables to determine the proper length for the new cables and obtain new cables to match.

Install the new cables onto the bottom brackets and reinstall the bottom brackets onto the door.

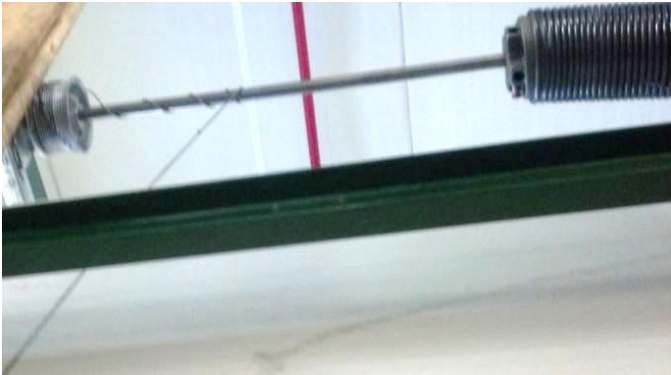


Route the cable up the vertical track behind the rollers and temporarily secure the ends near the cable drums.

Starting on the left side, attach the cable to the drum and rotate the drum until the cable is tight. If single shaft, repeat for the right side and secure the shaft into place with locking pliers. If a split shaft is supplied, follow the same procedure for the right side and lock into place with locking pliers. Make sure the door is level and place a pair of locking pliers above one roller on each side of the door to prevent it from rising once the springs are wound.

Apply tension to the springs and check the door for level and balance. If level and balance are ok, remove locking pliers and check operation one final time.

Cable Off One Side / Door Closed and Out of Level



If the door has more than one spring, relieve the tension from all but one of the springs. Using the winding cone of the remaining wound spring, backwind the spring shaft until the high side of the door is level with the low side, the door is in the fully closed position, and there is slack in the cable that has remained on the drum.

Warning! Never attempt to backwind the shaft using one winding cone to backwind more than one spring. This can overload the cone causing the cone to crack or break and can cause serious injury.

Secure the cable that remains on the drum in order to keep it in place. Inspect the cables for damage and replace if necessary. Reposition the cable that was off to properly wrap onto the cable drum and return spring tension to the cables.

Verify both cables are pre-wrapped the same amount on both drums and have equal tension. Reapply spring turns to any unwound springs. Carefully remove all clamps and check the door for level and balance.

Cable Off with Door Open

When the door is open all or part of the way, variables for reinstalling cables change dramatically. When dealing with this situation extreme caution must be taken.

The best action to take is to try to lower the door safety to the fully closed position. This will allow access to the spring line without dislodging the door and creating a hazard.

In a situation where the door cannot be closed, first secure the door with clamps, ropes, cable pullers, or a forklift if available.

With the door open, chances are, access to the existing winding cones will be blocked. In this event, install a backwinding tool on the end of the shaft outside the end bearing bracket, allowing the installer to backwind the springs as needed.



Warning! Using a single winding cone to backwind more than one spring can overload the winding cone, resulting in cone failure and risk of severe injury. Always use a properly rated backwinding tool when backwinding more than one spring.

Level the door while taking caution to ensure the rollers do not fall out of the horizontal track. If the door has one cable on, measure from the low side (the side with the cable off) to the ground and set a pair of locking pliers on the other track at the same point. Remove the clamps from below the high side roller so the door can travel down to the locking pliers installed at the level point.

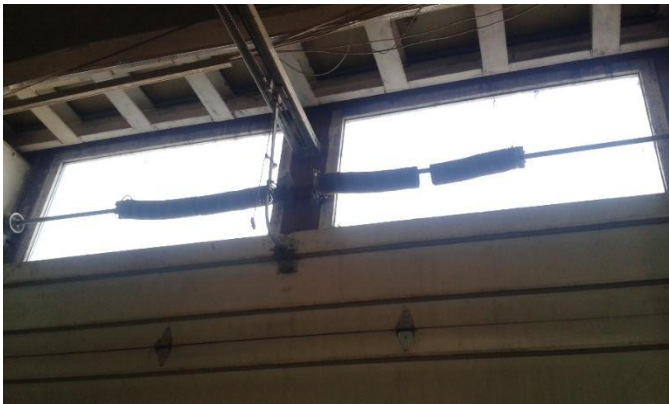
Backwind the spring(s) to allow the door to come to rest level on the locking pliers and allowing slack in the cable that is still on the drum. Secure the cable that is still on the drum to keep it from falling off.

With the door resting on the level clamps, reset the cable that has come off the drum while making sure to match the number of winds of cable with the other drum.

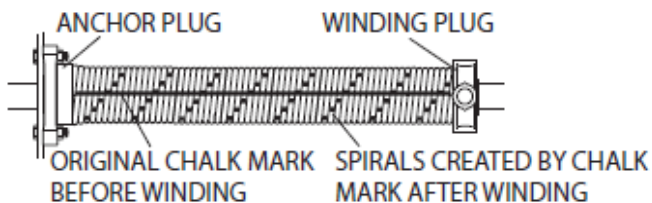
Place locking pliers above the bottom rollers to prevent the door from rising, and reapply original spring tension.

At this point, the door should be level, with the cables under proper tension with locking pliers below and above rollers on both sides. Leave the locking pliers above the bottom rollers. These will work as a stop should the door have too much tension. Now that the cables are reinstalled, lower the door until it rests on the floor. Check both cables and replace if damaged or frayed. Remove the locking pliers and check for proper operation of the door.

Servicing and Replacing Springs



When replacing torsion springs, it is first necessary to determine the number of turns on the existing springs. Look for turns indicated on the spring tag or by counting spirals on the springs. If the springs do not have spirals, draw a chalk line on the wound spring before unwinding to count turns when unwound.



Unwind the tension on all springs and verify the spring sizes. Determine the size of springs needed from the spring tag information, or by measuring the springs. Once the springs are unwound, remove the cables from the drums and loosen the drum set screws.

Unbolt the springs from the center bearing brackets. Depending on the type of brackets used, it may be necessary to place clamps on the center bearing brackets to secure the shaft to the center bearing brackets and prevent the shaft from falling. When working on a two-

piece solid shaft, unbolt the center coupler. This will allow the shaft assembly to be removed in two pieces.

The next step is to remove the torsion shaft assembly and place it on the ground. Torsion springs will vary dramatically in size and weight. If the torsion assembly is large, you may need to secure the torsion assembly using ropes or cable hoists. Large or tall doors may require the use of lifting equipment.

Slide the shaft left or right until it clears the end bearing bracket. Supporting the middle and taping on the outside of the end bearing bracket will help a stubborn shaft slide easier. It may be necessary to unbolt the end bearing brackets and/or center bearing brackets and remove them with the shaft assembly.

Remove the clamps or unbolt the center bearing bracket(s) and pull the shaft and springs out and slide the shaft to clear the other spring assembly. Depending on door size, more than one person may be needed.

While changing springs, take the opportunity to inspect the bearings and shaft for wear or damage. Replace the bearings if necessary.

Installation is essentially the reverse of the removal. Follow the procedures covered previously. Reinstall the shaft, springs, and brackets on the door. Reset the cables and drums and rewind the springs. Verify operation and balance of the door.

Snaking Springs

Snaking is a term used to describe when the body of a spring has become twisted or otherwise deformed. This occurs when a wound spring is stretched further than it is supposed to be. Any spring can be made to snake by stretching it too far.



Larger ID springs can have a tendency to snake on their own during winding because of spring sag. Duplex springs can have a tendency to snake on their own due to the difference in spring growth between the inner and outer springs as turns are applied. In both cases, the installer must control this spring growth and push the spring back into itself while winding. One common, simple method of controlling spring growth is to use vice grips on the shaft to prevent the spring from growing too far during winding.

Movement of the spring shaft after installation can cause a spring that wasn't snaking at original install to begin snaking. The cable drums need to be tight against the end brackets on both sides of the door and tight to the shaft to prevent the shaft from moving side to side. Shaft collars can be used on the shaft at the end brackets and/or center brackets in installations where shaft movement persists.

Another common cause of spring snaking is an inadequately mounted center bearing bracket. If the bracket is installed on a surface that is not rigid enough, it can flex when spring tension is applied. Any flex in the bracket effectively adds stretch to the spring, and can shift the body of the spring out of alignment, both of which can contribute to snaking. The mounting surface for the spring anchor center bearing brackets must be strong enough to hold the brackets rigidly and prevent flex under load.

Replacing Sections

Section replacement will vary according to door size and which section is being replaced. Similar to that covered previously, below are examples of the procedures for replacing sections on a 12 foot by 12 foot standard lift commercial door.

Bottom Three Sections:

Raise the door approximately 3 inches off the ground. Place clamps under the rollers at the top of the #4 section. Remove the hinge screws from the bottom leaves of the hinges between the #3 and #4 sections. Backwind the springs to lower the bottom 3 sections to the ground and secure. Unwind the springs. Remove the sections and transfer the hardware to the new sections.



Install the new sections in the tracks similar to a new install. Attach the cables, route them up to the cable drums, and wind the springs. When the last spring is wound and secured to the shaft, use the winding bars to control the springs and slowly raise the lower sections until they mate with the upper sections and clamp in place. Reinstall the hinge screws, remove the clamps, and check the door balance.

Top Three Sections: Unwind all springs. Remove the upper sections from the door. Transfer hardware onto the new sections. Stack the new sections on the door and assemble the hardware as normal. Rewind the springs and check the balance of the door.

Changing Intermediate Sections: To change intermediate sections, use one of the two procedures previously discussed, depending on the position of the sections to be replaced, and installer preference.

Working On a Door That Has Been Hit

One common service call is from doors that have been struck by motor vehicles or equipment. This can result in anything from minor section damage to complete dislodging of the door. In this example the door is a 12 foot by 12 foot door that is halfway open.



The bottom rollers are out of the tracks, and both cables have come off the drums. The door is operated by a jackshaft operator.

Assess the damage before attempting the repair. Take time to evaluate the situation and identify any hazards that may exist. Also make sure the work area is clear and safe. Develop a pre-job safety check list before proceeding.

Control the door! Make sure the power to the operator is locked out and tagged out. Mark off the work area with caution tape. Put locking pliers or clamps above and below the rollers on each side of the door to prevent it from moving. When both cables come off, some or all of the spring tension can unwind. The operator will sometimes hold the spring tension, but this should not be relied upon for safety reasons. The chain or brake could malfunction, causing serious injury or unnecessary additional damage to the door.

If there is access to the counterbalance assembly, the springs can be unwound after the door has been securely clamped. If there is no safe access to the counterbalance assembly, a cable puller and hoist or a backwinding tool can be used to control the spring tension. Attach the cable puller and hoist to the cables. Then remove clamps and carefully apply pressure to slowly lower the damaged sections. Install all rollers and release the hoist.

Inspect the track for damage and replace if necessary. In the event of an emergency service need, bent track can be temporarily straightened and used until new track can be installed.

Resetting the door - with the door back in the track and safely closed, repairs can begin. Inspect the bottom brackets and rollers for damage and replace if required. If the sections are sufficiently damaged so that both bottom rollers cannot be reinstalled it may be necessary to replace them. Once the sections are back in place, inspect for any structural damage. It may be necessary to install struts to reinforce the section. Inspect the cables and replace them if necessary.

Make any necessary spring adjustments. Manually operate the door, inspecting the balance throughout the travel, to ensure the door is safe and level.

Reattach the operator to the door and verify/set the limits.

Maintenance and Troubleshooting

The following sections illustrate some common maintenance and troubleshooting techniques for doors and operators. These are not intended as actual procedural instructions, but as a template for general practices with which a professional technician should be familiar. Many operators include electronic error codes to aid in troubleshooting problems.

Do not lubricate a motor. Motor bearings are rated for continuous operation. Do not lubricate a clutch or V-Belt. Inspect and service whenever a malfunction is observed or suspected. Always disconnect operator from power source before servicing.

WARNING! Never adjust the operator's clutch to compensate for an improperly balanced or damaged door. Repair all door defects prior to adjusting operator settings.

Door and Operator Maintenance Schedule

Check at intervals listed in the following chart:

| Item | Procedure | Monthly | Every 3 Months | Every 6 Months | Every 12 Months |
|----------------------------------|---|---------|----------------|----------------|-----------------|
| Drive Chain | Check for excessive slack. Adjust as required. Lubricate. | | X | | |
| Sprockets | Check set screw tightness | | X | | |
| Spring Counterbalance | Release operator and check for proper balance | | X | | |
| Clutch | Check and adjust as required | | | X | |
| Belt | Check condition and tension | | | X | |
| Fasteners | Check and tighten as required | | | X | |
| Manual Disconnect | Check and Operate | | | X | |
| Bearings and Shafts | Check for wear and lubricate | | X | | |
| Door | Inspect for wear and damage | | | | X |
| Operator | Inspect for unusual noises | | | | X |
| Operator | Inspect for evidence of corrosion | | | | X |
| Photo Eye/Sensing Edge Operation | Verify proper operation | X | | | |

Troubleshooting Sectional Doors

The chart below is a list of possible problems with the operation of a door. The causes listed are the most common, and are not meant to include all possibilities. With the variety of product and field conditions, other factors may be involved. If assistance beyond this troubleshooting chart is needed, please contact the supplier.

| TROUBLE | POSSIBLE CAUSE | REMEDY |
|---|--|---|
| Door is difficult to open; closes easily | Insufficient spring tension | Increase spring tension |
| Door is difficult to close; raises easily | Too much spring tension | Decrease spring tension |
| Door jumps up from floor | Too much spring tension Cable length too long | Decrease spring tension Check length and replace if incorrect |
| Door won't stay open | Insufficient spring tension Horizontal tracks pitched incorrectly | Increase spring tension Adjust pitch of horizontal tracks |
| Door does not contact the floor on one side | Unequal length or worn cables Uneven floor | Adjust cable drums to equal cable tension or replace cables Adjust bottom seal |
| Door tracks to one side when opened or doesn't travel level | Unequal cable lengths Horizontal tracks unequally pitched | Adjust cable drums to equal cable tension Adjust pitch of horizontal tracks |
| Door is jammed | Broken spring Cable broken or off drum Track is bent | Check and repair |
| Door only opens part way then locks up | Spring wound backwards | Verify proper hand and winding direction of spring(s) |
| Noisy hinges or rollers | Insufficient lubrication | Apply lubricant or replace if worn |
| Spring is snaking | Too much stretch | Reduce spring stretch |

Troubleshooting Operators

In addition to troubleshooting issues with the door itself, it may also be necessary to diagnose problems with electric operation. Operators are tested and adjusted at the factory before shipping, so when problems occur, they often arise after installation, particularly once external devices have been connected. If problems appear after adding external controls or accessories, the fault is frequently found in the external devices or in the wiring leading to them.

Verify all external wiring, ensuring that no conductors are pinched or damaged and that no external voltage is being introduced into the control circuit. The operator is designed to function only with dry contacts; all voltages required for proper operation are supplied by the operator's internal transformer.

The following troubleshooting guide will help identify the source of some common problems based on the symptoms observed:

| Symptom | Possible Cause | Suggested Action |
|--|--|---|
| Door will not respond to open or close push buttons. | Motor overload thermal protection has tripped. | Reset overload protection: press reset button or wait for operator to cool and reset. Is the door unbalanced? Is a larger operator needed? |
| | Circuit breaker tripped | Reset circuit breaker |
| | Fuse is blown | Replace/reset fuse. If fuse keeps blowing: Disconnect all external devices. Leave power terminals connected. (Remove power to terminals). Run operator artificially using jumpers and shorting out appropriate terminals as indicated in the startup and testing guide. Reconnect external devices one by one until you find one causing short to ground. Use an ohmmeter to check all incoming wires for continuity to ground. Meter should read infinity in all instances. If there is continuity between any control circuit wire and ground, this indicates a leak to ground and why the fuse blows when power is applied. In some cases, the trouble is intermittent, i.e., the fuse only blows at certain times. This problem is difficult to detect, but again, disconnect all wires going to external devices and run the operator. If the fuse does not blow, this indicates the trouble lies in the external devices. |
| | Transformer defective | Replace |
| | Defective Stop button | Replace |
| | Loose connection in one of the pushbuttons | Verify, tighten, or replace |
| | Defective open or close pushbutton | Replace |
| | Door will not respond to open command, but will respond to close command. | Defective Open pushbutton |
| Defective Open Limit Switch | | Replace |
| Loose wire on open pushbutton, open limit switch, or coil of open contactor. Bad open relay. | | Verify, tighten, or replace |
| Door will not respond to close command but will respond to open command. | Defective close button | Replace |
| | Defective close limit switch | Adjust |
| | Loose wire on close pushbutton, close limit switch, or coil of close contactor. Bad close relay. | Verify, tighten, or replace |
| | Entrapment protection fault | Verify and replace |
| Door moves in wrong direction with a three-phase motor. | Incorrect phasing | Interchange any two power leads |
| Door closes by itself and operator does not shut off at the end of closing travel. | Close contactor is defective | Verify and replace |

| | | |
|---|--|---|
| Door opens by itself and operator does not shut off at end of opening travel. | Close limit switch defective | Verify and replace |
| | Open contactor is defective | Verify and replace |
| Door coasts when stopped at any position. | Brake pad is worn out or requires adjustment | Replace or adjust |
| Sensing edge does not reverse door. | Pneumatic hose broken, electrical wiring not connected | Replace or reconnect |
| When door closes it reverses to fully open after it hits the floor. | Advanced close limit switch defective | Replace |
| | Advanced close limit switch not being engaged by traveling cam. | Advanced close limit switch needs adjusted slightly ahead of close limit switch. |
| | A close command is being given | Check close push button or any closing device for short circuit. |
| Radio control does not function or hesitates for 10 seconds before working. | It is normal for a radio receiver to take up to 10 seconds before being fully operational. | Check transmitter and receiver are programmed. Press transmitter and verify receiver reaction. Transmitter battery may be dead or receiver may need service. To test radio control function, momentarily short out terminals on operator. It should function normally. Receiver relay may be defective. |
| Motor hums, starts when spun | Capacitor defective | Replace |
| Motor fails to shut off at fully closed or opened positions. | Defective limit switch | Operate limit switch manually while door is moving. If door does not stop, replace switch. |
| | Limit cams are not adjusted | Verify and adjust |
| | Limit drive chain broken | Replace |
| | Loose sprocket on limit shaft | Tighten set screw |
| | Limit shaft does not rotate | Verify and replace |
| Motor turns but door does not move. | Sprocket key is missing | Replace |
| | Drive chain is broken | Replace |
| | Clutch is slipping | Adjust clutch tension |
| Motor hums or does not run. | Door locked or jammed | Verify manual operation of door. |
| | Dead phase (three-phase supply) | Check power supply, fuses on each phase. |
| | Brake does not release | Check wires to brake solenoid. Verify and adjust brake tension. |
| Limit switches do not hold their settings. | Loose drive or limit chain allows chain to jump sprocket teeth. | Adjust chain to proper tension |
| | Limit cam retainer not engaging slots in limit cams. | Be sure retainer is in slots of both cams. |
| | Limit cams are binding on the shaft threads which allow them to jump position on retainer. | Lubricate shaft threads. Limit cams should turn freely. |
| Radio control opens and reverses the door, but when the door is fully opened, will close door a little and bounce back to open position again. Door cannot be closed except by the close push button. | Advanced open limit switch is insufficiently advanced from the full open limit switch. When the door is fully opened, and a pulse is sent from transmitter, receiver maintains contact for 1.5 seconds. If advanced open limit switch has returned to normal state, reversing relay will be activated, and door bounces back to open position. | Adjust the advanced open limit |

| | | |
|--|--|---|
| Door closes by itself and operator does not shut-off at the end of closing travel. | Close contactor is defective | Verify and replace |
| Door opens by itself and operator does not shut-off at end of opening travel. | Close limit switch defective | Verify and replace |
| | Open contactor is defective | Verify and replace |
| Door coasts when stopped at any position. | Brake pad is worn out or requires adjustment | Replace or adjust |
| | Insufficient clutch adjustment | Adjust clutch |
| Sensing edge does not reverse door. | Pneumatic hose broken, electrical wiring not connected. | Replace or reconnect |
| When door closes it reverses to fully open after it hits the floor. | Advanced close limit switch is defective | Replace |
| | Advanced close limit switch is not being engaged by traveling cam | The advanced close limit switch needs adjusted slightly ahead of close limit switch. |
| | A close command is being given | Check close push button or any closing device for short-circuit. |
| Radio control does not function or hesitates for 10 seconds before working. | It is normal for a radio receiver to take up to 10 seconds before being fully operational. | Check transmitter and receiver are programmed. Press transmitter and verify receiver reaction. Transmitter battery may be dead or receiver may need service. To test radio control function, momentarily short out terminals on operator. It should function normally. Receiver relay may be defective. |
| Motor hums, starts when spun. | Capacitor defective | Replace |
| Motor fails to shut off at fully closed or opened positions. | Defective limit switch | Operate limit switch manually while door is moving. If door does not stop, replace switch. |
| | Limit cams are not adjusted | Verify and adjust |
| | Limit drive chain broken | Replace |
| | Loose sprocket on limit shaft | Tighten set screw |
| | Limit shaft does not rotate | Verify and replace |
| Motor turns but door does not move. | Sprocket key is missing | Replace |
| | Drive chain is broken | Replace |
| | Clutch is slipping | Adjust clutch tension |
| Motor hums or does not run. | Door locked or jammed | Verify manual operation of door |
| | Dead phase (three phase supply) | Check power supply, fuses on each phase |
| | Brake does not release | Check wires to brake solenoid. Verify and adjust brake tension. |
| Limit switches do not hold their settings. | Loose drive or limit chain allows chain to jump sprocket teeth | Adjust chain to proper tension |
| | Limit cam retainer not engaging slots in limit cams | Be sure retainer is in slots of both cams |
| | Limit cams are binding on the shaft threads which allow them to jump position on retainer | Lubricate shaft threads. Limit cams should turn freely. |
| Radio control opens and reverses the door, but when the door is fully opened, will close door a little and bounce back to open position again. Door cannot be closed except by the close pushbutton. | Advanced open limit switch is insufficiently advanced from the full open limit switch. When the door is fully opened, and a pulse is sent from the transmitter, the receiver maintains contact for 1.5 seconds. If the advanced open limit switch has returned to its normal state, the reversing relay will be activated, and the door bounces back to the open position. | Adjust the advanced open limit switch by bending the switch arm away from the open limit switch arm and more towards the traveling cam. |

Electrical Procedures

1. Disconnect the operator from its power source before opening the control box.
2. Inspect the wiring compartment and remove any dirt from the control unit.
3. Inspect all terminations for corrosion. Be particularly careful to check ground wires.
4. Check the terminal strip to ensure all screws are tight.
5. Verify the sensing edge or other safety devices installed on the operator are fully operational.
6. Verify the voltage at the input terminals while the operator is running. The voltage must not drop more than 10% during operation. If the voltage drop is excessive when running, the relays may chatter, the contact points will wear prematurely and may eventually weld.
7. Inspect the power terminals for corrosion.
8. Verify the current consumption of the unit with an ammeter. The value of current should be consistent with the name-plate specifications.
9. For three-phase operators, incorrect phasing of the power supply will cause the motor to rotate in the wrong direction. To correct this, interchange any two of the incoming three phase power lines.



You must always work with an *attitude of safety* when working in the repair of overhead doors because of the potential danger that exists in a malfunctioning door. Use common sense and think about the consequences of what you do during each step of the repair process. Also, point out any potential problems you see to the customer and make your recommendations in writing. Document everything that was done on a service call and have the customer sign and keep a copy of the paperwork.

By taking these recommended steps, you will limit potential liability to you and your company in the event that anything should go wrong with the door after you have completed your work. Most building owners disregard their door's need for maintenance or service work until something goes wrong. Take a few minutes to explain routine maintenance procedures and attach sectional door safety literature to the service paperwork.

Conclusion

This section on service and maintenance should provide a solid background of basics with which to start. In order to become proficient, you must experience many different types of job situations and have the opportunity to work with seasoned door technicians. If you run into difficulty and do not have access to the manufacturer's guidelines, you should always contact your supervisor or the manufacturer for the most effective and safest solution.

Section Eleven

Glossary of Terms

References (refer to the latest editions for the most current terms and definitions):

1. ANSI/CAN/UL 325, Standard for Safety for *Door, Drapery, Gate, Louver, and Window Operators and Systems*
2. DASMA TDS 160, *Sectional Garage Door Terminology*
3. NFPA 70, *National Electrical Code*
4. DASMA TDS 350, *Garage Door Operator and Gate Operator Terminology*

3-Hole Cable Clip: Metal clip tied to end of extension spring cable to allow length adjustment.

Accent Molding: Half-round and square mouldings that provide a distinctive mode of expression to doors.

Accessory: Any supplemental item or device added to the basic gate or door system.

Active Coils: The number of working coils in a torsion spring.

Adjustable Clutch: See Clutch.

Air Infiltration: The leakage or passage of air through a door system.

Aircraft-Type Cable: Several strands of galvanized wire rope braided together.

Angle Brace: Lateral brace attached to back hang and roof construction or ceiling.

Angle Iron: Length of L-shaped steel material generally used to support and brace rear of horizontal tracks from roof construction or ceiling.

Angle Mounted Track: A method of fastening vertical track to a door jamb using a full height continuous angle.

Astragal: A compressible or deformable seal provided on the bottom edge of a door.

Astragal Retainer: A component, mounted to the bottom edge of a door, that holds an astragal in place.

Automatic Latch: An automatic door locking device.

Back Hang: Hanger fabricated from angle iron, which attaches the end of the horizontal tracks to roof construction or ceiling.

Backroom: Horizontal distance measured into a building from the door mounting surface to the first obstruction within the zone required to install or operate the door.

Ball Bearing: A load bearing device that uses trapped rolling balls to reduce rotating friction.

Bar Joist: A lightweight truss adaptable for the support of roof decks.

Bead: A strip of metal, vinyl, or rubber used to secure glass around the periphery of a pane.

Black: Color-marking convention to mark parts as Right Side, Left Wound.

Blind Rivet: A type of fastener that mechanically joins two pieces of material together by means of a riveting tool.

Booster Spring: Additional spring, usually an extension spring, provided to compensate for weakened counterbalance.

Bottom Bracket: A structural support located predominantly on the bottom section that holds track rollers and may also provide for attachment of lifting cables. Bracket locations other than at bottom section corners are possible.

Bottom Corner Bracket: See Bottom Bracket.

Bottom Corner Fixture: See Bottom Bracket.

Bottom Fixture: See Bottom Bracket.

Bottom Rail: The lower-most horizontal rail of a door section.

Bottom Weatherseal: Astragal or other weatherstrip attached to the bottom of a door to seal against the floor.

Bow: Condition where a garage door bottom rail of a wood door is not level or straight, which is characterized by a closed door “smiling” (corners turned up).

Bracket Mounted: Method of fastening vertical track to jamb using jamb brackets.

Broken Cable Device: A bottom fixture intended to prevent a door from falling in the event of cable breakage.

Bushing: A fixed or removable lining used to constrain, guide, or reduce friction.

Cable: See Aircraft-Type Cable.

Cable Clamp: Manufactured device used to secure two pieces of cable to each other.

Cable Drum: Grooved drum, fitted on torsion spring shaft, onto which lifting cable is wound when door is opened.

Cable Drum Set Screws: Normally refer to set screws that attach the drum to the shaft/tube. One screw may secure the cable to the drum in order to secure proper cable length.

Cable Length: Specific amount of cable required to properly operate the door.

Cable Safety Device: A bottom fixture designed to slow or stop the descent of a door in the event of a cable breakage.

Cable Stop: A swaged fitting at the end of the cable to prevent slippage through a slot in a drum.

Cam: Rotating piece that transfers rotary motion into linear motion.

Cam Tube: Tube encasing a torsion spring assembly that imparts axial force.

Ceiling: Top horizontal surface in the interior of a garage.

Center Bearing Bracket: A bracket that houses a shaft bearing and aligns and supports the torsion shaft and spring(s) assembly. Also serves to anchor stationary cone(s) to header.

Center Bearing Plate: A plate or bracket that can house a shaft bearing and is used to align and support the counterbalancing mechanism to the torsion shaft as well as anchor one end of torsion springs to the header.

Center Bushing: Metal or plastic bushing used with a center bracket to support a torsion tube.

Center Hinge: A hinge generally located on the intermediate stiles to allow sections to pivot as door opens. Also used as graduated edge hinge between bottom and intermediate section.

Center Lift Cable: Additional cable assembly which is secured to outside of door at points toward the center of the door, used to provide extra lifting support for extremely wide or heavy doors.

Center Post: The vertical building structure (or member) between two single car doors, or a vertical reinforcement usually installed for high wind events. Sometimes also used to refer to a Vertical Post.

Center Stile: Vertical member of a door section which provides structural rigidity and location for center hinge attachment.

Chain Hoist: A mechanical device used to raise and lower the door by use of a hand chain.

Chain Hoist Operator: Jackshaft type operator to which chain hoist is attached.

Channel Frame: Frame used in jamb construction consisting of steel channel shapes installed where the flanges of the shapes wrap around the corners of jambs.

Chill: A square shaft that connects an outside handle to an inside lock set or night latch.

Clearance: The amount of sideroom, headroom, and backroom required to properly install a sectional door.

Clevis Pin: A steel pin used in conjunction with a cotter pin to hold a counterbalance cable to a bottom bracket or an operator arm to an operator bracket.

Clutch: A mechanical slippage device that allows for some degree of stopping the gate or door should it meet an obstruction.

Commercial Door: A door which is intended for vehicular use at entrances of commercial buildings such as loading docks, service stations, parking garages and manufacturing plants.

Contact Edge Sensor: A sensor, attached to an edge surface of a door, a gate or an object in the vicinity of the door or gate, that upon detecting an obstruction via contact with the edge, signals the operator to stop and/or reverse (source: ANSI/CAN/UL 325, Type B2 Entrapment Protection).

Containment Cable: A cable threaded through an extension spring to retain the spring if it breaks.

Contour Track: Horizontal track that follows the contour of roof construction or ceiling.

Cotter Pin: A half-round metal strip bent into a pin, whose ends can be flared after insertion through a slot or hole.

Counterbalance: To oppose or balance with an equal weight or force.

Counterbalance Shaft: See Torsion Shaft.

Counterbalance System: A system which counteracts the weight of a garage door to allow a reduced force to open and close the door.

Counterbalance Tension: See Counterbalance.

Coupler: A device to connect two counterbalance shafts together, end-to-end.

Cycle: An action on the door from the fully closed position, to the fully open position, and returned to the fully closed position.

Cylinder: The part of a key operated lock that accepts the key and contains the locking pins.

Daylight Opening: Opening dimensions taken between face and jambs and between floor and header.

Dead Coils: The number of coils rendered inactive by the spring plugs.

Dead in the Head: The lack of counterbalancing when the door is in the open position, failing to keep the door fully open.

Dead Load: A static applied load, or a load without movement, generally referring to the weight of the door.

Decal: A template of information attached to a garage door, or in its vicinity, to convey relevant information concerning the garage door system.

Design Wind Load: Horizontal design load applied to a garage door based on such factors as wind speed, building height, and door horizontal location.

Disconnect Chain: Used in conjunction with industrial door operators to disengage operator and permit manual use of emergency hand chain to facilitate operation of door in event of power failure.

Door Casing: The framing members with which a door opening is finished.

Door Frame: The frame into which the door fits; consists of two door jambs and a door header.

Door Header: The upper part of a door frame, consisting of the head jamb, head casing, stop and trim molding.

Door Jamb: The upright framing on each side of the door opening.

Door Opening: The clear open width and height.

Door Schedule: A list of door sizes, locations, and special requirements shown on a construction document.

Door Section: A single segment of a sectional door.

Door Size: Door dimensions characterized by the width first and the height second.

Double End Stile: When a door section utilizes two stiles adjacent to each other on each end of the section.

Double Glazing: Use of two thicknesses of glazing within an opening to improve insulating value and/or reduce sound transmission.

Double Shaft: Double torsion spring shaft used when additional space is required to accommodate counterbalance spring lengths.

Double Strength Glass: A grade of window glass lighter than plate glass and usually 1/8" thick.

Double Top Roller Fixture: Fixture used at the top section consisting of two top brackets

to incorporate a longer roller shaft. Usually requires double end stiles on top section.

Double Track Low Headroom: Addition of second pair of horizontal tracks to reduce the high point of travel of top section and permit door being mounted in area with minimum headroom facilities.

Dowel: Wooden pin for fastening wood usually glued in between stiles and rails to strengthen a joint.

Drawbar Operator: Electric operator which mounts above the door in the horizontal position and lifts door by pulling and pushing the top section. For normal headroom and low headroom doors.

Drip Cap: A projection over the head of a door opening, or on the top of a wall, to throw water clear of the building.

Drip Lap: An angled weather seal provided between sections on steel doors in lieu of a rabbeted joint to prevent entrance of the elements.

DSB: Acronym for Double Strength Grade B Glass.

Duplex Spring: A combination of two torsion springs of different diameters telescoped within spring fittings.

Duty Cycle: The number of cycles per a defined time period that a door or gate operator is designed to perform.

Eave Height: Height measured from the floor to the underside of an eave.

Edge Sensor: See Contact Edge Sensor.

Edge Transmitter: A wireless device used to transmit a signal from a contact edge sensor to a receiver connected to a gate or door operator which functions to stop and/or reverse direction.

Electric Operator: An electrically-powered device to control the opening and closing of a door.

Embossed Door Section: Door section featuring embossed panels.

Embossed Panel: Panel containing surfaces raised in relief from a flat surface.

Embossed Rosette: Special ornament or design accessory made of wood, hardboard or aluminum with designs raised in relief from the surface.

End Bearing Plate: Plate commonly used on torsion spring counterbalance units.

End Hinge: See Graduated Edge Hinge.

End Stile: Stile located at each end of a door section which provides for attachment of graduated edge hinges.

End Stile Sealing Strip: Foamed plastic strip to seal sections at end stiles of steel and fiberglass doors.

Entrapment: The condition when a object is caught or held in a position that increases the risk of injury. (source: ANSI/CAN/UL 325)

Entrapment Protection Device: A device installed with a gate or door operator, or internal circuitry, intended to prevent persons from becoming caught or held in a position that increases the risk of injury.

Escutcheon: A plate surrounding the lock mechanism on outside of door.

Exhaust Port: Opening in bottom section to accept hose to vent tailpipe exhaust.

Extension Spring: Provides power or tension by stretching or pulling, and is usually mounted along the horizontal section of track extending from front of door opening to the back hang.

Exterior Lock: Keyed lock on exterior of door.

External Entrapment Protection Device: A device, examples being a contact edge sensor, a photoelectric sensor, or similar entrapment protection device, which provides protection against entrapment when activated and is not incorporated as a permanent part of an operator. (source: ANSI/CAN/UL 325).

Extrusion: Fabricated shapes made by forcing hot aluminum, or plastic, billets through a die in an extrusion press.

Fault Condition: Detection of an operational error.

Faux Divided Lite: One piece of glass divided by muntions to appear as several lites.

Ferrule: Metal ring or cap which is affixed to a cable by compressing so as to form a button or loop on the end of the cable.

Finger Joint: Joint used in joining lumber together at ends of lumber pieces.

Flag Bracket: Wall angle bracket used to connect the counterbalance unit, vertical, and horizontal tracks together.

Flame Spread Index: A measurement of horizontal flame spread across a product specimen under controlled laboratory conditions; the product is compared to the performances of red oak, which is standardized to 100, and gypsum board, which is standardized to zero.

Flush Door: Door comprised of sections unbroken by visible rails and stiles where the facing of the entire door presents an even surface.

Follow-the-Roof Pitch: See Contour Track.

Follow-the-Roof Track: See Contour Track.

Front Mounted Low Headroom: Low headroom hardware where springs mount on torsion shaft above opening.

Front Mounted Spring: A counterbalance spring that is mounted to the header above the door.

Full Vertical Lift: See Vertical Lift.

Full View Section: Full Vision Section (A totally glazed section with various types of glass or clear plastic. Section formed of aluminum extrusions which will marry with steel or aluminum sections above and below).

Full Vision Section: See Full View Section.

Galvanizing: Zinc coating to protect steel against corrosion.

Gauge: U. S. Standard, established by Congress in 1893, specifying that weight per square foot would be indicated by a numbering system; larger numbers indicate smaller thickness and vice versa.

Glazed: Fitted with panes of glass or clear plastic.

Glazing Strip: Extruded plastic or rubber strips between glazing and window frame to resist water infiltration.

Graduated Edge Hinge: Hinge placed on edge of door sections allowing sections to pivot as door opens and closes. Hinges hold track rollers and are graduated and numbered for correct placement to ensure flush fit of door against jambs when closed.

Gusset: Metal reinforcement plate, angle or bracket which is fastened in corners to stiffen joints.

Hang Down: The amount of the door that hangs down from the door opening when the door is in the open position.

Header: See Door Header.

Header Seal: Weather-stripping mounted at opening header to seal the opening between header and curtain.

Headplate: Supporting plate for the lifting drum located in line with the outer edge of the door.

Headroom: Vertical clear space required above the door opening, and below the lowest ceiling obstruction, required for proper installation and operation of the door and its hardware.

High Arc: The highest point of travel of the top panel as it travels through the track radius.

High Cycle Spring: Counterbalance springs with increased cycle life capability for high usage doors.

High Lift: Distance from header to underside of horizontal track, when high lift track is required.

High Lift Drum: A cable drum contoured to balance a high lift door.

High Lift Track: Track and hardware that causes the door to rise vertically some distance above the top of the door opening before it levels out into a horizontal position.

High Moment Arm: Radius of a cable drum, including cable, at point of cable peel off from the drum in the closed position.

Hinge: Hardware item that joins door sections together, and allows sections to pivot independent of each other.

Hinge Support Plate: Plate used to support the hinge mounting area, i.e. a backup plate.

Hinge Tube: Tube used to connect two hinge leaves together.

Horizontal Angle: Angle used to stiffen horizontal track.

Horizontal Radius: Section of track that transitions from vertical to horizontal track welded, bolted or riveted to the horizontal track and then bolted to the flag angle.

Horizontal Reinforcing Angle: See Horizontal Track Angle.

Horizontal Rise: The upward slope of the horizontal track which helps to start the door downward and helps maintain cable tension.

Horizontal Track: Track used in the horizontal segment of a track assembly.

Horizontal Track Angle: An “L” shaped angle affixed to the horizontal track to stiffen it.

Horizontal Track Assembly: An assembly made up of horizontal track and reinforced with an angle that is used to both guide and support the door in the horizontal position.

Hot Off the Floor: Condition where the door has a tendency to lift off the floor.

Inch-Pounds: English unit of measurement of torque.

Inclined Track: Tapered spacing of the vertical track away from the jamb, permitting weather tight closing of door against jamb and easy release for opening the door by eliminating friction.

Inside Hook Up: Connection where the counterbalance cable is on the inside of the track, between the door panel and the vertical track.

Inside Hook Up Bottom Bracket: Bottom bracket where the cable is routed between the vertical track and the door sections.

Inside Lock: Spring loaded, sliding deadbolt lock operable only from interior of the door.

Installation: Placing a door in position for use.

Installer: Person placing the door in position for use.

Insulated Door: Door sections containing insulating material.

Insulating Glass: Multi-pane glass assembly containing air space between panes for insulation.

Insulation: Material having ability to reduce heat or cold transmission.

Intermediate Hinge: See Center Hinge.

Intermittent Duty: A limited duty operator with a determined maximum cycles per hour.

IPPT: Acronym for Inch-Pounds Per Turn; torque rate of a spring, indicating the number of inch-pounds of torque delivered to a shaft for each turn the spring is wound.

ISLO: An acronym for *inside looking out*.

Jackshaft-Type Operator: Operator which is mounted on wall or ceiling, with drive provided to turn a torsion shaft.

Jamb: See Door Jamb.

Jamb Angle: See Wall Angle.

Jamb Bracket: “L” shaped bracket used to connect the vertical track to the door jamb

Jamb Extension: Framing extensions of door jambs above opening height; required to support door track and spring assemblies.

Joint, Rabbeted: See Joint Shiplap.

Joint, Shiplap: A raised back portion of a section joint, fitting with a lowered front portion of a section joint, to create a weather-tight seal between door sections.

Joint, Tongue-And-Groove: A joint with an interior raised portion, fitting with a joint with an interior lowered portion, to create a weather-tight seal between door sections.

Key: A square piece of steel that slides into a key way to prevent parts from rotating on a shaft.

Key Switch Control: Use of key switch to actuate a door operator in place of or in addition to a pushbutton or transmitter.

Key Way: A groove, milled into an object, which when used with a key will prevent parts from rotating on a shaft.

Keyed-Alike: Two or more lock cylinders intended to be opened with the same key.

Keyed Shaft: A shaft that has an integrated key way.

K-Value: Laboratory-determined value of thermal conductance of a material.

Lag screw: A heavy wood screw with a square or hex head and a coarse thread.

Lap Jamb: Condition where door sections lap the door opening on each jamb.

Lateral Force: Force applied from or toward the side.

Leading Edge: The most forward part of the gate or door while it is in motion.

Left Hand: The left side determined from a position standing on the same side of the gate or door as the operator looking at the gate or door.

Lift Clearance: See High Lift.

Lift Clearance Track: See High Lift Track.

Lift Handle: A handle attached to the inside or outside of a door section, to be grasped by hand when a door is to be operated manually.

Line of Sight: The position of a control device located in such a way that the entire door or gate to be operated is directly visible during the full travel of the door or gate to the person operating the control.

Lintel: A horizontal member spanning and carrying the load above an opening.

Lite: See Vision Lite.

Lock: Device to secure door to vertical track(s) in the closed position.

Lock Bar with Cremone: Rotating the cremone or lock bar disc from outside or inside will force lock bars into cut-outs in track to lock door.

Long-Stem Roller: Roller with a shaft length of 7 inches or longer.

Louver: An opening with slats or screening for ventilation.

Low Headroom Hardware: See Low Lift Hardware.

Low Headroom Track: See Double Track Low Headroom.

Low Lift Hardware: Low headroom accessories which enable a door system to operate in minimal headroom conditions.

Low Moment Arm: Smallest radius, or distance from the shaft axis, to the center of the cable that regards cable peel off point on cable drums.

LSLO: An acronym for *left side looking out*.

Lubricant: A substance used to lubricate.

Lubricate: To make a surface smooth or slippery; to reduce friction.

Maintenance: The act of keeping a door system in good working condition.

Manual Release: A device or system to allow the gate to be operated in a manual mode.

Master Keying: Arrangement whereby cylinder locks, although fitted with different keyed cylinders, can be opened or locked by means of one master key.

Meeting Rail: The top horizontal rail or bottom horizontal rail of any section that meets and joins to form a weatherproof seal.

Mill Certification: A report or document from the producing mill that provides all pertinent data relative to the composition, structure, heat, etc. of a given metal.

MIP: Acronym for Maximum Inch-Pounds; (IPPT x Turns = MIP); Used to describe the total torque required on a shaft to raise a given door weight from the floor, and also is the measurement of the torque capacity of a particular wire size at a desired cycle level of operation.

Mounting Plate: Flat steel or wood member placed on the wall to accommodate spring supports, spring shaft bearings, chain hoists and mounting for operators.

Mullion, Door: A movable, vertical structure or post that spans from floor to lintel, to which is mounted the left hand tracks or guides of one door, and the right hand tracks or guides of an adjacent door. Divides an opening width to permit the use of two doors, and is movable, to permit the use of the full opening width.

Mullion, Window: Framing member forming a divide between units of a window.

Muntin: A bar member separating panes of glass within a sash or door.

NEC (National Electrical Code): A standard that governs the use of electrical wire, cable and fixtures and electrical and optical communications cable installed in buildings. Note: The NEC was developed by the NEC Committee of the American Standards Institute (ANSI), was sponsored by the National Fire Protection Association (NFPA) and is identified by the description ANSI/NFPA 70-xxxx, the last four digits representing the year of NEC revision.

NEMA (National Electrical Manufacturers Association): A trade association made up of electrical suppliers that set voluntary standards

for safety and performance of electrical products principally enclosures, motors and motor starters.

Oil: See lubricant.

Oil-Canning: A slight buckling in sheet metal, causing the appearance of waviness or unevenness.

Opening Height: Distance from floor to the bottom of header.

Opening Width: Distance between jambs of the door opening.

Operator: An electric or air-powered mechanism that opens and closes a door.

Outside Hook Up: Connection where the counterbalance cable is on the outside of the tracks.

Outside Hook Up Bottom Bracket: Bottom bracket where the cable is routed outside the tracks.

Overlay: Decorative ornaments of metal, wood, or hardboard used for outside decoration of garage door sections.

Pan Door: A garage door composed of sheet metal door sections.

Panel: (1) A flat or raised and decorative design between stiles on door sections; (2) A span between center hinges.

Pass Door: A swinging pedestrian door built into a sectional door. Not recognized as an exit door by model codes.

Perforated Angle: Angled metal with a series of punched holes used to hang garage doors and operators.

Perimeter Seal: Weatherstrip installed at the perimeter of a garage door.

Photoelectric Sensor: A device that uses a light beam or other technology for the purpose

of detecting obstructions by providing a detection signal to the operator upon the breaking of the beam, NOT requiring physical contact with the gate. Where permitted by ANSI/CAN/UL 325, this device may be used as an external entrapment protection device.

Pinch Resistant: Term for a door that has been designed to prevent entrapping, crushing, breaking, severing or dislocating a person's finger.

Pocket Wheel: A wheel or drum machined to receive the individual links of a chain; used to directly transmit power

Polyurethane: A type of foam insulation commonly foamed in place by manufacturers of garage door sections.

Pre-Finished: Finish characterized by galvanized steel painted with a primer, then given an oven-baked topcoat.

Pre-Painted: See Pre-Finished.

Prime: To lay on the first coat of primer paint.

Prime-Painted: Coated with primer paint.

Pull Down Rope: A rope connected to the bottom bracket; used to manually pull the door down.

Pulley: A wheel turning around an axis and having a groove on its rim in which runs a cable, chain, or rope.

Push Down Spring: Spring-activated push rods mounted on horizontal tracks to start door down during closing portion of door cycle; generally used with a jackshaft-type operator or a manual chain hoist.

Push Nut: Stamped metal fastener designed to be pushed onto a shaft to secure an assembly.

Quarter Round: Molding showing a quarter circle in its cross section.

Quarter Turn: A unit of turn measurement when winding tension into a torsion spring.

Radial Force: A force generated from the center of an object toward the outside.

Radius: See Horizontal Radius.

Radius Track: See Horizontal Radius.

Radio Control: A wireless device that transmits or receives signals to the gate or door operator.

Rail: Horizontal member of a section.

Rain Stop: Ledge provided at the point where the bottom rail meets the floor to prevent water from running under the door and allowing for runoff of the water onto the drive or approach.

Raised Panel: See Panel.

Rate of Rise: Measurement of change per revolution of a drum's moment arm.

Rear Mount: When the counterbalance system is attached at the rear of the horizontal tracks.

Red: Indicates color for Left Side, Right Wound.

Regular Angle Mount: See Angle Mounted Track.

Removable Center Post: Post/track assembly which substitutes for door jamb in wide door openings so that multiple doors may be used instead of a single large door, and which can be released and carried from an opening.

Residential Door: A sectional door which is intended for vehicular use in a residential garage.

Restraining Cable: See Containment Cable.

Reversal: A change in gate or door motion to the opposite direction.

Reverse Angle Mount: An “L” shaped angle with the wall leg toward the door opening used to connect the vertical track to the jamb. Used in low headroom and sideroom restricted garages as well as lap joint.

Roller: See Track Roller.

Roller bracket: A device that is mounted to a door section and holds a track roller.

RSLO: Acronym for *right side looking out*.

R-Value: Thermal resistance value; inverse of U-Value.

Sash: The framework which holds the glass in a window or door.

Sash Muntin: One of the rabbeted bars into which glass is fitted in a sash containing two or more lights.

Scarf Joint: Method of joining pieces of lumber together by gluing and pinning with wood dowels.

Scribing: Cutting a door bottom rail to match the contour of the floor.

Section: Garage door component that extends the full width of an opening; usually joined together by hinges.

Sectional Door: Door made of two or more horizontal sections hinged together so as to provide a door capable of closing the entire opening and which is by means of tracks and track rollers.

Sectional-Type Door: See Sectional Door.

Servicing: To repair or provide maintenance for a door system.

Shaft Bearing: A bearing that is used to maintain torsion shaft alignment and reduce friction.

Sheave: A metal or plastic pulley that is designed to guide the cables employed in a counterbalance system.

Sheave Fork: A yoke type device used to attach the sheave to extension springs.

S-Hook: Hardware device used to connect an extension spring to a pulley. These are also used with other door related hardware (i.e. chain on locks).

Shiplap Section Joint: Section joint interface that steps up from one level to a second level from the front of the door to the back of the door.

Shop Drawings: Drawings provided by the manufacturer or door supplier to the architect-engineer showing the plans, sections, elevations, and details of the work required, submitted to assure proper interpretation of the intent of the architectural drawings.

Side Bearing Plate: See End Bearing Plate.

Sideroom: A horizontal measurement from each side of the door opening, outward to the nearest obstruction.

Single Car: Commonly used to refer to smaller width doors used on one car openings.

Single Strength Glass: See Single Thick Glass.

Single Thick Glass: A type of sheet glass used in glazing sashes.

Slant: The pitch of a roof.

Snap Latch: See Automatic Latch.

Solar Glass: A type of tinted glass.

Special Door: Non-standard door which must be custom manufactured and/or specified.

Specifications: A detailed statement of the quantity and type of material to be used in the construction of a garage door system.

Spring Anchor Bracket: See Center Bearing Bracket.

Spring Assembly Closed Wound: A coiled torsion spring with no gaps between the coils.

Spring Assembly Open Wound: A coiled torsion spring with equal gaps between each coil.

Spring Balance: The amount of turns needed to counterbalance the weight of the garage door.

Spring Bumper: Spring mechanism mounted on horizontal track that eases the door to stop in its upward travel to reduce shock and prevent pull down rope breakage. Can be made from leaf springs or tension rods.

Spring Constant: Mathematically developed number from basic spring wire formulas, that applies to any specific wire size and coil diameter combination; used to determine the number of active coils a spring must contain.

Spring Containment Device: See containment cable.

Spring Fitting: A plug or cone used to adapt the torsion springs to the torsion shaft and/or center bearing bracket. One piece is a stationary cone while the other fitting is a winding plug.

Spring Pad: Pad installed on header above the door to anchor the center bearing bracket. Can be mounted in various locations, not necessarily in center, depending on size of springs.

Spring Repair Block: Device used to temporarily clamp a broken spring.

Stationary Cone: Part that fits into the end of a torsion spring permitting the spring to be fixed to the center bearing bracket. May also incorporate a retainer for a ball bearing or bushing.

Steel Jamb: Door framing made from either channel or angle iron.

Steel Jamb Mounted: A track system intended for mounting to a steel jamb.

Step Down Plate: A means of closing a sectional door the last few inches of its travel.

Step/Lift Plate: A part that can be used as a step down plate and a lift handle for manually operating a sectional door.

Stile: Vertical reinforcement member of a section.

Stile-and-Rail Garage Door: A sectional garage door featuring sections each made up of horizontal rail and vertical stile structural framing members that support panels connected to such members.

Stock Door: Door made to standard size and generally kept in inventory at either distributor or factory warehouse.

Stop Mould: Serves to seal the perimeter of the door against weather and light infiltration; usually nailed to the jamb, outside the door.

Stress: The amount of work required of a spring at a desired cycle level.

Striker Plate: A plate used in conjunction with a locking system to secure a lock mechanism.

Strut: Support stiffener to reduce deflection of the door sections in the horizontal position. Also, to increase wind load capability of a door.

T Handle: A handle in the shape of a "T".

Test Wind Load: Specified difference in static air pressure (positive or negative), equal to a specified percentage greater than or equal to 100% of the design load.

Thermal Break: The separation between the outer and inner surfaces of a door section.

Three Wire System: Wire system composed of a hot wire, a neutral wire and a ground wire.

Tongue and Groove Section Joint: Section joint interface commonly composed of a middle protrusion on a garage door section edge mating with a middle groove on an abutting section edge.

Top Fixture: A bracket for positioning the top guide roller on the top section of a door.

Top Rail: Horizontal rail forming the top of a door as distinguished from the meeting rails and bottom rail.

Top Seal: Weatherstripping which fastens to the top of the door to seal the door along the top of the opening.

Torque: The twisting force around an axis.

Torsion: Act of twisting or turning of a torsion spring by the exertion of forces tending to turn one end about a longitudinal axis while the other end is held stationary.

Torsion Bar: A long metal element that transfers torque from a spring to a winding plug.

Torsion Shaft: A shaft that transfers torque from springs to load.

Torsion Spring: A spring that works by turning one end about a longitudinal axis while the other end is held or turned in the opposite direction developing torque.

Track: Channel shaped metal bars or rails in which upward acting doors operate via track rollers.

Track Graduation: The differential distance from the track to the door jamb, measured at the top and bottom of the vertical track.

Track Guard: Added protection for back of vertical track recommended in cases where powered material handling fork trucks and

similar equipment may be operating in the area.

Track Radius: See Horizontal Radius.

Track Roller: Roller assembly for guiding the door sections along track.

Trajectory: The arc of travel or sweep of the top section as the door is raised from closed to open position.

Translucent Door: Door that allows the passage of light without being transparent.

Transom: A small window above a door.

Transom Bar: A horizontal crossbar in a window, over a door, or between a door and window or fan light above it.

Transom Section: An extra section above a garage door opening sometimes used to allow extra lift of the horizontal tracks to accommodate a trolley type operator.

Trim: The finishing materials; such as the lock and handles on the door.

Triplex Spring: Three springs of increasing diameter assembled one inside another using special spring fittings.

Tubular Shaft: A hollow shaft.

Turn: A 360-degree revolution of a component about its axis.

Turns on Spring: See Winds on Spring.

Twist: A form of warp caused by the twisting or winding of the edges of a rail.

Two Wire System: Wire system composed of a hot wire and a neutral wire.

U.L. (Underwriters Laboratories): A non-government organization that develops safety standards for devices, systems and materials, and labels and lists various products. The

organization also operates laboratories for product testing.

U-Value: Thermal transmission coefficient which is a measurement of heat, in BTU's, transmitted through one square foot of material (the door) in one hour at a temperature difference of 1 degree from one side to the other

Upper Vertical Track: Upper track assembly on a vertical lift door.

Vent: An opening located in the bottom section of a door for ventilation.

Vertical Lift: Refers to a hardware design that causes doors to open vertically where no horizontal tracks are required.

Vertical Lift Drum: A cable drum with changing radius grooves to negate spring tension.

Vertical Track: The portion of track that is oriented vertically and is adjacent to the jamb.

Vertical Track Assembly: An assembly made up of a piece of vertical track and a piece of continuous angle or jamb brackets used to secure the track to the jamb.

Vision Lite: Glazing that is mounted in a door.

Wall Angle: Continuous "L" shaped angle(s) used to connect the vertical track to the door jamb.

Warning Tag: A tag with warnings and/or instructions for safe operation.

Water Seal: A coating of some kind used to prevent the absorption of water.

Weatherstrip: Material used at the perimeter of a garage door, or between joints of a garage door, intended to improve a door's performance against air infiltration and thermal transmission.

Wedge Connection: A device composed of a steel wedge and clip for securing the joint between vertical and horizontal track sections.

Wicket Door: See Pass Door.

Wind Load: See Design Wind Load.

Winding Bar: See Winding Rod.

Winding Cone: Part that fits into a torsion spring permitting winding and tension adjustment.

Winding Cone Set Screw: Set screw fasteners used to lock the winding plug to the torsion shaft.

Winding Rod: A solid rod that fits into the socket of the winding plug to tension torsion springs.

Winds On Spring: The number of winding turns on a torsion spring.

Wire Glass: Glass into which wire netting is woven prevent splintering from heat or impact.

Wire Size: The diameter of the wire in a spring.

Wired Control: A control implemented in a form of fixed physical interconnections between the control, the associated devices, and an operator to perform predetermined functions in response to input signals.

Wireless Control: A control implemented in means other than fixed physical interconnections (such as radio waves or infrared beams) between the control, the associated devices, and an operator to perform predetermined functions in response to input signals.

Wood Jamb: Upright wood piece forming the side of an opening.

Wood Jamb Mounted: Refers to mounting vertical track to wood jambs.

Woodruff Key: Special half-moon shaped steel key.

Section Twelve

DASMA Standards and Technical Data Sheets

Door and Access Systems Manufacturers Association (DASMA) has produced many publications which can aid with both understanding the requirements of the product being installed and dealing with various common situations which arise in the field. These and other Standards and Technical Data Sheets relative to sectional doors, operators, and electronics can be found at DASMA's website dasma.com under the Data Sheets and Standards dropdown. A certified technician should be familiar with the documents listed below and their content.

Below outlines these documents relative to sectional doors and operators at the time of this publication. Reference the DASMA website for latest versions and availability.

Standards:

- ANSI/DASMA 110 *Standard for Lifting Cables for Sectional Type Doors*
- ANSI/DASMA 102 *Specifications for Sectional Overhead-Type Doors*
- ANSI/DASMA 103 *Standard for Counterbalance Systems on Residential Sectional Garage Doors*
- ANSI/DASMA 105 *Test Method for Thermal Transmittance and Air Infiltration of Garage Doors*
- DASMA 303 *Performance Criteria for Accessible Communications Entry Systems*
- ANSI/DASMA 107 *Room Fire Test Standard for Garage Doors Using Foam Plastic Insulation*
- ANSI/DASMA 108 *Standard Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference*
- ANSI/DASMA 109 *Standard Method for Testing and Rating Sectional Doors: Determination of Life Cycling Performance*
- DASMA 112 *Test Method for Air Leakage of Sectional Garage Doors, Rolling Doors, and High Performance Doors*
- ANSI/DASMA 115 *Standard Method for Testing Sectional Garage Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure*
- ANSI/DASMA 116 *Standard for Section Interfaces on Residential Garage Door Systems*

Technical Data Sheets –Operator & Electronics:

- *Garage Door Operator and Gate Operator Terminology (TDS 350)*
- *Federal and State Garage Door Operator Legislation Guidelines for Dealers and Installers (TDS 351)*
- *Loop Systems and Depth in Road Pavements (TDS 354)*
- *Access Controlled Egress Doors (TDS 355)*
- *Vehicular Commercial Door and Gate Operators, and OSHA Requirements (TDS 358)*
- *Gate operators, Commercial Door Operators, and NEC Provisions (TDS 359)*
- *Garage Doors Operated in Tandem (TDS 361)*
- *Residential Garage Door Operator Pre-Wiring Diagram (TDS 362)*
- *Evaluation of Door or Gate Operators Employing Photoelectric Sensors (TDS 363)*
- *Installation Location of Photoelectric Sensors on Residential Garage Doors (TDS 364)*

- *Dimensions to Consider When Installing an Accessible Communications System (TDS 365)*
- *Edge Sensors (TDS 368)*
- *Frequently Asked Questions Regarding Automated Residential Garage Door Systems (TDS 369)*
- *Rationale Behind Development of Provisions of DASMA 303 Performance Criteria for Accessible Communications Entry Systems (TDS 372)*
- *Door and Gate Operator Remote Control Troubleshooting Guide (TDS 374)*
- *Motor Operated Commercial Sectional Doors and Rolling Doors: Typical Installation Concerns (TDS 375)*
- *Telephone Entry/Access Control Systems Purposes, Types and Installation Basics (TDS 379)*
- *Proper Installation of Photoelectric Non-Contact Sensors on Vehicular Commercial Door Operators (TDS 382)*
- *Garage Door Operator Wall Control Button Mounting Height ADA Requirements and ANSI/CAN/UL 325 (TDS 384)*
- *Opening a Motorized Garage Door to Exit a Home Through the Garage in a Power Outage (TDS 385)*
- *Garage Doors and Operators Used in Entertainment Venues (TDS 386)*
- *Connecting Garage Door Jambs to Building Framing (TDS 161)*
- *Wood Door Finishing Guidelines (TDS 162)*
- *U-factor and R-value for Residential and Commercial Garage Doors (TDS 163)*
- *Drywall Surfaces and the Mounting of Garage Door Hardware (TDS 164)*
- *Manual Operation of an Automatic Garage Door (TDS 165)*
- *Guidelines For Connecting a Drawbar Operator to a Sectional Garage Door (TDS 166)*
- *Residential Sectional Garage Door & Electric Operator Checklist for Home Inspectors and Consumers (TDS 167)*
- *Wind Loads on Garage Doors – FAQ (TDS 168)*
- *Official Color Codes for Torsion and Extension Springs (TDS 171)*
- *Garage Door Labels (TDS 172)*
- *Garage Doors and Ventilation (TDS 173)*
- *Building Occupant – Checking a Garage Door for Damage (TDS 174)*
- *Post-High Wind Event Door Operation by a Trained Door Systems Technician (TDS 175)*
- *Adding Weight to a Garage Door Assembly (TDS 176)*
- *Application of Kd Factor to Garage Door Wind Load Determination Using ASCE 7 (TDS 177)*
- *Garage Door Wind Load Determination – Effective Wind Area (TDS 178)*
- *Wood Garage Door Inspection and Maintenance Guidelines (TDS 179)*
- *Wind Load Ratings for Non-Tested Garage Door and Rolling Door Sizes (TDS 180)*
- *General Code Inspection Guidelines for Wind Load (TDS 181)*
- *Technical Considerations for Dock Doors (TDS 182)*
- *Garage Door Component Substitution (TDS 183)*
- *Garage Doors and Tidal Surge Related Breakaway Construction (TDS 184)*
- *Thermal Bowing of Garage Doors with Bonded Core Sections (TDS 185)*

Technical Data Sheets – Commercial & Residential Garage Door:

- *General Code Inspection Guidelines for Sectional Garage Doors (TDS 151)*
- *Garage Doors & High Wind Events (TDS 152)*
- *Vertically Reinforced Sectional Garage Doors for Wind Load Conditions (TDS 153)*
- *DASMA Metal Gauge Chart (TDS 154)*
- *Residential and Commercial Wind Load Guides (TDS 155)*
- *Wood Horizontal and Vertical Back Jamb Detail Guidelines (TDS 156)*
- *Garage Doors and Foam Plastic (TDS 157)*
- *Glazing in Garage Doors (TDS 158)*
- *Garage Doors and Foam Plastics- Canadian Applications (TDS 159)*
- *Sectional Garage Door Terminology (TDS 160)*

- *Vehicular Access Doors and the Wildland-Urban Interface (TDS 186)*
- *Environmental Considerations for Exterior Doors (Sectional Doors; Rolling Doors and High Performance Doors) (TDS 187)*
- *Insurance Mitigation Factors for Homeowners Purchasing Garage Doors in Florida (TDS 188)*
- *Sound Transmission (TDS 189)*
- *Factors Affecting Spring Cycle Life (TDS 190)*
- *Sectional Garage Doors and Tornadoes: Wind Mitigation and Personal Safety (TDS 191)*
- *Securing Garage Doors During High Wind Events (TDS 192)*
- *Wind Exposure Categories (TDS 193)*
- *PSF versus MPH in Door Specifications (TDS 194)*
- *Garage Doors and Condensation (TDS 195)*
- *U-factor on Garage Doors and the DASMA Thermal Performance Verification Program (TDS 196)*
- *Water Infiltration Under the Bottom of a Sectional Door (TDS 197)*
- *Residential One-Piece Garage Door and Electric Operator Checklist for Home Inspectors and Consumers (TDS 198)*
- *Garage Door Installation Details with Prefabricated Wood I-Joists (TDS 199)*
- *Standard Lift Garage Doors with Jackshaft Operation (TDS 1501)*
- *The International Residential Code and Wind Load Labels (TDS 1502)*
- *Wind-Driven Rain and Sectional Garage Doors: Reasonable Expectations (TDS 1503)*



*To learn more about the Institute of Door Dealer Education and Accreditation,
please visit the IDEA website:*

dooreducation.com