

Rack and Pinion Elevator Buyers Guide

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Preface

Specifying and purchasing a rack and pinion elevator can be a daunting task considering the complexities of the various CODE requirements, myriad of drives, guide rails, brakes, and control systems offered in the marketplace.

Our goal in writing this guide is to bring together the information you need to give you a better understanding of the most important aspects of these machines and to help you compare them in a systematic way. This will be your short course in Rack and Pinion elevator design!

We'll offer details on these important machine elements:

- *General Machine Specifications*
- *CODE Compliance*
- *Safety – some very important items;*
 - *Rack and pinion gear design and Safety Factor*
 - *Safety Brake design and Safety Factor*
 - *Control system operation and safety features*
- *Durability - Useful Life at your location – usage cycle, environmental*
- *Traveling Cable Management*
- *Ease of Maintenance – proprietary or “off-the-shelf”*
- *Ease of Use - operational features; operator interface, communications, instructions*
- *Cost vs. Value - determine which machine is the best buy*

We will use the ASME A-17.1, 2004 revision, of the Safety CODE for Elevators and Escalators standards, as the baseline for comparison of these key elements in this guide. The relevant CODE for your location may be a different, so be sure to contact the Local Jurisdiction Permitting Authority before you select your machine. Additionally, there are other CODES for temporary use machines, such as for building construction, and for offshore equipment. This Guide is primarily written for permanently installed elevators designed in accordance with A-17.1.

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1 Introduction

1.1 Rack and Pinion Concept

A rack and pinion elevator is unlike the elevators you ride in office buildings. Those elevators use cables for hoisting the car with the drive motors typically located in an elevator machine room at the top of the elevator hoist way. A rack and pinion elevator is different; there are no hoist cables and the drive motors are mounted on top of the car. The drive gear, a pinion it is called, is attached to the drive motor and engages a permanently mounted gear track, called a gear rack, which is routed up and permanently mounted in the elevator hoist way. The big advantage to a rack and pinion drive is the positive engagement drive cannot slip like cable systems and they can be designed for use in harsh environments.

1.2 Common Uses

Rack and pinion machines are common in many industries, such as factories, bridges, offshore derricks, mines, dams, building construction, and many other industrial locations. Capacities range from 500 pounds to 10,000 pounds or more.

1.3 Special Purpose Personnel Machines

There are many applications requiring the transport of personnel for inspection and maintenance of facilities. A good solution for this is a permanently mounted rack and pinion elevator. As you would expect, elevators must conform to CODES, and in this case the most common CODE in use is the ASME A-17.1 Safety CODE for Elevators and Escalators. This CODE recognizes the need for these specialty machines and has provided for them in the CODE as Part 5, Section 5.7, classifying them as "Special Purpose Personnel". A primary distinction of this Part/Section is the limitation of Rated Load to a maximum 1,000 lbs, although there are other important CODE specifications which waive some of the requirements of larger freight/personnel machines. If you only need to transport authorized personnel and their tools and equipment, in a secure environment, such as a factory setting where the machine is not available for general use by the public, this classification should be considered. In some cases it is appropriate to request a variance on the Rated Load for a SPP machine which is usually granted.

2 General Machine Specifications

2.1 Determine the Specifications

Let's get started. First, define the general specifications baseline for the machine using Table 1 confirming the selected vendors will quote the requested specifications. Each vendor should specify each of the following;

- CODE revision the machine is to comply with and the relevant Part and Section, e.g. A-17.1-2004 Part 5, Section 5.7 Special Purpose Personnel Elevators.
- Load Rating to be used.
- Rated Speed required.
- Allowable wind speed operation limits for outdoor installations. (Some manufacturers prohibit operation above 35 MPH wind speed which limits the value of the system).

Table 1 General Machine Specifications (Sample)

	Vendor #1	Vendor #2	Vendor #3
List Vendors	Tower Elevator Systems, Inc.		
CODE Built To	A-17.1, 2004 revision		
CODE Part and Section	Part 4, Section 4.1 Part 5, Section 5.7		
Load Rating	1,000 pounds		
Rated Speed	100 FPM nominal		

This establishes the baseline for comparison. Next, we will examine the key elements discussed earlier.

3 CODE Compliance

3.1 Compliance is Crucial

CODE compliance is crucial for licensing and for liability concerns. Each vendor should be required to produce documentation for evaluation and confirmation of CODE compliance meeting your specifications. Any vendor refusing to produce supporting documentation should be excluded from your consideration.

The CODE is divided into Parts and Sections, e.g.

- Part 4, Section 4.1, *Rack and Pinion Elevators*
- Part 5, Section 5.7, *Special Purpose Personnel Elevators*
- Part 2 *Electric Elevators*
- Part 8, Section 8.3, *Engineering Test, Type Test, and Certification*

4 Safety

The safety of your riders is of utmost importance to you and your company. In evaluating machines for safety you should compare both the physical equipment and documentation provided by the manufacturer. Easy to read operating Instructions and signage can play a positive role in equipment safety.

4.1 Safety Factor Analysis

Here are some definitions we will use throughout this guide.

4.1.1 Table 2 Safety Factor Definitions

UBS	Ultimate Breaking Strength - The load imposed on an object that will cause deformation failure of the object.
SF	Safety Factor - The ratio to apply to the UBS of a material to calculate the Safe Working Load allowed.
SWL	Safe Working Load - The value result of the calculation in applying the SF to an UBS.
Formula: $UBS \text{ divided by } SF = SWL$	

5 Rack and Pinion Gear Design

The CODE requires the rack and pinion gears to be designed to an 8:1 Safety Factor using the ANSI/AGMA standard 2001-D04, with an assumption of a minimum 200,000 life cycles. This means the design “Safe Working Load” on the rack or pinion must not exceed 1/8th of their Ultimate Breaking Strength.

5.1 How to Compare Rack Gears

To compare gear racks you will need to know;

- Rack width.
- Tooth profile, e.g. 3 Dp 25 Pa.
- Steel strength properties with copies of the MTR’s, Mill Test Reports.

To insure the CODE requirements are met, require each vendor to furnish copies of their design engineering report showing each of these variables and the resultant allowable loads using the 8:1 CODE required Safety Factor.

Additionally, obtain copies of the steel Mill Test Reports to insure the steel strength matches the design expectations. *We have seen instances where imported rack was used without any assurance of steel properties and resultant Safety Factors. Unless you ask, there is no way to insure you are protected as the CODE requires.*

5.2 How to Compare Pinion Gears

Be aware; pinion gears are subjected to greater stress and wear as they are continually in contact any time the machine moves, unlike the rack which is only in use as the machine passes a given point. Generally, pinion gears will be designed ¼” or so wider with stronger steel than the rack to account for this and to insure positive engagement in case of minor misalignment.

5.2.1 Table 3 Rack Load Ratings Examples (Based on grade 4140 steel)

These are gross machine loads, not Rated Load capacity

Example	Rack Width	Single Pinion Drive Capacity with 8:1 SF	Dual Pinion Drive Capacity with 8:1 SF
1	1.5	4,365 lb.	8,730 lb.
2	2”	5,820 lb	11,640 lb.
3	2.5”	7,275 lb	14,550 lb.

6 Brakes – Normal and Safety

6.1 Normal Operation Brakes

Review the “normal operation” braking design, number of brakes, and confirm their rating for dynamic or parking application. The goal here is to get an understanding of how the brakes work, what causes them to engage, disengage, etc. Machines using Variable Frequency Drives, VFD, normally use the VFD drive for dynamic braking and motor brakes for parking only. Brakes used for dynamic braking vs. parking only will require maintenance much sooner.

6.2 Emergency Over Speed Brakes

In addition to normal operation brakes, the CODE requires a “Safety” emergency over speed brake designed to engage and bring the car to a safe stop in the event of an over speed condition. The Safety Brake will be subjected to high inertial loading during actuation, so they must be designed with proper Safety Factors to prevent failure.

- Review the design, number of brakes, and load rating to insure the brake is within its' design torque limits.
- Insure the Safety Brake is not the weak link in the drive system designed with a lower Safety Factor than the drives.

6.2.1 Centrifugal Brake

The traditional type of Safety Brake found on rack and pinion machines is a centrifugally actuated drum assembly mounted to a pinion driven shaft. Actuation occurs when internal fly weights mounted to the shaft are slung outward though centrifugal force if the shaft turns fast enough. The weights engage the cone brake drum through friction causing it to rotate, which tightens the brake and brings the car to a stop.

One shortfall of this type brake system is there is no reporting on readiness condition as the brake is a “dumb” device. Since corrosion or rusting may cause the brake to become inoperative with no indication, this is a serious concern. Also, it is somewhat difficult to test this brake which may require a person in the car to perform the test. Once the brake is set it can be difficult to un-set to rescue the car. *Review the various vendor Safety Brake designs carefully as this is a very important part of machine safety.*

Also, pay particular attention and verify the load rating of any brake. If a machine uses multiple drives and only has one Safety Brake, there is likely a 50% or greater loss of Safety Factor for the brake. This should be avoided.

6.2.2 Disc Brakes

Some machines use an enclosed multi-disc brake. Typically, this type brake will be spring actuated and electrically disengaged, which allows electronic monitoring of the brake status, a very desirable feature.

6.2.3 CODE Loophole

We imagine the CODE was written expecting a single drive machine when the Safety Brake language was written. Over time, and to take advantage of rack cost savings, dual or multiple drives have become common. Although the CODE is silent on the number of Safety Brakes required, we think the Safety Factor for the brakes should equal that of the drives and rack gears.

- All loads transfer through the gear teeth, so this is the limiting factor on rack and pinion capacity and Safety Factor determination.
- If there are two pinion drives, there should be two Safety Brakes to maintain the pinion-tooth-to-rack-tooth gear engagement 8:1 Safety Factor.
- If there are two pinion drives and only one Safety Brake pinion engagement, there is a 50% reduction in Safety Factor at this pinion engagement point. We do not think the CODE intended for this loophole de-rating to be allowed.

6.3 Post Actuation Safety Maintenance

Review and compare the required procedure for resetting or servicing the Safety Brake mechanism after actuation. If the unit must be returned to the factory for service and calibration you may be out of service for an extended period, plus the cost of removal and reinstalling the brake. This can also be an indication of an inferior design which causes damage to the Safety Brake if used.

6.3.1 Higher Technology

A preferred design causes the Safety Brake to **actuate each time the car is stopped and is continuously electronically monitored by the controller**. This insures the brake meets preset state-of-readiness criteria and prevents use of the machine with an inoperable brake; a huge improvement over “dumb” unmonitored brakes. The fact the brakes engage every time the car stops insures the device is “limber” and ready to work.

6.4 Safety Brake Governor

The governor is the device that causes the Safety Brake to engage in an over speed condition. Review the Safety Brake governor design with particular attention to Safety Brake actuation speeds. The CODE minimum is 115% of Rated Speed. The higher the actuation speed (percentage over Rated Speed) the higher the “G” forces imposed on the riders and equipment when the brake engages. Compare the actuation speed and percentage over Rated Speed and you will find some are quite high. A lower emergency braking actuation speed/percentage is an important safety feature.

Keep in mind, the entire machine gross load including dynamic loading is imposed onto the pinion engagement of the Safety Brake. If a machine requires two drives, but only has one Safety Brake pinion, that pinion is 50% overloaded when compared to the drive system. To avoid this, require an equal number of Safety Brakes as there are drives.

6.5 Safety Brake Testing

Operational testing of the Safety Brake is important to insure the brake is functional. If a brake sits unused for long periods the internal parts can lose lubrication or become corroded. The only sure method of proving a brake is ready to work is to check it. Review each vendor’s maintenance and testing specifications. Some only require actual Safety testing on 5 year intervals! We think this is far too long a period to allow a brake to sit untested. This 5 year specification may be the result of the difficulty of testing some of the older braking systems. Current technology can allow quarterly or annual testing, which is much better.

6.5.1 Higher Technology

Compare the means of actuating the Safety Brake equipment. It is desirable if the Safety Brake testing can be performed by a technician at ground elevation remotely, using a touch screen interface, HMI, rather than from inside the car.

7 Safety Brake Certification

Safety Brake maintenance can be very expensive. Some manufacturers brakes, including those using the industry standard centrifugal brake, must be re-certified annually or every three years. This requires labor to remove and ship the brake, labor replace with a spare or have the machine out of service until the recertified brake is returned, and then labor to reinstall the recertified brake.

The Tower Elevator System, Inc. brakes **only require re-certification every 10 Years**. This improvement in utility function is a big savings for our customers; less machine down time removing brakes and less maintenance costs.

8 Control Systems

8.1 PLC (Programmable Logic Controllers)

It is common to see PLC's (Programmable Logic Controllers) used for processing controller operation. PLC devices are very common in industry for automation of motor processes around the world. In an elevator application involving personal hazards or risk of serious damage to property, the PLC must be rated and manufacturer approved for elevator controller use. *Require your vendors to provide proof from the PLC manufacturer of approval of the PLC for elevator controller use.*

Insure the controller is UL classified for elevator operation by checking for the vendor listing on the UL website, <http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm>.

8.1.1 Higher Technology

Consider specifying a "Safety PLC" vs. non-Safety PLC for your controller. These Safety PLC devices are designed to be "fail safe" specifically for applications involving risk of injury, death, or property damage. If a PLC is used, require the vendor to provide proof from the PLC manufacturer that it is approved for use in an elevator control application. This is a very important safety item, as non-safety PLC's can partially fail without warning and cause a hazardous situation to exist. Safety PLC's have been CODE required in Europe for some time and may become so for A-17.1 in the future. The safety benefits far outweigh the initial cost penalty, so we suggest you specify a Safety PLC and take advantage of this technological advancement.

8.2 Operator Interface

The easier a machine is to operate the better. The operator panel should be configured in a manner that is obvious to a new user and incorporates signage to assist quickly. A handset accessed pre-recorded voice messaging system with operation and safety recordings can be a bonus in assisting your riders.

8.3 Floor Landing Interface

Each floor call panel should include a call button which illuminates when pressed and signage to indicate the floor location.

9 Communication Systems

9.1 Intercom System

Compare the voice communications systems. There are feature distinctions between "intercom" and "telephone" systems which can add significant benefits for safety and utility.

9.2 Network Connected System

The ability to connect to an outside line for emergency 911 calling or to an inside phone network can be an invaluable tool in an emergency. Battery backup systems should keep the communication system operable for at least 3 hours in the event of a power outage. Some systems may offer voice messaging for safety information, site information, or other benefit.

10 Traveling Cable Management

10.1 Self Coiling

Some manufactures use a barrel and let the traveling cable self coil into the barrel. This may be reliable for a very short height machine, but generally, this is probably not the best method to manage this high voltage and important cable.

10.2 Trolley Carrier

A trolley is described as a weighted pulley guided on the elevator rails, free hanging under the elevator car. The traveling cable is routed from the car, down and around the trolley pulley, and then back up the hoist way to a junction box mounted approximately ½ way up the hoist way. As the car travels, the trolley also travels under the car, on guide wheels similar to the car guide wheels. The traveling cable loop is held taught by the weighted trolley. The challenge with this design is managing the free hanging cable from the trolley up to the car on one side of the trolley pulley and the other loose cable running from the trolley pulley wheel back up to the junction box mounted in the hoist way. Also, when the car is not in use and is sitting at the base landing, the free hanging cable running up to the junction box is exposed to wind, abrasion, and UV.

10.2.1 Smart Reel

The Smart Reel is a patented system only available from Tower Elevator Systems, Inc. This system is comprised of;

- 1) A reel located at the base landing area which winds up and lets out the traveling cable as the car moves up and down the hoist way.
- 2) A slotted conduit running the full height of the elevator travel to contain the traveling cable, which protects the cable. The conduit vertical slot opening width is smaller than the traveling cable diameter, so the cable is contained inside the conduit. As the car travels, the traveling cable is supported by a *lift bar* which is attached to the elevator car. This lift bar protrudes into the slotted conduit and lifts the traveling cable. A short section of the cable is converted to a ribbon shape at the lift bar, allowing the cable to exit the slot for connection to the drive motor and car operating panel.

10.2.2 Higher Technology

Having the high voltage traveling cable protected from wind, ice, UV, and abrasion is a big improvement over the trolley system, especially in outdoor or hazardous locations.

11 Rescue Lowering (Not CODE required)

11.1 Rescuing Stranded Riders

In the event of a car travel over speed, the Safety Brake is required to actuate, causing the car to come to a safe stop. In the event of an over speed condition, controller malfunction, or a power loss, the occupants may be stranded, unless the car is equipped with a rescue lowering system. Review the rescue lowering systems, if offered. Some systems are designed to allow continuous use and others only support intermittent use with frequent stopping to allow the system to cool. Evaluate the actual procedure for use.

It can be dangerous for occupants to exit the car to climb down from a stranded car, so a full function properly designed self rescue lowering system is essential.

11.1.1 Higher Technology

Some systems require simply pushing and holding a button as opposed to others, which require pulling a lever to release and “slip” the brakes. In a rescue lowering situation, uncomplicated ease of use for an anxious operator will be major factor in a successful rescue.

12 Manufacturing Quality and Machine Durability

12.1 Materials used for fabrication

12.1.1 Fabrication Materials

Depending on the installation location, a machine may be built with ferrous metals and coated with paint or may need to be built with stainless steel or hot dip galvanized materials. First, make a determination of the environmental conditions at the site, including temperature, wind, ice, salt air, corrosive atmosphere, dust, moisture, or other factors. Historically, tubular or pipe materials often rust out from the inside and should be avoided. A cheap machine that rusts out in 5 years may not be such a good buy after all. Any painted finish is less durable than hot dip zinc or galvanized coatings and will likely require additional maintenance over time.

12.1.2 Manufacturing Quality Control

Insure the machine meets the American Welding Society, AWS, CODE D1.1, which requires documentation to insure all steel meets the design for strength and that the welding procedures and welder qualifications meet the CODE standards. Consider making, or hiring an independent inspector to make, physical site inspection of the fabrication facilities to insure your product is produced in accordance with the design. At the minimum, require copies of the Quality System governing the manufacturing and copies of the AWS welding procedure specification, WPS, and welder qualifications. You should also require copies of the Mill Test Reports, MTR's, to insure the steel meets the design specifications.

12.1.3 Heavy Usage Machines

Your bidders need to know how hard (number of trips a day, percentage of loading) this machine will be subjected to. Require this usage cycle to be stated in the proposals. Ask each vendor to detail the options available to maximize heat dissipation and power components life for a heavy usage machine.

13 Ease of Maintenance

13.1 Procedures

13.1.1 Documentation

The documentation should be specific to your installation, including lubrication intervals based on your requested usage, and considering the site environmental conditions.

13.1.2 Ease of performing procedures

Get a copy of the Owner's Manual and review the interval and actual procedures to see how difficult or complicated maintaining the machine will be. The better the documentation, the less training your operator will need, and there will be less likelihood of errors in the maintenance of your machine.

13.2 Replacement Parts

13.2.1 Proprietary or "Off-the-Shelf"

Custom, patented, or proprietary components can be a negative for owners. Inquire of each vendor regarding these type parts. The more off the shelf components, the greater assurance you have of parts availability in the future. In particular, inquire about the Safety Brake cost, availability, maintenance, and testing requirements. Another benefit of off the shelf parts is access to manufacturers design data, often on their web sites.

14 UL or Other Certifications

14.1 Controller

The ASME A-17.1 CODE requires the controller to be certified. Get assurance of this.

14.2 National Electric CODE, NEC

There are NEC requirements for many aspects of these systems. Get assurance the machine meets the applicable NEC requirements for the traveling power cable amperage and voltage drop at your site based on site voltage, motor horsepower, cable length, and wire gauges.

15 Dual Drive Discussion

15.1 Why Multiple Drives

In designing a rack and pinion elevator system, especially for taller installations, it is sometimes desirable to use more than one drive unit atop the car. Dual drives are common. This is done for a variety of reasons; however, the key reason for having multiple drives is to optimize and reduce the rack size needed to carry the load while maintaining the 8:1 Safety Factor.

15.2 Understanding Rack Loading

Let me explain. When two or more drives are positioned above each other on the same rack, *each drive can carry the full amount of the rack design load*. If you review **Table 2**, you will see the SWL gross load of a 2" wide rack is 3,086 lbs. This means that *a single pinion* running on this 2" rack can carry 3,086 lbs gross load while maintaining a SF of 8:1 per the CODE.

15.3 The Dual Drive Advantage

With a dual drive machine, the gross load can be 6,172 lbs. Each drive pinion and rack engagement is **independent** and **can carry the full rack load rating**. This allows a system to be built with 50% less rack capacity than would be needed for a single drive machine. Gear rack is an expensive component of a system and on taller systems the rack savings can easily offset the cost of an additional drive.

As noted earlier, dual drives can save rack cost by reducing the rack width required for a given gross load by sharing the load between multiple pinions on the same rack, but there is another distinct advantage to multiple drives; *redundancy*. Redundancy adds to statistical safety.

15.4 Safety Brake; The Most Critical Component

So, we can conclude it is good to have dual drives for redundancy in pinion security and for normal braking, but what about the Safety Braking system? On a single drive machine, one Safety is expected and adequate as it can equal the drive Safety Factor.

On a multiple drive system *where the rack width has been reduced for rack efficiency*, you must have an equal number of Safety Brakes to maintain the 8:1 SF of the rack. Pay special attention to the design of Safety Braking systems on multiple drive machines to insure they maintain the 8:1 SF as this is the most important component in your machine. Be aware; there are instances of dual drive machines being sold that do not meet CODE for rack design. Demand your vendor provides a properly designed and CODE compliant 8:1 Safety Factor rack and pinion gear.

15.5 The Dual Drive Dilemma

A dual drive machine using an optimized (reduced width) rack *and fitted with only one Safety Brake* can only give a 4:1 Safety Factor at the brake pinion-to-rack engagement, due to the reduced rack width. And that assumes the brake itself is properly designed for this double loading.

Be aware, a dual drive machine with a single Safety Brake is a serious Safety Factor reduction to be avoided. The only way to obtain rack optimization with dual drives is to have dual Safety Brakes. *This is the dual drive dilemma.*

*Applying the correct Safety Factor
to the drive pinions, gear rack and Safety Brake pinion
is imperative to avoid CODE violation and placing
riders at risk of reduced Safety Factors*

16 Product Comparison

16.1.1 Table 4 Head-to-Head Comparison

Item #	Feature	Best Answer	Vendor 1	Vendor 2	Vendor 3
	<i>SAMPLE FORM</i>		<i>Tower Elevator Systems, Inc.</i>		
1.	Number of drives	Multiple preferred	2		
2.	Number of Normal Operation Brakes	Equal to # of drives, multiple preferred	2		
3.	Number of Safety Brakes	Equal to # of drives, multiple preferred	2		
4.	Safety Brake engineering rating available	Yes	Yes		
5.	Rack has been optimized due to multiple drives	Either Yes or No is OK	Yes		
6.	What is the rack width? <i>Enter here for ease of comparison vendor to vendor.</i>		3"		
7.	Rack meets the 8:1 SF <u>at the Drive(s)</u> pinions engagement point(s). <i>Do not accept less than 8:1 SF.</i>	Yes	Yes		
8.	Rack engineering showing 8:1 SF available.	Yes	Yes		
9.	Rack meets the 8:1 SF <u>at the Safety Brake(s)</u> pinion engagement point(s). <i>Do not accept less than 8:1 SF.</i>	Yes	Yes		
10.	Rack and pinion steel origin.	Domestic	Domestic		
11.	Rack steel Mill Test Reports available	Yes	Yes		
12.	* NFPA 79-2002 Fail Safe fault reporting to the Operator display panel (HMI)	Yes	Yes		

13.	Visual HMI operator display of Safety Brake status	Yes	Yes		
14.	Brakes are "Off the shelf" AGMA rated readily available, vs. proprietary.	Yes	Yes		
15.	The Safety device stands unused for long periods of time unmonitored.	No	No		
16.	* Safety Brake system is continuously monitored by the controller for operational readiness.	Yes	Yes		
17.	Note trip speed percentage over Rated Speed. <i>The lower the percentage, the less G force loading.</i>	15-20%	20%		
18.	Safety Brake can be tested remotely, not requiring a person in the car.	Yes	Yes		
19.	Does Safety Brake require return to the manufacturer for calibration after actuation?	No	No		
20.	Cost for replacement Safety Brake. <i>Enter here for ease of comparison vendor to vendor.</i>		\$3,950		
21.	Machine has a Self Rescue feature to avoid stranded riders.	Yes	Yes		
22.	What is the continuous lowering distance rating for the Self Rescue system?	Unlimited	Unlimited		
23.	How is the Self Rescue descent speed controlled; slipping brake/clutch or automatic speed governor	Automatic	Automatic		
24.	Is the controller monitored by a Safety PLC? See Note 1 below	Yes	Yes		
25.	If a PLC is used, will the vendor provide proof of approval for elevator use by the PLC manufacturer	Yes	Yes		
26.	What is the maximum MPH wind speed operation allowed (outdoor installations)	Higher is better	No limit per local wind zone		

* NOTE 1. Digital monitoring, actuation, and disengagement of the Safety Brake is an improvement in reliability and safety when controlled with a Fail Safe rated PLC meeting NFPA 79-2002 Category I, Section 9.4.3 and 11.3.4, for safety-related control functions and having been certified with a COC for A17.7 3.4.6 and 3.4.9.

17 Final Analysis

So now you see; evaluating a rack and pinion elevator is not a simple matter. In making your choice, keep the safety of your riders and liability exposure the highest priorities. Relative cost must be measured after a thorough consideration of these issues plus ease of operation, maintenance, and quality of materials, which will support a longer useful life.

The best machine value may not be the cheapest to purchase day one, but cost of ownership will escalate quickly if there are safety incidents, down time due to poor quality and difficulty in obtaining repair parts, or the product rusts out and must be prematurely replaced.

These machines are not a commodity suitable for “apples to apples” comparison and lowest price equals best deal decisions. The more you understand about them, the easier it gets to see the differences.

18 Product and Technology Support

Safety Rated Industrial PLC Controllers (NFPA 79-2002)

Siemens Fail-safe Controllers

SIMATIC Safety Integrated Industrial PLC Safety systems provide the highest level of safety for humans, machines and environment. They are used to prevent accidents and damage resulting from a fault or malfunction.

The safety SIMATIC controllers (SIMATIC Safety Integrated) monitor themselves, detect faults autonomously and immediately change into or remain in a safe mode when a fault occurs. They are optimized for use in production engineering and provide air-tight safety for all its many facets.

19 Biography

James Tiner, “Jim”, has over 35 years working in industrial construction, much of it with industrial elevators, including construction of some of the worlds’ tallest industrial elevators (up to 1,950’). Mr. Tiner is an NAEC Certified Elevator Technician and inventor of the Smart Reel cable management system. Jim is currently CEO of Tower Elevator Systems, Inc., guiding the development and manufacturer of the Trac-Cab rack and pinion elevator systems.