This booklet is a supplemental guide for those who want to use the Educational Focus book to acquire continuing-education contact hours. The Educational Focus book is a compilation of 55 articles from ELEVATOR WORLD published in 19 magazine issues between March 2002 and October 2003. The book is available from Elevator World at www.elevatorbooks.com. Sixteen of nineteen chapters (49 of the 55 articles) can be used to receive contact hours of continuing education. A maximum of 21 hours of credit is possible from those chapters if all approved tests are passed.

- The National Association of Elevator Contractors (NAEC) Education Committee has approved all 16 chapters (21 hours) for credit toward Certified Elevator Technician (CET®) recertification.
- The NAEC Education Committee has approved 11 chapters (16 hours) toward Certified Accessibility Lift and Residential Elevator Technician (CAT®) recertification.
- NAESA International (NAESA) Certification Board has approved all 16 chapters (21 hours) toward Qualified Elevator Inspector (QEI) recertification.

On the next 24 pages are the Learning Objectives, Learning Reinforcement Questions and Learning Assessment Questions (final exam) for each chapter or grouping of chapters, as well as instructions and costs for receiving credit.

Costs: As a general rule contact hours of credit for text-based material are $30 for the first contact hour and $20 for each subsequent hour. However, the entire package of exams can be purchased at a discount when bought all at once; and the exams can be taken over a two-year period.

- The Educational Focus book costs $63.25 ($53.76 for subscribers).
- Note: This Educational Focus Guide to CE is FREE. It may be downloaded and printed anytime from www.elevatorbooks.com.

Cost of all tests for 21 hours of credit for a CET or *QEI: $430 ($365 for subscribers). Tests bought individually would cost $570. (*QEI applied for 9/1/07)
- Cost of all tests for 16 hours of credit for a CAT: $330 ($280 for subscribers). Tests bought individually would cost $420.

Instructions:
- Purchase the Educational Focus book if you do not already own it.
- Download the Educational Focus Guide to CE.
- Read the chapter or grouping of chapters for which you wish to receive credit.
- Read the chapter or grouping of chapters in the Educational Focus book.
- Study the Learning Reinforcement Questions (in this booklet) for the chapter or grouping of chapters for which you wish to receive credit.
- Purchase the test or package of tests at www.elevatorbooks.com if you have not already done so. You will receive a login and password at that time.
- Answer the Learning Assessment Examination Questions (in this booklet) for that chapter either online at www.exambuilder.com or fill out the elevator World Continuing Education Reporting Form (at the end of this booklet) for the corresponding chapter and submit by mail with payment.
- 80% is a passing grade. If you take the test online, you will know immediately if you passed. Two free retakes are included in the purchase price of the test.
- Elevator World will send you a certificate for the contact hours of continuing education you have earned.
- Elevator World will keep a record of your tests and scores for 7 years.

Contact Elevator World for more information: (251) 479-4514 – Tricia Cartee, ext. 123, Brad O’Guynn, ext. 138 or Robin Lawley, ext. 119.
Chapter 1 – ELEVATOR CONTROLLERS

**Study Material:** Four articles
*(Educational Focus pages 1-19)*

**Credit available:** Two contact hours

**Approved by NAEC for CET and CAT**

**Applied to NAESAI for QEI**

**Cost of test:** $50.00 ($42.50 for subscribers)

if not purchased in a package

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**Learning Objectives**

*After reading these articles (pages 1-19), you should have learned about:*

- Four different types of controller systems and their applications
- Diagnosing problems with controller systems
- Installation peculiarities of the different controller systems
- Testing controller systems prior to turnover
- Maintenance issues involving the controllers in these articles

**Learning Reinforcement Questions**

- What are the application differences between the controllers?
- What is the most important thing to remember when troubleshooting microprocessor control systems?
- What are programmable profiles for inspection?
- What are “data traps”?*
- What voltage changes affect communicating with controllers?
- Troubleshooting controllers requires what type of knowledge?
- In the Swift Wizard software, how are numerical parameters adjusted?
- What does a technician use “data traps” for in the controller Performa?
- What systems must be closed before the microprocessor will allow the elevator to move?
- What is the most important thing to remember when troubleshooting microprocessor-based control systems?

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**TROUBLESHOOTING MICROPROCESSOR BASED CONTROL SYSTEMS**

*by Ian MacMillan, O. Thompson Co.*

6. To accurately diagnose and correct problems with elevator control systems using microprocessors, it is necessary to have:
   - An intimate knowledge of computers and solid-state devices.
   - A good working knowledge of the basic devices common to all elevator controllers.
   - An engineering degree.
   - All of the above.

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**Learning Assessment Examination Questions**

**GALAXY ELEVATOR CONTROL INSTALLATION AND ADJUSTMENT**

*by Mark Duckworth, GAL Manufacturing Corp.*

1. In a galaxy controller, all machine-room wires are connected to:
   - Each other.
   - Relay switches.
   - Terminal blocks.
   - None of the above.

2. With a Galaxy controller, the perforated steel-tape leveling system is kept taut by which method?
   - A spring attached at the bottom of the hoistway.
   - The weight of the tape itself
   - A counterweight
   - A weight at the end of the tape

3. How many field-adjustable variables are there for the car and group combined in the Galaxy controller?
   - 26
   - 46
   - 64
   - 52

4. In the Galaxy controller, what is the constant rate to increase to top speed or decrease to leveling speed?
   - Rollover jerk rate.
   - Acceleration and deceleration rates.
   - Soft-start rate.
   - None of the above.

5. What does the Galaxy controller provide at each terminal to guarantee that the car slows down and stops at the terminal?
   - A back-up/slow-down system.
   - An over-run switch.
   - A potentiometer.
   - A speed-profile adjustor.

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**ADJUSTING COMPUTERIZED ELEVATOR SYSTEMS**

*by Barry Finch and Rob Isabelle, CEC*

11. When using Swift Wizard software, what are the values called that are needed at initial installation?
   - Start-up values.
   - Car parameter data.
12. What parameters define brake operation at the start of a trip in the Swift Wizard software?
   a. Brake-start-lifting voltage.
   b. Brake-lifting voltage.
   c. Brake-lift time.
   d. All of the above.

13. In the Swift Wizard software, how are numerical parameters adjusted?
   a. By typing in new numerical parameters.
   b. By clicking the plus and minus keys to raise or lower the selected parameters.
   c. By pulling a slide bar with the computer mouse.

14. What does the diagnostic screen in Swift Wizard show?
   a. The current operation of any selected car.
   b. A previous operation stored within the controller.
   c. A 30-second screen capture.
   d. All of the above.

15. What color is the title bar of the Swift Wizard diagnostic screen when viewing captured or stored data?
   a. Red.
   b. Blue.
   c. Green.
   d. Yellow.

16. Many common problems with encoders are the result of what?
   a. Failure to run wiring in a separate conduit.
   b. Failure to perform field surveys.
   c. Mounting the encoder on the shaft.
   d. None of the above.

17. When installing the IMC Performa, what must the system learn before attempting to run the car on automatic operation?
   a. Building height.
   b. Building floor heights.
   c. Floor population.
   d. Up-peak time.

18. Before attempting to run Performa at contract speed, the installer should start at ____ of contract speed and monitor motor field, armature voltage and motor current while increasing in 10% increments.
   a. 75%
   b. 80%
   c. 50%
   d. 35%

19. Which of the following is not one of the three programmable inspection profiles provided by Performa?
   a. Inspection Velocity/Low.
   b. Reduced Inspection.
   c. Inspection Velocity/High.
   d. Locked Inspection.

20. In Performa, the service technician uses a “data trap” to perform what function?
   a. To review controller status during the six-second period immediately prior to an event.
   b. To review all similar events in a 24-hour period.
   c. To review controller status during the ten minute period immediately prior to an event.
   d. To record time between similar events.

Chapter 2 – ELEVATOR DOOR OPERATORS

Study Materials: Two articles (Educational Focus pages 19-30)
Credit available: Two contact hours
Approved by NAEC for CET and CAT
Applied to NAESAI for QEI
Cost of test: $50.00
if not purchased in a package

Learning Objectives
After reading these articles (pages 19-30), you should have learned about:
- The operation of several different door operators
- How to keep a door-operator package working properly
- What the main difference is in elevator controllers
- The kinds of door controllers used for glass doors or doors on unusual size
- The electrical-safety issues involved in installing door operators

Learning Reinforcement Questions
- Why do door operators have the most potential to dissatisfy building owners/manager?
- What is one of the biggest mistakes made in the installation of door closers?
- What are the two common designs for door drives?
- What three categories do door-operator control systems fall into?
- Why are closed-loop VVVF controls becoming so popular?
- What are the advantages of a closed-loop VVVF system?
- What types of door-operator package are needed for glass doors?
- What is the most common maintenance required for door-operator packages?
- What element of the elevator system has the potential to satisfy or dissatisfy a building manager?
- What is a system capable of adjusting the real-time operation to match the prescribed operation called?

Learning Assessment Examination Questions

DOOR OPERATORS
By Michael A. Von Dohre and Tony Cecere, Atlantic Tech Systems, LLC

1. What is the main difference among various elevator manufacturers’ door-operator controllers?
   a. Programmer language
   b. Voltage for outputs and inputs
   c. Power supply
   d. The user friendliness of the system
2. What types of manufacturers’ boards may be found in door operators?
   a. Microprocessor and cell-based.
   b. Radio-controlled and relay-logic.
   c. Relay-logic and microprocessor.
   d. Microprocessor and cell-based.

3. How many volts does the Atlantic Tech Systems microprocessor door operator require?
   a. 110 V AC.
   b. 220 V AC.
   c. 90 V AC.
   d. 230 V AC.

4. What does the door-control board of the Atlantic Tech Systems door operator monitor?
   a. The leveling.
   b. The door motor.
   c. The power source to the door.
   d. None of the above.

5. What allows different companies’ elevator equipment to be compatible with a variety of door-controller-company equipment?
   a. Relay flexibility.
   b. Power-source variation.
   c. Multivoltage boards.
   d. None of the above.

6. How many adjustment points for field adjusting does the 90-VDC operator package have?
   a. Two.
   b. Four.
   c. Eight.
   d. Six.

7. What types of door-operator package are needed for elevators with glass doors?
   a. Hydraulic and/or rack-and-pinion.
   b. Gearless and asynchronous.
   c. Linear motion and hydraulic.
   d. Geared and hydraulic.

8. What is the most common maintenance required for door operator packages?
   a. Visual check during regular maintenance visits.
   b. Grease and oil.
   c. Door alignment.
   d. Chain replacement.

9. What is the way to keep a door operator working properly?
   a. Keep the track clear of obstructions.
   b. Keep every component free from dirt, grease and oil.
   c. Buffer the power source.

10. What “enemy” increases callbacks for the door operator?
    a. Smoke.
    b. Toxic waste.
    c. Dirt.
    d. Grease.

11. Which tool is necessary for use in troubleshooting the door-operator package?
    a. A standard voltmeter.
    b. Fuses.
    c. Jumpers.
    d. A non-conductive screwdriver.

12. When troubleshooting all door operators, what first step should the technician always take?
    a. Perform a simple test of the open- and close-door sensors.
    b. Perform a visual inspection of the entire system.
    c. Perform a visual inspection of the board.
    d. Check that you have 12 VDC on the power-supply plug black and white wires.

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**PASSENGER ELEVATOR DOOR OPERATORS 101**
by Doug Witham, GAL Manufacturing Corp.

13. Which element of the elevator system has the potential to satisfy or dissatisfy a building manager?
    a. Design of the cab.
    b. Speed of the elevator-system response.
    c. Door-operating equipment.
    d. Floor-to-floor time.

14. What are the two different designs used for driving door panels called?
    a. Asynchronous and harmonic.
    b. Center-driven and linear.
    d. Harmonic and gearless.

15. Which door drive is more complex but offers more stability and higher tolerance?
    a. Harmonic.
    c. Center-driven.
    d. Gearless.

16. Which category below is not one of the three door-operator control systems?
    a. Cam & contact resistance controls.
    b. AC open-loop controls.
    c. Cam & contact solid-state controls.
    d. Closed loop/variable-voltage, variable-frequency (VVVF) controls.

17. Which category of door operator requires more knowledge and time to set and maintain?
    a. Cam & contact resistance controls.
    b. AC open-loop controls.
    c. Cam & contact solid-state controls.
    d. Closed-loop/variable-voltage, variable-frequency (VVVF) controls.

18. What is a system capable of adjusting the real-time operation to match the prescribed operation called?
    a. Self adjusting.
    b. Intelligent design.
    c. Closed loop.
    d. Self actualized.

19. True or False: In a closed-loop control system, the timing of the door-open and -close cycle is essentially the same with the hatch doors connected or disconnected.
    a. True
    b. False

20. What is one of the biggest mistakes seen by GAL in door-operator installation?
    a. An attempt to loosen tension on the door closer to ease operation
b. An attempt to overpower a binding door panel by increasing tension on the closer.
c. An attempt to adjust the door alignment with the door operator in open position.
d. An attempt to adjust the door alignment with the door operator in closed position.

21. True or False: It is normal for car doors to meet slightly off center.
   a. True
   b. False

22. When fine tuning door operation, which aspects can be adjusted?
   a. The point in the cycle where a function is activated.
   b. The point in the cycle where a function is deactivated.
   c. The magnitude or power.
   d. All of the above.

23. What type of door operator may need special grounding requirements?
   a. Cam & contact resistance controls.
   b. AC open-loop controls.
   c. Cam & contact solid-state controls.
   d. Closed loop/variable-voltage, variable-frequency (VVVF) controls.

24. Adjusting the magnitude of a function requires meeting the following criteria.
   a. Smooth and quiet operation.
   b. Doors must not “slam.”
   c. Staying within code parameters for closing force and kinetic energy.
   d. All of the above.

25. Which modern door-operation feature allows the technician to adjust door operation in two or more cars that need to perform the same function?
   a. Multifunction car adjustment.
   b. Download/upload for multi-car group.
   c. Group works.
   d. Repeat performance.

Learning Reinforcement Questions

• Why is an inexpensive filter a real money saver?
• What are the innovative features of the UV-5 hydraulic control valve?
• What two things affect the pressure in a hydraulic system?
• Why are hydraulic elevators considered safer in certain emergency situations?
• The pressure-relief valve should be set at what percentage of the working pressure?
• What are the reasons for an uneven ride?
• What is the standard to determine if a valve must be serviced for leakage?

Learning Assessment Examination Questions

HYDRAULIC ELEVATOR CONTROL VALVES AND POWER UNITS
by R. Kirk Muller, Maxton Manufacturing Co.

1. True or False: Hydraulic oil in the hydraulic elevator system requires maintenance like any other component.
   a. True
   b. False

2. In a hydraulic elevator system, why would you find welding slag, plastic and metal bits, or Teflon tape contaminating the oil?
   a. Improperly installed pipe threads.
   b. Inadequate cleaning of the inside of the pipe after machining.
   c. Other trades working in the vicinity of the equipment.
   d. All of the above.

3. What device can a technician employ to assure the quality of the oil in the system?
   a. An oil pre-cleaner.
   b. A tank discharge filter.
   c. A coffee filter strainer.
   d. A oil change-out schedule.

4. What is the benefit of repositioning the valve (from the obsolete under-tank position) to above the tank in a modernization?
   a. It eliminates the need for tank shut-off valves to perform control-valve maintenance.
   b. If re-piping is needed, it pays to put it in a more-accessible position.
   c. It provides a safer condition for the mechanic when adjusting.
   d. All of the above.

5. What component has reduced the size and cost of power units?
   a. Submersible pump/motors.
   b. Reverse valves.
   c. Direct discharge valves.
   d. None of these.

6. On a Maxton hydraulic control, the technician should know something is seriously amiss if he finds which situation?
   a. The oil is dark.
   b. The tank is dented.
   c. The control valve requires constant adjustment.
   d. There is a bitter smell in the machine room.

7. Who should rebuild hydraulic control valves?
   a. It is simple enough for the technician to do the job.
   b. It should only be done at the shop.

Chapter 3 – HYDRAULIC ELEVATORS

Study Materials: Three articles
(Educational Focus pages 31-38)
Credit available: One contact hour
Approved by NAEC for CET and CAT
Applied to NAESAI for QEI
Cost of test: $30.00 if not purchased in a package

Learning Objectives

After reading these articles (pages 31-38), you should have learned about:
• The steps to take to avoid hydraulic failure
• The outline for modernization of obsolete hydraulic components or systems
• The features of the UV-5 hydraulic control valve
• Why the advent of the submersible pump has reduced component size
• Why control valves should not need constant adjusting, and what to do if they do
c. It should be done by the manufacturer.
d. A local machine shop can do it.

UNITIZED HYDRAULIC CONTROL VALVES
by Abe Salehpour and William Lawrence,
Elevator Equipment Corp.

8. On the EECO UV-5 pump, what is innovative about the pump inlet mount, a clamp ring bolted to the body with high-tensile socket-head cap screws?
   a. It allows the valve to be aligned without a pipe wrench.
   b. It allows for a variety of steel fittings to suit any pump unit.
   c. It allows the valve to be swiveled in any direction.
   d. All of the above.

9. What two things affect hydraulic pressure sensed by the motor?
   a. Gross load on the elevator platform and size of piping from pump.
   b. Size of the tank and pumping distance.
   c. Gross load on the elevator platform and internal resistance of the hydraulic system itself.
   d. Internal resistance of the hydraulic system itself and size of piping.

10. What type of hydraulic relief valve opens the set pressure and either holds that pressure or drops it slightly as the bypass valve unloads (opens)?
   a. Pilot-operated.
   b. Direct-operating.
   c. Spring-operating.
   d. Spring-loaded.

11. What is the benefit of “quick-disconnect” EECO valves?
   a. They can be removed quickly for cleaning and maintenance.
   b. They allow moving pressure gauges from the cylinder port to the pump port without tools.
   c. They sense internal resistance and disconnects the valve before pressure can build.
   d. None of the above.

12. Describe what occurs when the system “dead-ends.”
   a. Pressure is trapped in the cylinder port.
   b. The check valve closes.
   c. The piston bumps against the stop ring.
   d. All of the above.

13. What is the EECO recommendation for all pressure gauges?
   a. They should be liquid filled and calibrated to 1,00 PSI.
   b. They should be vacuum type and calibrated to 1,00 PSI.
   c. They should be liquid filled and calibrated to 1,000 PSI.
   d. They should be vacuum type and calibrated to 5,000 PSI.

14. ASME A17.1 Rule 303 states that pressure relief value may be set up to ____ % of the working pressure measured at the valve.
   a. 100%
   b. 200%
   c. 125%
   d. 150%

SAFETY AND SERVICING OF HYDRAULIC ELEVATORS
by Roy W. Blain, Blain Inc.

15. True or False: A traction elevator is considerably safer than a hydraulic elevator in earthquake-endangered areas.
   a. True
   b. False

16. In case of fire, why do hydraulic elevators give rescue personnel an advantage?
   a. Heat and smoke rise up into a traction-elevator machine room.
   b. Damaged traction equipment may be hard to get to.
   c. The hydraulic emergency lowering valve is at ground level.
   d. All of the above.

17. What is the purpose of the slack-rope valve on the EV 100 valve with a 1:2 roped-hydraulic system?
   a. It allows manual lowering of the ram when the car is suspended by the safeties.
   b. It prevents manual lowering of the ram when the car is suspended by the safeties.
   c. It traps ropes to prevent tangling when ram is manually lowered.
   d. None of the above.

18. Friction in the cylinder head can be a reason for what?
   a. Leakage into the pit.
   b. An uneven ride.
   c. Hydraulic failure.
   d. Poor leveling.

19. After a fault is located during hydraulic-elevator troubleshooting, what is the first step the technician should take?
   a. Position the car between the two upper floors.
   b. Position the car at the lowest level.
   c. Place the car on pipe stands.
   d. Pull the mainline switch.

20. With no load in the car, what should constant-speed leveling time be?
   a. 2-2.5 seconds.
   b. 2.5-3 seconds.
   c. 1-2 seconds.
   d. None of the above.

21. If the car cannot be seen during adjustment of the valve, how may the technician assess acceleration and deceleration times?
   a. By the changes in sound of the oil flow in the control valve.
   b. By taking measurements in the reservoir tank.
   c. By the use of a spectrometer on the pump head.
   d. None of the above.

22. How often should built-in filters on the EV 100 elevator-control valve be inspected for contamination?
   a. Once a quarter.
   b. Twice a year.
   c. Never.
   d. Once a year.

23. The European Code EN81-2 requires that the loaded elevator not leak downward by which standard?
   a. 20 millimeters in 20 minutes.
   b. 10 millimeters in 10 minutes.
c. 10 millimeters in 20 minutes.
d. No leakage is allowed.

24. What oil condition causes pump inefficiency, aging of oil and frequent releveling?
   a. Oil temperature below 70°F.
   b. Contamination in the reservoir.
   c. Oil temperature above 130°F.
   d. All of these things.

Chapter 4 – DISPATCHING SYSTEMS

Study materials: Two articles
(Educational Focus pages 39-46)
Credit available: One contact hour
Approved by NAEC for CET only
Applied to NAESAI for QEI
Cost of Test: $30.00
if not purchased in a package

Learning Objectives
After reading these articles (pages 39-46), you should have learned about:
• The major zoning methods for dispatching
• The structure of the controller area network (CAN)
• The three kinds of controllers that form a signal control based on CAN
• The number of signal lines needed for CAN-based dispatching
• How easy or difficult CAN may be to adjust (add or reduce landings)

Learning Reinforcement Questions
• What are the three zoning methods?
• How can dynamic zoning shorten passenger waiting times and solve up-peak problems?
• What are the three types of controllers that CAN is composed of?
• How does CAN prioritize multiple signals?
• What aspect of CAN allows transmission of control signals in serial communication?

Learning Assessment Examination Questions

THE RESEARCH DYNAMIC PROGRAMMING ZONING CONTROL METHOD IN ELEVATOR UP-PEAK MODE
by Zong Qun, Luo Xin-Yu and Wang Zhen-Shi,
School of Electrical Automation and Energy Engineering, Tianjin University, China

1. What is the term for when most or all of the traffic is on the ground floor traveling to the upper floors?
   a. Up-peak.
   b. Morning rush.
   c. Leisure traffic pattern.
   d. Down-peak.

2. Which is not one of the three zoning methods?
   a. Static zoning.
   b. Optimized zoning.
   c. Dynamic zoning.
   d. Layout-time zoning.

3. Which zoning type has zoning areas dependent on traffic-flow distribution?
   a. Static zoning.
   b. Optimized zoning.
   c. Dynamic zoning.
   d. Layout-time zoning.

4. True or False: It is quicker to calculate in exhaustion method than the zoning method.
   a. True
   b. False

SERIAL COMMUNICATION OF CONTROL SIGNALS FOR ELEVATOR BASED ON CAN BUS
by Wan Jianru, Liu Hongchi and Liu Chunjiao, Tianjin University, China

5. What do the letters CAN stand for?
   a. Cobol Actuated Node.
   b. Complex Area Network.
   c. Controller Area Network.
   d. Communication Activated Net.

6. What aspect of CAN allows transmission of control signals in serial communication?
   a. Multiple-host structure.
   b. Daisy-chain structure.
   c. Integrated coupling system.
   d. None of the above.

7. True or False: Every node of a CAN can send signals at any time.
   a. True
   b. False

8. In the CAN system, what happens when more than two nodes send signals at the same time?
   a. The system prioritizes (requests) the information.
   b. The lowest-priority node stops sending a signal.
   c. The highest-priority node goes through without being influenced by the other signals.
   d. All of the above.

9. What is not one of the three kinds of controllers composing the CAN bus signal control?
   a. Landing controller.
   b. Pit/hoistway controller.
   c. Machine-room controller.
   d. Lift-car controller.

10. Of the three kinds of controllers in the CAN bus signal control, which one does NOT need 8255 to expand its ports?
    a. Landing controller.
    b. Pit/hoistway controller.
    c. Machine-room controller.
    d. Lift-car controller.

11. CAN has no concept of node address; therefore, how is communication supported?
    a. Binary codes.
    b. Data blocks.
    c. Cobol language.
    d. Radio signal.

12. What process allows CAN to realize point-to-point, point-to-multiple-point, and whole broadcast communication?
a. Message filtering.
b. Optimization.
c. Attitude adjustment.
d. Fuzzy logic.

13. What does CRC check and bit filling do in the CAN bus system?
   a. Shuts down the system in emergency.
   b. Creates a database of messages.
   c. Checks for errors in transmission.
   d. None of the above.

14. In the CAN bus technology, how many signal lines are needed for a 24-layer landing elevator?
   a. 156 signal lines.
   b. 75 signal lines.
   c. 4 signal lines.
   d. 24 signal lines.

Chapter 5 – ELEVATOR DRIVE SYSTEMS
combined with
Chapter 12 – ELEVATOR COMMUNICATION

Study Materials: Eight articles
(Educational Focus pages 47-66 and pages 129-130)
Credit available: Three contact hours
Approved by NAEC for CET and CAT
Applied to NAESAI for QEI
Cost of test: $70.00
if not purchased in a package

Learning Objectives
After reading these articles (pages 47-66 and 129-130), you should have learned:
• Proper installation methods for AC, DC and hydraulic elevator drives
• The correct wire to use for control and signal circuit leads.
• Common issues encountered with the Magnetek HPV 900 AC drive
• How to solve various start-up problems with DC drives
• Proper installation of hydraulic soft-start drives
• The composition of carbon brushes
• How to select a size of a drive motor
• The application of serial communication to elevator drives

Learning Reinforcement Questions
• What is the maximum allowable bar-to-bar height differential in adjacent bars?
• Why would asbestos never be used as a base material in any brush?
• In drive setup, define the term “High Speed Setting.”

Learning Assessment Examination Questions

AC, DC AND HYDRAULIC ELEVATOR DRIVES
by Magnetek Elevator Products
INSTALLATION AND START-UP OF CLOSED-LOOP
AC ELEVATOR DRIVES, SPECIFICALLY
MAGNETEK’S HPV 900
by Tony Frey, Magnetek

1. To allow proper installation of the HPV 900 AC elevator drive, what minimum clearance must be maintained above and below the unit?
   a. 3 centimeters.
   b. 5 centimeters.
   c. 7 centimeters.
   d. 10 centimeters.

2. To achieve proper encoder-speed feedback essential for proper motor control, which suggestion below is not a good idea?
   a. Insulate both the encoder case and shaft from the motor.
   b. Use a hub or hollow shaft encoder with a concentric motor stub shaft.
   c. The encoder electronics may use unlimited slew-rate differential line drivers.
   d. Use direct motor mounting for the encoder without couplings.

3. True or False: The encoder power-supply voltage should use the lowest possible voltage available.
   a. True
   b. False

4. In the HPV 900, the installer should never connect main AC power to which output terminals?
   a. U.
   b. V.
   c. W.
   d. All of the above.

5. What type of wire should be used for control- and signal-circuit leads?
   a. Unshielded straight wire.
   b. Twisted pair (unshielded).
   c. Twisted (shielded).
   d. Any of the above.

6. What type of wire should be used for control- and signal-circuit leads?
   a. Unshielded straight wire.
   b. Twisted pair (unshielded).
   c. Twisted (shielded).
   d. Any of the above.

7. When running the drive in low-speed operation check, what should the technician observe about the encoder polarity?
   a. The motor phasing should rise faster than the encoder phasing.
   b. The motor phasing should match the encoder phasing.
   c. The motor phasing should rise slower than the encoder phasing.
   d. None of the above.
8. If the technician is having difficulty getting motor torque under 15% during motor tuning, what are the possible causes?
   a. No compensation chains.
   b. Flux reference values are not equal to 100%.
   c. There is high friction in the elevator system.
   d. All of the above.

9. Which of the following is not one of the five status LED’s that show current operational status on the HPV 900 AC Drive?
   a. Abort.
   b. Ready.
   c. Torque Limit.
   d. Run.

10. In the HPV900 DC drive, what is “Speed Dev”?
    a. It is “speed devil,” a nickname for the HPV 900.
    b. It is a situation when the speed feedback is failing to properly track the speed reference.
    c. It is the torque-limit LED.
    d. None of the above.

11. In the HPV 900 DC drive, which type of problem has occurred when the sum of all phase currents has exceeded 50% of the rated amps of the drive?
    a. Torque limit.
    b. Shutdown.
    c. Ground fault.
    d. Decommissioning.

COMMISSIONING OF THE MAGNETEK DSD 412 DC ELEVATOR DRIVE
by Mark Kobiske

12. For the DSD 412 DC drive to recognize the selected current range, what must be set correctly?
    a. F1.
    b. S1.
    c. F2.
    d. L2.

13. What is the preferred method of mounting the encoder for the DSD 412 DC Drive?
    a. Offset from the motor armature.
    b. Isolated by couplings.
    c. Inline with the motor armature.
    d. None of the above.

14. What is not one of the two automatic tests that need to be performed prior to operating the motor of the DSD 412 DC drive?
    a. Drive Diagnostics.
    b. Auto-Phase.
    c. Self-Tune.

SOLVING COMMON STARTUP ISSUES WITH MAGNETEK’S DSD 412 DC ELEVATOR DRIVES
by Donald Vollrath

15. On the DSD 412 DC drive, which possible problem can occur when armature-voltage feedback wires are reversed or missing?
    a. A fuse blows in the middle of the run.
    b. The system runs backward.
    c. The system won’t run at all.
    d. The drive “sweats.”

16. On the DSD 412 DC drive if the start or stop is not smooth, what component of the elevator system should the technician check?
    a. Governor.
    b. Encoder.
    c. Brake.
    d. Power source.

APPLICATION OF THE MAGNETEK HPV 100 HYDRAULIC ELEVATOR SOFT STARTER
by Jerry Reichard

17. What feature simplifies the HPV 100 hydraulic starter setup?
    a. A low voltage requirement.
    b. Digital current control.
    c. Analog current control.
    d. User-friendly initiation process.

18. Name one of the two current adjustments for the HPV 100 Hydraulic starter?
    a. Run current.
    b. Overload current.
    c. Leveling current.
    d. Slow-down current.

19. What does the “stall prevention” feature on the HPV 100 potentially eliminate?
    a. It prevents stops between floors.
    b. It eliminates service calls on hot days when the oil overheats.
    c. It eliminates service calls on cold days when the oil is thick.
    d. None of the above.

20. What fault code is indicated in the HPV 100 when the starter does not detect all three phases of the incoming power?
    a. Indicator remains on continuously.
    b. Four-flash.
    c. Two-flash.
    d. Six-flash.

GET THE LEAD OUT!: CARBON BRUSHES IN ELEVATOR APPLICATIONS
by Keith Challenger, National Electrical Carbon Products, Inc., and Nick O’Dell, Grubstreet LLC

21. What substance was used as a base in early carbon brushes?
    a. Lead.
    b. Graphite.
    c. Coal.
    d. Arsenic.

22. Why would asbestos never be used as a base material in any brush?
    a. It is too heavy and doesn’t wear well.
    b. It would expose elevator technicians to particles dangerous to health.
    c. It is an insulator and would prevent the flow of current.
    d. It is too fragile for brush base material.
23. What is the protective conducting layer of a carbon brush called?
   a. Outer strata.
   b. Conductor edge.
   c. Conductor face.
   d. Commutator surface film.

24. What is the maximum allowable bar-to-bar height differential in adjacent bars?
   a. 0.0015 inches.
   b. 0.0025 inches.
   c. 0.0005 inches.
   d. 0.0050 inches.

25. What problem may occur when a bar following a dead one is burned?
   a. Low current density.
   b. Winding fault.
   c. Bad brush-holder contact.
   d. High current density.

26. True or False: Electro-graphite brushes are able to meet a wide variety of electrical loads and current densities.
   a. True
   b. False

**WHAT IS AN AC VARIABLE FREQUENCY DRIVE?**
*by Frank Di Paola and Paul Krasko, Equiptex Industrial Products Corp.*

27. What is a solid-state device that controls the voltage and frequency supplied to a three-phase motor called?
   a. DC variable-frequency drive.
   b. Transistor voltage-control system.
   c. AC variable-frequency drive.
   d. None of the above.

28. What is a general guideline when selecting the size of a drive motor?
   a. It should be able to handle 1.5 times the nameplate FLA of the motor for 60 seconds.
   b. It should be able to handle 2 times the nameplate FLA of the motor for 60 seconds.
   c. It should be able to handle 2 times the nameplate FLA of the motor for 30 seconds.
   d. It should be able to handle 1.5 times the nameplate FLA of the motor for 30 seconds.

29. In drive setup, define the term “High Speed Setting.”
   a. Leveling speed.
   b. Contract speed.
   c. Inspection speed.
   d. Overspeed.

30. What values can the drive monitor to provide troubleshooting information?
   a. Motor torque.
   b. Peak currents.
   c. Input voltage.
   d. All of the above.

**CHAPTER 12 – ELEVATOR COMMUNICATIONS**

**SERIAL COMMUNICATION TO ELEVATOR DRIVES**
*By Tony Frey, Magnatek Elevator Products*

1. What is the functional benefit of serial communication in high-performance elevator drives?
   a. Zero speed command is truly zero
   b. Serial communication allows monitoring of a variety of drive information
   c. Allows the car controller to control a variety of drive information
   d. All of the above

2. How should the HPV 900 and DSD 412 drives’ transmission lines be terminated?
   a. By a serial port with cube ID
   b. With a termination resistor of 100 Ohms (1/2 WATT)
   c. DB-9 male connector
   d. DB-5 female connector

3. In troubleshooting the HPV 900, what does “COMM FAULT” indicate?
   a. Communications timeout
   b. Drive is running – no message for 40 msec.
   c. Bad message checksum
   d. All of the above

**Chapter 6 – DOOR PROTECTION SYSTEMS**

**Study Materials:** Three articles
*(Educational Focus pages 67-77)*

**Credit available:** One contact hour

**Approved by NAEC for CET and CAT**

**Applied to NAESAI for QEI**

**Cost of test:** $30.00
if not purchased in a package

**Learning Objectives**
After reading these articles (pages 67-77), you should have learned:
- The conditions that affect elevator light screen door controls.
- The difference between light curtains and 3D detection
- The installation methods for the Pana40 family of detectors and the doors they are designed to fit best.
- Understand the importance of plumb and alignment in installing door-protection devices.
- Understand the proper maintenance techniques for door-protection devices.
- The major benefits of electronic door-detector units.

**Learning Reinforcement Questions**
Study these points before attempting the examination below:
- What conditions do today’s light screens have to be immune to?
- What are the Pana40 family of door detectors programmed to detect?
- How do 3D detectors differ from light curtains?
- What does a Memco Vision system have that other systems do not?
- Why should transmitter and receiver units be installed slightly back from the leading edge of the door panel?
• What are most callbacks on door-protection units caused by?
• Describe the maintenance routine for door-protection units.

**Learning Assessment Examination Questions**

**CRITICAL REQUIREMENTS OF TODAY’S LIGHT SCREEN DOOR CONTROLS**
by Robert A. Warner, Tri-Tronics Co., Inc.

1. Light screens in today’s elevators are sensitive to_____.
   a. High-powered strobes on passenger vehicles and forklifts
   b. Direct sunlight
   c. Newer varieties of florescent lights
   d. None of the above.

2. Unexplained failures in door protection that often occur in the winter are caused by:
   a. High humidity.
   b. Static discharge from passengers’ hands on the light-screen housing.
   c. Wool clothing moving past the light screen.
   d. Building heating systems.

3. In the Tri-Tronics Door Protection System, what is used to protect the system from water?
   a. O-rings similar to those used in the space shuttle.
   b. Industrial gaskets.
   c. Epoxy.
   d. Wax seals.

4. To be safe during a “brownout” condition, the light-screen edge should have the capability to operate at which voltages?
   a. 85-90 VAC.
   b. 50-55 VAC.
   c. 25-30 VAC.
   d. 90-120 VAC.

5. What does Tri-Tronics provide for mounting the system on difficult door jambs?
   a. Super glue.
   b. Adjustable brackets.
   c. Nylon adaptors that screw into the stud.
   d. Stud clamps.

**ELEVATOR DOOR PROTECTION SYSTEMS**
by Jennifer Fenton, Memco Ltd.
(Janus Elevator in the U.S.)

6. What is the primary difference between Memco’s Pana40 Plus and the Pana40 Plus 3D?
   a. The doors on which they operate.
   b. The power requirements.
   c. The detection zones.
   d. Installation timeframe.

7. The Fail Safe Operation on the Memco Pana40 Plus performs which action when power is lost?
   a. Reports power loss to building management.
   b. Holds doors open until fault is cleared.
   c. Closes doors until power is restored.
   d. None of the above.

8. The Memco Pana40 Plus 3D has _______ detection systems.
   a. Four
   b. Two
   c. Three
   d. Six

9. Which Pana40 Plus 3D detector is more suitable for center-opening doors with a wide running clearance?
   a. Standard: part no. 770 000.
   b. Ultraslim: part no. 774 000.
   c. Leading Edge: part no. 770 010.
   d. Slimline: part no. 770 020.

10. The Memco Vision system of door protection uses a video camera mounted above the elevator doors to______?
    a. Record vandalism to the door system
    b. Detect moving and stationary passengers in its field
    c. Provide security/surveillance of elevator lobby or landing
    d. All of the above

**INFRARED DOOR PROTECTION INSTALLATION AND MAINTENANCE**
by Peter Thomson and Ned Badis, TL Jones (Microscan) Ltd.

11. Door reopening on elevators with a mechanical edge or shoe device require what to operate the door reopen function?
    a. A proximity of 12 inches.
    b. A broken eye beam.
    c. Extreme force on the door edge.
    d. Physical contact with an obstruction.

12. How does infrared-based technology interface with elevator-door control circuitry?
    a. Radio control.
    b. Voltage-free relay contacts.
    c. Cell technology.

13. Which part is not one of the three that normally make up a microprocessor-based infrared device?
    a. Power supply.
    b. Operating panel.
    c. Transmitter unit.
    d. Receiver unit.

14. Where is the power supply usually mounted in an infrared door-protection system?
    a. On top of the car.
    b. Under the car.
    c. In the machine room.

15. Elevators fitted with infrared “non-contact” door-protection devices have the following advantage over those with mechanical devices:
    a. Fewer door-related problems.
    b. Longer life for the door operator.
    c. Reduced maintenance costs.
    d. All of the above.

16. Which instruction is incorrect when installing an infrared door-protection unit?
    a. Receiver and transmitter must be vertically plumb.
    b. Top-beam height must be within 1 inch of the door top.
    c. Bottom beam must be within 1 inch of the floor.
    d. Receiver and transmitter must be mounted slightly back from the leading edge of the door panel.
17. During installation of infrared door-protection systems, cables should be routed in which manner to minimize electrical interference?
   a. Parallel with other wiring.
   b. Not parallel and away from all other wiring.
   c. Grounded to the power source.
   d. Parallel and clipped to other hoistway wiring.

18. During routine maintenance, what should the technician do last in the infrared door-protection system?
   a. Vigorously polish the receiver and transmitter lenses.
   b. Check connectors and terminations between unit and power supply for loose fittings.
   c. Block any of the beams to see if the doors reopen.
   d. Check units to be sure they are securely fitted to the car doors.

19. When troubleshooting a door problem with an infrared door-protection system, what step should the technician check first?
   a. Alignment of the transmitter and receiver units.
   b. Cables for cuts or breaks.
   c. Relay activity by turning the power to the unit on and off.
   d. Check lenses for dust or dirt.

20. To what are most callbacks to electronic door detection attributed?
   a. Water or dust entering the unit.
   b. Damage to the unit from door strikes.
   c. Damage to the cable from constant movement.
   d. Misalignment.

**Learning Assessment Examination Questions**

**ELEVATOR GUIDE RAILS INSTALLATION AND ALIGNMENT**
by Asray Sanayi Ve Ticaret Ltd. Sti.

1. What is the main function elevator guide rails perform?
   a. Prevent the car from falling.
   b. Support the building.
   c. Support the hoistway.
   d. Define the path along which the elevator rides.

2. What are guide rails made of?
   a. Aluminum.
   b. Pig metal.
   c. Steel.
   d. Ceramic.

3. “T” profiles can be formed into high-quality guide rails using which manufacturing method(s)?
   a. Cold drawing.
   b. Hot rolling.
   c. Machine processing.
   d. All of the above.

4. How can guide-rail ends be protected during hoisting and installation?
   a. Padding the ends with blanketing material.
   b. Fixing a piece of metal sheet to the ends.
   c. Wrapping with rubber sheeting.
   d. None of the above.

5. When fixing guide rails to the building with braces, what special care should be taken?
   a. Allow enough room for movement.
   b. Be sure the braces are welded to the rail.
   c. Be sure braces are tightly secured to the rail.
   d. None of the above.

6. Large elevators need thick and modified fishplates.
   a. True
   b. False

7. What geometrical position(s) are important when installing guide rails?
   a. The rails have to be placed parallel.
   b. The rails have to be placed vertically.
   c. The rail surfaces on which the skates roll have to be placed on the same plane.
   d. All of the above.

8. Which condition would cause the guide shoes to wear out early?
   a. The rails are not installed properly parallel.
   b. The rails are not installed properly vertically.
   c. The rail surfaces on which the skates roll are not positioned on the same plane.

9. Which condition would cause the car to vibrate and run less smoothly?
   a. The rails are not installed properly parallel.
   b. The rails are not installed properly vertically.
   c. The rail surfaces on which the skates roll are not positioned on the same plane.
RIDING PATH: INSTALLATION AND ALIGNMENT  
by the Savera R&D Team

10. What is the primary mistake made when installing guide rails?  
a. Not considering the cost.  
b. Not taking the environmental conditions into account.  
c. Not making sure the riding path meets design conditions.  
d. Not allowing enough time.

11. To eliminate discontinuity of the angle or slope in guide-rail joints, what does Savera recommend?  
a. Use of the Autoline System.  
b. A laser alignment system.  
c. Fishplate bracing.  
d. Beam flexion theory.

12. What type of tool ensures that the distance between guides and alignment on the “YY” axis is correct?  
a. Shims on the foot blade.  
b. Use of a template.  
c. A level and square.  
d. An alignometer.

13. During guide-rail installation, when may the bracket screws be tightened to set the final position?  
a. When all control-system needles show 0.2 millimeter.  
b. When all control-system needles show 0.  
c. None of these.

ELEVATOR RAIL INSTALLATION AND ALIGNMENT  
by Steve Wurth, Wurtec, Inc.

14. What is the first step in a successful guide-rail installation?  
a. A review of the building plans with the general contractor.  
b. A survey of the completed hoistway.  
c. A team review of safety issues.  
d. None of the above.

15. Which device or tool is typically used to align guide rails?  
a. A plumb line.  
b. A skip hoist.  
c. An electric light beam.  
d. A level.

16. How can tension be applied to a plumb line?  
a. Tying a weight to the end of the line.  
b. Submerging the weight in liquid.  
c. Using a tensioning device.  
d. All of the above.

17. Which device can be used to allow the installer to quickly set the location of the rail to the dropped plumb line?  
a. An alignment gauge that fits on the rail face.  
b. A marked bracket in the pit.  
c. Brackets sticking out with millimeters marked all the way up the hoistway.  
d. A laser level you can buy at Home Depot.

18. What is the first rail installed in the pit called?  
a. The “set” rail.  
b. The “king” rail.  
c. “Rail one.”  
d. The “repeater”

19. Once the pit rails are set, what does the term “facing the rails” mean?  
a. Smoothing the surface (face) of the rails on site.  
b. Aligning the rails to each other.  
c. Distressing the face edge of the rails to ensure grip.  
d. None of the above.

20. Referring to guide-rail installation, what do the letters “DBG” stand for?  
b. Drag before grip.  
c. Double bottom guides.  
d. Distance between guides.

21. What is the most efficient way to provide installer access to all rail brackets in a hoistway?  
a. Permanent scaffolding.  
b. Moving a platform in the hoistway.  
c. Either method is efficient.

22. Which temporary moving platform swings like a large basket in the hoistway?  
a. Go devil.  
b. False car.  
c. Shafter.  
d. Skip hoist.

23. What is the last operation required once the rails have been installed and aligned?  
a. Dress the rail joints.  
b. Final “facing” of the rails.  
c. Test ride in a false car.  
d. Inspection.

Chapter 8 – ELEVATOR SAFETIES AND GOVERNORS

Study Materials: Three articles  
(Educational Focus pages 90-98)  
Credit available: One contact hour  
Approved by NAEC for CET and CAT  
Applied to NAESAI for QEI  
Cost of test: $30.00  
if not purchased in a package

Learning Objectives
After reading these articles (pages 90-98), you should have learned about:

- How the European code addresses safeties and governors
- The various types of safety gears used in the U.S.
- The types of governors and how they are connected to the elevator car and system
- How to properly maintain and/or repair safeties and governors
- Lift testing systems used in Europe and their benefits

Learning Reinforcement Questions

- What is ADIASYSTEM, and what does it do?
- Describe the benefits of the TUV testing system. Do counterweights have governors?
- How often should the safety gear be checked?
- Misplacement of the safety gear could lead to what kind of damage?
• Braking the elevator in the upward direction is a new concept that is mandated by which code?
• What are the two types of safety gears?

Learning Assessment Examination Questions

BI-DIRECTIONAL SAFETY GEARS FOR CABIN
by Bertoni Stefano
Montanari Giulio & Co.

1. What change to the concept of elevator braking does EN 81 state?
   a. It designates size of the brake sheave.
   b. It mandates braking in the UP direction.
   c. It defines the relationship of the cable to the sheave.
   d. None of the above.

2. When ordering bidirectional safety gears, which mass considerations need to be considered?
   a. Mass of the capacity.
   b. Mass of the cabin, frame and accessories.
   c. Mass of the counterweights.
   d. All of the above.

ELEVATOR SAFETY AND GOVERNORS
by K. Subramaniam, Johnson Lifts Private Ltd.

3. Which part of the elevator actuates the safety clutch in the event of an overspeed?
   a. Overspeed governor.
   b. Overspeed tachometer.
   c. Rope speedometer.
   d. Sheave monitor.

4. Which two designs of safety gear are in general use?
   a. Digressive and proactive.
   b. Instantaneous and digressive.
   c. Progressive and proactive.
   d. Instantaneous and progressive.

5. What is inertia?
   a. A multiplication factor of mass and load.
   b. A multiplication factor of load and speed.
   c. A multiplication factor of speed and distance.
   d. A multiplication factor of mass and distance.

6. Which type of safety design has a version consisting of drive, screw and wedge?
   a. Digressive.
   b. Instantaneous.
   c. Progressive.
   d. Wedge.

7. What is the purpose of the electrical safety switch incorporated into the safety system?
   a. To deliver power to the emergency communications system when the safety is activated.
   b. So the system can be turned off to test the mechanical safety.
   c. To apply the brake by removing power from the motor before mechanical gripping takes place.
   d. None of the above.

8. Where is the pendulum governor normally located?
   a. In the pit.
   b. In the machine room.
   c. On top of the car.
   d. At the top landing.

9. How is the governor connected to the car?
   a. By a rope.
   b. Electronically.
   c. Using radio frequency.
   d. None of the above.

10. Describe the governor wheel of modern pendulum governors.
    a. It is smooth.
    b. It is uniformly distressed to provide traction.
    c. It has a deep “V” groove.
    d. It has a shallow “U” groove.

11. Why is safety-gear location important?
    a. Mistakes in location with respect to the guides can lead to severe damage to the guides.
    b. Mistakes in location can lead to poor maintenance and testing procedures.
    c. Poorly located safety gears can lead to unnecessary car stoppages.

12. Define “passive components.”
    a. They only work when needed.
    b. They don’t perform in the normal working of the elevator.
    c. They do not need much routine maintenance.
    d. All of the above.

13. How often should the service technician provide routine maintenance and checks to the safety gear and governor?
    a. Once a month.
    b. Once every four months.
    c. Once every six months.
    d. Once a year.

14. What is a prompting factor that indicates a governor’s bushing may need replacing?
    a. Worn bushings will create noise.
    b. Worn bushings will be black.
    c. Worn bushings will be pitted.
    d. None of the above.

15. Preferably, where should governor recalibration take place?
    a. On the installation site.
    b. At a regular test bench.
    c. Only by the original manufacturer.

16. When would a counterweight be provided with a separate governor and safety-gear unit?
    a. When the pit floor cannot take an impact load.
    b. When the floor below the pit is being put to use.
    c. Both of the above.
LIFT SAFETY GEAR TESTING WITHOUT WEIGHTS: A CRITIQUE AND OVERVIEW  
by Dr. Lutfi Al-Sharif,  
WSP Group

17. What is always a concern when conducting a full-load rated-speed test?  
   a. The strength it takes for the “tester” to load the weights.  
   b. The time it takes to conduct the test.  
   c. Damage to the elevator from the test.  
   d. Overspeed in the up direction.

18. Which computer-aided system carries out a measurement during no-load application and infers what the value at free-fall full load would be?  
   a. Adiasystem.  
   b. Microbounce System.  
   c. Telletest.  
   d. Wintest.

19. When using the TUV method, what major assumption regarding the safety-gear force must be relied on?  
   a. Safety-gear force is dependent on distance.  
   b. Safety-gear force is dependent on load.  
   c. Safety-gear force is dependent on system mass.  
   d. Safety-gear force is load independent.

20. What extra result can be given by the TUV method of safety-gear tests that cannot be given by standard testing methods?  
   a. Free-fall, full-load deceleration can be predicted.  
   b. No-load deceleration can be given.  
   c. Slack-rope acceleration can be given.  
   d. None of the above.

Chapter 9 – ELEVATOR CAR ENCLOSURES

Study Materials: Three articles  
(Educational Focus pages 99 - 109)  
Credit available: One contact hour  
Approved by NAEC for CET and CAT  
Applied to NAESAI for QEI  
Cost of test: $30.00  
if not purchased in a package

Learning Objectives
After reading these articles (pages 99-109), you should have learned about:  
• Design and customizing of elevator enclosures (cabs)  
• The role that the cab plays in the elevator system  
• The different materials used to build elevator cabs  
• Code requirements having to do with elevator cabs  
• The design and materials used for interlocking panels  
• How to achieve the right look in cab design

Learning Reinforcement Questions  
Study these points before attempting the examination below:  
• Should design issues be addressed before manufacturing, or is “field verification” allowed in elevator-cab design?

Learning Assessment Examination Questions

DESIGNING ELEVATOR CABS  
by Farid Waleh

1. What should the field crew installing a customized cab never have to do?  
   a. Touch up the panels after delivery.  
   b. Make field modifications to meet clearances or functions.  
   c. Take more than two days to install it.  
   d. Go back to the manufacturer for components.

2. When should cab design issues be resolved?  
   a. In concert with the manufacturing process.  
   b. On site, during installation.  
   c. Before manufacturing begins.  
   d. Before final signoff.

RESPECTING THE ELEVATOR CAB  
by Louis Blaiotta, Sr.

3. According to this author, in the three “B’s” of an elevator system, what is the elevator cab considered?  
   a. The “brass.”  
   b. The “brawn.”  
   c. The “brains.”  
   d. The “beauty.”

4. The cab constitutes what percentage of the monetary value of the elevator system?  
   a. 85%.  
   b. 50%.  
   c. 15%.  
   d. 25%.

5. What are the two kinds of commercial elevator-cab construction types?  
   a. Wood core and steel shell.  
   b. Solid wood and steel shell.  
   c. Wood core and composite metals.  
   d. Stone shell and steel shell.

6. True or False: A wood-core cab construction is an ideal choice in the modernization market.  
   a. True  
   b. False

7. What solution to the steel-shell cab design allows for a more aesthetically pleasing cab?  
   a. Development of baked-on designs for steel.  
   b. Development of hanging (removable) panels.  
   d. Development of digital designs on steel.

8. Which cab design found its first markets in humid or tropical regions?  
   a. Laminated steel-shell cabs.  
   b. Lightweight granite cabs.  
   c. Wood-core panels covered with plastic.  
   d. Digitally designed steel panels.
9. What are the downsides to buying a package elevator system?
   a. Proprietary equipment.
   b. Cab upgrades are costly.
   c. Accessory options are limited.
   d. All of the above.

10. What specific requirements of the elevator cab are addressed in ASME A17.1/CSA B44?
    a. Structural integrity.
    b. Fire resistance.
    c. Electrical shock in the cab.
    d. All of the above.

INTERLOCKING PANELS: ELEVATOR REMODELING MADE EASY
by Jeff Day and Glenn Bostock

11. What is a system of interlocking elevator panels that can be installed in a single day called?
    a. ILP system.
    b. ODC system.
    c. IEP system.
    d. None of the above.

12. What construction design of the ILP system accounts for its speed and versatility?
    a. Pre-hung composites.
    b. Horizontal construction method.
    c. Lightweight design.
    d. Manufacturing precision.

13. What is a reveal?
    a. A clear acrylic panel.
    b. A removable ceiling panel that hides lighting.
    c. A stainless-steel corner liner that runs from floor to ceiling.
    d. An edge of paneling that hides installation screws.

14. What element in a cab interior can create an illusion of more space?
    a. Mirrors above the handrail.
    b. Light-colored panels at eye level.
    c. White ceiling and hidden lighting.
    d. Horizontal stripes.

15. Which type of cab lighting provides maximum light at minimum cost?
    a. Halogen lighting.
    b. Entergy-Plus® lighting.
    c. Florescent lighting.
    d. All of the above.

16. What should be included in the elevator-cab interior when the elevator is also used as a freight elevator?
    a. Blankets to cover the floor.
    b. Removable wall pads and hangers.
    c. Permanent durable Kevlar® panels.
    d. Stainless-steel bumper guards.

Chapter 10 – ELEVATOR HOISTING MACHINES

Study Materials: Two articles
(Educational Focus pages 110-120)
Credit available: One contact hour
Approved by NAEC for CET and CAT
Applied to NAESAI for QEI
Cost of test: $30.00
if not purchased in a package

Learning Objectives
After reading these articles (pages 110-120), you should have learned about:
   - The tools required for installing the elevator hoisting machine
   - The technique of leveling the bed for the elevator hoisting machine
   - How to adjust the brake
   - The tools required for maintenance of gear machines
   - The exact procedure for gear-machine maintenance
   - How to install new bearing
   - The kind of damage that necessitates replacement of the worm and gear

Learning Reinforcement Questions
   - What are the signs that the gear may need replacement?
   - What technique is used to remove the gear (which is machined to a shrink fit)?
   - What is the most critical maintenance task? What is “clearance,” and how does it happen?
   - How do you avoid contamination of new oil?
   - Name several ways to detect main shaft bearing failure.
   - What is the most important aspect in installing the reducer?
   - What do you underlay the machine bed frame with to level it out?

Learning Assessment Examination Questions

INSTALLING THE GEAR MACHINE
by Roberto Zanon Sanchez, Autür S.A.

1. What is the first thing an installer must check before installing a gear unit?
   a. Leveling of the bed frame.
   b. That bed frame edges are squared up.
   c. Strength of the bed frame.
   d. Hoistway openings.

2. What is mechanically the most important aspect in installing the gear reducer?
   a. Making sure the bolts are equidistant.
   b. Alignment of the outgoing shaft.
   c. Tension on the machine sheave.
   d. All of the above.

3. What is happening if the flywheel pointer oscillates while screwing the bolts?
   a. The bed frame is not level.
   b. The tension on the machine sheave is uneven.
   c. The installer is misaligning the outgoing shaft.
   d. The bolts are not equidistant.

4. Which two requirements are considered when choosing a gear machine?
a. Maximum torque required and maximum power required.
b. Minimum torque required and minimum power required.

5. True or False: It is acceptable to mix synthetic and mineral oil.
   a. True
   b. False

6. What component protects the motor from overheating?
   a. An automatic fan.
   b. Liquid coolant.
   c. Thermisters.
   d. A rheostat.

7. What tool is needed to adjust the brakes on a gear motor?
   a. 12-millimeter wrench.
   b. A hammer.
   c. A pneumatic lock wrench.
   d. A screwdriver.

8. When should the first mineral-oil change be performed on a gear motor?
   a. After 100 hours of effective service.
   b. After 12-18 months of service.
   c. After 400 hours of effective service.
   d. It depends on the usage.

9. What should the technician do during gear-oil change to prevent contamination of new oil?
   a. Drain all of the used (old) oil first.
   b. Add an affective oil cleaner to the used oil.
   c. Clean out the gearbox with bleach before adding new oil.
   d. Use an oil filter.

10. Which type of gear ball bearings need changing most often during maintenance?
    a. Commutator bearings.
    b. Torque bearings.
    c. Worm axial bearings.
    d. None of the above.

11. What is a sign that a gear may need replacing?
    a. Wear on the tips.
    b. Appearance of clearance.
    c. Broken spokes.
    d. Noise.

GUIDE TO MACHINE MAINTENANCE & REPAIR
by Michael Gash

12. What is the most critical maintenance task to ensure longevity of a traction machine?
    a. Cleaning.
    b. Lubrication.
    c. Power regulation.
    d. Vacuuming (or blowing).

13. What could indicate that thrust bearings may require replacement?
    a. Thrust bearings are hot to the touch.
    b. A burnt or smoky smell in the machine room.
    c. Noticeable noise or vibration from the thrust housing.
    d. Metal debris beneath the housing.

14. What indicates that a main shaft bearing has failed?
    a. A vibration inside the cab at higher floors.
    b. A low-frequency rumbling in the machine room.
    c. A dial indicator placed on the traction sheave shows “play” when the machine rotation is reversed.
    d. All of the above.

15. What could cause gear-tooth contact patterns to NOT meet the manufacturer’s “ideal setting”?
    a. Worm/gear misalignment.
    b. Too much lubricant.
    c. Dust in the housing.
    d. A manufacturing mistake.

16. How can the technician adjust “backlash”?
    a. Reduce torque on the shaft.
    b. Add tension to the sheave.
    c. Add or remove shims under the shaft support blocks.
    d. None of the above.

17. What type of damage necessitates replacement of the worm and gear?
    a. Fretting (groove lines).
    b. Wear (steps or ripples in the tooth face).
    c. Discoloration of the worm-shaft teeth.
    d. All of the above.

18. If replacing a gear, what must a technician do to remove it from the center assembly?
    a. Heat the gear with a rosebud torch in a circular motion.
    b. Hit it gently with a rubber mallet to break the seal.
    c. Apply heated lubricant to the gear.
    d. Apply “liquid freeze” to the center shaft.

19. How should the technician tighten bolts in a newly installed gear?
    a. In a clockwise formation.
    b. In a “T” formation.
    c. In a “criss-cross” pattern.
    d. In a counterclockwise formation.

20. Why is “tramming” necessary?
    a. It ensures that the car will run smoothly.
    b. It prevents possible damage to the bearing during operation.
    c. It prevents the gearbox from leaking during operation.
    d. It locks the shaft in place.

Chapter 11 – ESCALATORS

Study Materials: Three articles
(Educational Focus pages 121-128)
Credit available: One contact hour
Approved by NAEC for CET only
Applied to NAESAI for QEI
Cost of test: $30.00
if not purchased in a package

Learning Objectives
After reading these articles (pages 121-128), you should have learned about:
- The benefits of thermoplastic escalator handrails
- The proper storage conditions for escalator handrails
- The things that contribute to handrail slippage
- Proper escalator alignment techniques
- How to accurately find the center line on an escalator
- The proper tools for escalator alignment
Learning Reinforcement Questions

• What is the most common cause of excessive heat in handrails?
• Describe the proper storage techniques for handrails.
• After storage, how long should a handrail “relax” before installation?
• Describe how to accurately find the center line on an escalator.
• How long does it typically take eight workers to dismantle, survey and reassemble an escalator?
• What is a Watt’s Link?
• In what circumstances do step chains lengthen unnaturally?

Learning Assessment Examination Questions

HOW TO GET THE MAXIMUM LIFE OUT OF YOUR ESCALATOR HANDRAILS
by Field Technical Services, EHC

1. What are the benefits of splicing escalator handrails for installations?
   a. It reduces unit downtime.
   b. It saves installation time.
   c. Calculating the length does not have to be as exact.
   d. All of the above.

2. In the cleaning process, what routine cleaning step is necessary with rubber handrails but unnecessary with thermoplastic handrails?
   a. Polishing.
   b. Trimming.
   c. Sterilizing.
   d. Use of soap.

3. Where should escalator handrails be stored?
   a. In an elevator machine room.
   b. In a dark, cool and dry environment.
   c. In a nearby elevator pit, if available.
   d. At the supplier’s warehouse, not on site.

4. Which “symptom” can occur when the escalator handrail’s rubberized drive surface is hard, shiny or glazed?
   a. Fraying.
   b. Cracking.
   c. Sticking.
   d. Slippage.

5. What is the most common cause of excessive heat in an escalator handrail?
   a. Off-center installation.
   b. Dust in the slider area.
   c. Over-tensioning.
   d. Sunlight.

6. What aesthetic finishes are possible with thermoplastic escalator handrails?
   a. Pantone and metallic colors.
   b. Safety messages.
   c. Images.
   d. All of the above.

ESCALATOR ALIGNMENT TECHNIQUES
by Marcus R. Hoffmann de Visme

7. What “critical combination” of tools is necessary to conduct an escalator rebuild survey?
   a. A plumb bob and T-square.
   b. A tachometer and level.
   c. A level and plumb bob.
   d. A tachometer and T-square.

8. Typically, dismantling, surveying and reassembling an escalator takes eight technicians how long?
   a. Four weeks.
   b. Ten weeks.
   c. 30 days.
   d. Eight weeks.

A PROPOSED SOLUTION TO ESCALATOR TENSION CARRIAGE PROBLEMS
by Marcus R. Hoffmann de Visme

9. What escalator component maintains necessary tension in the chains, and the idler shaft and its bearings?
   a. A tension sheave.
   b. The tension carriage.
   c. An equalization frame.
   d. None of the above.

10. What are the escalator components that enable both the step wheels to run smoothly between the tension carriage and the main escalator track to work?
    a. Slider tracks.
    b. Tension tracks.
    c. Half tracks.
    d. Comb guides.

11. In what circumstances do chain lengths increase unequally?
    a. On unusually long escalators.
    b. Where passengers stand on one side and walk on the other.
    c. When lubricant is restricted.
    d. Any of the above.

12. What could be added to an escalator to eliminate tension carriage slewing?
    a. A pair of Watt’s links.
    b. Lengthening the tension carriage.
    c. Shortening the tension carriage.
    d. Additional lubrication.

Chapter 14 – ELEVATOR SUSPENSION SYSTEMS

Study Materials: Four articles
(Educational Focus pages 135-153)
Credit available: Three contact hours
Approved by NAEC for CET and CAT
Applied to NAESAI for QEI
Cost of test: $70.00 if not purchased in a package

Learning Objectives
After reading these articles (pages 135-153), you should have learned about:
• The safe and proper installation of wedge sockets
• The steps to be taken and report to be written on an elevator-rope investigation
• How a modernization can affect rope wear and slippage
• How a piece of chalk and a magnet can be used in a rope investigation
• The advantages of steel wire rope
• The application of various types of elevator ropes
• How compensation rope and governor ropes differ from elevator rope
• Lubricants and application methods
• Rust on ropes and its causes
• How compensating weight is mounted
• How to correctly order elevator rope

Learning Reinforcement Questions
• Describe the maintenance of wedge sockets.
• Describe the tools needed for an elevator-rope investigation.
• Where is the worst area of wear on elevator ropes?
• Describe how a magnet may indicate problems in a rope investigation.
• What is the most common strand construction for elevator rope?
• Describe the ideal “elevator rope.”
• Describe the proper method for lubricating ropes.
• Describe proper installation and handling methods for elevator ropes.
• Describe the development of rust and what it means.
• What is the principle of compensation weight (ropes, chains or cable)?
• Describe the advantages of flat compensation cables.
• What special feature must the inspector’s clock/watch have to aid in measuring rope tension?
• Describe the tools needed to conduct a rope slippage test.
• What tools are needed to conduct a rope slippage test?
• What rope change is the criterion for rope retirement?

Learning Assessment Examination Questions

THE CARE OF AND FEEDING OF WEDGE SOCKETS
by Mark L. Lane

1. When installing new wedge sockets, what is the most important thing the installer should do before running the car?
   a. Tie down all sockets.
   b. Be sure nuts are tight.
   c. Be certain the cotter pin is in its hole in the rod.
   d. All of the above.

2. True or False: An elevator with 1:1 roping has approximately one-half the length of wire rope than a 2:1 roped car.
   a. True
   b. False

3. Which tension device tests all ropes at the same moment?
   a. Load-cell testing device.
   b. Compression-spring tester.
   c. Tension-equalization tester.
   d. Mechanical rope-testing device.

4. Which device is installed on the socket rods to eliminate metal-to-metal touching?
   a. Busing washer.
   b. Cotter pin.
   c. Isolation bushing.
   d. Bushing buffer.

5. When the time comes to shorten the rope in a wedge socket, what is one of the most important things to be done after hanging the car?
   a. Pre-measure the existing rope.
   b. Ensure that the shortened rope is round (not compressed).
   c. Heat and re-form the shortened compressed rope.
   d. Cut the rope.

ELEVATOR ROPE INVESTIGATION
by William Sport Wirerope Works, Inc.

6. What special feature must the inspector’s clock/watch have to aid in measuring rope tension?
   a. Second hand.
   b. Day and date.
   c. Barometer.
   d. Pressure gauge.

7. What change affecting the ropes may have occurred if the elevator car has undergone a modernization?
   a. Car speed.
   b. Car load.
   c. Car weight.
   d. None of the above.

8. When observing the ropes in operation, where is the worst wear typically visible?
   a. At the drive sheave when the car is in the lobby.
   b. At the secondary sheave when the car is in the lobby.
   c. At the drive sheave when the car is at the top landing.
   d. At the secondary sheave when the car is at the top landing.

9. What tools are needed to conduct a rope slippage test?
   a. Hammer, straightedge and chalk.
   b. Straightedge, chalk and measuring device.
   c. Phillips screwdriver, measuring device and wax marker.
   d. Straightedge, wax marker and measuring device.

10. What is the minimum D/d ratio required by code?
    a. 30:1.
    b. 50:1.
    c. 40:1.
    d. 45:1.

11. Problems regarding tight sheaves, improper tensioning or differential groove depths will produce throw-off with a high content of which substance?
    a. Grease.
    b. Wax.
    c. Asbestos.
    d. Metal.

12. Where do the most accurate rope measurements occur?
    a. In the machine room.
    b. From the car top.
    c. In the pit.
    d. None of the above.

13. Which rope change is the criterion for rope retirement?
    a. Twisting pattern in a lay length.
    b. Diameter of the rope at the primary sheave.
    c. Number of breaks in a lay length.
    d. All of the above.
14. What could extended lay readings indicate?
   a. Loss of core support.
   b. Slippage.
   c. Groove deterioration.
   d. None of the above.

15. What problem causes abrasion and wear all on one side of a rope?
   a. Heavy loading.
   b. Improper alignment.
   c. Groove deterioration.
   d. Poor rope quality.

16. What is the proper percentage of tension for ropes to perform equally?
   a. 5% of the highest to the lowest reading.
   b. 15% of the highest to the lowest reading.
   c. 10% of the highest to the lowest reading.
   d. 20% of the highest to the lowest reading.

17. What is an advantage of steel-wire rope?
   a. Its core strength.
   b. Its redundancy.
   c. Its weight.
   d. None of the above.

18. What about wire-rope composition makes it ideal for moving over a sheave?
   a. It is smooth enough to glide without losing traction.
   b. The wires are wound helically.
   c. It doesn’t transfer heat to the sheave.
   d. None of the above.

19. Which is the most common strand construction of rope for elevators worldwide?
   a. Warrington.
   b. Seale.
   c. Warrington-Seale.
   d. Bethlehem.

20. Which type of strand has proven to be a solution for drives with a lot of narrowly arranged sheaves and reverse bending?
   a. Warrington.
   b. Seale.
   c. Warrington-Seale.
   d. Bethlehem.

21. Which rope construction is better suited for low-speed goods elevators and low-duty passenger elevators?
   a. Eight-strand rope with steel core.
   b. Six-strand rope with fiber core.
   c. Nine-strand rope with steel core.
   d. Eight-strand rope with fiber core.

22. Which rope construction is the most efficient solution for suspension rope in high-rise elevators?
   a. Eight-strand rope with steel core.
   b. Six-strand rope with fiber core.
   c. Nine-strand rope with steel core.
   d. Eight-strand rope with fiber core.

23. What is the most traditional type of rope used in a roped-hydraulic elevator?
   a. Eight-strand rope with steel core.
   b. Six-strand rope with fiber core.
   c. Nine-strand rope with steel core.
   d. Eight-strand rope with fiber core.

24. Since the introduction of safety gears in both directions, what feature is required in governor ropes?
   a. Highly lubricated interior core.
   b. Higher breaking forces.
   c. Only steel-core ropes.
   d. Larger-diameter ropes.

25. True or False: When handling wire rope, the technician should pull the rope off the reel sideways.
   a. True
   b. False

26. How should a kink in a rope be corrected?
   a. Twist at one of its ends.
   b. Twist at the site of the kink.
   c. Twist both ends in opposite directions.
   d. Hang and load the rope.

27. True or False: Ropes have no clearly defined modulus of elasticity (E-modulus).
   a. True
   b. False

28. What is needed to relubricate ropes?
   a. A rope lubrication device.
   b. A sponge and oil can.
   c. An oil can and brush or paint roller.
   d. A spray bottle of oil and rags.

29. What special rope is recommended for open-air elevators?
   a. Galvanized rope.
   b. Rope coated in acrylic.
   c. Rubberized rope.
   d. None of the above.

30. Define “rope bleeding” or “red dust.”
   a. Rust on the rope due to under-lubrication.
   b. Red abrasion on the rope caused by a decrease in diameter of the rope core.
   c. Red rust on the rope due to exposure to extremes in temperature.
   d. Rust on the rope due to high humidity.

31. Where is the compensation weight mounted?
   a. Between the front corner of the cab and the counterweight.
   b. From the machine beam to the counterweight.
   c. Between the car center and the counterweight.
   d. Diagonally between the back corner of the cab and the counterweight.

32. Which device is used to clamp the steel supporting members of the compensation weight?
   a. U-bolts.
   b. Crimping sleeves or rope clamps.
c. Wedge clamps or rope clamps.
d. Chinese sling.

**HOW TO CORRECTLY ORDER WIRE ROPE**
*by Howie Frank*

33. What is the maximum allowable rope stretch?
   a. 6 inches per 100 feet.
   b. 12 inches per 50 feet.
   c. 12 inches per 100 feet.
   d. 15 inches per 100 feet.

34. Where can the technician find information regarding diameter and breaking strength of ropes?
   a. The crosshead data plate.
   b. The rope tag.
   c. The specs for the elevator.
   d. The inspection certificate inside the cab.

35. To what does “rope grade” refer?
   a. Iron grade.
   b. Traction rope.
   c. Extra-high-strength rope.
   d. All of these.

36. What is different in right-lang-lay rope compared to right-regular-lay rope?
   a. Right-lang-lay rope wires do not go in the same direction as the rope strands.
   b. Right-regular-lay rope wires do not go in the same direction as the rope strands.

37. If there is not a crosshead data plate and the building is over 50 years old, what should the technician assume the rope-core construction to be?
   a. 8 X 19 Seale rope.
   b. 8 X 19 Warrington rope.
   c. 6 X 25 filler wire.
   d. None of these.

38. True or False: Governor and compensation ropes are never lang lay.
   a. True
   b. False

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**Chapter 15 – TESTING EQUIPMENT**

**Study Materials: Four articles**
*(Educational Focus pages 154-165)*

**Credit available: One contact hour**

**Approved by NAEC for CET only**

**Applied to NAESAI for QEI**

**Cost of test: $30.00 if not purchased in a package**

**Learning Objectives**
*After reading these articles (pages 154-165), you should have learned about:*

- The procedures for using the SafeTach Elevator Performance Meter
- The proper use of the Adiasystem for testing elevators
- The parameters that the Adiasystem can test with different types of elevators
- The procedures and proper use of the Lat Lazer JZC system
- The factors that affect ride quality in an elevator

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**Learning Reinforcement Questions**

- Describe the process and the number of people needed to use the SafeTach.
- List the advantages of the Adiasystem over physical testing methods.
- What is the software base for Adiasystem?
- Describe the features of the LAT Lazer.
- What simple tool does the Lat Lazer replace?
- What international standard was developed to address ride quality?

**Learning Assessment Examination Questions**

**ELEVATOR PERFORMANCE METER VS. RIDE ANALYSIS TOOLS**
*by Bill Harmon and Maxton Manufacturing Technical Staff*

1. What are the two main categories of elevator-performance-analysis systems?
   a. In cab and off site.
   b. On site and remote.
   c. Portable and fixed.
   d. None of the above.

2. Which system type would categorized the SafeTach Elevator Performance Meter?
   a. Portable.
   b. Fixed.
   c. Remote.
   d. In-cab.

3. How many technicians are necessary to operate the SafeTach (EPM)?
   a. Two.
   b. One.
   c. Three.
   d. Four.

4. How many runs can the SafeTach (EPM) compare?
   a. Six.
   b. Four.
   c. Three.
   d. Eight.

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**THE CURRENT FEATURES OF ADIASYSTEM FOR INSPECTING ELEVATORS**
*by Alfons Petry*

5. What is the Adiasystem?
   a. A computer-based elevator-testing system.
   b. An advanced diagnostic system for elevators.
   c. A method for inspecting elevators developed in Germany.
   d. All of the above.

6. The determination of traction using the Adiasystem method consists of which measurement?
   a. Whether the car can remain stationary with a full load.
   b. Whether the adhesive friction between ropes and sheave is sufficient to prevent slippage.
   c. Whether pressure of brake will hold the car with 150% load.
   d. The size of the machine to the load.
7. With hydraulic elevators, what does the Adiasystem measure?
   a. Whether there is sufficient pressure in the cylinder.
   b. Whether the car can remain stationary with a full load.
   c. Whether the elevator is capable to relevel with rated load.
   d. None of the above.

8. Which new capability did the redesign of the Adiasystem software allow?
   a. DOS environment converted to Linux.
   b. COBAL language converted to Basic.
   c. DOS environment converted to Windows.
   d. COBAL language converted to Windows.

9. True or False: The Adiasystem only has the capability to measure elevator safety aspects of interest to an inspector.
   a. True
   b. False

10. What, in addition to the safety test, can the Adiasystem data logger be used to record/diagnose?
    a. Emergency stops.
    b. Ride comfort measurements.
    c. Accelerations or decelerations.
    d. All of the above.

11. Which Adiasystem feature’s dual purpose significantly improves the accuracy of the “balance test”? 
    a. A transducer that measures kinetic energy.
    b. An electronic load cell for safety measurements on power-operated doors.
    c. A memory chip that calculates system speed.
    d. None of the above.

   TESTING EQUIPMENT
   by Rainer Schmitt, Wittur AGK KTS

12. What is the Lat Laser JZC?
    a. A device inspectors use to see if the guide rails are aligned.
    b. An installation device for the correct alignment of guide rails and elevator doors.
    c. A replacement for a plumb-line procedure.
    d. All of the above.

13. An Independent, microprocessor-controlled measuring device with an integrated acceleration sensor is called a ________.
    a. Travel data sensor
    b. Trip checker
    c. Lift acceleration checker
    d. Telemetry sensor

14. Which measuring device of the pressure sensor enables the detection of the hydraulic-system pressure?
    a. Relief valve.
    b. Wire strain gauge.
    c. Cylinder leak sensor.
    d. Anti-creep cuff.

15. True or False: The standard ISO 18738 establishes what is and what is not acceptable in terms of elevator ride quality.
    a. True
    b. False

16. What produces vibration in an elevator system?
    a. Milli Gs.
    b. Moving elements and control elements.
    c. Guide rails and clips.
    d. Loose fixtures.

17. When evaluating the function of the elevator components, which question(s) should be asked in a first-order analysis?
    a. Is the vibration acceptable?
    b. Does the vibration show up in the horizontal or vertical axis?
    c. Is the vibration impulsive or continuous?
    d. All of the above.

18. If a vibration shows up in the horizontal axis, what is the cause and/or source of the vibration?
    a. Rail misalignment and/or roller guides.
    b. Ropes and/or sheaves.
    c. Controller, drive or counterweight.
    d. Machine or brake.

19. True or False: When addressing ride quality, it is desirable to address the vibration that people feel.
    a. True
    b. False

20. In a general sense, where are most continuous horizontal vibration sources located?
    a. On the car or in the hoistway.
    b. In the machine room or the pit.
    c. In the hoistway or the pit.
    d. None of the above.

21. What analytical tool can be used to perform a second order analysis to find the source of continuous vertical vibration?
    a. Spectrum Z channel.
    b. Fast Fourier transform.
    c. EVA 625 data analyzer.
    d. Taylor slow-burn tool.

Chapter 16 – ELEVATOR ENTRANCES

Study Materials: Three articles
(Educational Focus pages 166-177)
Credit available: One contact hour
Approved by NAEC for CET and CAT
Applied to NAESAI for QEI
Cost of test: $30.00
if not purchased in a package

Learning Objectives
After reading these articles (pages 166-177), you should have learned about:
• Proper installation techniques for 3D elevator-door safety edges
• Adjustment and troubleshooting issues for 3D elevator-door safety edges
• The suitability of 3D elevator-door safety edges for different types of doors
• The two alternating roles of the hoistway entrance
• The various types of elevator-door operation and entrances
• The fail-safe aspects of elevator-door operation.
Learning Reinforcement Questions

• What are the three components of the 3D elevator-door safety edge?
• Are 3D safety edges a closed- or open-loop system?
• Explain the three operating modes for 3D elevator-door safety edges.
• Why should 3D elevator safety edges be tested on different floors?
• What are the two alternating roles of the elevator entrance?
• Describe the different types of elevator doors and their application.
• Why are elevator door locks opened by positive action?
• Why does the ground-floor door assembly require more attention than all the other entrances?

Learning Assessment Examination Questions

OPERATION & INSTALLATION OF A 3D ELEVATOR DOOR SAFETY EDGE
by Laith Hasen, and Memco Janus Elevator Products Ltd.

1. What type of protective zone protects elevator passengers from being injured by hoistway doors?
   a. 2D detectors.
   b. Light curtains.
   c. 3D detectors.
   d. I-beams.

2. What is one of the common misconceptions about 3D zone protection?
   a. It will pick up people passing by in the hallway.
   b. Children will play in it and hold up traffic.
   c. It will slow traffic in the building to a standstill.
   d. None of the above.

3. Which item is not a part of the 3D system?
   a. Transmitter edge.
   b. 3D coupling.
   c. Controller.
   d. Receiver edge.

4. Where should the 3D transmitter be mounted to allow “looking” into the landing?
   a. Center above door.
   b. Left side (when viewed from landing).
   c. Right side (when viewed from landing).

5. Where should 3D edges be mounted?
   a. As close as possible to the center of the door edge.
   b. As close as possible to the back of the door edge.
   c. As close as possible to the leading edge of the door.
   d. As far as possible from the leading edge of the door.

6. What is the maximum advisable separation between the edges when the doors are fully closed?
   a. 1 inch.
   b. 1/2 inch.
   c. 3/4 inch.
   d. 5/8 inch.

7. Which of these is not one of the three operating modes in the 3D system?
   a. On as doors close.
   b. On at 10 inches.
   c. 3D timeout.
   d. On at 32 inches

8. Which 3D operating mode automatically reopens doors a maximum of three times before automatically disabling the 3D?
   a. 3D timeout.
   b. On as doors close.
   c. On at 10 inches.
   d. 3D timed close.

9. True or False: 3D door-protection systems are suitable for side-opening doors only.
   a. True
   d. False

10. When troubleshooting a door problem, what purpose do the diagnostic readouts on the 3D system serve?
    a. Let the technician know if a cable has been cut.
    b. Let the technician know if the problem is with the receiver or transmitter edge.
    c. Let the technician differentiate between a light-curtain and 3D trigger.
    d. All of the above.

11. True or False: It is always advisable to test the 3D on different floors.
    a. True
    d. False

RESPECTING THE ELEVATOR ENTRANCE
by Louis Blaiotta, Sr. and Louis “LJ” Blaiotta, Jr., Columbia Elevator Products Co., Inc.

12. What important role does the elevator entrance perform?
    a. Barricade protection of the hoistway.
    b. Preventing flames moving from floor to floor in a fire.
    c. Access to the hoistway.
    d. All of the above.

13. Which elevator entrance design features one door panel that operates by moving horizontally along the path of the sill?
    a. Center-sliding single door.
    c. Uni-door assembly.
    d. None of the above.

14. Which type of door entrance is most frequently found in undersized or tight shaftways?
    b. Center-parting.
    c. Multi-speed, multi-panel.
    d. Uni-door assembly.

15. Which entrance design type minimizes load/unload times?
    b. Center-parting.
    c. Multi-speed, multi-panel.
    d. Single swing door.

16. Where is space sacrificed when using multi-speed doors?
    a. In the hoistway.
    b. Behind the operator panel.
    c. On the platform.
    d. In the entranceway opening.

17. What standard regarding fire protection must elevator doors require?
    a. Resist fire temperature of 1800 degrees for 1-1/2 hours.
    b. Resist fire temperature of 2000 degrees for 3 hours.
c. Resist fire temperature of 2500 degrees for 1-1/2 hours.
d. Resist fire temperature of 1800 degrees for 2-1/2 hours.

18. To be awarded a Class B-1 1/2-Hour Rated Fire Door Certification, what function must the elevator doors perform?
a. Not fall out of the framework before the test completion.
b. Remain operable within the limits of the test criteria.
c. Have no holes or breaches of door integrity.
d. Remain intact to the completion of the test.

THE ELEVATOR ENTRANCE AND ITS SAFETY PROTECTION
by John K. John and K. Subramaniam,
Johnson Lifts Pvt. Ltd., Chennai, India

19. True or False: It is imperative that the electrical contact in an elevator door lock to be “positively” opened.
a. True
b. False

20. What basic aspect of an electrical circuit of a door lock makes the system “fail-safe”?
a. Safety contacts are all located on the high tension side of the circuit.
b. Safety contacts are all waterproofed.
c. Safety contacts are positioned close to the floor.
d. Safety contacts are all redundant.

21. Which elevator door requires extra attention during maintenance?
a. Hall landing doors.
b. The ground-floor door.
c. The top-landing door.
d. Call doors.

Chapter 18 – FREIGHT ELEVATOR DOORS

Study Materials: Two articles
(Educational Focus pages 186-195)
Credit available: One contact hour
Approved by NAEC for CET only
Applied to NAESAI for QEI
Cost of test: $30.00
if not purchased in a package

Learning Objectives
After reading these articles (page 186-195), you should have learned about:
• The basic components of the freight-door controller
• The installation techniques and placement for the freight-door controller
• The ways to reduce hoistway wiring for freight doors
• The advantages of using limit switches and proximity sensors
• The relationship between the car gate and the landing door
• How to find out if three-phase motors are phased properly
• The field survey and why it is important to freight-door installation
• The proper installation techniques for freight-elevator doors, interlocks and controllers

Learning Reinforcement Questions
• Describe the five basic components of the elevator freight-door controller.
• What are the three places freight-door-controller wiring needs to connect?
• Explain the role of proximity sensors and the advantages of their use.
• What does it mean when the door or car-gate motors run in the wrong direction?
• What are the advantages of vertically bi-parting doors on freight elevators?
• Describe the process for installing freight-elevator doors, operators and interlocks.

Learning Assessment Examination Questions

FREIGHT ELEVATOR DOOR CONTROL SYSTEMS EXPLAINED
by Steve Reynolds, The Peelle Co., Ltd.

1. Which basic freight-door component initiates only the landing-door operators and push buttons at the car’s landing destination?
a. Landing operator.
b. Zone switch.
c. Landing segregation.
d. Retiring cam.

2. Where is the door controller for a freight door typically installed?
a. The machine room.
b. The car top.
c. At each landing.
d. In the car.

3. What is not one of the three places wiring from the freight-door controller must connect to?
a. The elevator car.
b. The landing doors.
c. The car-top inspection station.
d. The elevator controller.

4. What component allows a single set of wiring for all door motors and landing-door push buttons?
a. A zone switch integrated with door interlock.
b. Door interlocks integrated with elevator-controller bypass.
c. Fuzzy logic in both door controller and elevator controller.
d. Door interlocks fitted with restrictors

5. What is one reason when proximity sensors are not affected by dirt, grease or water?
a. They are protected by light porous guard
b. They are self cleaning
c. They do not require physical contact
d. All of the above

6. Because of their sequence of operation, what is necessary in the “relationship” of the hoistway landing doors and car gate?
a. They are independent of each other.
b. They are dependent upon each other.
7. What is the problem when a door or car gate wants to close when it should be opening?
   a. Door or gate motors are running in the wrong direction.
   b. The three-phase motor is reversed.
   c. Two wires have been switched to the motor.
   d. All of the above.

**INSTALLING FREIGHT ELEVATOR DOORS**

*by Joseph De Simone, Courion Industries, Inc.*

8. What type of freight door provides full-opening-width access to the inside of the car?
   a. Horizontally biparting doors.
   b. Center-opening sliding doors.
   c. Vertically biparting doors.
   d. Swing doors.

9. How should freight-door panels be transported?
   a. In a vertical position with heavy side down.
   b. Flat, supported on skids.
   c. Heavy side up in a vertical position.
   d. Any position is acceptable.

10. How is freight-door equipment marked?
    a. Left or right as viewed from the landing.
    b. Left or right as viewed from the hoistway.

11. What is the most important step in the freight-door installation process?
    a. Door guide rail installation.
    b. The field survey.
    c. Interlock alignment.
    d. Door controller programming.

12. Which step in freight-door installation is most ignored by elevator mechanics?
    a. Door guide rail alignment.
    b. Which door should be installed first.
    c. The field survey.
    d. Door-controller connection to elevator controller.

13. True or False: It is important to use washers under the head of the guide-rail bolts.
    a. True
    b. False

14. What can be done to remedy in-and-out variations of the guide rails from the jamb?
    a. Filing the guide rail smooth.
    b. Shimming behind the guide rails.
    c. Lubrication of the guide rails.
    d. None of the above.

15. Where are the interlock mounting holes located in passenger type doors?
    a. In the passenger guide rails.
    b. On the car-top-door mount.
    c. On the doors.
    d. Beneath the car (under door jamb).

16. In vertically biparting freight doors, which door panel should be installed first?
    a. Upper panel.
    b. Lower panel.

17. In freight-door installation, when both side angles are not flat against the guide bolts, what must be removed before proceeding with installation?
    a. Shims.
    b. Blocking.
    c. Twist.
    d. Torque.

18. When should the auto-start set switch be actuated?
    a. When the doors are halfway open.
    b. When the upper door is 1 inch from being fully open.
    c. When the lower door is 1/4 inch to 3/4 inch from being fully open.
    d. When both doors are 1/2 inch from being fully open.

19. With the interlock in locked position, the door panel should not be able to open more than __________.
    a. 2 inches
    b. 1-1/2 inches
    c. 3/4 inch
    d. 2-1/2 inches

20. Define “EUD.”
    a. Emergency unlocking device
    b. Electrically unlocked door
    c. Emergency unload drop-down
    d. None of the above
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