



Elevating Devices Mechanic – E  
Lifts for Persons with Physical Disabilities  
In-School Curriculum Standard

# **Elevating Devices Mechanic**

## **EDM - E**

### **Lifts for Persons with Physical Disabilities**

# **In-School Curriculum Standard**

## **July 2009**



# Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

## PREFACE

This Elevating Devices Mechanic Curriculum Training Standard has been developed in keeping with the Common Format Guidelines prescribed by the Technical Standards and Safety Authority (TSSA) in conjunction with the Elevating Devices Training and Certification Advisory Board (TCAB). The Curriculum Standard reflects the content necessary for appropriate progression through each level of the Elevating Devices Mechanic in-school program.

For easy reference, a time allocation has been included for each respective reportable subject and units, along with a breakdown of theory and application in the delivery of the performance objectives.

The continual introduction of innovative techniques and more complex equipment is resulting in increasing demands for Elevating Devices Mechanics who are not only skilled in the practical aspects of the trade, but who also have a sound theoretical knowledge of the testing, diagnosing and servicing requirements. The Curriculum Standard has been developed to provide this theoretical knowledge and to offer some practical applications to complement the on-the-job work experience of the Elevating Devices Mechanic.

The Curriculum Standard has been designed to give the instructor every opportunity for flexibility and innovation without significant departures from content. Since the scope of the prescribed Curriculum Standard is quite extensive, the Mechanic-In-Training will be expected to reinforce the acquired knowledge through regular independent out-of-classroom assignments.

The Curriculum Standard includes specific references to on-the-job training. While on-the-job training has been linked to the respective in-school learning outcomes and learning content objectives, employers should not assume complete coverage in all aspects of the modules. The in-school delivery focuses primarily on the knowledge required and fundamental skills that support the respective objectives outlined in the workplace training. Employers are expected to complete the delivery of these objectives by ensuring the prescribed in-school knowledge is applied to the practical learning experiences in the work setting.

Regular evaluations of a Mechanic-In-Training's learning achievements must be performed in both theory and practical applications throughout the program.

### **Participation by Stakeholders**

TSSA, working in collaboration with the Elevating Devices TCAB participated in the development of this document. The development was based on the schedule of training that was developed by the Ministry of Training Colleges and Universities and the Elevating Devices TCAB in 2001 and the in-school curriculum revised in 2002.



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Summary of Total Program In-School Training Hours

<b>Reportable Subjects</b>	<b>Total</b>	<b>Theory</b>	<b>Application</b>
1. Safety	24	24	0
2. Introduction to Elevating Devices	13	13	0
3. Mechanical Print Reading	15	6	9
4. Ladders, Scaffolding and Work Platforms	6	5	1
5. Rigging and Hoisting	12	9	3
6. Introduction to Applicable Codes and Standards	6	2	4
7. Mechanical Practices	30	21	9
9. Basic Hydraulics	9	9	0
10. Elevator Hydraulic Systems	36	28	8
11. Hydraulic Elevator Installation	21	17	4
12. Basic Electricity	60	42	18
13. Industrial Electricity for Elevating Devices	54	43	11
14. Motors, Generators, Controls and AC Drives	17	17	0
15. Solid State Electronics	22	22	0
16. Circuit Tracing	16	10	6
18. Lifts for Persons with Physical Disabilities	21	19	2
19. General Preventive Maintenance	6	6	0
<b>Total</b>	<b><u>368</u></b>	<b>288</b>	<b>80</b>



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 1

Title: Safety

Duration: 24 Total Hours

Theory: 24 Hours    Application: 0 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to practice workplace safety in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

- 1.1 – Define the fundamentals of personal protective equipment.
- 1.2 – Describe the dangers of asbestos, synthetic mineral fibres and silica.
- 1.3 – Define the fundamentals of hand and power tool safety.
- 1.4 – Define the fundamentals of hazards in the hoistway, machine room and Pit.
- 1.5 – Define the fundamentals of electrical safety.
- 1.6 – Define the fundamentals of safety when babbitting.
- 1.7 – Define the fundamentals of safety when using oxy-acetylene equipment for heating and flame cutting.
- 1.8 – Define the fundamentals of environmental hazards.
- 1.9 – Define the fundamentals of Material Handling.
- 1.10 – Describe the safety issues relating to substance abuse.
- 1.11 – Describe the role of the Workplace Safety & Insurance Board (W.S.I.B.)



- 1.12 – Describe the workplace fire safety and prevention requirements.
  - 1.13 – Define the essential workplace housekeeping procedures.
  - 1.14 – Describe the types and applications of effective communication techniques.
  - 1.15 – Identify the required Ministry of Labour and TSSA procedures for accidents and unsafe working conditions.
  - 1.16 - Describe the public safety requirements for the workplace.
- 

Learning Content:

- 1.1 – Define the fundamentals of personal protective equipment.

[1.5/0]

- personal protective equipment
  - § head guarding
  - § problems for hair and jewellery
  - § guarding eyes, ears, hands and feet
  - § use of respirators
  - § protective clothing
  - § use of fall arrest devices and travel restraint as per the requirements of the Occupational Health and Safety Act
  - § use of back belts
  - § code reference: applicable codes, standards and regulations

- 1.2 – Describe the dangers of asbestos, synthetic mineral fibres and silica.

[1/0]

- dangers of asbestos, synthetic products and Silica
  - § recognize the toxic effects
  - § define the types of potential exposure
  - § use of P.P.E. to minimize effects of exposure
  - § responsibilities and action procedures

- 1.3 – Define the fundamentals of hand and power tool safety.

[2/0]

- hand tool safety
  - § safe use and application of hand tools
  - § maintenance of hand tools
  - § safe storage of hand tools



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- power tool safety
  - § inspection
  - § operation
  - § maintenance
  - § storage
  - § electrical safety
  - § code reference: applicable codes, standards and regulations

### 1.4 – Define the fundamentals of hazards in the hoistway, machine room and pit. [5/0]

- identify hazards when removing elevating device from service and positioning in hoistway.
- identify hazards of placing the elevating device back into normal service.
- Identify hazards of stored mechanical energy
- Identify hazards of stored pneumatic energy
- identify hazards of using hoistway access switches and unlocking. devices
- identify hazards of Gaining Access to and Egress from the elevating device car pit.
- identify hazards from overhead deflector sheaves, traction sheaves and deflector sheaves on car.
- identify hazards associated with moving counterweights when on car top and in the pit.
- identify hazards associated with vanes and other devices that present a shear hazard in the hoistway.
- code reference: applicable codes, standards and regulations
- identify hazards caused from falling objects
- identify hazards of falling and exposure to electric shock
- identify hazards of moving on uneven or unstable surfaces
- identify slippery conditions
  - § dirt
  - § oil grease
  - § ice and water
- identify hazards of working around rotating or moving equipment
- code reference: applicable codes, standards and regulations

### 1.5 – Define the fundamentals of electrical safety. [3/0]

- define “tag and lockout procedures”
  - § verify NO POWER
- describe the use of electrical meters and instruments
  - § testing for presence of electricity
- define the hazards from stored electrical energy and other sources
  - § capacitors



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- § inductors
- § interconnections
- directors ruling 106/93 & 01/82
- define the safe use of jumpers
  - § appropriate use
  - § potential hazards
- code reference: applicable codes, standards and regulations

1.6 – Define the fundamentals of safety when babbitting.  
[1/0]

- identify the requirements for Personal Protective Equipment P.P.E.
- identify the requirements for clean clothing
- define the specified Babbitt composition
- identify the required babbitting equipment
- identify the hazards associated with heating babbitt
  - § use of heating equipment
  - § handling molten Babbitt
- identify the dangers of moisture in babbitting
- identify the dangers of fumes in babbitting

1.7 – Define the fundamentals of safety when using oxy-acetylene equipment for heating and flame cutting.  
[1/0]

- define the requirements of wearing Personal Protective Equipment (P.P.E.).
- identify the safe handling methods and storage requirements of oxy-acetylene equipment.
  - § turning on and off equipment
  - § hazards of using oxygen around lubricating oil or grease
  - § explosion hazards
  - § equipment storage and transportation
  - § regulator adjustment

1.8 – Define the fundamentals of environmental hazards.  
[1/0]

- chemical hazards
- physical hazards
- biological hazards
- toxic substances

1.9 – Define the fundamentals of material handling.  
[1/0]





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- planning storage
- specified PPE
- warm up
- adequate lighting
- communication
- use of dollies
- lifting techniques

1.10 – Describe the safety issues relating to substance abuse.

[1/0]

- describe alcohol, prescription and non-prescription drug abuse
- recognize symptoms
- awareness of programs and counseling

1.11 – Describe the role of the Workplace Safety and Insurance Board (W.S.I.B.)

[1/0]

- define the role of the W.S.I.B
- define the role and responsibilities of the employer and employee

1.12 – Describe the workplace fire safety and prevention requirements.

[1/0]

- interpret the Occupational Health and Safety Act (O.H.S.A.)
- identify potential fire hazards
- identify the class of fires and the application of the appropriate fire extinguisher
- develop an emergency action plan including evacuation procedures
- describe the use of extinguishers, respirators, stretchers and fire blankets
- describe the factors that determine when a fire should not be fought

1.13 – Define the essential workplace housekeeping procedures.

[1/0]

- Identify hazardous areas in the workplace
  - § wet floors and liquid spills
  - § poor illumination
  - § debris in walking area
  - § loose carpet and uneven surfaces
  - § storage of tools and equipment

1.14 – Describe the types and applications of effective communication techniques.

[0.5/0]



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- identify the four types of communication and situational applications
  - § Verbal
  - § Written
  - § Visual
  - § Body language

1.15 – Identify the required Ministry of Labour and TSSA procedures for accidents and unsafe working conditions.

[2/0]

- define the procedures for identifying and reporting unsafe conditions
- describe how to attend to injured workers
- practice writing an accident and incident report that complies with the Ministry of Labour and TSSA Accident Reporting Procedures
- review the TSSA “Emergency Evacuation Training and Certification Policy”

1.16 - Describe the public safety requirements for the workplace.

[1/0]

- define the method of notifying building personnel of elevating device shut-down or reinstatement to service.
- define the reasons for notifying building personnel that the elevating device has been shut down or returned to service
- define the requirement for and location of “maintenance in progress” signs
- define the equipment requirements and procedure for barricading entrances.
- define the requirements for barricading
- minimizing hazards associated with public contact with tools or materials in the work area

Reference material for this section includes the following:

The Act:

Occupational Health and Safety Act, R.S.O. 1990

4 Sector Regulations:

Regulations for Construction Projects, O. Reg. 213/91

Industrial Establishments Regulations, O. Reg. 851

Health Care and Residential Facilities Regulation, O. Reg. 67/93

Mines and Mining Plants Regulation, O. Reg. 854

Elevator Industry Safety Handbook



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 2

Title: Introduction to Elevating Devices

Duration: 13 Total Hours

Theory: 13 Hours                      Application: 0 Hours

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### General Learning Outcome:

Upon successful completion of this reportable subject, the EDM-T is able to describe the introductory information of the elevating devices industry in accordance with historical and current elevating systems.

2.1 – History and Terminology of Vertical Transportation

2.2 – Other Elevating Devices

2.3 – Acts, Regulations, Standards and Codes

---

2.1– History and Terminology of Vertical Transportation

Duration:            Total Hours: 5            Theory: 5 hours            Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the history and terminology of vertical transportation and the evolution to the modern elevating devices in accordance with government safety regulations, manufacturers recommendations and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

2.1.2- Describe terminology concerning elevators, escalators and other elevating devices.

### Learning Content:

2.1.2- Describe terminology concerning elevators, escalators and other elevating devices.  
[2/0]



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- identify a glossary of elevating devices terms:
  - § car assembly equipment

2.2.1- Define the fundamentals of lifts for persons with physical disabilities.

2.2.1- Define the fundamentals of lifts for persons with physical disabilities.  
[3/0]

- Ontario Regulation 209/01
- Code Adoption Document
- CSA B355
- CSA B613

Duration:      Total Hours: 8      Theory: 8 hours      Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe other elevating devices covered under the Elevating Devices Regulations in accordance with manufacturer's design features.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

2.3– Acts, Regulations, Standards and Codes

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

2.3.1- Identify the basic differences between acts, regulations, standards and codes.

2.3.2- Describe the essentials of the Technical Standards and Safety Act, Regulations, Code Adoption Document, Policies and Procedures.

2.3.3- Interpret the essentials of the Ontario Building Code Act and Regulations.

2.3.4- Define the essentials of the Ontario Health and Safety Act (Construction/ Industrial) as it applies to this trade.

2.3.5- Describe the essentials of W.H.M.I.S. as it applies to this trade and industry.

2.3.6- Define the essentials of the various Codes and Standards as they apply to elevating devices.



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2.3.7- Identify the legal responsibilities as they apply in the various acts, regulations, standards and codes and how they affect this trade.

2.3.8- Identify the fundamentals of the TSSA Directors rulings.

### Learning Content:

2.3.1- Identify the basic differences between acts, regulations, standards and codes.  
[1/0]

- basic information concerning the differences between the topics covered in acts, those covered in regulations and those in standards.
- explanation of the relationship between acts, regulations and standards.
- review Code adoption documents.

2.3.2- Describe the essentials of the Technical Standards and Safety Act, Regulations and Code Adoption Document Policies and Procedures.  
[2/0]

- Basic information (overview) concerning topics in the Technical Standards and Safety Act and Regulations and Training and Certification of Mechanics.

2.3.3- Interpret the essentials of the Ontario Building Code Act and Regulations.  
[1/0]

- Overview of the topics which are directly relevant to elevating devices.

2.3.4- Define the essentials of the Ontario Health and Safety Act (Construction/ Industrial) as it applies to this trade.  
[1/0]

2.3.5- Describe the essentials of W.H.M.I.S. as it applies to this trade and industry.  
[1/0]

2.3.6- Define the essentials of the various Codes and Standards as they apply to elevating devices.  
[0.5/0]

- code reference: applicable codes, standards and regulations

2.3.7- Identify the legal responsibilities as they apply in the various acts, regulations, standards and codes and how they affect this trade.  
[0.5/0]

- Identify the legal responsibilities:



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- § EDM-T
- § Elevating devices mechanic

2.3.8- Identify the fundamentals of the TSSA Directors rulings.  
[1/0]

- refer to the TSSA web site ([www.tssa.org](http://www.tssa.org))
- sign-up for electronic notifications on TSSA website
- identify the legal responsibilities
- explain the reasons for directors rulings



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 3

Title: Mechanical Print Reading

Duration: 15 Total Hours  
Theory: 6 Hours      Application: 9 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able interpret mechanical print reading in accordance with manufacturer's recommendations and specifications and approved industry standards.

- 3.1 – Architectural/Structural Prints
  - 3.2 – Elevating Device Layout Prints
  - 3.3 – Elevating Devices Mechanical Print Reading
- 

### 3.1– Architectural/Structural Prints

Duration: 3 Total Hours      Theory: 3 hours      Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to interpret architectural/structural prints in accordance with manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:



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- 3.1.1- Identify the fundamentals of architectural/structural prints.
- 3.1.2- Describe the construction features of architectural/structural prints.
- 3.1.3- Locate and identify key elements on an architectural/structural print relating to the construction/installation of an elevating device.

### Learning Content:

- 3.1.1- Identify the fundamentals of architectural/structural prints.  
[0.5/0]

- identify the type and application of architectural/structural drawings
  - § drawing type
  - § location of identifying information
    - building address
    - drawing number
    - plan views
    - elevation views
    - drawing scale
    - specifications

- 3.1.2- Describe the construction features of architectural/structural prints.  
[0.5/0]

- nomenclature relating to sectional views
- number of landings and floor elevations
- symbols relating to :
  - § doors
  - § windows
  - § structural beams
  - § beam connections
  - § fasteners
  - § poured concrete
  - § concrete blocks
  - § masonry
  - § timber
  - § drywall
  - § footings reinforcing rods
  - § anchors
  - § concrete inserts
  - § through bolts
  - § heating cooling and ventilation ducts
  - § exhaust fans





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- § plumbing
- § sanitary drains
- § sump holes
- § cored holes

3.1.3- Locate and identify key elements on an architectural/structural print relating to the construction/installation of an elevating device.

[2/0]

- location of elevating device in the plan views
- location of elevation views and determine floor heights and number of landings
- determine the travel, pit depth and overhead
- locate the system of grid lines on the drawings and relate position of elevating device to the grid lines
- determine the thickness and type of finished walls for the hoistway
- determine the location of fixtures forming part of the elevating device control equipment and other ancillary fixtures.
  - § Central Alarm and Control Facility (CACF)
  - § lobby dispatch panel
  - § recall switches
  - § smoke and heat sensors
  - § sprinkler heads
  - § display systems
- locate the elevating device entrances
- locate the elevating device machine room
  - § machine room configuration
  - § secondary level configuration
  - § special trenches or tunnels for:
    - oil lines
    - electrical conduit

### 3.2– Elevating Device Layout Prints

Duration: 8 Total Hours Theory: 0 hours Application: 8 hours

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe elevating device layout prints in accordance with manufacturer's recommendations and specifications and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:



3.2.1- Interpret the information on an elevating device print.

3.2.2- Identify the key aspects of elevating device print reading.

3.2.3- Locate and identify positioning of components

3.2.4- Locate and identify clearances

3.2.5- Locate and identify power requirements

Learning Content:

3.2.1- Interpret the information on an elevating device print.  
[0/2]

- location of identifying information
  - § building address
  - § drawing number
  - § plan and elevation views
  - § drawing scale

3.2.2- Identify the key aspects of elevating device print reading.  
[0/1]

- location and depth of pit
- identify the normal travel of the elevating device
- locate and identify the overhead and related dimensions
- locate the width and depth of the hoistway in the plan view

3.2.3- Locate and identify positioning of components  
[0/2]

- locate and identify position of guide rails
- identify the size and orientation of the car frame
- locate and identify pit equipment:
  - § buffers
  - § rail foot brackets
  - § pit channels
  - § compensating sheave
  - § pit ladder
  - § pit stop switch
  - § pit light and light switch

3.2.4- Locate and identify clearances



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[0/1]

- locate and identify clearances:
  - § sill to sill running clearance
  - § car to car counterweight clearance
  - § car to hoistway wall clearance
  - § clearances at top and bottom of hoistway
  - § run-by, buffer stroke and clearances
  - § controller and main disconnect clearances

### 3.2.5- Locate and identify power requirements

[0/2]

- identify the correct location of main electrical components
  - § main disconnect switches
  - § car light disconnect / power supply
  - § signal switches
  - § dispatcher disconnect switches
- confirm the elevating device power requirements
  - § voltage
  - § amperage

### 3.3– Elevating Devices Mechanical Print Reading

Duration: Total Hours: 4 Theory: 3 hours Application: 1 hour

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to explain elevating device mechanical print reading procedures in accordance with manufacturer's recommendations and specifications and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:

3.3.1- Describe the fundamentals of drawing title blocks, notes and abbreviations.

3.3.2- Describe the fundamentals of visualization, projection and views.

3.3.3- Explain the fundamentals of dimensioning.

3.3.4- Identify typical machine elements associated with elevating devices.



Learning Content:

3.3.1- Describe the fundamentals of drawing title blocks, notes and abbreviations.  
[1/0]

- drawing title blocks
  - § drawing name
  - § number system
  - § revisions
  - § dates
- reading notes
  - § importance of recognition
  - § data
- understanding abbreviations
- scale indication and measuring scales

3.3.2- Describe the fundamentals of visualization, projection and views.  
[1/0]

- orientation of objects
- third vs. first angle of projection
- basic arrangement of views
- transference of dimensions
- auxiliary and section views
- isometric and exploded views

3.3.3- Explain the fundamentals of dimensioning.  
[1/0]

- definition and requirements of dimensioning
- dimensioning systems
- rules for dimensioning
- checking dimensions
- English vs. metric system of units

3.3.4- Identify typical machine elements associated with elevating devices.  
[0/1]

- structural steel sections
- shafts, keys and pins
- fasteners
  - § types
  - § thread nomenclature
- weld symbols



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number	4
Title:	Ladders, Scaffolding and Work Platforms
Duration:	6 Total Hours
	Theory: 5 Hours      Application: 1 Hour

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to explain the use of ladders, scaffolding and work platforms in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

- 4.1 – Describe the fundamentals of using ladders.
  - 4.2 – Explain the fundamentals of using scaffolding.
  - 4.3 – Explain the fundamentals of using work platforms.
- 

### Learning Content:

- 4.1 – Describe the fundamentals of using ladders.  
[0.5/0.5]

- ladder angle limits
- ensure secure footing
- determine the required height
- define correct positioning
- guard area in vicinity of ladder
- tie-off the ladder as required
- load limits
- maintenance and storage
- materials used to construct ladders
- code reference: applicable codes, standards and regulations



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- C.S.A Certification and Duty Ratings

### 4.2 – Explain the fundamentals of using scaffolding. [1.5/0.5]

- OSHA requirements (construction)
- Identify when scaffolding requires engineering
- methods of assembly and disassembly
- recognizing hazards and obstructions
- leveling
- bracing and tying-off
- guarding the work area
- installing the planking and railings
- personal protective equipment
- recognize load limits
- inspect scaffolding
- perform maintenance
- storage of scaffolding and planks
- differences between hoistway and exterior scaffolding
- code reference: applicable codes, standards and regulations

### 4.3 – Explain the fundamentals of using work platforms. [3/0]

- work platforms v/s false cars
- advantages and disadvantages of each
- assembly and disassembly of each type
- overhead protection requirements
- false cars
  - § drawing name
  - § ensure safeties are correct size for rail
  - § test safeties
  - § maintain logbook of false car use/problem/repairs
- guard work area
- use of railings and kickboards
- personal protective equipment
- check safe load limits
- inspect work platforms and false cars
- maintain work platforms and false cars
- correct storage methods]
- code reference: applicable codes, standards and regulations



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number:	5	
Title:	Rigging and Hoisting	
Duration:	12 Total Hours	
	Theory: 9 Hours	Application: 3 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the safe use of rigging and hoisting equipment in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

- 5.1 – Define the fundamentals and types of rigging and hoisting equipment
  - 5.2 – Describe the construction features and application of rigging and hoisting equipment.
  - 5.3 – Explain the operating principles of rigging and hoisting equipment.
  - 5.4 – Describe the safe use in the workplace of rigging and hoisting equipment.
  - 5.5 – Define the fundamentals of hardware for hoisting equipment.
- 

### Learning Content:

- 5.1 – Define the fundamentals and types of rigging and hoisting equipment  
[2/0]
  - chain block
  - come-along
  - tigger hoist
  - cat-head
  - electrical devices
  - hydraulic devices



- pneumatic devices

5.2 – Describe the construction features and application of rigging and hoisting equipment.  
[2/0]

- equipment assembly
- limitations on the use of cat-heads
- slings and sling arrangements
  - § ratings
  - § wire rope v/s nylon rope
- securing and balancing a load
- test lifts
- estimating weights of equipment
- load capacities of lifting equipment

5.3 – Explain the operating principles of rigging and hoisting equipment.  
[1/1]

- limitations on the use of cat-heads
- slings, sling arrangements, applications
  - § ratings
  - § soft slings
  - § wire rope
- chain block
- come-along
- tugger hoist
- cat-head
- electrical devices
- hydraulic devices
- pneumatic devices

5.4 – Describe the safe use in the workplace of rigging and hoisting equipment  
[2/2]

- guarding the work area
- awareness of pinch points
- safety in the lifting area
- communications
  - § verbal
  - § hand signals
- ventilation and lighting
- personal protective equipment
- inspection, maintenance and repair of equipment
- recommended storage of equipment





## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- maintaining logbooks
- code reference: applicable codes, standards and regulations

5.5 – Define the fundamentals of hardware for hoisting equipment.  
[2/0]

- hooks and mousing
- eye bolts and shackles
- tag lines
- shims
- fillers
- spacers
- jacks
- spreader bars



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 6

Title: Introduction to Applicable Codes and Standards

Duration: 6 Total Hours

Theory: 2 Hours                      Application: 4 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is capable of describing the fundamentals of locating, accessing and interpreting the information contained within the CSA B355 Standard.

- 6.1 – Define the introductory information of the development of codes and standards for the CSA B355 code book.
  - 6.2 – Not Required or Not Applicable
  - 6.3 – Describe the format of standards and conventions used for codes.
  - 6.4 – Perform the procedure to access information from the CSA B355 code book.
- 

### Learning Content:

- 6.1 – Define the introductory information of the development of codes and standards for the CSA B355 code book.  
[1/0]
  - the hierarchy of Standards Canada, Canadian Standards Association (CSA) and other code writing bodies.
  - CSA and technical committees
  - Technical committee and sub-committees
    - § recommended reading of the code making process at CSA
      - hierarchy



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- policies and procedures
- organizational charts

6.3 – Describe the format of standards and conventions used for codes.  
[1/0]

- the numbering system
- terminology for:
  - § differences between a “code” and a “Standard”
  - § interpretations
  - § inquiries
  - § ballots
  - § letter ballots
  - § define “consensus”

6.4 – Perform the procedure to access information from the BSA C355 code book.  
[0/4]

- search for keywords
- process of elimination
  - § the hierarchal approach
- use of trade terms
- searching with the index
- search levels and cross references



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 7

Title: Mechanical Practices

Duration: 30 Total Hours

Theory: 21 Hours                      Application: 9 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the mechanical practice procedures for elevating device maintenance in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

- 7.1 – Define the fundamentals of mechanical print reading, associated mathematics and science.
  - 7.2– Describe the fundamentals of power transmission components.
  - 7.3 – Describe the basic introductory information and fundamentals of bearings and seals.
  - 7.4 – Describe the fundamentals of precision measurements.
  - 7.5 – Describe the fundamentals of materials and fastening technology.
  - 7.6 – Describe the basic introductory information and fundamentals of lubrication.
  - 7.7 – Describe the fundamentals of test instruments.
- 

### Learning Content:

- 7.1 – Define the fundamentals of mechanical print reading, associated mathematics and science.  
[7.5/0]



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- drawing types
  - § orthographic
  - § isometric
- drawing views of machine components
  - § multi-view
  - § auxiliary views
  - § assembly
  - § detail drawings
  - § bills of materials
  - § title block
  - § change orders
  - § dimensions
  - § tolerances
  - § notes
- applied mathematics
  - § adding, subtracting, multiplying, dividing
  - § conversion of fractions
  - § algebra
  - § trigonometry
- strength of materials
  - § tensile strength
  - § hardness
  - § corrosion protection
  - § safety factors
- heat transfer
  - § convection
  - § radiation
  - § conduction

7.2– Describe the fundamentals of power transmission components.  
[4.5/3]

- V-belts
- belt sheaves
- taper bushings
- chains and sprockets
- gear and rear reducers
- couplings, keys, pins and set screws
- belt alignment
  - tools
  - procedure

7.3 – Describe the basic introductory information and fundamentals of bearings and seals.  
[4/2]



- bearing types
  - § sleeve (journal) bearings
  - § anti-friction bearings
    - ball
    - taper
    - roller
    - thrust
  - § mounted bearings
    - pillow blocks
    - flange cartridges
- causes of bearing failures
  - § lack of lubrication
  - § contamination
  - § overloading
  - § overheating
  - § electrolysis
- identification of bearing failures
  - § scoring
  - § galling
  - § corrosion
  - § pitting
- bearing removal procedures
  - § pullers
  - § press
- bearing lubrication procedures
  - § cleaning
  - § repacking
  - § grease gun
- identify seals
  - § static
  - § dynamic
  - § application
- procedure for removal and installation of seals
  - § pullers
  - § drivers

7.4 – Describe the fundamentals of precision measurements.  
[0.5/2.5]

- inch and metric measurements
  - § imperial system
  - § metric system
- describe precision measuring tool construction features
  - § micrometers



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § calipers
- § dial indicators
- § feeler gauges
- § levels
- § scribing tools
- describe precision measuring tool use
  - § micrometers
  - § calipers
  - § dial indicators
  - § feeler gauges
  - § levels
  - § scribing tools
- describe precision measuring tool maintenance and storage procedures
  - § lubrication
  - § accuracy checks
  - § corrosion protection
  - § storage location and method

### 7.5 – Describe the fundamentals of materials and fastening technology. [3/0]

- identify and describe properties and application for:
  - § ferrous metals
  - § non-ferrous metals
  - § alloys
- identify and describe application for non-metallic materials
  - § neoprene
  - § plastics
  - § composites
- define the mechanical properties of metals and alloys
  - § tensile strength
  - § yield strength
  - § hardness
  - § elongation rate
- identify and select fasteners for specific applications
  - § bolts
  - § through bolts
  - § nuts
  - § lock washers
  - § flat washers
  - § bevel washers
  - § pins
  - § dowels
  - § retaining rings
  - § screws



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § mechanical anchors
- § chemical anchors
- § shields
- § inserts
- identify thread types
  - § UNC
  - § UNF
  - § Metric
  - § NPT
  - § NPTF
- identify grade of fasteners
  - § head markings
  - § strength of materials
  - § reference CSA B44 Section 9.1

7.6 – Describe the basic introductory information and fundamentals of lubrication.  
[1.5/0.5]

- lubricant types and properties
  - § oil
  - § grease
  - § solids
  - § gases
- use of lubrication devices
  - § grease guns
  - § oil cans
  - § mechanical
- storage of lubrications
  - § fire protected
  - § ventilation
  - § temperature
  - § containers
  - § location
- disposal requirements

7.7 – Describe the fundamentals of test instruments.  
[0/1]

- use test instruments
  - § stopwatches
  - § tachometers
  - § pressure gauges
  - § torque wrenches





## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number:	9	
Title:	Basic Hydraulics	
Duration:	9 Total Hours	
	Theory: 9 Hours	Application: 0 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the fundamentals, construction and operating principles of basic hydraulic systems in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

- 9.1 – Define the fundamentals and types of hydraulic systems.
  - 9.2 – Describe the construction features and applications of hydraulic systems and components.
  - 9.3 – Explain the operating principles of hydraulic systems and components.
- 

### Learning Content:

- 9.1 – Define the fundamentals and types of hydraulic systems.  
[3/0]
  - describe the advantages of using hydraulics for elevating devices
  - identify hydraulic system types
    - § open system
    - § closed system
  - define the properties of hydraulic fluids:
    - § viscosity
    - § fire resistance
    - § lubricity



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § contamination from foreign particles, air and water
- define basic principles for force, work and power.
  - § weight and specific gravity
  - § pressure and force
  - § static pressure
  - § gauge pressures in English and Metric units
  - § Pascal's Law
  - § conversion of energy and hydraulic power
  - § pressure losses

### 9.2 – Describe the construction features and applications of hydraulic systems and components.

[3/0]

- tanks and reservoirs
  - § materials used
  - § location
  - § capacities
  - §
- distribution systems
  - § pipes
  - § tubing
  - § flexible hoses and fittings
  - § couplings
    - grooved
    - threaded
    - crimped
  - § pressure ratings of pipes, hoses, couplings and fittings
- pumps
  - § gear
  - § vane
  - § screw
- pump drives
  - § electric motors
  - § couplings
- plungers and cylinders
  - § plunger stop ring
  - § plunger coupling
  - § cylinders
    - above ground
    - below ground
    - gland, seal (packing), wiper ring
- control valves
  - § relief valve



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § manual lowering valve
- § shut off valve
- § pipe rupture valve
- § flow control devices
- pressure switches
- pressure gauges
- jacks
  - § types
  - § capacities

### 9.3 – Explain the operating principles of hydraulic systems and components. [3/0]

- tanks and reservoirs
- distribution systems
  - § pipes
  - § tubing
  - § flexible hoses and fittings
  - § couplings
- pumps
- pump drives
  - § electric motors
- plungers and cylinders
  - § plunger stop ring
  - § plunger coupling
  - § cylinders
    - above ground
    - below ground
    - gland, seal (packing), wiper ring
- valve control of flow direction, rate, and pressure
  - § relief valve
  - § manual lowering valve
  - § shut off valve
  - § pipe rupture valve
  - § flow control devices
- pressure switches
- pressure gauges
- jacks
  - § conversion of pressure and flow to linear force



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number:	10
Title:	Elevator Hydraulic Systems
Duration:	36 Total Hours
	Theory: 28 Hours                      Application: 8 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to perform the inspection, testing, troubleshooting and adjustment procedures of elevator hydraulic systems in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

- 10.1 – Describe the construction features and applications of elevator hydraulic pumping systems and components.
  - 10.2– Describe the construction features and applications of typical elevator hydraulic jacking systems and components.
  - 10.3 – Explain the operating principles of elevator hydraulic systems and components.
  - 10.4 – Inspect, test and troubleshoot elevator hydraulic systems.
  - 10.5– Perform adjustment procedures for elevator hydraulic systems.
- 

### Learning Content:

- 10.1 – Describe the construction features and applications of typical elevator hydraulic pumping systems and components.

[6/0]

- tanks and reservoirs  
§ level gauge



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § filler cap/breather
- § oil heater/cooler
- § oil filter/strainer
- distribution systems
  - § pipes
    - short run
    - under-ground
  - § tubing
  - § flexible hoses and fittings and limitations according to code
  - § couplings
    - grooved e.g.( Victaulic, Grinnel)
    - threaded, NPT and NPTF
    - isolation
  - § pressure ratings of pipes, hoses, couplings and fittings
  - § sound isolation
- pumps
  - § gear
  - § vane
  - § screw
- pump drives
  - § couplings
  - § electric motors
    - submersed
    - non-submersed
- plungers and cylinders
  - § plunger stop ring
  - § plunger coupling
  - § cylinders
    - above ground & below ground
    - gland, seal (packing), wiper ring
- control valves
  - § makes: (e.g. Maxton, Blain, Beringer, GMV)
  - § relief valve
  - § manual lowering valve
  - § shut off valve
  - § pipe rupture valve
  - § flow control devices
  - § muffler
- pressure switches
- pressure gauges

10.2 – Describe the construction features and applications of typical elevator hydraulic jacking systems and components.



[4/0]

- telescoping jack unit
  - § plunger
  - § piston steadiers (followers)
  - § cylinder
    - end treatment for in-ground or above ground
  - § head (gland) arrangements
  - § corrosion protection
    - corrosion
    - electrolysis
    - passive and active cathodic protection
    - PVC protection
- code reference: applicable codes, standards and regulations

10.3 – Explain the operating principles of elevator hydraulic systems and components.

[6/0]

- fluid level indicators
- fluid filters
- distribution systems
  - § hydraulic fluid circuits
  - § hydraulic fluid flow rates
- pumps
  - § gear
  - § vane
  - § screw
- pump drives
  - § electric motors
- plungers and cylinders
  - § plunger stop ring
  - § plunger coupling
  - § cylinders
    - above ground
    - below ground
    - gland, seal (packing), wiper ring
- valve control of flow direction, rate, and pressure
  - § flow requirements
  - § relief valve
  - § manual lowering valve
  - § shut off valve
  - § pipe rupture valve
  - § flow control devices
  - § pressure compensation
- pressure switches



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- pressure gauges
- telescoping jacks
  - § conversion of pressure and flow to linear force
  - § check valve operation
  - § piston and rod seal operation
- safeties
- roped hydraulics

### 10.4 – Inspect, test and troubleshoot elevator hydraulic systems. [6/4]

- visual inspection
  - § fluid leaks
  - § loose fasteners or brackets
  - § corrosion
- testing
  - § determine cause of fault:
    - discuss case studies
    - hydraulic defects
    - electrical defects
    - mechanical defects
- troubleshooting
  - § isolating the fault
    - primary cause
    - secondary cause
  - § unexplained loss of oil in the hydraulic system
  - § trapped air problems
  - § excessive high or low oil temperatures

### 10.5– Perform adjustment procedures for elevator hydraulic systems. [6/4]

- control valve set-up procedure
  - § use manufacturer's data
- operating sequence for valve solenoids
  - § use manufacturer's data
- relief valve set-up
  - § use manufacturer's data
- packing (seal) friction
  - § use manufacturer's data
- effects of oil temperature on control valve performance



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number:	11
Title:	Hydraulic Elevator Installation
Duration:	21 Total Hours
	Theory: 17 Hours                      Application: 4 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the installation procedures for hydraulic elevators in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

11.1 – Identify the differences between the installation of traction and hydraulic elevators.

11.2 – Define the fundamentals of installing jack units.

11.3 – Define the fundamentals of installing oil lines.

11.4 – Define the fundamentals of installing the pumping unit.

11.5 – Define the fundamentals of adjusting the control valve.

11.6 – Define the fundamentals of establishing the working pressure and performing relief valve tests.

11.7 – Define the fundamentals of completing field test and data reports.

11.8 – Define the fundamentals of performing tests for inspection.

---

### Learning Content:

11.1 – Identify the differences between the installation methods of traction and hydraulic elevators.





[1/0]

- drive components
- Jack units
- oil lines
- pumping units
- installation sequences & differences
- site planning
- plumbing in ground and above ground cylinders
- plumbing hoistway

11.2 – Define the fundamentals of installing jack units.

[2.5/0]

- identify the features of in-ground jack units
  - § one piece
  - § two piece
  - § telescopic
  - § plumbing
    - cylinder
    - hoistway
- identify the features of above ground jack units
  - § one piece
  - § two piece
  - § telescopic
  - § plumbing
    - cylinder
    - hoistway
  - § roped hydraulics
- describe the alignment procedure for jack units

11.3 – Define the fundamentals of installing oil lines.

[1.5/1]

- describe the installation procedures for:
  - § oil lines with grooved couplings
  - § oil lines with grooved fittings
  - § oil lines with threaded fittings
  - § oil lines using flexible hoses and fittings
  - § victaulic couplings
  - § mufflers
  - § oil supports
- describe the procedures to bleed air from the hydraulic system
- Refer to Code: B44 Clause 3.19



11.4 – Define the fundamentals of installing the pumping unit.  
[3.5/0]

- outline the important issues regarding the work area around the pump unit
- discuss the orientation of the pumping unit vs the oil line direction
- describe the method to secure the pump unit to the floor
- refer to code: B44 clause 4.18

11.5 – Define the fundamentals of adjusting the control valve.  
[1.5/1.5]

- outline the control valve adjustment procedures following the manufacturer's recommendations
- identify the process of co-ordination with the electrical controls

11.6 – Define the fundamentals of establishing the working pressure and performing relief valve tests.  
[3.5/0]

- define working pressure
- describe manufacturer's relief valve test procedures
- refer to code: B44 clause 4.19

11.7 – Define the fundamentals of completing field test and data reports.  
[1/1]

- describe the field testing procedures for:
  - § car speeds
  - § up/down
  - § rated load/empty
  - § safety testing (roped hydraulics)
  - § working pressure
  - § relief pressure
  - § supply voltage at motor with full current load
  - § disconnect fuse rating and overload setting

11.8 – Define the fundamentals of performing tests for inspection.  
[2.5/0.5]

- outline the details of a TSSA elevating device inspection
- define the inspection checklist
  - § full load safety test (roped hydraulics)
  - § full load running test
  - § redundancy check
  - § run-by distance and clearance checks



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § door opening times and closing force
- § ground tests of primary safety circuit
- § identification of machine room equipment
- § final clean up procedures
- § turnover inspection
- § mechanical stored energy
  - pipe stands
  - rail clamps
- code reference: applicable codes, standards and regulations



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number:	12
Title:	Basic Electricity
Duration:	60 Total Hours
	Theory: 42 Hours                      Application: 18 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe basic fundamentals of electricity and related electrical circuits in accordance with manufacturer's recommendations and specifications and approved industry standards.

- 12.1 – Review basic mathematics.
  - 12.2 – Describe the fundamentals of electricity and relation to the structure of matter.
  - 12.3 – Define the fundamentals and work with direct current electrical circuits.
  - 12.4 – Define the fundamentals and work with alternating current electrical circuits.
  - 12.5 – Describe voltage, current and resistance measurements.
  - 12.6 – Define the principles of permanent magnetism.
  - 12.7 – Define the principles of electromagnetism.
- 

### Learning Content:

- 12.1 – Review of basic mathematics  
[5/0]
  - review number systems
    - § whole numbers
    - § decimals



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § fractions
- § reciprocals
- § percent
- § powers
- § roots
- § ratio
- § proportion

12.2 – Describe the fundamentals of electricity and relation to the structure of matter.  
[2/0]

- atomic structure of matter
  - § free electrons
  - § source of electricity
  - § define nature of electricity
  - § static electricity

12.3 – Define the fundamentals and work with direct current electrical circuits.  
[15/9]

- define direct current
- electrical terms
  - § voltage
  - § amperage
  - § resistance
  - § Electro Motive Force ( EMF)
  - § Potential Difference (PD)
  - § ohm's law
- electrical circuits
  - § build and observe characteristics of electrical circuits
    - series circuits
    - parallel circuits
    - series/parallel circuits
    - Kirchoff's law
    - power and heat loss
- electrical components
  - § observe the operating characteristics of electrical components
  - § resistors
    - series
    - parallel
    - colour coding
    - wattage
    - potentiometers/rheostats
  - § capacitors
    - types



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- series/parallel
- colour coding
- ratings
- timing circuits
- uses
- § diodes
  - types
  - identification
  - uses
  - capacities
  - series/parallel

### 12.4 – Define the fundamentals and work with alternating current electrical circuits. [14/4]

- define alternating current
- electrical terms
- electrical symbols
  - § sine wave
- RMS value of voltage and current
  - § inductance
  - § capacitance
  - § impedance
- AC power

### 12.5 – Describe voltage, current and resistance measurements. [2/3]

- Identify precautions
  - § switching from ohmmeter to voltage and amperage scales
  - § moisture
  - § electrical shock prevention
- measure AC and DC voltage and amperage
  - § analog meters
  - § digital meters
- measure resistance
  - § ohmmeter
  - § multi-meter

### 12.6 – Define the principles of permanent magnetism. [2/1]

- define and observe characteristics of permanent magnetism
  - § properties of permanent magnets
  - § action of magnetic poles



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § magnetic fields
- § magnetic properties

12.7 – Define the principles of electromagnetism.  
[2/1]

- define and observe characteristics of electromagnetism
  - § properties of electromagnets
  - § action of magnetic fields around a conductor
  - § principles of induced voltage
  - § effects of motion on induced voltage
  - § factors that affect induced voltage
  - § define Lenz's Law



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 13

Title: Industrial Electricity for Elevating Devices

Duration: 54 Total Hours

Theory: 43 Hours                      Application: 11 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the fundamentals of industrial electricity as applied to elevating devices in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

13.1 – Electrical System Control Devices

13.2 – Transformers

13.3 – Electrical Distribution and Control Systems

13.4 – Electrical Schematic Diagrams

13.5 – Electrical Circuit Conductors, Wiring Devices & Methods

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13.1 - Electrical System Control Devices

Duration:            Total Hours: 11    Theory: 8 hours    Application: 3 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the construction, operation and identify schematic symbols of electrical system control devices as





## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

applied to elevating devices in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

13.1.1 – Describe the construction features of electrical system control devices, and identify their corresponding schematic symbols.

13.2.2 – Explain the operating principles of electrical system control devices.

### Learning Content:

13.1.1-Describe the construction features of electrical system control devices, and identify their corresponding schematic symbols.

[6/2]

- switches
  - § switch notation
  - § contacts and ratings
  - § pushbutton type
  - § toggle switch
  - § rotary switch
  - § snap action switch
  - § limit switches (positive acting)
  - § dual in line switches (DIP)
- relays
  - § basic relay
    - coils
    - types of contacts
  - § types of relays
    - AC v/s DC relays
    - plug in relays
    - reed relays
    - memory relays (set/reset, mechanical latching)
    - phase monitoring
    - solid state
    - Normally Open (N/O) contacts
    - Normally Closed (N/C) contacts
    - power contacts
- relay ratings
- identify common relay circuits
  - § relay interlocks (electrical and mechanical interlock)



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- § self holding contacts
- § diode controlled relay
- solenoids
- timers
  - § air and oil dashpot
  - § motor driven
  - § thermal or bimetallic
  - § solid state timers
- contactors
- main line disconnect switches
  - § purpose
  - § ratings
  - § auxiliary contacts
- circuit protection devices
  - § fuses (ratings, types)
  - § circuit breakers
  - § overload relays
  - § over temperature sensing devices
- rectifiers

13.1.2- Explain the operating principles of electrical system control devices.  
[2/1]

- switches
  - § effects of operation under load
  - § DIP/switch settings/operation
- relays
  - § contact wipe
  - § contact gap
  - § contact material
  - § contact conditions
  - § mechanical operating principles
  - § electrical operating principles
  - § magnetic operating principles
- solenoids
  - § mechanical vs. electrical operation
- timers
  - § on delay/off delay
  - § adjustment
- contactors
  - § contact wipe
  - § contact gap
  - § contact material
  - § contact conditions



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- § mechanical operating principles
- § electrical operating principles
- § magnetic operating principles
- main line disconnect switches
  - § types
  - § hazards
- circuit protection devices
  - § adjustment
- rectifiers
  - § heat dissipation

### 13.2 - Transformers

Duration:            7 Total Hours    Theory: 6 hours    Application: 1 hours

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals of electrical transformers in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:

13.2.1 – Define the fundamentals of electrical transformers.

13.2.2 – Describe the construction features of electrical transformers.

13.2.3 – Explain the principles of operation of electrical transformers.

#### Learning Content:

13.2.1- Define the fundamentals of electrical transformers.  
[2/0]

- transformer fundamentals:
  - § transformer action
  - § moving magnetic fields
  - § transformer losses
  - § transformer ratings
- transformer types
  - § air core
  - § iron core
  - § auto transformers



13.2.2- Describe the construction features of electrical transformers.  
[2/0.5]

- transformer construction features
  - § primary windings
  - § secondary windings
  - § winding turns/voltage ratio
  - § nameplate data
- transformer voltage, current and power ratings
- practical transformers

13.2.3- Explain the principles of operation of electrical transformers.  
[2/0.5]

- transformer operation
  - § primary windings
  - § secondary windings
  - § moving magnetic fields
  - § transformer losses
- application for electrical isolation and spike removal

### 13.3 - Electrical Distribution and Control Systems

Duration: 12 Total Hours Theory: 12 hours Application: 0 hours

General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals of electrical distribution and control systems in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

13.3.1 – Describe the construction features of electrical distribution and control systems.

13.3.2 – Explain the operating principles of electrical distribution and control systems.

13.3.3 – Define the installation code requirements pertaining to CEC Section 38.

Learning Content:

13.3.1- Describe the construction features of electrical distribution and control systems.



[8/0]

- distribution systems
  - § single phase two and three wire
  - § three phase
  - § three phase star and delta connections
- neutral and ground connections
- bonding
- control Systems
  - § grounded and ungrounded control systems
    - grounded controlled
    - ungrounded controlled
- electrical power circuits
  - § motor start circuits
  - § power circuits
- motion control systems
  - § single speed AC motors
  - § AC induction motors
  - § hydraulic elevator motion controls
  - § static drives
  - § variable voltage- Variable frequency drives
- brake controls
  - § DC
  - § AC
  - § brake cooling through resistance

13.3.2- Explain the operating principles of electrical distribution and control systems.

[3/0]

- distribution systems
  - § voltage relationship
    - phase to phase
    - phase to ground
  - § integrity of mechanical connections
- control Systems
  - § grounded
  - § ungrounded
- electrical power circuits
  - § motor start circuits
  - § power circuits
- motion control systems
  - § single speed AC motors
  - § solid state drive
  - § variable voltage- Variable frequency drives
- brake controls



- § DC
- § AC
- § brake cooling through resistance

13.3.3 – Define the installation code requirements pertaining to CEC Section 38.  
[1/0]

- refer to code reference:
  - § code reference: applicable codes, standards and regulations

#### 13.4 - Electrical Schematic Diagrams

Duration:            Total Hours: 5    Theory: 3 hours    Application: 2 hours

General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals and draw electrical schematic diagrams in accordance with code requirements and manufacturers symbols.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

13.4.1 – Define, interpret and draw the fundamentals of electrical schematic diagrams.

13.4.2 – Identify power control functions in electrical schematic diagrams.

Learning Content:

13.4.1- Define, interpret and draw the fundamentals of electrical schematic diagrams.  
[1/1]

- define electrical schematic diagram nomenclature
- read and interpret electrical schematic diagrams
- draw electrical schematic diagrams

13.4.2- Identify power control functions in electrical schematic diagrams.  
[2/1]

- locate and identify power and control functions in an electrical schematic diagram.
  - § power circuit



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- § rotating equipment
- § power supplies
- § fuses and breakers
- § overload/overheat devices
- § safety circuit
- § direction circuit
- § brake circuit
- § door operating circuit
- § door position monitoring system
- § signals
- § valve solenoids (hydraulic)
- § car and hoistway door interlocks

### 13.5 - Electrical Circuit Conductors, Wiring Devices and Methods

Duration:            Total Hours: 19    Theory: 14 hours    Application: 5 hours

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals of electrical circuit conductors and safety systems in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:

13.5.1 – Define the basic fundamentals of electrical circuit conductors, wiring devices and methods.

13.5.2 – Define the application and use of electrical circuit conductors, wiring devices and methods.

#### Learning Content:

13.5.1- Define the basic fundamentals of electrical circuit conductors, wiring devices and methods.

[5/3]

- electrical conductors
  - § solid
  - § stranded
  - § insulating materials and ratings



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- American wire gauge numbers (AWG)
- current carrying capacity of conductors (Ampacity)
- thermal rating and designations for conductors
- stripping and connecting wires
- determining wire sizes
- construction Wiring
  - § raceways
  - § duct (electrical wireway)
  - § risers
  - § conduit
    - rigid
    - EMT
    - Flex
    - Liquid tight Flex
  - § fittings
  - § enclosures and connectors
  - § routing and bracketing
  - § handling materials and tools
- survey and planning
- making pull sheets
  - § for traveling cables
  - § from field wiring diagrams
  - § from straight line wiring diagrams

[3/0]

- Wiring the hoistway and machine room
  - § wiring tools
  - § wiring materials
  - § wiring hardware
  - § hoistway devices
    - interlocks
    - safety circuit
    - direction limits
  - § marking wires and cables
  - § pulling hoistway wires
    - branch runs
    - using a running car
  - § pulling machine room wires
  - § connecting machine room wires
  - § connecting hoistway wires





## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

[3/0]

- Traveling Cables
  - § general description
  - § construction of traveling cables
  - § proper handling
  - § preparation
  - § installation
  - § replacement
  - § protection

[2/0]

- Piping and wiring the car
  - § Car fixtures and equipment
  - § Car junction box
  - § Piping the car
  - § Junction box on top of the car
  - § Junction box under the car
  - § Junction box inside the car operating panel
  - § Devices and switches

13.5.2- Define the application and use of electrical circuit conductors, wiring devices and methods.

[1/2]

- electrical conductors
- American wire gauge numbers (AWG)
- current carrying capacity of conductors (Ampacity)
- thermal rating and designations for conductors
- stripping and connecting wires
- determining wire sizes
- construction Wiring
- survey and planning
- making pull sheets



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 14  
Title: Motors, Generators, Controls and AC Drives  
Duration: 17 Total Hours  
Theory: 17 Hours Application: 0 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the fundamentals of electrical generator and motor systems as applied to elevating devices in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

14.1 – Not Required or Not Applicable

14.2 – Motor Principles

14.3 – DC Generators and Motors

14.4– AC Motors, Drives and Controls

---

### Learning Content:

14.2 - Motor Principles

Duration: Total Hours: 5 Theory: 5 hours Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals of motors for elevating devices in accordance with government safety regulations, and approved industry standards.

### Learning Outcomes:



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Upon successful completion, the apprentice is able to:

14.2.2 – Describe / explain the basic fundamentals and operating principles of electric motors.

### Learning Content:

14.2.2- Describe / explain the basic fundamentals and operating principles of electric motors.  
[5/0]

- motor Action
- counter Electromotive force (CEMF)
- speed of a motor
- efficiency
- hysteresis Loss
- armature Eddy current loss
- pole face Eddy currents
- types of Motors
- speed and torque in a compound motor

14.3 – DC Generators and Motors

Duration: Total Hours: 5 Theory: 5 hours Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals of DC Motors for elevating devices in accordance with government safety regulations, and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

14.3.1 – Define the fundamentals and applications of DC motors for elevating devices.

14.3.2 – Describe the construction features of DC motors for elevating devices.

14.3.3 – Explain the operating principles of DC motors for elevating devices.

14.3.4- Describe the DC motor control systems for elevating devices.



Learning Content:

14.3.1- Define the fundamentals and applications of DC motors for elevating devices.

[1/0]

- review of DC motor circuits
  - § series
  - § shunt
  - § compound
  - § field windings

14.3.2- Describe the construction features of DC motors for elevating devices.

[2/0]

- describe the construction features of DC motors:
  - § main frame
  - § pole pieces
  - § field windings
  - § types of field windings
    - series
    - shunt
  - § end bells
  - § armature assemblies
    - armature core
    - laminations
    - windings
      - lap
      - wave
    - commutator
    - Brush rigging
    - Bearings (roller, ball, sleeve)
    - Cooling
    - Balancing
  - § name plate data

14.3.3- Explain the operating principles of DC motors for elevating devices.

[1]

- DC motor operating characteristics
  - § input voltage and amperage
  - § torque
  - § current draw
  - § load and speed compensation
  - § motors for other elevating devices
    - other DC motors



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14.3.4- Describe the DC motor control systems for elevating devices.  
[1/0]

- describe the speed control
- describe the speed sensing devices
  - § tachometers
  - § encoders
- describe the electronic drive safety features

14.4 - AC Motors, Drives and Controls

Duration:      Total Hours: 7    Theory: 7 hours    Application: 0 hours

General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals of AC motors, drives and controls for elevating devices in accordance with government safety regulations, and approved industry standards.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

14.4.1 – Define the fundamentals and applications of AC motors for elevating devices.

14.4.2 – Describe the construction features of AC motors for elevating devices.

14.4.3 – Explain the operating principles of AC motors for elevating devices.

14.4.4 – Describe AC motor drive and control systems for elevating devices.

Learning Content

14.4.1- Define the fundamentals and applications of AC motors for elevating devices.  
[1.5/0]

- review of DC motors
- motor action (AC)
- rotating field
- armature rotation
- simple AC motors
  - § induction motors
  - § capacitance in an AC circuit
  - § split phase and capacitor start motors



- § synchronous motors
- § AC series motors
- § variable frequency motors

14.4.2- Describe the construction features of AC motors for elevating devices.  
[2/0]

- AC motor construction features:
  - § main frame
  - § pole pieces
  - § stator
  - § rotating field winding
    - “WYE” connections
    - “Delta” connections
    - Proper wiring of connections
    - Reversing direction of rotation
  - § rotor
  - § name plate data

14.4.3- Explain the operating principles of AC motors for elevating devices.  
[1/0]

- AC motor performance characteristics
  - § torque
  - § current draw

14.4.4- Describe AC motor drive and control systems for elevating devices.  
[2.5/0]

- drives and control systems
  - § AC hydraulic pump motor (full or reduced starting voltage)
    - soft start
  - § types of motor control
  - § encoders
  - § braking circuit and DC Buss
- motors for other elevating devices
  - § Hydraulic elevators
  - § Power door openers motors
  - § Other AC motors



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 15  
Title: Solid State Electronics  
Duration: 22 Total Hours  
Theory: 22 Hours      Application: 0 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the fundamentals of solid state electronic devices as applied to elevating devices in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

15.1 – Electronic fundamentals

15.2 – Diodes

15.3 – Transistors

15.4 – Thyristors

15.5 – Analogue Integrated Circuits

15.6 – Power Supplies and Operational Amplifiers

15.7 – Digital Systems

---

15.1- Electronic Fundamentals

Duration:      Total Hours: 2.5      Theory: 2.5 hours      Application: 0 hours

### General Learning Outcome:



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Upon successful completion of this reportable subject, the apprentice is able to describe the electronic fundamentals in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

15.1.1 – Identify solid state electronic components used in elevating devices.

15.1.2 – Define the fundamentals of solid state electronic devices.

### Learning Content:

15.1.1- Identify solid state electronic components used in elevating devices.  
[0.5/0]

- diodes
- transistors
- thyristors
- integrated circuits
  - § analog
  - § digital

15.1.2- Define the fundamentals of solid state electronic devices.  
[2/0]

- define the introductory information of solid state electronic devices
  - § review atomic theory of matter
  - § define semiconductor material
  - § identify the advantages and disadvantages of semi-conductor materials
  - § define semiconductor crystals
- define conduction in intrinsic germanium and silicon
  - § low temperature characteristics
  - § high temperature characteristics
  - § hole theory
  - § current flow
- define conduction in doped germanium and silicon
  - § "N" type semiconductors
  - § "P" type semiconductors
- define precautions in the care and handling of solid state devices
  - § static discharge
  - § excessive heat
  - § ultra violet light
  - § radio frequency induction





## 15.2 - Diodes

Duration: Total Hours: 2 Theory: 2 hours Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the construction, operation and testing procedures for diodes in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

15.2.1 – Define the construction features and operating characteristics of diodes

### Learning Content:

15.2.1- Describe the construction features and operating characteristics of diodes.  
[2/0]

- define the purpose and function of diodes
- define the characteristics of semiconductor diodes
  - § PN junction
  - § ions
  - § junction diodes
  - § depletion region
  - § barrier voltage
- define diode forward and reverse biasing
- define the characteristics of germanium diodes
  - § forward characteristics
  - § reverse characteristics
- define the characteristics of silicon diodes
  - § forward characteristics
  - § reverse characteristics
- define diode ratings
  - § temperature considerations
- identify diode symbols
- identify diode applications in AC and DC elevator circuits
- define rectifiers
  - § half wave
  - § full wave
  - § three phase
- define the characteristics of zener diodes
  - § voltage-current characteristics



- § zener voltage
- § power distribution
- § power-temperature curves
- identify zener diode packages
- define voltage regulation with zener diodes
- identify zener diode applications in elevator circuits
- define varistors
- define light emitting diodes (LED)
  - § LED construction features
  - § circuit operation
  - § application in elevator circuits
- define photodiodes
  - § application in elevator circuits

### 15.3 - Transistors

Duration: Total Hours: 2 Theory: 2 hours Application: 0 hours

General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the construction, operation and perform testing procedures of transistors in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

15.3.1 – Define the construction features and operating characteristics of transistors.

Learning Content:

15.3.1- Describe the construction features and operating characteristics of transistors.  
[2/0]

- define the purpose and function of transistors
- define the configuration of transistors
  - § PNP junction
  - § NPN junction
- define construction process
  - § construction techniques
  - § packaging
- define the operating characteristics of transistors
  - § biasing action for NPN transistors
  - § biasing action for PNP transistors



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- § transistor amplification
- identify transistor circuit arrangements
  - § common emitter
  - § common base
  - § common collector
- define junction FET
- define insulated gate FET
- define FET circuit arrangements
- describe transistor applications in elevator circuits

### 15.4 – Thyristors

Duration:            Total Hours: 2    Theory: 2 hours    Application: 0 hours

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the construction features and operating characteristics of thyristors in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:

15.4.1 – Describe the construction features of thyristors.

15.4.2 – Explain the operating characteristics and application of thyristors.

#### Learning Content:

15.4.1- Describe the construction features of thyristors.  
[0.5/0]

- define the purpose and function of thyristors
- define the purpose and function of bi-directional triode thyristors
- define the configuration of thyristors
  - § silicon controlled rectifiers (SCR'S)
- describe the basic construction features of thyristors
  - § silicon controlled rectifiers (SCR'S)
- describe the basic construction features of bi-directional triode thyristors

15.4.2- Explain the operating characteristics and application of thyristors.  
[0.5/0]

- describe the basic operation of thyristors



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- § silicon controlled rectifiers (SCR'S)
- § voltage-current characteristics
- describe the practical application of SCR'S
- define the configuration of bi-directional triode thyristors
- describe the basic operation of bi-directional triode thyristors
- describe the practical application of bi-directional triode thyristors

### 15.5 - Analogue Integrated Circuits

Duration: Total Hours: 2 Theory: 2 hours Application: 0 hours

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the fundamentals and characteristics of analogue integrated circuits in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:

15.5.1 – Define the fundamentals and characteristics of analogue integrated circuits.

15.5.2 – Explain the operating characteristics of analogue integrated circuits.

#### Learning Content:

15.5.1- Describe the fundamentals and characteristics of analogue integrated circuits.  
[1/0]

- define the purpose and function of analogue integrated circuits
- define the development of analogue integrated circuits
- describe analogue integrated circuit packaging
  - § dual in-line packaging (DIP)
  - § surface mount technology (SMT)
  - § heat sink
- describe the application of integrated circuits in elevators
  - § basic power supplies
  - § regulated power supplies
  - § operational amplifier (OP AMP)

15.5.2- Explain the operating characteristics of analogue integrated circuits.  
[1/0]



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- describe analogue integrated circuit packaging
  - § dual in-line packaging (DIP)
  - § surface mount technology (SMT)
  - § heat sink
- describe the application of integrated circuits in elevators
  - § basic power supplies
  - § regulated power supplies
  - § operational amplifier (OP AMP)

### 15.6 - Power Supplies and Operational Amplifiers

Duration: Total Hours: 3 Theory: 3 hours Application: 0 hours

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the fundamentals of power supply and operational amplifier systems for solid state electronic devices in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:

- 15.6.1 – Define the fundamentals and characteristics of power systems for solid state electronic devices.
- 15.6.2 – Define the fundamentals and characteristics of operational amplifiers for solid state electronic devices.
- 15.6.3 – Describe the testing procedures of power systems for solid state electronic devices.

#### Learning Content:

15.6.1- Define the fundamentals and characteristics of power systems for solid state electronic devices.

[1.5/0]

- define the purpose and function of power supply systems
- define the application of power supply systems in elevator electronic systems
- describe the design features of power supply devices
  - § power transformers
  - § rectifiers
    - half wave
    - full wave



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- full wave bridge
- § voltage multipliers
- § half wave voltage doubler
- § full wave voltage doubler
- § ripple
- § filter networks
- § regulators
  - voltage regulators
  - zener diode regulators
  - series pass transistor regulators
  - integrated circuit regulators
- § circuit protection
- § types of power supplies used in the elevator industry

15.6.2- Define the fundamentals and characteristics of operational amplifiers for solid state electronic devices.

[1/0]

- define the purpose and function of operational amplifiers
- describe the application of operational amplifiers
- describe the construction features of operational amplifiers
- identify the power supplies for operational amplifiers
- define the term gain as applied to operational amplifiers

15.6.3- Describe the testing procedures of power systems for solid state electronic devices.

[0.5/0]

- identify the recommended testing equipment
- outline the recommended testing procedures

### 15.7 - Digital Systems

Duration: Total Hours: 8.5 Theory: 8.5 hours Application: 0 hours

#### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the fundamentals, testing of digital systems for solid state electronic devices in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

#### Learning Outcomes:

Upon successful completion, the apprentice is able to:



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

15.7.1 – Define the fundamentals and characteristics of numbering systems for solid state electronic devices.

15.7.2 – Define the fundamentals of digital integrated circuits for solid state electronic systems.

15.7.3 – Define the fundamentals of microprocessors for solid state electronic systems.

15.7.4 – Describe the testing procedures of power systems for solid state electronic devices.

15.7.5 – Describe the programmable logic control (P.L.C.) system for microprocessors.

### Learning Content:

15.7.1- Define the fundamentals and characteristics of numbering systems for solid state electronic devices.

[1/0]

- define the fundamentals of the numbering system
  - § decimals
  - § binary
  - § octal
  - § hexadecimal

15.7.2- Define the fundamentals of digital integrated circuits for solid state electronic systems.

[2/0]

- define the fundamentals, purpose and function of:
  - § gates
  - § digital integrated circuits
  - § printed circuit boards
    - handling procedures
    - inspection procedures
  - § memory elements
    - flip flops
    - counters
    - registers
    - memory
    - SMI, MSI, LSI, VLSI, devices
  - § define memory terms
    - ROM, RAM, PROM, EPROM, EEPROM, EAPROM

15.7.3- Define the fundamentals of microprocessors for solid state electronic systems.

[1/0]



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- define the fundamentals, purpose and function of microprocessors
- define the terms relating to microprocessors
  - hardware
  - software
  - CPU

15.7.4- Describe the testing procedures of power systems for solid state electronic devices.  
[2/0]

- testing procedures for integrated circuits
- troubleshooting procedures for microprocessors
  - fault logs
  - error codes

15.7.5- Describe the programmable logic control (P.L.C.) system for microprocessors.  
[1.5/0]

- define Programmable Logic Control (PLC)
- describe the features of the programmable logic control
- identify the applications for programmable logic control
- outline the function of the programmable logic control feature





## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 16

Title: Circuit Tracing

Duration: 16 Total Hours

Theory: 10 Hours                      Application: 6 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to trace and diagnose elevating devices electrical/electronic circuits in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

16.1 – Fundamentals of Circuit Tracing

16.2 – Elevating Devices System Control Circuit Tracing

16.3 – Electrical / Electronic Test Equipment.

16.4 – Troubleshooting Procedures

---

16.1- Fundamentals of Circuit Tracing

Duration:            Total Hours: 2    Theory: 2 hours    Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the fundamentals of circuit tracing electrical schematic diagrams in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

16.1.1 – Review electrical/electronic wiring diagram nomenclature.

16.1.2 – Define the fundamentals of circuit tracing.

### Learning Content:

16.1.1- Review electrical/electronic wiring diagram nomenclature.  
[1/0]

- review electrical/electronic schematic wiring diagram nomenclature
- review reading and interpreting procedures for electrical/electronic schematic wiring diagrams

16.1.2- Define the fundamentals of circuit tracing.  
[1/0]

- review electrical/electronic schematic wiring diagram nomenclature
- review reading and interpreting procedures for electrical/electronic schematic wiring diagrams
- locate and identify features of electrical/electronic wiring diagrams:
  - § field wiring
  - § straight line (schematics)
  - § identify wiring diagram symbols used by major manufacturers
  - § nomenclature

16.2 - Elevator Devices System Control Circuit Tracing

Duration: Total Hours: 4 Theory: 2 hours Application: 2 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the procedure to perform circuit tracing of elevating devices system wiring diagrams in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

16.2.1 – Define the procedure to perform circuit tracing of Constant Pressure relay, P.L.C. and microprocessor based Control Systems.



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### Learning Content:

16.2.1- Define the procedure to perform circuit tracing of Constant Pressure relay, P.L.C. and microprocessor based Control Systems.  
[2/2]

- review electrical/electronic schematic wiring diagrams for elevating device constant pressure control systems
- identify the main system components
  - \* trace the circuit from the power source through the wiring, connections, electrical / electronic devices and return ground path
    - § power control
      - pump motor connections
    - § logic functions
      - starting and acceleration
    - § safety circuits

16.3 - Electrical/Electronic Diagnostic Test Equipment

Duration: Total Hours: 4 Theory: 3 hours Application: 1 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the function, construction features, operation and use of electrical/electronic diagnostic test equipment in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

16.3.1 – Define the purpose and fundamentals of diagnostic test equipment.

16.3.2 – Define the construction features, types and applications of diagnostic test equipment.

16.3.3 – Explain the principles of operation of diagnostic test equipment.

16.3.4 - Perform inspection and testing procedures using diagnostic test equipment in accordance with the manufacturer's recommendations.

### Learning Content:

16.3.1- Define the purpose and fundamentals of diagnostic test equipment.



[0.5/0]

- electric meters (analog v/s digital)
- safety when testing electrical/electronic circuits

16.3.2- Define the construction features, types and applications of diagnostic test equipment.  
[1/0]

- ammeter
- voltmeter
- ohmmeter
- digital multi-meter (DMM)
- continuity circuit tester
- high and low impedance multi-meters
- current probe
- induction pickup

16.3.3- Explain the principles of operation of diagnostic test equipment.  
[1/0]

- ammeter
- voltmeter
- ohmmeter
- high and low impedance multi-meters
- meggers

16.3.4- Perform inspection and testing procedures using diagnostic test equipment in accordance with the manufacturer's recommendations  
[0.5/1]

- ammeter, voltmeter, ohmmeter
- continuity circuit tester
  - high and low impedance multi-meters
  - current probe
- induction pickup

16.4 - Troubleshooting Procedures

Duration: Total Hours: 6 Theory: 3 hours Application: 3 hours

General Learning Outcome:



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Upon successful completion of this reportable subject, the apprentice is able to describe and carry out the trouble shooting procedures of electrical/electronic circuits in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

16.4.1 – Describe electrical/electronic circuit trouble shooting procedures.

16.4.2 – Perform trouble shooting procedures on elevating device electrical/electronic control circuits.

### Learning Content:

16.4.1- Describe electrical/electronic circuit trouble shooting procedures.  
[1/1]

- describe the various troubleshooting processes

16.4.2- Perform trouble shooting procedures on elevating device electrical/electronic control circuits.  
[2/2]

- perform troubleshooting procedures on relay, P.L.C. and microprocessor based control circuits



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 18

Title: Lifts for Persons with Physical Disabilities

Duration: 21 Total Hours

Theory: 19 Hours      Application: 2 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the construction, operation, installation and inspection procedures of lifts for persons with physical disabilities in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

18.1 – Define the fundamentals of lifts for persons with physical disabilities.

18.2 – Describe the construction features of lifts for persons with physical disabilities.

18.3 – Explain the operating principles of lifts for persons with physical disabilities.

18.4 – Describe the installation and construction procedures of lifts for persons with physical disabilities.

18.5 – Describe the inspection and testing procedures of lifts for persons with physical disabilities.

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### Learning Content:

18.1 – Define the fundamentals of lifts for persons with physical disabilities.  
[2/2]

- interpret the elevating devices code adoption document, Part VII
  - § B355 code
  - § B613 code
  - § Code adoption Document Part VII



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

18.2 – Describe the construction features of lifts for persons with physical disabilities.  
[5/0]

- describe the basic construction features of the following lift devices
  - § stair chair lifts
  - § stair platform lifts enclosed
  - § stair platform lifts unenclosed
  - § vertical platform lifts enclosed
  - § vertical platform lifts unenclosed

18.3 – Explain the operating principles of lifts for persons with physical disabilities.  
[5/0]

- identify the lift control methods for all types of lift devices
- explain lift operating procedures
- types of drives

18.4 – Describe the installation and construction methods of lifts for persons with physical disabilities.  
[4/0]

- installation procedures
- construction methods

18.5 – Describe the inspection and testing procedures of lifts for persons with physical disabilities.  
[3/0]

- visual inspection
- test procedures



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Number: 19

Title: General Preventive Maintenance

Duration: 6 Total Hours

Theory: 6 Hours    Application: 0 Hours

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### Evaluation & Testing:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the term.
- Final exam at end of term.
- Periodic quizzes.

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the general maintenance procedures and safety procedures for the installation, service, repair, modernization or alterations to elevating devices in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

19.1 – Public Safety

19.2 – Liability Concerns

19.3 – Preventive Maintenance Practice

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19.1– Public Safety

Duration:    Total Hours: 1    Theory: 1 hours    Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the requirements to secure a work area in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes:





## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

Upon successful completion, the apprentice is able to:

19.1.1 Define the need to notify building personnel of elevating device shut- down or reinstatement to service.

19.1.2 – Not Required or Not Applicable

19.1.3 – Not Required or Not Applicable

19.1.4 Define the importance of effective communication, courtesy and personal appearance when dealing with the public in occupied buildings and worksites.

### Learning Content:

19.1.1- Define the method of notifying building personnel of elevating device shut-down or reinstatement to service.  
[0.5/0]

- define the reasons for notifying building personnel that the elevating device has been shut down or returned to service
- maintenance in progress” signs
  - define the requirement for “maintenance in progress” signs
  - define the location for “maintenance in progress” signs
- requirements and procedure for barricading entrances
  - define the requirements for barricading entrances
  - define the equipment requirements for barricading

19.1.4- Define the importance of effective communication, courtesy and personal appearance when dealing with the public in occupied buildings and worksites.  
[0.5/0]

- describe what is meant by effective communication
- define examples of courtesy to the public
- define what is meant by appropriate appearance

19.2– Liability Concerns

Duration: Total Hours: 1.5 Theory: 1.5 hours Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to define the liability concerns for installing/constructing, servicing, repairing, maintaining, or modernizing



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

elevating devices in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:

19.2.1 Define the relevant information and specific details regarding the difference between an incident and an accident.

### Learning Content:

19.2.1- Define the relevant information and specific details regarding the difference between an incident and an accident.

[1.5/0]

- define an incident
- securing the site and witnesses following an incident
  - define the procedure to secure a site
  - define the procedure to document details about a witness
- describe the procedure to notify company officials
- describe the procedure to notify the TSSA
- describe the method to record observations following an incident
- describe the method to obtain all available information following an incident.
- define the owner responsibilities
- define the contractor responsibilities
- explain the differences in responsibilities between each
- review the TSSA incident report form
- code reference: applicable codes, standards and regulations

19.3– Preventive Maintenance Practice

Duration: 3.5 Total Hours Theory: 3.5 hours Application: 0 hours

### General Learning Outcome:

Upon successful completion of this reportable subject, the apprentice is able to describe the general preventative maintenance practices for elevating devices in accordance with government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes:

Upon successful completion, the apprentice is able to:



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- 19.3.1 Define the relevant information and specific details pertaining to working in occupied buildings.
- 19.3.2 Define the relevant information and specific details regarding observations of elevating device equipment and performance during site visits.
- 19.3.3 Define the relevant information and specific details regarding taking the elevating device out of service and lock-out procedures.
- 19.3.4 Define the relevant information and specific details regarding the procedure for re-instatement of the elevating device back into service for public use.
- 19.3.5 Define the relevant information and specific details regarding the use of remote monitoring.
- 19.3.6 Define the relevant information and specific details regarding log books.
- 19.3.7 Describe the procedures for service and repair.

### Learning Content:

- 19.3.1- Define the relevant information and specific details pertaining to working in occupied buildings.  
[0.5/0]
  - safe use of jumpers (applicable directors rulings)
  - securing the work area
  - appropriate personal appearance in occupied areas
  - maintain acceptable condition of the work site
  - refrain from using abusive language
  - minimize the effects of objectionable noise levels
  - place tools, material and equipment in locations that minimize disruption and safety hazards to occupants of the building
- 19.3.2- Define the relevant information and specific details regarding observations of elevating device equipment and performance during site visits.  
[0.5/0]
  - check all safety circuits & devices
  - check mechanical operating components
  - check electrical operating components
  - check for abnormal noises or odours
  - check condition of all equipment
  - check condition of drive equipment
  - check operation and condition of fixtures



## Elevating Devices Mechanic – E Lifts for Persons with Physical Disabilities In-School Curriculum Standard

- observe appearance and cosmetic details
- observe operation

19.3.3- Define the relevant information and specific details regarding taking the elevating device out of service and lock-out procedures.  
[0.5/0]

- describe method of locking main disconnect switch in the off position
- describe the method of assuring the device is mechanically secured

19.3.4- Define the relevant information and specific details regarding the procedure for re-instatement of the elevating device back into service for public use.  
[0.5/0]

- describe the procedure to follow that ensures that the electrical protective devices are operating normally
- follow the specified procedure that will ensure all equipment is restored to normal operation
- describe the procedure to test and verify the correct operation prior to returning to service

19.3.5- Define the relevant information and specific details regarding the use of remote monitoring.  
[0.5/0]

- describe the procedure to use modems
- outline how to read and interpret information provided by computer monitor systems
- produce and interpret a diagnostic screen or printer
- using display management technique

19.3.6- Define the relevant information and specific details regarding log books.  
[0.5/0]

- identify historical introduction of log book
- outline the value and advantages of log books
- define the purpose of the log book
- identify the information that must be entered into the log book
- use of log books for extra relevant information
- provide example of typical log book
- reference the Ontario Elevating Devices Regulations, Section 32, (operation and maintenance)
- applicable codes and standards

19.3.7- Describe the procedures for service and repair.  
[0.5/0]



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- follow safety rules for working in machine rooms, on car tops and in the hoistway or pit
- follow the specified procedure when taking equipment out of service, in order not to endanger building occupants and elevating device users
- follow the accepted procedure when reinstating equipment back into service
  - § ride the elevating device to ensure it is operating according to specifications prior to releasing it for public use
- observe the location of smoke and heat detector when using heat and smoke generating equipment and procedures
- prevent dropping items from car tops or hall entrances when doors are open
- provide protection for floors and carpets from
  - § oil
  - § grease
  - § moving heavy equipment



## **MINIMUM EQUIPMENT & SUPPLIES FOR EACH PROGRAM REPORTABLE SUBJECT**

### **Provide Examples of the following items**

#### **1. Safety:**

- Code Books
- Acts and Regulations
- Code Adoption
- Policies and Procedures

#### **2. Introduction to Elevating Devices:**

- Fall Arrest Harness
- Personal Protective Equipment (PPE)
- Oxy-Acetylene simulator
- Fire extinguisher for A,B,C
- WSIB reporting forms
- OHSA construction

#### **3. Mechanical Print Reading:**

- Architectural, Structural and Mechanical Prints

#### **4. Ladders, Scaffolding and Work Platforms:**

- Various types of Ladders
- Scaffolding and Planks
- Various types of rope fastening devices
- Beam clamps
- Crosby clips
- Rigging hardware
- Rope terminations

#### **5. Rigging and Hardware:**

- Come along
- Small manual chain block
- Assorted slings

#### **6. Introduction to applicable codes and standards:**

- The current applicable codes and standards

#### **7. Mechanical Practice:**

- Assorted components of belt, chain and power transmission systems
- Assorted bearings, bushings and seals
- Precision measuring tools and instruments
- Assorted mechanical test instruments



**9. Basic Hydraulics:**

- No additional equipment required

**10. Elevator Hydraulic Systems:**

- Typical elevator hydraulic pumping system components
- Typical jack unit
- Hydraulic pressure gauge

**11. Hydraulic Elevator Installation:**

- Cylinder plumbing devices
- Typical hydraulic oil line fastenings and couplings

**12. Basic Electricity:**

- Various electrical components
- Hand tools and electrical testing devices
- Permanent magnets and electro-magnetic components

**13. Industrial Electricity for Elevating Devices:**

- Typical electrical control devices
- Various types of transformers
- Typical electrical schematic drawings
- Various types of circuit conductors and wiring devices
- Wiring tools, materials and hardware

**14. Motors, Generators, Controls and AC Drives:**

- No additional equipment required

**15. Solid State Electronics:**

- Various types of solid state electronic components
- Various PLC's and microprocessor controls

**16. Circuit Tracing:**

- Typical relay control systems
- Typical power control drive systems

**18. Lifts for Persons with Physical Disabilities:**

- Typical installation and electrical drawings

**19. General Preventive Maintenance:**

- Typical log books as required by provincial regulations
- Typical test equipment