



**PROVINCIAL PLAN OF TRAINING
FOR THE
INDUSTRIAL INSTRUMENT MECHANIC
OCCUPATION**

June 2003

Preface

This Provincial Plan of Training derived from the Atlantic Training Standard, is based upon the 2000 edition of the National Occupational Analysis for the Industrial Instrument Mechanic trade. It was developed through the cooperative efforts of the Atlantic Apprenticeship Council, which consists of both the Atlantic Directors of Apprenticeship and Apprenticeship Board Chairs. This document describes the curriculum content for the Industrial Instrument Mechanic apprenticeship training program and outlines each of the courses necessary for completion of apprenticeship.

Acknowledgment

Advisory committees, industry representatives, instructors and apprenticeship staff provided valuable input into the development of this Provincial Plan of Training. Their dedication to quality apprenticeship will benefit institutional training for apprentices in this trade.

Apprenticeship Plan of Training Evaluation Form

Thank you for your interest in the development and revision of this Plan of Training. Upon review of this document, please record your feedback in relation to the following items:

- course division and organization
- relevancy of the content
- errors or omissions
- other suggestions for improvement and consideration

Overall comments are to be entered on this evaluation form and specific changes are to be entered directly on the document in the relevant area(s). When all feedback has been recorded, return this evaluation form along with the revised Plan of Training to the Apprenticeship Office noted at the bottom of the page.

(PLEASE PRINT)

Trade: Industrial Instrument Mechanic

Full Name: _____

Type of Position: (Trade Practitioner, Instructor, etc.): _____

Company: _____

Address: _____

Comments: (Use a separate sheet of paper if necessary)

Return Evaluation Form and Plan of Training to:

*Manager, Industrial Training
Division of Institutional and Industrial Education
Department of Youth Services and Post-Secondary Education
P.O. Box 8700
St. John's, NF
A1B 4J6*

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REQUIRED RELATED COURSES

| | |
|---|----|
| Workplace Correspondence | 81 |
| Customer Service | 83 |
| Quality Assurance/Quality Control | 85 |
| Introduction to Computers | 87 |
| Workplace Skills | 92 |
| Job Search Techniques | 94 |
| Entrepreneurial Awareness | 95 |

Program Outcomes

Upon completion of the Industrial Instrument Mechanic Apprenticeship Program, apprentices will have the knowledge and skills required to perform the following tasks:

| | |
|---------|---|
| Task 1 | Demonstrates safe work practices and personal protection. |
| Task 2 | Utilizes drawings, codes, standards and government regulations. |
| Task 3 | Utilizes tools and measuring equipment. |
| Task 4 | Demonstrates common work practices and procedures. |
| Task 5 | Maximizes operating efficiency of process control system. |
| Task 6 | Facilitates new installations. |
| Task 7 | Maintains field mounted pressure equipment. |
| Task 8 | Maintains field mounted flow equipment. |
| Task 9 | Maintains field mounted level equipment. |
| Task 10 | Maintains field mounted temperature devices. |
| Task 11 | Maintains analyzers. |
| Task 12 | Maintains speed measuring devices. |
| Task 13 | Maintains weight and density measuring devices. |
| Task 14 | Maintains vibration measurement devices. |
| Task 15 | Maintains consistency measuring devices. |
| Task 16 | Maintains final control elements. |
| Task 17 | Maintains calibration, reference, comparison standards and test equipment. |
| Task 18 | Maintains signal transmission systems. |
| Task 19 | Maintains transducers (signal conditioners) current/pressure, pressure/current, current/voltage, voltage/current, current/current, current/digital, frequency/voltage). |
| Task 20 | Maintains operator interface (panel mounted) equipment. |
| Task 21 | Maintains hydraulic systems. |
| Task 22 | Maintains pneumatic systems. |
| Task 23 | Maintains distributed control systems (DCS). |
| Task 24 | Maintains programmable logic controllers (PLC). |

Program Structure

| NF Course No. | Atlantic Course No. | Course Name | Suggested Hours | Pre-requisites | Page No. |
|---------------|---------------------|---|-----------------|---------------------------|----------|
| TS-1510 | | Occupational Health & Safety | 6 | | 12 |
| TS-1530 | | First Aid | 14 | | 15 |
| TS-1520 | | WHMIS | 6 | | 16 |
| ER-1110 | IIM -0110 | Hand Tools | 5 | | 19 |
| ER-1120 | IIM -1115 | Power Tools | 5 | IIM - 0110 | 22 |
| ER-1130 | IIM -1120 | Fasteners & Adhesives | 5 | IIM - 1115 | 23 |
| ER-1140 | IIM - 0125 | Direct Current (DC) Theory | 30 | None | 25 |
| ER-1150 | IIM - 1130 | Series & Parallel Circuits | 30 | IIM - 0125 | 27 |
| ER-1160 | IIM - 0135 | Codes | 15 | | 29 |
| ER-1170 | IIM - 1140 | Voltage Drop & Power Loss | 30 | IIM - 1130 IIM - 0135 | 30 |
| ER-1180 | IIM - 1145 | Single-Phase Theory | 25 | IIM - 1140 | 32 |
| ER-1190 | IIM - 1150 | Three-Phase Theory | 15 | IIM - 1145 | 34 |
| ER-1225 | IIM - 1155 | Conduit, Tubing & Fittings | 15 | IIM - 1120, IIM - 0135 | 35 |
| ER-2110 | IIM - 0160 | Troubleshooting Techniques | 15 | | 36 |
| ER-1760 | IIM - 1165 | Motors | 30 | IIM - 1150 | 37 |
| ER-2215 | IIM 0170 | Pneumatic Systems (Instrument Air Supply) | 30 | | 39 |
| ER-2235 | IIM - 0175 | Hydraulic Systems | 15 | | 41 |
| ER-2155 | IIM - 1180 | Process Measurement | 100 | IIM - 1130 | 43 |
| ER-1730 | IIM - 1185 | Electronics | 60 | IIM - 1150 | 46 |
| ER-1740 | IIM - 1190 | On-Off Control | 40 | IIM - 1165 | 49 |
| ER-2160 | IIM - 1195 | Solid State Drives | 30 | IIM - 1185 | 52 |
| ER-2225 | IIM - 1200 | Control Valves | 30 | IIM - 1180 | 54 |
| ER-2190 | IIM - 1205 | Process Control | 70 | IIM - 1180 | 57 |
| ER-1770 | IIM - 1210 | Process Analyzers | 60 | IIM - 1180 | 59 |
| ER-2380 | IIM - 0215 | Vibration | 10 | | 64 |
| ER-1710 | IIM - 1220 | Signal Transmission | 15 | IIM - 1180 | 66 |
| ER-2325 | IIM - 1225 | Boiler Control | 30 | IIM - 1205 | 68 |
| ER-2170 | IIM - 1230 | PLC Fundamentals | 30 | IIM - 1185 IIM - 1190 | 70 |
| ER-2180 | IIM - 1235 | Programming PLC's | 30 | IIM - 1230 | 72 |

| NF Course No. | Atlantic Course No. | Course Name | Suggested Hours | Pre-requisites | Page No. |
|--------------------------|--------------------------------|-----------------------------------|----------------------------|-----------------------|---------------------|
| ER-2200 | IIM - 1240 | Distributed Control Systems | 30 | IIM - 1235 | 74 |
| ER-1780 | IIM - 1245 | DCS Process Applications | 40 | IIM - 1245 | 76 |
| ER-1790 | IIM - 1250 | PLC Process Applications | 45 | IIM - 1235 | 78 |
| CM-2150 | | Workplace Correspondence | 45 | | 81 |
| MR-1220 | | Customer Service | 30 | | 83 |
| SP-2330 | | Quality Assurance/Quality Control | 30 | | 85 |
| MC-1050 | | Introduction to Computers | 30 | | 87 |
| SD-1700 | | Workplace Skills | 30 | | 92 |
| SD-1710 | | Job Search Techniques | 15 | | 94 |
| SD-1720 | | Entrepreneurial Awareness | 15 | | 95 |

CONDITIONS GOVERNING APPRENTICESHIP TRAINING

1.0 GENERAL

The following general conditions will apply to all apprenticeship training programs approved by the Provincial Apprenticeship and Certification Board in accordance with the Apprenticeship Training and Certification Act. Where an occupation requires additional conditions, these will be noted in the specific plan of training for that occupation. In no case should there be a conflict between these conditions and the additional requirements specified in certain plans of training.

2.0 ENTRANCE REQUIREMENTS

2.1 Entry into the occupation as an apprentice requires:

The completion of designated first year courses specific to the occupation
OR

Indenturing into the occupation by an employer who agrees to provide the appropriate training and work experiences as outlined in this plan of training.

OR

Enrolment in a program of studies that includes all entry and advanced level skills and required work experiences as approved by the Provincial Apprenticeship and Certification Board.

2.2 Notwithstanding the above, each candidate must have successfully completed a high school program or equivalent and in addition may be required to have completed certain academic subjects as specified in particular plans of training. Mature students, at the discretion of the Director of Institutional and Industrial Education, may be registered. A mature student is defined as one who has reached the age of 19 and who can demonstrate the ability and the interest to complete the requirements for certification.

2.3 At the discretion of the Director of Institutional and Industrial Education, credit towards the apprenticeship program may be awarded to an apprentice for previous work experience and/or training as validated through prior learning assessment.

2.4 A Registration for Apprenticeship form must be duly completed.

3.0 PROBATIONARY PERIOD

The probationary period for each memorandum of understanding will be six months. Within that period the memorandum may be terminated by either party upon giving the other party and the Provincial Apprenticeship and Certification Board one week notice in writing.

4.0 TERMINATION OF A MEMORANDUM OF UNDERSTANDING

After the probationary period referred to in Section 3.0 herein, the memorandum of understanding may be terminated by the Board by mutual consent of the parties thereto or cancelled by the Board for proper and sufficient cause in the opinion of the Board.

5.0 APPRENTICESHIP PROGRESSION SCHEDULE AND WAGE RATES

5.1 Progression Schedule

| 7200 Hour Programs | Requirements for Progression | Progress To |
|---------------------------|---|---------------------------------|
| First Year Apprentice | 25% of Course Credit Hours, Plus relevant work experience totaling 1800 hours | Second Year |
| Second Year Apprentice | 50% of Course Credit Hours, Plus relevant work experience totaling 3600 hours | Third Year |
| Third Year Apprentice | 75% of Course Credit Hours, Plus relevant work experience totaling 5400 hours | Fourth Year |
| Fourth Year Apprentice | 100% of Course Credit Hours, Plus completion and sign-off of workplace skills required for certification totaling 7200 hours | Write Certification Examination |
| 5400 Hour Programs | Requirements for Progression | Progress To |
| First Year Apprentice | 33% of Course Credit Hours, Plus relevant work experience totaling 1800 hours | Second Year |
| Second Year Apprentice | 66% of Course Credit Hours, Plus relevant work experience totaling 3600 hours | Third Year |
| Third Year Apprentice | 100% of Course Credit Hours, Plus completion and sign-off of workplace skills required for certification totaling 5400 hours | Write Certification Examination |

| 4800 Hour Programs | Requirements for Progression | Progress To |
|---------------------------|---|---------------------------------|
| First Year Apprentice | 33% of Course Credit Hours, Plus relevant work experience totaling 1600 hours | Second Year |
| Second Year Apprentice | 66% of Course Credit Hours, Plus relevant work experience totaling 3200 hours | Third Year |
| Third Year Apprentice | 100% of Course Credit Hours, Plus completion and sign-off of workplace skills required for certification totaling 4800 hours | Write Certification Examination |

5.2 For the duration of each Apprenticeship Training Period, the apprentice, who is not covered by a collective agreement, shall be paid a progressively increased schedule of wages which shall not be less than:

| Program Duration | Wage Rates | | Comments |
|--|----------------------|-----|--|
| 7200 Hours | 1 st Year | 55% | These wage rates are percentages of the prevailing journeyperson's wage rate in the place of employment of the apprentice. No apprentice shall be paid less than the wage rate established by the Labour Standards Act (1988), as now in force or as hereafter amended, or by other Order, as amended from time to time replacing the first mentioned Order. |
| | 2 nd Year | 65% | |
| | 3 rd Year | 75% | |
| | 4 th Year | 90% | |
| 5400 Hours and 4800 Hours | 1 st Year | 55% | |
| | 2 nd Year | 70% | |
| | 3 rd Year | 85% | |
| 4000 (Hairstylist) - The apprentice shall be paid no less than the minimum wage for hours worked and a commission agreed upon between the apprentice and the employer. | | | |

6.0 TOOLS

Apprentices shall be required to obtain hand tools as and when specified by the Board.

7.0 PERIODIC EXAMINATIONS AND EVALUATION

7.1 Every apprentice shall submit to such occupational tests and examinations as the Board shall direct. If after such occupational tests and examinations the apprentice is found to be making unsatisfactory progress, his/her rate of

wage shall not be advanced as provided in Section 5 until his/her progress is satisfactory to the Director of Institutional and Industrial Education and his/her date of completion shall be deferred accordingly. Persistent failure to pass required tests shall be a cause for revocation of his/her Memorandum of Understanding.

- 7.2 Upon receipt of reports of accelerated progress of the apprentice, the Board may shorten the term of apprenticeship and advance the date of completion accordingly.
- 7.3 For each and every course, a formal assessment is required for which 70% is the pass mark. At the discretion of the instructor, the summative mark may be for completion of a theory examination or a combination of the theory examination and an assigned practical project.

8.0 GRANTING OF CERTIFICATES OF APPRENTICESHIP

Upon the successful completion of apprenticeship, the Board shall issue a Certificate of Apprenticeship

9.0 HOURS OF WORK

Any hours employed in the performance of duties related to the designated occupation will be credited towards the completion of the term of apprenticeship. Appropriate documentation of these hours must be provided.

10.0 COPIES OF THE REGISTRATION FOR APPRENTICESHIP

The Director of Institutional and Industrial Education shall provide copies of the Registration for Apprenticeship form to all signatories to the document.

11.0 RATIO OF APPRENTICES TO JOURNEYPERSONS

The ratio of Apprentices to Journeypersons normally shall not exceed one apprentice to every one journeyperson employed. Exceptions for specific occupations may occur with the approval of the Provincial Apprenticeship and Certification Board.

12.0 RELATIONSHIP OF THE PLAN OF TRAINING TO A COLLECTIVE BARGAINING AGREEMENT

Collective agreements take precedence over the conditions outlined in the plan of training.

13.0 AMENDMENTS TO A PLAN OF APPRENTICESHIP TRAINING

A plan of training may be amended at any time by the Provincial Apprenticeship and Certification Board.

14.0 EMPLOYMENT, RE-EMPLOYMENT AND TRAINING REQUIREMENTS

- 14.1 The plan of training requires Apprentices to attend regularly their place of employment.
- 14.2 The plan of training requires Apprentices to regularly attend training programs for that occupation as prescribed by The Provincial Apprenticeship and Certification Board.
- 14.3 Failure to comply with Sections 14.1 and/or 14.2 will result in cancellation of the Memorandum of Understanding. Apprentices may have their M.O.U.'s reinstated by the Provincial Apprenticeship and Certification Board but would be subject to a commitment to complete the entire program as outlined in the General Conditions of Apprenticeship. Permanent cancellation in the said occupation is the result of non-compliance.
- 14.4 Cancellation of the Memorandum of Understanding to challenge journeyperson examinations, if unsuccessful, would require an apprentice to serve a time penalty of two (2) years before reinstatement as an apprentice or registering as a Trade Qualifier.
- 14.5 Under the plan of training the employer is required; to keep each apprentice employed as long as work is available, and if the apprentice is laid off due to lack of work, to give opportunity to be re-employed before another is hired.
- 14.6 The employer will permit each apprentice to attend regularly training programs as prescribed by the Provincial Apprenticeship and Certification Board.
- 14.7 Apprentices who cannot acquire all the workplace skills at their place of employment will have to be evaluated in a simulated work environment at a training institution and have sign-off done by instructors to meet the requirements for certification.

15.0 APPEALS TO DECISIONS BASED ON CONDITIONS GOVERNING APPRENTICESHIP TRAINING

Persons wishing to appeal any decisions based on the above conditions must do so in writing to the Minister of Youth Services and Post-Secondary Education within 30 days of the decision.

REQUIREMENTS FOR RED SEAL CERTIFICATION

1. Evidence that the required work experiences outlined in this plan of training have been obtained. This evidence must be in a format that clearly outlines the experiences and must be signed by an appropriate person or persons attesting that these experiences have been obtained to the level required.
2. Normally, a combination of training from an accredited training program and suitable work experience totalling 7200 hours

Or

A total of 9000 hours of suitable work experience.

3. Completion of a National Red Seal examination, to be set at a place and time determined by the Industrial Training Division.
4. Payment of the appropriate examination fee.

ROLES AND RESPONSIBILITIES OF STAKEHOLDERS IN THE APPRENTICESHIP PROCESS

The Apprenticeship process involves a number of stakeholders playing significant roles in the training of apprentices. This section captures, in a broad sense, these roles and the responsibilities that result from them.

The Apprentice

- ▶ to complete all required technical training courses as approved by the Provincial Apprenticeship and Certification Board.
- ▶ to find appropriate employment.
- ▶ to complete all required work experiences in combination with the required hours.
- ▶ to ensure that the work experiences are well documented.
- ▶ to approach apprenticeship training with an attitude and commitment that fosters the qualities necessary for a successful career as a qualified journeyperson.
- ▶ to obtain the required hand tools as specified by the Board for each period of training of the apprenticeship program.

The Employer

- ▶ to provide high quality work experiences in an environment that is conducive to learning.
- ▶ to remunerate apprentices as set out in this Plan of Training or Collective Agreements.
- ▶ to provide feedback to Training Institutions, Industrial Training Division and Apprentices in an effort to establish a process of continuous quality improvement.
- ▶ where appropriate, to release apprentices for the purpose of returning to a training institution to complete the necessary technical courses.
- ▶ to ensure that work experiences of the apprentices are documented.

The Training Institution

- ▶ to provide a high quality learning environment.
- ▶ to provide the necessary student support services that will enhance an apprentice's ability to be successful.
- ▶ to participate with other stakeholders in the continual updating of programs.

The Industrial Training Division

- ▶ to establish and maintain program advisory committees under the direction of the Provincial Apprenticeship and Certification Board.
- ▶ to promote apprenticeship training as a viable career option to prospective apprentices and other appropriate persons involved, such as career guidance counsellors, teachers, parents, etc.
- ▶ to establish and maintain a protocol with training institutions, employers and other appropriate stakeholders to ensure the quality of apprenticeship training programs.
- ▶ to ensure that all apprentices are appropriately registered and records are maintained as required.
- ▶ to schedule all necessary technical training periods for apprentices to complete requirements for certification.
- ▶ to administer provincial/interprovincial examinations.

The Provincial Apprenticeship and Certification Board

- ▶ to set policies to ensure that the provisions of the Apprenticeship Training and Certification Act are implemented.
- ▶ to ensure that advisory and examination committees are established and maintained.
- ▶ to accredit institutions to deliver apprenticeship training programs.

Description:

This course is designed to give participants the knowledge and skills necessary to interpret the Occupational Health and Safety Act, laws and regulations; understand the designated responsibilities within the laws and regulations; the right to refuse dangerous work; and the importance of reporting accidents.

Course Outcomes:

Upon successful completion of this unit, the apprentice will be able to:

- prevent accidents and illnesses
- improve health and safety conditions in the workplace

Theory

1. Interpret the Occupational Health and Safety Act laws and regulations
 - a. Explain the scope of the act
 - Application of the act
 - Federal/Provincial jurisdictions
 - Canada Labour Code
 - Rules and regulations
 - Private home application
 - Conformity of the Crown by the Act
2. Explain responsibilities under the Act & Regulations
 - Duties of employer, owner, contractors, sub-contractors, employees, and suppliers
3. Explain the purpose of joint health and safety committees
 - Formation of committee
 - Functions of committee
 - Legislated rights
 - Health and safety representation
 - Reporting endangerment to health
 - Appropriate remedial action
 - Investigation of endangerment
 - Committee recommendation
 - Employer's responsibility in taking remedial action
4. Examine right to refuse dangerous work
 - Reasonable grounds for refusal

- Reporting endangerment to health
- Appropriate remedial action
- Investigation of endangerment
- Committee recommendation
- Employer's responsibility to take appropriate remedial action
- Action taken when employee does not have reasonable grounds for refusing dangerous work
- Employee's rights
- Assigning another employee to perform duties
- Temporary reassignment of employee to perform other duties
- Collective agreement influences
- Wages and benefits

5. Describe discriminatory action

- Definition
- Filing a complaint procedure
- Allocated period of time a complaint can be filed with the Commission
- Duties of an arbitrator under the Industrial Relations Act
- Order in writing inclusion
- Report to commission Allocated period of time to request Arbitrator to deal with the matter of the request
- Notice of application
- Failure to comply with the terms of an order
- Order filed in the court

6. Explain duties of commission officers

- Powers and duties of officers
- Procedure for examinations and inspections
- Orders given by officers orally or in writing
- Specifications of an order given by an officer to owner of the place of employment, employer, contractor, sub-contractor, employee, or supplier
- Service of an order
- Prohibition of persons towards an officer in the exercise of his/her power or duties
- Rescinding of an order
- Posting a copy of the order
- Illegal removal of an order

7. Interpret appeals of others

- Allocated period of time for appeal of an order
- Person who may appeal order
- Action taken by Commission when person involved does not comply with the order
- Enforcement of the order

- Notice of application
- Rules of court

8. Explain the process for reporting of accidents

- Application of act
- Report procedure
- Reporting notification of injury
- Reporting accidental explosion or exposure
- Posting of act and regulations

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Describe work situations that one might want to refuse.
2. Interview someone in your occupation on two or more aspects of the act and report results.

TS1530

First Aid

Description:

This course is designed to give the apprentice the ability to recognize situations requiring emergency action and to make appropriate decisions concerning first aid.

Complete a **St. John Ambulance** Standard First Aid Certificate course.

TS 1520

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

Description:

This course is designed to give participants the knowledge and skills necessary to define WHMIS, examine hazard identification and ingredient disclosure, explain labeling and other forms of warning, and introduce material safety data sheets (MSDS).

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- interpret and apply the Workplace Hazardous Materials Information System (WHMIS) Regulation under the Occupational Health & Safety Act.

Required Knowledge and Skills:

1. Define WHMIS safety
 - Rational and key elements
 - History and development of WHMIS
 - WHMIS legislation
 - WHMIS implementation program
 - Definitions of legal and technical terms
2. Examine hazard identification and ingredient disclosure
 - Prohibited, restricted and controlled products
 - Classification and the application of WHMIS information requirements
 - Responsibilities for classification
 - the supplier
 - the employer
 - the worker - Classification: rules and criteria
 - information on classification
 - classes, divisions and subdivision in WHMIS
 - general rules for classification
 - class A - compressed gases
 - class B - flammable and combustible materials
 - class C - oxidizing material
 - class D - poisonous and infectious material
 - class E - corrosive material
 - class F - dangerously reactive material
 - Products excluded from the application of WHMIS legislation
 - consumer products
 - explosives
 - cosmetics, drugs, foods and devices
 - pest control products

- radioactive prescribed substances
- wood or products made of wood
- manufactured articles
- tobacco or products of tobacco
- hazardous wastes
- products handled or transported pursuant to the Transportation of Dangerous Goods (TDG) Act
- Comparison of classification systems - WHMIS and TDG
- General comparison of classification categories
- Detailed comparison of classified criteria

3. Explain labeling and other forms of warning

- Definition of a WHMIS label
 - supplier label
 - workplace label
 - other means of identification
- Responsibility for labels
 - supplier responsibility
 - employer responsibility
 - worker responsibility
- Introduce label content, design and location
 - supplier labels
 - workplace labels
 - other means of identification

4. Introduce material safety data sheets (MSDS)

- Definition of a material safety data sheet
- Purpose of the data sheet
- Responsibility for the production and availability of data sheets
 - supplier responsibility
 - employer responsibility
 - workers responsibility

Practical

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Locate WHMIS label and interpret the information displayed.
2. Locate a MSDS sheet for a product used in the workplace and determine what personal protective equipment and other precautions are required when handling this product.

SUGGESTED RESOURCES:

1. WHMIS Regulation
2. Sample MSDS sheets

NOA Reference:

The material covered satisfies in whole or in part, the requirements of the National Occupational Analysis task 3.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- use appropriate hand tools to execute tasks related to the occupation.

Theory:

1. Identify the types of screwdrivers and describe the care, use and application.
 - standard type
 - robertson
 - phillips
 - reed and prince
 - posidrive, clutch, and torx
 - screw-starter
 - offset
2. Identify the types of hammers, and describe the care, use and application.
 - claw
 - ball-peen
 - sledge
 - soft-face hammers and mallets
3. Identify the types of pliers and describe the care, use and application.
 - linesman
 - diagonal-cutting
 - long-nose
 - slip joint
 - high-leverage cutter
 - locking
4. Identify the types of wrenches, and describe the care, use and application.
 - open-end
 - box-end
 - combination
 - flare-nut (line)
 - hex-key (allen)
 - adjustable
 - pipe
 - socket drives
 - sockets

- torque

5. Identify the types of hacksaw blades and describe the care, use and application.
6. Identify the types of files and describe the care, use and application.
7. Identify the types of taps and dies and describe the care, use and application.
8. Identify the types of measuring and layout tools, and describe the care, use and application.
 - vernier caliper
 - micrometer
 - dial indicator
 - wire gauge
 - feeler gauge
9. Identify the types of punches and chisels, and describe the care, use and application.
 - starting punches
 - pin and drift punch
 - taper punch
 - centre punch
 - cape chisel
 - round nose chisel
 - diamond point chisel
 - cold chisel
10. Identify the types of hand-operated knock-out punches and describe the care, use and application.
 - Knockout punches
 - C clamp punch
 - Hydraulic
11. Identify the types of flaring tools, tubing benders, cutting tools and describe their care, use and application.

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Demonstrate the use of:
 - screwdrivers
 - hammers
 - pliers
 - wrenches

- hack saws
- files
- taps and dies
- measuring and layout tools
- punches and chisels
- flaring tools
- tubing benders
- cutting tools

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis Task 3.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- use appropriate power tools to execute tasks related to the occupation.

Theory:

1. Identify the types of portable drills and describe the care, use and application.
 - cordless drill
 - electric drill
 - electric hammer
 - rotary hammer
2. Describe drill presses and their operating procedures.
3. Identify safe working speeds of wheels on portable and pedestal grinders.
4. Identify the types of circular, sabre, and reciprocating saws and describe the care, use and application.
5. Describe the care and use of air powered tools.
 - operating pressured
 - pressure regulators
 - in-line oilers
 - care of hoses/fittings
 - impact wrenches

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Demonstrate the use of:
 - portable drills
 - drill presses
 - pedestal grinders
 - portable grinders
 - circular saws
 - sabre saws
 - reciprocating saws

- air powered tools

IIM - 1120

Fasteners & Adhesives

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 4 and throughout the NOA.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- select and use the various fastening devices associated with the occupation.

Theory:

1. Describe the types, sizes, classifications and uses of various fastening devices.
 - nails
 - adhesives
 - wood screws
 - sheet metal screws
 - machine screws and bolts
 - nuts and washers
 - masonry anchors and shields
 - cavity fasteners
 - screw anchors
 - miscellaneous anchors
 - epoxy anchors
2. Describe the procedures to operate powder actuated tools.
 - general safety precautions
 - safe operation
 - specific precautions (operator, tools, power loads, and materials)
 - qualified operator
 - general information
 - requirements for operator card
 - colour coding for powder charges
 - types of power loads
 - power level selection
 - material hardness testing
 - high velocity
 - low velocity tools

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install various fastening devices.
 - nails
 - adhesives
 - wood screws
 - sheet metal screws
 - machine screws and bolts
 - nuts and washers
 - masonry anchors and shields
 - cavity fasteners
 - screw anchors
 - miscellaneous anchors
 - epoxy anchors
2. Torque fastening devices to specifications.
 - deflection torque wrenches
 - pre-set/digital torque wrenches
 - torque break-away tabs
3. *Use powder actuated tools to fasten material to concrete and steel.
 - fastening relatively soft material permanently to concrete
 - fastening relatively soft material permanently to steel
 - fastening metal permanently to concrete
 - fastening metal permanently to steel
 - fastening removable items or material to concrete
 - fastening removable items or material to steel

****Note: These performance activities cannot be conducted in the absence of a certified operator.***

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis throughout the NOA.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate understanding of the basic concepts of direct current (DC) theory.

Theory:

1. Describe atomic structure.
 - matter
 - atoms
 - electric charge
 - protons, electrons, neutrons
 - conductors, insulators
2. Describe different sources of electricity.
 - friction
 - heat light and solar energy
 - piezoelectric
 - mechanical (magnetism)
 - chemical (primary and secondary cells, the action of the lead-acid cell)
3. Describe useful application and hazards caused by static charges.
 - negative charge
 - positive charge
 - law of charges
 - electrostatic field (dielectric field)
 - applications
4. Describe the effects of electricity.
 - heat effect
 - magnetic effect
 - psychological and physiological effects
5. Define electrical absolute values.
 - unit prefixes
 - electrical absolute values (resistance, pressure, flow, power, etc.)
 - ohm's law
6. Describe the types and the components of electrical circuits.
 - electron path
 - load

- source
- control
- electron current flow
- conventional current flow
- closed circuit
- open circuit
- short circuit

7. Describe the procedures used to compute values of electrical energy and power.
 - introduction to mechanical power, energy, etc.
 - combining the power formula and ohm's law
 - Kilowatts and horsepower
8. Describe the procedures for using electrical measuring instruments.
 - ammeter
 - voltmeter
 - ohmmeter
 - multimeter

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Use electrical measuring instruments
 - ammeter
 - voltmeter
 - ohmmeter
 - multi meter

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis throughout the NOA.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- determine the absolute values of devices connected in series, parallel or any combination of these two.

Theory:

1. Describe procedures used to analyze and compute amperage and voltage in series DC circuits.
 - current relationships
 - resistance relationships
 - voltage relationships
 - circuit fault analysis
 - circuit applications
2. Describe procedures used to analyze and compute amperage and voltage in parallel DC circuits.
 - current relationships
 - resistance relationships
 - voltage relationships
 - circuit fault analysis
 - circuit applications
3. Describe procedures used to analyze and compute amperage and voltage in combination DC circuits.
 - series/parallel circuits
 - parallel/series circuits
 - voltage and current relationships in complex circuits
4. Describe procedures used to analyze and compute resistance and/or continuity in basic DC circuits.
5. Describe procedures used to analyze and compute power consumption in basic DC circuits.

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Prove Ohm's Law.
2. Analyze and measure:
 - voltage
 - current
 - equivalent resistance
 - power in dc circuits
 - series and parallel circuits

NOA Reference:

The material covered satisfies in whole or in part, the requirements of the National Occupational Analysis task 2 and throughout the NOA.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of and apply the various codes used in the occupation.

Theory:

1. Describe the layout and structure of the Canadian Electrical Code (CEC), Part 1.
2. Describe the layout and structure of the National Building Code (NBC).

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Locate, select and gather information from the CEC, Part 1.
2. Locate, select and gather information from the NBC.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis throughout the NOA.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- calculate voltage drop and power losses in circuits and conductors.

Theory:

1. Explain conductor terminology.
 - mils and circular mils
 - square mils
 - stranded conductors
 - the approximate wire table
 - conductor insulation requirements
 - AWG sizes
 - calculation for circular mils (square millimeters/ohms/milifoot)
2. Discuss the factors affecting resistance of conductors.
 - type of material
 - temperature
 - length
 - cross-sectional area
 - the mil-foot
 - the microhm-cm
 - temperature coefficient of resistance
3. Explain voltage drop and power loss in electrical circuits.
 - factors affecting voltage drop
 - CEC requirements
4. Explain Kirchhoff's current and voltage laws.
 - current law
 - voltage law
5. Explain three-wire circuits.
 - purpose of neutral wire
 - open neutral

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Calculate voltage drop and power loss in circuits and conductors.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis throughout the NOA.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate understanding of the basic concepts of alternating current (AC).

Theory:

1. Describe the principles of magnetism and electromagnetism.
2. Describe the concepts of Alternating Current.
 - principles of the elementary generator
 - self-induction and mutual induction
 - faraday's law
 - cycle
 - sine wave
 - electrical and mechanical degrees
 - alternating current and voltage values (maximum, effective and average values) - relationship between generated voltages (phase)
3. Explain how to determine the properties of an AC circuit.
 - resistance
 - capacitance
 - inductance
 - impedance
4. Explain how to determine absolute values in a AC series circuit containing RLC components.
 - relationships between voltage and current in resistive, capacitive, and inductive AC circuits
 - characteristics of series connected resistive, capacitive, and inductive loads
5. Explain how to determine absolute values in a AC parallel circuit containing RLC components.
 - relationship between voltage and current in resistive, capacitive, and inductive AC circuits
 - characteristics of parallel connected resistive, capacitive, and inductive loads
6. Explain how to calculate power and power factor in AC circuits.
 - apparent power
 - power in reactive AC circuits
 - power in resistive/reactive AC circuits

- power factor

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Measure sine waves using an oscilloscope.
2. Measure phase angle.
3. Calculate instantaneous reactance.
4. Compute capacitive phase shift and reactive power.
5. Compute inductive phase shift and reactive power.
6. Compute vectors and phasors in series AC circuits.
7. Calculate impedance.
8. Measure, using a circuit:
 - equivalent capacitance
 - inductive reactance
 - equivalent inductance
 - power in AC circuits

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 16.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- understand the theoretical base required to work with electrical apparatus and devices which utilize a three-phase power source.

Theory:

1. Describe three-phase circuits.
 - advantages of three-phase
 - phase sequence
 - Y/Delta connections
2. Describe the voltage and current values in three-phase wye connections.
3. Describe voltage and current values in three-phase delta connections.
4. Describe procedures used to calculate three-phase power, volt-amperes, reactive power, and power factor.
 - three-phase apparent power
 - three-phase power
 - power factor
 - reactive power

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Balance three-phase circuits.
2. Measure phase sequence.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 18.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- Install various types of conduits and fittings.

Theory:

1. Describe the various types of conduits and fittings and their applications and procedures for installation.
2. Describe the terms associated with the bending of conduits and tubing.
3. Describe the procedures for cutting, coupling, and termination methods used with rigid conduits.
4. Describe sources of corrosion.
 - dissimilar metals
 - electrolysis
 - environmental contaminants

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install various types of conduits and fittings.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis throughout the NOA.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of troubleshooting techniques.

Theory:

1. Describe the basics of failures.
 - how hardware fails
 - how software fails
 - environmental effects on failure rates
 - functional failures
 - systematic failures
 - common-cause failures
 - failure states
2. Describe troubleshooting methods.
 - seven-step procedure (define the problem/collect information/analyze information/determine sufficiency of information/propose a solution/test the solution/repair)
 - substitution method
 - fault insertion method
 - infra-red thermal detection method
3. Describe troubleshooting safety aspects.
 - human error in industrial settings
 - plant hazards faced during troubleshooting (electrical/mechanical/stored energy/thermal/chemical)
 - electrically hazardous areas
 - work permit maintenance procedures

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Troubleshoot various Instrumentation equipment & systems.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 12 and 16.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- maintain DC and AC motors.

Theory:

1. Describe the construction of direct current motors.
 - field poles
 - armature
 - commutator
 - motor nameplate data
2. Explain the basic differences between shunt, series and compound motors.
 - DC compound motors
 - stepper motor
 - electronically commutative
 - permanent magnet
3. Explain the operating characteristics of various types of direct-current motors.
4. Describe the components of a typical single phase motor.
5. Describe the operating principles of single phase motors.
 - induction motor principles
 - rotating magnetic field
 - current and voltage
 - frequency
6. Describe the operating principles of a universal (series) motor.
7. Describe the operating principles of three-phase squirrel cage induction motors.
8. Describe motor testing devices.
 - tachometers
 - stroboscope
 - frequency indicators
 - phase rotation tester
 - phase sequence indicator

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Use test equipment to test motors.
2. Identify the motor types and components.
3. Install, service and maintain DC And AC motors.

IIM - 0170 Pneumatic Systems (Instrument Air Supply)

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 4 and 22.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- install instrument air supply systems and equipment.
- maintain instrument air supply systems and equipment.
- troubleshoot instrument air supply systems and equipment.

Theory:

1. Identify and interpret pneumatic drawings and sketches.
2. Describe the parts and characteristics of various types of compressors and associated equipment.
 - instrument air requirements
 - pressure
 - estimation of air requirements
 - types of compressors
 - principles of operation
 - location of air intake and filters
 - compressor operation
3. Describe the procedures used to install conditioning devices in instrument air supply systems.
 - moisture removal
 - dehydrators
 - traps
 - separators
 - air coolers
 - air dryers
 - absolute and relative humidity of air
 - dew point
 - use of psychometric chart
 - desiccant dehydrators
 - oil removal
4. Describe the procedures used to select and install tubing and fittings.
 - Main branch lines
 - piping size and sizing
 - piping materials
 - pipe cutting; deburring and threading
 - copper (PVC) covered
 - brass

- steel
- aluminum
- plastic
- other types used in instrumentation
- selection of tubing; size and type
- selection of tubing fittings
- tubing run
- cut, ream and assemble copper and brass pipe
- solder fittings and tubing
- flare tubing

5. Describe the procedure used to install pressure instruments.

- pressure taps
- position
- types of connections
- methods of installing taps
- working pressure of unit

6. Describe the procedure used to install special applications.

- process fluids in leads
- methods of sealing out process
- choice of suitable sealing liquid
- protection of instruments
- corrosive vapours
- weather
- dust
- vibration

7. Describe the procedures used to detect leaks in tubing runs.

- pressure test
- lighted candle
- odoriferous air
- soap test

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install instrument air supply systems and equipment.
2. Maintain instrument air supply systems and equipment.
3. Troubleshoot instrument air supply systems and equipment.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 21.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of hydraulic systems, their components and applications.
- demonstrate knowledge of the procedure used to troubleshoot and maintain hydraulic systems.

Theory:

1. Use hydraulic formulas to solve problems.
 - pascal's law
 - bernoulli's principle
 - pressure drop and flow
 - horsepower and torque
2. Identify the components needed to make up a basic hydraulic system.
 - pumps
 - actuators
 - hydraulic fluid
 - piping and sealing
 - motors
3. Describe the operation of various plumbing components used in hydraulic systems.
 - filters
 - accumulators
 - intensifiers
 - pressure switches
 - gauges and flowmeters
4. Describe the operation and purpose of various valves used in hydraulic systems.
 - directional control valves
 - pressure control valves
 - volume control valves
5. Describe the use of schematic diagrams in troubleshooting systems.
6. Describe preventative maintenance procedures.
 - seals
 - motor vanes
 - checking for leaks
 - cavitating pumps

7. Describe fluid maintenance procedures.
 - assessing fluid condition
 - replace fluids
 - replace filters

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Troubleshoot a hydraulic system using a schematic diagram.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 7, 8, 9, 10, 17, and 20.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- calibrate instruments and devices.
- install instruments and devices.
- maintain instruments and devices.
- configure smart instruments
- maintain calibration standards

Theory:

1. Define terminology associated with pressure measurement.
2. Describe procedures used to perform calculations that relate to pressure measurement and the properties of fluids.
3. Explain the principles involved in pressure measurement equipment such as:
 - motion detectors
 - linear potentiometer
 - linear motion variable inductor
 - linear variable differential transformer - LVDT
 - linear motion variable capacitor
 - flapper-nozzle transmitters
 - strain gauge
4. Identify and compare common applications and perform calculations using various differential pressure methods.
 - level measurement by differential pressure
 - density measurement by differential pressure
 - flow measurement by differential pressure
5. Describe pressure measurement procedures to verify proper operation within an acceptable tolerance of error.
 - test instruments for pressure measurement
 - calibration principles
 - calibration procedures
6. Describe the mounting details of pressure and differential pressure instruments.
7. Explain the accepted terminology and concepts of theory for the measurement of temperature.

8. Describe the measuring of temperature in an industrial process.
 - thermometers
 - thermocouples
 - resistance thermometers - RTD's
 - thermistors
 - pyrometer
9. Describe the considerations and limitations when installing temperature measuring elements and devices in an industrial process.
10. Explain the basic concepts and terminology used in industrial flow measurement.
11. Determine the considerations, limitations and procedures when installing flow measuring devices in a process.
 - differential pressure flowmeters
 - variable area rotameters
 - open channel flowmeters
 - positive displacement flowmeters
 - magnetic flowmeters
 - mass flowmeters
 - turbine flowmeters
12. Describe procedures used to calculate calibration points (curves) for flow measuring instruments.
13. Explain the theory for the measurement of level.
14. Describe the various methods of measuring levels in an industrial process.
 - direct measurement methods
 - constant displacement devices
 - hydrostatic head level measurement
 - electronic level measuring systems
 - ultrasonic
 - weighing
 - radioactive
 - granular solids
 - level measurements
15. Describe the configuration of smart transmitters and their applications.
 - HART protocol
 - foundation field bus
 - configuring transmitters
16. Describe the maintenance and calibration of recorders and indicators.
17. Describe calibration standards.
18. Describe the importance of record keeping procedures.

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install various measurement instruments.
2. Calibrate various measurement instruments and record calibration data.
3. Perform calculations that relate to pressure measurement and the properties of fluid.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 16 & 17.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- understand basic problems with power supply and rectifiers.
- troubleshoot basic problems with power circuits.

Theory:

1. Describe the basic fundamental characteristics of semiconductor materials.
 - semiconductor atoms
 - covalent bonding
 - n-type semiconductor material
 - p-type semiconductor material
 - negative temperature coefficient of resistance
2. Describe the characteristics of PN junction diode.
 - reverse bias
 - forward bias
 - voltage/current graph
 - diode specifications
 - diode polarity
3. Describe the operation of single-phase rectifier circuits.
 - rectifier wave forms
 - half-wave rectifier
 - full-wave rectifier
 - full-wave bridge rectifier
 - ripple frequency
4. Describe the procedures used to calculate and measure power, current and voltage values in rectifier circuits.
 - average values
 - effective (RMS) values
 - peak inverse voltage
5. Describe filter circuits for single-phase rectifiers.
 - capacitor filter
 - choke filter
 - LC filter
 - PI filter

6. Describe the operation of the zener diode.
 - voltage/current graph
 - DC voltage regulator circuits
 - AC clipping action
7. Describe the operation of three-phase rectifiers.
 - wye connected half-wave rectifier
 - compute the average dc output of a half-wave, three-phase rectifier
 - three-phase bridge rectifier
8. Describe other diode applications.
 - free wheeling diodes
 - light-emitting diodes
 - photo diodes
9. Describe the features of the bi-polar junction transistor.
 - NPN transistor
 - PNP transistor
 - common case styles
10. Describe the basic action of the transistor as a switch.
 - single-transistor switch
 - two-transistor switch
11. Identify special types of bi-polar junction transistors.
 - darlington transistor
 - photo transistors
12. Describe the features of the silicon controlled rectifier (SCR).
 - symbols and leads
 - typical ratings
 - common case styles
13. Describe the action of the SCR in a DC circuit.
 - diode analogy
 - triggering action
 - commutation
14. Describe the action of the SCR in an AC circuit.
 - half-wave rectification
 - phase control
 - conduction angles
 - full-wave rectification
15. Describe the characteristics of the bi-directional triode thyristor (triac).
 - symbol and leads
 - typical ratings

16. Describe the features of the operational amplifier.
 - symbol
 - packaging
 - operation as comparator
17. Describe the number systems used in digital systems.
 - decimal system
 - binary system
 - octal system
 - hexadecimal system
 - conversion between systems
18. Identify the common binary codes.
 - binary coded decimal (BCD)
 - American standard code for information interchange (ASCII)
 - gray code
19. Describe the operation of common logic gates.
 - and gate
 - or gate
 - not gate
 - nand gate
 - nor gate
 - exclusive -or circuit

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Troubleshoot basic problems with electric circuits.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis Tasks 8, 16 and 20.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of the installation and maintenance of discrete control devices.
- demonstrate knowledge of the installation and maintenance of on-off control systems.
- demonstrate knowledge of the installation and maintenance of annunciator panels.

Theory:

1. Describe the construction and operation of pushbuttons.
2. Describe the construction and operation of selector switches.
3. Describe the construction and operation of centrifugal switches.
4. Describe the construction and operation of limit switches.
5. Describe the operation/limitations and installation procedures of proximity switches.
 - inductive proximity sensors
 - installation techniques
 - ultrasonic proximity sensors
 - detection and accuracy
 - capacity proximity sensors
 - wiring proximity sensors
6. Describe the operation and installation procedures of photo sensors and switches.
 - photo tubes (photo missive cells)
 - solar cells (photo voltaic cells)
 - photo resistive cells (photo conductive)
 - photo diodes/photo transistors
 - installation of photo switches
7. Describe the operation of temperature-operated switches.
 - purpose of temperature-operated switches
 - definitions and terms
 - input devices
8. Describe the methods of determining liquid levels.
 - sight glass
 - float switches/controls

- photo-type level detectors
- pressure switches

9. Describe the methods of determining liquid levels.
 - types of pressure switches
10. Describe the methods used to determine the movement of air or liquids.
11. Describe the basic operation of general purpose relays.
12. Interpret wiring and schematic diagrams.
 - standard electrical symbols
 - diagrams and interpretation
 - wiring diagrams
 - schematic diagram
 - tracing control circuit current flow
 - tracing power circuit current flow
13. Describe the purpose and operation of common magnetic starters and controllers.
 - magnetic contractor
 - electromagnet operation
 - control-circuit transformers
 - magnetic motor starter sizes
 - power contacts
 - overload relay
14. Describe the construction and operation of overload devices.
 - thermal overload relay
 - solid state overload unit
15. Describe control circuits used with starters.
 - two-wire control
 - three-wire control
 - control circuit transformer
 - pushbutton connections
16. Describe the installation and troubleshooting procedures for annunciator panels.
 - annunciator types and features

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install discrete control devices.
2. Install and troubleshoot an annunciator panel.

3. Install a motor control system.
4. Interpret wiring schematic diagram.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 16.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- understand the operation of solid state drives.
- install solid state controls for motors.
- calibrate solid state controls for motors.

Theory:

1. Describe the operation of solid state DC motor controllers.
 - power converters
 - field voltage control
 - armature voltage control
 - protection
 - speed control
 - reversing
2. Describe the calibration and troubleshooting procedures for solid state DC motor controllers.
3. Describe the features of variable frequency AC drives.
 - DC power section
 - AC power section
 - control section
 - size and ratings
4. Describe the operation of motors used with variable frequency AC drives.
 - speed characteristics
 - torque characteristics
 - braking
 - reversing
 - protection
5. Describe the testing and troubleshooting problems with variable frequency AC and DC drives.
6. Describe the operation of various types of drives.

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Set-up and calibrate solid state (AC & DC) drives.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 16.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of installation and maintenance of control valves.
- demonstrate knowledge of installation and maintenance of pneumatic, hydraulic and electric actuators.

Theory:

1. Define control element terminology.
 - control valve nomenclature
 - rotary-shaft valve nomenclature
2. Describe the different types and application/function of final control elements found in an industrial process.
 - control valve functions and characteristics
 - control valve actuators
 - diaphragm actuators
 - piston actuators
 - electro-hydraulic actuators
 - manual actuators
 - electric actuators
 - control valve bodies
 - pinch valves
 - single-ported valve bodies
 - balanced-plug cage-style valve bodies
 - high-capacity cage-guided valve bodies
 - reverse-acting cage-guided valve bodies
 - double-ported valve bodies
 - three-way valve bodies
 - boot-style valve bodies
 - butterfly valve bodies
 - v-notch ball valve bodies
 - eccentric-disc control valve bodies
 - control valve end connectors
 - screwed pipe threads
 - bolted gasket flanges
 - welding end connections
 - valve body bonnets
 - extension bonnets
 - bellows seal bonnets

- control valve packing
 - TFE V-ring
 - TFE-impregnated asbestos
 - graphite asbestos
 - laminated and filament graphite
 - semi-metallic
- valve stem packing lubrication
 - conventional characterized valve plugs
 - characterization of cage-guided valve bodies
 - valve plug guiding
 - restricted capacity control valve trim
- special control
 - high pressure control valves
 - high temperature control valves
 - small flow control valves
 - large flow control valves

3. Describe the accessories used with control valves.

- valve positioners
- hand wheels and manual operations
- hydraulic snubber
- limit/proximity switches
- solenoid valve manifold
- supply pressure regulator
- pneumatic lock-up systems
- fail-safe systems for pistons
- electro-pneumatic transducers

4. Describe the procedures for installing and maintaining control valves.

- piping arrangements
- pipeline cleanliness
- inspection before installation
- good piping practice
- control valve maintenance
 - replacing actuator diaphragm
 - replacing stem packing
 - replacing threaded seat rings
 - grinded metal seats
 - lubricating control valve packing
 - adjusting travel and connecting stem

5. Describe the calibration of smart valves and positioners.

- intelligent systems for control valves
- digital positions

6. Describe ANSI and ASTM standards as they apply to control valves.

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install and maintain various control valves and accessories.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 2, 5, 6, and 20.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- understand the basic concept of automatic process control
- inspect and calibrate control equipment
- perform tuning procedures in control systems
- troubleshoot control systems

Theory:

1. Describe the basic control concepts.
 - control loop variables
 - typical manual control
 - feedback control
 - manual feed forward control
 - automatic feed forward control
 - process control and process management
2. Describe the functional structure of feedback control.
 - single feedback control loop
 - block diagrams
 - functional layout of a feedback loop
 - dynamic components
 - mathematical model of a loop
3. Describe the setup and calibration of controls
 - controllers
 - on-off control
 - proportional control action
 - reset control action
 - rate control action
 - PID control
4. Describe process dynamics.
 - dead time
 - closed-loop response vs. open-loop response
 - transfer lag
5. Describe tuning on control systems.
 - closed-loop tuning methods
 - simple open-loop method

6. Describe the set-up and troubleshooting of cascade, ratio control and dead time control.
7. Describe feed forward control.
8. Describe adaptive control.
9. Interpret instrumentation blue prints.
 - ISA symbols
 - SAMA symbols
 - P&ID diagrams
 - control logic diagrams

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Set-up and calibrate controllers
2. Tune control systems

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 11, 13 and 15.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- describe the selection, operation and application of different types of process analyzers
- describe the maintenance and installation procedures applicable to process analyzers
- demonstrate how process analyzers are calibrated

Theory:

1. Describe pH system operations and their maintenance.
 - theory of dissociation, ionization and pH
 - application of pH in industrial processes
 - use of dyes to measure pH
 - use of buffers as a standard for calibration of pH analyzers
 - operation and service maintenance of reference electrodes in a pH measuring system
 - operation and service maintenance of glass electrodes in a pH measuring system
 - operation and application of dual electrodes and differential electrode systems
 - effects of temperature on:
 - pH
 - measuring electrodes
 - reference electrodes
 - methods of thermo-compensation
 - manual
 - automatic
 - electrode assembly holders and flow chambers used pH measuring systems
 - methods of automatic electrode cleaning
 - ultrasonic
 - fluid jet
 - mechanical brush
 - hydrodynamic
 - effects of electrode errors
 - grounding
 - shielding
 - moisture
 - calibration of analyzers/transmitters

2. Describe ORP systems and their operation and maintenance.
 - theory and units for ORP measurement
 - industrial process applications for ORP measurement
 - bleach production
 - bleaching reaction
 - water treatment
 - mineral waste treatment
 - types of ORP measuring electrodes
 - electrodes assembly holders and flow chambers used in ORP measuring systems
 - service maintenance procedures for ORP electrodes
 - sources of electrode errors, common to ORP measuring systems
 - use of specialized buffers to standardize an ORP electrode system
 - calibration of ORP analyzers
3. Describe specific ion measurement systems and their operations and maintenance.
 - theory units of specific ion measurement
 - common specific ions measured
 - specific ion electrode systems
 - use of specialized buffers to standardize a specific ion electrode system
 - application of some common specific ion measuring systems
 - water treatment
 - demineralization
 - operation and service maintenance of specific ion measuring electrodes
 - calibration of monovalent or divalent cation or anion specific analyzers
4. Describe conductivity measurement systems and their operations and maintenance.
 - theory and units for conductivity measurement
 - industrial applications using conductivity measurement
 - how temperature affects conductivity measurement
 - methods of temperature compensation
 - manual
 - automatic
 - types of conductivity cells
 - proper location for conductivity cells in a process
 - conductivity cell maintenance procedures
 - operation and calibration of conductivity analyzers
5. Describe dissolved oxygen (D.O.) analysis systems and their operations and maintenance.
 - theory of dissolved oxygen analysis
 - industrial process applications using dissolved oxygen analysis
 - D.O. cells and their related maintenance procedures
 - operation and calibration of D.O. analyzers
 - hydrogen difference of D.O. analyzers
 - polarographic cell type

6. Describe gas chromatography systems and their operations and maintenance.
 - theory and principle of operation of a gas chromatography
 - theory and principles of operation analyzer components
 - columns
 - temperature control
 - detectors
 - thermal conductivity
 - flame ionization
 - gas density balance
 - injection and function valves
 - temperature and carrier gas
 - flow control
 - programmers
 - optical readers
 - magnetic tapes
 - micro processor
 - operation and calibration of a gas chromatography
7. Describe the operation and uses for X-ray analyzers.
 - X-ray sources
 - X-ray detectors
 - readout
 - types of processes analyzed
8. Describe the ultraviolet absorption process analyzer.
 - absorption spectrum
 - analyzers components
 - analyzers applications
 - analyzers calibration
9. Describe infrared process analyzers.
 - absorption spectrum
 - analyzer detectors
 - analyzer applications
 - analyzer calibration
10. Describe oxygen analyzers.
 - types of O₂ analyzers
 - uses of O₂ analyzers
 - calibration
11. Describe thermal conductivity gas analyzers.
 - operating principles
 - gas selection
 - calibration
 - applications

12. Describe density analyzers.
 - types
 - applications
 - calibrations
13. Describe viscosity measuring system.
 - types of measuring devices
 - applications
 - calibration
14. Describe consistency measuring system.
 - types
 - applications
 - calibration
15. Describe nuclear radiation analytical instrumentation.
 - nuclear principle
 - beta and gamma uses
 - nuclear radiation detectors
 - safety (Atomic Energy of Canada Regulations)
 - applications
 - calibration
16. Describe refractive index analyzers.
 - operation (critical angle)
 - application
 - calibration
17. Describe moisture/dew point analyzers.
 - principle
 - measuring systems
 - applications
 - calibration
18. Describe the sample conditioning systems for process analyzers.
 - take offs
 - drying samples
 - filtering samples
 - multiple stream switching
 - calibration samples
 - transport time considerations
19. Describe the installation procedures for process analyzers.
 - liquid
 - gas

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Calibrate and install various process analyzers.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 14.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- install and calibrate vibration measurement devices.

Theory:

1. Describe vibration and its causes.
 - motion
 - unbalance
 - misalignment
 - bent shafts
 - gears
 - belts and chains
 - bearings
 - torque variations
 - electromagnetic forces
 - aerodynamic forces
 - hydraulic forces
 - looseness
 - rubbing
 - resonance
2. Describe the characteristics and significance of vibration.
 - frequency
 - displacement
 - velocity
 - acceleration
 - phase
3. Describe the measurement of vibration amplitude and its effect on machine operation.
 - displacement
 - velocity
 - acceleration
 - severity charts
 - complex vibrations
4. Describe the methods of measuring machinery vibration.
 - meter
 - monitors

- analyzers
- transducers
- seismic pickups
- accelerometer pickups

5. Describe the basic operation and mounting requirements of pickups.
 - seismic
 - accelerometer
 - stud mounting
 - hand held
 - probe
 - magnetic pickup holders
 - shaft stick
 - non-contact pickups
6. Describe the procedures used to measure the following machine vibration.
 - horizontal direction
 - vertical direction
 - axial direction

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Measure machinery vibration.
2. Set-up and calibrate a vibration measuring monitoring device.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 18 and 19.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- install signal wiring.
- install, calibrate and maintain transducers and related equipment.

Theory:

1. Describe types of signal cable.
2. Describe the installation and testing procedures for signal cable.
3. Describe methods of wiring, calibration and maintenance of signal transducers.
 - current/pressure
 - pressure/current
 - current/voltage
 - voltage/current
 - current/current
 - current/digital
 - frequency/voltage
4. Describe the application and installation of intrinsic safety barriers.
 - hazardous location classes
 - intrinsic barrier types
 - wiring requirements
5. Describe the application and installation of surge suppressors.
 - gas filled breakdown devices
 - metal-oxide varistors (MOV)
 - R-C networks
 - free wheeling and zener diodes
6. Describe the application and installation of multiplexers.
7. Describe the application and installation of radio telemetry systems.

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install and calibrate various signal transducers and related equipment.

NOA Reference:

This topic was identified as important at the Atlantic Curriculum meeting. It is not represented in the National Occupational Analysis.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- interpret boiler control Process & Instrument Diagram (P&ID) drawings.
- interpret boiler control Scientific American Manufacturers Association (SAMA) control drawings.

Theory:

1. Describe boiler basics and the steaming process.
2. Describe combustion of fuels, excess air and products of combustion.
3. Describe the steam supply system.
4. Describe the firing rate demand for utility and industrial boilers.
5. Describe main steam and reheat steam temperature control.
6. Describe boiler interlocks.
7. Describe feedwater supply and boiler water circulation systems.
8. Describe feedwater control systems.
9. Describe boiler draft systems.
10. Describe the measurement and control of boiler draft.
11. Describe the measurement and control of combustion air flow.
12. Describe flue gas analysis trimming of combustion control systems.
13. Describe fluid and solid fuel burners.
14. Describe burner management and flame safety interlocks.
15. Describe combustion control systems.

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Interpret boiler control P&ID and SAMA control drawings.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 24.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of the operation of PLC's.
- demonstrate knowledge of the installation and troubleshooting of PLC's.

Theory:

1. Describe the features of a programmable controller.
 - central processing unit
 - CPU diagnostics
 - memory types
 - memory organization
 - (scan) program execution
 - power supply
 - I/O system
 - I/O addressing
 - discrete inputs
 - discrete outputs
 - analog I/O
 - remote I/O
 - programming terminals and peripheral devices
 - dedicated programming terminals
 - mini-programmers
 - computer-based programming terminals
 - peripheral devices
2. Describe installation and troubleshooting procedures for a programmable controller.
 - safety considerations
 - system layout
 - proper grounding techniques
 - sources of electrical interference
 - I/O installation
 - field checkout of programmable controllers
 - PLC troubleshooting

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Install and troubleshoot a PLC.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 24.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of PLC programming.

Theory:

1. Describe the procedure for programming a PLC using ladder logic or 'instruction set' type languages.
 - ladder logic
 - ladder logic programs
 - I/O instructions
 - controller scan
 - programming restrictions
 - safety circuitry
 - I/O addressing
 - timers
 - types of PLC timers
 - cascading timers
 - reciprocating timers
 - counters
 - types of PLC counters
 - cascading counters
 - combining counter and timer circuits
 - math functions
 - data comparison
 - addition
 - subtraction
 - multiplication
 - division
2. Describe the general principles of transmission media, protocols, testing and troubleshooting of PLC data highway systems.
 - data highways
 - protocol
 - token passing
 - topology
 - transmission media
 - data highway types

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Program a PLC.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis task 23.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of the procedures to configure and install DCS systems and their peripheral devices.

Theory:

1. Describe a typical DCS (Distributed Control System).
 - definition of DCS
 - basic DCS functions
 - role of the computer in DCS
 - DCS and expert systems overview
 - overall structure
 - I/O modules
 - local I/O bus
 - controller modules
 - communications modules
 - real time data highway
 - host computer interfaces and PLC gateways
 - power distributions systems
 - expanding and upgrading a DCS
2. Describe procedures used to program a DCS.
 - write program
 - programming concepts
 - executive software
 - system support software
 - application software
 - communication software
3. Describe procedures used to install field equipment, run data highways, and make connections to the DCS system.
 - physical location
 - environmental conditioning
 - power source
 - wiring
 - intrinsically safe barriers
 - system checkout and site power up
 - typical system layouts
 - start up services

- system documentation

4. Describe procedures used to analyze video displays, use a system keyboard, and troubleshoot DCS control systems.

- historical trending
- operator interface hardware
- CRT display monitors
- alphanumeric keyboard
- operator keyboard
- hard copy devices
- displays
- engineering workstations
- levels of support programs
- categories of maintenance
- enhancement maintenance
- preventative maintenance
- corrective maintenance
- service contracts

5. Describe the typical UPS (Uninterruptible power supply) system used to supply a distributed control system.

- purpose and applications
- power line problems
- UPS system configurations

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Program a DCS.
2. Install equipment, run data highways, and make connections to the DCS.
3. Analyse a video display.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 5 and 23.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- configure control loops.
- tune control loops.
- interpret DCS programs.
- troubleshoot system problems.
- describe fibre optic applications.

Theory:

1. Describe the procedures used to interpret DCS programs
 - SAMA control systems
 - function block programming
 - digital control symbols
2. Describe the procedures used to configure a DCS system.
 - basic PID loop
 - cascade control
 - ratio control
 - feed forward control
 - override control
3. Describe the procedures used to employ advanced programming features.
 - signal characterization
 - gain characterization
 - feed forward
 - multiple valve manipulation
 - open-loop backup
 - rate of change control
 - failure protection
4. Describe the procedures used to interpret boiler control application drawings.
 - combustion control
 - drum level control
 - steam temperature control
 - furnace pressure control
5. Describe the features of fibre optic cables.
 - fibre type
 - step-index multi-mode

- graded-index multi-mode
 - single mode
- fibre fabrication methods
 - modified chemical vapor deposition
 - outside vapor deposition
 - axial vapor deposition
- fibre cable design and construction
 - TubeStar
 - LiteTube
 - LiteStar

6. Describe the components and operation of a fibre optic communication system.

- optical sources
 - LED's
 - semiconductor lasers
- optical detectors
 - PIN diodes
 - avalanche photo diodes
- light propagation through core
 - monochromatic
 - coherent
- signal
 - digital
 - analog

7. Describe the procedures for troubleshooting DCS network.

- Remote I/O
- Data Highway
- Devicenet

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Configure a loop and DCS system.
2. Configure a control application on a DCS system.
3. Troubleshoot a DCS network.

NOA Reference:

The material covered satisfies, in whole or in part, the requirements of the National Occupational Analysis tasks 5, 18, 19, 20 and 24.

Course Outcomes:

Upon the successful completion of this course, the apprentice will be able to:

- configure analog modules
- configure PID loops
- troubleshoot process applications
- interface a PLC with an HMI system
- troubleshoot PLC networks

Theory:

1. Describe procedures used to calculate input/output relationships.
 - analog to digital conversion
 - digital to analog conversion
2. Describe the procedures used to configure analog modules.
 - voltage/current input modules
 - voltage/current output modules
 - TC and RTD input modules
3. Describe procedures for troubleshooting analog modules.
 - fault bits
 - validity bits
4. Describe the procedure for troubleshooting PID control loops.
 - PID loop setup
 - PID loop tuning
5. Describe the procedure for interfacing a PLC with and HMI system.
 - industrial panels
 - HMI software
6. Describe the procedures for troubleshooting PLC networks.
 - remote I/O
 - data highway
 - device net

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Troubleshoot analog applications
2. Troubleshoot PID loop
3. Interface a PLC with HMI
4. Troubleshoot a PLC network

REQUIRED RELATED COURSES

Description:

This course is designed to give students the opportunity to study the principles of effective writing. Applications include letters, memos, and short report writing.

Course Outcomes:

Upon completion of the course, students will be able to:

- understand the importance of well-developed writing skills in business and in career development.
- understand the purpose of the various types of business correspondence.
- examine the principles of effective business writing.
- examine the standard formats for letters and memos.
- write effective letters and memos.
- examine the fundamentals of informal reports and the report writing procedure.
- produce an informal report

Required Knowledge and Skills:**1.0 Review of Sentences and Paragraph Construction**

- 1.1.1 Define a sentence and review the four types.
- 1.1.2 Identify the essential parts of a sentence, particularly subject and predicate, direct and indirect object.
- 1.1.3 Differentiate among phrases, clauses, and sentences.
- 1.1.4 Explore the major concepts related to subject-verb agreement.
- 1.1.5 Apply rules and principles for writing clear, concise, complete sentences which adhere to the conventions of grammar, punctuation, and mechanics.

1.2 Examine and Apply Principles of Paragraph Construction

- 1.2.1 Discuss the basic purposes for writing.
- 1.2.2 Define a paragraph and describe the major characteristics of an effective paragraph.
- 1.2.3 Write well-developed, coherent, unified paragraphs which illustrate the following: A variety of sentence arrangements; conciseness and clarity; and adherence to correct and appropriate sentence structure, grammar, punctuation, and mechanics.

2.0 Business Correspondence**2.1 Examine the Value of Business Writing Skills**

- 2.1.1 Discuss the importance of effective writing skills in business
- 2.1.2 Discuss the value of well-developed writing skills to career success

2.2 Examine Principles of Effective Business Writing

- 2.2.1 Discuss the rationale and techniques for fostering goodwill in business communication, regardless of the circumstances
- 2.2.2 Review the importance of revising and proofreading writing

2.3 Examine Business Letters and Memos

- 2.3.1 Differentiate between letter and memo applications in the workplace
- 2.3.2 Identify the parts of a business letter and memo
- 2.3.3 Explore the standard formats for business letters and memos
- 2.3.4 Examine guidelines for writing an acceptable letter and memo which convey: acknowledgment, routine request, routine response, complaint, refusal, and persuasive request, for three of the six types listed
- 2.3.5 Examine samples of well-written and poorly written letters and memos

3.0 Informal Report

3.1 Examine the Fundamentals of Informal Business Reports

- 3.1.1 Identify the purpose of the informal report
- 3.1.2 Identify the parts and formats of an informal report
- 3.1.3 Identify methods of information gathering

3.2 Apply Informal Report Writing Skills and Oral Reporting Skills

- 3.2.1 Gather pertinent information
- 3.2.2 Organize information into an appropriate outline
- 3.2.3 Draft a five minute informal report
- 3.2.4 Edit, proofread, and revise the draft to create an effective informal report and present orally using visual aids.

Description:

This course focuses on the role of providing quality customer service. It is important to have a positive attitude and the necessary skills to effectively listen and interpret customer concerns about a product, resolve customer problems, and determine customer wants and needs. Students will be able to use the skills and knowledge gained in this course to effectively provide a consistently high level of service to the customer.

Course Outcomes:

Upon successful completion of this course, students will:

- know and understand quality customer service
- know why quality service is important
- know and understand the relationship between “service” and “sales”
- understand the importance of and to demonstrate a positive attitude
- recognize and demonstrate handling of customer complaints

Required Knowledge and Skills:**1. Providing Quality Service**

- Define quality service
- List the types of quality service
- Define Service vs. Sales or Selling
- Explain why quality service is important
- Identify the various types of customers
- Define customer loyalty

2. Determining Customers Wants and Needs

- List four levels of customer needs
- Identify important customer wants and needs
- Identify ways to ensure repeat business

3. Demonstrating a Positive Attitude

- List the characteristics of a positive attitude
- Explain why it is important to have a positive attitude
- List ways that a positive attitude can improve a customer's satisfaction
- Define perception
- Explain how perception can alter us and customers
- Understand how to deal with perception

4. Effectively Communicating with customers

- Describe the main elements in the communication process
- Identify some barriers to effective communication
- Define body language
- Explain how body language would affect customers
- Determine why body language is important
- Define active listening and state why it is important
- Describe the four components of active listening
- Contrast good and bad listeners
- List and discuss the steps of the listening process

5. Effectively using Questioning Techniques

- List questioning techniques
- Write two examples of an open question
- Perform a questioning and listening role play

6. Using the Telephone Effectively

- List the qualities of a professional telephone voice
- Explain why telephone skills are important
- Demonstrate effective telephone skills

7. Asserting Oneself: Handling Complaints and Resolving Conflict

- Define assertiveness
- Define communication behaviours
- Relate assertions to effective communication
- Practice being assertive
- Understand the process of assertive guidelines for action
- Practice giving an assertive greeting
- Acknowledge multiple customers

8. Dealing with Difficult Customers

- Describe how you would deal with anger
- Complete a guide to controlling feelings
- Determine how you would feel dealing with an upset customer
- Suggest some techniques that might control your own feelings
- Understand leadership styles and the nature of organizations
- List ways to dealing with conflict / customer criticism
- Be aware of certain guidelines when confronting customers
- List ways of preventing unnecessary conflict with customers
- Review current skills and knowledge of customer service
- Develop a customer satisfaction improvement plan

SP 2330 QUALITY ASSURANCE/QUALITY CONTROL

Description:

This course is designed to give students an understanding of the concepts and requirements of QA/QC such as, interpreting standards, controlling the acceptance of raw materials, controlling quality variables and documenting the process. It includes information on quality concepts, codes and standards, documentation, communications, human resources, company structure and policy, teamwork and responsibilities.

Course Outcomes:

Upon completion of this course, students will be able to:

- develop the skills and knowledge required to apply quality assurance/quality control procedures
- develop an awareness of quality management principles and processes

Required Knowledge and Skills:

1. Describe the reasons for quality assurance and quality plans.
2. Explain the relationship between quality assurance and quality control.
3. Describe quality control procedures as applied to the production and checking of engineering drawings in applicable occupations.
4. Describe quality control procedures as applied to the acceptance and checking of raw materials.
5. Explain the role of communications in quality management.
6. Explain why it is important for all employees to understand the structure of the company and its production processes.
7. Explain how human resource effectiveness is maximized in a quality managed organization.
8. Explain the role of company policy in quality management.
9. Explain the purpose of codes and standards.
10. Explain the concepts of quality
 - a. cost of quality
 - b. measurement of quality
 - c. quality control and quality assurance
 - d. elements of quality
 - e. elements of the quality audit

- f. quality standards
- g. role expectations and responsibilities

11. Explain the structure of quality assurance and quality control

- a. Define quality assurance, quality control and documentation terminology
- b. Describe organizational charts
- c. List the elements of a quality assurance system
- d. Explain the purpose of the quality assurance manual
- e. Describe quality assurance procedures
- f. Explain the key functions and responsibilities of personnel

12. Complete quality assurance/quality control documentation

- a. Describe methods of recording reports in industry
- b. Describe procedures of traceability (manual and computer-based recording)
- c. Identify needs for quality control procedures

13. Apply quality control to projects

- a. Follow QA/QC procedures for drawings, plans and specifications in applicable occupations.
- b. Calibrate measuring instruments and devices in applicable occupations.
- c. Interpret required standards
- d. Follow QA/QC procedures for accepting raw materials
- e. Carry out the project
- f. Control the quality elements (variables)
- g. Complete QA/QC reports

Description:

This course is designed to give the student an introduction to computer systems. Particular emphasis is given to word processing, spreadsheet, e-mail and the Internet.

Course Outcomes:

Upon completion of this course, students will have a basic understanding of:

- computer systems and their operation.
- popular software packages, their applications and future trends in computer applications

Required Knowledge and Skills:

1. Microcomputer System Hardware and Software Components
 - 1.1 Microcomputer Hardware
 - 1.1.1 System Components
 - 1.1.1.1 Identify major components of a computer system.
 - 1.1.2 Function of each Component
 - 1.1.2.1 Describe the function of the microprocessor.
 - 1.1.2.2 Describe and give examples of I/O DEVICES.
 - 1.1.2.3 Describe primary storage (RAM, ROM, Cache).
 - 1.1.2.4 Define bit, byte, code and the prefixes k.m. and g.
 - 1.1.2.5 Describe secondary storage (diskettes and hard disks, CD ROMS, Zip Drives etc).
 - 1.1.2.6 Describe how to care for a computer and its accessories.
 - 1.2 Microcomputer Software
 - 1.2.1 Software Definition and Types
 - 1.2.1.1 Define software.
 - 1.2.1.2 Describe, operational and application software used in this course.
 - 1.2.1.3 Define file and give the rules for filenames and file extensions..
 - 1.2.2 System Software (Windows 95)

- 1.2.2.1 Getting Started with Windows
- 1.2.2.2 Start and quit a Program
- 1.2.2.3 Get Help
- 1.2.2.4 Locate a specific file using the **find** function of Win95
- 1.2.2.5 Changing system settings:wall paper, screen saver, screen resolution, background.
- 1.2.2.6 Starting a program by using the Run Command
- 1.2.2.7 Shutting down your computer

1.2.3 File Management Commands (Windows 95)

- 1.2.3.1 View directory structure and folder content
- 1.2.3.2 Organizing files and folders
- 1.2.3.3 Copy, delete, and move files and folders
- 1.2.3.4 Create folders
- 1.2.3.5 Maximize and minimize a window
- 1.2.3.6 Print directory/folder content
- 1.2.3.7 Describe the Windows 95 taskbar

2. Word Processing

2.1 Keyboarding Techniques

- 2.1.1 Identify and locate alphabetic and numeric keys
- 2.1.2 Identify and locate function keys: special keys, home keys, page up key, page down key, numeric key pad, shift keys, punctuation keys, tab key

2.2 Word Processing

2.2.1 Understanding word processing

- 2.2.1.1 The Windows Component
- 2.2.1.2 The Menu Bar
- 2.2.1.3 Menu Indicators
- 2.2.1.4 The Document Window
- 2.2.1.5 The Status Bar
- 2.2.1.6 The Help Feature
- 2.2.1.7 Insertion Point Movements

2.2.2 Create a document

- 2.2.2.1 Change the Display
- 2.2.2.2 The Enter Key
- 2.2.2.3 Enter Text

2.2.3 Save, Open and Exit a document.

- 2.2.3.1 Save a document
- 2.2.3.2 Close a document.
- 2.2.3.3 Start a new document Window
- 2.2.3.4 Open a document
- 2.2.3.5 Exit Word Processor

2.2.4 Edit a Document

- 2.2.4.1 Add New Text
- 2.2.4.2 Delete text
- 2.2.4.3 Basic Format Enhancement (split and join paragraphs, insert text)

2.2.5 Understand Hidden Codes

- 2.2.5.1 Display Hidden Codes
- 2.2.5.2 Delete Text Enhancements

2.2.6 The Select Feature

- 2.2.6.1 Identify a Selection
- 2.2.6.2 Move a Selection
- 2.2.6.3 Copy a Selection
- 2.2.6.4 Delete a Selection
- 2.2.6.5 Select Enhancements
- 2.2.6.6 Save a Selection
- 2.2.6.7 Retrieve a Selection

2.2.7 Change Layout Format

- 2.2.7.1 Change layout format: (margins, spacing, alignment, paragraph indent, tabs, line spacing, page numbering)

2.2.8 Change Text Attributes

- 2.2.8.1 Change text attributes: (bold, underline, font, etc.)

2.2.9 Use Auxiliary Tools

- 2.2.9.1 Spell Check

2.2.10 Select the Print Feature

- 2.2.10.1 Select the Print Feature: (i.e; number of copies and current document)
- 2.2.10.2 Identify various options in print screen dialogue box

3. Electronic Spreadsheet

3.1 Spreadsheet Basics

3.1.1 The Worksheet Window

3.2 Operates Menus

3.2.1 Use a Menu Bar

3.2.2 Use a Control Menu

3.2.3 Use a Shortcut Menu

3.2.4 Save, Retrieve from Menus

3.3 Create a Worksheet

3.3.1 Enter Constant Values and Formulas

3.3.2 Use the Recalculation Feature

3.3.3 Use Cell References (relative and absolute references)

3.4 Use Ranges

3.4.1 Type a Range for a Function

3.4.2 Point to a Range for a Function

3.4.3 Select a Range for Toolbar and Menu Commands

3.5 Print a Worksheet

3.5.1 Print to the Screen

3.5.2 Print to the Printer

3.5.3 Print a Selected Range

3.6 Edit a Worksheet

3.6.1 Replace Cell Contents

3.6.2 Insert and Delete Rows and Columns

3.6.3 Change Cell Formats

3.6.4 Change Cell Alignments

3.6.5 Change Column Width

3.6.6 Copy and Move Cells

4. Electronic Mail and the Internet

4.1 Electronic Mail

4.1.1 Compose and send an e-mail message

4.1.2 Retrieve an e-mail attachments

4.1.3 Send an e-mail message with attachments

4.1.4 Retrieve and save e-mail attachments

4.1.3 Print an e-mail message

4.1.4 Delete an e-mail message

4.2 The Internet

- 4.2.1 Overview of the World Wide Web
- 4.2.2 Accessing Web sites
- 4.2.3 Internet Web Browsers
- 4.2.4 Internet Search Engines
- 4.2.5 Searching Techniques

Description:

This course involves participating in meetings, doing safety inspections, completing employment insurance forms, writing letters of employment insurance appeal, and filing a human rights complaint. Includes information on formal meetings, unions, worker's compensation, employment insurance regulations, worker's rights and human rights.

Course Outcomes:

Upon completion of this course, students will be able to:

- Participate in meetings (conduct meetings).
- Be aware of union procedures
- Be aware of workers' compensation regulations.
- Be aware of occupational health and safety regulations.
- Be aware of employment insurance regulations
- Be aware of workers' rights.
- Be aware of human rights

Required Knowledge and Skills:

1. Meetings
 - a. Explain preparation requirements prior to conducting a meeting
 - b. Explain the procedures for conducting a meeting.
 - c. Explain participation in meetings.
 - d. Explain the purpose of motions.
 - e. Explain the procedure to delay discussion of motions.
 - f. Explain how to amend and vote upon a motion.
2. Unions
 - a. Why do unions exist?
 - b. Give a concise description of the history of Canadian labour.
 - c. How do unions work?
 - d. Explain labour's structure.
 - e. Describe labour's social objectives.
 - f. Describe the relationship between Canadian labour and the workers.
 - g. Describe the involvement of women in unions.
3. Worker's Compensation
 - a. Describe the aims, objectives, benefits and regulations of the Workers Compensation Board.
 - b. Explain the internal review process.
4. Occupational Health and Safety
 - a. Describe the rules and regulations directly related to your occupation.

5. Employment Insurance Regulations
 - a. Explain employment insurance regulations
 - b. Describe how to apply for employment insurance.
 - c. Explain the appeal process.
6. Worker's Rights
 - a. Define labour standards.
 - b. Explain the purpose of the Labour Standards Act.
 - c. List regulations pertaining to:
 - i. Hours of work.
 - ii. Minimum wages.
 - iii. Employment of children.
 - iv. Vacation pay
7. Human Rights
 - a. Describe what information cannot be included on an application.
 - b. Describe what information cannot be included in an interview
 - c. Why is there a Human Rights Code?
 - d. Define sexual harassment.
8. Participate in meetings.
 - a. Follow the form of getting a motion on the floor
 - b. Discuss a motion
 - c. Amend a motion
 - d. Vote on a motion.
9. Complete a safety inspection of your shop.
10. Complete an employment insurance application form.
11. Write a letter of appeal.
12. Analyze a documented case of a human rights complaint with special emphasis on the application form, time frame, documentation needed, and legal advice available.

Description:

This fifteen-hour seminar is designed to give students an introduction to the critical elements of effective job search techniques.

Required Knowledge and Skills:**Examine and Demonstrate Elements of Effective Job Search Techniques**

- Identify and examine employment trends and opportunities
- Identify sources that can lead to employment
- Discuss the importance of fitting qualifications to job requirements
- Discuss and demonstrate consideration in completing job application forms
- Establish the aim/purpose of a resume
- Explore characteristics of effective resumes, types of resumes, and principles of resume format
- Explore characteristics of and write an effective cover letter
- Explore, and participate in a role play of a typical job interview with commonly asked questions and demonstrate proper conduct
- Explore other employment related correspondence
- Explore the job market to identify employability skills expected by employer
- Conduct a self-analysis and compare with general employer expectations

Description:

This fifteen-hour seminar is designed to introduce the student to the field of entrepreneurship, including the characteristics of the entrepreneur, the pros and cons of self-employment, and some of the steps involved in starting your own business.

Required Knowledge and Skills:

1. Explore Self-Employment: An Alternative to Employment
 - Identify the advantages and disadvantages of self-employment vs. regular employment
 - Differentiate between an entrepreneur and a small business owner
 - Evaluate present ideas about being in business
2. Explore the Characteristic of Entrepreneurs
 - Identify characteristics common to entrepreneurs
 - Relate their own personal characteristics with those of entrepreneurs.
 - Evaluate their present ideas about business people
3. Identifying Business Opportunities
 - Distinguish between an opportunity and an idea.
 - List the existing traditional and innovative business ventures in the region.
 - Explain the general parameters between which business ventures should fit.
 - Summarize the role of such agencies Regional Economic Development Boards, Business Development Corporations, etc.
 - Identify potential business opportunities within the region.
4. Demystifying the Entrepreneurial Process.
 - Explain the entrepreneurial process
 - Describe the purpose of a business plan
 - Identify the main ingredients of a business plan
 - Summarize the role of such agencies as BDC's, ACOA, Women's Enterprise Bureau etc.
 - List other agencies where assistance - financial and otherwise - is available to those interested in starting a business venture.