



**PROVINCIAL PLAN OF TRAINING
FOR THE
REFRIGERATION
AND AIR CONDITIONING MECHANIC
OCCUPATION**

Document Status	Date Distributed	Mandatory Implementation Date	Comments
Original Version	May, 2006	September, 2006	

May, 2006

Preface

This curriculum outline has been based upon the National Occupational Analysis for the Refrigeration and Air Conditioning Mechanic trade 2004 edition.

This document is intended to describe the apprenticeship curriculum content of the Refrigeration and Air Conditioning Mechanic theory training program. It describes the suggested content of each of the technical training courses required for completion of apprenticeship.

No part of this curriculum outline may be reproduced or transmitted in any form or by any means without written permission from the Atlantic Canada Association of Apprenticeship Directors and Board Chairpersons.

Acknowledgment

Various advisory committees, industry representatives, instructors and apprenticeship staff provided valuable input to the development of this curriculum standard. Without their dedication to quality training, this document would not have been produced. A sincere thank you.

This Curriculum Standard has been approved by the Atlantic Canada Association of Apprenticeship Directors and Board Chairpersons.

Apprenticeship Training Standard 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)

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 Education
P.O. Box 8700
St. John's, NF
A1B 4J6*

Table of Contents

Preface	i
Acknowledgment	ii
Evaluation Form	iii
Conditions Governing Apprenticeship Training	1
Regulations Specific to Refrigeration & Air Conditioning Mechanic Occupation	7
Requirements for Red Seal Certification	8
Roles and Responsibilities of Stakeholders in the Apprenticeship Process	9
Program Outcomes	11
Program Structure	12
Program Content	16
*Basic Math	150
REQUIRED RELATED COURSES	
Workplace Communications	153
Customer Service	155
Quality Assurance/Quality Control	157
Introduction to Computers	159
Workplace Skills	163
Job Search Techniques	165
Entrepreneurial Awareness	167

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:

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

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	Completion of entry level (Block 1) courses, plus relevant work experience totaling a minimum of 1800 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3600 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus relevant work experience totaling a minimum of 5400 hours	Fourth Year
Fourth Year Apprentice	Completion of advanced level (Block 4) courses and (Block 5) <i>if applicable</i> , plus sign-off of workplace skills required for certification totaling a minimum of 7200 hours**	Write Certification Examination
5400 Hour Programs	Requirements for Progression	Progress To
First Year Apprentice	Completion of entry level (Block 1) courses, plus relevant work experience totaling a minimum of 1800 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3600 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus sign-off of workplace skills required for certification totaling a minimum of 5400 hours	Write Certification Examination

4800 Hour Programs	Requirements for Progression	Progress To
First Year Apprentice	Completion of entry level courses (Block 1), plus relevant work experience totaling a minimum of 1600 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3200 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus sign-off of workplace skills required for certification totaling a minimum of 4800 hours	Write Certification Examination

* All direct entry apprentices must meet the **Requirements for Progression** either through Prior Learning Assessment and Recognition or course completion before advancing to the next year.

** Apprentices in a 7200 hour program which incorporates more than four blocks of training are considered fourth year apprentices pending completion of 100% course credits and workplace skills requirements.

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 Hours			(Hairstylist Program) - 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 Education within 30 days of the decision.

**REGULATIONS SPECIFIC TO
THE REFRIGERATION AND AIR CONDITIONING MECHANIC OCCUPATION**

1. RATIO OF APPRENTICES TO JOURNEYPERSONS

The ratio of apprentices to journeypersons shall not exceed one apprentice for each journeyperson employed.

REQUIREMENTS FOR RED SEAL CERTIFICATION FOR APPRENTICES

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. Successful completion of all required courses in program.
3. A combination of training from an approved training program and suitable work experience totalling 7200 hours
4. Completion of a National Red Seal examination, to be set at a place and time determined by the Industrial Training Division.
5. 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.
- ▶ to designate occupations for apprenticeship training and/or certification.

Program Outcomes

Upon completion of the Refrigeration and Air Conditioning Mechanic Program, students will have demonstrated the knowledge and skills required to perform the following tasks:

- Task 1 Utilizes mechanical and architectural drawings, acts, codes, standards, legislation, and service and operating manuals.
- Task 2 Operates and maintains tools and equipment.
- Task 3 Demonstrates work practices and procedures.
- Task 4 Coordinates refrigeration and air conditioning installation and maintenance.
- Task 5 Performs system components, accessories and materials acquisition and handling.
- Task 6 Plans installation of refrigeration and air cooling systems.
- Task 7 Installs refrigeration and air cooling systems.
- Task 8 Commissions refrigeration and air cooling systems.
- Task 9 Maintains refrigeration and air cooling systems.
- Task 10 Plans installation of heating, ventilating and air conditioning systems.
- Task 11 Installs heating, ventilating and air conditioning systems.
- Task 12 Commissions heating, ventilating and air conditioning systems.
- Task 13 Maintains heating, ventilating and air conditioning systems.
- Task 14 Plans installation of control systems.
- Task 15 Installs control systems.
- Task 16 Commissions control systems.
- Task 17 Maintains control systems.

Program Structure

Entry Level Courses					
NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-requisites	Page No.
TS-1510		Occupational Health and Safety	6	None	16
TS-1520		WHMIS	6	None	19
TS-1530		First Aid	14	None	22
RF-1160	RAC-0100	Safety Orientation	12	None	23
RF-1170	RAC-1100	Hand/Power Tools and Fasteners	20	RF-1160	25
RF-1210	RAC-1105	Tube, Pipe, Fittings, Soldering and Brazing	40	RF-1170	28
RF-1220	RAC-1110	Refrigeration Fundamentals	80	RF-1160	30
RF-1230	RAC-1115	Refrigeration Tools and Instruments	35	RF-1170; RF-1220	34
RF-1240	RAC-1120	Refrigerants, Oils and Refrigerant Management	35	RF-1230	36
RF-1250	RAC-1125	Refrigeration System Valves and Accessories	35	RF-1220	40
RF-1260	RAC-1130	Leak Testing, Evacuation and Charging	30	RF-1250	42
RF-1270	RAC-1135	Electrical Fundamentals	40	RF-1160	44
RF-1280	RAC-1140	Single and Three Phase Motor Fundamentals	30	RF-1270	46
RF-1310	RAC-1145	Electrical Components	20	RF-1270	49
RF-1320	RAC-1150	Control Fundamentals	30	RF-1310	51
RF-1330	RAC-1155	Air Conditioning Fundamentals	15	RF-1220; RF-1270	54
RF-1340	RAC-1160	Rigging Techniques	20	RF-1160	56
RF-1350	RAC-1200	System Analysis with Pressure Enthalpy Diagrams	35	RF-1220	58
RF-1360	RAC-1205	Compressors	30	RF-1220; RF-1280	61
RF-1370	RAC-1210	Condensers	20	RF-1220	64
RF-1380	RAC-1215	Evaporators	25	RF-1220	66
RF-1390	RAC-1220	Metering Devices	30	RF-1380	68
RF-1400	RAC-1225	Automatic Flow Controls and Application	30	RF-1250; RF-1390	71
RF-1410	RAC-1230	System Ancillary Components	25	RF-1400	73

Refrigeration and Air Conditioning Mechanic

Entry Level Courses					
NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-requisites	Page No.
RF-1440	RAC-1245	Refrigerant Recovery and Recycling Procedures	10	RF-1230	79
RF-1450	RAC-1250	Refrigeration and A/C Installation 1	30	RF-1260; RF-1270	80
RF-1460	RAC-1255	Troubleshooting Techniques	20	RF-1450	82
RF-1470	RAC-1260	Industry and Relevant Codes	15	RF-1460	83
RF-1480	RAC-1265	Control Circuits and Wiring Diagrams	30	RF-1320; RF-1410	85
RF-1490	RAC-1270	Motor Controls, Relays and Transformers	30	RF-1480	87
RF-1510	RAC-1280	Air Conditioning Equipment	20	RF-1330	91
RF-1520	RAC-1300	Refrigeration Load Calculations	30	RF-1220; RF-1510	92
*MA-1060		Basic Math	60	None	150
CM-2150		Workplace Communications	45	None	153
MR-1220		Customer Service	30	None	155
SP-2330		Quality Assurance/Quality Control	30	None	157
MC-1050		Introduction to Computers	30	None	159
SD-1700		Workplace Skills	30	None	163
SD-1710		Job Search Techniques	15	None	165
SD-1720		Entrepreneurial Awareness	15	None	167
Total Hours			1103		

REQUIRED WORK EXPERIENCE

Block 2					
NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-requisites	Page No.
RF-1420	RAC-1235	Evaporative Condensers and Cooling Towers	20	RF-1220; RF-1370	75
RF-1430	RAC-1240	Fluid Dynamics and Pumps	15	RF-1170; RF-1220	77
RF-1500	RAC-1275	Refrigeration Equipment	30	RF-1210; RF-1240; RF-1320; RF-1340; RF-1350; RF-1360; RF-1370; RF-1440; RF-1470; RF-1490	89
RF-1530	RAC-1305	Refrigeration System and Pipe Design	30	RF-1520	94

Block 2					
NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-requisites	Page No.
RF-1540	RAC-1310	Refrigeration and A/C Installation 2	30	RF-1530	97
RF-1550	RAC-1315	System Capacity Control	30	RF-1510	100
RF-1560	RAC-1320	Compressor Diagnostics and Repair	20	RF-1540; RF-1550	101
RF-1570	RAC-1325	Troubleshooting Systems and Their Components	20	RF-1560	103
RF-1640	RAC-1360	Understanding, Interpreting and Troubleshooting Wiring Diagrams	30	RF-1570	117
RF-1760	RAC-1450	Basic Electronics	15	RF-1160	143
Total Hours			240		

REQUIRED WORK EXPERIENCE

Block 3					
NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-requisites	Page No.
RF-1580	RAC-1330	Psychrometrics	25	RF-1330	104
RF-1590	RAC-1335	Air Conditioning System Design	25	RF-1580	106
RF-1600	RAC-1340	Heat Pump Systems	30	RF-1510; RF-1590	108
RF-1610	RAC-1345	Fans, Mechanical Drives and Air Filtration	25	RF-1220; RF-1600	110
RF-1620	RAC-1350	Air Measuring Instruments and System Balancing	15	RF-1220	113
RF-1630	RAC-1355	Control Applications and Components	25	RF-1510	115
RF-1660	RAC-1400	Air Conditioning Load Calculations	15	RF-1330	121
RF-1670	RAC-1405	Duct Systems and Design	25	RF-1660	122
RF-1680	RAC-1410	Humidification and DeHumidification Equipment	15	RF-1170; RF-1530; RF-1590	125
RF-1690	RAC-1415	Installation of Air Conditioning Equipment	20	RF-1680	127
RF-1700	RAC-1420	Air Conditioning System Troubleshooting	20	RF-1640	129
Total Hours			240		

REQUIRED WORK EXPERIENCE

Block 4					
NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-requisites	Page No.
RF-1650	RAC-1365	Industrial System Components	25	RF-1570	119
RF-1710	RAC-1425	Energy Management and Indoor Air Quality	20	RF-1700	131
RF-1720	RAC-1430	Chillers and Chiller Systems	30	RF-1710	134
RF-1730	RAC-1435	Multiplex Refrigeration Systems	35	RF-1720	137
RF-1740	RAC-1440	Speciality Systems (Ultra-low, Cryogenic)	15	RF-1570	139
RF-1750	RAC-1445	Control Application and Components	15	RF-1700	141
RF-1770	RAC-1455	Wiring Diagrams	30	RF-1720	145
RF-1780	RAC-1460	Specialized Control Systems	30	RF-1760	146
RF-1790	RAC-1465	Industrial Refrigeration Systems	40	RF-1650	148
Total Hours			240		

* A student who can meet the Mathematics requirement through an ACUPLACER online test may be exempted from Mathematics 1060.

TS-1510 OCCUPATIONAL HEALTH AND SAFETY

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
 - I) 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
 - I) Duties of employer, owner, contractors, sub-contractors, employees, and suppliers
3. Explain the purpose of joint health and safety committees
 - i) Formation of committee
 - ii) Functions of committee
 - iii) Legislated rights
 - iv) Health and safety representation
 - v) Reporting endangerment to health
 - vi) Appropriate remedial action
 - vii) Investigation of endangerment
 - viii) Committee recommendation
 - ix) Employer's responsibility in taking remedial action
4. Examine right to refuse dangerous work
 - i) Reasonable grounds for refusal
 - ii) Reporting endangerment to health

- iii) Appropriate remedial action
- iv) Investigation of endangerment
- v) Committee recommendation
- vi) Employer's responsibility to take appropriate remedial action
- vii) Action taken when employee does not have reasonable grounds for refusing dangerous work
- viii) Employee's rights
- ix) Assigning another employee to perform duties
- x) Temporary reassignment of employee to perform other duties
- xi) Collective agreement influences
- xii) Wages and benefits

5. State examples of work situations where one might refuse work.

6. Describe discriminatory action

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

7. Explain duties of commission officers

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

8. Interpret appeals of others

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

- iv) Enforcement of the order
- v) Notice of application
- vi) Rules of court

9. Explain the process for reporting of accidents

- i) Application of act
- ii) Report procedure
- iii) Reporting notification of injury
- iv) Reporting accidental explosion or exposure
- v) 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 and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Conduct an interview with someone in your occupation on two or more aspects of the act and report results.
2. Conduct a safety inspection of shop area.

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
 - i) Rational and key elements
 - ii) History and development of WHMIS
 - iii) WHMIS legislation
 - iv) WHMIS implementation program
 - v) Definitions of legal and technical terms
2. Examine hazard identification and ingredient disclosure
 - i) Prohibited, restricted and controlled products
 - ii) Classification and the application of WHMIS information requirements
 - iii) 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
 - iv) 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

- v) Comparison of classification systems - WHMIS and TDG
- vi) General comparison of classification categories
- vii) Detailed comparison of classified criteria

3. Explain labeling and other forms of warning

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

4. Introduce material safety data sheets (MSDS)

- i) Definition of a material safety data sheet
- ii) Purpose of the data sheet
- iii) 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 and Labrador, 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

TS-1530

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 or Canadian Red Cross** Standard First Aid Certificate course.

RF-1160

SAFETY ORIENTATION

Outcomes:

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

- practice safety and maintain a safe work environment.
- safely work around electricity.

Objectives and Content:

1. Identify types of personal protective equipment and describe their purpose and use.
 - i) hearing protection
 - ii) dust mask
 - iii) respirator
 - iv) safety glasses
 - v) protective clothing
 - vi) guards and shields
2. Identify types of equipment used for working at heights and describe their safe use and maintenance.
 - i) fall arrest systems
 - ii) safety nets
 - iii) safety ropes
 - iv) life lines
 - v) lanyards
 - vi) anchor points
3. Describe the procedures used to install, maintain and inspect fall protection systems.
4. Identify relevant safety regulations and describe their application.
 - i) federal
 - WHMIS
 - ii) provincial
 - Workers Compensation Board
 - code of practice
 - industry standards
 - iii) municipal
5. Describe potential work hazards on-site.
6. Describe employer/employee responsibilities for workplace safety.
7. Describe the safety requirements for working in confined spaces.

8. Describe safety practices when working in or near trenches and excavations.
9. Describe the purpose of lockout/tag-out procedures and their application to the work site.
10. Define the term proximity work and describe its associated safety procedures.
 - i) barriers and barricades
 - ii) adjacent perimeter areas
 - iii) public safety
11. Identify types of ladders and scaffolding and describe their applications, use and inspection procedures.
12. Identify the classes of fires and their associated fire extinguishers.
13. Identify various flammable materials and describe the precautions to be taken to prevent combustion.
14. Describe safe working practices when working on electrical equipment.
15. Describe the factors involved in creating an electric shock and the conditions that determine its' severity.
16. Describe the type of fire extinguisher and safety considerations observed when extinguishing an electrical fire.

Practical:

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

1. Perform a lock-out procedure on an operating refrigeration system.

RF-1170 HAND/POWER TOOLS AND FASTENERS

Outcomes:

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

- select, use and care for hand/power tools and fasteners to execute tasks.

Objectives and Content:

1. Identify the types of screwdrivers and describe their care, use and application.
 - i) standard type
 - Keystone
 - Cabinet
 - ii) Robertson
 - iii) star type
 - Phillips
 - Reed and Prince (Frearson)
 - iv) Posidrive
 - v) Clutch
 - vi) Torx
 - vii) Screw-starter
 - viii) Offset
2. Identify the types of hammers and describe their care, use and application.
 - i) claw
 - ii) ball-peen
 - iii) sledge
 - iv) soft-face hammers and mallets
3. Identify the types of pliers and describe their care, use and application.
 - i) linesman
 - ii) diagonal-cutting
 - iii) long-nose
 - iv) slip joint
 - v) high-leverage cutter
 - vi) locking
4. Identify the types of wrenches and describe their care, use and application.
 - i) open-end
 - ii) box-end
 - iii) combination
 - iv) flare-nut
 - v) hex-key (Allen)
 - vi) adjustable

- vii) pipe
- viii) socket
- ix) sockets
- x) torque

5. Identify the types of hacksaw blades and describe their care, use and application.
6. Identify the types of files and describe their care, use and application.
7. Identify the types of taps and dies and describe their care, use and application.
8. Identify the types of measuring and layout tools and describe their care, use and application.
 - i) vernier caliper
 - ii) micrometer
 - iii) dial indicator
 - iv) wire gauge
 - v) feeler gauge
 - vi) measuring tape
 - vii) combination square
 - viii) levels
9. Identify the types of punches and chisels, and describe their care, use and application.
 - i) starting punches
 - ii) pin and drift punches
 - iii) taper punch
 - iv) center punch
 - v) cape chisel
 - vi) round nose chisel
 - vii) diamond point chisel
 - viii) cold chisel
 - ix) gasket punch
10. Identify the types of hand operated, hydraulic knock-out punches and describe their care, use and application.
11. Identify the types of portable drills and describe their care, use and application.
 - i) cordless
 - ii) electric
 - iii) electric hammer
 - iv) rotary hammer
 - v) angle
12. Identify types of drill presses and describe their operating procedures.

13. Identify the types of grinders and describe their care, use and application.
 - i) portable
 - ii) pedestal
14. Identify the types of power saws and describe their care, use and application.
 - i) circular
 - ii) sabre
 - iii) reciprocating
15. Identify the types of fastening devices and describe their sizes, classifications, use and application.
 - i) nails
 - ii) adhesives
 - iii) wood screws
 - iv) sheet metal screws
 - v) machine screws and bolts
 - vi) nuts and washers
 - vii) masonry anchors and shields
 - viii) cavity fasteners
 - ix) screw anchors
 - x) epoxy

Practical:

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

1. Install various fastening devices.
2. Torque fastening devices to specifications with torque wrenches.
3. Assemble and dis-assemble equipment using various tools.

RF-1210

TUBE, PIPE, FITTINGS, SOLDERING AND BRAZING

Outcomes:

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

- cut, fit, swage, flare, bend, solder and braze copper tubing.
- cut, fit and thread pipe.

Objectives and Content:

1. Identify the types of copper tubing and describe their sizes, weight, applications and procedures for installation.
 - i) ACR
 - ii) nominal
 - iii) soft drawn
 - iv) hard drawn
2. Identify the types of fittings and describe their use, applications and procedures for installation.
 - i) elbows
 - ii) tees
 - iii) couplings
 - iv) bushings
 - v) "P" Traps
 - vi) flared
3. Identify types of flaring and swaging tools and describe their use, care and applications.
4. Identify the various types of mechanical brass fittings and describe their sizes, use, applications and procedures for installation.
5. Describe the procedures used to bend copper tubing.
 - i) spring benders
 - ii) mechanical benders
6. Describe the safe use of acetylene, oxygen, and nitrogen cylinders used in soldering and brazing.
 - i) identification
 - ii) storage
 - iii) handling
 - iv) transport
7. Describe the safe use and care of air/acetylene and oxygen/acetylene equipment and accessories.
 - i) regulators

- ii) hoses
- iii) torch handle
- iv) torch tips
- v) reverse-flow check valves

8. Describe the procedures, applications of soldering and brazing and identify the properties, use , care and applications of associated filler metals.
 - i) silver brazing rod
 - ii) phosphorus-copper brazing rod
 - iii) soft solder
9. Describe the use, care and application of nitrogen when brazing copper tubing.
10. Describe the methods, use and applications of pipe hangers and supports.
11. Identify the types of threaded pipe and describe their sizes, weight, fittings and applications.

Practical:

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

1. Assemble air-acetylene and oxy-acetylene equipment.
2. Install soft and hard drawn copper tubing.
 - i) different methods of cutting copper tubing
 - ii) ream copper tubing
 - iii) bend copper tubing
 - iv) prepare tubing for soldering/brazing
 - v) solder and braze copper tubing
 - vi) select copper/brass mechanical and sweat fittings
3. Fabricate flares and swages in various sized copper tubes.
4. Fabricate various pipe hangers and supports.
5. Assemble, light and adjust air-acetylene and oxy-acetylene equipment and demonstrate safe use.

RF-1220

REFRIGERATION FUNDAMENTALS

Outcomes:

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

- understand and analyze the refrigeration cycle and operation.

Objectives and Content:

1. Describe the history of refrigeration and air conditioning.
2. Describe the refrigeration and air conditioning occupation in terms of:
 - i) maintenance
 - ii) installation
 - iii) service and repair
 - iv) troubleshooting
 - v) component and system design
 - vi) customer relations
3. Describe the basic concepts of:
 - i) temperature
 - ii) mass and weight
 - iii) density
 - iv) specific gravity
 - v) specific volume
4. Describe the various temperature scales and explain procedures used to perform conversion calculations from one scale to another.
 - i) fahrenheit
 - ii) celsius
 - iii) rankin
 - iv) kelvin
5. Define terminology associated with the Refrigeration and Air Conditioning occupation.
 - i) heat
 - ii) British Thermal Unit (BTU)
 - iii) sensible heat
 - iv) latent heat
 - v) specific heat
 - vi) atmospheric pressure
 - vii) gauge pressure
 - viii) absolute pressure
 - ix) vacuum

6. Define matter and explain the characteristics in each state.
7. Describe basic gas laws.
 - i) Boyle's
 - ii) Charles'
 - iii) Dalton's
 - iv) Perfect gas
 - v) Pascal's
8. Describe heat flow and identify methods of heat transfer.
 - i) convection
 - ii) conduction
 - iii) radiation
9. Describe the characteristic changes that take place during the "change of state."
 - i) evaporation
 - ii) condensation
 - iii) freezing
 - iv) melting
 - v) sublimation
10. Describe the effect of pressure on evaporation, condensation, freezing and melting temperatures.
11. Describe superheat and subcooling and their significance in the refrigeration cycle.
12. Describe the vapour compression cycle.
13. Identify the components of the vapour compression cycle and describe their function.
 - i) compressor
 - ii) condenser
 - iii) metering device
 - iv) evaporator
14. Describe the physical changes of the refrigerant as it circulates through the system.
15. Describe the pressure/temperature chart and the relationship between temperature and pressure of a refrigerant.
16. Describe the attributes of a pressure enthalpy diagram.

17. Describe the following terms and explain how to locate them as plotted on a pressure/enthalpy diagram of a vapour compression cycle.
 - i) compressor (suction) superheat
 - ii) condenser subcooling
 - iii) condenser temperature difference
 - iv) direction of refrigerant flow
 - v) evaporator superheat
 - vi) evaporator temperature difference
 - vii) high side
 - viii) low side
 - ix) pressure drop
 - x) discharge temperature
 - xi) saturated discharge pressure
 - xii) saturated discharge temperature
 - xiii) saturated liquid
 - xiv) saturated suction pressure
 - xv) saturated suction temperature
 - xvi) saturated vapour
 - xvii) subcooled liquid
 - xviii) superheated vapour
 - xix) temperature drop
 - xx) temperature rise
18. Describe the following concepts and how they effect capacity.
 - i) condensation
 - ii) expansion
 - iii) heat of compression
19. Define the following and describe how each is determined.
 - i) mass flow rate
 - ii) heat of compression
 - iii) net refrigeration effect
 - iv) system capacity
 - v) ton of refrigeration
20. Describe factors that determine food quality.
 - i) moisture content
 - ii) enzymes
 - iii) microorganisms (bacteria, yeasts, and molds)
 - iv) temperature
21. Describe how the refrigeration process preserves food.
22. Describe factors that optimize storage of refrigerated and frozen foods.
 - i) packaging
 - ii) storage time
 - iii) storage temperature

- iv) humidity
- v) air movement
- vi) mixed storage
- vii) product condition at time of storage

23. Describe freezing methods.

- i) slow (sharp)
- ii) quick freezing
 - air blast
 - direct contact
 - indirect contact
 - immersion

Practical:

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

1. Operate a refrigeration system to:
 - i) measure operating temperatures
 - ii) obtain operating pressures
 - iii) plot the operating characteristics on a pressure enthalpy diagram
 - iv) determine the amount of superheat
 - v) determine the amount of subcooling
 - vi) determine net refrigerating effect
2. Perform calculations:
 - i) convert temperatures from one scale to another
 - ii) convert pressures from absolute to gauge pressure
 - iii) use various gas laws
3. Identify components of a refrigeration system.
 - i) compressor
 - ii) discharge line
 - iii) condenser
 - iv) liquid line
 - v) metering device
 - vi) evaporator
 - vii) suction line
 - viii) system accessories
 - ix) condensate line

RF-1230 REFRIGERATION TOOLS AND INSTRUMENTS

Outcomes:

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

- identify and utilize the appropriate specialty tool, instrument or accessory during system diagnosis and repair.

Objectives and Content:

1. Describe the use, application and types of thermometers.
 - I) glass
 - ii) dial
 - iii) electronic
 - analog
 - digital
 - iv) recording
2. Describe the types of electronic temperature sensors.
 - i) thermocouple
 - ii) thermistor
 - iii) resistance temperature device (RTD)
3. Describe the use and application of:
 - i) gauge manifold
 - ii) schrader valve core tool
 - iii) quick couplers
 - iv) charging hoses
4. Describe the use and application of leak detectors.
 - i) electronic
 - ii) fluorescent dye and ultraviolet lamp
 - iii) halide
 - iv) litmus paper
 - v) soap
 - vi) sulphur test
 - vii) ultrasonic
5. Describe the use and application of a vacuum pump.
6. Identity vacuum measuring instruments and describe their use and applications.
 - i) electronic thermistor
 - ii) utube mercury manometer

7. Describe the use and application of a refrigerant recovery/recycle unit.
8. Describe the use and application of a sling psychrometer.
9. Describe the use and application of a refrigeration oil pump.
10. Describe the use and application of an acid test kit.
11. Describe the use and application of an oil conversion test kit.
12. Describe the use and application of a refractometer.
13. Describe the use and application of a refrigerant weighing equipment.
 - I) charging cylinder
 - ii) scales
 - electronic
 - mechanical
14. Describe the use and application of electrical test meters.
 - i) ammeter
 - ii) megger
 - iii) multimeter
 - iv) ohmmeter
 - v) voltmeter
 - vi) wattmeter
15. Describe the use and application of air flow meters.
 - i) pitot tube and inclined manometer
 - ii) flowhood
 - iii) rotating vane anemometer
 - iv) thermal anemometer
 - v) velometer

Practical:

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

1. Test systems with various test instruments, tools and accessories.

RF-1240

REFRIGERANTS, OILS AND REFRIGERANT MANAGEMENT

Outcomes:

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

- identify desirable refrigerant properties.
- identify the appropriate refrigerants and their containers.
- understand refrigerant handling procedures.
- understand refrigerant oil handling procedures.
- understand compliance with the relevant Code of Practice/provincial regulations in the handling of CFC's.
- identify the use and application of ammonia as a refrigerant.
- identify the safety hazards of ammonia.

Objectives and Content:

1. Describe refrigerant properties.
 - i) thermodynamic
 - ii) physical characteristics
2. Describe the temperature/pressure relationship of refrigerants.
3. Define the terminology associated with refrigerants.
 - i) azeotrope
 - ii) blend
 - iii) chlorofluorocarbon (CFC)
 - iv) fractionation
 - v) glide
 - vi) hydrocarbon (HC)
 - vii) hydro chlorofluorocarbon (HCFC)
 - viii) hydro fluorocarbon (HFC)
 - ix) inorganic
 - x) near azeotrope
 - xi) zeotrope
4. Define the following according to the B-52 Mechanical Refrigeration Code.
 - i) primary refrigerant
 - ii) secondary refrigerant
5. Describe refrigerant migration and prevention.
6. Describe the procedures used to transport refrigerant cylinders.
7. Describe the procedures used to transfer refrigerants.

8. Identify refrigerant cylinders and describe their colour codes as per Air Conditioning and Refrigeration Institute (ARI) Guideline "N".
 - i) container
 - ii) approved container
 - iii) approved cylinder
 - iv) disposable container
9. Describe the following refrigerant handling terms.
 - i) recovery
 - ii) reuse
 - iii) reclaim
 - iv) recycle
 - v) retrofit (conversion)
10. Describe the operating procedures used to recover refrigerant from a refrigeration system.
 - i) active
 - liquid method
 - vapour method
 - push/pull method
 - ii) passive
11. Describe refrigerant applications.
 - i) low temperature
 - ii) medium temperature
 - iii) high temperature
 - iv) ultralow
12. Describe and understand the effect of the ozone layer depletion theory and global warming potential (GWP).
13. Identify and interpret federal/provincial refrigerant regulations and describe how they are applied.
14. Describe the function of refrigerant oil in a refrigeration system.
15. Describe the following terms associated with refrigerant oils.
 - i) dielectric strength
 - ii) flash point
 - iii) floc point
 - iv) hygroscopic
 - v) miscibility
 - vi) pour point
 - vii) viscosity

16. Describe the procedures to determine the types of oil used for various refrigerants.
 - i) alkylbenzene
 - ii) mineral
 - iii) polyolester
 - iv) polyalkylene glycol (PAG)
17. Describe the use and handling of refrigerant oils.
 - i) storage
 - ii) handling
 - iii) disposal
18. Describe the procedures to use an acid test kit.
19. Describe refrigerant and oil conversion procedures.
 - i) mineral oil to alkylbenzene
 - ii) mineral oil to polyolester
20. Describe the procedures to use an oil conversion test kit.
21. Describe the procedures to use a refractometer.
22. Describe how the refrigeration industry affects ozone depletion.
23. Describe the mechanic's responsibilities concerning working on refrigeration systems.
24. Describe how refrigerants can be contained and prevented from release when designing, installing and servicing systems.
25. Describe the disposal of refrigerant as per Environment Canada's Code of Practice.
26. Describe the determining factors requiring that a refrigeration system be converted to a lower ozone depletion potential (ODP) refrigerant.
27. Describe the following relating to oil and ammonia mixtures.
 - i) mixability
 - ii) relative density of each
 - iii) behavior of oil and ammonia
28. Describe the characteristics of ammonia.
 - i) safety
 - equipment
 - ii) chemical make-up
 - iii) cylinder identification
 - iv) environmental concerns

- v) leak detection
- vi) physical characteristics
 - boiling point
 - toxicity level and its' effects
 - flammability
- vii) reporting ammonia spills and clean-up procedure

29. Describe the pressure temperature relationship of ammonia.

30. Define primary refrigerant and secondary refrigerant.

Practical:

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

1. Demonstrate procedures to remove, add and transfer refrigerant in an operating system.
2. Identify the type of refrigerant in an operating system.
3. Identify the type of refrigerant oil in an operating system.
4. Demonstrate refrigerant and oil conversion.
5. Demonstrate compressor oil change.
6. Identify colour coded refrigerant containers.
7. Recover refrigerant from a refrigeration system.
8. Perform an acid test.
9. Perform an oil conversion test.
10. Demonstrate the use of a refractrometer.

RF-1250

REFRIGERATION SYSTEM VALVES AND ACCESSORIES

Outcomes:

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

- identify various refrigeration valves, their use, operation and application.
- identify various refrigeration accessories, their use, operation and application.

Objectives and Content:

1. Identity types of shut-off valves and describe their use, operation and applications.
 - i) angle
 - ii) ball
 - iii) diaphragm
 - iv) globe
 - v) service
2. Identify “service or access valves” and describe their use, operation and applications.
 - i) 3-way service
 - ii) angle
 - iii) charging
 - iv) king
 - v) line tap (piercing)
 - vi) schrader
3. Describe the use and application of a check valve.
4. Describe the use and application of water regulating valves.
5. Describe the use and application of:
 - i) inlet pressure regulators
 - ii) outlet pressure regulators
 - iii) pressure differential regulators
6. Describe the use and applications of solenoid valves.
 - i) direct acting
 - ii) pilot operated
 - 2-way
 - 3-way
 - 4-way

7. Describe the use and applications of system filter, dehydration and acid removal devices.
 - I) filters (liquid, suction)
 - standard
 - removable core
 - ii) filter/driers (liquid, suction)
 - standard
 - removable core
 - iii) acid removal (liquid, suction)
 - iv) bi-flow (heatpump)
8. Describe the use and application of a liquid/moisture Indicator.
9. Describe the use and application of a suction accumulator.
10. Describe the use and application of oil separators.
11. Describe the use and application of a liquid receiver.
12. Describe the use and application of pressure relief devices.
13. Describe the use and application of a heat exchanger.

Practical:

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

1. Locate and explain the purpose of various system valves and accessories on operating refrigeration and air conditioning systems.

RF-1260 LEAK TESTING, EVACUATION AND CHARGING

Outcomes:

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

- leak test refrigeration systems using various leak detection methods.
- dehydrate and evacuate refrigeration systems to a deep vacuum.
- charge a refrigeration system.

Objectives and Content:

1. Describe leak detection methods according to:
 - i) B-52 Mechanical Refrigeration Code
 - ii) environmental regulations
2. Define terminology associated with leak testing, evacuation and charging.
3. Describe various leak detection tools and/or methods and principles of operation.
 - i) halide
 - ii) electronic
 - iii) ultrasonic
 - iv) fluorescent dye and ultraviolet light
 - v) bubble solutions
 - vi) standing nitrogen pressure test
 - vii) standing vacuum test
4. Describe leak testing of ammonia systems using:
 - i) sulphur sticks
 - ii) litmus paper
5. Describe the reasons for dehydrating and evacuating refrigeration systems and how and why the process works.
6. Identify types of vacuum pumps and describe their oils and maintenance procedures.
 - i) single-stage
 - ii) two-stage
7. Describe multiple or deep evacuation.
8. Describe the procedures to use a vacuum gauge.
 - i) electronic thermistor
 - ii) u-tube mercury manometer

9. Describe the procedures to use a gauge manifold.
 - i) installation on system (service and schrader valve access)
 - ii) removal from system (service and schrader valve access)
10. Describe the procedures used to evacuate a system.
 - i) schrader valve access
 - ii) service valve access
11. Describe the use of refrigerant weighing devices and their procedures for weighing in a charge.
 - i) charging cylinder
 - ii) mechanical scale
 - iii) electronic scale
12. Describe the conversion of weight scales.
 - i) imperial
 - ii) metric
13. Describe the charging procedures in the vapour and/or liquid state on a refrigeration system with a critical charge.
14. Describe the charging procedure in the vapour and/or liquid state on a refrigeration system with a receiver and sightglass.

Practical:

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

1. Install and remove gauge manifold on refrigeration and air conditioning systems.
2. Evacuate a refrigeration system using a vacuum gauge.
 - i) schrader valves
 - ii) service valves
3. Charge a refrigeration system:
 - i) using a refrigerant weighing device
 - ii) with no refrigerant weighing device

RF-1270

ELECTRICAL FUNDAMENTALS

Outcomes:

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

- apply the fundamental concepts of electricity and electrical safety.
- measure voltage, resistance, current and power, and calculate their interrelationship.
- identify the components of simple circuits.

Objectives and Content:

1. Define the terms:
 - i) Electricity
 - ii) Conductor
 - iii) Semiconductor
 - iv) Insulator
2. Describe the law of electric charges.
3. Describe current and electron flow.
 - i) Alternating current
 - ii) Direct current
4. Define electromotive force and describe its' sources.
5. Define the following electrical terms, their unit of measurement and symbol:
 - i) Current
 - ii) Energy
 - iii) Power
 - iv) Resistance
 - v) Voltage
6. Define and describe the function of the following in an electrical circuit.
 - i) Conductor
 - ii) Load
 - iii) Resistor
7. Define conductor ampacity rating and list the factors used in determining it.
8. Describe the factors considered in the selection of wire insulating materials.
9. Describe the factors that determine the resistance value of a conductor.

10. Describe how resistors are rated.
11. Describe colour coding for resistors.
12. Describe the relationship between current, energy, power, resistance and voltage.
13. Describe the magnetic effects of current.
14. Describe the components and function of a simple electrical circuit.
15. Describe the characteristics of an electrical circuit.
 - i) Series
 - ii) Parallel
 - vii) Series-parallel
16. Describe the law of conservation of energy and apply it to each component of an electric circuit.
17. Describe and apply Kirchhoff's laws of voltage and current in series, parallel, and combination circuits.
18. Describe the use , application and procedures of electrical test instruments.
 - i) Ammeter
 - ii) Multimeter
 - iii) Ohmmeter
 - iv) Voltmeter
19. Describe the differences between an analog and digital meter.
20. Describe the term continuity and how it can be checked with a voltmeter.

Practical:

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

1. Measure the voltage, component resistance and current of a refrigeration system using both an analog and digital meter.
2. Conduct experiments to demonstrate the characteristics of series, parallel, and combination electrical circuits using Ohm's law and Kirchhoff voltage and current laws.

RF-1280

SINGLE AND THREE PHASE MOTOR FUNDAMENTALS

Outcomes:

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

- identify, diagnose and service single and three phase motors.

Objectives and Content:

1. Describe the generation and application of electricity.
 - i) single phase
 - ii) three phase
2. Describe the differences between a single and three-phase circuit.
3. Describe the procedure for measuring voltage, resistance and current in a single and three phase circuit.
4. Describe the principles of motor operation.
5. Describe the construction details of single and three-phase motors.
6. Describe the factors that determine the speed, direction and rotation of motors.
7. Identify types of motors and describe their characteristics and applications.
 - i) capacitor start induction run
 - ii) capacitor start and run
 - iii) permanent split capacitor
 - iv) resistance start induction run
 - v) shaded pole
 - vi) three phase
8. Describe the characteristics of a capacitor and how to test it out of the circuit.
9. Describe the use, operation and wiring configuration of single phase starting devices.
 - i) current relay
 - ii) potential relay
 - iii) electronic starting relay
 - iv) centrifugal switch
10. Describe the use, operation and wiring configuration of three phase starting devices.
 - i) relay

- ii) contactor
- iii) motor starter

11. Describe the procedure to diagnose winding failure in a single phase motor.
12. Describe the procedure to diagnose winding failure in a three phase motor.
13. Describe the effects load and voltage changes have on motor operation.
14. Describe the factors that can cause motor overheating.
15. Describe the meaning and application of motor name plate information.
16. Describe the advantages and disadvantages of:
 - i) single phase motors
 - ii) three phase motors
17. Describe the operation and application of three phase motors.
18. Describe the methods used to change speeds of three phase motors.
19. Describe the procedures used to reverse the direction of rotation of a three phase motor.
20. Describe the winding configurations for three phase motors.
 - i) delta
 - ii) wye
21. Describe motor troubleshooting techniques.
 - i) noise
 - ii) vibration
 - iii) ground
 - iv) shorts
 - v) bearings
 - vi) switches
 - vii) opens
22. Describe replacement motor selection criteria.
23. Describe the effects of motor pulley selection, adjustment and alignment.
24. Identify the types of motor overload protection devices and describe their use and applications.
 - I) internal overload protection
 - thermostatic devices

- resistance temperature detector (RTD)
- thermocouple
- thermistor

ii) external overload protection

- magnetic
- thermal
- thermal/current
- electronic

iii) low and high voltage protection

iv) phase failure, reversal and ground fault protection

25. Describe the procedures to use a megger meter.

Practical:

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

1. Check out single and three phase motors.
2. Identify and install electrical starting components on single phase motors.
3. Connect, run and reverse three phase motors.
4. Check motor insulation resistance with a megger meter.

RF-1310

ELECTRICAL COMPONENTS

Outcomes:

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

- identify and understand the operation of conductors, switching relays, overloads and transformers.
- select and size conductors.
- check out and select replacement switching relays, overload devices and transformers.

Objectives and Content:

1. Describe a simple circuit and each of its components.
2. Describe an overloaded, grounded and short circuit.
3. Identify conductor types and describe their sizes and applications.
4. Describe the use, application of distribution panels and wiring configurations.
 - i) single phase
 - ii) three phase
5. Identify types of overcurrent protection devices and describe their use and how they are rated.
 - i) fuses
 - plug
 - time delay
 - cartridge
 - renewable
 - non-renewable
 - time delay
 - ii) circuit breakers
 - thermal
 - magnetic
 - thermal-magnetic
 - iii) thermal overload
6. Identify types of switching relays and describe their component parts, uses, ratings and configurations.
 - i) electromechanical
 - ii) magnetic-reed
 - iii) solid state
 - iv) timing

7. Identify the types of transformers and describe their use, applications, construction and operation..
 - i) single phase
 - ii) three phase
8. Describe transformer voltages, current and power relationships.

Practical:

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

1. Troubleshoot overload circuits and components for proper operation.
2. Troubleshoot and wire switching relays.
3. Troubleshoot transformers.

RF-1320

CONTROL FUNDAMENTALS

Outcomes:

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

- understand control fundamentals and applications.
- apply automatic control concepts.

Objectives and Content:

1. Define terminology associated with control fundamentals.
 - i) control point
 - cut in
 - cut out
 - ii) differential
 - fixed
 - variable
 - iii) offset
 - iv) range
 - v) reset
 - vi) set point
 - vii) deadband
 - viii) span
 - ix) throttling range
2. Describe system control and the components of a control circuit.
3. Describe different categories of control devices.
 - i) electrical
 - ii) mechanical
 - iii) electromechanical
 - iv) electronic
 - v) pneumatic
4. Describe and compare the application of control systems on refrigeration and air conditioning systems including:
 - i) energy conservation
 - ii) monitoring
 - iii) operation
 - iv) safety
5. Describe and compare open loop and closed loop control using the following terms:
 - i) controller
 - ii) control medium

- iii) controlled variable
- iv) controlled device
- v) manipulated variable
- vi) control agent
- vii) corrective action

6. Describe the differences in the following types of control:

- i) on/off
- ii) proportional or modulating
- iii) two position
- iv) timed two position

7. Describe control and control actions and include:

- i) loads
- ii) switches
- iii) circuits

8. Describe specific sensors used for the measurement of the following:

- I) flow
 - vane or paddle
 - pitot tube
 - vortex tube or orifice plate
- ii) humidity
 - electronic
 - mechanical (hygroscopic)
- iii) liquid level
 - electronic
 - mechanical
- iv) pressure and/or pressure difference
 - bellows
 - diaphragm
 - piezoresistive
- v) temperature
 - bi-metal strip
 - rod and tube
 - sealed bellows
 - sealed bellows and capillary and/or bulb
 - resistive wire
 - thermistor
 - thermocouple

9. Describe the differences in operating, safety and monitoring controls.

Practical:

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

1. Draw and describe an open and closed loop control circuit.
2. Draw and describe various control circuits.
3. Draw and describe a typical residential heat/cool system control circuit.

RF-1330

AIR CONDITIONING FUNDAMENTALS

Outcomes:

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

- understand the factors that determine good air conditioning design.
- apply air conditioning principles.

Objectives and Content:

1. Describe the process of air conditioning including:
 - i) temperature
 - ii) humidity
 - iii) filtration
 - iv) air movement
2. Describe the factors that affect human comfort.
 - I) rate of body heat loss or gain
 - convection
 - radiation
 - evaporation (humidity)
 - ii) air quality
 - ventilation
 - contaminants
 - smoke
 - dust particles
 - biological microorganisms
 - toxic gases
3. Describe each component and subsystem of a comfort air conditioning system.
4. Describe the difference between air circulation and ventilation.
5. Define the terms:
 - i) dew point temperature
 - ii) dry bulb temperature
 - iii) enthalpy
 - iv) moisture content
 - v) relative humidity
 - vi) sensible heat factor
 - vii) specific volume
 - viii) wet bulb temperature

6. Describe the use and application of a psychrometric chart and identify the property points and constant property lines.
7. Describe the use of a psychrometric chart to determine air properties.
8. Describe the terms indoor and outdoor design conditions and describe their differences.
9. Describe comfort zone as it relates to indoor air conditions.

Practical:

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

1. Plot air properties on a psychrometric chart.

RF-1340

RIGGING TECHNIQUES

Outcomes:

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

- identify, apply and tie various knots.
- identify simple machines and calculate their mechanical advantage.
- reeve multiple pulleys.
- determine the safe working load of rigging equipment.
- lift and/or secure heavy tools and/or equipment.
- manipulate crane loads with crane operators by the use of appropriate hand signals.

Objectives and Content:

1. Identify the various classes of levers and describe their application.
2. Identify types of simple machines and describe procedures to calculate mechanical advantage.
 - i) inclined plane
 - ii) lever
 - iii) pulley
 - iv) screw
 - v) wedge
 - vi) wheel and axle
3. Describe the effect of load capacity of a sling when the sling angle to the load is decreased.
4. Identify types of knots and describe their applications and procedures to tie.
 - i) reef knot
 - ii) clove hitch
 - iii) bowline
 - iv) running bowline
 - v) timber hitch
 - vi) half hitch
5. Identify types of hitches and describe their applications.
 - i) single vertical
 - ii) single choker
 - iii) single basket
6. Describe the use and benefit of spreader bars when lifting a load.

7. Identify types of rigging hardware and describe their use and applications.
 - i) load hook
 - ii) grab hook
 - iii) eye bolt
 - iv) shackle
 - v) turnbuckle
8. Describe safe working load as it pertains to fiber rope, wire rope and chain.
9. Describe the advantage of reeving a multi -sheave block rather than threading.
10. Describe hand signals for boom equipment.
 - i) raise load
 - ii) raise load slowly
 - iii) lower load
 - iv) lower load slowly
 - v) raise boom
 - vi) lower boom
 - vii) swing load left and right
 - viii) stop
 - ix) emergency stop
11. Identify fall arrest equipment and describe its use and applications.
12. Describe methods of lifting heavy objects.
13. Describe the use of portable ladders.
 - i) extension ladder
 - ii) step ladder

Practical:

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

1. Tie various knots for lifting and securing loads.
2. Demonstrate crane hand signals.
3. Demonstrate setup and use of ladders.
4. Reeve multiple pulleys.

RF-1350

SYSTEM ANALYSIS WITH PRESSURE ENTHALPY DIAGRAMS

Outcomes:

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

- troubleshoot refrigeration systems by plotting system performance on a pressure enthalpy diagram.

Objectives and Content:

1. Define terminology associated with system analysis with pressure enthalpy diagrams.
2. Describe the properties of a pressure enthalpy diagram.
3. Identify the following areas of the pressure enthalpy diagram.
 - i) liquid
 - ii) saturation
 - iii) vapour
 - iv) subcooling
 - v) superheat
4. Describe the location of temperature and pressure points of a refrigeration cycle on a pressure enthalpy diagram.
5. Describe the difference between the simple saturated refrigeration cycle and an actual refrigeration cycle.
6. Describe the affects on system capacity resulting from:
 - i) changes in saturated discharge temperature
 - ii) changes in saturated suction temperature
 - iii) liquid subcooling
 - iv) suction superheat
 - v) suction to liquid heat exchanger
 - vi) high and low side pressure drops
7. Describe the difference between theoretical horsepower and brake horsepower.
8. Describe the effects of pressure loss in refrigeration piping.

9. Describe the concept of system equilibrium and the factors that determine system balance.
10. Describe the effect on system performance in an unbalanced system.

Practical:

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

1. Plot a refrigeration cycle on a pressure enthalpy diagram.
2. Calculate the following from plotted data:
 - i) actual displacement
 - ii) brake horsepower
 - iii) coefficient of performance
 - iv) compression ratio
 - v) condenser heat of rejection
 - vi) desuperheating
 - vii) heat of compression
 - viii) mass flow rate
 - ix) net refrigeration effect
 - x) subcooling
 - xi) system capacity
 - xii) theoretical displacement
 - xiii) theoretical horsepower
 - xiv) total heat rejected from the condenser
 - xv) total heat rejected from the system
3. Apply cycle diagrams to assist with troubleshooting the following.
 - i) bent or damaged tubing
 - ii) dirty condenser
 - iii) dirty evaporator
 - iv) dirty filter drier
 - v) dirt in coils
 - vi) fully restricted metering device
 - vii) loss of refrigerant
 - viii) low load
 - ix) low air flow
 - x) overcharge of refrigerant
 - xi) moisture in system
 - xii) non-condensables in system

- xiii) partially restricted metering device
- xiv) poorly serviced equipment
- xv) undercharge of refrigerant
- xvi) undersized refrigerant lines

RF-1360

COMPRESSORS

Outcomes:

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

- check compressors electrically and mechanically for proper operation.
- check and replace electrical starting components of hermetic compressors.
- identify system problems that could lead to compressor failures.

Objectives and Content:

1. Describe the function of the compressor in the refrigeration system.
2. Identify the different major types of compressors used in the refrigeration and air conditioning industry and describe their applications.
 - i) reciprocating
 - ii) screw
 - iii) rotary
 - iv) scroll
 - v) centrifugal
3. Describe the difference between open drive, hermetic and semi-hermetic compressors.
4. Describe belt drive and direct drive compressors.
5. Describe the use and application of a compressor shaft seal.
6. Describe the major component parts of a reciprocating compressor and their function.
 - i) crankshaft
 - crank throw
 - eccentric
 - ii) connecting rod
 - iii) piston
 - iv) valves
 - reed valves
 - ring valves
 - discus valve
 - v) valve plate
 - vi) head
 - vii) motor
 - viii) housing

7. Describe the mechanical operation of a reciprocating compressor and include:
 - i) compressor efficiency
 - ii) lubrication
 - iii) cooling
8. Describe hermetic compressor motor cooling.
9. Describe compressor classifications according to temperature ranges.
10. Describe the electrical terminals on single phase compressor motors and the identification procedures.
11. Identify the four types of single phase compressor motors and describe their components and operating characteristics.
12. Describe the starting principles of single phase motors.
13. Describe the relative differences in starting torques of the four types of motors.
14. Describe the operation of single phase compressor motor starting relays.
 - i) current
 - ii) potential
15. Describe procedures used to check and replace compressor motor starting relays.
 - i) current
 - ii) potential
16. Describe the operation of solid state motor starting relays.
17. Describe how motor starting torque can be improved.
18. Describe the construction and operation of run and start capacitors used with compressor motors.
19. Define the following capacitor terms.
 - i) applied voltage
 - ii) bleed resistor
 - iii) capacitor bank
 - iv) identified terminal
 - v) microfarad
 - vi) voltage rating
20. Describe how capacitors of different values may be substituted as replacements.
21. Describe the operating principles of overload and overcurrent devices.

22. Describe the difference between pilot duty and line duty, both inherent and non-inherent.
23. Describe hermetic motor burn-out and distinguish between a mild or severe burn.
24. Describe the factors that can contribute to motor burn-out.
25. Describe the clean up procedures following a hermetic motor burn-out, including acid testing.
26. Describe the difference between electrical and mechanical failure of a hermetic compressor.

Practical:

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

1. Check and replace current and potential relays.
2. Check and replace start and run capacitors.
3. Sketch and explain overload operation.
4. Test and check compressor motor windings.
5. Repair compressor assemblies
 - I) Disassemble, inspect and repair, reassemble, open and semi-hermetic compressors.

RF-1370

CONDENSERS

Outcomes:

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

- describe the selection, application, operation and servicing of condensers.
- install, service and repair condensers.

Objectives and Content:

1. Describe condenser function in terms of:
 - i) condensing
 - ii) desuperheating
 - iii) subcooling
2. Classify condensers according to the following configurations.
 - i) air or water cooled
 - ii) circuits and passes
 - iii) fins and fin spacing
 - iv) plate
 - v) primary and secondary surface
 - vi) shell and coil
 - vii) shell and tube
 - viii) tube and tube
3. Describe the two categories of water cooled condensers and their design considerations.
 - i) wastewater
 - ii) recirculated
4. Describe the effect of the following on the capacity and efficiency of condensers.
 - i) air or water velocity
 - ii) counter flow versus parallel flow
 - iii) condensing temperature difference
 - iv) fouling and fouling rates
 - v) number of circuits
 - vi) number of passes
 - vii) refrigerant pressure loss
 - viii) refrigerant velocity
 - ix) condenser subcooling
 - x) thick versus thin coils

5. Describe condenser capacity rating and the considerations for proper sizing.
6. Describe the service and repair of condensers.
 - i) descaling
 - ii) retubing
 - iii) fin / coil cleaning
7. Describe methods of head pressure control.
 - i) air cooled
 - fan cycling
 - flooded condenser
 - modulating dampers
 - variable speed fan
 - ii) water cooled
 - wastewater
 - water valve
 - recirculated
 - temperature
 - flow
 - by-pass valves
 - diverter valves
 - fixed
 - modulating
8. Describe piping considerations for condensers.
 - i) discharge piping
 - ii) liquid (condensate) piping
 - iii) waterside piping
 - supply
 - drain
 - isolation valves

Practical:

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

1. Identify air and water cooled condensers in industry catalogues.
2. Select condensers based on given design criteria.
3. Demonstrate condenser cleaning procedures.

RF-1380

EVAPORATORS

Outcomes:

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

- demonstrate knowledge of the selection, application, operation, installation and servicing of evaporators.

Objectives and Content:

1. Classify evaporators according to:
 - i) types of construction
 - bare tubed
 - plate surface
 - finned
 - ii) circuits and passes
 - iii) counter, cross and parallel flow
 - iv) direct expansion, flooded and liquid overfeed
 - v) fins and fin spacing
 - vi) forced and induced
 - vii) plate or eutectic
 - viii) primary and secondary surface
2. Describe the evaporators used in each of the following applications.
 - i) air coolers
 - ii) air driers
 - iii) ice maker
 - iv) water and brine chillers
3. Describe the various defrost methods and any piping considerations for each type:
 - I) off cycle
 - pressure initiated and terminated
 - time initiated and terminated
 - ii) electric
 - time initiated, temperature and/or time terminated
 - time initiated, pressure and/or time terminated
 - iii) hot gas
 - iv) reverse flow
 - v) heat bank
4. Describe drain pan heaters and evaporator fan control for walk-in freezers.

5. Describe the use and application of evaporator drain lines, including drainline heaters, pipe slope and insulation.
6. Describe the differences in direct (dry) expansion and flooded chillers.
7. Describe the effect of the following on the capacity and efficiency of evaporators:
 - i) air or water velocity
 - ii) counter flow versus parallel flow
 - iii) evaporator temperature difference
 - iv) frost accumulation and fin spacing
 - v) number of circuits
 - vi) number of passes
 - vii) oil circulation
 - viii) refrigerant pressure loss
 - ix) refrigerant velocity
 - x) evaporator superheat
 - xi) surface wetting
 - xii) thick versus thin coils
8. Describe evaporator capacity rating and the considerations for proper sizing.
9. Describe the service and repair of evaporators.
 - i) descaling
 - ii) retubing
 - iii) fin/coil cleaning
10. Describe considerations for the placement of evaporators in refrigerated boxes.
11. Describe piping considerations required for the following evaporator configurations:
 - i) evaporator located above compressor
 - ii) evaporator located below compressor
 - iii) multiple evaporators, individual suction lines
 - iv) multiple evaporators, single suction line

Practical:

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

1. Identify air cooling evaporators and water chillers in industry catalogues.
2. Select evaporators based on given design criteria.
3. Demonstrate evaporator coil cleaning procedures.

RF-1390

METERING DEVICES

Outcomes:

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

- demonstrate knowledge of installation, servicing, adjusting and repairing metering devices.

Objectives and Content:

1. Describe the purpose of the evaporator metering device in a refrigeration system.
2. Describe the use, operation and construction of the following metering devices.
 - i) automatic expansion valve
 - ii) capillary tube
 - iii) electronic expansion valve
 - iv) hand expansion valve
 - v) high and low side floats
 - vi) liquid level controls
 - vii) restrictor/orifice/piston
 - viii) thermostatic expansion valves
 - ix) thermal electric valve
3. Describe and compare the operation of metering devices in terms of the following:
 - i) refrigerant charge
 - ii) system application (direct expansion, flooded, liquid overfeed)
 - iii) responsiveness to load variations.
4. Describe the sizing, selection and installation of a capillary tube.
5. Describe the system characteristics of a capillary tube system under the following conditions.
 - i) high load
 - ii) low load
 - iii) refrigerant overcharge
 - iv) refrigerant undercharge
 - v) separated capillary/suction heat exchanger
6. Describe the methods of clearing plugged capillary tubes.
7. Describe the charging procedures of a capillary tube system.

8. Define the following thermostatic expansion valve terms.
 - i) constant superheat
 - ii) hunting
 - iii) starving
 - iv) flooding
 - v) tonnage capacity
9. Describe the following thermostatic expansion valve application differences based on:
 - i) bulb charges
 - ii) bulb responsiveness
 - iii) equalization (external or internal)
 - iv) operating temperature range
 - v) temperature
10. Describe selection criteria for thermostatic and automatic expansion valves.
11. Describe thermostatic expansion valve tonnage ratings and the variables that affect valve capacity.
12. Describe the operation and application of pressure limiting thermostatic expansion valves.
13. Describe the service and adjustment procedures of thermostatic expansion valves.
 - i) single evaporator installation
 - ii) multi-evaporator installation
14. Describe the term glide in regard to superheat measurement and adjustment.
15. Describe the installation and service of automatic expansion valves.
16. Describe the method of charging a system with an automatic expansion valve.
17. Describe the installation and service of electronic and thermal electric expansion valves.
18. Describe the service and adjustment of high and low side floats.
19. Describe the service and adjustment of liquid level controls.
20. Describe troubleshooting techniques with expansion valves operating in the following conditions:
 - i) high load conditions
 - ii) low load conditions
 - iii) refrigerant overcharge

- iv) refrigerant undercharge
- v) restricted
- vi) defective power element

21. Identify the types of distributors and describe their use and applications.

- i) venturi
- ii) pressure drop
- iii) centrifugal
- iv) manifold

Practical:

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

1. Select expansion valves based on various applications.
2. Install, adjust and repair expansion valves on operating systems.
3. Troubleshoot systems operating with:
 - i) high load conditions
 - ii) low load conditions
 - iii) refrigerant overcharge
 - iv) refrigerant undercharge
 - v) restricted expansion valve

RF-1400

AUTOMATIC FLOW CONTROLS AND APPLICATION

Outcomes:

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

- understand the operation of, install, maintain, service, repair and troubleshoot refrigeration flow control devices.

Objectives and Content:

1. Describe the operation of direct acting and pilot operated.
 - i) solenoid valves
 - ii) inlet pressure regulator
 - iii) outlet pressure regulator
 - iv) differential pressure regulator
2. Describe the operation, installation, maintenance, service, repair and troubleshooting procedures of valves.
 - i) check
 - ii) slide
 - 3 way
 - 4 way (reversing)
 - heat reclaim
 - hot gas defrost
 - iii) solenoid
3. Describe the operation, installation, maintenance, service, repair and troubleshooting procedures of regulators.
 - I) crankcase pressure
 - ii) differential pressure
 - iii) evaporator pressure
 - stop valve feature
 - iv) condenser flooding control
 - v) hot gas bypass
 - vi) receiver pressure
4. Describe the operation, installation, maintenance, service, repair and troubleshooting procedures of oil level controls.
 - I) oil level regulator
 - mechanical
 - electro-mechanical
 - ii) oil reservoir and check valve

Practical:

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

1. Disassemble, inspect, service, repair and adjust various refrigeration flow control valves.

RF-1410

SYSTEM ANCILLARY COMPONENTS

Outcomes:

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

- understand the operation of, install, maintain, service, repair and troubleshoot refrigeration ancillary components.

Objectives and Content:

1. Describe the operation, installation, maintenance, service, repair and troubleshooting procedures of:
 - i) accumulator
 - ii) crankcase heater
 - iii) discharge muffler
 - iv) hand valves
 - liquid receiver
 - flow through
 - surge type
 - v) liquid line filter/drier
 - vi) oil separator
 - vii) oil filters
 - viii) relief devices
 - diaphragm
 - dual relief valve and manifold
 - fusible plug
 - spring loaded
 - ix) service valves
 - x) schrader valves
 - xi) sightglass
 - xii) solenoid valve
 - xiii) suction filter
 - xiv) suction to liquid heat exchanger
 - xv) vibration eliminators
2. Describe the operation, installation, maintenance, service, repair and troubleshooting procedures for electronic and mechanical controls.
 - i) oil failure
 - ii) high pressure
 - iii) low pressure
 - iv) fan cycling

Practical:

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

1. Install, wire, adjust, check operation and troubleshoot various pressure operated electrical controls.
2. Install, wire, adjust, repair, check operation and troubleshoot various ancillary devices.

RF-1420

EVAPORATIVE CONDENSERS AND COOLING TOWERS

Outcomes:

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

- understand the principles of cooling tower and evaporative condenser design.
- demonstrate knowledge of the selection, application, operation, installation and service of cooling towers and evaporative condensers.

Objectives and Content:

1. Demonstrate the knowledge of the application of cooling towers and evaporative condensers and their differences.
2. Describe the heat rejection principle used by cooling towers and evaporative condensers.
3. Describe the factors that influence the effectiveness of cooling towers.
 - i) wet bulb temperature
 - ii) amount of exposed water surface and length of time of exposure
 - iii) velocity of air moving through the tower
 - iv) direction of the air flow with relation to the exposed water surface
 - parallel
 - crossflow
 - counter
4. Describe the differences between the following types of cooling towers.
 - i) natural draft
 - ii) induced draft
 - iii) forced draft
5. Describe the factors that influence the effectiveness of evaporative condensers.
6. Identify the components of an evaporative condenser and describe their applications.
7. Identify the components of a cooling tower and describe their applications.
8. Describe the differences between spray filled and splash deck towers.
9. Describe the differences between water tower and city waste water systems.
10. Describe the advantages of a closed circuit water cooling tower.

11. Describe a dry type cooling tower and its advantages in cold climates.
12. Describe the factors to consider when installing a cooling tower or evaporative condenser in cold climates.
13. Describe head pressure control by controlling cooling tower heat rejection rate or evaporative condenser evaporation rate.
14. Describe and determine the capacity of a cooling tower and an evaporative condenser using psychrometric processes.
15. Define the terms approach and range as they apply to cooling towers.
16. Describe seasonal maintenance required for evaporative condensers and cooling towers.
17. Describe the following water problems incurred with cooling towers and evaporative condensers including control measures.
 - i) algae, slime and bacteria
 - ii) corrosion
 - iii) dirt and debris
 - iv) scaling (bleed-off)

Practical:

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

1. Identify cooling towers and evaporative condensers in industry catalogues.
2. List troubleshooting procedures for cooling towers and evaporative condensers.
3. List seasonal start-up, operational and shut-down procedures.

RF-1430

FLUID DYNAMICS AND PUMPS

Outcomes:

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

- understand the principles of fluid flow within duct and pipe systems.
- identify operational system performance based on fluid and/or air flow dynamics.

Objectives and Content:

1. Describe the principles of fluid flow within duct and piping systems.
2. Define the following terms and their relationships:
 - i) static pressure
 - ii) total pressure
 - iii) velocity
 - iv) velocity pressure
 - v) volume
3. Describe the units used to measure:
 - i) fluid flow
 - ii) air flow
4. Describe the application of formulas to solve relevant problems using the following:
 - i) Bernoullis' effect
 - ii) Boyles' law
 - iii) Charles' law
 - iv) Dalton's law
 - v) Pascals' law
 - vi) Perfect gas law
5. Describe the uses of circulating pumps in refrigeration and air conditioning systems.
 - i) open system
 - ii) closed system
6. Identify the components of a water circulating pump.
7. Define the terms friction head, net positive suction head and the cause and prevention of cavitation.
8. Describe the factors to be considered when selecting a circulating pump and include the following terms:
 - i) friction head
 - ii) static head

- iii) total pumping head
- iv) velocity head

9. Describe the use and interpretation of a pump curve.
10. Describe the use and operation of circulating pumps as they are applied either in series or in parallel.
11. Describe the effects of air in an open or closed water or brine system and the procedures for purging it from the system.

Practical:

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

1. Select circulating pumps based on written system parameters.
2. Purge air from a water system.
3. Determine pump performance from a system pump curve.
4. Dismantle, repair and test circulating pumps.
5. Apply formulas to solve fluid flow problems.

RF-1440

REFRIGERANT RECOVERY AND RECYCLING PROCEDURES

Outcomes:

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

- demonstrate knowledge of refrigerant recovery from various systems.
- maintain refrigerant recovery/recycle equipment.

Objectives and Content:

1. Describe the recovery of liquid and vapour refrigerant from systems using service valves and schrader access valves.
2. Describe the procedures used to recycle refrigerants.
3. Describe the use and procedures for distillation of refrigerant.
4. Describe the procedures to field test recovered refrigerant.
5. Describe refrigerant recovery/recycle equipment maintenance procedures. . . .
6. Describe refrigerant recovery cylinder testing procedures.
 - i) Department of Transportation stamp
 - ii) testing intervals
7. Describe the safe use and application of refrigerant recovery cylinders.
 - i) water capacity (W.C.)
 - ii) tare weight (T.W.)
 - iii) pressure rating
 - iv) maximum fill capacity

Practical:

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

1. Recover refrigerant from various systems with different types of service/access valves.
2. Test refrigerants for acid and cross-contamination.

RF-1450 REFRIGERATION AND A/C INSTALLATION 1

Outcomes:

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

- identify and apply procedures, materials and components in the installation of refrigeration and air conditioning systems.

Objectives and Content:

1. Describe the factors to consider when selecting refrigeration and air conditioning equipment.
2. Describe the factors in determining the installed location of refrigeration and air conditioning equipment.
3. Compare copper and steel pipe.
4. Compare copper and steel fittings.
5. Describe the use and application of filter/driers, metering devices and solenoid valves.
6. Describe the use and application of electrical diagrams.
7. Describe the use and application of piping schematic diagrams.
8. Describe wiring techniques.
9. Describe approved leak testing methods.
10. Describe approved evacuation methods.
11. Describe refrigerant charging techniques.
12. Describe the procedures used to check and adjust controls for normal operation.
13. Describe the procedures used to check and adjust evaporator superheat.
14. Describe the use of equipment start-up reports.
15. Describe documentation of all control settings.
16. Describe documentation of all system operating temperatures and pressures.

Practical:

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

1. Document control settings of an operating system.
2. Document system operating temperatures and pressures of an operating system.

RF-1460

TROUBLESHOOTING TECHNIQUES

Outcomes:

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

- apply troubleshooting techniques when servicing refrigeration and air conditioning systems.

Objectives and Content:

1. Describe the difference between a systematic check out procedure and the art of troubleshooting.
2. Describe troubleshooting procedures.
3. Describe how to read and interpret troubleshooting charts.
4. Describe the wear profile and its causes and effects on electrical components.
5. Describe mechanical and electrical component failure:
 - i) wear
 - ii) causes
 - iii) methods of reducing wear
 - iv) replacement procedures
6. Describe how the senses are used to identify problems while troubleshooting.

Practical:

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

1. Demonstrate troubleshooting procedures on systems.
2. Analyze abnormal circuit conditions. Use analog and digital meters to identify circuit conditions and component conditions.
 - i) ground fault
 - ii) open circuit
 - iii) overload
 - iv) potential voltage
 - v) short circuit
 - vi) system conditions

RF-1470

INDUSTRY AND RELEVANT CODES

Outcomes:

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

- understand the scope and jurisdiction of the B-52 Mechanical Refrigeration Code and other relevant codes.
- interpret the B-52 Mechanical Refrigeration Code and other relevant codes.

Objectives and Content:

1. Describe the scope and jurisdiction of the B-52 Mechanical Refrigeration Code.
2. Describe significant refrigeration terms using the B-52 Mechanical Refrigeration Code.
3. Describe the intent of the different code sections.
4. Describe the code sections of the B-52 Mechanical Refrigeration Code.
 - i) system selection and application requirements
 - ii) equipment design and construction
 - iii) installation
 - iv) over pressure protection
 - v) maintenance of systems
 - vi) precautions
5. Describe and interpret Environment Canada's Code of Practice for the Reduction of Chlorofluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
6. Identify and interpret relevant sections in the C22.1 National Electrical Code, including the "Hermetic Refrigeration Motor Compressors" section.
7. Identify and interpret municipal, provincial and other applicable plumbing codes sections that pertain to refrigeration and air conditioning installation and service.
8. Describe the importance of CSA and UL approved equipment.

Practical:

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

1. Locate and review code sections in the "B-52 Mechanical Refrigeration Code".

Refrigeration and Air Conditioning Mechanic

2. Locate and review code sections in the “Code of Practice for the Reduction of Chlorofluorocarbon Emissions from Refrigeration and Air Conditioning Systems”.
3. Locate and review municipal, provincial and other applicable plumbing sections that pertain to the installation and service of refrigeration and air conditioning equipment.

RF-1480

CONTROL CIRCUITS AND WIRING DIAGRAMS

Outcomes:

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

- install, service and repair various control circuits.
- demonstrate knowledge to wire control circuits to achieve the desired control functions.
- demonstrate knowledge of wiring diagrams.

Objectives and Content:

1. Describe the operation of a control system and how it is wired into a system using the listed components.
 - i) valves
 - ii) dampers
 - iii) actuators
 - iv) double pole double throw switch
 - v) double pole single throw switch
 - vi) power supply (for circuit boards)
 - vii) relays (electrical and pneumatic)
 - viii) single pole double throw switch
 - ix) single pole single throw switch
 - x) starters and contactors
 - xi) timers
 - xii) transducers
 - xiii) transformers
 - xiv) thermister
 - xv) control fuses
2. Describe the operation of a safety control circuit and how it is wired into a system using the listed components.
 - i) alarm circuits
 - ii) anti-short cycling devices
 - iii) discharge gas temperature sensors
 - iv) flow switches
 - v) high and low pressure controls
 - vi) high and low limit thermostats
 - vii) humidity controls
 - viii) oil failure controls
 - ix) overload devices

- x) temperature control
- xi) winding thermostats

3. Describe and illustrate the following control applications.
 - i) off cycle defrost (temperature and pressure)
 - ii) pump-down cycle
 - iii) pump-out cycle
 - iv) timed defrost
 - v) lock-out or reset circuit
4. Describe the difference between a pictorial and schematic wiring diagram.
5. Describe the legend and standard symbols of a schematic diagram.

Practical:

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

1. Draw schematic diagrams based on a written sequence of control events complete with a legend.
2. Draw a schematic wiring diagram from a pictorial diagram.
3. Wire control circuits.

RF-1490

MOTOR CONTROLS, RELAYS AND TRANSFORMERS

Outcomes:

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

- understand the principle of operation of motor controls, relays and transformers.
- identify, service and wire motor controls, relays and transformers.

Objectives and Content:

1. Describe the principles of operation of a transformer.
2. Identify the components of a transformer.
3. Describe the use and application of transformers.
 - i) step-down
 - ii) step-up
 - iii) isolation
 - iv) center-tapped
 - v) autotransformer
4. Describe transformer load limitations and determine load limitations from transformer ratings.
5. Describe the difference between open and closed circuit voltages of a class 2 transformer.
6. Describe the procedures used to check operation of a transformer.
7. Describe the operation, wiring and servicing of control or switching relays.
8. Describe the operation, wiring and servicing of motor overload protection devices.
 - i) internal
 - ii) external
9. Describe the operation, wiring and servicing of motor starters.
 - i) electro-mechanical
 - ii) solid state
10. Identify the components of a motor control circuit and describe their function.
 - i) safety
 - ii) operating

11. Describe the procedures used to size or set the safety overload protection.
 - i) auto reset
 - ii) manual reset
12. Compare the application and operation of full voltage, part winding and wye-delta starting.
13. Describe the application, operation and service of autotransformers and starters and their components.

Practical:

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

1. Install, service and repair motor controls and relays.
2. Install and service control transformers.

RF-1500

REFRIGERATION EQUIPMENT

Outcomes:

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

- demonstrate knowledge of installation, maintenance, servicing and repairing refrigeration equipment.

Objectives and Content:

1. Identify types of commercial refrigeration equipment and describe their operating characteristics, application, installation, service and repair.
 - i) merchandisers
 - ii) process refrigeration
 - iii) specialty equipment
 - iv) vending machines
 - v) walk-in / reach-in coolers
 - vi) walk-in / reach-in freezers
 - vii) water fountains
2. Describe the differences to be considered during design, construction and service of freezers and coolers.
 - i) box construction
 - ii) drain placement
 - iii) control
 - iv) defrost
3. Describe the operation of a commercial ice machine.
 - i) cuber
 - ii) flaker
4. Describe the operation of an industrial ice flaker.
5. Describe various harvest methods for ice machines.
6. Describe the procedures used to troubleshoot ice machines.
 - i) water supply
 - ii) refrigeration
 - iii) electrical

Practical:

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

1. Demonstrate check out procedures for refrigeration equipment.
2. Maintain, service and repair refrigeration equipment.

RF-1510

AIR CONDITIONING EQUIPMENT

Outcomes:

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

- understand the application, construction and installation of unitary and split air conditioning systems.
- identify, maintain, service and repair window, rooftop, packaged room and split system air conditioning units.

Objectives and Content:

1. Describe the components, operating characteristics and applications of air conditioning units.
2. Describe installation, service and maintenance procedures for air conditioning units
3. Interpret wiring and control diagrams for air conditioning units.
4. Describe the operating temperatures and pressures of a direct expansion air conditioning system.
 - i) condenser temperature difference
 - ii) discharge temperature
 - iii) evaporator superheat
 - iv) evaporator temperature difference
 - v) subcooling at the condenser
 - vi) suction superheat
 - vii) temperature drop
 - viii) volumes and velocities of air flowing over the cooling coil
5. Describe a systematic check of a direct expansion air conditioning system.

Practical:

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

1. Maintain, service and repair air conditioning equipment.
2. Demonstrate check out procedures of air conditioning equipment.

RF-1520 REFRIGERATION LOAD CALCULATIONS

Outcomes:

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

- calculate a refrigeration heat load.

Objectives and Content:

1. Define refrigeration load and the need to determine an accurate load calculation.
2. Describe individual loads that must be considered when calculating the total refrigeration load.
 - i) transmission
 - ii) air change
 - iii) product
 - iv) miscellaneous
3. Describe heat transfer rates and resistance using K, C, U and R values.
4. Define the term air change and describe the methods of determining the amount of infiltrated air.
5. Describe sources of heat gain that must be considered when calculating product load.
 - i) heat of respiration
 - ii) load profile
 - iii) latent heat
 - iv) sensible heat
6. Describe miscellaneous sources of heat gain that must be considered when calculating refrigeration loads.
 - i) fans
 - ii) lights
 - iii) motors
 - iv) people
 - v) infiltration / usage
7. Describe the procedures used to calculate refrigeration loads.

Practical:

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

1. Calculate heat of transmission loads for fixture temperatures above and below 32°F.
2. Calculate air infiltration loads for fixture temperatures above and below 32°F.
3. Calculate product loads for fixture temperatures above and below 32°F.
4. Calculate miscellaneous loads for fixture temperatures above and below 32°F.
5. Calculate total loads for fixture temperatures above and below 32°F.
6. Calculate and BTU/hr load required for:
 - i) air defrost
 - ii) electric defrost
 - iii) hot gas defrost

RF-1530

REFRIGERATION SYSTEM AND PIPE DESIGN

Outcomes:

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

- apply the principles of refrigeration system design.
- select system components based on design criteria.

Objectives and Content:

1. Describe fundamental design considerations of a refrigeration system.
 - I) system cleanliness
 - ii) capacity at design conditions
 - iii) compressor safe operating conditions
 - iv) oil return
 - pipe sizing
 - hot gas
 - suction
 - liquid
 - condensate
 - velocity
 - single and double risers
 - v) excessive liquid refrigerant at compressor
 - vi) minimize pressure drop in the refrigeration piping
2. Describe the capacity ratings of major components according to industry standards.
3. Describe and compare the required horsepower per ton of a high, medium and low temperature system.
4. Describe the selection of compressors and condensing units.
5. Describe the selection of evaporators and air and water cooled condensers.
6. Describe sizing procedures using graphs and tables.
 - i) compressor
 - ii) multiple compressors
 - iii) compressors with cylinder unloading
 - iv) evaporator
 - v) multiple evaporators operating at the same and different temperatures
7. Describe procedures to graph evaporator and compressor data on a saturated suction temperature capacity chart to determine:
 - i) balance point

- ii) operating saturated suction temperature
- iii) operating evaporator temperature difference
- iv) cabinet relative humidity
- v) system operating capacity

8. Describe the selection of air cooled condensers for a given temperature difference using heat of rejection factors and/or pressure enthalpy diagram.
9. Describe the selection of thermostatic expansion valves.
10. Describe the selection of various system accessories.
11. Describe the suction, liquid, discharge and condensate lines and include the following:
 - i) acceptable fluid velocities
 - ii) acceptable pressure losses
 - iii) oil circulation
 - iv) refrigerant circulation
12. Describe piping practices as applied to the following pipe sections.
 - i) condensate
 - ii) discharge
 - iii) liquid
 - iv) suction
13. Describe the penalty imposed by pressure drop in a refrigeration or air conditioning system and recommended maximum pressure drop.
14. Describe equivalent pipe lengths for fittings and valves.
15. Describe procedures to determine refrigerant pressure losses and velocities from tables.
16. Describe the procedures for selection of refrigerant line sizes.
17. Describe the use, application and selection of double suction and discharge risers.
18. Describe piping problems and solutions.
19. Describe set, run, and travel measurements and apply to constructing offsets.

Practical:

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

1. Select equipment from manufacturers catalogues based on design criteria ensuring that components selected are matched and balanced.
2. Calculate and select proper tubing size for suction, liquid, discharge and condensate lines.
3. Graphically analyze data gathered for the following system components.
 - i) compressor
 - ii) multiple compressors
 - iii) compressors with cylinder unloading
 - iv) evaporator
 - v) multiple evaporators operating at the same and different temperatures
4. Determine refrigerant pressure losses and velocities from tables.

RF-1540 REFRIGERATION AND A/C INSTALLATION 2

Outcomes:

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

- sketch a piping schematic.
- sketch an electrical schematic.
- install refrigeration and air conditioning systems.

Objectives and Content:

1. Describe procedures used to sketch a system piping schematic and include the following:
 - i) isolation valves
 - ii) major components
 - iii) piping and fittings
 - iv) controls and accessories
 - v) safety devices
 - vi) pipe sizes
2. Describe procedures used to sketch a system electrical schematic and include the following:
 - i) cycling controls
 - ii) distribution lines for control and power circuits
 - iii) major system components
 - iv) operating controls
 - v) power sources
 - vi) safety controls
3. Describe the factors that determine optimum location of evaporators and condensers.
4. Describe the selection of refrigerants for high, medium and low temperature applications.
5. Describe the procedures used to create a complete bill of material.
6. Describe the installation of evaporators.
7. Describe the installation of condensing units and condensers.
8. Describe the installation of connecting piping, including pipe supports, slope and insulation where required.

9. Describe the installation of:
 - i) filters and filter/driers
 - ii) metering devices
 - iii) solenoid valves
 - iv) isolation valves
 - v) other flow controls and accessories
10. Describe the installation and wiring of operating and safety controls.
11. Describe the procedures used to perform a leak test.
12. Describe approved evacuation procedures.
13. Describe refrigerant charging procedures.
14. Describe the adjustment of operating and safety controls.
15. Describe system start-up and procedures to check:
 - i) compressor voltage, voltage imbalance and amperage
 - ii) refrigerant charge
 - iii) oil levels
 - iv) operating pressures
 - v) superheat (evaporator and compressor)
 - vi) discharge temperature
 - vii) cabinet temperatures
16. Describe the check out and adjustment of all flow controls.
17. Describe the elements of and the procedures to complete an installation report.
 - i) project objective
 - ii) equipment list
 - iii) schematics and drawings
 - iv) sizing and selection calculations
 - v) refrigerant used
 - vi) balance graphs and charts
 - vii) system test results
 - viii) disposition of recovered refrigerants and hazardous wastes
 - ix) summarize complete installation and shutdown

Practical:

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

1. Install refrigeration and air conditioning systems and components.
2. Check and record system operating conditions.
3. Create a complete bill of material.

RF-1550

SYSTEM CAPACITY CONTROL

Outcomes:

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

- demonstrate knowledge of the requirement for system capacity control.
- identify, install, adjust, service and troubleshoot capacity control devices.

Objectives and Content:

1. Describe capacity control and the importance of balancing system capacity with system load.
2. Describe the negative effects of system imbalance.
3. Describe the use, application, operation and service of evaporator capacity control.
4. Describe the use, application, operation and service of compressor capacity control.
 - I) cylinder unloading
 - cylinder by-pass unloading
 - cylinder suction valve unloading
 - ii) compressor suction limiting
 - iii) hot gas by-pass (artificial load)
 - iv) multiple compressors
 - v) variable speed compressor
5. Describe the procedures used to troubleshoot capacity controls.

Practical:

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

1. Install and adjust various capacity control devices.
2. Troubleshoot capacity controls.

RF-1560 COMPRESSOR DIAGNOSTICS AND REPAIR

Outcomes:

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

- analyze causes of compressor failures.

Objectives and Content:

1. Describe the two modes of compressor failure.
 - i) electrical
 - ii) mechanical
2. Describe the difference between the primary reason for compressor failure and the resultant reason compressor failure.
3. Describe factors that can contribute to compressor electrical failure including:
 - i) defective motor or motor protector
 - ii) improper clean up after a previous compressor failure
 - iii) low, high, or unbalanced voltage/amperage
 - iv) loose wiring or faulty controls
 - v) mechanical failure
 - vi) misapplication of compressor
4. Describe factors that can contribute to compressor mechanical failure including:
 - i) mechanical component failure
 - ii) improper lubrication/oil return
 - iii) high discharge temperatures
 - iv) slugging
5. Describe factors that can contribute to compressor lubrication problems.
 - i) improper liquid refrigerant control
 - ii) refrigerant migration
 - iii) refrigerant floodback
 - iv) flooded starts
 - v) compressor overheating
6. Describe the use and application of:
 - i) pump down cycle
 - ii) pump out cycle
 - iii) solenoid drop
7. Describe compressor efficiency and how it is determined.

8. Describe the difference between oil pressure and net oil pressure.
9. Describe the procedures to determine net oil pressure.

Practical:

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

1. Measure net oil pressure.
2. Disassemble compressors to identify failure.

RF-1570

TROUBLESHOOTING SYSTEMS AND THEIR COMPONENTS

Outcomes:

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

- troubleshoot system and component problems in refrigeration and air conditioning systems.

Objectives and Content:

1. Outline troubleshooting methods for problems with:
 - i) system
 - ii) compressor
 - iii) evaporator
 - iv) condenser
 - v) metering devices
 - vi) electrical components
2. Outline procedures used to troubleshoot systems and components.

Practical:

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

1. Troubleshoot:
 - i) systems
 - ii) compressors
 - iii) evaporators and condensers
 - iv) metering devices
 - v) electrical controls and circuits

RF-1580

PSYCHROMETRICS

Outcomes:

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

- predict the changes in air properties in the air conditioning process.
- measure and plot the changes in air properties as it is being conditioned.

Objectives and Content:

1. Describe the following terms in relation to a psychrometric chart:
 - I) dry bulb temperature
 - ii) wet bulb temperature
 - iii) dew point
 - iv) total heat content
 - latent
 - sensible
 - v) moisture content
 - vi) relative humidity
 - vii) specific volume
2. Identify the property points and constant property lines represented on a psychrometric chart.
3. Describe the air conditioning process, identify the air properties and the procedures used to plot on a psychrometric chart.
 - i) air mixing
 - ii) by-pass factor
 - iii) cooling and dehumidification
 - iv) heating and humidification
 - v) evaporative cooling
 - vi) dehumidification
 - vii) humidification
 - viii) sensible cooling
 - ix) sensible heating
4. Describe the changes in air properties for the following situations:
 - i) sensible heating and cooling
 - ii) heating and humidification
 - iii) cooling and dehumidification
 - iv) air mixing
 - v) evaporative cooling
5. Describe air volume flow rate required for a zone.

6. Describe the calculations for determining:
 - i) latent heat
 - ii) sensible heat
 - iii) total heat

Practical:

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

1. Plot system conditions on a psychrometric chart.
2. Calculate latent, sensible and total heat.
3. Determine the quantity of water required to raise the relative humidity to a pre-determined level.

RF-1590

AIR CONDITIONING SYSTEM DESIGN

Outcomes:

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

- apply fundamental air conditioning design principles.

Objectives and Content:

1. Describe types of air conditioning systems.
 - i) air conditioning system
 - ii) comfort air conditioning
 - iii) industrial air conditioning
 - iv) year round air conditioning
2. Identify and describe the components of a comfort air conditioning system.
3. Describe the conditioned variables controlled in a comfort zone.
4. Describe the difference between air recirculation and ventilation.
5. Describe the use, application and operation of economizers.
 - i) built-up
 - ii) packaged
6. Describe air volumes and velocities of air circulation at various points in an air conditioning circuit.
7. Identify and describe the two main types of fans.
 - i) axial
 - ii) radial
8. Describe and identify the location of the following:
 - i) supply air grills/ducts
 - ii) return air grills/ducts
 - iii) exhaust air/ducts
9. Identify the following accessories and describe their use and applications.
 - i) humidifiers
 - ii) air cleaners
 - iii) economizers
 - iv) heaters
10. Describe the use, application and methods of zoning.

11. Describe the following:
 - i) core areas
 - ii) multi-purpose occupancies
 - iii) perimeter areas
 - iv) single purpose occupancies
12. Identify types of unitary equipment and describe their use and applications.
13. Describe the operation of the following systems:
 - i) constant volume single zone
 - ii) constant volume terminal reheat
 - iii) constant volume dual duct
 - iv) constant volume multi-zone
 - v) constant volume face and by-pass
 - vi) variable air volume
14. Describe the operation of chilled water systems, indicating system variations and methods of providing ventilation.

Practical:

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

1. Select system components based on design criteria.
2. Compare operating capacity to design capacity using manufacturers data.

RF-1600

HEAT PUMP SYSTEMS

Outcomes:

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

- apply heat pump principles of operation in installing, servicing and troubleshooting heat pumps.

Objectives and Content:

1. Define heat pump and describe the principle of operation.
2. Describe the different classifications of heat pumps.
 - i) air to air heat pump
 - ii) water/liquid to air heat pump
3. Describe the use and function of a four way valve.
4. Define the terms:
 - i) auxiliary heat
 - ii) balance point
 - iii) coefficient of performance (COP)
 - iv) emergency heat
 - v) indoor coil
 - vi) outdoor coil
 - vii) energy efficiency rating (EER)
 - viii) seasonal energy efficiency rating (SEER)
5. Describe the use, application and operation of the defrost cycle as related to heat pumps.
6. Describe the use and application of Geothermal heat pumps.
 - i) closed loop
 - ii) open loop
7. Describe environmental considerations when selecting Geothermal heat pumps.
 - i) primary refrigerants
 - ii) secondary refrigerants
8. Describe the use and application of freeze protection for water to air heat pumps.
9. Describe water quality as related to open loop systems.
 - i) volume of water available
 - ii) temperature of well water

- iii) mineral content

10. Explain the formula to determine the quantity of water required to either absorb or reject the required heat in a Geothermal heat pump.
11. Describe typical control sequences for heat pumps.
12. Describe troubleshooting procedures:
 - i) 4-way valve
 - ii) airside
 - iii) defrost
 - iv) waterside
 - v) controls

Practical:

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

1. Troubleshoot heat pump systems.

RF-1610

FANS, MECHANICAL DRIVES AND AIR FILTRATION

Outcomes:

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

- apply the principles of air movement, fan operation and filter application.
- identify types of fans used in the industry.
- align and adjust fan and blower drives.
- identify and select filters for various applications.

Objectives and Content:

1. Describe fans and how they move air.
2. Describe the two types of fans or blowers used in air conditioning equipment.
 - I) Axial
 - Propeller type
 - vane type
 - ii) Radial
 - backward curved
 - forward curved
 - straight
3. Define the following terms as they apply to fans.
 - i) blocked tight static pressure
 - ii) centrifugal or radial flow
 - iii) fan static pressure
 - iv) fan total pressure
 - v) guide vanes
 - vi) impeller and casing
 - vii) propeller and casing
 - viii) propeller or axial flow
 - ix) wide open volume flow
4. Describe clockwise and counter-clockwise rotation of a propeller fan and how to distinguish the proper rotation of a fan blade.
5. Describe the use, application and interpretation of a fan performance curve chart.
6. Describe the two types of drives for fans.
 - i) belt drive
 - ii) direct drive

7. Identify types of bearings and describe methods of lubrication.
8. Describe factors that affect fan performance.
 - i) pitch
 - ii) rotation
 - iii) diameter
 - iv) speed
 - v) number of blades
 - vi) motor horsepower
 - vii) balance
9. Describe the effects of fan speed changes using fan laws.
10. Describe the effects of varying pulley sizes on belt driven blower units.
11. Describe the use, application and adjustment of variable pitch pulleys.
12. Identify the types of V-belts and describe their sizes, installation and adjustment.
13. Identify the types of mechanical air filters and describe their operation, installation and servicing.
14. Identify special application type filters and describe their use.
 - i) HEPA
 - ii) activated carbon
 - iii) activated alumina with potassium permanganate
 - iv) electrostatic
 - v) other
15. Describe how mechanical air filters are rated.
 - i) efficiency
 - ii) resistance
 - iii) particulate holding capacity
16. Describe methods to monitor filter efficiency.
17. Describe the use and operation of electronic air cleaners.
18. Describe the differences between the operation and efficiency of electronic air cleaners and mechanical filters.
19. Describe troubleshooting techniques for electronic air cleaners.

Practical:

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

1. Demonstrate blower belt replacement, adjustment and alignment.
2. Demonstrate pulley/sheave removal, replacement, alignment and adjustment.
3. Troubleshoot electronic air cleaners.
4. Demonstrate blower fan speed adjustment.

RF-1620

AIR MEASURING INSTRUMENTS AND SYSTEM BALANCING

Outcomes:

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

- apply the principles of air measurement in the servicing of air conditioning equipment.
- measure air quantities from grills, diffusers and ductwork.

Objectives and Content:

1. Describe the use, application and operating principles of the following instruments.
 - i) pitot tube and inclined manometer
 - ii) flowhood
 - iii) rotating vane anemometer
 - iv) sling psychrometer
 - v) thermal anemometer
 - vi) tachometer
 - vii) velometer
2. Define the terms:
 - i) CFM
 - ii) LS
 - iii) FPM
 - iv) MS
 - v) static pressure
 - vi) velocity pressure
 - vii) total pressure
3. Describe the procedures used to measure air flow using the “temperature rise” method.
4. Describe duct traverse and the procedures used to measure average air velocity in a square, rectangular or round duct.
5. Describe the use and application of a duct friction chart.
6. Describe the use, application and interpretation of the “circular equivalents of rectangular duct” chart.
7. Describe air balancing, the procedures and associated reports.

Practical:

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

1. Demonstrate air measurement with various instruments.

RF-1630

CONTROL APPLICATIONS AND COMPONENTS

Outcomes:

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

- Identify and apply system control applications used in air conditioning systems.

Objectives and Content:

1. Describe sequence of operation, system layout and component inter-relationship of a ventilation control system using an H diagram.
 - i) fan interlock
 - ii) minimum position
 - iii) damper location
2. Describe sequence of operation, system layout and component inter-relationship of a mixed air control system using an H diagram.
 - i) fan interlock
 - ii) mixed air control
 - iii) minimum position
 - iv) damper location
3. Describe sequence of operation, system layout and component inter-relationship of an economizer control system using an H diagram.
 - i) fan interlock
 - ii) mixed air control
 - iii) changeover thermostat and/or enthalpy control
 - iv) minimum position
 - v) damper location
4. Describe sequence of operation, system layout and component inter-relationship of a heating control system, both space or discharge air controlled using an H diagram.
 - i) fan interlock
 - ii) low limit
 - iii) supply or space temperature
5. Describe sequence of operation, system layout and component inter-relationship of an outdoor air temperature reset (of discharge air) control system, using an H diagram.
 - i) fan interlock
 - ii) discharge controller

- iii) outdoor air temperature reset controller
- iv) low limit

6. Describe sequence of operation, system layout and component inter-relationship of a VAV control system with cooling (c/w economizer) using an H diagram.

- i) fan interlock
- ii) mixed air low limit
- iii) minimum position
- iv) changeover controller
- v) static pressure controller and inlet vane motor
- vi) low limit controller
- vii) damper location
- viii) VAV controls
- ix) space thermostat

Practical:

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

1. Establish sequence of operation and line diagrams showing component inter-relationship for various control applications.

RF-1640 UNDERSTANDING, INTERPRETING AND TROUBLESHOOTING WIRING DIAGRAMS

Outcomes:

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

- read, interpret and draw pictorial and schematic wiring diagrams.
- troubleshoot systems using wiring diagrams.

Objectives and Content:

1. Describe the difference between a pictorial wiring diagram and a schematic (ladder) wiring diagram.
2. Describe and illustrate standard wiring symbols used in schematic wiring diagrams.
 - i) capacitor
 - ii) circuit breaker
 - iii) crossing wires (no connection)
 - iv) crossing wires (connection)
 - v) delay switches
 - vi) double pole double throw switch
 - vii) double pole single throw
 - viii) flow switch
 - ix) fuses
 - x) ground
 - xi) humidity control
 - xii) normally open and normally closed contacts
 - xiii) overloads
 - xiv) pressure control
 - xv) relay coil
 - xvi) temperature
 - xvii) transformer
 - xviii) single pole single throw switch
 - xix) single pole double throw switch
3. Describe the format of a schematic wiring diagram.
4. Describe what is meant by “normally open” or “normally closed” when referring to a switch in a schematic wiring diagram.
5. Describe the procedure used to read a schematic wiring diagram when troubleshooting electric circuits.
6. Describe the “hopscotch” method when troubleshooting schematic wiring diagrams.

Practical:

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

1. Draw schematic diagrams of various circuits.
2. Convert pictorial diagrams to schematic diagrams.
3. Determine system sequence of operation from schematic diagrams.

RF-1650

INDUSTRIAL SYSTEM COMPONENTS

Outcomes:

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

- Identify and troubleshoot components in industrial systems.

Objectives and Content:

1. Describe the use, application, operation and location of the following:
 - i) automatic purgers
 - ii) distillers
 - isolation valves
 - relief valve arrangement
 - iii) flow control valves (DX and flooded systems)
 - liquid level controls
 - level alarms
 - pressure regulators
 - solenoid and check valves
 - iv) oil separators and receivers
 - v) traps and accumulators
 - vi) safety valves
 - checkvalve
 - high and low side valves
 - fire valve
 - vii) stop valves
 - isolation and bypass valves
 - service and charging valves
2. Describe oil return to compressors in industrial systems.
 - i) manual control
 - ii) automatic control
 - iii) oil accumulation (oil drains)
3. Describe methods of compressor cooling.
 - i) de-superheat jackets
 - ii) water jackets

Practical:

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

1. Tour an operating industrial plant with the plant engineer and identify system components and review their operation.

RF-1660 AIR CONDITIONING LOAD CALCULATIONS

Outcomes:

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

- Calculate an air conditioning load.

Objectives and Content:

1. Describe air conditioning load.
2. Describe the variables that effect the heating and cooling load.
3. Describe peak load.
4. Describe the terms:
 - i) design conditions
 - ii) solar load
 - iii) conduction load
 - iv) internal load
 - v) infiltration and/or ventilation load
5. Describe heat transfer rates using K, C, U and R values.
6. Describe “American Society of Heating Refrigerating Air-Conditioning Engineers” (ASHRAE) and discuss their role as a resource in the design of HVAC and R systems.
7. Describe the load calculation procedure for heating and cooling.

Practical:

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

1. Perform heat loss/gain calculations and select equipment using manufacturers’ data.
 - i) residential
 - ii) commercial

RF-1670

DUCT SYSTEMS AND DESIGN

Outcomes:

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

- apply duct design principles to troubleshoot, install and service air conditioning systems.

Objectives and Content:

1. Describe the use and application of the following duct systems:
 - i) high pressure
 - ii) medium pressure
 - iii) low pressure
2. Describe how duct size, shape and system operating pressure and velocity affect construction and operating costs of a duct system.
3. Describe velocity, static and total pressure and their effect on duct sizing.
4. Describe the use and application of the following segments of ductwork:
 - i) exhaust duct
 - ii) outside air duct
 - iii) relief duct
 - iv) return duct
 - v) supply duct
5. Describe the use and application of duct insulation.
 - i) acoustic
 - ii) thermal
6. Define the term “sound attenuation” and describe methods of reducing sound transmission.
7. Describe duct construction materials, shape, gauge and application.
 - i) round
 - ii) flexible
 - iii) oval
 - iv) square
 - v) rectangular
8. Describe the use and application of the following dampers used in duct systems.
 - i) backdraft
 - ii) balancing

- iii) fire
- iv) smoke
- v) splitter
- vi) volume

9. Describe the term “equivalent length” when referring to duct fittings.
10. Describe “COANDA effect” in relation to ceiling diffusers.
11. Describe the following components:
 - i) diffuser
 - ii) grill
12. Describe characteristics of a ducted air distribution system and include:
 - i) diffuser and grill placement
 - ii) diffuser throw and terminal velocity
13. Describe the recommended face velocities for the following:
 - i) filters
 - ii) louvers
 - iii) coils
 - iv) return air grills
14. Describe the use and application of the following duct fittings.
 - I) boot fitting
 - ii) cleats
 - drive
 - “S”
 - iii) end cap
 - iv) elbow
 - horizontal
 - vertical
 - v) flexible duct connector
 - vi) offset
 - vii) plenums
 - viii) radius tee
 - ix) riser
 - x) starting collar
 - xi) transitions
 - xii) take-offs
 - xiii) turning vanes
15. Describe friction loss and the use and application of duct friction loss chart.
16. Describe the use and application of a circular equivalent of rectangular duct chart.

17. Describe methods of sizing duct.
 - i) equal friction
 - ii) extended plenum (reduced velocity)
18. Describe air leakage and its control.

Practical:

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

1. Size a residential duct system based on design criteria.
2. Size a commercial duct system based on design criteria.

RF-1680

HUMIDIFICATION AND DEHUMIDIFICATION EQUIPMENT

Outcomes:

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

- apply the principles of humidification and dehumidification to select and install associated equipment.

Objectives and Content:

1. Define the terms:
 - i) dehumidification
 - ii) humidification
 - iii) relative humidity
 - iv) dry bulb temperature
 - v) wet bulb temperature
2. Describe the following using a psychrometric chart.
 - i) dehumidification
 - ii) humidification
3. Describe problems that can be created by excessively dry air.
 - i) comfort
 - ii) health
 - iii) static electricity
 - iv) moisture stability of products in the production process
 - v) structural problems
4. Describe problems that can be created by excessively humid air.
 - i) condensation
 - ii) mold
 - iii) health
 - iv) comfort
5. Describe the use and operation of the following controls.
 - i) dehumidistat
 - ii) humidistat
6. Describe the procedure for sizing a humidifier.
7. Describe the procedure for sizing a dehumidifier.

8. Identify types of humidifiers and describe their operation and installation.
 - I) atomizing
 - compressed air
 - impeller
 - ultrasonic
 - ii) electric
 - steam injection
 - vaporizing
 - iii) rotating plate
 - iv) rotating drum
 - v) steam

9. Identify types of dehumidifiers and describe their operation and installation of dehumidifiers.
 - I) refrigerated
 - residential
 - commercial
 - pool dehumidification
 - rink dehumidification
 - ii) desiccant
 - heat recovery ventilator
 - heat wheel

Practical:

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

1. Calculate the size of a humidifier based on a given criteria and select equipment from manufacturer's data.

2. Calculate the size of a dehumidifier based on a given criteria and select equipment from manufacturer's data.

RF-1690 INSTALLATION OF AIR CONDITIONING EQUIPMENT

Outcomes:

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

- install residential and commercial air conditioning systems.

Objectives and Content:

1. Describe the installation of packaged rooftop air conditioners.
 - i) accessory installation
 - ii) controls
 - iii) drain piping and traps
 - iv) duct connections
 - v) location
 - vi) power supply
 - vii) rigging and hoisting considerations
 - viii) roof penetrations/roof curb
 - ix) roof supports
 - x) start-up and check out
2. Describe the installation of a split air conditioning system.
 - i) controls
 - ii) drain piping, traps and overflow protection
 - iii) duct connections
 - iv) location of indoor coil and condensing unit
 - v) refrigeration piping
 - vi) power supply
 - vii) rigging and hoisting considerations
 - viii) support of indoor coil
 - ix) start-up
 - x) wall penetrations
3. Describe the installation of a ductless split air conditioning system:
 - i) controls
 - ii) drain piping and traps
 - iii) location of indoor coil and condensing unit
 - iv) refrigeration piping
 - v) power supply
 - vi) rigging and hoisting considerations
 - vii) support of indoor coil
 - viii) start-up
 - ix) wall penetrations

4. Describe the installation of a “window” or ‘through the wall’ air conditioning system.
 - i) location
 - ii) power supply
 - iii) rigging and hoisting considerations
 - iv) support
 - v) start-up
 - vi) wall penetrations
 - window mount
 - wall mount

5. Describe the installation of packaged water cooled air conditioners.
 - i) accessory installation
 - ii) controls
 - iii) drain piping and traps
 - iv) duct connections and/or diffuser
 - v) location
 - vi) power supply
 - vii) rigging and hoisting considerations
 - viii) start-up
 - ix) water supply

Practical:

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

1. Review manufacturers’ installation data.

2. Examine various air conditioning installations and discuss installation techniques.

RF-1700 AIR CONDITIONING SYSTEM TROUBLESHOOTING

Outcomes:

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

- troubleshoot air conditioning system problems.

Objectives and Content:

1. Discuss problems resulting from incorrect velocities and volumes of air flow through cooling coils.
2. Describe factors that cause low and high air flow rates and corrective measures.
3. Describe and illustrate the effects, using fan laws, on fan motor operation when increasing or decreasing air flow.
4. Describe methods of determining mixed air temperature and percent of outside air.
5. Describe the troubleshooting procedures for the following components:
 - i) room thermostats
 - electro-mechanical
 - electronic
 - ii) damper motors
 - iii) damper motor stroking and linkage adjustment
 - iv) economizers
 - enthalpy control or outside air thermostat
 - mixed air control
 - minimum position
6. Describe the symptoms of the following problems and their corrective measures:
 - i) high and low head pressure
 - ii) high and low load
 - iii) inefficient compressor
 - iv) liquid line restriction
 - v) system under/overcharge
7. Describe the symptoms of improper zone control and air distribution and their corrective measures.

Practical:

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

1. Determine the ventilation air requirement and calculate the mixed air temperature to calibrate the minimum position of an economizer.
2. Set-up operation and calibrate a rooftop economizer system.
3. Analyze and adjust air flow on an operating air conditioning system.

RF-1710

ENERGY MANAGEMENT AND INDOOR AIR QUALITY

Outcomes:

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

- apply fundamental indoor air quality principles to identify indoor air quality problems and apply corrective measures.
- identify energy inefficiencies in the operation of refrigeration and air conditioning systems and apply corrective measures.

Objectives and Content:

1. Describe various indoor airborne contaminants, their sources and cost to the economy and health.
 - i) gaseous
 - ii) liquid
 - iii) organic
 - iv) smoke
 - v) smog
 - vi) solid
2. Describe methods of controlling indoor contaminants.
 - I) eliminate source of contamination
 - ii) ventilation
 - heat recovery ventilator
 - heat exchanger
 - infiltration
 - mechanical ventilation
 - iii) air cleaning
 - mechanical filters
 - electronic air cleaners
 - ion generator
3. Describe how air conditioning systems can maximize indoor conditions for best comfort and health environments.
4. Describe ventilation air and discuss the recommended ventilation air quantities required for various applications.
5. Describe efficiency ratings.
 - i) energy efficiency rating (EER)
 - ii) seasonal energy efficiency rating (SEER)
 - iii) coefficient of performance (COP)
 - iv) heating season performance factor (HSPF)

6. Describe the effect on refrigeration system efficiency including:
 - i) control settings
 - ii) case loading
 - iii) defrost
 - iv) head pressure control
 - v) pipe sizing
 - vi) system balance
 - vii) system charge
 - viii) component cleanliness
7. Describe the effect on air conditioning system efficiency including:
 - I) capacity control
 - ii) system control
 - iii) economizers
 - outside air temperature changeover
 - enthalpy control changeover
 - iv) heat recovery
 - run around loop
 - heat wheel
 - heat pipes
8. Describe methods of energy management and their benefits.
 - I) ventilation control
 - minimize outdoor air for ventilation
 - low leakage dampers
 - close ventilation during unoccupied periods
 - ii) free cooling
 - economizer
 - cooling tower
 - iii) exhaust fan control
 - manual control (as opposed to continuous)
 - timed control
 - backdraft dampers
 - iv) reset control of heating and cooling setpoints
 - v) equipment scheduling
 - vi) night setback of heating and setup of cooling setpoints
 - vii) conversion of constant volume systems to variable air volume
 - viii) optimum start/stop
 - ix) power demand monitoring

Practical:

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

1. Calculate ventilation requirements of a commercial air conditioning installation.
2. Develop an energy management strategy based on a given building model.

RF-1720

CHILLERS AND CHILLER SYSTEMS

Outcomes:

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

- troubleshoot and service chiller systems.

Objectives and Content:

1. Describe the application of liquid chilling to commercial refrigeration, industrial refrigeration and to comfort air conditioning.
2. Describe the components and operation of a reciprocating comfort air conditioning chiller system.
3. Describe the components of an ice rink chiller system and its operation.
4. Describe control schematics of reciprocating comfort air conditioning chillers and identify specific controls including:
 - i) freeze protection
 - ii) time delays
 - iii) flow switches
 - iv) interlocks
5. Describe control schematic diagrams of ice rink chillers.
6. Describe the motor cooling cycle of centrifugal chillers.
7. Describe the lubrication cycle of centrifugal chillers.
8. Identify types of high efficiency purge units and describe their use, applications and service.
9. Describe the start-up procedure of a centrifugal chiller using an electrical schematic diagram.
10. Describe the methods of capacity control of chillers.
 - i) reciprocating
 - ii) centrifugal
 - iii) screw
 - iv) scroll
11. Describe the function of the thrust balance disc and the labyrinth seals in a centrifugal chiller.

12. Describe the refrigeration cycle in a single and multistage centrifugal chiller.
13. Describe the differences in chiller barrels used with direct expansion and flooded chiller systems.
14. Describe chiller barrel components including:
 - i) baffles
 - ii) tube sheet
 - iii) passes
 - iv) circuits
 - v) star inserts
 - vi) range
 - vii) approach
 - viii) surge drum
15. Describe procedures to determine the fluid flow rate and the pump head required for a chiller application.
16. Describe the procedures to install a chiller system and include:
 - i) mounting
 - ii) piping
 - iii) cooling tower connections
 - iv) power wiring
 - v) control wiring
 - vi) chilled water pumps
 - vii) all accessories
17. Describe the charging, checking and adding of brine to an ice rink (vented) system.
18. Describe the charging, checking and adding of water to an air conditioning chiller (not vented) system.
19. Describe the service and the repair of chiller barrels including the repair and replacement of tubes.
20. Describe the start-up and shut-down of an air conditioning chiller system.
21. Describe the start-up and shut-down of an ice rink chiller.
22. Describe surging, its cause and cure in a centrifugal chiller system.
23. Explain the function of the load demand limiter.
24. Describe the application of free cooling with centrifugal chiller systems.

25. Describe the procedures and precautions associated with leak testing low pressure chillers.

Practical:

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

1. List start-up procedures of reciprocating chillers from manufacturer's data.
2. List start-up procedures of ice rink chillers from manufacturer's data.
3. List start-up procedures of centrifugal chillers from manufacturer's data.

RF-1730 MULTIPLEX REFRIGERATION SYSTEMS

Outcomes:

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

- apply the principles of operation to install, service and troubleshoot multiplex refrigeration systems.

Objectives and Content:

1. Describe the use, application and advantages of multiplex refrigeration systems.
2. Describe operation, piping schematic, control valve placement, installation, service and troubleshooting of a commercial parallel rack refrigeration system and include:
 - I) alarms
 - ii) defrost
 - hotgas
 - koolgas ®
 - defrost clock
 - electronic
 - mechanical
 - iii) evaporator temperature control
 - evaporator pressure regulator
 - thermostat and solenoid
 - iv) electronic metering devices
 - v) field piping
 - condenser
 - evaporators
 - heat reclaim
 - air
 - water
 - vi) head pressure control
 - flooded
 - temperature and/or pressure
 - split condenser
 - floating head
 - vii) low and medium temperature applications
 - viii) multi compressor control
 - pressure (conventional)
 - electronic
 - ix) oil level control
 - x) split suction header

3. Describe the operation, installation, service, maintenance and troubleshooting of refrigerated cases and boxes including:
 - I) dairy case
 - ii) frozen food case
 - coffin case
 - doors
 - open multi deck
 - iii) fish case
 - iv) meat prep room
 - v) meat case
 - vi) produce case
 - vii) walk-in freezer
 - viii) walk-in cooler

Practical:

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

1. Review system operation from manufacturers service data.
2. Demonstrate service procedures and control adjustments on operating system.
3. Review refrigerated case installation from manufacturer's data.

RF-1740

**SPECIALTY SYSTEMS
(ULTRA-LOW, CRYOGENIC)**

Outcomes:

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

- apply the principles of operation to troubleshoot and service cryogenic and ultra-low refrigeration systems.

Objectives and Content:

1. Describe cryogenics and describe its applications.
2. Describe the fluid used in cryogenics.
3. Describe the safety precautions required when working on cryogenic systems.
4. Describe ultra low refrigeration and its applications.
5. Describe the use, operation and application of a cascade refrigeration system and include system components and controls.
6. Describe the use, operation and application of a compound refrigeration system and include system components and controls.
7. Describe the purpose of compound systems in ultra-low refrigeration and the suitable refrigerants.
8. Describe the start-up and charging procedure of a cascade refrigeration system.
9. Describe the start-up and charging procedure of a compound refrigeration system.
10. Describe the special precautions when installing and servicing cascade and compound refrigeration systems.

Practical:

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

1. Sketch compound and cascade refrigeration systems' piping configurations.
2. Review charging procedures from manufacturer's data.

RF-1750

CONTROL APPLICATION AND COMPONENTS

Outcomes:

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

- install, service, repair and troubleshoot refrigeration and air conditioning controls components.

Objectives and Content:

1. Describe operation, service and troubleshooting of control systems found on rooftop heat/cool packaged equipment.
2. Describe the difference between the application of two position controllers and modulating controllers.
3. Describe the operation of the following types of control.
 - i) Proportional (P)
 - ii) Proportional plus Integral (PI)
 - iii) Proportional plus Integral plus Derivative (PID)
4. Describe the use, application and operation of a pneumatic control system.
5. Define the terms:
 - i) direct acting
 - ii) reverse acting
6. Identify types of electric and electronic damper motors and describe their operation, service and repair.
 - i) two-wire motor and controls
 - ii) three-wire motor and controls
 - iii) spring return motors
7. Identify types of dampers and describe their purpose, operation, adjustment and service.
8. Identify types of valves and describe their purpose, operation, application and service.
 - i) two-way
 - ii) three-way
 - mixing
 - diverting

9. Describe the application, operation, service, maintenance and troubleshooting of an economizer and include.
 - I) actuator
 - ii) ambient lock-out
 - iii) controls
 - enthalpy control
 - outside air thermostat
 - minimum positioner
 - mixed air thermostat
 - iv) dampers
 - v) relays
 - vi) spring return
 - vii) two position and modulating
10. Describe the use, application, operation and troubleshooting of time delay relays.
11. Describe the use, application operation and troubleshooting of impedance relays as used in a lockout circuit.

Practical:

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

1. Troubleshoot various air conditioner control systems using manufacturer' electrical diagrams.
2. Troubleshoot economizers using various manufacturer's electrical diagrams.
3. Sketch the components of a basic pneumatic control system.
4. Wire time delay and lockout circuits.

RF-1760

BASIC ELECTRONICS

Outcomes:

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

- identify and test fundamental electronic components related to circuit boards.

Objectives and Content:

1. Define and describe the use, application, operation and testing of the following:
 - i) diode
 - cathode
 - anode
 - forward and reverse biased
 - light emitting diode (LED)
 - symbols
 - ii) full wave bridge rectifier power supply
 - polarity identification
 - symbol
 - iii) photocell
 - iv) thermistor
 - N.T.C.
 - P.T.C.
 - symbol
 - v) thermistors
 - silicon controlled rectifier (SCR)
 - cathode
 - anode
 - gate
 - symbol
 - triac
 - main terminal 1
 - main terminal 2
 - gate
 - symbol
 - heatsink
2. Describe the use, application, operation, testing and color coding of resistors.
3. Describe the use, application and troubleshooting procedure of circuit boards.
 - i) manufacturer test procedures
 - ii) inputs
 - iii) outputs
 - iv) power supply

- v) wiring
 - connections
 - grounds
 - shorts

Practical:

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

1. Outline manufacturer's electronic circuit board test procedures.
2. Test and identify various electronic components.

RF-1770

WIRING DIAGRAMS

Outcomes:

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

- troubleshoot refrigeration and air conditioning systems from interpreting electrical wiring diagrams.

Objectives and Content:

1. Describe system sequence of operation for the following systems using their associated wiring diagrams.
 - I) chiller
 - ii) heat pump
 - iii) ice cuber
 - iv) ice flaker
 - v) refrigeration condensing unit
 - vi) refrigeration defrosts
 - electric
 - hotgas
 - vii) rooftop air conditioner
 - viii) split air conditioner
 - ix) window air conditioner
2. Describe methods of troubleshooting electrical circuits using various meters.
 - i) ammeter
 - ii) voltmeter
 - iii) ohmmeter
3. Describe troubleshooting procedures when using a schematic wiring diagram.

Practical:

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

1. Using a wiring diagram, troubleshoot:
 - i) walk-in freezer
 - ii) rooftop air conditioner
 - iii) air conditioning chiller
 - iv) ice rink chiller
 - v) ice machine
 - vi) heat pump

RF-1780

SPECIALIZED CONTROL SYSTEMS

Outcomes:

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

- identify D.D.C. (direct digital control) control applications and components and understand D.D.C. system capabilities.

Objectives and Content:

1. Define the terms:
 - I) application software
 - ii) analog
 - iii) converter
 - analog to digital
 - digital to analog
 - iv) CPU front end
 - v) D.D.C.
 - vi) digital
 - vii) input/output devices
 - viii) microprocessor-based controller
 - ix) point
 - x) software
 - operating software
 - application software
 - direct digital control software
 - energy management software
 - optimum start/stop
 - night cycle
 - night purge
 - enthalpy
 - load reset
 - zero energy band
 - distributed power demand
 - building management software
 - alarm lockout
 - alarm monitoring
 - communications module
 - global points
 - run time
 - time and event programs
2. Describe advantages of a D.D.C. control system over a conventional control system.

3. Describe the types or levels of controllers found in commercial buildings.
 - I) system level controller
 - ii) zone level controller
4. Describe and sketch a typical configuration of a microprocessor controller used for an automatic control application.

Practical:

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

1. List the control capabilities of a D.D.C. control system applied to a small commercial building.
2. View an operating D.D.C. control system installed at a facility.

RF-1790 INDUSTRIAL REFRIGERATION SYSTEMS

Outcomes:

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

- install, maintain, service, repair and troubleshoot flooded, liquid recirculating, direct expansion and compound systems.

Objectives and Content:

1. Describe the types of compressors used in industrial refrigeration systems.
 - I) reciprocating
 - V type
 - W type
 - V.S.A. type
 - compound
 - ii) helical screw
 - iii) rotary booster
2. Describe the types of capacity control for the above compressors.
3. Describe the types of condensers used in industrial systems.
 - I) water cooled condensers
 - ii) evaporative condensers
4. Describe the types of metering devices used in industrial systems.
 - I) high side float
 - ii) low side float
 - iii) liquid level control
 - float and solenoid
 - electronic sensor
 - level master control
 - iv) thermostatic expansion valve
 - v) hand expansion valve
 - flow control
 - flow regulation
 - throttle valves
5. Describe the types of evaporators used with industrial systems.
 - I) direct expansion
 - blower coils
 - bare pipe coils
 - ii) flooded blower coils
 - upflow
 - downflow
 - iii) flooded gravity systems
 - rate of recirculation
 - low pressure receiver

- chiller barrels
- separation header

6. Describe the function and location of the intercooler.

- I) vertical
- ii) subcooling coil

7. Describe the function and location of these ancillary devices:

- I) controlled pressure receiver
- ii) dump tanks
- iii) emergency fire box
 - emergency valve
 - emergency switch
- iv) liquid return drum
- v) oil separator
- vi) oil return solenoid
- vii) oil drain valves
- viii) pumper drums
- ix) pilot receiver
- x) surge drums

8. Describe the type and function of the centrifugal recirculating pump in the liquid overfeed system of an industrial system.

- I) rate of recirculating
 - up flow evaporators
 - down flow evaporators
 - brine recirculating system

9. Describe the function and location of an automatic purger for an industrial system.

Practical:

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

1. View operating refrigeration plant with the plant engineer and identify system components and review their operation.

***MA-1060**

BASIC MATH

Description:

This course in Basic Math requires knowledge of general mathematical concepts and processes to enable trades persons to function in the institutional setting by developing numeracy skills required for technical courses. This math course should also provide a foundation for experiential learning through a knowledge of math relating to on-the-job skills and practices.

Course Outcomes:

1. To develop numeracy skills and knowledge required for institutional and on-the-job learning.
2. To develop the capability to apply mathematical concepts in the performance of trade practices.
3. To develop an appreciation for mathematics as a critical element of the learning environment
4. To use mathematical principles accurately for the purposes of problem solving, job and materials estimation, measurement, calculation, system conversion, diagram interpretation and scale conversions, formulae calculations, and geometric applications.

Prerequisites:

Course Duration: 60 hrs.

Course Objectives (Knowledge):

1. Define and calculate using whole number operations
2. Define and demonstrate use of correct orders of operations
3. Demonstrate examples of operations with fractions and mixed numbers
4. Demonstrate examples of operations with decimals
5. Demonstrate examples of operations with percentages
6. Employ percent/decimal/fraction conversion and comparison
7. Define and calculate with ratios and proportions

8. Use the Imperial Measurement system in relevant trade applications
9. Use the Metric Measurement system in relevant trade applications
10. Perform Imperial/Metric conversions
11. Define and demonstrate the formulation of variables
12. Demonstrate and define the various properties of angles and make relevant calculations

Major Tasks/Sub-tasks (Skills):

Note: To emphasize or further develop specific knowledge objectives, students may be asked to complete practical demonstrations which confirm proper application of mathematical theory to job skills.

REQUIRED RELATED COURSES

CM-2150

WORKPLACE COMMUNICATIONS

Description:

This course is designed to introduce students to the principles of effective communication including letters, memos, short report writing, oral presentations and interpersonal communications.

Course Outcomes:

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

- understand and apply communication skills as outlined in the Employability Skills 2000, Conference Board of Canada
- 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 and orally present an informal report
- examine effective listening skills and body language in communication

Objectives and Content:

1. Apply rules and principles for writing clear, concise, complete sentences which adhere to the conventions of grammar, punctuation, and mechanics.
2. Explain the rules of subject-verb agreement.
3. Define and describe the major characteristics of an effective paragraph
4. Examine the Value of Business Writing Skills
 - i) Describe the importance of effective writing skills in business
 - ii) Describe the value of well-developed writing skills to career success as referenced in the Employability Skills
5. Examine Principles of Effective Business Writing
 - i) Discuss the rationale and techniques for fostering goodwill in business communication, regardless of the circumstances
 - ii) Review the importance of revising and proofreading
 - iii) Differentiate between letter and memo applications in the workplace & review samples
 - iv) Identify the parts of a business letter and memo
 - v) Review the standard formats for business letters and memos
 - vi) Examine samples of well-written and poorly written letters and memos

- vii) Examine guidelines for writing sample letters and memos which convey: acknowledgment, routine request, routine response, complaint, refusal, persuasive request and letters of appeal
- 6. Examine the Fundamentals of Informal Business Reports
 - i) Identify the purpose of the informal report
 - ii) Identify the parts and formats of an informal report
 - iii) Identify methods of information gathering
 - iv) Describe the methods of referencing documents
 - v) Review the importance of proof reading and editing
- 7. Examine types of presentations
 - i) Review & discuss components of an effective presentation
 - ii) Review & discuss delivery techniques
 - iii) Review & discuss preparation & use of audio/visual aids
 - iv) Discuss & participate in confidence building exercises used to prepare for giving presentations
- 8. Interpersonal Communications
 - i) Examine and apply listening techniques
 - ii) Discuss the importance of body language

Practical:

- 1. 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. Write sample letters and memos which convey: acknowledgment, routine request, routine response, complaint, refusal, persuasive request and letters of appeal.
- 3. Gather pertinent information, organize information into an appropriate outline & write an informal report with documented resources.
 - i) Edit, proofread, and revise the draft to create an effective informal report and present orally using visual aids
 - ii) Participate in confidence building exercises
- 4. Present an effective presentation.
- 5. Evaluate presentations.

MR-1220

CUSTOMER SERVICE

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 be able to:

- define customer service
- explain why service is important
- describe the relationship between “service” and “sales”
- demonstrate an understanding of the importance of a positive attitude
- demonstrate methods of resolving customer complaints

Objectives and Content:

1. Define quality service
 - i) Identify and discuss elements of customer service
 - ii) Explain the difference between Service vs. Sales or Selling
 - iii) Explain why quality service is important
 - iv) Identify the various types of customers & challenges they may present
 - v) Describe customer loyalty
 - vi) Examine barriers to quality Customer Service
2. Explain how to determine customers wants and needs
 - i) Identify customer needs
 - ii) Explain the difference between customer wants and needs
 - iii) Identify ways to ensure repeat business
3. Demonstrate an understanding of the importance of having a positive attitude
 - i) Identify & discuss the characteristics of a positive attitude
 - ii) Explain why it is important to have a positive attitude
 - iii) Explain how a positive attitude can improve a customer’s satisfaction
 - iv) Define perception and explain how perception can alter us and customers
 - v) Describe methods of dealing with perception
4. Communicating effectively with customers
 - i) Describe the main elements in the communication process
 - ii) Identify some barriers to effective communication
 - iii) Explain why body language is important
 - iv) Define active listening and state why it is important

- v) Identify and discuss the steps of the listening process
- vi) Identify and discuss questioning techniques

5. Demonstrate using the telephone effectively

- i) Explain why telephone skills are important
- ii) Describe the qualities of a professional telephone interaction

6. Demonstrate an understanding of the importance of asserting oneself

- i) Define assertiveness
- ii) Discuss assertive techniques
- iii) Explain the use of assertiveness when dealing with multiple customers

7. Demonstrate techniques for interacting with challenging customers in addressing complaints & resolving conflict

- i) Examine & discuss ways to control feelings
- ii) Examine & discuss ways to interact with an upset customer
- iii) Examine & discuss ways to resolve conflict/customer criticism
- iv) Examine & discuss ways to prevent unnecessary conflict with customers

Practical:

1. Participate in activities to demonstrate knowledge of the course objectives.

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 as related to the trade
- develop an awareness of quality principles and processes
- apply quality assurance/quality control procedures in a shop project

Objectives & Content:

- 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 specifications and processes 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 a quality environment.
- 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 in various occupations.
- 10. Explain the concepts of quality
 - i) cost of quality
 - ii) measurement of quality
 - iii) elements of quality

- iv) elements of the quality audit
- v) quality standards
- vi) role expectations and responsibilities

11. Explain the structure of quality assurance and quality control

- i) Describe organizational charts
- ii) Identify the elements of a quality assurance system such as ISO, CSA, WHMIS, Sanitation Safety Code (SSC)
- iii) Explain the purpose of the quality assurance manual
- iv) Describe quality assurance procedures

12. Examine quality assurance/quality control documentation

- i) Describe methods of recording reports in industry
- ii) Describe procedures of traceability (manual and computer-based recording)
- iii) Identify needs for quality control procedures

Practical:

1. Apply quality control to a project

- i) Follow QA/QC procedures for drawings, plans and specifications in applicable occupations.
- ii) Calibrate measuring instruments and devices in applicable occupations.
- iii) Interpret required standards
- iv) Follow QA/QC procedures for accepting raw materials
- v) Carry out the project
- vi) Control the quality elements (variables)
- vii) Complete QA/QC reports

MC-1050

INTRODUCTION TO COMPUTERS

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 and security issues.

Course Outcomes:

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

- computer systems and their operation.
- popular software packages, their applications
- security issues of Computers

Objectives & Content:

1. Identify the major components of microcomputer system hardware and software system.
2. Describe the functions of the microprocessor.
 - i) Describe and give examples of I/O DEVICES.
 - ii) Describe primary storage (RAM, ROM, Cache).
 - iii) Define bit, byte, code and the prefixes k.m. and g.
 - iv) Describe secondary storage (diskettes and hard disks, CD ROMS, Zip Drives etc).
 - v) Describe how to care for a computer and its accessories.
3. Describe microcomputer software
 - i) Define software.
 - ii) Describe types of operational and application software
 - iii) Define file and give the rules for filenames and file extensions.
4. Describe windows software
 - i) Start and quit a Program
 - ii) Demonstrate how to use the help function
 - iii) Locate a specific file using the **find** function
 - iv) Identify system settings:wall paper, screen saver, screen resolution, background
 - v) Start a program by using the Run Command
 - vi) Shutting down your computer
5. Identify File Management commands
 - i) Demonstrate how to view directory structure and folder content
 - ii) Organize files and folders
 - iii) Copy, delete, and move files and folders

- iv) Create folders
- v) Maximize and minimize a window
- vi) Describe windows task bar

6. Describe Keyboards

- i) Identify and locate alphabetic and numeric keys
- ii) Identify and locate function key & special keys

7. Describe Word Processing

- i) Describe Windows components
- ii) Menu bar
- iii) Menu indicators
- iv) Document window
- v) The Status bar
- vi) The Help feature
- vii) Insertion point movements

8. Describe the procedure used to development of a document

- i) Enter text
- ii) Change the display

9. Describe the procedure for opening, saving and exiting documents

- i) Saving a document
- ii) Closing a document.
- iii) Starting a new document Window
- iv) Opening a document
- v) Exiting word processor

10. Describe the procedure for editing a Document

- i) Adding new text
- ii) Deleting text
- iii) Using basic format enhancement (split and join paragraphs, insert text)

11. Describe the main Select Features

- i) Identify a selection
- ii) Moving a selection
- iii) Copying a selection
- iv) Deleting a selection
- v) Saving a selection

12. Explain how to change Layout Format

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

13. Explain how to change Text Attributes

- i) Changing text attributes: (bold, underline, font, etc.)

14. Describe the Auxiliary Tools
 - i) Using Spell Check & Thesaurus
15. Describe Print features
 - i) Selecting the Print Feature: (i.e; number of copies and current document)
 - ii) Identifying various options in print screen dialogue box
16. Examine & Discuss Electronic Spreadsheet
 - i) Spreadsheet Basics
 - ii) The Worksheet Window
17. Describe Menus
 - i) Menu Bar
 - ii) Control menu
 - iii) Shortcut menu
 - iv) Save, Retrieve form menus
18. Describe the components of a worksheet
 - i) Entering constant values and formulas
 - ii) Using the Recalculation feature
19. Describe Use ranges
 - i) Typing a range for a function
 - ii) Pointing to a range for a function
 - iii) Selecting a range for toolbar and menu commands
20. Describe how to print a worksheet
 - i) Printing to the Screen
 - ii) Printing to the Printer
 - iii) Printing a selected Range
21. Describe how to edit a worksheet
 - i) Replacing cell contents
 - ii) Inserting & deleting rows and columns
 - iii) Changing cell formats
 - iv) Changing cell alignments
 - v) Changing column width
 - vi) Copying and moving cells
22. State major security issues in using computers
 - i) Pass words
 - ii) Accessing accounts
 - iii) Viruses and how they can be avoided
 - iv) Identity theft and ways to protect personal information
23. Describe how to use Electronic Mail
 - i) E-mail etiquette

- ii) E-mail accounts
- iii) E-mail messages
- iv) E-mail message with attachments
- v) E-mail attachments
- vi) Print e-mail messages
- vii) Deleting e-mail messages

24. Explain the Internet and its uses

- i) The World Wide Web(www)
- ii) Accessing Web sites
- iii) Internet Web Browsers
- iv) Internet Search Engines
- v) Searching Techniques
- vi) Posting documents on-line

Practical:

1. Create a document using Word Processing.
2. Complete word processing exercises to demonstrate proficiency in word processing
3. Prepare and send e-mails with attachments
4. Retrieve documents and e-mail attachments and print copies
5. Develop & print a spread sheet.
6. Post a document on-line

SD-1700

WORKPLACE SKILLS

Description:

This course involves participating in meetings, information on formal meetings, unions, workers' compensation, employment insurance regulations, workers' rights and human rights.

Course Outcomes:

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

- Participate in meetings
- Define and discuss basic concepts of:
 - unions
 - workers' compensation
 - employment insurance
 - workers' rights
 - human rights
 - workplace diversity
 - gender sensitivity

Objectives & Content:

1. Meetings
 - i) Identify & discuss meeting format and preparation required for a meeting.
 - ii) Explain the purpose of an agenda.
 - iii) Explain the roles and responsibilities of meeting participants.
 - iv) Explain the purpose of motions and amendments and withdrawals.
 - v) Explain the procedure to delay discussion of motions.
 - vi) Explain the voting process.
2. Unions
 - i) State why unions exist.
 - ii) Give a concise description of the history of Canadian labour.
 - iii) Explain how unions function.
 - iv) Explain labour's structure.
 - v) Describe labour's social objectives.
 - vi) Describe the relationship between Canadian labour and the workers.
 - vii) Describe the involvement of women in unions.
3. Worker's Compensation
 - i) Describe the aims, objectives, benefits and regulations of the Workplace Health, safety and Compensation Commission.
 - ii) Explain the internal review process.
4. Employment Insurance
 - i) Explain employment insurance regulations

- ii) Describe how to apply for employment insurance.
- iii) Explain the appeal process.
- iv) Identify the components of a letter of appeal.

5. Worker's Rights

- I) Define labour standards.
- ii) Explain the purpose of the Labour Standards Act.
- iii) Identify regulations pertaining to:
 - Hours of work
 - Minimum wages
 - Employment of children
 - Vacation pay
- iv) Explain the purpose of the Occupational Health & Safety Act as it refers to workers' rights

6. Human Rights

- i) Describe what information cannot be included on an employment application.
- ii) Describe what information cannot be included in an interview.
- iii) Examine the Human Rights Code and explain the role of the Human Rights Commission.
- iv) Define harassment in various forms and identify strategies for prevention.

7. Workplace Diversity

- I) Define and explore basic concepts and terms related to workplace inclusively including age, race, culture, religion, socio-economic, sexual orientation with an emphasis on gender issues and gender stereotyping.

8. Gender Sensitivity

- I) Explore gender and stereotyping issues in the workplace by identifying strategies for eliminating gender bias.

Practical:

1. Prepare an agenda.
2. Participate in a meeting.
3. Analyze a documented case of a human rights complaint with special emphasis on the application, time frame, documentation needed, and legal advice available.

SD-1710

JOB SEARCH TECHNIQUES

Description:

This course is designed to give students an introduction to the critical elements of effective job search techniques.

Course Outcomes:

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

- Demonstrate effective use of Job Search Techniques

Objectives & Content:

1. Identify and examine employment trends and opportunities
2. Identify sources that can lead to employment
3. Access and review information on the Newfoundland and Labrador Apprenticeship and Certification Web site and the Apprenticeship Employment Gateway
4. Analyze job ads and discuss the importance of fitting qualifications to job requirements
5. Identify and discuss employability skills as outlined by the Conference Board of Canada.
6. Discuss the necessity of fully completing application forms.
7. Establish the aim/purpose of a resume
8. Explore characteristics of effective resumes, types of resumes, and principles of resume format .
9. Explore characteristics of an effective cover letter.
10. Identify commonly asked questions in an interview.
11. Explore other employment related correspondence.
12. Explore the job market to identify employability skills expected by an employer.
13. Conduct a self-analysis and compare with general employer expectations.
14. Discuss the value of establishing and maintaining a portfolio.

Practical:

1. Complete sample application forms.
2. Write a resume.
3. Write an effective cover letter.
4. Establish a portfolio.
5. Write out answers to commonly asked questions asked during interviews.
6. Identify three potential employers from the Apprenticeship Employment gateway, Apprenticeship & Certification web site.

SD-1720

ENTREPRENEURIAL AWARENESS

Description:

This course 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.

Course Outcomes:

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

- Identify the various types of business ownership, the advantages and disadvantages of self-employment and identify the characteristics of an entrepreneur.
- State the purpose and identify the main elements of a business plan.

Objectives & Content:

1. Explore Self-Employment: An Alternative to Employment
 - i) Identify the advantages and disadvantages of self-employment vs. regular employment
 - ii) Differentiate between an entrepreneur and a small business owner
 - iii) Evaluate present ideas about being in business
2. Identify and discuss various types of business ownership
 - i) Explore the Characteristic of Entrepreneurs
 - ii) Identify characteristics common to entrepreneurs
 - iii) Compare one's own personal characteristics with those of entrepreneurs.
 - iv) Examine one's present ideas about business people
3. Identify Business Opportunities
 - i) Distinguish between an opportunity and an idea.
 - ii) Examine existing traditional and innovative business ventures
 - iii) Identify and summarize the role of various agencies that support business development.
 - iv) Identify potential business opportunities.
4. Review the Entrepreneurial Process.
 - i) Explain the entrepreneurial process
 - ii) Describe the purpose of a business plan
 - iii) Identify & discuss the main elements of a business plan

Practical:

1. From a list potential business opportunities prepare a list of elements that would have to be included in a business plan.