



RED RIVER COLLEGE

OF APPLIED ARTS, SCIENCE AND TECHNOLOGY

**Refrigeration and Air Conditioning Technician Program
Curriculum Validation**

**Final Report
December 2003**

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Refrigeration and Air Conditioning Technician Program Curriculum Validation - Final Report

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REFRIGERATION AND AIR CONDITIONING TECHNICIAN PROGRAM CURRICULUM VALIDATION - FINAL REPORT

INTRODUCTION

The Curriculum Validation process for the Refrigeration and Air Conditioning Technician program began in January 2003. The Curriculum Validation model used was designed by the Program and Curriculum Development (PCD) department to address the college's regulatory compliance requirements for program evaluation outlined in The Colleges Act (1991, article 4.1.e) and approved by the Red River College (RRC) Senior Academic Committee (SAC). The intent of the Curriculum Validation model is to ensure that programs are current and meet the demands of the markets they serve. The model dictates the completion of a series of seven activities which result in the deliverables listed below. However, because of concerns related to low student and graduate satisfaction rates, some additional activities were undertaken following consultation with the Program Chair. These activities included a review of Program Advisory Committee Minutes, a review of the recent *Student Evaluation of Program Survey results*, and consideration of some instructor-related research provided by the program Chair.

CURRICULUM VALIDATION DELIVERABLES

The Refrigeration and Air Conditioning Curriculum Validation process produced six (6) interrelated deliverables:

1. Environmental Scan
2. A validated industry DACUM chart
3. An Integrated program learning outcomes chart*
4. A vision statement and related goals
5. A 5-year renewal plan in Gantt chart format
6. A final report

* It should be noted that there are usually seven deliverables associated with the curriculum validation model. The process followed for Refrigeration and Air Conditioning Curriculum Validation did not result in a separate Program learning outcomes chart – the program learning outcomes that were identified are embedded in the Integrated program learning outcomes chart.

ENVIRONMENTAL SCAN (APPENDIX 1)

The purpose of the environmental scan was to provide the Program Chair and faculty with a broad comparison of similar programs across Canada. The scan provided an opportunity for comparative analysis by gathering information on similar programs currently being delivered by:

- Algonquin College
- New Brunswick Community College
- Malaspina University-College
- Nova Scotia Community College
- Formation Professionnelle de Lachine Pavillon Dalbé-Viau
- Saskatchewan Institute of Applied Science and Technology

The information was gathered through websites, e-mails, phone contact and teleconferencing. The scan gathered information under the following categories:

- Name of institution, location and contact person
- Size of program
- Credentials issued
- Program features
- Curriculum model
- Curriculum content
- Student assessment
- Current and coming challenges
- Curriculum renewal
- Partnerships
- Additional information (other and comments)

A detailed comparison of the programs can be found in Appendix 1. The following are highlights of the issues and trends identified from the Environmental Scan:

- Programs varied in length from 1200 hours (SIAST) to 1800 hours (Pavillon Dalbé-Viau),
- All programs, with the exception of Pavillon Dalbé-Viau, have a Work Practicum component,

- Nova Scotia Community College requires all students to complete a learning portfolio as part of the graduation requirement,
- Nova Scotia Community College uses learning contracts to aid in student retention,
- Enrolment rates have been constant for all programs and have been meeting established quotas,
- Attrition rates average 30-35% which is about the same for RRC,
- Several colleges use personal interviews as part of the student selection process,
- Some challenges faced by several colleges include limited time for program delivery, insufficient funding for new equipment, and under-representation of female students,
- With the exception of RRC, all programs have a September start date, and
- Like RRC, Nova Scotia Community College has concerns about the discrepancy between the college's pass mark of 60% and the 70% pass mark required by Apprenticeship to be awarded Level 1 recognition.

VALIDATED INDUSTRY DACUM (APPENDIX 2)

The DACUM workshop was held on February 25 – 26, 2003. Participants included business owners, journeypersons, sales professionals and apprentices from the Refrigeration and Air Conditioning field. The program instructor attended as an observer. Participants were asked to identify the major competencies required by entry level technicians in the field of Refrigeration and Air Conditioning. At the end of the two days, the resulting DACUM chart identified twelve (12) general areas of competencies broken down into one hundred and thirty eight (138) skills and abilities.

The total time the participants were able to participate in the DACUM process varied from one hour to two days. As well, there was an under-representation of technicians participating in the process. These two factors led the DACUM workshop facilitator to question the validity of the occupational analysis. As a result and in consultation with the Chair, Construction Trades, PCD arranged for the DACUM chart to be reviewed by Refrigeration technicians who received journeyperson status within the last year. A DACUM validation workshop involving 6 journeypersons was conducted on March 29, 2003. Participants reviewed the chart and suggested changes. These changes were incorporated into the final DACUM chart.

The validated Refrigeration and Air Conditioning technician DACUM analysis identified the following general areas of competencies:

1. Perform basic maintenance
2. Service and maintain heating/cooling systems
3. Service and maintain halogenated refrigeration system
4. Communicate
5. Be professional
6. Interact with co-workers/customers
7. Document
8. Work with refrigerants
9. Work safely
10. Install pipes
11. Use technology
12. Use basic sheet metal skills to service and maintain A/C units

INTEGRATED PROGRAM LEARNING OUTCOMES (APPENDIX 3)

The Program learning outcomes workshop was conducted on April 25, 2003 and was attended by all faculty members including the related instructors. Participation was fluid, as several instructors were required to absent themselves to attend to classes. The workshop participants identified twenty five (25) additional skills/abilities that were not identified in the DACUM analysis and which were felt to be required of entry level technicians. These additional skills/abilities were integrated into the DACUM occupational analysis chart.

Following the Program learning outcomes workshop, a meeting was held with the program instructor on May 14, 2003 to identify those college-wide learning outcomes (CWLO's) that are expected of program graduates. The instructor verified that those CWLO's found in the Integrated program learning outcomes chart were part of the existing curriculum. Incorporation of these CWLO's into programs and courses is articulated in the RRC Operational Plan and is an objective for all programs. The results of the integration served as the focus for curriculum renewal and are outlined in the Integrated program learning outcomes chart.

VISIONING WORKSHOP

The visioning workshop was held on June 5, 2003. Participants included the Program Chair, the program instructor, a Program Advisory Committee representative and a related instructor. The feeder documents provided for this activity were the validated DACUM chart, the Integrated program learning outcomes chart, the recent *Student Evaluation of Program Survey* results, and a summary of the unresolved issues identified in the minutes of Program Advisory Committee meetings held between March 2000 and March 2003. These issues included:

- Low enrolment of women in the program.
- Students withdrawing from the program due to being offered full-time employment by the employers that were hosting the work experience component of the program.
- Outstanding issues associated with converting the program to a co-op format (especially increasing the length of the program to accommodate the additional time required for the co-op component and only having an intake every two years).
- The absence of roof top equipment for use by the program for practical training.
- Need for additional instructional support during lab/shop experience.
- A March start does not provide students with adequate preparation for the work experience component that begins in May.
- Students should be able to provide their work experience employers with a listing of skills that they have developed to-date (portfolio).
- Students need to develop strong communication skills including the ability to prepare accurate and detailed work order reports.
- Industry trends which include a greater use of computers, the increase use of electronics and microprocessors (DDC controls) in refrigeration and air conditioning equipment and the increasing use of new refrigerants.
- Applicant orientation and pre-enrolment information sessions.
- Work ethic (employability skills)
- Canadian Adult Achievement Test (CAAT) diagnostic testing for all students to determine strengths and weaknesses in language, spelling, grammar, mathematics, etc. and to identify who may need additional support.

- Compulsory certification of all working technicians (by Apprenticeship Branch) and the impact this has on the work experience component of the program.

The question central to the visioning process was: “In five years, the Refrigeration and Air Conditioning Technician program will be a leading contributor to the field. What will the 2008 program look like?” The workshop identified four (4) main areas of focus for program renewal:

1. Curriculum
2. Partnerships and industry satisfaction
3. Resources – staffing, equipment
4. Student success and satisfaction

PROGRAM RENEWAL PLAN (APPENDIX 4)

The plan for renewal of the Refrigeration and Air Conditioning technician program is comprised of a vision statement, goals and recommendations. The timeframe for program renewal is September 2003 to June 2008.

VISION STATEMENT

In the next five years, the Refrigeration and Air Conditioning technician program will be recognized internationally as a leader in the provision of training that prepares graduates for successful careers in the industry.

Goal statements

The Refrigeration and Air Conditioning Technician program has developed the following goals to realize its vision:

1. Curriculum

Deliver a high quality, comprehensive certificate program which meets the training needs of individuals whose occupational goal is an entry-level position in Refrigeration and Air Conditioning. The program will:

- Expand the practical electrical skills training.

Implementation deadline: June 2005

- Establish a Curriculum Committee comprised of faculty and major stakeholders to guide the curriculum renewal process.

Implementation deadline: June 2004

- Introduce an additional two week Work Practicum for students to gain practical skills and experience in heating.

Implementation deadline: June 2004

- Introduce a North American Technician Excellence (NATE) exam preparation component to the program. NATE certification will give graduates international recognition for the knowledge and skills they have gained in the program.
Implementation deadline: June 2004
- Introduce/expand the skills associated with heating controls, pipe fitting, electrical wiring, arc welding, machine shop, power engineering, air distribution systems, basic sheet metal skills, basic computer applications, and business fundamentals.
Implementation deadline: June 2005

2. Partnerships and industry satisfaction

Increase partner involvement with the design and delivery of the program.

The program will:

- Increase Program Advisory Committee participation in the on-going curriculum renewal process by recruiting representatives to serve on the newly established Curriculum Committee
Implementation deadline: June 2004
- Negotiate an expansion of the articulation agreements with the Apprenticeship Branch to increase program recognition.
Implementation deadline: Ongoing
- Investigate alternate meeting times for the Program Advisory Committee as a strategy to increase industry participation on the committee.
Implementation deadline: June 2004
- Strengthen existing partnerships with industry, trade associations and the Apprenticeship Branch to ensure that the program continues to meet current industry requirements and accreditation standards.
Implementation deadline: Ongoing
- Increase the number of employers that participate in the Work Practicum component of the program.
Implementation deadline: Ongoing

3. Resources

Ensure that sufficient facilities, staffing and other resources are available for the program to achieve its vision. The program will:

- Seek to increase funding for the purchase of program equipment.
Implementation deadline: Ongoing
- Hire an Electrical instructor
Implementation deadline: June 2004
- Hire a lab supervisor
Implementation deadline: June 2004
- Solicit donations of equipment from industry partners for use in the labs.
Implementation deadline: Ongoing
- Provide on-going staff development opportunities to ensure that the instructors remain current with the requirements of industry.
Implementation deadline: On-going
- Provide appropriate classroom and lab space for use by students in the program.
Implementation deadline: Ongoing

4. Student success and satisfaction

Increase student satisfaction and success in the program. The program will:

- Assess the functional level of Math, Language and Reading skills (using the Canadian Adult Achievement Test) of all incoming students and make referrals for academic upgrading as required.
Implementation deadline: Ongoing
- Deliver Refrigeration and Air Conditioning industry information sessions for incoming students with the involvement of industry practitioners.
Implementation deadline: Ongoing
- Implement a mid-program student feedback-of-instruction process for all courses.
Implementation deadline: Ongoing
- Deliver a comprehensive student orientation one week prior to the program start date.
Implementation deadline: Ongoing

The following items were not addressed at the Visioning workshop, but they are significant issues that need to be addressed as they could have a positive impact on student retention and satisfaction. They were included in the 5-year program renewal plan with the following recommendations for implementation:

- Consider an alternate program start-date that will ensure that students have sufficient time to gain the necessary knowledge and skills prior to the first Work Practicum placement.
Review deadline: June 2004
- Investigate the “Student Satisfaction with Instructor” issue that was identified as part of the recent “Student Evaluation of Program” survey results.
Review deadline: June 2004

CONCLUSION

This report has summarized and highlighted the most significant findings and issues identified during the Curriculum Validation of the Refrigeration and Air Conditioning Technician program. The Program and Curriculum Development Department acknowledges the valuable input of the Refrigeration and Air Conditioning Program Advisory Committee, the DACUM participants (including the DACUM Validation participants), the Program Faculty and related instructors in providing their expertise, knowledge and commitment to the success of this project.

APPENDIX 1

Environmental Scan

REFRIGERATION AND AIR CONDITIONING CURRICULUM VALIDATION

ENVIRONMENTAL SCAN

COLLEGE	SIZE OF PROGRAM	CREDENTIAL ISSUED	PROGRAM FEATURES	CURRICULUM MODEL	CURRICULUM CONTENT
<p>Red River College</p> <p>2055 Notre Dame Avenue, Winnipeg, Manitoba, R3H 0J9</p> <p>Website: www.rrc.mb.ca</p> <p>Contact person: George Kurowski and Sydney Bloomfield</p> <p>Telephone: (204)632-6075 Fax:</p> <p>Email: gkurowsk@rrc.mb.ca sbloomfield@rrc.mb.ca</p>	<p>Number of faculty: 2</p> <p>Number of students: 18</p>	<p>Certificate</p>	<p>Length: 10 months – 1265 hours</p> <p>Program starts in March of each year</p> <p>Entrance requirements: Manitoba Senior 4 (Grade 12) including Physics 30S and Physical Science 30G (Grade 11);</p> <p>Applicants who will be at least 18 years of age on or before September 30 in their year of registration who do not meet the regular admission requirements may apply under the special admission criteria. Individuals applying as a special admission applicant must have successfully completed RRC Adult 11 or a minimum of one credit of: Math 30S/40G, Applied Math 30S, Pre-Calculus Math 30S, or Consumer Math 40S; and one credit of Physics 30S or Physical Science 30G. English 30S/30G is strongly recommended; reference books are essential; above-average reading vocabulary and comprehension required</p> <p>Graduation requirements: Students must have a minimum pass mark of 70% in each course.</p>	<p>Program uses traditional delivery style of instruction</p> <p>Experiential component: Students may receive credit for prior learning/training acquired through life or work experience.</p> <p>Unique delivery features such as: laptops, distributed learning practices, instructional technology</p>	<p>Course Hours & Titles</p> <ul style="list-style-type: none"> • Blueprint Reading & Sketching - 50 • Related Gas Welding - 25 • Safety & Fundamentals – Theory - 30 • Fundamental Principles -33 • Refrigeration Systems – Theory - 70 • Refrigeration Systems – Practical - 135 • Commercial Systems – Theory - 100 • Commercial Systems – Practical - 250 • Calculation of Heat Transfer – Theory - 50 • Air Conditioning Systems – Theory - 30 • Air Conditioning Systems – Practical - 30 • Refrigeration Electrical – Theory – 130 • Refrigeration Electrical – Practical - 50 • Fundamentals of Gas Heating - 50 • In-Industry Training - 80 • Mathematics - 64 • Science - 64 • WHMIS Workshop - 4 • Communication -20 <p>Course outlines available at website</p>

STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>Red River College</p> <p>Content theory: written test – 70%</p> <p>Assessment: ongoing</p> <p>Skills assessment: subjective evaluation with a minimum pass mark of 70%</p> <p>Grading scale: A+ - 4.5 -Outstanding A – 4.0 – Excellent B+ - 3.5 – Very Good B – 3.0 – Good C+ - 2.5 – Above Average C – 2.0 – Average D – 1.0 – Marginal F – 0.0 – Failure</p> <p>Assessment practices for any experiential components (practicum, clinical, work experience, co-op)</p>	<p>Content including employability skills, inclusiveness, global orientation: none at this time</p> <p>Delivery of the program: none at this time</p> <p>Assessment practices: none at this time</p> <p>Instructional technology: none at this time</p>	<p>Process: Curriculum validation process</p> <p>Frequency: Every five years</p>	<p>Business/Industry</p> <p>Articulation agreements with Manitoba Education, Training and Youth, Apprenticeship Branch</p> <p>Union</p>	<p>Tuition & student fees - \$1871 for Canadian students; \$9000 for international students</p> <p>Books & Supplies - \$500</p> <p>Graduates are eligible for accreditation as Level 1 Refrigeration and Air Conditioning Mechanics if they complete this program with a passing grade of 70% or more, and become registered as an apprentice by their employer within one year of completing this program of study. Graduates are entitled to at least 600 hours, and possibly 900 hours of credit towards their first 1800-hour year of apprenticeship training at the discretion of the contractor</p>	

COLLEGE	SIZE OF PROGRAM	CREDENTIAL ISSUED	PROGRAM FEATURES	CURRICULUM MODEL	CURRICULUM CONTENT
<p>Algonquin College</p> <p>1385 Woodroffe Ave, Ottawa, Ontario, K2G 1V8</p> <p>Website: www.algonquincollege.com</p> <p>Contact person:</p> <p>Jim Bell; Professor Air Conditioning and Refrigeration Mechanic Heating, Refrigeration and Air Conditioning Technician</p> <p>Phone: 613-727-5252 1-800-565-4723 Fax: 613-727-7632</p> <p>Email: bellj@algonquincollege.com</p>	<p>Number of faculty: 5</p> <p>Number of students: 100</p>	<p>Diploma</p>	<p>Program length: 48 weeks</p> <p>Program starts in September and is offered at the Woodroffe Campus</p> <p>Entrance requirements: English, Grade 12. (ENG4C or ENG4G, or equivalent, is required.) Mathematics, Grade 11, MTT3G, or mathematics with a similar content or Mathematics, Grade 12 (MAP4C). If qualified applicants exceed number of spaces in program, candidates with proficiency in Math and English will be given preference</p> <p>Graduation requirements: Completion of all program courses with a minimum GPA of 2.0</p>	<p>Learning outcomes vs. instructional objectives vs. competency based: A combination of learning outcomes, objectives and competency-based instruction</p> <p>Experiential component: None</p> <p>Unique delivery features: Courses may be offered in the classroom, lab, entirely on-line, or a hybrid mode which combines classroom sessions and on-line learning; each full-time student is provided an email account which is used to communicate program or course events;</p>	<p>Course titles & hours:</p> <p><u>Level 01</u></p> <ul style="list-style-type: none"> • Computer applications - 48 hrs • Electricity I - 32 hrs • Refrigeration Theory I - 80 hrs • Refrigeration Practical I - 64 hrs • Heating Theory I - 96 hrs • Heating Practical I - 64 hrs • Occupational Health and Safety - 48 hrs • Related Science and Calculations I - 32 hrs <p><u>Level 02</u></p> <ul style="list-style-type: none"> • Electricity II – 112 hrs • English I – 48 hrs • Heating Theory II – 80 hrs • Heating Practical II – 144 hrs • Related Science and Calculations II – 32 hrs • Choose one from equivalencies: General Education Elective – 48 hrs <p><u>Level 03</u></p> <ul style="list-style-type: none"> • Reporting Technical Information – 64 hrs • Introduction to Personal Finance – 48 hrs. • Forced Air Systems – 64 hrs • Forced Air Applications – 80 hrs • Heating Theory III – 96 hrs • Heating Practical III – 64 hrs • Related Science and Calculations III – 32 hrs <p>course outlines available on website</p>

STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>Algonquin College</p> <p>Content theory assessment: Written tests, assignments and exams</p> <p>Skills assessment: Oral questioning while observing practical operations and observing the procedures and outcomes - sometimes with a time element imposed</p> <p>Assessment practices work practicum: No work practicum component</p>	<p>Delivery of the program: Program length too short to cover all aspects of HRAC program; increase the number of hours of the RAC component; most of this tied directly to provincial funding</p>	<p>Process: The heating component curriculum (under TSSA) is reviewed on an ongoing basis as well by them, after receiving feedback from colleges and other stakeholders.</p> <p>Frequency: Continuous within the department; changes made each semester if necessary last internal college wide curriculum review was about 5 years ago; Fuels area- TSSA requests input from all stakeholders then has a series of meetings; RAC contact person - Carol Olinski at the Ministry of Training Colleges and Universities - Carol.Olinski@edu.gov.on.ca</p>	<p>Government: Technical Standards and Safety Authority which is under the Ministry of Consumer and Business Services (MCBS).</p>	<p>High demand for graduates</p> <p>Upon graduation, students may be granted up to 2000 hours towards a Refrigeration and Air Conditioning apprenticeship</p> <p>Program is divided into 3 levels. At the end of the second level, after successfully completing the provincial requirements, students may apply for OBT3 and G3 certificates of qualification. At the end of the third level, after successful completion of provincial requirements, students may apply for OBT2 and G2 certificates of qualification</p> <p>Tuition fees for 2002-03 are:</p> <ul style="list-style-type: none"> • Tuition Fee – \$1190 per term • Information Technology Fee - \$50 per term • Student Activity/sports Fee: \$60: 50 per term • Student Centre Building Fee – \$17.50 per term • Health Service Fee - \$10 per term • Health Plan Fee - \$105 paid annually • Graduation Fee - \$30 in final term • Transcript Fee - \$25 payable in Level I <p>International students pay all Canadian fees plus International Premium of \$5333.34 per term</p>	

STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
Algonquin College				<p>Books and supplies are approximately \$1700 for the entire program</p> <p>There are 2 areas in Refrigeration</p> <ol style="list-style-type: none"> 1. Apprenticeship (Refrigeration and Air Conditioning Apprentice - certification (outcomes, curriculum) falls under the Ministry of Training Colleges and Universities (MTCU). 2. Post secondary Heating Refrigeration and Air Conditioning Technician program. Heating certification (curriculum) falls under the Technical Standards and Safety Authority which is under the Ministry of Consumer and Business Services (MCBS). <p>In 1996, Ontario invoked compulsory in-school training for heating fuels certification in 1996 with a compulsory curriculum</p>	

COLLEGE	SIZE OF PROGRAM	CREDENTIAL ISSUED	PROGRAM FEATURES	CURRICULUM MODEL	CURRICULUM CONTENT
<p>New Brunswick Community College</p> <p>99 Augustus Street, St Andrews, NB, E5B 2E9</p> <p>Website: www.standrews.nbcc.nb.ca</p> <p>Contact person: Ellen Belyea</p> <p>Telephone: 506-529-5626 Fax: 506-529-5209</p> <p>Email: Ellen.Belyea@gnb.ca</p>	<p>Number of faculty: 3</p> <p>Number of students: 21-22</p>	<p>Certificate</p>	<p>Length: 40 weeks</p> <p>Program starts in September of each year and is offered in French at the Edmundston campus and in English at the St Andrews campus</p> <p>Entrance requirements:</p> <ul style="list-style-type: none"> A High School diploma or Adult High school diploma or a GED Certificate; when the number of applicants exceed the number of spaces in the program, selection will be based on level of achievement in academic subjects – value 60% and related work experience – value 40% <p>This program is an apprenticeable occupation in New Brunswick</p> <p>Graduation requirements: Upon completion of this program, graduates write the Block I apprenticeship exam administered by the Department of Training and Employment Development with a passing grade of 70% or higher</p>	<p>Conventional delivery with Computer Based Training (CBT) and Computer Aided Instruction (CAI) with Shop/Lab, practical assignments and shop refits.</p> <p>Experiential component: scheduled practical training sessions are scheduled throughout the program; an unpaid component of 90 hours of work practicum in industry</p> <p>Program uses specialized classroom lectures/lab instruction, computer-based training and computer-aided instruction and web based training</p>	<p>Course titles:</p> <ul style="list-style-type: none"> Communications – 30 hrs First Aid – 16 hrs Associated Math – 60 hrs Computer Concepts – 30 hrs WHMIS – and Occupational Health and Safety – 6 hrs Workplace Safety – 15 hrs Rigging – 15 hrs Refrigeration and Air Conditioning Fundamentals – 120 hrs Refrigerants and Oils – 45 hrs Practical Skills – 75 hrs Solder/Tubing/Pipework – 150 hrs Refrigeration & Air Conditioning Tools and Equipment – 90 hrs Electrical Fundamentals – 135 hrs Motors & Motor Controls – 90 hrs Work Practicum – 90 hrs CFC/HCFC/HFC Control in the Refrigeration & Air Conditioning Industry – 6 hrs Air Conditioning Fundamentals – 45 hrs Heating, Ventilation, Air Conditioning & Refrigeration Controls – 45 hrs <p>Course outlines available online at www.standrews.nbcc.nb.ca</p>

STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>New Brunswick Community College</p> <p>Content theory: Exams, tests, quizzes with LXR Test and labs, assessments. Pass = 60%</p> <p>Skills assessment: Projects & practical ; Pass/Fail</p> <p>Assessment practices work experience: Work Practicum is compulsory; each student has the employer complete a form and then send completed form back to the college; each student evaluates the employer; each employer is supplied with an evaluation form as well as an attendance record for the practicum; completed forms are returned to the college and evaluated by the instructors.</p>	<p>Money for new technology</p>	<p>Process: Input from faculty and management input; input from Occupational Certification and Apprenticeship Advisory Committee for trade; input from industry representatives</p> <p>Frequency: Annual program review</p>	<p>High school</p> <p>Business/Industry</p> <p>Government</p> <p>Union</p> <p>International: Cuba and Mexico</p>	<p>Tuition fee for the program is \$2400 per year for Canadian students; textbooks and program supplies are approximately \$750</p> <p>Scientific calculator, headphones, safety boots, toolkit, work gloves, CSA approved safety glasses coveralls and uniform are required</p> <p>Working knowledge of computers and software will be advantageous</p>	

COLLEGE	SIZE OF PROGRAM	CREDENTIAL ISSUED	PROGRAM FEATURES	CURRICULUM MODEL	CURRICULUM CONTENT
<p>Malaspina University-College</p> <p>222 Cowichan Way, Duncan, BC V9L 6P4</p> <p>Website: www.mala.bc.ca</p> <p>Contact person: Walter Seiler- Instructor/ coordinator</p> <p>Telephone: (250)746-3525</p> <p>Fax:</p> <p>Email: mutineer@shaw.ca</p>	<p>Number of faculty: 1</p> <p>Number of students: Limited to 16 students per year</p>	<p>Certificate</p>	<p>Length: 10 months</p> <p>Starts date: beginning of September, and applications are accepted anytime</p> <p>Entrance requirements: Grade 10 or equivalent; Grade 12 preferred; Grade 11 Math recommended; physically fit; good hand-eye coordination; interview with program staff; a criminal record check, (requirement of School District 79); Students are required to complete a Math, English, and mechanical reasoning assessment test; previous work experience may be accepted in lieu of stated educational requirements</p> <p>Graduation requirements: Students must achieve a minimum pass mark of 70%</p>	<p>Learning outcomes vs. instructional objectives vs. competency based: 30% learning outcomes; 70% competency-based for practical component</p> <p>Experiential component: An opportunity for work experience (HVAC 116T) is a component of this program</p> <p>The program combines classroom instruction with hands-on practical assignments and sophisticated computer-based instruction</p> <p>This program is delivered in a modular structure; individuals may wish to select certain modules for upgrading.</p> <p>Employability skills are kept up to date through the instructor who has connections in industry.</p> <p>The program uses Computer Aided Instructional software to enhance the learners troubleshooting ability.</p>	<p>Fall Semester:</p> <ul style="list-style-type: none"> • HVAC 100T: Effective Learning Techniques • HVAC 101T: Shop and Personal Safety • HVAC 102T Shop Tools and Equipment • HVAC 103T Fundamentals of Electricity and Magnetism • HVAC 104T The Canadian Electrical Code C22.1-98 • HVAC 105T Automatic Controls • HVAC 106T Electric Motors • HVAC 107T Principles of Heat • HVAC 108T Commercial Refrigeration <p>Spring Semester:</p> <ul style="list-style-type: none"> • HVAC 109T Dynamics of Air Conditioning, Heating and Humidification • HVAC 110T Liquified Petroleum Gas and Natural Gas Heat • HVAC 111T Alternate Heating Systems • HVAC 112T Air Filtration and Humidification <p>Special Session:</p> <ul style="list-style-type: none"> • HVAC 113T Dynamics of Air Conditioning (Cooling) • HVAC 114T All Weather Heating Systems • HVAC 115T Chilled Water Air Conditioning Systems • HVAC 116T Work Experience

Malaspina University- College					Course hours: Information not provided Course outlines available at www.mala.ca/calendar/crshvac.asp
STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>Content theory: The program is delivered in a modular structure with each module consisting of several units; theory examinations are given at the end of each unit.</p> <p>Skills assessment Students are required to work on props in the shop and complete practical hands on tasks as well the students work on Refrigeration equipment supplied by a local business. The students are assessed on the completion of work as well as the quality. Students attend class Monday to Thursday on an extended day and are encouraged to seek work experience for the Fridays, those that have done so report increased understanding in the theoretical and practical aspects of the program.</p> <p>Assessment practices for work experience: There is a two week practicum. Student assessments are done by the employer and the students bring back evaluation of the work experience component</p>	<p>Presently the pre-apprenticeship system is going through changes and programs are being modified to reflect the direction from the Ministry of Advanced Education Training and Technology.</p>	<p>Process: Information not provided</p> <p>Frequency: Information not provided</p>	<p>School District #79 and Cowichan Senior Secondary School in Duncan</p> <p>Business/Industry; local business and Industry in providing equipment and work experience placement,</p> <p>Associate member of the Heating Refrigeration and Air Conditioning Institute of Canada.</p>	<ul style="list-style-type: none"> • Tuition fees: \$237 per month for Canadian students; \$3900 per semester for International students • Student activity fee: 4% of tuition • Student association fees: \$13.01 per month 	

COLLEGE	SIZE OF PROGRAM	CREDENTIAL ISSUED	PROGRAM FEATURES	CURRICULUM MODEL	CURRICULUM CONTENT
<p>Nova Scotia Community College</p> <p>NSCC Marconi Campus PO Box N42 1240 Granlake Road Sydney, Nova Scotia B1P 6J7</p> <p>Website: www.nsccl.ns.ca</p> <p>Contact person: Paul Goyetche</p> <p>Phone: (902) 563-2310 (1-866-679-6722 toll-free)</p> <p>Email: paul.goyetche@nsccl.ca</p>	<p>Number of faculty: 1 and 3 related instructors</p> <p>Number of students: 18-24</p>	<p>Certificate</p>	<p>Length: One year</p> <p>Division of academic year : Program starts in September and there are three semesters; in-school work is completed by the end of April and Work Practicum starts at the beginning of May for 5 weeks</p> <p>Entrance requirements: High school graduation or equivalent</p> <p>Selection process: students are selected on academic credentials and resume</p> <p>Graduation requirements: students have to complete all courses with a minimum pass mark of 60%; each student must complete a portfolio and demonstrate understanding of its benefits to career</p>	<p>Program is delivered with a combination of lectures, PowerPoint presentations and shop time;</p>	<p>Course titles and hours</p> <ul style="list-style-type: none"> • Basic Safety - 60 • Introduction to Refrigeration – 120 • Blueprint Reading - 30 • Refrigeration Science I - 30 • Mathematics for Trades – 30 • Computer - Fundamentals - 60 • Communications - Fundamentals - 60 • Electronics - 90 • Basic Electricity - 60 • Metering Devices - 60 • Compressors - 60 • Evaporators – 60 • Condensers - 60 • Work Experience - 200 <p>Course outlines available to students within 3 days of registration</p>
STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>Content theory: Theory is continuous written testing throughout the year; 1st semester – short paragraphs and short answers; 2nd semester – multiple choice</p> <p>Assessment: No component of the program is worth more than 40%</p>	<ul style="list-style-type: none"> • Students may be required to attend labs at least 90% of time; will have to give some consideration if this is challenged by student; presently this is only done in one program • Program will include 8 hours of business management for next year • High attrition rate for students so enrolment is high 	<p>Process: Combination of input from instructional staff and Program Advisory Committee</p> <p>Frequency: Yearly</p>	<p>Business/Industry</p> <p>Government</p>	<ul style="list-style-type: none"> • Students eligible to register for Level I apprenticeship are credited with 1000 hours • College offers time management and study skills seminars for students • Learning contracts are used for student success and student retention • Program graduates about 12 students per year 	

STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>Nova Scotia Community College</p> <p>Skills assessment: 1st semester – mini projects and demonstrations; 2nd semester – major project relating to all components of program;</p> <p>Assessment practices work practicum: Pass/Fail; practical assessment done by instructor if a visit to job site is possible; student has to keep detailed journal of tasks performed at job site; journal marked by instructor</p>	<ul style="list-style-type: none"> • Program Advisory Committee (PAC) identified that students need more knowledge and skills in electrical courses; next year the electrical courses in theory and practical will be increased by one week each • PAC would like to see some <i>Confined Spaces</i> training offered by college 				

COLLEGE	SIZE OF PROGRAM	CREDENTIAL ISSUED	PROGRAM FEATURES	CURRICULUM MODEL	CURRICULUM CONTENT
<p>Centre de formation professionnelle de Lachine Pavillon Dalbé-Viau</p> <p>1600, rue Provost Lachine (Québec) H8S 1P1</p> <p>Website: www.csmb.qc.ca/formationcontinue/centre/10.asp</p> <p>Contact person: Pat: Chardain: 1-514-637-2260</p> <p>Phone: 1-514-637-2260 Fax: 514-765-7599 Email: pchardain@educ.csmb.qc.ca</p>	<p>Number of faculty: 12; (three French groups and one English group);</p> <p>Number of students: 22 with each group of instructors</p>	<p>Diploma</p>	<p>Length: 1800 hours</p> <p>Program starts in the Fall term</p> <p>Admission requirements: Hold a Secondary School Diploma (SSD). OR Age: Be at least 16 years of age on September 30th of the current school year AND have earned the Secondary IV credits in language of instruction, second language and mathematics or have been granted recognition of equivalent learning in accordance with sections 232 and 250 of the Education Act. OR Age: Be at least 18 years of age upon starting the program and have the functional prerequisites prescribed according to Section 465 of the Education Act</p> <p>Graduation requirements: Student must complete the 33 modules</p>	<p>There is no individualized teaching</p> <p>There is no work/study component in this program</p>	<p>Course titles & hours:</p> <ul style="list-style-type: none"> • Construction Organizations – 15 hrs • Health & Safety on Construction Sites – 30 hrs • The Trade & Training Process – 30 hrs • Refrigeration Cycle Theory – 60 hrs • Maintenance Equipment & Mechanics - 90 hrs • Oxyacetylene Cutting, Welding & Brazing – 30 hours • Recovering Refrigerants – 45 hrs • Metering Devices – 45 hrs • Condensers & Evaporators - 15 hrs • Reciprocating Compressors – 30 hrs • Basic Refrigerating Circuits – 75 hrs • General Electricity – 60 hrs • Diagrams & Sketches – 30 hrs • Motor Circuits & Electrical Control Assemblies – 120 hrs • Fluid System Regulators & Accessories – 60 hrs • Piping for Refrigeration Systems – 45 hrs • Walk In Refrigerators – 120 hrs • Refrigerated Display Cases – 60 hrs • Ventilation & Air Conditioning Processes – 90 hrs • Heat Exchangers – 30 hrs • Electronic Control Circuits – 45 hrs • Plans & Specifications – 30 hrs

<p>Centre de formation professionnelle de Lachine Pavillon Dalbé-Viau</p>					<ul style="list-style-type: none"> • Maintaining & Troubleshooting Self-contained Air Conditioning Units – 60 hrs • Installing Split-System Heat Pumps – 105 hrs • Job Search Techniques – 30 hrs • Compressors – 30 hrs • Centrifugal Pumps – 30 hrs • Humidifiers – 15 hrs • Load Calculations – 45 hrs • Controllers & Control Software – 90 hrs • Maintaining & Troubleshooting Heat Pumps – 75 hrs • Chiller Maintenance – 45 hrs • Central Air Conditioning Systems – 120 hrs <p>Syllabus and/or course outlines available: Information not provided</p>
STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>Content theory: Written exam for each module;</p> <p>Skills assessment Practical exam for each module</p> <p>Assessment practices for work practicum: No work practicum component</p>	<p>None at this time</p>	<p>Information not provided</p>	<p>Information not provided</p>	<ul style="list-style-type: none"> • Tuition fees: \$40 per semester plus fees for safety boots and glasses • Additional cost of program paid by the government of Quebec • The ministry of education consulted with refrigeration contractors from all regions to get a consensus as to their requirements for a refrigeration apprentice. The meetings resulted in the development of 33 modules. to accommodate industry demands for more time in specific modules. 	

COLLEGE	SIZE OF PROGRAM	CREDENTIAL ISSUED	PROGRAM FEATURES	CURRICULUM MODEL	CURRICULUM CONTENT
<p>Saskatchewan Institute of Applied Science and Technology (SIAST)</p> <p>Idylwyld and 33rd Street PO Box 1520 Saskatoon SK S7K 3R5</p> <p>Website: www.siastr.sk.ca</p> <p>Contact person: Dennis Gillies</p> <p>Phone: (306) 933-6385 1-800-567-3263 (SK Toll Free)</p> <p>Email: GilliesD@siastr.sk.ca</p>	<p>Number of faculty: 2</p> <p>Number of students: 14 pre-employment students and about 5 to 6 apprentice groups of 12 each per year</p>	<p>Certificate</p>	<p>Program length: 34 weeks</p> <p>Program starts in August</p> <p>Entrance requirements: Grade 12 with a level of 30 Math; minimum overall average of 60%; Applicants who do not meet the stated academic qualifications may qualify through approved alternate admissions tests.</p> <p>Graduation requirements: The passing mark for pre-employment is 60% and for apprentices is 70%; Graduates receive credit towards refrigeration apprenticeship and exemption from portions of apprenticeship training according to the standing obtained and apprenticeship regulations</p>	<p>Experiential component: Students may be granted credit through Prior Learning Assessment and Recognition Unique delivery features: Knowledge and skill development will occur through classroom lectures, laboratory work, clinical experience(s) , discussions, and/or shop work; instructors will monitor and test progress</p>	<p>Course titles & hours:</p> <ul style="list-style-type: none"> • Comprehensive Final – 15 hrs • Industrial Communication – 60 hrs • Basic Electricity – 165 hrs • Graphics – 135 hrs • Mathematics – 135 hrs • Soldering – 45 hrs • Basic Piping Techniques – 45 hrs • Work Experience – 30 hrs • Fundamentals of Refrigeration 45 hrs • Basic Refrigeration Cycle – 45 hrs • Basic Refrigeration System Components – 105 hrs • Refrigerants & Accessories – 105 hrs • Hermetic Compressor Motors – 75 hrs • Defrost Systems & Piping – 45 hrs • Refrigeration & Load Calculations – 45 hrs • Enthalpy & Psychrometrics – 45 hrs • Capacity & Head Pressure Control Systems – 45 hrs • Basic System Installation – 60 hrs • System Design & Operation - 60 hrs • Electrical Control Systems – 75 hrs • Mechanical & Electrical Skills – 45 hrs • Basic Hand Tools – 30 hrs • Welding – 30 hrs • Introduction to WHMIS – 15 hrs <p>Course outlines available on website</p>

STUDENT ASSESSMENT	CURRENT and COMING CHALLENGES	CURRICULUM RENEWAL	PARTNERSHIPS	OTHER	COMMENTS
<p>Saskatchewan Institute of Applied Science and Technology (SIAST)</p> <p>Content theory assessment: Instructor did not want to provide information</p> <p>Skills assessment: Instructor did not want to provide information</p> <p>Assessment practices for any experiential components (practicum, clinical, work experience, c-op): Instructor did not want to provide information</p>	<p>Content including employability skills, inclusiveness, global orientation: Instructor did not want to provide information</p> <p>Delivery of the program: Instructor did not want to provide information</p> <p>Assessment practices: Instructor did not want to provide information</p> <p>Instructional technology: Instructor did not want to provide information</p>	<p>Process: Instructor did not want to provide information</p> <p>Frequency: Instructor did not want to provide information</p>	<p>No partnerships other than where students are placed for apprenticeship (students usually find an employer to apprentice with)</p>	<p>Tuition fees: \$2431</p> <p>Books and supplies are approximately \$490</p> <p>Graduates receive credit towards refrigeration apprenticeship and exemption from portions of apprenticeship training according to the standing obtained and apprenticeship regulations</p> <p>Employment opportunities were good last year and it looks the same this year</p>	

APPENDIX 2

Validated industry DACUM Chart



REFRIGERATION AND AIR CONDITIONING TECHNICIAN Validated DACUM

Facilitated by Mike Stuhldreier and Sandra Sukhan
February 25th and 26th, 2003

PERFORM BASIC
MAINTENANCE
A

Lubricate bearings A1	Follow checklist A2	Identify condition of coils A3	Change belts A4	Change air filters A5	Check pulleys for wear A6	Identify and explain basic unit maintenance needs/requirements A7	
S	S	S	S	S	S	S	
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	
Interpret sight glass A8	Clean unit A9	Identify condition of belts A10	Identify oil leaks A11	Change bearings A12	Identify and explain condition of heat exchanger A13	Identify condition of basic pumps A14	Troubleshoot basic pumps A15
S	S	S	S	S	S	S	S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c

REPAIR
HEATING/COOLING
SYSTEMS
B

Read schematics - (electrical, mechanical) B1	Identify/explain air distribution system B2	Troubleshoot basic air distribution systems B3	Adjust thermostats B4	Diagnose basic problems B5	Explain how a variety of meters work B6	Use variety of meters B7	Use variety of hand tools B8
S	S	S	S	S	S	S	S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Use variety of power tools B9	Use variety of welding tools/techniques B10	Check for leaks B11	Check power supply B12	Identify a variety of heating systems B13	Explain how heating systems work B14	Check fuses B15	Troubleshoot basic electrical systems B16
S	S	S	S	S	S	S	S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Change relays/contactors B17	Change electric motor B18	Interpret psychometric chart B19	Identify various power sources (voltage, phases) B20	Diagnose basic problems of gas furnaces B21	Pump down a system B22		
S	S	S	S	S	S		
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c		

REPAIR
REFRIGERATION
SYSTEM
C

Read a variety of gauges C1	Work with scales C2	Identify/explain refrigeration components C3	Diagnose basic problems C4	Follow rules/codes/guidelines (ie. Refrigerant changeover) C5	Use variety of leak detection devices C6	Gather information C7	Identify proper operating conditions C8
S	S	S	S	S	S	S	S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Use high pressure gases C9	Explain basic refrigeration cycle C10	Identify/explain variety of refrigeration systems C11	Identify/explain storage properties of perishable items C12	Use "rules of thumb" C13	Use arc welding techniques C14		
E	S	S/E	S/E	S	S		
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c		

S - denotes sustaining
E - denotes emerging

DACUM Skill Rating Scale: Ratings on this scale are based on industrial performance standards.
 1 - Can perform some parts of this skill satisfactorily but requires assistance and/or supervision to perform the entire skill.
 2 - Can perform this skill satisfactorily but requires periodic assistance and/or supervision
 3 - Can perform this skill satisfactorily without assistance and/or supervision.

4a - Can perform this skill satisfactorily with more than acceptance speed and quality.
 4b - Can perform this skill satisfactorily with initiative and adaptability to special problem situations.
 4c - Can perform this skill satisfactorily and can lead others in performing it.

 Rating revision made at March 29/03 DACUM validation

COMMUNICATE
D

Read and interpret sequence of operations D1 S	Listen D2 S	Ask questions D3 S	Complete service forms D4 S	Write D5 S	Follow written/oral instructions D6 S	Write recommendation reports D7 S	Be concise D8 S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Apply math skills D9 S	Do conversions D10 S	Use appropriate terminology D11 S	Use appropriate manners D12 S	Read manuals D13 S			
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c			

BE PROFESSIONAL
E

Be organized E1 S	Be responsible E2 S	Be punctual E3 S	Display positive attitude E4 S	Display personal competence E5 S	Learn continuously E6 S	Maintain professional credentials E7 S	Deal with adversity E8 S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Think outside the box E9 S	Think critically E10 S	Identify personal limitations E11 S	Identify personal strengths/weaknesses E12 S	Maintain professional appearance E13 S	Be motivated E14 S	Take initiative E15 S	Display personal integrity E16 S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Be honest E17 S	Be adaptable E18 S	Read/follow workplace policies/procedures E19 S	Manage time E20 S				
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c				

INTERACT WITH CO-WORKERS/CUSTOMERS
F

Follow sexual harassment guidelines F1 S	Take/follow instructions F2 S	Deal with conflict F3 S	Be a team player F4 S	Accept criticism F5 S	Show respect F6 S	Learn from mistakes F7 S	Be observant F8 S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Read non-verbal cues F9 S							
1 2 3 4a 4b 4c							

S - denotes sustaining
E - denotes emerging
R - Retiring

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- 3 - Can perform this skill satisfactorily without assistance and/or supervision.

- 4a - Can perform this skill satisfactorily with more than acceptable speed and quality.
- 4b - Can perform this skill satisfactorily with initiative and adaptability to special problem situations.
- 4c - Can perform this skill satisfactorily and can lead others in performing it.

 Rating revision made at March 29/03 DACUM validation

DOCUMENT
G

Complete work order G1 S	Complete time sheets G2 S	Obtain customer consent G3 S	Complete accident reports G4 S	Fill out warranty forms G5 S	Complete O.D.P. G6 S	Identify/explain government regulatory forms G7 S	Complete maintenance forms G8 S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Maintain W.H.M.I.S. sheets G9 S	Maintain/update inventory sheets G10 S	Maintain personal daily log G11 S	Complete MSDS form G12 S				
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c				

WORK WITH REFRIGERANTS
H

Identify refrigerants/properties H1 E/S	Explain refrigerant properties H2 E/S	Perform pressure tests H3 E/S	Evacuate systems H4 E/S	Reclaim/recover/recycle refrigerants H5 E/S	Charge refrigerants H6 E/S	Identify/explain refrigeration oil properties H7 E/S	Identify/explain super heat sub-cooling H8 S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c

WORK SAFELY
I

Identify dangers I1 E/S	Identify ventilation restrictions I2 E/S	Provide appropriate ventilation I3 E/S	Store refrigerants properly I4 E/S	Handle refrigerants safely I5 E/S	Wear appropriate protective clothing/gear I6 E/S	Use ladder safely I7 S	Handle chemicals I8 E/S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Identify dangerous situation and act accordingly I9 E/S	Dispose chemicals/refrigerants safely I10 E/S	Read/interpret M.S.D.S. / W.H.M.I.S. I11 S	Drive a vehicle I12	Apply variety of rigging techniques I13 E/S	Lift heavy objects I14 S	Apply basic first aid I15 S	Identify/explain personal worker rights I16
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Work safely with gas I17 S	Identify hazardous roof conditions I18 S						
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c						

INSTALL PIPES
J

Hang/support pipes J1 S	Make flares J2 S	Perform nitrogen purge J3 S	Apply standard piping practices J4 S	Install/identify appropriate piping J5 S	Use appropriate compounds J6 S	Thread, cut, fit pipe J7 S	Perform basic piping techniques J8 S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Pipe in basic heating systems J9 S	Calculate water pressure drops J10 S						
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c						

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- 4c - Can perform this skill satisfactorily and can lead others in performing it.

■ Rating revision made at March 29/03 DACUM validation

USE TECHNOLOGY
K

Use word processor	Access computer data	Change operating settings electronically	Read/interpret diagnostic data	Communicate effectively with radio	Identify/explain building automation systems
K1	E	K2	E	K3	E
K4	S	K5	S	K6	E
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c

PERFORM BASIC SHEET METAL SKILLS
L

Calculate air flow	Identify/explain air flow characteristics	Suspend ducts	Cut ducts	Remove ducts	Install ducts	Identify air flow problems	Identify/explain fan laws
L1	S	L2	S	L3	S	L4	S
L5	S	L6	S	L7	S	L8	S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c

PERFORM BASIC MACHINING SKILLS
M

Use Caliper	Use micrometer	Identify/explain metals specific to trade	Apply variety of metal filing techniques	Sharpen drill bits	Use hacksaw	Drill and tap	Use a punch
M1	S	M2	S	M3	S	M4	S
M5	R	M6	S	M7	S	M8	S
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c	1 2 3 4a 4b 4c
Use a feeler gauge	Use dial indicator						
M9	S	M10	S				
1 2 3 4a 4b 4c	1 2 3 4a 4b 4c						

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4c - Can perform this skill satisfactorily and can lead others in performing it.

 Rating revision made at March 29/03 DACUM validation

APPENDIX 3

Integrated program learning outcomes Chart

REFRIGERATION AND AIR CONDITIONING

Integrated program learning outcomes

Facilitated by Robert Richard and Sandra Sukhan

April 25th, 2003

PERFORM BASIC MAINTENANCE A	Lubricate bearings A1	Follow checklist A2	Identify condition of coils A3	Change belts A4	Change air filters A5	Check pulleys for wear A6	Identify and explain basic unit maintenance needs/requirements A7	
	Interpret sight glass A8	Clean unit A9	Identify condition of belts A10	Identify oil leaks A11	Change bearings A12	Identify and explain condition of heat exchanger A13	Identify condition of basic pumps A14	Troubleshoot basic pumps A15
SERVICE & MAINTAIN AIR HEATING/COOLING SYSTEMS B	Read electrical/ mechanical schematics B1	Identify/explain air distribution system B2	Troubleshoot basic air distribution systems B3	Set up and adjust thermostats B4	Diagnose basic problems B5	Explain how a variety of meters work B6	Use variety of test meters B7	Use variety of hand tools B8
	Use variety of power tools B9	Use variety of gas welding tools/techniques B10	Check for refrigerant leaks B11	Check power supply B12	Identify a variety of heating systems B13	Explain how heating systems work B14	Check fuses B15	Troubleshoot basic electrical systems B16
	Change relays/contactors B17	Change electric motor B18	Interpret psychometric chart B19	Identify various power sources (voltage & phases) B20	Diagnose basic problems of gas furnaces B21	Pump down refrigeration system B22		
SERVICE & MAINTAIN HALOGENATED REFRIGERATION SYSTEM C	Read a variety of gauges C1	Work with scales C2	Identify/explain refrigeration components C3	Diagnose basic problems C4	Follow rules/codes/guidelines (i.e., Refrigerant changeover) C5	Use variety of leak detection devices C6	Gather information C7	Identify proper operating conditions C8
	Use high pressure gases C9	Explain basic refrigeration cycle C10	Identify/explain variety of refrigeration systems C11	Identify/explain storage properties of perishable items C12	Use "rules of thumb" C13	Use arc welding techniques C14		
COMMUNICATE D	Read and interpret sequence of operations D1	Listen D2	Ask questions D3	Complete service forms D4	Write D5	Follow written/oral instructions D6	Write recommendation reports D7	Be concise D8
	Apply math skills D9	Do conversions D10	Use appropriate terminology D11	Use appropriate manners D12	Read manuals D13	Prepare resume/cover letter D14	Apply job search skills D15	



Shading denotes a proposed Program Learning Outcome

BE PROFESSIONAL
E

Be organized E1	Be responsible E2	Be punctual E3	Display positive attitude E4	Display personal competence E5	Learn continuously E6	Maintain professional credentials E7	Deal with adversity E8
Think "outside the box" E9	Think critically E10	Identify personal limitations E11	Identify personal strengths/weaknesses E12	Maintain professional appearance E13	Be motivated E14	Take initiative E15	Display personal integrity E16
Be honest E17	Be adaptable E18	Follow workplace policies/procedures E19	Manage time E20				

INTERACT WITH CO-WORKERS/CUSTOMERS
F

Follow sexual harassment guidelines F1	Take/follow instructions F2	Deal with conflict F3	Be a team player F4	Accept criticism F5	Show respect F6	Learn from mistakes F7	Be observant F8
Read non-verbal cues F9							

DOCUMENT
G

Complete work order G1	Complete time sheets G2	Obtain customer consent G3	Complete accident reports G4	Fill out warranty forms G5	Complete O.D.S. reports G6	Identify/explain government regulatory forms G7	Complete maintenance forms G8
Maintain W.H.M.I.S. sheets G9	Maintain/update inventory sheets G10	Maintain personal daily log G11	Reference M.S.D.S. form G12				

WORK WITH REFRIGERANTS
H

Identify refrigerants/properties H1	Explain refrigerant properties H2	Perform pressure tests H3	Evacuate systems H4	Reclaim/recover/recycle refrigerants H5	Charge refrigerants H6	Identify/explain refrigeration oil properties H7	Identify/explain super heat sub-cooling H8
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Shading denotes a skills/ability not currently taught in the program that were proposed Program Learning Outcomes

WORK SAFELY I	Identify dangers I1	Identify ventilation restrictions I2	Provide appropriate ventilation I3	Store refrigerants properly I4	Handle refrigerants safely I5	Wear appropriate protective clothing/gear I6	Use ladder safely I7	Handle chemicals safely I8
	Identify dangerous situations and act accordingly I9	Dispose chemicals/refrigerants safely I10	Read/interpret M.S.D.S. / W.H.M.I.S. I11	Operate service vehicles in a diligent and courteous manner I12	Apply variety of rigging techniques I13	Lift heavy objects I14	Apply basic first aid I15	Identify/explain personal worker rights I16
	Work safely with refrigerant compressed gases I17	Identify hazardous roof conditions I18	Tag off/lock off I19	Transport dangerous goods safely I20	Obtain TDG certification I21	Practice electrical safety I22		
INSTALL PIPES J	Hang/support copper refrigeration pipes J1	Make flares J2	Perform nitrogen purge J3	Apply standard copper piping practices for refrigeration applications J4	Install/identify (appropriate) copper piping J5	Use appropriate compounds J6	Thread, cut, fit pipe J7	Perform basic piping techniques when using refrigeration tubing J8
	Pipe in basic heating systems J9	Calculate water pressure drops J10						
USE TECHNOLOGY K	Use word processing software K1	Use computer to access data K2	Change operating settings electronically K3	Read/interpret diagnostic data K4	Communicate effectively with radio K5	Identify/explain building automation systems K6		
USE BASIC SHEET METAL SKILLS TO SERVICE AND MAINTAIN A/C UNITS L	Measure airflow with various instruments L1	Identify/explain general air flow characteristics L2	Suspend light duty ducts hangers L3	Cut ducts L4	Remove ducts L5	Install ducts L6	Identify air flow problems L7	Identify/explain fan laws L8
PERFORM BASIC MACHINING SKILLS M	Use Calipers M1	Use micrometer M2	Identify/explain metals specific to trade M3	Apply variety of metal filing techniques M4	Sharpen drill bits M5	Use hacksaw M6	Drill and tap M7	Use a punch M8
	Use a feeler gauge M9	Use dial indicator M10						



Shading denotes a proposed Program Learning Outcome

APPENDIX 4

Five-year program renewal plan – Gantt Chart