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Optional Requirements for Interim Credentials for Pipefitter/Steamfitter

Level 1 1,700 – 2000 Hours OJL and 1st Year RI

- Completion of Brazing Certification UA-51 – The completed braze test assembly shall be visually examined for cleanliness and the presence of brazing filler metal all around the joint at the interface between the socket and the pipe. Outside surfaces shall be free of excessive braze metal and oxidation. Sectioning tests shall be in accordance with ASME Code Section IX.

- OSHA 10/30-Hour Course – Smart Mark is an OSHA approved safety and health training program. It is a standardized and intensive program that was developed in 1998 by the Construction Industry Partnership (CIP) that prepares construction industry workers to identify hazards and prevent on-the-job accidents.

- Soldering Certification – The Copper Development Association Inc. (CDA) regularly receives inquiries regarding the methods and procedures required to qualify installers for the installation of soldered-joint copper piping systems. Currently, there are no known qualifications requirements developed and certified by any consensus code-writing body. Therefore, to provide a qualified procedure for the testing and certification of solderers, the CDA has developed the following Soldering Procedure Specification. The attached documents satisfy the requirements and processes that contributed to the development of ASTM B 828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.*

- Confined Space – This training is a combination of OSHA's 2260 3-day classroom-based confined space course on OSHA's General Industry Standard with CPWR's 2-day hands-on simulated entry training. The OSHA 2260 course is designed to direct students to first determine if a space is a confined space, then to properly classify each confined space as either permit-required or a non-permit space. The course

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also allows students to determine which options are effective at protecting workers entering permit spaces. Topics include legal issues, permit programs, ventilation and rescue. CPWR's hands-on training includes air-monitoring, ventilation, supplied-air respiral (SARs), self-contained breathing apparatus (SCBAs) entry procedures, retrieval and other aspects of permit-required confined space entry.

- Forklift Certification – Upon successful completion of this course, the member will be able to differentiate the different types of forklifts and powered industrial equipment, understand material handling techniques, understand operating techniques, determine hazards associated with powered industrial equipment and implement and maintain a forklift/powered industrial equipment safety program. The student will take a comprehensive online exam at the end of the course. A score of 80% is required to receive certification.

- First Aid/CPR – The student will learn basic life support, which includes Cardiopulmonary Resuscitation, Automated External Defibrillation, and related subjects such as initial care for Angina, Stroke, and Foreign Body Airway Obstruction. The basic first aid portion includes procedures for emergency moving of the injured, wounds/bleeding, traumatic shock, fractures, burns with special emphasis on accidental electrical contact, eye injuries, allergic reactions, seizures, drug overdoses, temperature-related problems and many other job related emergencies.

Level 2 3,400 – 4,000 Hours OJL and 2nd Year RI

- Crane Signalperson Certification – Signalperson Training Program is a state of the art interactive training aid. The program covers all the pertinent requirements of the current OSHA 1926.550, ASME B30.5, B30.3, B30.23, and even the current OSHA Cranes and Derrick Standard 1926.1400. The course will cover theoretical and practical components of signaling and crane characteristics and limitations. Certification will be provided by the National Commission for the Certification of Crane Operators (NCCCO).

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- Individual Welding Process Certification UA-70 – The completed test assembly shall be visually examined in accordance with paragraph 4.8.1 of AWS D1.1, and shall be uniform and free of cracks, porosity, slag, and undercut shall not exceed 1/32".

Level 3 5,100 – 6,000 Hours OJL and 3rd Year RI

- Green Systems Awareness Certification – The certification consists of four parts. In order to receive this certification a member must achieve an 80% on each four parts, which include Core, HVAC, Plumbing, and Electrical. No certification is given if they fail one or more sections.

- Individual Welding Process Certifications UA-21 – The completed test assembly shall be visually examined over the entire circumference, inside and outside, showing complete joint penetration with complete fusion of weld metal and base metal (no concavity); and shall be uniform and free of cracks, incomplete fusion, incomplete penetration, porosity, slag, and undercut (not to exceed 1/32")

- CFC Universal Certification - Overview of the Issues on the U.S. Environmental Protection Agency's (EPA) certification under Section 608 include:
  Core Information
  Type 1 Certification (Small Appliances)
  Type 2 Certification (High-Pressure)
  Type 3 Certification (Low-Pressure)

- R410A Certification – The HVACR industry has been using HCFC's since the 1940s. Due to environmental and competitive pressure, HCFCs including R-22 are being phased out. In response, many of the manufacturers began selling equipment that uses HFC-410A. R-410A presently marketed under the brand names Honeywell AZ-20, Carrier Puron, or DuPont Suva. Air-conditioning equipment manufactured for R-410A will require contractors and technicians to shift to different tools, equipment and safety standards when installing or changing out older split A/C systems and repairing systems in the field.

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R-410 has a much higher vapor pressure than R-22. These higher pressures create some safety concerns. To address the issues of safe handling, training and certification with the uses of R-410A the industry worked together to unify behind a Universal R-410 Safety Training & Certification Program. The AC&R Safety Coalition members include RSES, ESCO Institute, Ferris State University, Indoor Air Quality Association, Industrial Technology Excellence, Green Mechanical Council, HVAC Excellence, COSA and the United Association. Together working with numerous manufacturers, wholesalers and industry associations, a third party has developed a universal R-410A curriculum and certification.

The apprentice must complete each level of the above requirements and certifications to be eligible to receive an Interim Credential Certification from the United States Department of Labor's Office of Apprenticeship. The Interim Credential will read the following for each level:

Level 1 – Brazing Certification UA-51

OSHA 10- and 30-Hour Course

Soldering Certification

Confined Space

Forklift

First Aid/CPR

Level 2 – Crane Signal Person Certification

UA-70 Welding Certification

Level 3 – Green Systems Awareness Certification

UA-21 Welding Certification

CFC Universal Certification

R-410 A Certification

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The Certificate of Completion of Apprenticeship will be issued when the last year of apprenticeship is completed with all other remaining requirements.

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UA-51 BRAZE TEST SPECIFICATION

Manual Torch Brazing Process

Maximum Time Permitted for Test is Two Hours

COUPON MATERIALS

- Tube Material: SB-75 Seamless Tube (0.060" wall)
- Fitting Material: B16.22 Stop Coupling (0.055" wall)
- Fitting/Tube Size: 1 ½" Type L (1.625" OD Tube)
- Number of Coupons: Two Socket Couplings, Four Joints Total

JOINT CONFIGURATION

- Socket Joints Required
- Socket Clearance: 0.002" to 0.010"
- Overlap of Socket and Pipe: 1.09"

FLOW POSITION

- Two Joint in Each the Horizontal and Vertical Up-Flow Positions
- Face Fed Filler Metal

BRAZING FILLER MATERIALS

- Filler Metal: BCuP-2 Through BCuP-7
- Product Form: Round, Square, or Rectangular Rod

BRAZING FLUX

- None Permitted

FUEL GAS

Oxyacetylene, Natural, Propane, or MAPP® Gas

INTERNAL PURGING

- Oil Free Dry Nitrogen ≥ 5 CFH (The purge gas shall flow until the brazement is cool to the touch so that no oxidation forms on the I.D. of the tube and fitting.)

GENERAL BRAZING TECHNIQUES

- Prebraze Cleaning: Surface particles and dirt shall be removed using a clean lint-free cloth. Surface oxidation shall be removed with the use of a nylon abrasive cloth.

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- Postbraze Cleaning: Use a wet cloth or stainless steel wire brush to remove loose surface oxidation.
- Nature of Flame: Neutral
- Brazing Tip Sizes: (Optional) 54 Through 30: Use of Turbo Torch or Rosebud Permitted.

INSPECTION AND TESTING

- The completed braze test assembly shall be visually examined for cleanliness and the presence of brazing filler metal all around the joint at the interface between the socket and the pipe. Outside surfaces shall be free of excessive braze metal and oxidation.
- Assembly shall be examined by Sectioning Tests in accordance with ASME Code Section IX.

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DESIGNATED TRAINING TOPICS

10-HOUR CONSTRUCTION INDUSTRY OUTREACH TRAINING PROGRAM
10-HOUR MANDATORY COURSE TOPICS

The 10-hour Construction Industry Outreach Training Program is intended to provide an entry-level construction worker's general awareness on recognizing and preventing hazards on a construction site. The training covers a variety of construction safety and health hazards which a worker may encounter at a construction site. OSHA recommends this training as an orientation to occupational safety and health. Workers must receive additional training on hazards specific to their job. Training should emphasize hazard identification, avoidance, control and prevention, not OSHA standards. Instructional time must be a minimum of 10 hours.

Breakdown of topics is as follows:

- **Mandatory – 4 hours**: Four topics to be taught, ranging from one-half to two hours each (Introduction to OSHA; OSHA Focus Four Hazards; Personal Protective and Lifesaving Equipment; Health Hazards in Construction)
- **Elective – 2 hours**: Choose at least two of these topics for a minimum of one-half hour each. Must cover at least two hours.
- **Optional – 4 hours**: Learn any other construction industry hazards or policies and/or expand on the mandatory or elective topics, minimum of one-half hour each.

10-HOUR CONSTRUCTION INDUSTRY REQUIREMENT COURSE TOPICS

Introduction to OSHA – One Hour

- OSH Act, General Duty Clause, Employer and Employee Rights and Responsibilities, Whistleblower Rights, Recordkeeping basics
- Inspections, Citations, and Penalties
- General Safety and Health Provisions, Competent Person, Subpart C
- Value of Safety and Health
- OSHA Website, OSHA 800 Number and Available Resources

OSHA Focus Four Hazards – Two Hours (must cover all four areas – minimum 15 minutes on each)

- Fall Protection, Subpart M (e.g., floors, platform, roofs)
- Electrical, Subpart K (e.g., overhead power lines, power tools and cords, temporary wiring, grounding)

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- Struck By (e.g., falling objects, trucks, cranes)
- Caught In/Between (e.g., trench hazards, equipment)

Personal Protection and Lifesaving Equipment – 30 Minutes, Subpart E

Health Hazards in Construction – 30 Minutes (e.g., noise, hazards communication and crystalline silica)

ELECTIVES

Choose at least two of the following topics – Must add up to at least two hours: Minimum one-half hour each:

- Materials Handling, Storage, Use and Disposal, Subpart H
- Tools – Hand and Power, Subpart I
- Scaffolds, Subpart L
- Cranes, Derricks, Hoists, Elevators, and Conveyors, Subpart N
- Excavations, Subpart P
- Stairways and Ladders, Subpart X

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DESIGNATED TRAINING TOPICS
30-HOUR CONSTRUCTION INDUSTRY OUTREACH TRAINING PROGRAM
30-HOUR MANDATORY COURSE TOPICS

The 30-Hour Construction Outreach Training Program is intended to provide a variety of training to workers with some safety responsibility. Workers must receive additional training on hazards specific to their job. Training should emphasize hazard identification, avoidance, control and prevention, not OSHA standards. Instructional time must be a minimum of 30 hours. OSHA subpart references are provided for informational purposes; training should emphasize hazard awareness.

Breakdown of topics is as follows:

- **Mandatory – 12 hours**: Five topics to be taught, ranging from one to five hours each
- **Elective – 12 hours**: Choose at least six of these topics for a minimum of one-half hour each.
- **Optional – 6 hours**: Learn any other construction industry hazards or policies and/or expand on the mandatory or elective topics, minimum of one-half hour each.

30-Hour Construction Industry Course Topics

Introduction to OSHA – at least Two Hours

- OSH Act, General Duty Clause, Employer and Employee Rights and Responsibilities, Whistleblower Rights, Recordkeeping Basics
- Inspections, Citations, and Penalties
- General Safety and Health Provisions, Competent Person, Subpart C
- Value of Safety and Health
- OSHA Website, OSHA 800 Number and Available Resources

OSHA Focus Four Hazards – at least Five Hours (must cover all four areas – minimum 30 minutes on each)

- Fall Protection, Subpart M (e.g., floors, platform, roofs)
- Electrical, Subpart K (e.g., overhead power lines, power tools and cords, temporary wiring, grounding)
- Struck By (e.g., falling objects, trucks, constructing masonry walls)
- Caught In/Between (e.g., trench hazards, unguarded machinery, equipment)

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Personal Protection and Lifesaving Equipment – at least Two Hours

Health Hazards in Construction – at least Two Hours

Stairways and Ladders, Subpart X – at least One Hour

ELECTIVES

30-Hour Elective Course Topics

Choose at least six of the following topics – Must add up to at least 12 hours

- Fire Protection and Prevention, Subpart F
- Materials Handling, Storage, Use and Disposal, Subpart H
- Tools – Hand and Power, Subpart I
- Welding and Cutting, Subpart J
- Scaffolds, Subpart L
- Cranes, Derricks, Hoists, Elevators, and Conveyors, Subpart N
- Motor Vehicles, Mechanized Equipment and Marine Operations; Rollover Protective Structures and Overhead Protection; and Signs, Signals and Barricades, Subpart O, W, and G
- Excavations, Subpart P
- Concrete and Masonry Construction, Subpart Q
- Steel Erection, Subpart R
- Confined Space Entry
- Powered Industrial Vehicles
- Ergonomics

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SUMMARY SOLDERING CERTIFICATION

The Copper Development Association Inc. (CDA) regularly receives inquires regarding the methods and procedures required to qualify installers for the installation of soldered-joint copper piping systems. Currently, there are no known qualifications requirements developed and certified by any consensus code-writing body. Therefore, to provide a qualified procedure for the testing and certification of solderers, the CDA has developed the following Soldering Procedure Specification. The attached documents satisfy the requirements and processes that contributed to the development of ASTM B 828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.*

These documents were developed by the Copper Development Association Inc. and tested by PRL Metallurgical Laboratory, a division of Regal Cast, Inc.,* an ASME-recognized test laboratory.

It is the responsibility of the contractor using this specification and the supporting qualification records to ensure that the appropriate tests are conducted to qualify each solderer. It is also the contractor's responsibility to assure that these specifications meet any additional requirements of the referencing document. **The contractor shall maintain a signed and dated record of the Soldering Procedure Specifications, Procedure Qualification Records and the resulting Solderer Performance Qualifications and shall assume responsibility or liability of any kind in connection with the use of these documents. CDA makes no representation or warranties of any kind in the use of these documents.**

The documents are:

- Soldering Procedure Specification (SPS) – the document that specifies the required soldering variables for a specific application
- Procedure Qualification Record (PQR) – a record of soldering variables and conditions used to produce an acceptable test solder joint and the result of tests conducted to qualify a soldering procedure specification
- Solderer Performance Qualification Record (SPQR or SQR) – a record of the soldering conditions used to produce an acceptable test solder joint and the results of the tests performed on the solder joint to qualify the solderer

* PRL Metallurgical Laboratory, P.O. Box 1170, 307 N. Ninth Avenue, Lebanon, PA 17046

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SPS No. CDA-S001

TITLE

Soldering Procedure Specification CDA-2001 for Soldering Copper and Copper Alloy Tube and Fittings Using a Manual Air-fuel Torch and ASTM B 828 Procedures

SCOPE

This procedure is applicable for the soldering of copper tube and copper alloy fittings in the range of 0.375" nominal to 8.0" nominal. Wall thickness range shall be from 0.023" to 0.298". The tube and fitting for the test solder joint shall be fabricated in the horizontal position.

BASE METAL

Base metals shall be UNS C12200 copper conforming to the requirements of Group BM No. 300 as listed in Table B1 of ANSI/AWS B2.2-91.

FILLER METAL

Filler metals shall meet the requirements of Table 5 of the latest revision of ASTM B 32, *Standard Specification for Solder Metals*. Filler metals shall contain less than 0.2% lead (Pb). Filler metals shall be stored in accordance with manufacturer's recommendations and shall be 0.125" wire.

SOLDERING FLUX

Soldering fluxes shall be in accordance with the requirements of ASTM B 813, *Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube and Fittings.*

PURGE

No purge gas required.

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JOINT DESIGN AND TOLERANCES

Joint type shall be socket/lap. The minimum and maximum joint clearance/capillary space shall be 0.002" to 0.010". Lap (overlap) shall meet the dimensional requirements of the latest revisions of ASME/ANSI B16.22 *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings* or MSS SP-104 *Manufacturers Standardization Society, Wrought Copper Solder Joint Pressure Fittings.*

NOTE #1 BASE METAL (Preparation)

CUTTING

Cut tube ends square. Cutting process shall be performed in a manner that prevents tube ends from being deformed. If a tube cutter is used, it shall be free of oil, dirt, lint and other debris. The cutter wheel(s) shall be sharp and the rollers free-rolling.

REAMING

Ream all tube ends to the original I.D. of the tube to remove the small burr created by the cutting operation. Care shall be exercised to ensure that no shavings are left in the tube.

CLEANING

Surface oxidation on the I.D. of the fitting shall be removed with an appropriately sized fitting brush or abrasive cloth. Surface oxidation on the O.D. of the tube ends shall be removed with a wire brush or abrasive cloth for a distance slightly more than the depth of the fitting cup. Steel wool shall not be used.

FLUXING

Apply a thin even coating of flux with a brush to both tube and fitting as soon as possible after cleaning.

ASSEMBLY AND SUPPORT

Insert tube ends into the fitting cup, making sure that the tube end is seated against the base of the fitting cup. Support the tube and fitting assembly to ensure an adequate capillary space around the entire circumference of the joint.

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NOTE #2 SOLDERING PROCESS (Post-Solder Procedures)

POST-SOLDER CLEANING

When the joint is cool to the touch, the outside shall be cleaned using a damp cloth to remove any remaining soldering flux and allow a clear visual inspection of the joint.

VISUAL EXAMINATION

The finished joint shall be visually examined. The following conditions shall be considered unacceptable according to this specification:

- Drips of excess solder on the outside of the tube and/or fitting
- Cracks in the tube or fitting
- Cracks in the solder filler metal

PEEL TEST

The finished joint shall be sectioned lengthwise and flattened to separate the tube from the fitting. Following sectioning of the finished solder joint, the joint shall be visually examined. The following conditions shall be considered unacceptable according to this specification (see **Appendix A**):

- A total area of defects (unsoldered area, flux inclusions, or incomplete bridging of solder metal between the tube and fitting [see **Appendix A,** Bridging]) of greater than 30% of the total faying area (the front edge to the rear edge of the overlap) of any of the individual joints
- A sum of the lengths of the defects measured on any one line in the direction of the lap shall not exceed 30% of the length of the lap.
- Solder voids that extend from the inside edge of the fitting to the outside edge creating a leak path through the capillary space, regardless of the area of the void.

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APPENDIX A

ACCEPTANCE CRITERIA FOR VISUAL EXAMINATION AND PEEL TESTING OF SOLDER JOINTS

Solder Coverage:

Strength and pressure ratings of solder joints for copper tube and fittings are found in Annex A of ASME B16.22, *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.* It is generally accepted that a minimum of 70% fill of solder material into the capillary space of the joint is required to ensure acceptable strength and pressure capabilities.[1-2] For purposes of qualifying individuals in soldering competency, this specification requires a minimum of 70% fill in any joint (see **Number of Joints**).

NOTE: *Grading of these joints can be accomplished by overlaying the soldered surface of the tube or fitting with a clear plastic sheet with a grid printed on it. By counting the squares in the grid covering areas not covered by solder (see* **Bridging***) and comparing them to the total number of squares covering the faying surface, a percentage of coverage can be calculated.*

Bridging:

Bridging is the spanning of the solder from the outside surface of the tube to the inside surface of the fitting, indicating complete fill of the capillary space. If bridging does not occur, the surfaces of the tube and fitting may just be "tinned," not adding anything of significance to strength and pressure capabilities. When joints are cold-peeled, areas that have been properly bridged will be a dull gray color on one or both corresponding surfaces indicating a physical separation of the solder material. There may be specks of copper indicating that the solder metal actually separated from the copper surface. Areas where this bridging has not taken place will show shiny silver surfaces on the corresponding faying surfaces, associated with an area where the solder depth is lower, indicating there was no physical separation of the solder metal when the joint was peeled.

The areas that have not been properly bridged shall be counted as part of the total void areas for purposes of calculating total solder coverage.

[1] American Society of Metals, Metals Handbook, Ninth Edition, Volume 6, (Menlo Park, OH: American Society of Metals, 1983) 1095.

[2] American Welding Society, Soldering Manual, 2nd ed, revised, (Miami: American Welding Society, 1978) 23.

[1]NITC - National Inspection Testing Corporation; EPA – Environmental Protection Agency; OSHA –Occupational Safety and Health Administration; EPRI – Electric Power Research Institute; ESCO Institute; ASSE – American Society of Safety Engineers; NCCCO – National Commission for the Certification of Crane Operators; ASME – American Society Mechanical Engineers; IAPMO – International Association of Plumbing and Mechanical Officials

Location of Defects:

The location of defects in a soldered joint and their relation to each other can greatly affect the strength of the joint. Defects in a line from the front edge to the rear edge of the overlap (faying surfaces) will result in a leaking joint and will also reduce the strength of the joint. Therefore, for purposes of qualifying individuals, this specification also requires:

- The sum of the lengths of all defects, measured in a straight line in the direction of the lap (from front of cup to back of cup), are not to exceed 30% of the length of the lap.
- No solder void, or incomplete bridging, may extend continuously along the entire length of the capillary space from the inside of the fitting to the outside creating a leak path through the capillary space.

These requirements must be met for all joints in the test series.

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APPENDIX A

TEST JOINTS

Range of Diameters:

There can be significant differences in the equipment and technique used to solder larger diameters and smaller diameters. Consequently, test solder joints will qualify a solderer as follows:

- 1" nominal test joints will qualify a solderer for diameters up to 1 ½" nominal.
- 2" nominal test joints will qualify a solderer for diameters from 2" through 3" nominal.
- 4" nominal test joints will qualify a solderer for diameters from 2" through 5" nominal.
- 6" nominal test joints will qualify a solderer for diameters from 2" through 6" nominal.
- 8" nominal test joints will qualify a solderer for diameters from 2" through 8" nominal.

Number of Test Joints:

Four test joints will be required for each diameter range to be qualified. Test joints of all assemblies are to be soldered in the horizontal position.

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Confined Space Rescue Technician

Orientation Module
Introduction to Confined Space Rescue
Course Introduction - Preface
Confined Space Identification - Chapter 1
OSHA Regulation - Chapter 2
Confined Space Hazards - Chapter 4
Atmospheric Monitoring - Chapter 5
Hazard Control - Chapter 6
Personal Protective Equipment - Chapter 7
Phases of Confined Space Rescue - Chapter 8
Rescue Rope and Related Equipment - Chapter 9
High Point Anchor Systems - Chapter 10
Communications - Chapter 11
Permitting Confined Spaces - Chapter 12

Skills Module
Knots
Chapter 9
How to Tie a Figure Eight Stopper
How to Tie a Figure Eight on a Bight
How to Tie a Figure Eight Follow Through
How to Tie a Figure Eight Bend
How to Tie a Square Knot
How to Tie an Overhand Bend
How to Tie a Double Overhand Bend (Double Fisherman Knot)
How to Attach a 3-Wrap Prusik to a Rescue Rope
How to Construct a Modified Trucker's Hitch

Skills Module
Anchor Systems
Chapter 9
How to Tie a Single Loop Anchor Sling
How to Tie a Basket Sling
How to Tie a Multi-Loop Anchor Sling (Wrap Three, Pull Two)
How to Tie a Tensionless Hitch
How to Construct a Back-Tied Anchor System

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Skills Module
RPM
Chapter 9
How to Attach and Operate a Brake Bar Rack as Part of the RPM
How to Construct and Operate a Load Release Hitch as Part of the RPM
How to Attach a Prusik Loop to the RPM for Use in a Haul System
How to Construct and Operate the RPM

Skills Module
Belay Systems
Chapter 9
How to Construct and Operate a Tandem Prusik Belay System
How to Convert a Tandem Prusik Belay System to a Retrieval Line

Skills Module
Raising Systems
Chapter 9
How to Construct and Operate a 2:1 Ladder Rig Mechanical Advantage System
How to Construct and Operate a 3:1 Z-Rig Mechanical Advantage System Through High Point Anchor
How to Construct and Operate a 3:1 Piggyback Mechanical Advantage System Through High Point Anchor
How to Construct and Operate a 4:1 Mechanical Advantage System
How to Construct and Operate a 4:1 Pre-Rig Mechanical Advantage System

Skills Module
Rescuer and Victim Packaging
Chapter 9
How to Tie Two Half Hitches
How to Tie a Round Turn and Two Half Hitches
How to Tie and Attach a Hasty Chest Harness (Double Locking Lark's Foot) to a Victim
How to Tie and Attach Wristlets and Anklets
How to Secure a Victim to a Rescue Litter
How to Rig a Litter for Vertical Rescue
How to Rig a Victim in a SKED Litter
How to Rig a Victim in an LSP Half Back or Equivalent
How to Don a Pre-Sewn Class III Rescue Harness

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Skills Module
Respiratory Equipment
Chapter 7
How to Don and Operate a Self-Contained Breathing Apparatus (SCBA)
How to Don and Operate a Supplied Air Respirator (SAR) and Escape Pack
How to Operate a Supplied Air Respiratory System
How to Lay-Out and Deploy Supplied Air Lines
How to Provide Victim Respiratory Protection

Skills Module
Communication Systems
Chapter 11
How to Perform a Verbal Communication System
How to Perform a Hand Signal Communication System
How to Operate a Rope Signal Communication System
How to Operate a Light Signal Communication System
How to Operate a Tapping and Rapping Communication System
How to Operate a Portable Radio Communication System
How to Operate a Hardwire Communication System

Skills Module
Hazard Control
Chapter 6
How to Lock-Out/Tag-Out an Electrical Equipment Switch
How to Lock-Out/Tag-Out an Electrical Circuit Switch
How to Lock-Out/Tag-Out a Gate Valve
How to Operate a Ventilation Ducting
How to Deploy Ventilation Ducting
How to Deploy a Manhole Saddle Vent
How to Perform Positive Pressure (Supply) Ventilation
How to Perform Negative Pressure (Exhaust) Ventilation
How to Perform Combination Ventilation
How to Perform Local Supply Ventilation
How to Calculate Ventilation Air Exchanges

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Skills Module
Atmospheric Monitoring
Chapter 5
How to Perform Instrument Start-Up
How to Determine the Instrument Target Gases
How to Bump Test the Instrument
How to Check the Peaks on the Instrument
How to Clear the Peaks on the Instrument
How to Perform Remote Sampling
How to Use a Conversion Chart to Assess Flammability
How to Perform Instrument Shut-Down

Skills Module
High Point Anchor Systems
Chapter 10
How to Construct and Operate a Ladder Gin System
How to Construct and Operate a Ladder "A" Frame System
How to Set-Up and Operate a Tripod System
How to Operate Cable and Winch Systems

Confined Space Entry Module
Confined Space Entry
Confined Space Rescue – Vertical Entry
Confined Space Rescue – Horizontal Entry
Confined Space Rescue – Tapered Cross Section
Confined Space Rescue – In-Pipe
Confined Space Rescue – Non-Entry

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Forklift Safety Course Outline

Powered Industrial Trucks
Definition
Scope of Standard
Forklift Accidents
Forklift Fatalities
Industries Where Powered Industrial Truck Accidents Occurred
Nonfatal Occupational Injuries and Illnesses by Source
Overview of Forklift Hazards
Four Major Areas of Concern:
--General Hazards that Apply to the Operation of All or Most Powered Industrial Trucks;
--Hazards Associated with the Operation of Particular Types of Trucks;
--Hazards of Workplaces Generally;
--Hazards of the Particular Workplace Where the Vehicle Operates
Training Requirements
Performance-Oriented
Safe Operations
Training Program Implementation
Training Program Content
Refresher Training and Evaluation
Evaluation of Powered Industrial Truck Operators
--After Initial Training,
--After Refresher Training, and
--At Least Once Every Three Years
Employer Certification Shall Include:
--Name of Operator
--Date of Training
--Date of Evaluation
--Identity of Person(s) Performing the Training or Evaluation
Avoidance of Duplicative Training
Components of a Forklift
Certification
Classes of Commonly-Used Powered Industrial Trucks
Explanation of Types of Powered Industrial Trucks
Class I – Electric Motor Rider Trucks
Counterbalanced Rider Type, Stand Up

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Three-Wheel Electric Trucks, Sit-Down
Counterbalanced Rider Type, Cushion Tires, Sit-Down (High and Low Platform)
Counterbalanced Rider, Pneumatic Tire, Sit-Down (High and Low Platform)
Class II – Electric Motor Narrow Aisle Trucks
High Lift Straddle
Order Picker
Reach Type Outrigger
Side Loaders, Turret Trucks, Swing Mast and Convertible Turret/Stock Pickers
Low Lift Pallet and Platform (Rider)
Class III – Electric Motor Hand or Hand/Rider Trucks
Low Lift Platform
Low Lift Walkie Pallet
Reach Type Outrigger
High Lift Straddle
High Lift Counterbalanced
Low Lift Walkie/Rider Pallet
Class IV – Internal Combustion Engine Trucks – Cushion (Solid) Tire
Class V – Internal Combustion Engine Trucks – Pneumatic Tires
Class VI – Electric & Internal Combustion Engine Tractor
Rough Terrain Straight Mast Forklifts
Rough Terrain Extended-Reach Forklifts
Stability of Powered Industrial Trucks
Definitions
General
Basic Principles
Stability Triangle
Longitudinal Stability
Lateral Stability
Dynamic Stability

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First Aid Course Syllabus

Course Intros
Course, Instructor, and Student Introductions
Facility Orientation
General Course Information, Course Completion Requirements
Emergency Action Plan (EAP)

First Aid
Initial Assessment vs. Secondary Assessment
Emergency Moves: Clothes Drag, Seat Carry
Physical Exam and SAMPLE History
Documentation and Legal Considerations
Sudden Illness
Wounds
Water Sterilization Steps
Bleeding
Caring for Shock
Burns
Injuries to Muscles, Bones, and Joints
Splints
Bites and Stings
Administering Epinephrine
Assisting with Bronchodilators (inhalers)
Heat Related Emergencies
Cold Related Emergencies
In-Line Stabilization for Head, Neck and Back Injuries
Backboard Techniques
Common Types of Injuries in Your Area
First Aid Kits

Course Review
First Aid

Course Written Exams
First Aid

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References: American Heart Association guidelines, American Red Cross guidelines

Adult CPR Course

Course Duration

Approximately 45-60 minutes

NOTE: It is strongly recommended that you read the entire course before taking the exam. However, we understand that many of our clients are trained professionals who simply need a quick refresher. If you are familiar with the material you can proceed directly to the exam immediately after registration in which case you may be certified within a few minutes.

Lesson 1: Introduction

Brief History of CPR

Mechanics of Artificial Life Support

Fundamentals of Human Physiology (circulatory system) and CPR Applications

What is expected during an emergency (including EMS response).

Lesson 2: Adult CPR

Definitions

Scene Assessment and Appropriate Response

A-B-Cs of Adult CPR for One Rescuer

A-B-Cs of Adult CPR for Two Rescuers

Exam

Eight multiple choice and true-or-false questions

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United Association Crane Signalperson Training Course

Student Task List

ASME Standard Hand Signals, Section B30.5 and B30.3 – Student will demonstrate ability to correctly signal:

- Hoist
- Lower
- Use Whip Line
- Use Main Hoist
- Raise Boom
- Lower Boom
- Move Slowly
- Lower the boom and raise the load.
- Raise the boom and lower the load.
- Swing
- Stop
- Emergency Stop
- Travel
- Dog Everything
- Travel – Track machine on both tracks
- Travel – Track machine on one track
- Extend Boom
- Retract Boom
- Extend Boom (One-Hand Signal)
- Retract Boom (One-Hand Signal)
- Trolley Travel
- Tower Travel

Operations and Limitations – Student will demonstrate knowledge of:

- Drift
- Radius
- Boom Angle
- Two-Blocking
- Boom Deflection
- Dynamic Loading
- Dynamic Unloading
- Side Loading
- Rated Capacity
- Quadrants of Operation
- Wind

Signalperson Requirements – Students must demonstrate knowledge of:

- Crane Function Names
- Special Signals
- Audible Travel Signals
- Safe Work Practices
- Working Near Energized Power Lines: ASME
- Working Near Energized Power Lines: OSHA (Current)
- Working Near Energized Power Lines: OSHA (Proposed)
- Occupant Qualifications
- Occupant Responsibilities
- Communications

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OSHA 1926.550 Cranes and Derricks – Students will demonstrate knowledge of:

- OSHA 1926.550(a) General Requirements
- OSHA 1926.550(b) Crawler, Locomotive, and Truck Cranes
- OSHA 1926.550(c) Hammerhead Tower Cranes
- OSHA 1926.550(d) Overhead and Gantry Cranes
- OSHA 1926.550(e) Derricks
- OSHA 1926.550(f) Mobile Cranes and Barges
- OSHA 1926.550(g) Crane and Derrick Suspended Platforms

ASME B30.3, B30.5, and B30.23 – Students will demonstrate knowledge of:

- Excerpts from ASME B30.3 – 3.3 Signals
    - Signals; Operating Near Electric Power Lines
- Excerpts from ASME B30.5 – 3.5 Operating Practices
    - Operating Practices; Moving the Load
- Excerpts from ASME B30.5 – 3.3 Signals
    - Signals; General
- Excerpts from ASME B30.23
    - Management

Student will demonstrate knowledge of subject matter by proficiently answering review questions prior to successfully completing <u>proctored written and practical testing by third party agency</u>.

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UA-70 WELD TEST SPECIFICATION

Manual SMAW Welding Process

Maximum Time Permitted for Test Is Two Hours

TEST COUPON MATERIALS

- Pipe: A-106, NPS 2, Sch. 40, 0.154" Wall (3" long)
- Plate: A-36, (7" x 7" square), 3/16" Thick

JOINT CONFIGURATION

- 90° T-Joint
- Fillet Weld

TEST POSITION

- 5F fixed position
- Coupon position maintained without rotation or change in height.
- Uphill progression required on vertical portions of weld joint.

WELDING CONDITIONS

- E 7018 3/32", 1/8", 5/32" or 3/16" Diameter
- Amperage Range: 3/32" 70 to 100; 1/8" 90 to 140; 5/32" 120 to 190; 3/16" 200 to 275
- Direct Current & Electrode Positive

GENERAL WELDING TECHNIQUES

- Minimum preheat of 50°F is required.
- Initial & interpass cleaning with brushing & grinding using hand or power tools
- The cover pass must be left in the "as welded" condition, clean with wire brush. (Grinding on the completed test coupon is not allowed.)

INSPECTION AND TESTING

- The completed test assembly shall be visually examined in accordance with paragraph 4.8.1 of AWS D1.1, and shall be uniform and free of cracks, porosity, slag and undercut shall not exceed 1/32".
- Test coupon shall be prepared with a suitable finish for macroetch examination in accordance with paragraph 4.30.2 of AWS D1.1.

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UA Green Systems Awareness Certification

Section I *Core*
Energy Analysis and Awareness
Renewable Energy & Sustainable Energy
Energy Management
Building Information Modeling (BIM)
Commercial Building Energy Consumption Survey (CBECS)
Energy Conservation Measures (ECM)
Energy Information Administration (EIA)
Energy Audit
Energy Consumption and Demand Analysis
Heat Load Calculation
Life Cycle Cost Analysis 1
Worksheet #1

Section II *HVAC/R*
Heating-Ventilation-Air Conditioning-Refrigeration
Energy Efficiency Ratings
Energy Efficiency Ratio
Seasonal Energy Efficiency Ratio
Annual Fuel Utilization Efficiency
Heating Season Performance Factor
Coefficient of Performance (COP)
Comfort Conditioning
Ventilation and Indoor Air Quality
Comfort Cooling Methods and Green Alternatives
Mechanical Air Conditioning
Evaporative Cooling
Passive Cooling Systems
Solar Cooling
Thermal Storage
Commercial Refrigeration
U.S. EPA GreenChill (Advanced Refrigeration Partnership)
Refrigerant Containment Practices
Energy Conservation Measures
New and Replacement Equipment
Comfort Heating Methods and Green Alternatives
Combustion Analysis
Forced Air
Condensing Furnaces

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Modulating Furnaces
Condensing Boilers
Instantaneous Boiler
Solar Water Comfort Heating
Solar Air Heating
Waste Heat Recovery
Radiant Panel Systems
Thermal Mass
Optimized Steam Systems
Steam Traps
Comfort Heating and Cooling Combination Systems and Green Alternatives
Geothermal Systems
Air-to-Air Heat Pumps
Packaged Terminal Air Conditioners (PTAC)
Mini-Split Systems
Worksheet #2

Section III *Electrical*
Electrical Production and Consumption
Electrical Power
Nuclear Energy
Fuel Cells
Photovoltaic
Wind Turbines
Motor Efficiency
Lighting
Fluorescent
LED
Tidal and Ocean Energy
Ghost Loads
Residential Major Appliances
Worksheet #3

Section IV *Plumbing*
Hydrologic Cycle
Potable Water Conservation
Flow Restriction
Faucets/Showerheads/Pre-Rinse Spray Valves
High Efficiency Plumbing Fixtures
Water Closets
Ultra Low Flush
Dual Flush

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Ultra Low Flush Urinal
Waterless Fixtures
Removable Cartridge/Insert Waterless Urinal
Cartridge Free Waterless Urinals
Composting Toilet
High Efficiency Plumbing Appliances
Clothes Washers
Dishwashers
Ice Machines
Garbage Disposals
Hot Water Distribution Systems
Hot Water Circulating Systems
On Demand Water Circulating System
Gravity Water Circulating Systems
Dedicated Line Water Circulating Systems
Water Distribution Piping Installation
Protection of the Water Distribution System
Water Heating Equipment
Storage Water Heaters
Demand (Tankless) Water Heaters
Heat Pump Water Heaters
Indirect Water Heaters
Solar Water Heaters
First Hour Rating
Wastewater Reuse Systems
Landscape Irrigation Systems
Drain Water Heat Recovery System
Gray Water and Reclaimed Water Reuse Systems
Reclaimed Water Systems
Gray Water Systems
Rain Water Harvesting
Fire Protection Systems and the Environment
Industrial Fire Protection Systems
Residential Fire Protection Systems
Green Plumbing System Relevance to LEED
Worksheet #4
LEED Worksheet
Summary

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UA-21 WELD TEST SPECIFICATION

Manual SMAW Welding Process

Maximum Time Permitted for Test Is Three Hours

PIPE COUPON MATERIAL

- Material Specification: SA 106
- Pipe Size: NPS 2, XXS, 0.436" Wall

JOINT CONFIGURATION

- Single Vee Groove Without Backing or Retainers
- Bevel: 35 deg. ± 5 deg. Land: 0 to 1/8"
- Root Gap: 1/16" to 1/8"
- Misalignment: 1/16" Maximum

TEST POSITION

- 6G fixed position, coupon position maintained without rotation or change in height.
- Uphill progression required on vertical portions of weld joint.

WELDING CONDITIONS

ROOT

- E 6010 3/32" or 1/8" Diameter
- Deposit 0.125" of E 6010
- Amperage Range: 3/32" 40 to 80; 1/8" 75 to 125
- Direct Current & Electrode Positive

BALANCE

- E 7018 3/32", 1/8" or 5/32" Diameter
- Amperage Range: 3/32" 70 to 100; 1/8" 115 to 165; 5/32" 150 to 220
- Direct Current & Electrode Positive

GENERAL WELDING TECHNIQUES

- Minimum Preheat of 50°F is required.
- Back gouging of welds is not permitted.
- I.D. Root Penetration: Flush to 1/8" Maximum
- O.D. Reinforcement: Flush to 1/8" Maximum
- Stringer beads required for root pass, subsequent passes may be stringer or weave beads.
- Initial & interpass cleaning with brushing & grinding using hand or power tools
- The cover pass must be left in the "as welded" condition, clean with wire brush. (Grinding on the completed test coupon is not allowed.)

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INSPECTION AND TESTING

- The completed test assembly shall be visually examined over the entire circumference, inside and outside, showing complete joint penetration with complete fusion of weld metal and base metal (no concavity); and shall be uniform and free of cracks, incomplete fusion, incomplete penetration, porosity, slag, and undercut (not to exceed 1/32").
- Test coupon shall be examined by radiography in accordance with ASME Code Section IX.

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Universal Certification for EPA Under Section 608

CORE

Ozone Depletion

- Destruction of Ozone by Chlorine
- Presence of Chlorine in CFC and HCFC Refrigerants
- Identification of CFC, HCFC, and HFC Refrigerants (not chemical formulas, but idea that R-12 is a CFC, R-22 is an HCFC, R-134 is an HFC, etc.)
- Idea that CFCs have higher ozone-depletion potential (ODP) than HCFCs, which in turn have higher ODP than HFCs.
- Health and Environmental Effects of Ozone Depletion
- Evidence of Ozone Depletion and Role of CFCs and HCFCs

Clean Air Act and Montreal Protocol

- CFC Phase-Out Date
- Venting Prohibition at Servicing
- Venting Prohibition at Disposal
- Venting Prohibition on Substitute Refrigerants in November 1995
- Maximum Penalty Under CAA
- Montreal Protocol (international agreement to phase out production of ozone-depleting substances)

Section 608 Regulations

- Definition/Identification of High- and Low-Pressure Refrigerants
- Definition of System-Dependent vs. Self-Contained Recovery/Recycling Equipment
- Identification of Equipment Covered by the Rule (all air-conditioning and refrigeration equipment containing CFCs or HCFCs except motor vehicle air conditioners)
- Need for Third-Party Certification of Recycling and Recovery Equipment Manufactured After November 15, 1993
- Standard for Reclaimed Refrigerant (ARI 700)

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Substitute Refrigerants and Oils

- Absence of "Drop-in" Replacements
- Incompatibility of substitute refrigerants with many lubricants used with CFC and HCFC refrigerants and incompatibility of CFC and HCFC refrigerants with many new lubricants. (Includes identification of lubricants for given refrigerants, such as esters with 134; alkylbenzenes for HCFCs.)
- Fractionation Problem (tendency of different components of blends to leak at different rates)

Refrigeration

- Refrigerant States (vapor vs. liquid) and Pressures at Different Points of Refrigeration Cycle; How/When Cooling Occurs
- Refrigeration Gauges (color codes, ranges of different types, proper use)

Three R's

- Definitions:
  1. Recover
  2. Recycle
  3. Reclaim

Recovery Techniques

- Need to avoid mixing refrigerants.
- Factors affecting speed of recovery (ambient temperature, size of recycling or recovery equipment, hose length and diameter, etc.).

Dehydration Evacuation

- Need to evacuate system to eliminate air and moisture at the end of service.

Safety

- Risks of Exposure to Refrigerant (e.g., oxygen deprivation, cardiac effects, frostbite, long-term hazards)
- Personal Protective Equipment (gloves, goggles, self-contained breathing

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apparatus—SCBA—in extreme cases, etc.)

- Reusable (or "recovery") Cylinders vs. Disposable Cylinders (Ensure former DOT approved, know former's yellow and gray color code, never refill latter.)
- Risks of Filling Cylinders More than 80 Percent Full
- Use of Nitrogen Rather than Oxygen or Compressed Air for Leak Detection
- Use of Pressure Regulator and Relief Valve with Nitrogen

Shipping

- Labels required for refrigerant cylinders (refrigerant identification, DOT classification tag).

TYPE 1 (Small Appliances)

Recovery Requirements

- Definition of "Small Appliance"
- Evacuation requirements for small appliances with and without working compressors using recovery equipment manufactured before November 15, 1993.
- Evacuation requirements for small appliances with and without working compressors using recovery equipment manufactured after November 15, 1993.

Recovery Techniques

- Use of pressure and temperature to identify refrigerants and detect noncondensables
- Methods to recover refrigerant from small appliances with inoperative compressors using a system-dependent or "passive" recovery device (e.g., heat and sharply strike the compressor, use a vacuum pump with non-pressurized recovery container).
- Need to install both high and low side access valves when recovering refrigerant from small appliances with inoperative compressors.
- Need to operate operative compressors when recovering refrigerant with a system-dependent (passive) recovery device.
- Should remove solderless access fittings at conclusion of service.
- 134a as likely substitute for 12.

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Safety

- Decomposition Products of Refrigerants at High Temperatures (HCl, HFl, etc.)

TYPE 2 (High-Pressure)

Leak Detection

- Signs of Leakage in High-Pressure Systems (excessive superheat, traces of oil for hermetics)
- Need to leak test before charging or recharging equipment.
- Order of Preference for Leak Test Gases (nitrogen alone best, but nitrogen with trace quantity of 22 better than pure refrigerant)

Leak Repair Requirements

- Allowable annual leak rate for commercial and industrial process refrigeration
- Allowable annual leak rate for other appliances containing more than 50 lbs of refrigerant

Recovery Techniques

- Recovering liquid at beginning of recovery process speeds up process.
- Other Methods for Speeding Recovery (chilling recovery vessel, heating appliance or vessel from which refrigerant is being recovered)
- Methods for reducing cross-contamination and emissions when recovery or recycling machine is used with a new refrigerant
- Need to wait a few minutes after reaching required recovery vacuum to see if system pressure rises (indicating that there is still liquid refrigerant in the system or in the oil).

Recovery Requirements

- Evacuation requirements for high-pressure appliances in each of the following situations:
    1. Disposal
    2. Major vs. non-major repairs
    3. Leaky vs. non-leaky appliances

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4. Appliance (or component) containing less vs. more than 200 lbs
5. Recovery/recycling equipment built before vs. after November 15, 1993

- Definition of "Major" Repairs
- Prohibition on using system-dependent recovery equipment on systems containing more than 15 pounds of refrigerant

Refrigeration

- How to identify refrigerant in appliances.
- Pressure-temperature relationships of common high-pressure refrigerants (may use standard temperature-pressure chart—be aware of need to add 14.7 to translate psig to psia)
- Components of high-pressure appliances (receiver, evaporator, accumulator, etc.) and state of refrigerant (vapor vs. liquid) in them

Safety

- Should not energize hermetic compressors under vacuum.
- Equipment Room Requirements Under ASHRAE Standard 15 (oxygen deprivation sensor with all refrigerants)

TYPE 3 (Low-Pressure)

Leak Detection

- Order of preference of leak test pressurization methods for low-pressure systems (first: hot water method or built-in system heating/pressurization device such Prevac; second: nitrogen)
- Signs of Leakage into a Low-Pressure System (e.g., excessive purging)
- Maximum Leak Test Pressure for Low-Pressure Centrifugal Chillers

Leak Repair Requirements

- Allowable annual leak rate for commercial and industrial process refrigeration
- Allowable annual leak rate for other appliances containing more than 50 lbs of refrigerant

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Recovery Techniques

- Recovering liquid at beginning of recovery process speeds up process.
- Need to recover vapor in addition to liquid.
- Need to heat oil to 130°F before removing it to minimize refrigerant release.
- Need to circulate or remove water from chiller during refrigerant evacuation to prevent freezing.
- High-pressure cut-out level of recovery devices used with low-pressure appliances.

Recharging Techniques

- Need to introduce vapor before liquid to prevent freezing of water in the tubes.
- Need to charge centrifugals through evaporator charging valve.

Recovery Requirements

- Evacuation requirements for low-pressure appliances in each of the following situations:
    1. Disposal
    2. Major vs. non-major repairs
    3. Leaky vs. non-leaky appliances
    4. Appliance (or component) containing less vs. more than 200 lbs
    5. Recovery/recycling equipment built before vs. after November 15, 1993
- Definitions of "Major" and "Non-Major" Repairs
- Allowable methods for pressurizing a low-pressure system for a non-major repair (controlled hot water and system heating/pressurization device such as Prevac)
- Need to wait a few minutes after reaching required recovery vacuum to see if system pressure rises (indicating that there is still liquid refrigerant in the system or in the oil).

Refrigeration

- Purpose of Purge Unit in Low-Pressure Systems
- Pressure-Temperature Relationships of Low-Pressure Refrigerants

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Safety

- Equipment Room Requirements Under ASHRAE Standard 15 (oxygen deprivation sensor with all refrigerants).
- Under ASHRAE Standard 15, need to have equipment room refrigerant sensor for 123.

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R-410A Course Content

R-410A and the R-22 Phase-Out

- HCFC Phase-Out Schedule
- Regulation and Change
- The Future
- Safety and R-410A

Refrigeration & Air Conditioning Systems Fundamentals

- Vapor Compression System
- Condensing Pressure
- Evaporating Pressure
- Refrigerant States & Conditions
- Saturation
- Vapor Pressure
- Superheat
- Subcooling

R-410A Considerations

- Compressor
- Compression Ratios
- Condenser
- Receiver
- Filter/Driers
- Liquid Line
- Metering Device
- Evaporator
- Suction Line

Refrigerant Chemistry & Applications

- Chlorofluorocarbons (CFCs)
- Hydrochlorofluorocarbons (HCFCs)
- Hydrofluorocarbons (HFCs)
- Blends
- Blend Fractionation
- Blend Temperature Glide
- Superheat & Subcooling
- Calculation for Near-Azeotropic Blends
- Subcooling & Superheat
- Temperature Glide
- Evaporator Superheat Calculation
- Condenser Subcooling Calculations

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- Blend Lubricants

HCFC-22 Replacement Candidates

- R-410A
- Typical Operating Pressures
- Temperature Glide & Fractionation
- Pressure/Temperature Chart
- R-407C
- Temperature Glide & Fractionation

Basic Service Tools

- Gauge Manifold
- R-410A Considerations
- Micron Gauge
- Vacuum Pumps
- R-410A Considerations
- Leak Detectors
- R-410A Considerations

Refrigerant Recovery Systems

- Passive Recovery (System Dependent)
- Active Recovery (Self-Contained)
- R-410A Considerations

Refrigerant Charging

- Undercharge
- Overcharge

R-410A System Charging

- Charging for Proper Subcooling
- Charging for Proper Superheat
- Precautions

R-407C System Charging

R-407C Refrigerant Leaks & Leak detectors

Refrigeration Oils & Applications

- Oil Groups
- Synthetic Oils
- Alkylbenzene
- Glycols

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- Esters
- Waste Oils
- Lubricants, R-410A, R-407C & R-134A
- Advantages of POE vs. Mineral Oils
- Concerns with POE Lubricants

Safety

- Personal Safety Protection
- Electrical Safety
- Safe Refrigerant Handling
- Storage Cylinders
- Shipping
- ASHRAE Standard 34
- Equipment Room/Jobsite Safety
- Monitors/Alarms

Ventilation

- Purge Venting
- Breathing Apparatus

Safety Overview

- R-410A Considerations
- Material Safety Data Sheet
- Toxicity
- Flammability
- Combustibility
- Ingestion
- Skin/Eye Contact
- Inhalation
- Refrigerant Decomposition

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