Certifying the finest in HVACR

Low-GWP Refrigerants Certification

KATE

Knowledge Areas of Technician Expertise

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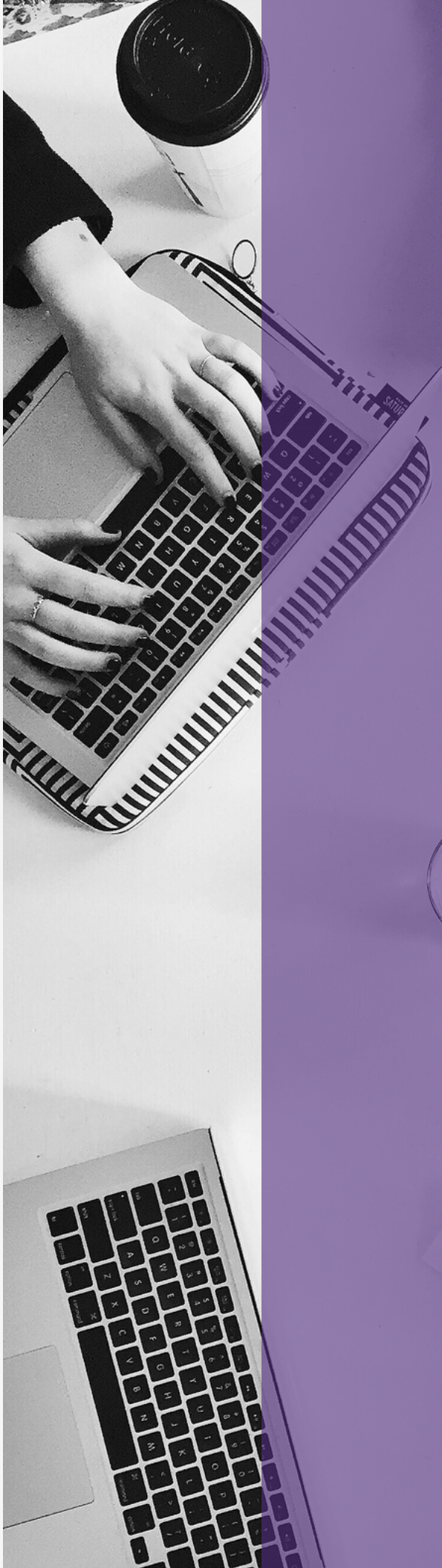


Low-GWP Refrigerants Certification Exam

Exam Information & Qualifications

The Low GWP Refrigerants Certification Exam tests a candidate's knowledge of the necessary skills and job knowledge necessary to use low global warming potential refrigerants properly and safely. The exam covers all aspects of handling these refrigerants, including storage, transport, charging, and evacuation.

This is a test and certification for technicians in the HVACR industry. This test for certification is not intended for the HVACR system designer, sales force, or the engineering community.

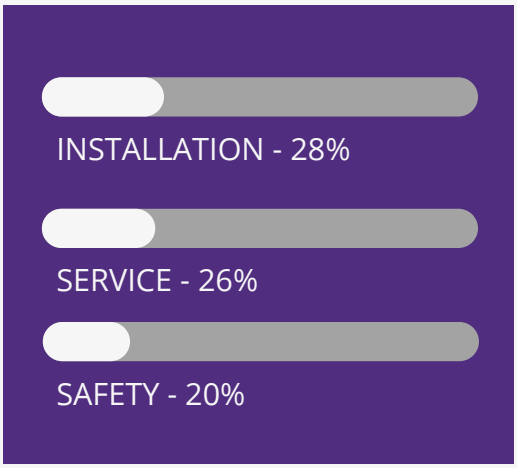
Exam Copyrights

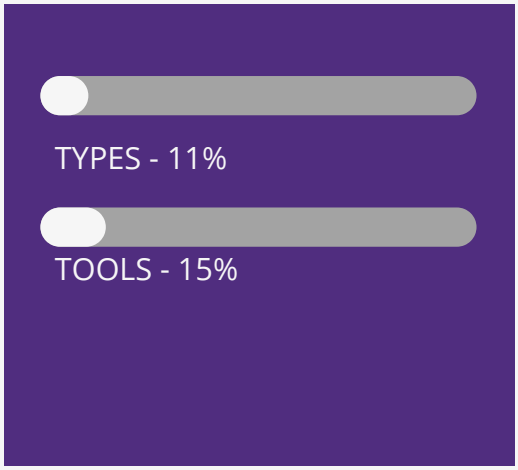
Passing Score Development Process

The passing score for this test was established using a systematic procedure (a Passing Score Study). This procedure employed the judgment of experienced RESNET professionals and educators. The passing scores were set using criteria defining competent performance.

Exam Subject Areas

Percentages of questions that will be in each section of the exam:





Exam Specifications:

- **Passing Score: Pass/Fail**
- **2.5 Hour Time Limit**
- **Closed Book**
- **100 Questions**

Study Resources

NATE offers resource materials to help technicians prepare for the Low-GWP Refrigerant Certification exam. Completion or purchase of these study aids are not required to take the exam.

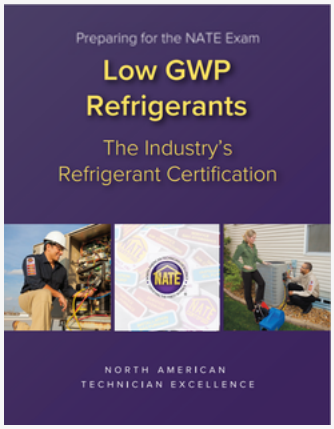
NATE Training Academy is an online training platform with interactive and on demand courses for HVACR technicians.

Classes include 2D and virtual realty simulations, videos, and knowledge checks to prepare technicians for the NATE Low-GWP Refrigerant Certification exam.

Learn more at www.NATEX.org.

Resources continue on next page

Study Resources (continued)



NATE's official study guides are graphic heavy and include practice questions at the end of each chapter.

You can find the Low-GWP Refrigerants study guide, as well as guides for other NATE certification exams, in the NATE online store.

www.NATEX.org/shop

KATES Knowledge Areas of Technician Expertise

All NATE exams are based on Knowledge Areas of Technician Expertise (KATEs), statistically proven job task analysis from experts in the HVACR industry. This KATEs outline covers all information tested in the **Low-GWP Refrigerants Certification Exam** and should be used as reference material.

Installation

- Task 1: Check local codes and regulations before installation to verify the application requirements.
- Task 2: Determine if a building permit is required.
- Task 3: Verify possession of a copy of manufacturer's installation and service instructions.
- Task 4: Install the refrigerant lineset for split systems with as few joints and as little exposed piping as possible when connecting the indoor and outdoor units to reduce the number of potential leak points.
- Task 5: Install protective enclosures for split system refrigerant linesets in accordance with the applicable safety standard (e.g., ASHRAE 15 or ASHRAE 15.2 [proposed]) to provide mechanical protection as needed.
- Task 6: Install the refrigerant lineset for split systems with the types of joints and fittings permitted in the equipment manufacturer's installation instructions for the refrigerant designation to prevent refrigerant leakage in the occupied space.
- Task 7: Inspect and pressure test the refrigerant linesets and joints for split systems before enclosing them to determine compliance with national and local codes.
- Task 8: Install equipment in accordance with manufacturer's written instructions to avoid hazards of improper installation.
- Task 9: Measure the equipment horizontal orientation using a level to verify that the system components are oriented correctly per the manufacturer's installation instructions.
- Task 10: Bleed nitrogen through the tubing while brazing joints following industry best practices to prevent oxidation.
- Task 11: Provide access to mechanical refrigerant connections on a system such that future maintenance and inspections can be conducted after installation.
- Task 12: Follow the equipment manufacturer's installation and repair instructions to evacuate the system to a sufficiently low pressure to remove non-condensable gases and moisture using dry nitrogen purge and re-evacuation if instructed to confirm that the vacuum level can be held for a specified time.
- Task 13: Record the details of the leak test method(s) for split systems and results to show compliance with national and local codes.
- Task 14: Establish and maintain adequate ventilation of the service area to avoid hazardous concentration level of refrigerant.
- Task 15: Charge the system with refrigerant using the original equipment manufacturer's (OEM) recommended charging process for the application and following proper procedures for charging with mixture refrigerants (400 series).

KATES Knowledge Areas of Technician Expertise

Installation (continued)

- Task 16: Secure all Schrader cores using a Schrader valve core tool and cap to seal all valves. Follow local code requirements for locking caps on service ports.
- Task 17: Leak-check joints using an appropriate leak detector capable of sensing a leak of ≤ 3g/year to maintain a safe installation.
- Task 18: Refrain from using a potential source of ignition (e.g., a halide torch or a detector using a naked flame) when using a detection method to search for a leak to maintain a safe working environment.
- Task 19: Install the joints inside the equipment, within their own enclosure, or outside the occupied space to prevent leaks from forming flammable concentrations within the occupied space.
- Task 20: Install refrigerant leak detection system or vented chase for joints not located outdoors or within the equipment to mitigate potential ignition sources following the requirements of safety standards.
- Task 21: Install refrigerant leak detector sensor using manufacturer's installation instructions as required by the product safety standards.
- Task 22: Install and check a leak detection sensor for units with charge levels above m1.
- Task 23: Install indoor equipment with refrigerant pressure relief devices with pipes discharging the release outside to prevent a release inside the occupied space.
- Task 24: Install safety shutoff valves and/or emergency control devices using the manufacturer's installation instructions as required to comply with the product safety standards.
- Task 25: Install markings indicating the use of flammable refrigerant on all accessible interconnecting tubing not viewable from any portion of the equipment at intervals no greater than every 6 m (20 ft.) to alert technicians to the presence of flammable refrigerants.
- Task 26: Install the equipment in an area appropriate for its charge level based on the manufacturer's installation manual to minimize the potential formation of flammable refrigerant concentrations within the occupied space.
- Task 27: Complete the charge marking on the equipment after installation to record the total charge in the system.
- Task 28: Ensure that if refrigerant detection is required that it enables airflow above the minimum required flow and that all zoning dampers fully open.
- Task 29: Install field-installed accessories that are only shown as approved for use based on the manufacturer's installation instructions to maintain a safe installation.
- Task 30: Measure the airflow of the indoor equipment using constant or detection actuated airflow and standard measuring equipment to determine that it meets the minimum airflow required by the manufacturer's installation instructions.
- Task 31: Mark service ports with the refrigerant number and Pantone red (PMS 185 or equivalent) where the color area shall be 650 mm^2, with a minimum of 25 mm in length to clearly show flammability risk.

KATES Knowledge Areas of Technician Expertise

Installation (continued)

- Task 32: Install outdoor equipment using A2L, A2, or A3 refrigerants no closer than five horizontal feet from any door or operable window that is below grade to prevent leakage of refrigerant into the occupied space.
- Task 33: Do not install equipment that contains A2L, A2, or A3 refrigerants in a means of egress to prevent potential ignition hazards in high traffic areas.
- Task 34: Do not install replacement components that have a different flammability classification than the original equipment to maintain safe operation.
- Task 35: Install equipment that has been listed by a nationally recognized testing laboratory to show compliance to product safety standards.
- Task 36: Ground indoor and outdoor equipment to prevent the lineset from becoming an electrical pathway

Service

- Task 1: Review the safety data sheet (SDS) for the refrigerant used in the system to understand hazards and precautions before servicing.
- Task 2: Verify that the occupied space is large enough in size (based on the system charge) to reduce the potential of localized flammable refrigerant concentrations forming in the event of a leak when servicing equipment with flammable refrigerants.
- Task 3: Ventilate the area properly to reduce the probability of a buildup of gas/refrigerants while servicing.
- Task 4: Use non-sparking, adequately sealed, or intrinsically safe leak detection equipment suitable for use with the type of refrigerant in question to avoid ignitions when servicing equipment containing flammable refrigerants.
- Task 5: Leave area leak detector turned on and at a low level throughout service to identify leaks as they occur.
- Task 6: Expect that leaks will only be observed by using leak detection equipment because refrigerants are normally colorless and do not use odorants.
- Task 7: Refrain from storing refrigerant tanks in direct sunlight or high-temperature ambient environments for extended periods of time to prevent over-pressurization of the refrigerant cylinders.
- Task 8: Refrain from using a torch or other incendiary heat source as a means of warming or melting ice build-up on frozen lines of the system because this could also be a source of ignition.
- Task 9: Use a tubing cutter as a non-incendiary method of opening system lines to eliminate sources of ignition.
- Task 10: Identify and repair refrigerant leaks on equipment prior to charging the system to eliminate future leaks.

KATES Knowledge Areas of Technician Expertise

Service

- Task 11: Vent hydrocarbon refrigerant (e.g., R-290, R-600) from a system to the atmosphere if the system is outside or the refrigerant vent path has direct and complete ventilation to the outdoors.
- Task 12: Evacuate a system using a vacuum pump approved for use with the refrigerant type in question to prevent the vacuum pump from potentially becoming a source of ignition.
- Task 13: Maintain a CO2 or similar Class B fire extinguisher in proximity to the work area to prevent spread of fire in the event of ignition when servicing equipment containing flammable refrigerants.
- Task 14: Create a perimeter around the working area when servicing equipment with flammable refrigerants to keep out ignition sources.
- Task 15: Hang signs to inform others that a flammable refrigerant system is being worked on to help maintain a safe working environment.
- Task 16: Provide ventilation to the service area during maintenance of equipment using a fan/blower appropriate to the refrigerant type in question to help prevent the formation of a flammable refrigerant concentration.
- Task 17: Discharge capacitors in equipment in a safe manner to avoid or eliminate their potential to become ignition sources for a flammable refrigerant.
- Task 18: Attach panels of electrical equipment enclosures and enclose live electrical components and wiring during charging, recovering, or purging of the system to avoid ignitions.
- Task 19: Refrain from using a potential source of ignition (e.g., a halide torch or a detector using a naked flame) when searching for leaks on a system containing a flammable refrigerant.
- Task 20: Purge and evacuate the system twice on equipment with A2 and A3 refrigerants before opening the circuit to properly inert the system.
- Task 21: Use nitrogen to purge lines in the system to remove residual refrigerant.
- Task 22: Use mechanical means to pinch off lines of a condenser or other system component removed from the system to avoid ignition of any residual refrigerant.
- Task 23: Replace system components, electronics, etc. only with original equipment manufacturer (OEM) or OEM-approved components to maintain system safety and compatibility.
- Task 24: Refrain from using silicone sealer on any segments of the system because it can interfere with the operation of the flammable refrigerant sensors.
- Task 25: Review the system nameplate and record the date and charge applied when servicing equipment to make this an available record for future use.
- Task 26: Locate the refrigerant charge label such that it is protected from the environment (e.g., rain and UV exposure).
- Task 27: Maintain a service record for the equipment on site to show a record of maintenance performed.

KATES Knowledge Areas of Technician Expertise

Service (continued)

- Task 28: Include the date of service and the initials of the technician performing the work in service records to indicate when and who was responsible.
- Task 29: Maintain detailed records of all work performed on refrigerant detectors or refrigeration system components to validate the system is in proper working order.
- Task 30: Record quantities and kind (new, recycled, or reclaimed) of refrigerant that has been charged on each occasion and the quantities of refrigerant that have been transferred from the system on each occasion on the equipment's service record to show the impact of a refrigerant leak over time.
- Task 31: Record changes and replacements of components of the system on the equipment's service record to provide a history of parts changed out over time.
- Task 32: Record results of all periodic/routine inspections on the equipment's service record to show history of equipment inspection.
- Task 33: Measure concentration of refrigerant at joints internal to the building after any refrigerant system repair or at least once every two years to eliminate leaks.
- Task 34: Verify the refrigerant detector installed with the equipment is functioning per original equipment manufacturer (OEM) instruction manual after any refrigerant system repair or at least once every two years to mitigate ignition.
- Task 35: Verify the ventilation/circulation system is functioning properly after any refrigerant system repair or at least once every two years to mitigate ignition.
- Task 36: Replace refrigerant leak detectors of the equipment based on the original equipment manufacturer (OEM) instruction manual to stay within life cycles.
- Task 37: Replace the refrigerant with another type within the equipment in accordance with the instructions of the original equipment manufacturer (OEM), approved by the authority having jurisdiction (AHJ), or conduct an evaluation of the equipment by a registered design professional or by an approved nationally recognized testing laboratory to validate the safety and suitability of the replacement refrigerant.
- Task 38: Store all chemicals capable of causing corrosion (e.g., chlorine, bleach, or ammonia) away from the system.

KATES Knowledge Areas of Technician Expertise

Safety

Identify the type of refrigerant and associated hazards

- Task 1: Check the system nameplate and labeling to determine the refrigerant designation and safety classification.
- Task 2: Inform the homeowner/customer that flammable refrigerant is in use to prevent them from introducing or allowing any sources of ignition into the system area.
- Task 3: Identify hazards associated with a refrigerant by reviewing the refrigerant safety data sheet (SDS) to determine necessary personnel protective equipment (PPE) and procedures.
- Task 4: Set up safety signs to warn individuals with access to the service work area of the potential of flammable and explosive conditions.
- Task 5: Establish and control a perimeter while working on an ACR system to maintain a safe work zone.
- Task 6: Verify that any retrofit refrigerant used to service an existing system designed for a non-flammable refrigerant is also non-flammable (e.g., A1 safety rating).

Establish and maintain a safe working environment

- Task 7: Examine the area for hot surfaces and sources of ignition when installing equipment in a machine room to determine compliance with building code requirements.
- Task 8: Remove all combustible or waste materials from the system location to prevent ignition or spread of potential fires.
- Task 9: Check the work area for and de-energize sources of ignition (including capacitors, contactors, or miscellaneous electrical devices) within the relevant area before performing service work to maintain a safe work zone.
- Task 10: Establish and maintain adequate ventilation of the service area to avoid hazardous concentration level of refrigerant.
- Task 11: Review regional and local codes and regulations to verify compliance.
- Task 12: Set up an appropriate portable gas monitor within the work area to monitor refrigerant concentrations prior to servicing any equipment to maintain a safe work zone.
- Task 13: Review work area for low lying areas to determine if there is a risk of potential pooling of refrigerant.
- Task 14: Verify that refrigerant charge sizes do not exceed the levels allowed in a space by reviewing relevant general and/or equipment specific safety standards.

KATES Knowledge Areas of Technician Expertise

Safety (continued)

Tools and Service Procedures

- Task 15: Install only original equipment manufacturer (OEM) approved components into the system to verify compatibility.
- Task 16: Verify that ACR system integral refrigerant leak sensors are functioning before performing service to maintain a safe working environment.
- Task 17: Replace refrigerant valve caps as part of job completion on both refrigerant cylinders and ACR equipment to avoid damage and unintended refrigerant release.
- Task 18: Brazing and soldering of refrigeration linesets and components must by performed by qualified personnel to maintain both a safe working environment and system installation.
- Task 19: Remove flammable refrigerant from the system and purge with nitrogen to inert the system before applying a torch or open flame to the system.
- Task 20: Verify that all tools used in installing and servicing the system (e.g., leak detectors, recovery machines) are approved and rated for use with the applicable refrigerant to avoid sources of ignition and maintain a safe working environment.
- Task 21: Verify that the gas is not discharged near an air intake or potential ignition source when venting hydrocarbon (HC) refrigerants outdoors or when purging nitrogen from a system containing a flammable refrigerant.

Transportation and Storage Issues

- Task 22: Transport and store flammable refrigerants using approved containers and cabinets, warning signs and placards, refrigerant inventory records, and in accordance with local regulations to avoid hazardous conditions.
- Task 23: Install combustible gas detection systems and class B fire suppression systems in all flammable refrigerant storage facilities.
- Task 24: Transport refrigerant-containing equipment in accordance with national/international regulations (e.g., CFR 49, DOT, IATA) to avoid hazardous conditions during shipment.
- Task 25: Prevent flammable refrigerant storage tanks and cylinders from being exposed to direct sunlight or excessive temperatures to prevent exceeding the rated pressure.
- Task 26: Label refrigerant cylinders to identify the type of refrigerant to clearly communicate the contents and associated hazards.
- Task 27: Transport, handle, and store flammable refrigerants in approved containers, following documented safety precautions to avoid hazardous conditions.

KATES Knowledge Areas of Technician Expertise

Safety (continued)

Types of Refrigerant

- Task 1: Check the equipment nameplate to determine the refrigerant designation and safety classification.
- Task 2: Determine from the refrigerant designation and safety classification whether a refrigerant in a system is flammable and/or toxic to determine the appropriate working practices.
- Task 3: Determine if a refrigerant may be recovered or may be safely vented by using the refrigerant designation to comply with Section 608 of the Clean Air Act.
- Task 4: Determine what types of tools are required based on the refrigerant's safety classification to perform safe installation, maintenance, and service.
- Task 5: Determine if a refrigerant is EPA SNAP approved for a given application by checking the EPA website to comply with Section 608 of the Clean Air Act.
- Task 6: Identify differences in brazing procedures for different refrigerants based on their safety classification to apply best working practices.
- Task 7: Determine if a replacement electrical component can be used in a system with a flammable refrigerant based on applicable safety standards and/or electrical classification to maintain safe operation.
- Task 8: Determine the appropriate refrigerant cylinder to use for a given refrigerant based on pressure characteristics and refrigerant safety classification so that the recovered refrigerant can be safely stored and transported.
- Task 9: Determine that the refrigerant detector used to monitor a service work area is suitable for the refrigerant based on the refrigerant designation so that it correctly senses hazardous refrigerant concentrations in the event of a leak.
- Task 10: Identify the warning signs of refrigerant decomposition by-products so appropriate safety responses can be taken.
- Task 11: Determine if there is sufficient volume in the occupied space for the refrigerant (e.g., m1, m2, m3) being used.
- Task 12: Determine if a replacement or retrofit refrigerant can be used in an existing system based on the original refrigerant designation and safety classification to maintain safe operation.
- Task 13: Determine if a compressor or refrigeration system is approved for use with A2L, A2, or A3 refrigerants by a registered design professional or nationally recognized test facility.
- Task 14: Identify refrigerant characteristics using a pressure temperature chart to determine appropriate charging practices and pressure and temperature readings.
- Task 15: Follow charging procedures for a refrigerant with glide if the refrigerant is a 400 series.
- Task 16: Maintain all required safety training and certification required through federal, state, and local codes to work with flammable refrigerants.
- Task 17: Determine what type of oil is required if oil is being changed or added.

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Tools

- Task 1: Verify the proper personal protective equipment (PPE) is used (e.g., eye, skin).
- Task 2: Determine what types of tools are required based on the refrigerant's safety classification to perform proper installation, maintenance, and service.
- Task 3: Remove refrigerant from the system using an approved venting or recovery machine that is not an ignition source to transfer the refrigerant to a storage cylinder.
- Task 4: Measure the vacuum pressure level using a micro vacuum gauge to confirm the vacuum reaches original equipment manufacturer (OEM) specified levels for the designated amount of time.
- Task 5: Follow designated gas detection procedures for the specific refrigerant type to test for residual refrigerant before initiating service work to avoid an ignition hazard after removing a flammable refrigerant charge from a system.
- Task 6: Use tube benders on system lines so that the center line bend radius is less than 2.5 times the external pipe to prevent a potential source of a leak.
- Task 7: Measure the amount by weight of refrigerant charge being put into the system by using a refrigerant charging scale.
- Task 8: Use a refrigerant manifold gauge set to check refrigerant system operating pressures.
- Task 9: Measure the power supply voltage with a meter to verify compatibility with the system name plate voltage before installation.
- Task 10: Identify differences in brazing procedures for different refrigerants based on their safety classification to apply best working practices.
- Task 11: Tighten Schrader cores using Schrader valve core tool to minimize leaks and verify caps are replaced.
- Task 12: Open a system charged with a flammable refrigerant for repair using tubing cut with a tube cutter after removing the entire refrigerant charge to avoid the ignition risk of un-sweating brazed fittings and joints.
- Task 13: Check for HF using litmus paper (or other practicable methods) and do a full cleanup using a qualified contractor to avoid injury after an ignition event.
- Task 14: Use only an approved leak detector for the refrigerant being used.
- Task 15: Determine the appropriate type of service valves to access the refrigeration system for service.
- Task 16: Determine the appropriate cylinder to be used with different refrigerants based on pressure characteristics and safety rating so that the recovered refrigerant can be safely stored and transported.
- Task 17: Check on shipping and storage requirements for cylinders with flammable refrigerants.
- Task 18: Determine the appropriate warning plaques and lock-out/tag-out devices to prevent accidental electrical shock and explosion.
- Task 19: Ground the equipment and cylinders following manufacturer's guidelines for A3 refrigerants.
- Task 20: Determine the appropriate pressure temperature chart for the refrigerant type to be applied in the system.
- Task 21: Confirm that all tools used for work around flammable refrigerants are suitable with minimum risk of being an ignition source to avoid accidents.