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# Heating, Air-conditioning, and Refrigeration Mechanics and Installers

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## Significant Points

- Job prospects are expected to be excellent.
- Employment is projected to grow much faster than the average.
- Employers prefer to hire those who have completed technical school training or a formal apprenticeship.

## Nature of the Work

Heating and air-conditioning systems control the temperature, humidity, and the total air quality in residential, commercial, industrial, and other buildings. By providing a climate controlled environment, refrigeration systems make it possible to store and transport food, medicine, and other perishable items. *Heating, air-conditioning, and refrigeration mechanics and installers*—also called technicians—install, maintain, and repair such systems. Because heating, ventilation, air-conditioning, and refrigeration systems often are referred to as HVACR systems, these workers also may be called HVACR technicians.

Heating, air-conditioning, and refrigeration systems consist of many mechanical, electrical, and electronic components, such as motors, compressors, pumps, fans, ducts, pipes, thermostats, and switches. In central forced air heating systems, for example, a furnace heats air, which is then distributed through a system of metal or fiberglass ducts. Technicians maintain, diagnose, and correct problems throughout the entire system. To do this, they adjust system controls to recommended settings and test the performance of the system using special tools and test equipment.

Technicians often specialize in either installation or maintenance and repair, although they are trained to do both. They also may specialize in doing heating work or air-conditioning or refrigeration work. Some specialize in one type of equipment—for example, hydronics (water-based heating systems), solar panels, or commercial refrigeration.

Technicians are often required to sell service contracts to their clients. Service contracts provide for regular maintenance of the heating and cooling systems, and they help to reduce the seasonal fluctuations of this type of work.

Technicians follow blueprints or other specifications to install oil, gas, electric, solid-fuel, and multiple-fuel heating systems and air-conditioning systems. After putting the equipment in place, they install fuel and water supply lines, air ducts and vents, pumps, and other components. They may connect electrical wiring and controls and check the unit for proper operation. To ensure the proper functioning of the system, furnace installers often use combustion test equipment, such as carbon dioxide testers, carbon monoxide testers, combustion analyzers, and oxygen testers. These tests ensure that the system will operate safely and at peak efficiency.

After a furnace or air-conditioning unit has been installed, technicians often perform routine maintenance and repair work to keep the systems operating efficiently. They may adjust burn-

ers and blowers and check for leaks. If the system is not operating properly, technicians check the thermostat, burner nozzles, controls, or other parts to diagnose and correct the problem.

Technicians also install and maintain heat pumps, which are similar to air conditioners but can be reversed so that they both heat and cool a home. Because of the added complexity, and the fact that they run both in summer and winter, these systems often require more maintenance and need to be replaced more frequently than traditional furnaces and air conditioners.

During the summer, when heating systems are not being used, heating equipment technicians do maintenance work, such as replacing filters, ducts, and other parts of the system that may accumulate dust and impurities during the operating season. During the winter, air-conditioning mechanics inspect the systems and do required maintenance, such as overhauling compressors.

Refrigeration mechanics install, service, and repair industrial and commercial refrigerating systems and a variety of refrigeration equipment. They follow blueprints, design specifications, and manufacturers' instructions to install motors, compressors, condensing units, evaporators, piping, and other components. They connect this equipment to the ductwork, refrigerant lines, and electrical power source. After making the connections, refrigerator mechanics charge the system with refrigerant, check it for proper operation and leaks, and program control systems.

When air-conditioning and refrigeration technicians service equipment, they must use care to conserve, recover, and recycle the refrigerants used in air-conditioning and refrigeration systems. The release of these refrigerants can be harmful to the environment. Technicians conserve the refrigerant by making sure that there are no leaks in the system; they recover it by venting the refrigerant into proper cylinders; they recycle it for reuse with special filter-dryers; or they ensure that the refrigerant is properly disposed of.

Heating, air-conditioning, and refrigeration mechanics and installers are adept at using a variety of tools to work with refrigerant lines and air ducts, including hammers, wrenches, metal snips, electric drills, pipe cutters and benders, measurement gauges, and acetylene torches. They use voltmeters, thermometers, pressure gauges, manometers, and other testing de-



*A heating, air-conditioning, and refrigeration mechanic works on a thermostat for a heating and air-conditioning system.*

## Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2008	Projected Employment, 2018	Change, 2008-2018 Number	Percent
Heating, air conditioning, and refrigeration mechanics and installers .....	49-9021	308,200	394,800	86,600	28

(NOTE) Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

VICES to check airflow, refrigerant pressure, electrical circuits, burners, and other components.

Other craft workers sometimes install or repair cooling and heating systems. For example, on a large air-conditioning installation job, especially where workers are covered by union contracts, ductwork might be done by sheet metal workers and duct installers; electrical work by electricians; and installation of piping, condensers, and other components by pipelayers, plumbers, pipefitters, and steamfitters. Home appliance repairers usually service room air-conditioners and household refrigerators. (Additional information about each of these occupations appears elsewhere in the *Handbook*.)

**Work environment.** Heating, air-conditioning, and refrigeration mechanics and installers work in homes, retail establishments, hospitals, office buildings, and factories—anywhere there is climate-control equipment that needs to be installed, repaired, or serviced. They may be assigned to specific job sites at the beginning of each day or may be dispatched to a variety of locations if they are making service calls.

Technicians may work outside in cold or hot weather, or in buildings that are uncomfortable because the air-conditioning or heating equipment is broken. In addition, technicians might work in awkward or cramped positions, and sometimes they are required to work in high places. Hazards include electrical shock, burns, muscle strains, and other injuries from handling heavy equipment. Appropriate safety equipment is necessary when handling refrigerants because contact can cause skin damage, frostbite, or blindness. When working in tight spaces, inhalation of refrigerant is a possible hazard.

The majority of mechanics and installers work at least 40 hours per week. During peak seasons, they often work overtime or irregular hours. Maintenance workers, including those who provide maintenance services under contract, often work evening or weekend shifts and are on call. Most employers try to provide a full workweek year-round by scheduling both installation and maintenance work, and many manufacturers and contractors now provide or even require year-round service contracts. In most shops that service both heating and air-conditioning equipment, employment is stable throughout the year.

### Training, Other Qualifications, and Advancement

Because of the increasing sophistication of heating, air-conditioning, and refrigeration systems, employers prefer to hire those who have completed technical school training or a formal apprenticeship. Some mechanics and installers, however, still learn the trade informally on the job.

**Education and training.** Many heating, air-conditioning, and refrigeration mechanics and installers receive their primary training in secondary and postsecondary technical and trade schools and junior and community colleges that offer programs

in heating, air-conditioning, and refrigeration. These programs can take between 6 months and 2 years to complete. Others get their training in the Armed Forces.

High school students interested in some initial training for this industry should take courses in shop math, mechanical drawing, applied physics and chemistry, electronics, blueprint reading, and computer applications. Some knowledge of plumbing or electrical work and a basic understanding of electronics are beneficial for an HVACR technician. Secondary and postsecondary students studying HVACR learn about theory of temperature control, equipment design and construction, and electronics. They also learn the basics of installation, maintenance, and repair.

Three accrediting agencies have set academic standards for HVACR programs: HVAC Excellence; the National Center for Construction Education and Research; and the Partnership for Air-Conditioning, Heating, and Refrigeration Accreditation. After completing these programs, new technicians generally need between 6 months to 2 years of field experience before they are considered proficient.

Many other technicians train through apprenticeships. Apprenticeship programs frequently are run by joint committees representing local chapters of the Air-Conditioning Contractors of America, the Mechanical Contractors Association of America, Plumbing-Heating-Cooling Contractors—National Association, and locals of the Sheet Metal Workers' International Association or the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada. Local chapters of the Associated Builders and Contractors and the National Association of Home Builders sponsor other apprenticeship programs. Formal apprenticeship programs normally last 3 to 5 years and combine paid on-the-job training with classroom instruction. Classes include subjects such as safety practices, the use and care of tools, blueprint reading, and the theory and design of heating, ventilation, air-conditioning, and refrigeration systems. In addition to understanding how systems work, technicians must learn about refrigerant products and the legislation and regulations that govern their use.

Applicants for apprenticeships must have a high school diploma or equivalent. Math and reading skills are essential. After completing an apprenticeship program, technicians are considered skilled trades workers and capable of working alone. These programs are also a pathway to certification and, in some cases, college credits.

Those who acquire their skills on the job usually begin by assisting experienced technicians. They may begin by performing simple tasks such as carrying materials, insulating refrigerant lines, or cleaning furnaces. In time, they move on to more dif-

ficult tasks, such as cutting and soldering pipes and sheet metal and checking electrical and electronic circuits.

**Licensure.** Heating, air-conditioning, and refrigeration mechanics and installers are required to be licensed by some States and localities. Requirements for licensure vary greatly, but all States or localities that require a license have a test that must be passed. The contents of these tests vary by State or locality, with some requiring extensive knowledge of electrical codes and others focusing more on HVACR-specific knowledge. Completion of an apprenticeship program or 2 to 5 years of experience are also common requirements.

In addition, all technicians who purchase or work with refrigerants must be certified in their proper handling. To become certified to purchase and handle refrigerants, technicians must pass a written examination specific to the type of work in which they specialize. The three possible areas of certification are: Type I—servicing small appliances; Type II—high-pressure refrigerants; and Type III—low-pressure refrigerants. Exams are administered by organizations approved by the U.S. Environmental Protection Agency, such as trade schools, unions, contractor associations, or building groups.

**Other qualifications.** Because technicians frequently deal directly with the public, they should be courteous and tactful, especially when dealing with an aggravated customer. They should be in good physical condition because they sometimes have to lift and move heavy equipment.

**Certification and advancement.** Throughout the learning process, technicians may have to take a number of tests that measure their skills. For those with relevant coursework and less than 2 years of experience, the industry has developed a series of exams to test basic competency in residential heating and cooling, light commercial heating and cooling, and commercial refrigeration. These are referred to as “Entry-level” certification exams and are commonly conducted at both secondary and postsecondary technical and trade schools.

Additionally, HVACR technicians who have at least 1 year of experience performing installations and 2 years of experience performing maintenance and repair can take a number of different tests to certify their competency in working with specific types of equipment, such as oil-burning furnaces. The Air Conditioning, Heating, and Refrigeration Institute offers an Industry Competency Exam; HVAC Excellence offers both a Secondary Employment Ready Exam and a Secondary Heat and Heat Plus exams; and National Occupational Competency Testing Institute offers a secondary exam; and the Refrigeration Service Engineers Society offers two levels of certification, as well. Employers increasingly recommend taking and passing these tests and obtaining certification; doing so may increase advancement opportunities.

Another way to increase advancement opportunities is to take advantage of any courses that will improve competency with computers; these courses are useful because of the increasing complexity of automated computer controls in larger buildings.

Advancement usually takes the form of higher wages. Some technicians, however, may advance to positions as supervisor or service manager. Others may move into sales and marketing. Still others may become building superintendents, cost estimators, system test and balance specialists, or, with the

necessary certification, teachers. Those with sufficient money and managerial skill can open their own contracting business.

## Employment

Heating, air-conditioning, and refrigeration mechanics and installers held about 308,200 jobs in 2008; about 54 percent worked for plumbing, heating, and air-conditioning contractors. The rest were employed in a variety of industries throughout the country, reflecting a widespread dependence on climate-control systems. Some worked for refrigeration and air-conditioning service and repair shops, schools, and stores that sell heating and air-conditioning systems. Local governments, the Federal Government, hospitals, office buildings, and other organizations that operate large air-conditioning, refrigeration, or heating systems also employed these workers. About 16 percent of these workers were self-employed.

## Job Outlook

With much faster than average job growth and numerous expected retirements, heating, air-conditioning, and refrigeration mechanics and installers should have excellent employment opportunities.

**Employment change.** Employment of heating, air-conditioning, and refrigeration mechanics and installers is projected to increase 28 percent during the 2008-18 decade, much faster than the average for all occupations. As the population and stock of buildings grows, so does the demand for residential, commercial, and industrial climate-control systems. Residential HVACR systems generally need replacement after 10 to 15 years; the large number of homes built in recent years will enter this replacement timeframe by 2018. The increased complexity of HVACR systems, which increases the possibility that equipment may malfunction, also will create opportunities for service technicians. A growing focus on improving indoor air quality and the increasing use of refrigerated equipment by a rising number of stores and gasoline stations that sell food should also create more jobs for heating, air-conditioning, and refrigeration technicians.

Concern for the environment and the need to reduce energy consumption overall has prompted the development of new energy-saving heating and air-conditioning systems. This emphasis on better energy management is expected to lead to the replacement of older systems and the installation of newer, more efficient systems in existing homes and buildings. Also, demand for maintenance and service work should rise as businesses and homeowners strive to keep increasingly complex systems operating at peak efficiency. Regulations prohibiting the discharge and production of older types of refrigerants that pollute the atmosphere should continue to result in the need to replace many existing air conditioning systems or to modify them to use new environmentally safe refrigerants. The pace of replacement in the commercial and industrial sectors will quicken if Congress or individual States change tax rules designed to encourage companies to buy new HVACR equipment.

**Job prospects.** Job prospects for heating, air-conditioning, and refrigeration mechanics and installers are expected to be excellent, particularly for those who have completed training from an accredited technical school or a formal apprenticeship. A growing number of retirements of highly skilled technicians

are expected to generate many more job openings. Many contractors have reported problems finding enough workers to meet the demand for service and installation of HVACR systems.

Technicians who specialize in installation work may experience periods of unemployment when the level of new construction activity declines, but maintenance and repair work usually remains relatively stable. People and businesses depend on their climate-control or refrigeration systems and must keep them in good working order, regardless of economic conditions.

In light of the complexity of new computer-controlled HVACR systems in modern high-rise buildings, prospects should be best for those who can acquire and demonstrate computer competency. Training in new techniques that improve energy efficiency will also make it much easier to enter the occupation.

### Earnings

Median hourly wages of heating, air-conditioning, and refrigeration mechanics and installers were \$19.08 in May 2008. The middle 50 percent earned between \$14.94 and \$24.84 an hour. The lowest 10 percent earned less than \$12.19, and the top 10 percent earned more than \$30.59. Median hourly wages in the industries employing the largest numbers of heating, air-conditioning, and refrigeration mechanics and installers were:

Local government.....	\$22.79
Hardware, and plumbing and heating equipment and supplies merchant wholesalers .....	22.18
Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance.....	20.83
Direct selling establishments.....	20.03
Building equipment contractors .....	18.26

Apprentices usually earn about 50 percent of the wage rate paid to experienced workers. As they gain experience and improve their skills, they receive periodic increases until they reach the wage rate of experienced workers.

Heating, air-conditioning, and refrigeration mechanics and installers generally receive a variety of employer-sponsored benefits. In addition to typical benefits such as health insurance and pension plans, some employers pay for work-related training and provide uniforms, company vans, and tools.

About 15 percent of heating, air-conditioning, and refrigeration mechanics and installers are members of a union. The unions to which the greatest numbers of mechanics and installers belong are the Sheet Metal Workers International Association and the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada.

### Related Occupations

Heating, air-conditioning, and refrigeration mechanics and installers work with sheet metal and piping, and repair machinery, such as electrical motors, compressors, and burners. Other workers who have similar duties include:

- Boilermakers
- Electricians
- Home appliance repairers

- Plumbers, pipelayers, pipefitters, and steamfitters
- Sheet metal workers

### Sources of Additional Information

For more information about opportunities for training, certification, and employment in this trade, contact local vocational and technical schools; local heating, air-conditioning, and refrigeration contractors; a local of the unions or organizations previously mentioned; a local joint union-management apprenticeship committee; or the nearest office of the State employment service or apprenticeship agency. You can also find information on the registered apprenticeship system with links to State apprenticeship programs on the U.S. Department of Labor's Web site: [http://www.doleta.gov/OA/eta\\_default.cfm](http://www.doleta.gov/OA/eta_default.cfm). Apprenticeship information is also available from the U.S. Department of Labor's toll free helpline: (877) 872-5627.

For information on career opportunities, training, and technician certification, contact:

➤ Air-Conditioning Contractors of America, 2800 Shirlington Rd., Suite 300, Arlington, VA 22206-3607. Internet:

<http://www.acca.org>

➤ Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201-3001. Internet:

<http://www.ahrinet.org>

➤ Associated Builders and Contractors, Workforce Development Department, 4250 North Fairfax Dr., 9th Floor, Arlington, VA 22203-1607.

Internet: <http://www.trytools.org>

➤ Carbon Monoxide Safety Association, P.O. Box 669, Eastlake, CO 80614-0669.

Internet: <http://www.cosafety.org>

➤ Green Mechanical Council 1701 Pennsylvania, Ave. NW, Suite 300 Washington, DC 20006-5813. Internet:

<http://www.greenmech.org>

➤ Home Builders Institute, National Association of Home Builders, 1201 15th St. NW., 6th Floor, Washington, DC 20005-2842. Internet: <http://www.hbi.org>

➤ HVAC Excellence, P.O. Box 491, Mt. Prospect, IL 60056-0521. Internet: <http://www.hvacexcellence.org>

➤ Mechanical Contractors Association of America, Mechanical Service Contractors of America, 1385 Piccard Dr., Rockville, MD 20850-4329.

Internet: <http://www.mcaa.org>

➤ National Center for Construction Education and Research, 3600 NW 43rd Street, Bldg. G, Gainesville, FL 32606-8134. Internet:

<http://www.nccer.org>

➤ National Occupational Competency Testing Institute, 500 North Bronson Ave., Big Rapids, MI 49307-2737. Internet:

<http://www.nocti.org>

➤ North American Technician Excellence, 2111 Wilson Blvd., Suite 510, Arlington, VA 22201-3051. Internet:

<http://www.natex.org>

- ▶ Plumbing-Heating-Cooling Contractors, 180 S. Washington St., P.O. Box 6808, Falls Church, VA 22046-6808. Internet: <http://www.phccweb.org>
- ▶ Radiant Panel Association, P.O. Box 717, Loveland, CO 80539-0717. Internet: <http://www.radiantpanelassociation.org>
- ▶ Refrigeration Service Engineers Society, 1666 Rand Rd., Des Plaines, IL 60016-3552. Internet: <http://www.rses.org>
- ▶ Sheet Metal and Air-Conditioning Contractors National Association, 4201 Lafayette Center Dr., Chantilly, VA 20151-1209. Internet: <http://www.smacna.org>
- ▶ United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry, United Association Bldg., 3 Park Place, Annapolis, MD 21401-3687. Internet: <http://www.ua.org>

The Occupational Information Network (O\*NET) provides information on a wide range of occupational characteristics. Links to O\*NET appear at the end of the Internet version of this occupational statement, accessible at <http://www.bls.gov/ooh/ocos192.htm>