**Chronicle Guidance Publications**

**Heating and Cooling Systems Technicians**

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**Occupational Subtitles:**
- Heating and Air-Conditioning Technicians
- Refrigeration Technicians

**Work Classification Based Related Occupations:**
- Air and Hydronic Balancing Technicians
- Gas-Appliance Servicers
- Industrial-Gas Servicers
- Solar Energy system Installers

**Interests Based Related Occupations:**
- Automobile Mechanics
- Milking System Installers
- Office Machine Servicers
- Pump Servicers

**Skills Based Related Occupations:**
- Home Appliance Installers
- Locksmiths and Safe Repairers
- Motorboat Mechanics
- Outdoor Power Equipment and Other Small Engine Mechanics

**Noteworthy Quote:**

“HVACR provides a unique opportunity for individuals who can blend solid mechanical aptitude with advanced technologies and troubleshooting skills. System technicians not only enjoy a lifelong, well-paying career full of challenging and interesting days, their work directly impacts the well-being of the entire society. HVACR is relied on every day in every facet of life, and the demand for knowledgeable technicians who can provide that reliability is only going to increase.”

—Mark Lowry, Executive Vice President, Refrigeration Service Engineers Society, Des Plaines, Illinois

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**Heating and cooling systems technicians** (`heating and `cool-ing `sys-tems tech`ni-cians) install, repair, troubleshoot, maintain, and service heating, ventilation, air-conditioning, and refrigeration (HVACR) systems.

Heating and cooling systems are widely used to control the climate in enclosed spaces. Many of these systems also help to control ventilation, humidity, and air purification. Applications range from systems in homes to large central systems in factories, commercial buildings, hospitals, and other large commercial and residential facilities. At home, most Americans control the temperature in their house with a thermostat. They can heat a house when the weather is cold and cool it when the weather is hot, insuring comfort at all times. In extreme temperature conditions, such as an Alaskan winter or Arizona summer, it can be a matter of survival.

To produce products and carry out processes, many manufacturing plants require climate control systems with wide-ranging or specific temperature, humidity, and pressure controls. For example, refrigeration is necessary to store, ship, and preserve perishable foods. Hospitals rely on refrigeration units to preserve drugs, tissues, and other biomedical products. Refrigeration serves in the carrying out of operations, such as the removal of raw synthetics in the oil processing industry. The manufacture of antibiotics, such as penicillin, requires refrigeration and moisture control under high vacuum.

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**Work Performed**

Heating and cooling systems technicians install, service, troubleshoot, maintain, and repair different types and sizes of heating, ventilation, air-conditioning, and refrigerating (HVACR) systems. The installation and servicing of heating and cooling systems, such as furnaces, air-conditioners, and refrigeration equipment, require basically the same knowledge and tools. However, heating and cooling systems technicians, also called **HVACR technicians**, may choose to specialize.

For instance, they may work only in large industrial and commercial installations, or they may primarily service domestic heating and cooling systems. They may specialize in either installation or maintenance and repair. They may work only with...
heating and air-conditioning systems and be designated heating and air-conditioning technicians. They may work only with refrigeration systems and be designated refrigeration technicians. Or they may specialize in one type of equipment such as solar panels or hydronics (water-based heating systems).

Before they install HVACR equipment, technicians study blueprints or the manufacturer’s instructions to see what the job requires. Technicians (or an engineer) may evaluate heating and cooling requirements to determine the kind of unit required, such as oil, gas, electric, solid-fuel, or multiple-fuel systems. They then install motors, compressors, condensing units, evaporators, burners, and other components on platforms or on the floor.

They assemble and install ducts and vents, fuel and water supply lines, cut and bend tubing to correct lengths and shapes, and cut and thread pipes. To join the pipes and tubing, they use couplings, sleeves, or joints. They also install air filters. After they have put the system together, they connect the system to an electrical control panel and connect the control panel to the power source. They test joints and connections for leaks. Finally, they insulate pipes and adjust the airflow.

Most air-conditioning and refrigeration systems utilize chemicals known as refrigerants. Technicians fill systems with refrigerants, monitor overall performance, and test for leaks. They watch the pressure gauges and adjust the amount of refrigerant and/or the controls to get the system working at optimal efficiency levels. They also take care to conserve, recover, and recycle refrigerants by transferring the refrigerant into cylinders using specialized equipment, and, after filtration, reusing it under specific conditions.

HVACR technicians in maintenance and repair work perform routine, periodic maintenance. They diagnose the causes of breakdowns and make repairs. To find defects, they test parts such as compressors, relays, and thermostats, and read pressure and vacuum gauges. Skilled technicians can pinpoint noisy valves, connecting rod knocks, rattling supports, vibration, and other defects.

Technicians also trace the electrical system for loose connections, faulty switches, defective controls, thermostats, fuses, and wiring. They oil moving parts and change dirty filters. They keep units filled with refrigerant, and adjust valves, belts, and drives. They check all parts of the system that might cause trouble. Periodically, technicians may overhaul systems, add refrigerant, and adjust airflow in the ducts.

Since most HVACR installations have fairly complex control systems, technicians must be able to read and follow control circuit diagrams. They use electrical, pneumatic, and electronic instruments to test motors, relays, starters, and overload devices and controls. When installing a furnace, technicians use carbon dioxide testers, carbon monoxide testers, combustion analyzers, and oxygen testers.

Technicians also use vacuum and pressure gauges, leak detectors, electric test instruments such as voltmeters, and hand and power tools such as electric drills, screwdrivers, hammers, and pliers. To install pipes, tubing, and ductwork, these technicians use pipe threaders, pipe cutters, pipe benders, expanders, flaring tools, and brazing, soldering, and welding equipment.

The most recent innovation is the development of computer hardware and software that allows heating and cooling units to automatically contact the maintenance establishment, via internet access, when problems arise. The maintenance establishment can then contact the technician in the field to examine the equipment and make any repairs.

Technicians may also sell their clients service contracts. Service contracts provide for regular maintenance of the HVACR systems. This allows technicians to troubleshoot and make regular adjustments and minor repairs to promote efficiency and reduce greenhouse gases and utility bills. This, in turn, helps both the customer and technician by reducing repair delays as well as downtimes caused by the seasonal fluctuations of this type of work.

**Working Conditions**

These workers install and maintain systems in homes, factories, office buildings, schools, sports arenas, shopping malls, supermarkets, theatres, ships and boats, hospitals, trains, and even space capsules. HVACR installation and service work takes place both indoors and outdoors. Technicians may work in cramped quarters. They may bend or crawl when doing repairs. They may do some climbing and lifting when working on rooftop units. They may work under rapid temperature changes and sometimes in cold-storage rooms or warehouses.

Risks in this trade include burns from torches, soldering irons, and heated components; electrical shock; and possible injury from handling heavy equipment. Contact with refrigerants can cause skin damage, frostbite, or blindness. Technicians may work in air tainted with ammonia, halocarbons, or carbon monoxide. However, the use of hard hats, safety glasses, safety belts, and shields are a standard requirement in this work. Skilled technicians who follow safety rules seldom hurt themselves or their co-workers.

**Hours and Earnings**

Most heating and cooling systems technicians usually work forty hours or more a week. As a rule, those in construction and installation may be assigned to specific job sites each day, or they may be dispatched to jobs by radio, cell phone, or pager. Like other maintenance workers, HVACR technicians often work evenings or weekends, and are on call for emergency repairs. They also often work overtime during peak seasons, such as very hot or cold weather when equipment breakdowns require swift repairs.

The earnings of HVACR technicians compare well with the earnings of other service technicians. They are among the highest paid technicians in the contracting and service industries. However, earnings within the industry vary widely depending on education, certification, experience, responsibilities, and employer. According to the Bureau of Labor Statistics, heating, air-conditioning, and refrigeration mechanics and installers averaged $19.09 an hour or
Apprenticeships usually begin at about 50 percent of the wage rate of experienced workers. As they acquire experience and skill, they receive regular raises until they are earning the rate of experienced workers. Large companies or contractors offer technicians paid vacations and holidays, medical insurance, pension plans. Some pay for work-related training and provide uniforms, company vans, and tools. Union fringe benefits may amount to 35 percent to 60 percent above and beyond the base rate. Small shops may offer some of these extras. Self-employed technicians must provide for their own insurance.

Education and Training

This work is becoming increasingly complex and sophisticated (with microelectronics in solid-state equipment controls, for instance). Employers prefer to hire workers with a technical school background or apprenticeship training. However, some of these workers learn their skills on the job. High school students interested in this work should take metal shop, mathematics, chemistry, physics, and mechanical drawing. A basic understanding of electronics, blueprint reading, and computer applications is useful in this work. Many high schools also offer actual hands-on training in heating, ventilation, air-conditioning, and refrigeration (HVACR).

Many technical and trade schools, community colleges, and the U.S. Armed Forces offer 6-month to 2-year programs of study in HVACR. Students study theory, design, and equipment construction. They also learn basic installation, repair, and maintenance. Three accrediting agencies have set academic standards for HVACR programs: HVAC Excellence; the National Center for Construction Education and Research (NCCER); and the Partnership for Air Conditioning, Heating, and Refrigeration Accreditation (PAHRA). After completing these programs, new technicians generally need an additional year or two of field experience before they can be considered proficient.

Apprenticeships are offered throughout the country. Frequently, these programs are run by joint committees made up of employers and local chapters of the Air-conditioning Contractors of America, the Plumbing-Heating-Cooling Contractors National Association, the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada, the Sheet Metal Workers’ International Association, the Associated Builders and Contractors, and other related organizations. Apprenticeships consist of on-the-job experience along with 144 hours of classroom instruction a year, and last three to five years. After completing an apprenticeship program, technicians are considered skilled tradesworkers.

Some technicians learn their trade on the job. New workers begin as trainees or shop helpers, and progress to become skilled technicians. In four or five years, these technicians should be able to do all kinds of repairs and installations. Most manufacturers of heating and cooling systems offer courses in the maintenance, installation, and repair of their equipment to employees of their dealer-contractors. Several organizations offer basic self-study, classroom, and Internet courses for individuals with limited experience. Rapid changes in this field also make it necessary for technicians to take continuing education courses. Equipment manufacturers and most organizations, such as the Refrigeration Service Engineers Society (RSES), offer relevant courses.

Certification and Unions

All technicians who work with refrigerants must obtain certification, specific to the type of work in which they specialize, to purchase and handle them. Technicians may become certified in servicing Type 1—small appliances, Type II—high pressure refrigerants, or Type III—low pressure refrigerants. To become certified, technicians must pass a written examination approved by the U.S. Environmental Protection Agency. Exams are offered by trade schools, unions, trade associations, and building groups.

Many HVACR training programs across the country also require that students pass the Industry Competency Exams (ICEs) prior to graduation. The ICEs measure entry-level skills and serve as a pretest for certification of experienced technicians. Numerous certification tests are offered in specific types of equipment through North American Technician Excellence, Inc. (NATE), RSES, HVAC Excellence, The Carbon Monoxide Safety Association (COSA), and Air Conditioning and Refrigeration Safety Coalition, among others.

Around 16 percent of these workers belong to a union. The United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada has around 300,000 members. Another important union is the Sheet Metal Workers International Association. It has about 150,000 members. Many who work for small shops or contractors or are self-employed, however, do not join a union.

Personal Qualifications

Heating and cooling systems technicians should enjoy working with their hands, and they should have an interest in how things work. These workers should be able to cooperate and get along well with others in the construction trades. They should also be able to work well alone without direct supervision. The ability to deal with customers is important. They should be tactful, courteous, neat, and willing to answer questions. If necessary, they should be able to give the system owner instructions on the use and care of the equipment.

Occupations can be adapted for workers with disabilities. Persons should contact their school or employment counselors, their state office of vocational rehabilitation, or their state department of labor to explore fully their individual needs and requirements as well as the requirements of the occupation.
Where Employed

The HVACR industry employs nearly 900,000 workers. In 2006, HVACR technicians held over 250,000 full-time jobs. Thousands of others held part-time positions. The widespread use of heating and cooling equipment requires the skills of these technicians in all parts of the United States. High concentrations of these technicians, however, are in big cities that have great numbers of residential, commercial, and industrial installations. Around one third of these technicians worked for cooling and heating contractors. Most of the rest worked for manufacturers, dealers, utility companies, servicers, and retail and industrial firms large enough to require full-time technicians. Nearly 1 of every 5 technicians was self-employed.

Employment Outlook

Prospects for these workers are very good. The Bureau of Labor Statistics projects employment of these workers to grow by 19 percent through the year 2014—an increase of around 51,000 jobs. An additional 36,000 positions are expected to open due to replacement needs. The growing need for climate control equipment for industrial, commercial, and home use will create a demand for service technicians who can design, install, maintain, and repair these systems. Rising energy costs and a growing concern with energy conservation and the use of environmentally safe refrigerants will induce people to have their old equipment repaired or replaced with energy-efficient/environmentally safe models. Installation of new systems may have some slow periods, but maintenance work is fairly steady, because people and businesses need their heating and cooling systems no matter what the economy.

Entry Methods

The Yellow Pages of the telephone directory list these businesses under “Air-conditioning Equipment and Systems,” “Air-conditioning Contractors and Systems,” “Heating Contractors,” or “Refrigerating Equipment—Commercial.” Job seekers should call on these businesses and apply for openings. Graduates of technical or trade schools, or two-year colleges may find jobs through school placement offices. Local union offices may have helpful facts on apprenticeships. Employment services, want ads in newspapers, and trade associations are other sources of job leads.

Advancement

Advancement is often from trainee/helper to installer to service technician. Technicians with education, certification, and experience may become shop supervisors or managers. Technicians working for a large factory or contractor may move into other branches of the field. They may become sales representatives, estimators, drafters, designers, specification writers, or field servicers. Technicians who have experience, drive, proven licensure, and the capital (money) to buy equipment may go into business for themselves.

For Further Research

Air-Conditioning and Refrigeration Institute, 4100 N. Fairfax Drive, Suite 200, Arlington, VA 22203. Web site: www.ari.org

Plumbing-Heating-Cooling Contractors National Association, 180 S. Washington Street, P.O. Box 6808, Falls Church, VA 22046. Web site: www.phccweb.org


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