

Precision Instrument and Equipment Repairers

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Significant Points

- Training requirements include a high school diploma and, in some cases, postsecondary education, coupled with significant on-the-job training.
- Good opportunities are expected for most types of jobs.
- Overall employment is expected to grow about as fast as average, but projected growth varies by detailed occupation.
- About 1 out of 4 are self-employed.

Nature of the Work

Repairing and maintaining watches, cameras, musical instruments, medical equipment, and other precision instruments requires a high level of skill and attention to detail. For example, some devices contain tiny gears that must be manufactured to within one one-hundredth of a millimeter of design specifications, and other devices contain sophisticated electronic controls.

Camera and photographic equipment repairers work through a series of steps in fixing a camera. The first step is determining whether a repair would be profitable. Many inexpensive cameras cost more to repair than to replace. The most complicated or expensive problems are referred back to the manufacturer. If the repairers decide to proceed, they diagnose the problem, often by disassembling numerous small parts in order to reach the source. They then make needed adjustments or replace a defective part. Many problems are caused by the electronic circuits used in many cameras, which require an understanding of electronics. Camera repairers also maintain cameras by removing and replacing broken or worn parts and cleaning and lubricating gears and springs. Many of the components and parts involved are extremely small, requiring a great deal of manual dexterity. Frequently, older camera parts are no longer available, requiring repairers to build replacement parts or strip junked cameras. When machining new parts, workers often use a small lathe, a grinding wheel, and other metalworking tools.

Camera repairers also repair the increasingly popular digital cameras. Repairs on such cameras are similar to those for most modern cameras, but, because digital cameras have no film to wind, they employ fewer moving parts.

Watch and clock repairers work almost exclusively on expensive timepieces, as moderately priced timepieces are cheaper to replace than to repair. Electrically powered quartz watches and clocks function with almost no moving parts, limiting necessary maintenance to replacing the battery. Many expensive timepieces still employ old-style mechanical movements and a manual winding mechanism or spring. This type of timepiece requires regular adjustment and maintenance. Any repair or maintenance work on a mechanical timepiece requires the disassembly of many fine gears and components. Each part is inspected for signs of significant wear. Some gears or springs may need to be replaced or machined. All of the parts are cleaned and oiled.

As for older cameras, replacement parts are frequently unavailable for antique watches or clocks. In such cases, watch repairers must machine their own parts. They employ small lathes and other machines in creating tiny parts.

Musical instrument repairers and tuners combine their love of music with a highly skilled craft. Musical instrument repairers and tuners, often referred to as technicians, work in four specialties: band instruments, pianos and organs, violins, and guitars. (Repairers and tuners who work on electronic organs are discussed in the *Handbook* statement on electronic home entertainment equipment installers and repairers.)

Band instrument repairers, brass and wind instrument repairers, and percussion instrument repairers focus on woodwind, brass, reed, and percussion instruments damaged through deterioration or by accident. They move mechanical parts or play scales to find problems. They may unscrew and remove rod pins, keys, worn cork pads, and pistons and remove soldered parts using gas torches. They repair dents in metal and wood using filling techniques or a mallet. Drums often need new drumheads, which are cut from animal skin. These repairers use gas torches, grinding wheels, shears, mallets, and small hand tools.

Piano repairers use similar techniques, skills, and tools. Repairers often earn additional income by tuning pianos, which involves tightening and loosening different strings to achieve the proper tone or pitch. Pipe-organ repairers do work similar to that of piano repairers on a larger scale. Additionally, they assemble new organs. Because pipe organs are too large to transport, they must be assembled on site. Even with repairers working in teams or with assistants, the organ assembly process can take several weeks or even months, depending on the size of the organ.



Musical instrument repairers often learn the trade through apprenticeships.

Violin repairers and guitar repairers adjust and repair string instruments. Initially, repairers play and inspect the instrument to find any defects. They replace or repair cracked or broken sections and damaged parts. They also restring the instruments and repair damage to their finish.

The work of *medical equipment repairers* differs significantly from other precision instrument and equipment repair work. Although medical equipment repairers work on fine mechanical systems, the larger scale of their tasks requires less precision. The machines that they repair include electric wheelchairs, mechanical lifts, hospital beds, and customized vehicles.

Medical equipment repairers use various tools, including ammeters, voltmeters, and other measuring devices to diagnose problems. They use handtools and machining equipment, such as small lathes and other metalworking equipment, to make repairs.

Other precision instrument and equipment repairers service, repair, and replace a wide range of equipment associated with automated or instrument-controlled manufacturing processes. A precision instrument repairer working at an electric power plant, for example, would repair and maintain instruments that monitor the operation of the plant, such as pressure and temperature gauges. These workers use many of the same tools that medical equipment repairers use. Malfunctioning parts are often replaced, but sometimes repair is necessary. Replacement parts are not always available, so repairers sometimes machine or fabricate a new part. Preventive maintenance involves regular lubrication, cleaning, and adjustment of many measuring devices.

Working Conditions

Camera, watch, and musical instrument repairers work under fairly similar solitary, low-stress conditions with minimal supervision. A quiet, well-lighted workshop or repair shop is typical, while a few of these repairers travel to the instrument being repaired, such as a piano, organ, or grandfather clock.

Medical equipment and precision instrument and equipment repairers normally work daytime hours. But, like other hospital and factory employees, some repairers work irregular hours. Precision instrument repairers work under a wide array of conditions, from hot, dirty, noisy factories to air-conditioned workshops to outdoor fieldwork. Attention to safety is essential, as the work sometimes involves dangerous machinery or toxic chemicals. Due to the individual nature of the work, supervision is fairly minimal.

Employment

Precision instrument and equipment repairers held 63,000 jobs in 2000. The overwhelming majority of medical equipment repairers and other precision instrument and equipment repairers were wage and salary workers. Medical equipment repairers often work for hospitals or wholesale equipment suppliers, while most precision instrument repairers work in manufacturing. On the other hand, about 1 out of 4 watch, camera and photographic equipment, and musical instrument repairers were self-employed. The following tabulation presents employment by occupation:

Medical equipment repairers	28,000
All other precision instrument and equipment repairers	15,000
Camera and photographic equipment repairers	7,200
Musical instrument repairers and tuners	7,100
Watch repairers	5,200

Training, Other Qualifications, and Advancement

Most employers require at least a high school diploma for beginning precision instrument and equipment repairers. Many employers prefer

applicants with some postsecondary education. Much training takes place on the job. The ability to read and understand technical manuals is important. Necessary physical qualities include good fine motor skills and vision. Also, precision equipment repairers must be able to pay close attention to details, enjoy problem solving, and have the desire to disassemble machines to see how they work. Most precision equipment repairers must be able to work alone with minimal supervision.

The educational background required for camera and photographic equipment repairers varies, but some background in electronics is necessary. Some workers complete postsecondary training, such as an associate degree, in this field. The job requires the ability to read an electronic schematic diagram and comprehend other technical information, in addition to good manual dexterity. New employees are trained on the job in two stages over about a year. First, they assist a senior repairer for about 6 months. Then, they refine their skills by performing repairs on their own for an additional 6 months. Finally, repairers continually hone and improve their skills by attending manufacturer-sponsored seminars on the specifics of particular models.

Medical equipment repairers are trained in a similar manner. A background in electronics is helpful, but not required. Like camera repairers, they often specialize in a model or brand. Medical equipment repair requires less training than other precision equipment repair specialties. There are no schools to train these repairers; instead, they learn through hands-on experience and observation. New repairers begin by observing and assisting an experienced worker over a period of 3 to 6 months. Gradually, they begin working independently, while still under close supervision.

Training also varies for watch and clock repairers. Several associations, including the American Watchmakers-Clockmakers Institute (AWI) and the National Association of Watch and Clock Collectors, offer certifications. Some certifications can be completed in a few months; some require simply passing an examination; and the most demanding certifications require 3,000 hours, over 2 years, of classroom time in technical institutes or colleges. (Clock repairers generally require less training than watch repairers because watches have smaller components and require greater precision.) Some repairers opt to learn through assisting a master watch repairer. Nevertheless, developing proficiency in watch or clock repair requires several years of education and experience.

For musical instrument repairers and tuners, employers prefer people with post-high school training in music repair technology. According to a 1997 Piano Technicians Guild membership survey, more than 85 percent of respondents had completed at least some college work; at least 50 percent had a bachelor's or higher degree, although not always in music repair technology. A few technical schools and colleges offer courses in instrument repair. Graduates of these programs normally receive additional training on the job, working with an experienced repairer. A few musical instrument repairers and tuners begin learning their trade on the job as assistants, but employers strongly prefer those with technical school training. Trainees perform a variety of tasks around the shop. Full qualification usually requires 2 to 5 years of training and practice.

Educational requirements for other precision instrument and equipment repair jobs also vary, but include a high school diploma, with a focus on mathematics and science courses. Most employers require postsecondary courses, as repairers need to understand blueprints, electrical schematic diagrams, and electrical, hydraulic, and electromechanical systems. In addition to formal education, a year or two of on-the-job training is required before a repairer is considered fully qualified. Some advancement opportunities exist, but many supervisory positions require more formal education.

Job Outlook

Good opportunities are expected for most types of precision instrument and equipment repairer jobs. Overall employment is projected to grow about as fast as the average for all occupations over the 2000-10 period. However, projected growth varies by detailed occupation.

Job growth among medical equipment repairers should grow about as fast as the average for all occupations over the projected period. The expanding elderly population should spark strong demand for medical equipment and, in turn, create good employment opportunities in this occupation.

On the other hand, employment of musical instrument repairers is expected to increase more slowly than average. Replacement needs will provide the most job opportunities as many repairers and tuners near retirement. While the expected increase in the number of school-age children involved with music should spur demand for repairers, music must compete with other extracurricular activities and interests. Without new musicians, there will be a slump in instrument rentals, purchases, and repairs. Because training in the repair of musical instruments is difficult to obtain—there are only a few schools that offer training programs, and few experienced workers are willing to take on apprentices—opportunities should be good for those who receive training.

Employment of camera and photographic equipment repairers is expected to decline. The camera repair business is fairly immune to downturns in the business cycle, as consumers are more likely to repair an expensive camera than to buy a new one. However, the popularity of inexpensive cameras adversely affects employment in this occupation, as most point-and-shoot cameras are cheaper to replace than repair.

Employment of watch repairers is expected to grow more slowly than average. However, applicants should have very good opportunities because a large proportion of watch and clock repairers are approaching retirement age and because of trends in watch fashions. Over the past few decades, changes in technology, including the invention of digital and quartz watches that need few repairs, caused a significant decline in the demand for watch repairers. In recent years, there has been a rapidly growing demand for antique and expensive mechanical watches, resulting in increased need for watch repairers.

The projected slower than average employment growth of other precision instrument and equipment repairers reflects the expected lack of employment growth in manufacturing and other industries in which they are employed. Nevertheless, good employment opportunities are expected for other precision instrument and equipment repairers due to the relatively small number of people entering the occupation and the need to replace repairers who retire.

Earnings

The following tabulation shows median hourly earnings for various precision instrument and equipment repairers in 2000. Earnings ranged from less than \$6.48 for the lowest 10 percent of watch repairers, to more than \$31.47 for the highest 10 percent of musical instrument repairers and tuners.

Medical equipment repairers	\$16.99
Musical instrument repairers and tuners	15.10
Camera and photographic equipment repairers	13.94
Watch repairers	12.08
All other precision instrument and equipment repairers	19.87

Earnings within the different occupations vary significantly, depending upon skill levels. For example, a watch and clock repairer may simply change batteries and replace worn wrist straps, while highly skilled watch and clock repairers, with years of training and experience, may rebuild and replace worn parts. According to a survey by the American Watchmakers-Clockmakers Institute, the median annual earnings of highly skilled watch and clock repairers were about \$40,000 in 2000.

Related Occupations

Many precision instrument and equipment repairers work with precision mechanical and electronic equipment. Other workers who repair precision mechanical and electronic equipment include computer, automated teller, and office machine repairers and coin, vending, and amusement machine servicers and repairers. Other workers who make precision items include dental laboratory technicians and ophthalmic laboratory technicians. Some precision instrument and equipment repairers work with a wide array of industrial equipment. Their work environment and responsibilities are similar to those of industrial machinery installation, maintenance, and repair workers. Much of the work of watch repairers is similar to that of jewelers and precious stone and metal workers. Camera repairers' work is similar to that of electronic home entertainment equipment installers and repairers. Both occupations work with consumer electronics that are based around a circuit board, but that also involve numerous moving mechanical parts.

Sources of Additional Information

For more information about camera repair careers, contact:

- The National Association of Photo Equipment Technicians (NAPET), 3000 Picture Pl., Jackson, MI 49201.

For additional information on medical equipment repair, contact your local medical equipment repair shop or hospital.

For information on musical instrument repair, including schools offering training, contact:

- National Association of Professional Band Instrument Repair Technicians (NAPBIRT), P.O. Box 51, Normal, IL 61761. Internet: <http://www.napbirt.org>

For additional information on piano repair work, contact:

- Piano Technicians Guild, 3930 Washington St., Kansas City, MO 64111-2963. Internet: <http://www.ptg.org>

For information about training, mentoring programs, and schools with programs in precision instrument repair, contact:

- ISA-The Instrumentation, Systems, and Automation Society, 67 Alexander Dr., P.O. Box 12277, Research Triangle Park, NC 27709. Internet: <http://www.isa.org>

For information about watch and clock repair and a list of schools with related programs of study, contact:

- American Watchmakers-Clockmakers Institute (AWI), 701 Enterprise Dr., Harrison, OH 45030-1696. Internet: <http://www.awi-net.org>