DOCUMENT RESUME

ED 112 274 CG 010 047

TITLE	Careers Canada. Volume 3, Mechanical Repair Occupations.
INSTITUTION	Department of Manpower and Immigration, Ottawa (Ontario).
PUB DATE	75
NOTE	38p.; For related documents, see CG 010 045-048
AVAILABLE FROM	Information Canada, Ottawa, K1A 0S9, Ontario, Canada (HC-$1.00)
EDRS PRICE	MF-$0.76 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Auto Body Repairmen; *Auto Mechanics (Occupation); Career Opportunities; Government Publications; *Machine Repairmen; Occupational Clusters; *Occupational Information; *Skilled Occupations
IDENTIFIERS	*Canada

ABSTRACT

This pamphlet, published by the Canadian Department of Manpower and Immigration, is the third of a Careers-Canada series and describes careers in mechanical repair occupations. The pamphlet is divided into eight major sections: (1) history and importance; (2) fields of work; (3) nature of work (this section is subdivided into automotive repair occupations, heavy-duty (diesel) repair occupations, industrial repair occupations, and trade and business occupations); (4) preparation and training; (5) working conditions; (6) personal qualities needed on the job; (7) future outlook; and (8) seeking employment. Several photographs are included. (RWP)

CAREERS CANADA

Manpower and Immigration

Main-d'œuvre et Immigration

MESSAGE FROM THE MINISTER

All Canadians must be given the opportunity to determine their abilities, develop them through education and training, and apply their talents in a meaningful occupation. To achieve this goal, sound information must be made available to every Canadian at a stage in their development where fruitful decisions can be made. Careers – Canada is a major effort towards this end.

The benefits of the Careers – Canada series should affect many people: the student considering entrance into the world of work; the worker seeking to change occupations; the prospective immigrant; the manpower or vocational guidance counsellor, in fact, anyone wishing to match people with jobs.

Many people have been involved in the production of Careers – Canada, I join them in wishing you every success in your career search.

Robert Andras

NOTE TO READERS

The ultimate judge of any material is the user. It is recognized that improvements can be made in the initial booklets and we ask all readers to forward any suggestions to us. The consolidation of these comments will allow us to better provide you with the type of information required.

Suggestions and comments should be addressed to:

Director,
Occupational and Career Analysis
and Development Branch,
Department of Manpower and Immigration,
305 Rideau Street,
OTTAWA, Ontario.
K1A 0J9

CONTENTS

HISTORY AND IMPORTANCE

We are deluged today with mechanical conveniences of all kinds, but except for a few "do-it-yourselfers", we look to mechanics and repairmen to fix the damaged toaster, the watch that went swimming, and the car that will not start. Without these people, life for most of us would come to a standstill.

And it has always been this way. Canada's earliest settlers depended on the blacksmith to make agricultural tools, machinery for the grist mill, and even cooking pots, and then expected him to repair these items when they broke or stopped working. This was true of most craftsmen at that time — they made the required article and then carried out necessary repairs.

In later years, as power replaced handwork, one group of specialists designed and built new equipment and others maintained and repaired it.

Canada's emergence as an industrial nation in the early 1900s caused many of the small craft shops to combine into large metal-working plants or factories to meet the need for agricultural and other mechanical equipment. With the small craft shops went the old producer-to-customer relationship. Products were supplied by shopkeepers who were unable to service or repair the items they sold. Certain products often had to be returned to distant plants for repair or replacement — a situation which, to some extent, exists today. This problem was at least partially overcome by the setting up of local service and repair facilities, either as part of the retailer's store or as separate shops.

The following pages describe a range of these occupations which may appeal to those who obtain personal satisfaction from working with their hands, with hand tools, and with machines. These occupations also offer the challenge to keep up-to-date on new equipment and methods and perhaps to become a specialist in a chosen field.

FIELDS OF WORK

Mechanical repair occupations provide employment for about 257,000 workers in Canada and are found in almost every kind of industry and business across the nation.

About half of these people work in wholesale and retail establishments which supply such items as farm equipment, motor vehicles, and hardware, or in stores and other outlets selling and servicing household appliances, sporting equipment, or business machines.

The next largest group – about one-quarter of the total – are employed in large manufacturing industries which produce primary metals, machinery products, railway equipment, and motor vehicles. Virtually all manufacturing plants have one or more mechanics on their payroll.

Relatively large numbers of mechanics work in the transportation field maintaining railway equipment, marine vessels, aircraft, and heavy vehicles. Government agencies depend on the skills of mechanics to carry out repairs as do gas, electrical, mining, and construction companies.

NATURE OF WORK

Most mechanics specialize, as indicated by their occupational titles; for example, motor vehicle mechanic, farm equipment mechanic or elevator constructor. Their work varies considerably with the specialty but, basically, all mechanics are concerned with finding the causes of defects, correcting them, and preventing their recurrence. Most repair work presents new problems, and analytical ability is necessary to find the cause of trouble and to put the mechanism back into working order.

The work itself calls for all-round skills in the use of handtools, versatility, and often the ability to improvise. When the trouble has been located, repairs are made usually by the installation of new or reconditioned parts. Depending on the specialty, mechanics may have to use machine tools to make a replacement part. In a number of occupations, a knowledge of basic electricity is required because an increasing number of products now incorporate electrical systems and components.

To be successful requires a genuine interest in finding out how mechanical things work or " why the wheels go round". Many mechanics have found or developed this interest through high school shop courses. Others have purchased an old car and discussed mechanical problems with vocational instructors or the local garage operator. There must be a willingness to broaden one's knowledge, skills, and experience. The almost endless flow of new processes and products entering the market requires workers who have a sound basic education and are anxious to keep up-to-date on the latest technical changes.

AUTOMOTIVE REPAIR OCCUPATIONS

During 1974, nearly 8½ million vehicle licenses were issued in Canada; of these more than 6 million were for passenger cars. The servicing of these vehicles provided employment for about 112,000 auto mechanics and related workers in every community across the country.

More than half the total number of auto mechanics are employed by general and specialty garages and in the service departments of automobile, truck, and farm equipment dealers and wholesalers.

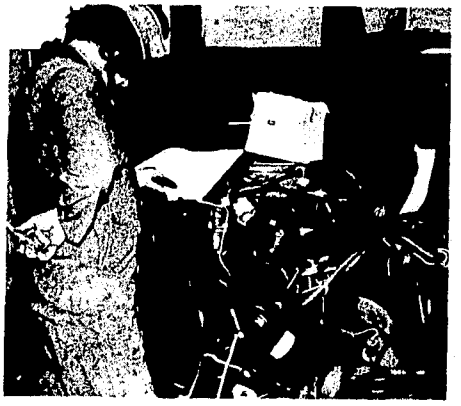
Many large manufacturing, transportation, and commercial companies operate repair shops to service their own fleets of cars, trucks, and heavy-duty equipment. Municipal, provincial, and federal government departments, especially those concerned with urban transit systems and highway maintenance, operate repair depots for all types of publicly owned vehicles.

Motor Vehicle Mechanics

Motor vehicle mechanics service and repair the mechanical, electrical, and related systems of a vehicle. These include the engine and accessories, wheels and chassis, transmission, steering and brake mechanisms, and ignition, lighting, and other electrical systems. While knowledgeable in all aspects of motor vehicle work, general mechanics are especially skilled in the servicing of internal combustion engines.

In all repair work, the first step is to "troubleshoot" — diagnose and find the source of trouble. To do this the mechanic discusses the symptoms with the customer, inspects the vehicle, and listens for abnormal noises. Much of this work is done today with electrical or electronic test equipment. When the problem has been located, the customer is usually given an estimate of costs by either the mechanic or service representative.

Next, corrective action — adjustment, resetting, or unit repair — may be taken. In most cases, new or reconditioned units are installed rather than making repairs. The mechanic removes the unit from the vehicle, dismantles it, reassembles it, and installs it once again. Simpler jobs, such as removing, cleaning, and testing spark plugs, chassis lubrication, or tire changing, may be given to apprentices. More highly

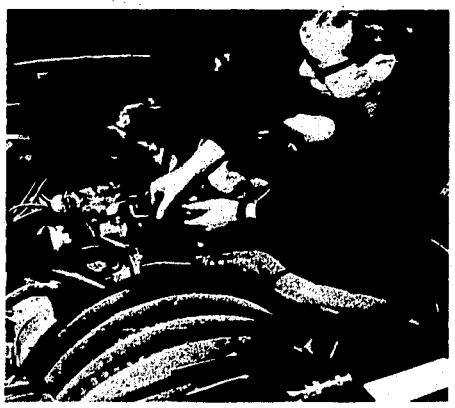


skilled work involves stripping down an engine, opening a transmission system, reassembling a gearbox, or installing a factory-reconditioned engine, and is carried out by a mechanic.

Hand tools most frequently used are wrenches, pliers, and hammers, although feeler gauges, rules, and calipers, together with the manufacturer's service manuals and drawings, are in constant use. Improvements in repair equipment in most shops have kept pace with the rapid developments in motor vehicle design and, in addition to hydraulically operated jacks and hoists, there is a wide variety of power tools — saws and grinders, valve extractors, and air-operated or electrical wrenches — to assist the mechanic.

General mechanics must have a working knowledge of electrical systems. In smaller garages, they trace faults such as short circuits using voltmeters and test lamps, resolder defective connections, change components, and adjust voltage regulators, distributors, and other electrical units. Other mechanics may specialize in the servicing and overhaul of the ignition, starting, lighting, and other systems.

Entry into this occupation is through an apprenticeship program. Full-time attendance during each year of apprenticeship in provincial trade schools is usually required.



Motor vehicle mechanics lead an active life, with much bending, stooping, and lifting. Good eyesight is essential as is the ability to hear and interpret knocks, rattles, and squeaks, which are usually the first signs of defects. Most garages are clean and equipped with labour-saving devices, but one must expect to come into contact with dirt, oil, and grease. In smaller garages mechanics may be required to answer service calls at all hours and frequently in bad weather.

Above-average mechanics may specialize in motor tuning or transmission system overhaul; others with organizing ability may move up to supervisor, estimator, service manager, field service engineer, and similar positions. There are also opportunities to become self-employed by opening a garage or service station. These businesses are highly competitive and success depends not only on mechanical ability but also on a sound knowledge of business practices.

Specialty Mechanics

Specialty mechanics — those mechanics who work in one area of automotive repair — are employed in larger garages, in maintenance shops operated by transport companies, and in repair shops providing one type of service only, for example, a transmission centre.

They may be trained either through an apprenticeship program in some provinces, or may develop a high degree of skill in one branch of automotive work through natural ability supplemented by upgrading courses in trade schools or community colleges or through manufacturer training courses.

Transmission mechanics remove, dismantle, overhaul, and reinstall the transmission and differential systems of vehicles. They strip down gear assemblies, lever systems, and shafts and bearings to be examined for excessive wear and other defects and replace worn parts. Rods, cables, and other shifting linkage and vacuum or electrically powered assists are checked and adjusted, electrical components such as relays and solenoids are examined.

Wheel alignment mechanics test and correct fautly alignment of frames, wheel suspension assemblies, and the steering mechanisms of cars, buses, trucks, and other vehicles. They use testing devices to check for twisted frames, bent axles, misalignement, and incorrect camber (tilt) or toe-in of wheels and make the necessary repairs.

Service station attendants fill vehicle fuel tanks and replenish engine oil. They check tire pressures and fluid levels in radiator, battery, and hydraulic systems. Periodically, they drain and replace engine oil, lubricate the chassis, and install anti-freeze in the customer's vehicle. They maintain cooling and exhaust

systems, change tires, and replace lights, belts, and spark plugs.

Radiator repairers clean, test, and repair the cooling systems of vehicles. They test the radiator, motor block, hoses, and pump for leaks under pressure; repair and install hoses, thermostats, and pumps; solder radiator cores; and clean the complete cooling system.

Auto-Body Repairers

Auto-body repairers are employed on a combination of welding and sheet-metal work on cars, trucks, and buses which are damaged through accident or corrosion. They straighten bodies, fenders, and frames, beat out dents, and replace parts damaged beyond repair.

Most auto-body repairers work in specialty body shops that repair collision-damaged vehicles or in the service departments of motor vehicle dealers. Others carry out repairs on fleets of cars, trucks, or buses owned by private companies.

The first task of repairers or service representatives is to prepare a cost estimate for the customer — usually an insurance company. They determine visible damage, check the alignment of the chassis, steering gear, and frame and decide which parts are to be repaired or replaced.

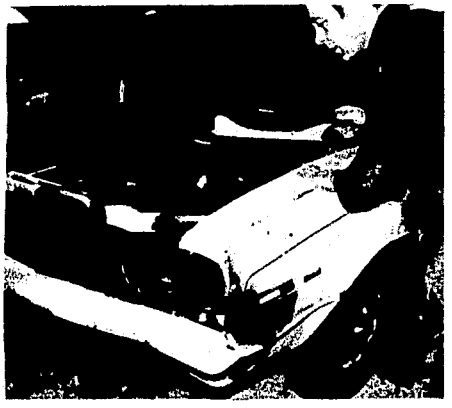
Chrome trim, lamps, grill sections, and parts of the upholstery are removed, either because they are damaged or would interfere with repair operations. Repairers then remove damaged or corroded sections of sheet metal by unbolting or by cutting with a pneumatic gun or a welding torch.

Damaged parts, such as fenders, are forced back into shape with hydraulic jacks, prying bars, and a power-operated tool called a "dozer", together with large pneumatic or hand hammers. The metal is then "bumped" with smaller hammers to a more accurate shape. It is often necessary to "shrink" the metal by repeated heating with an acetylene torch and cooling. To remove dents and ripples, further bumping is done while the metal is backed with steel or wooden "dolly" blocks. Low spots and depressions are tapped with a "picking" hammer and are filled with solder or plastic compound which repairers file and grind with power-sanding discs until they are smooth.

Constant checks are made for correct alignment, body contour, and door curvature using rules, calipers, and dividers, although experienced repairers often rely on their ability to judge these features by eye.

Various cracks may be welded, and replacement sections of sheet metal, which the repairer has cut to size and partly formed on the bench, are secured in position by welding or by riveting.

New parts, including grill sections, locks, striking plates, and door handles, are installed, and the repairer checks the installation for correct functioning. In addition, cracked or broken glass is replaced in door and window frames, and any necessary repairs are made to the



seats and upholstery. The repaired areas and replacement sections are then coated with priming paints and smoothed with electric sanders, and the finishing coats of paint are applied. This latter job may be done by spray painters.

Most auto-body repairers are trained through an apprenticeship program. Their work is heavy and sometimes dirty, and they must be able to stand, kneel, and bend for long periods.

Some body repairers advance to supervisory positions while, in the larger repair shops, they may become estimators or service advisors. The position of assessor or adjustor with an insurance company is another possibility, or they may establish their own shop.

HEAVY-DUTY (DIESEL) REPAIR OCCUPATIONS

Diesel engines today power buses, heavy trucks, farm tractors, railway locomotives, marine and naval vessels, and pleasure craft. In the construction field, diesel engines are used in heavy earth-moving equipment and for drilling, hoisting, and material handling. They are also used in electrical power-generating stations and in small factories, oil drilling rigs, pumping stations, mines, logging camps, and other establishments which are isolated from the usual power sources.

Diesel Mechanics

Many large companies and governments operating their own garages or repair shops hire diesel mechanics to carry out service and repair work on buses and heavy trucks.

Diesel mechanics, sometimes called bus mechanics or heavy-duty mechanics, are basically motor vehicle mechanics who work on vehicles of a much larger scale, sometimes with the aid of a helper. Although they handle breakdowns their main task is to prevent them from occuring through "preventive maintenance routines".

All buses and most transport vehicles are taken off the road when they have covered a certain mileage. The brakes, steering gear, tires, and other parts are examined or tested for faults. Certain units are removed from the vehicle and are stripped down and examined for defects which could cause breakdowns.

Considerable reconditioning work is done in the transport company's garage or in a repair and machine shop attached to the garage because of cost, vehicle size, and other factors. As a result, mechanics in heavy vehicle garages are often engaged in one branch of maintenance such as engine overhaul, wheel alignment, transmission system servicing, machining, welding or body repair.

Diesel repair mechanics usually receive their training through an apprenticeship program. Others may first train as motor vehicle mechanics and then qualify for work on diesels through additional on-the-job training.

As in other repair occupations, diesel mechanics perform work that is greasy and oily and that requires sustained physical effort. Repair shops, however, are well equipped

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with the latest in hoisting equipment and power-operated tools to lighten the work. Occasionally mechanics may be called out to a breakdown on the road and have to contend with poor weather conditions. Some shift work can be expected, particularly if they are employed on buses and other public utility vehicles.

It is possible for mechanics in fleet garages to move into the planning office as maintenance scheduler or into the operations office as dispatcher. In the garage, they may become chief mechanic, supervisor, or shop supervisor.

Heavy Equipment Mechanics

Equipment used in construction, mining, logging, and farming is repaired and maintained by heavy equipment mechanics who service all heavy-duty components and systems. This work is usually done in major repair depots while emergency repairs are often attended to at the work site.

Construction Equipment Mechanics

Construction equipment mechanics must be versatile for, in addition to carrying out maintenance duties, they must understand the principles of gasoline and diesel power and the auxiliary units of mobile and stationary earth-moving and material handling machines. These include trucks, bulldozers, draglines, air compressors, loaders, portable power plants, and concrete mixers.

On the construction site, mechanics carry out routine maintenance such as engine tuning, adjustment of fuel-injection systems components (or the carburation systems of gasoline engines), wheel or track changing, steering and brake adjustments, and similar running repairs.

In the repair shop, the work includes bench fitting such as dismantling and assembling major units, pinfitting, valve servicing and overhaul; tuning the engine and related carburetors, fuel pumps, and governors; and adjusting or servicing distributors, generators, alternators, starters, steering systems, brakes, and power trains. In addition, they service, maintain, and overhaul power control units, winches, heavy-duty clutches, transmission system shifts, torque converters, sprockets, and grousers, drive lines and differentials, and the blades, shovels, and other material-handling units of construction machinery.

In general, though training patterns may differ from province to province, construction equipment mechanics learn their trade through apprenticeship. In fact, many of the larger construction or equipment rental companies provide their own apprenticeship programs.

Maintenance of construction equipment is a strenuous job, and on-site mechanics often work long hours and in all kinds of weather during

the summer months. Those who work in the major repair depots, however, encounter much easier working conditions. Sometimes they are required to live at the construction camp, but there is usually compensation in bonus pay. Construction equipment mechanics may specialize or they may move up to site supervisor, shop supervisor, or field service engineer.

Farm Equipment Mechanics

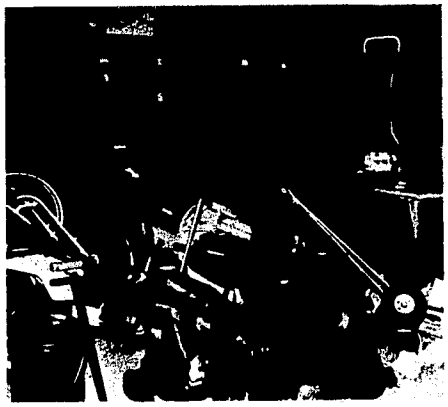
Farm equipment mechanics repair the electrical, mechanical, and hydraulic systems on tractors, tillage and harvesting machinery, and auxiliary equipment, usually working in the service shop of a retail farm machinery and equipment dealer. Their duties are similar to those of heavy vehicle mechanics in that farm machinery is also equipped with diesel engines. During the planting and harvesting periods, when machinery is in constant use and a breakdown could mean a great loss to the farmer, mechanics work long hours and must be skilled in making quick repairs. In the off season, they are occupied with the major overhaul and inspection of vehicles.

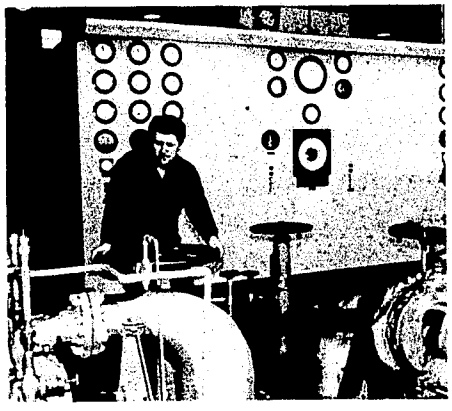
Power Engineers

Power engineers ensure the safe and efficient operation of the oil, gas, electrical, or coal-fired plants and the turbines, condensers, and generators which provide heating, air-conditioning, or refrigeration in buildings or which are used as a source of mechanical or electrical power. Depending on the province, these workers may be called stationary engineers, operating engineers, stationary enginemen, and engine operators, although the title "power engineer" is gaining use in most provinces.

They are employed in pulp and paper mills, oil refineries, food processing plants, electrical generating stations, public buildings, hospitals, schools, hotels, and industrial and manufacturing plants.

In smaller stations, power engineers observe gauges, record instrument readings, and check such factors as fuel consumption, feedwater treatment, water supplies, and steam pressures. From these data, they ensure efficient operation of the plant by adjusting levers, switches, valves, and various control devices. In addition, engineers are required to detect and locate faults and carry out periodic maintenance routines. They must supervise fueling operations, the oiling and greasing of moving parts, and the removal of





NATURE OF WORK

scale from boiler walls. The dismantling and overhaul of major units would likely be done, under the direction of a chief power engineer, by electricians, diesel mechanics, machinists, and welders.

Because of the progress that has been made in power engineering, a number of institutes of technology have established training programs; these usually require high school graduation for entrance. Some are about six months in length and lead to licensing examinations and employment. Others are two – or three-year programs which cover the field in more detail and prepare graduates for a more advanced level of employment.

Other potential engineers work in a power plant as a helper or fireman, and under the guidance of qualified engineers, learn to operate, maintain, and repair stationary equipment. As well, they follow a program of study that prepares them for licensing examinations. Most power plants operate on a 24-hour basis, requiring rotating shift work. As the necessary licenses are obtained, power engineers can move up the line from fourth-class engineer, to assistant or chief shift engineer, to chief operating engineer.

Marine Engineers

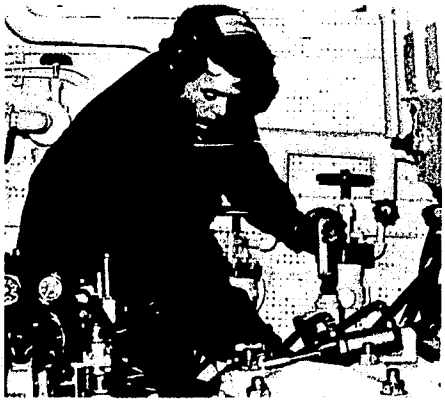
Marine engineers co-ordinate activities of the engine-room crew and are responsible for the operation and maintenance of the engine-room plant and machinery used in ships. This covers the generation and transmission of power for the auxiliary equipment used in lighting, heating, refrigeration and ventilation, the pump systems, steering gear, and machinery such as hoists and winches. Most vessels today have steam turbines or diesel engines, either as the main source of power or for the auxiliary equipment, and the marine engineer must be able to work on both types of engine.

The main field of employment is on freighters, tankers, cargo carriers, passenger ships, and ferry boats that sail the Pacific and Atlantic coastal regions and the inland waters of the Great Lakes and St. Lawrence Seaway system. Marine engineers are also employed with fishing fleets – mainly in Newfoundland, Nova Scotia, and British Columbia – working in shipbuilding or repair yards on supervisory duties or on readying vessels for service. An expanding field for marine engineers is the Canadian Coast Guard Service, which operates a fleet of vessels for ice-breaking, northern supply, and search and rescue. The Ministry of Transport employs a number of specially qualified marine engineers in Ottawa and in regional offices to implement safety and other regulations.

On board ship, the standing duties of marine engineers and related staff include the following: engine-room watch; regulating the amount of water to the boilers; supervising fueling operations; lubricating moving parts; operating controls which start, reverse, stop and regulate the speed of the vessel; and keeping watch on dials and gauges which record pressures, temperatures, and other indications of the engine's performance.

In addition to operating duties, marine engineers are actively engaged in maintenance or mechanical repair functions or in directing crew members in this work. They keep major breakdowns to a minimum by organizing periodic routine examinations of the machinery and mechanical equipment. Where possible, parts showing signs of wear and similar defects are replaced with spares, and the defective part is repaired in the ship's workshop. Facilities in the workshop vary with the size and type of ship. Smaller ships are equipped with handtools and perhaps a drill press and a lathe, while the larger ships have well-equipped machine shops.

Major overhaul and certain periodic maintenance routines are carried



out in the ship's home port. Marine engineers must supervise or actually undertake any mechanical repairs while the vessel is docked. Any damage sustained on the voyage must be attended to; worn valves and other components are replaced; main engine bearings are examined; diesel engines may be stripped down; drive shafts and similar mechanisms are repaired; and the generators, alternators, and other electrical equipment are overhauled.

Training in the field of marine engineering is available in marine colleges and institutes of technology. A program of classroom instruction is followed by related practical experience and time in the machine shop. Shipboard experience is necessary for marine certification.

Many, after leaving school or on completion of an apprenticeship program as a machinist, may go to sea as an oiler or junior engineer. While learning the job under the direction of marine engineers, they follow a program of studies which may include correspondence courses and full-time attendance at a training school.

The number of engineers on a ship depends on its tonnage, type of power plant, and class of voyage. On an average 5,000-ton steam ship, there would be a chief engineer (with second-class certificate), a second engineer, and two or three assistant or shift engineers (with third- or fourth-class certificates).

Work in the engine room of a vessel can be strenuous, noisy, and very warm. The practice of "standing watch" is followed in the engine room and on deck, so that engineers may actually work as much as a 56-hour week. There are regular shore leaves but prolonged absences from home can be expected.

Advancement to chief engineer in this field depends on the certificates held and the number and size of vessels operated by a company. On land, there are managerial and administrative positions in marine inspection services, the federal government, ship-building and repair yards, and with insurance companies.

INDUSTRIAL REPAIR OCCUPATIONS

Many mechanics are employed in manufacturing, industrial, and similar establishments, or in the railroad, marine, and other branches of transportation. Of the many mechanical repair occupations, a number have been selected for description which are found in industry or where the skills can usually be transferred from one field of work to another.

Although all mechanical tradesmen require an interest and ability in mechanics together with skills in the use of hand and machine tools, a few of those in manufacturing or similar companies are employed under a somewhat different set of working conditions than mechanics in trade and business occupations. Several of the occupations described may appeal to those who prefer to work as part of a team in a fixed place of employment.

NATURE OF WORK

Millwrights (Industrial Mechanics)

Millwrights erect or relocate machinery, while overhaul or maintenance functions are the work of industrial mechanics. Millwrights and industrial mechanics are treated separately in later paragraphs, but there is considerable overlap in their duties.

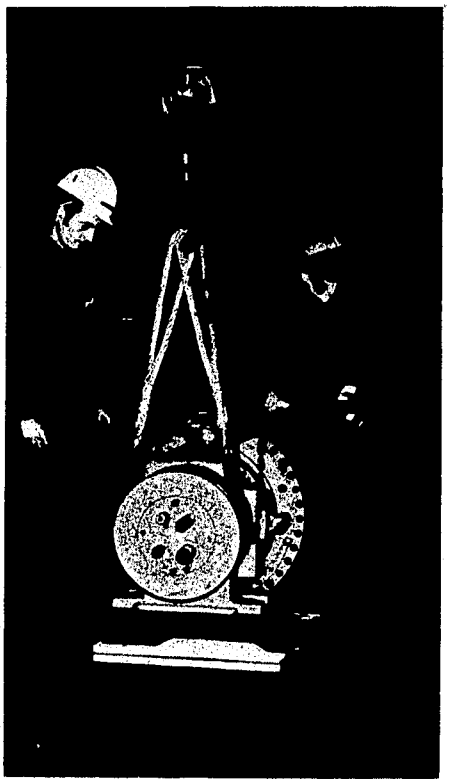
The main fields of employment for both millwrights and industrial mechanics are in establishments with enough production machinery and sufficient development and maintenance work to provide employment of a permanent nature. These include primary iron and steel plants, machinery manufacturing concerns, automobile factories, chemical plants, building or heavy engineering construction firms, and most of the smaller manufacturing plants.

Millwrights are skilled mechanics who move and install heavy industrial machinery. In a typical moving job, a foundation is prepared at the new site. Concrete may have to be poured into wooden forms or the foundations may be of wood, metal, or other materials depending on the type of machine, its weight, and function. When existing machinery is being removed to make room for new machinery, securing and hold-down hardware must be released and component parts dismantled. Notes and sketches are prepared for use when the machine is reassembled.

The machine is then moved by overhead crane, block and tackle, dollies, rollers, slings, or by truck to a new site. It is carefully lowered onto its prepared foundation, the alignment is checked with spirit levels, plumb lines, or optical devices such as the surveyor's transit and level, and necessary adjustments are made. The machine is then secured to studs or similar fasteners embedded in the foundation.

Those parts of the machine which were dismantled for transport are then reinstalled from notes or drawings made by the millwright or from engineering drawings. Such items as bearings are fitted, shafts installed and aligned, belts spliced and connected, and motors attached. Any parts found to be below standard during dismantling operations are replaced from stock or may be repaired by the millwright.

In moving heavy machinery, the millwright, either assisted by other workers or acting as a supervisor to a team of workers, plans the method and sequence of operations and must select lifting and other work aids. To reinstall those parts which were dismantled and to put the machine into operating condition requires the use of handtools and micrometers, verniers, dial indicators, or similar measuring devices, and a thorough understanding of the machine, its functions, and method of operation.



As well, millwrights may repair or maintain conveyors, pumps, cranes, hoists, and similar industrial equipment; oil and grease machinery, repair belts, and shafting; or they may form part of a team undertaking maintenance routines to keep a production line operating. They must be versatile, and have a knowledge of drafting, machining, fitting practices, pipefitting, and electrical work or, at least, must have sufficient knowledge of building codes, safety regulations, and job requirements to supervise workers in these trades.

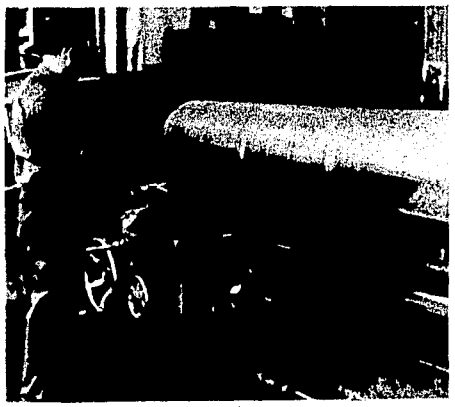
Industrial machinery mechanics service, repair, and overhaul machinery and mechanical equipment used in manufacturing plants.

The work done by such mechanics depends on the types of machine used in a particular plant. In an automotive plant, for example, "heavy" machines such as stamping presses, drop hammers, multiple drills, and lathes are used which demand high standards of workmanship and mechanical ability plus a knowledge of hydraulic, pneumatic, and electrical principles. In a box-making factory, ma-

chines that cut, fold, and label boxes in a continuous operation rely on complicated geometrical mechanisms, and the intricate knitting and weaving machines used in textile factories must be served to limits of accuracy measured in thousands of an inch. In other plants, of course, the machinery may be relatively simple, and here the work of millwrights is usually combined with machinery repair work.

Most mechanics are engaged in preventative maintenance routines and in providing emergency repairs and major overhaul. Periodically, machinery is lubricated and examined for wear and other defects which could lead to breakdowns. Less frequently, some dismantling is done to allow examination of the components and to permit parts replacement.

Although these routines keep breakdowns to a minimum, abnormal conditions such as incorrect operation and metal fatigue may result in stoppages. Mechanics find the fault and get the machine back into production. They make adjustments, repair defects, or install replacement parts which may necessitate dismantling the machine. This requires a thorough knowledge of machine operation and skill in the use of hand and power tools and precision measuring devices such as micrometers, dial indicators, and vernier calipers. Other skills such as welding and brazing may also be required. At major overhaul periods, parts are examined for defects, repairs are undertaken, and necessary replacements made. Operating tests are conducted to check such factors as end play, chain alignment, and vibration.



Apprenticeship is one of the usual methods of training for millwrights and industrial mechanics. Others may have served an apprenticeship as a machinist before going on to repair work; they may have been trained by an employer to take care of the requirements in a particular plant, or they have acquired their skills while working as a helper. In general, millwrights and industrial mechanics are employed in modern and sometimes air-conditioned plants, but their work is usually strenuous, dirty, and oily.

Workers who demonstrate technical ability and leadership may be promoted to supervisor or crew chief.

Refrigeration, and Air-Conditioning Mechanics

Refrigeration and air-conditioning systems in domestic, commercial and industrial establishments are installed and maintained by refrigeration and air-conditioning mechanics.

These mechanics work with construction contractors, equipment manufacturers or dealers, and in shops which specialize in repair and maintenance services only. They are also on the payroll of commercial and industrial establishments and in the marine, road, and railway branches of the transportation industry.

Most opportunities for refrigeration and air-conditioning mechanics are in the installation and maintenance of commercial and industrial systems. Refrigeration plants, for example, are used in dairies, meat-packing houses, curling and skating rinks, and warehouses. Air-conditioning systems are used in instrument-making laboratories and areas where large computers are installed, or in theatres or other large buildings where people congregate.

Refrigeration mechanics' work is similar to that of gasfitters, plumbers, and pipefitters.* From drawings and other instructions, they install pipelines through which the refrigerant will pass, make threaded, soldered or brazed joints, and mount regulators, control valves, and similar components. Pumps, compressors, condensors, and other parts are secured to prepared foundations and connected to the pipelines. Electric motors, switches, and sensing units are installed and connected to electrical power sources. Finally, the installation is completed by connecting gauges, indicators, and recording devices.

*These and related occupations are described in Careers in Construction in this series.

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After completing the installation, mechanics test joints for leaks and adjust various components. The system is then charged with refrigerant, and final adjustments are made to ensure the most efficient performance.

Air-conditioning mechanics work on two general types of equipment — "packaged" units and remote installations. Packaged units, as the name implies, are self-contained within a single cabinet and come in various sizes, from small units used to cool a room to the large size found in restaurants and stores. Remote installations have similar cooling units but these are usually much larger and are placed outside the space to be cooled, and air ducts lead to the air-conditioned space.

Installation work is similar in some respects to work on refrigerating plants because the cooling units used are basically the same. Since sheet-metal ducting is used, mechanics require a knowledge of ducting systems including air registers, vents, dampers, grills, diffusers, and special air-balancing or mixing units. In addition they must have an understanding of air-conditioning components including electronic air cleaners, humidifiers, filter banks, odour absorbers, and controllers. The latter range from simple on-off switches to complex systems incorporating electrical, pneumatic, and combined sensing elements together with their corresponding actuating devices.

Some maintenance procedures are applicable to both refrigeration and air-conditioning systems and include periodic lubrication, leakage tests, replenishment of refrigerant, replacement of filters, adjustment of valves and other components, and general preventive maintenance routines.

Should a breakdown occur, refrigeration and air-conditioning mechanics must find the reason using thermometers, gas leakage testers, pressure gauges, and electrical test equipment, and make repairs. They must as well have a knowledge of pipe-fitting practices, sheet-metal work, and building codes.

Apprenticeship is the usual method of training for refrigeration and air-conditioning mechanics. However, units being installed in plants for commercial and industrial uses are becoming increasingly complex, and those wishing to advance should consider the programs offered by trade schools, institutes of technology, and community colleges.

Mechanics employed on installation of systems in new buildings are exposed to extremes of temperature, and the work is strenuous, involving lifting and positioning heavy parts and assemblies. Those who also service and repair existing systems may have to make emergency repairs at all hours.

Skilled mechanics can advance to supervisory positions, or they may become troubleshooters on construction sites, searching out and looking after technical problems.

Instrument Technicians

A wide variety of instruments are used to measure speed, weight, flow, specific gravity, temperature, and density in the control or automation of industrial processes. These instruments incorporate mechanical, hydraulic, pneumatic, electrical, or electronic principles and provide work for maintenance and repair personnel in jobs requiring mechanical ability, manual dexterity, and some kowledge of scientific principles.

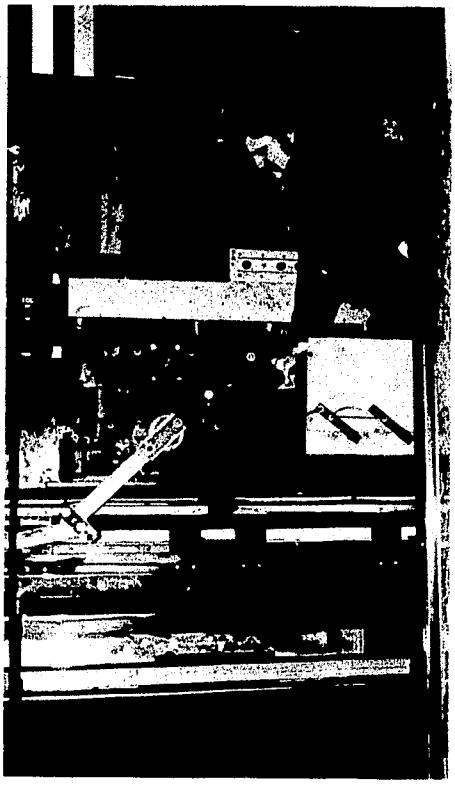
Employment may be found in most industries and in plants which either make instruments or provide repair and overhaul services. These include petroleum refineries, pulp and paper mills, electrical and gas utility companies, and automotive and aircraft industries, and chemical plants.

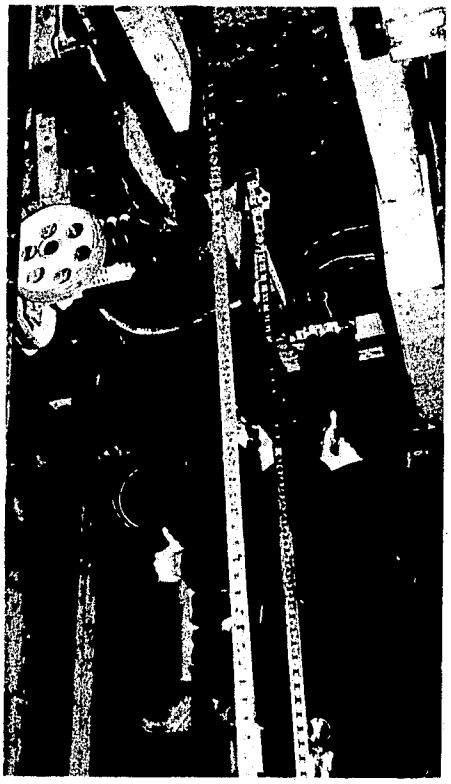
Instrument technicians repair, overhaul, and calibrate precision devices used to measure and record such things as rate of climb in aircraft, presence of gas, and electrical power consumption. In general, they work in two main areas: 1) as part of a team which installs, modifies, or repairs instrumentation systems, or 2) on-the-bench repair of instruments. Typically, they are concerned with installing instruments in control panels and aircraft and making connection to hydraulic, pneumatic, and electrical lines; calibrating instruments for specified accuracy; inspecting and testing instruments to isolate faults; and dissassembling, cleaning, and replacing parts, and reassembling instruments. The ability to concentrate on confined and exacting work is important to success as an instrument technician.

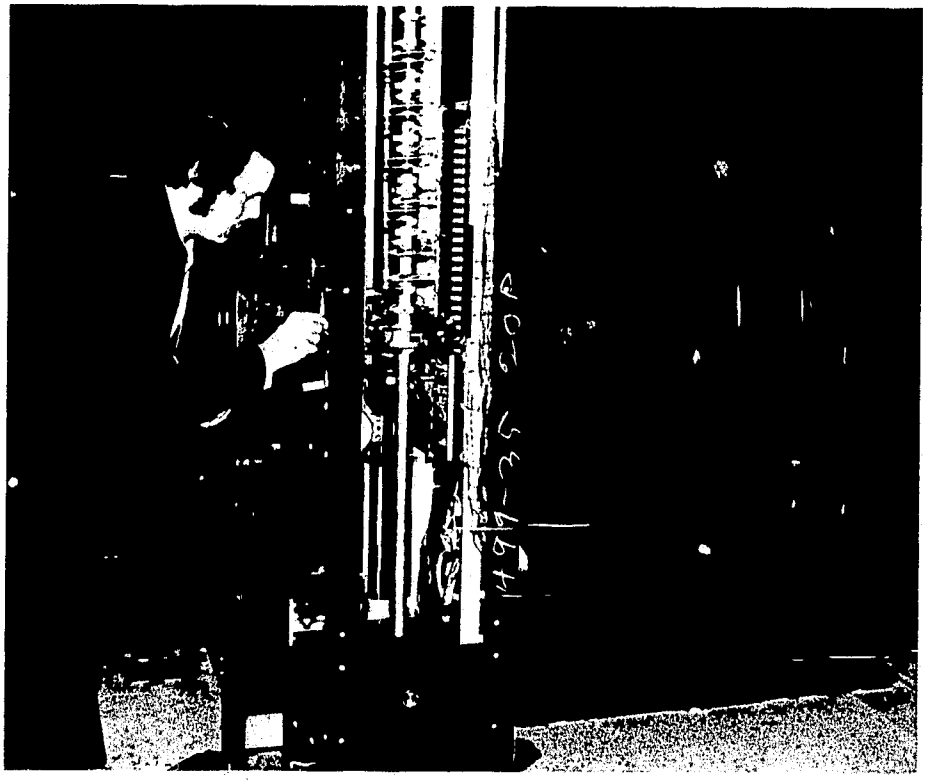
Most instrument establishments are clean, well lighted, and often air-conditioned. However, technicians who service instruments to control manufacturing processes may be exposed to noisy, dusty, or hot conditions.

Some instrument technicians learn their skill through an apprenticeship of an on-the-job training program conducted by a company. The instrumentation field, however, is becoming more complex, and those planning to enter and to advance in their chosen occupation should make every effort to obtain an apprenticeship or to complete a program of studies at an institute of technology or community college.

As with most industrial occupations, advancement depends on keeping up with the latest technical changes. Positions as supervisors or inspectors are available and, with experience and additional training, may lead to more highly paid work in engineering departments such as the lay-out and testing of consoles and the investigation of technical faults.







Elevator Constructors

The increasing numbers of high-rise buildings which have been constructed in the post-war years for industrial and residential use have created a corresponding increase in the demand for a variety of conveniences and facilities. Of these, the equipment used for vertical transport (passenger or freight elevators and dumb-waiters), inclined lifts (escalators), chair lifts and ski tows, have broadened the field of employment for elevator constructors.

Elevator constructors work mainly for elevator manufacturers who install, maintain, and repair these transport systems. Others are employed by local contractors specializing in maintenance or are on the payroll of business or government agencies.

Assembly and installation of elevator systems is the work of a crew of elevator constructors and helpers. At the building site, they first install the guide rails in the elevator shaft on which the car and its counterweight will travel. At the same time, motor generators and driving and braking mechanisms are installed either at the top of the elevator shaft or in a room next to the bottom of the shaft.

The car and its counterweight are fitted to guide rails, and hoisting cables are attached to the top of the car. Then such items as electrical motors, relays, safety and limit switches, signalling systems, and the electrical wiring are added. Final adjustments are made for safe and efficient operation, and the installation is examined and tested by government inspectors.

Servicing and maintenance of existing systems depends on the policy of the building owner. Maintenance of simple systems may be done by general electricians, elevator

mechanics, or the building supervisor. Complex assemblies used in modern elevators, however, need qualified workers with a thorough understanding of specialized equipment. Building owners usually contract maintenance to the manufacturer who originally installed the system, and this work is carried out by elevator mechanics and adjusters.

Mechanics clean and lubricate moving parts and examine, test, adjust, and replace various components. Typical jobs to ensure safe and efficient operation include the following: lights and operating systems are examined for correct operation; the floor selector controlling the automatic operation of the elevator is tested for correct functioning; electronic door selectors are adjusted for sensitivity; and such items as operating cables are examined for excessive wear.

Specialized personnel such as adjusters carry out the more complex work of setting and adjustment.

Installation and repair jobs require skill in the use of hand and power tools, measuring instruments, and electrical test equipment. Mechanics must understand the techniques of soldering, welding, pipefitting, and steel fabrication.

On a building site, elevator constructors are exposed to all weather conditions, and there is much bending, climbing, and lifting, including working at heights on new projects. Since it takes about 12 to 14 weeks to install an elevator, workers move from job to job frequently. Mechanics working in completed buildings are protected from the weather and their work is less strenuous than that of the construction group but they must often work in cramped and confined areas. Considerable travelling is involved, and elevator repair people are on call outside normal working hours.

Training programs are provided by elevator manufacturers, who usually require high school graduation. These are from two to four years in length, during which time the learner works at the manufacturing plant before being sent to a construction site as a helper. Classroom training usually covers mechanical, electrical, and electronic theory and test equipment. As with most repair occupations, the new employee is required to purchase a tool kit during the training period.

Promotion to supervisor, adjuster, service superintendent, sales representative, and management positions is possible. Positions are also open as inspectors with government agencies and with a few insurance companies.

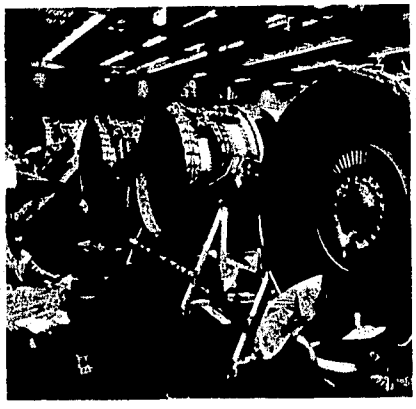
Aircraft Mechanics

The job of keeping aircraft structurally and mechanically sound is given to aircraft mechanics with aeroengine and airframe experience and to such related workers as electricians, radio-radar and instrument technicians, sheet-metal workers, machinists, and welders.

The main fields of employment are with airlines, aircraft manufacturers, and repair and overhaul companies. In addition, there are many small operators running flying schools or engaged in aerial mapping and mineral and oil exploration.

In large overhaul depots, the work is done by aircraft mechanics, called aeroengine mechanics if they work on only the engine, and airframe mechanics if they work on the airframe, and related tradesmen, supervisory staff, and licensed aircraft maintenance engineers. Small aircraft operators or repair shops frequently employ an aircraft maintenance engineer who may work alone or with the help of one or two mechanics. Servicing and maintenance are carried out as detailed in schedules, manuals, and service bulletins prepared by aircraft manufacturers — before flight, after flight, and after a stipulated time or number of flying hours.

Before flight, mechanics examine the aircraft for damage and obvious



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defects. Fuel tanks, crankcases, and hydraulic fluid levels are checked; the landing gear, including wheels and tires, is examined for wear and damage; flying controls are tested for correct functioning; and the engine is ground run to check its performance. When the examination is completed and repairs are made, the aircraft maintenance engineer certifies the aircraft fit for flight.

In overhaul depots, mechanics service and repair aircraft and make modifications as detailed by the manufacturer; they may change the role of the aircraft by fitting skis, floats, or additional seats.

At specified intervals mechanics replace time-expired and defective units and parts including engines, ignition wiring harnesses, and tires. Units which have been removed are overhauled in separate shops by mechanics specializing in such functions as engine overhaul, landing gear assembly and testing, and piping systems. Other specialty shops carry out radio and radar servicing, painting, and upholstering.

Mechanics, engineers, and other ground staff who service aircraft on airfields are exposed to all weather conditions. Maintenance personnel carry out strenuous work and must heed strict safety regulations.

Most aircraft mechanics are trained on the job, and technical high school graduation with good standing in mathematics, physics, and chemistry is desirable. Full-time training programs are available in a number of community colleges and institutes of technology. These are of two or three years' duration and are designed to meet the licensing requirements for engineers. Qualified workers may advance to supervisory positions. Mechanics who meet Ministry of Transport qualifications and pass the qualifying examination may become aircraft maintenance engineers.

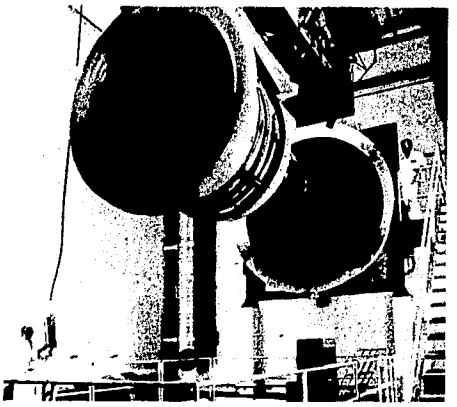
Aircraft Maintenance Engineers

The work of aircraft maintenance engineers is similar to that of aircraft mechanics in that they are concerned with the servicing, repair, and overhaul of the aircraft power plant (engines), airframe, and installed systems and equipment. Any or all this work may be done by engineers, however, who concentrate on fault diagnosis and the inspection and testing of the various systems for correct performance.

Before aircraft maintenance engineers can work in their field they must qualify by examination for a specific licence, issued in Canada by the federal Ministry of Transport. There are categories, depending on the area of repair and the part of the aircraft on which they work.

In general, aircraft engineers will be in the hangar or workshop inspecting work in progress and directing support workers. Frequently, however, they must work outside when the aircraft is checked for flight and for repairs.

The recommended route to qualify as an aircraft maintenance engineer is to complete high school and then follow a two- or three-year program at an institute of technology or trade school. Programs are designed to provide advanced knowledge and skill, required to meet licensing requirements. It consists of courses in drafting, metallurgy, theory of flight,



airframes and aircraft engines, welding, and the operation of a repair station. Practical experience is usually acquired through summer employment with an aircraft operator.

Graduates must work for about two years in a branch of aircraft repair – fixed wing aircraft, for instance – before sitting the Ministry of Transport licensing examination. Licences to work in other branches of the industry are available after additional study, experience in the branch, and the passing of qualifying examinations. Many engineers have acquired their practical experience by working as an aircraft mechanic and, through part-time study, have gained the required academic knowledge to be eligible for licensing.

Engineers may go on to supervisory positions in inspection, production, and maintenance departments.

TRADE AND BUSINESS OCCUPATIONS

Department stores, fuel supply companies, office equipment suppliers, sporting goods dealers, hardware stores, and other sales outlets employ workers in mechanical repair occupations to provide their customers with "after-sales" servicing and repair facilities. This work is done either in the customer's home, in a department of the retail store, in service centres operated by distributors and manufacturers, or in independent repair shops.

Employment opportunities exist in all parts of the country, with a large concentration in big cities.

Although service people are employed on different kinds of equipment, their work is similar in that all require analytical ability based on an understanding of mechanics and general fitting practices, related sciences such as hydraulics and electronics, the theory of the trade, and mathematics. A knowledge of basic electricity, particularly the ability to solve equations from circuit diagrams, is important.

On-the-job training is the usual method whereby workers enter this occupation. In most provinces, courses in this field are being added to the curricula of vocational schools, community colleges, and institutes of technology.

In all repair work, skill with the hands and hand tools is important. Service people must be able to retain the customer's confidence in their product and in their employer.

In a number of occupations included in this section there are opportunities to become self-employed – it is possible to open one's own business for those with sufficient capital.

Appliance Installers and Repairers

The modern homemaker uses a wide variety of appliances. Servicing and repairing these appliances, either in the home or in the repair shop, is the work of appliance installers and repairers.

Although they usually specialize in one "brand" or in certain groups such as major appliances (washing machines) or small appliances (toasters), their work is similar in that all are concerned with investigating customer complaints and providing remedial services. Independent shops offer service or repair facilities for a wide variety of types and brands of appliances.

With a defective appliance, the first step is to obtain a report from the customer. Obvious faults such as inadequate electrical or gas power supplies, frayed electrical cords, and other visible defects are rectified. An experienced repairer can also detect faults from grinding sounds (faulty gearing), loud humming (possibly a faulty motor), or other abnormal noises.

It may be necessary to dismantle the appliance so that the mechanical parts can be examined. This calls for skill in the use of pliers, wrenches, and screwdrivers or special hand tools. Additional checks may be required of the electrical circuits, fuel efficiency, temperatures, dial and indicator settings,

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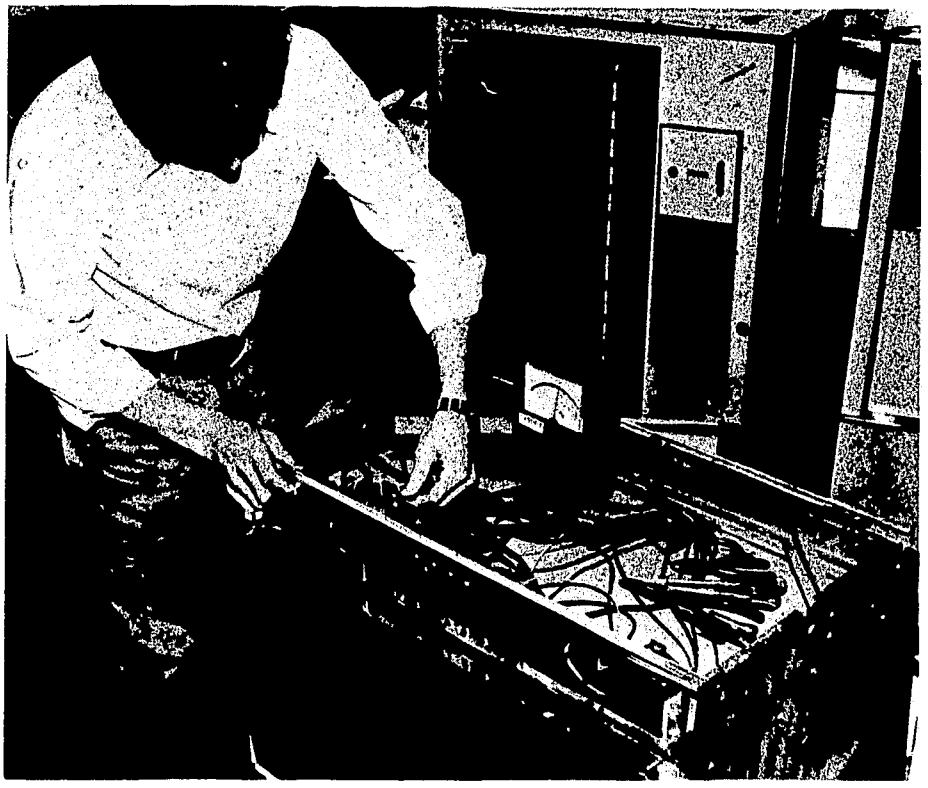
or timing cycles.

Most of the repair work done in customers' homes is accomplished by substituting replacement parts for those that are defective. Items which have been removed are returned to the store or forwarded to the manufacturer for overhaul. This provides a field of work for bench workers who usually specialize in one job.

Major appliance repairers work primarily in customers' homes installing or repairing laundry equipment, stoves, refrigerators, and other large appliances. Installation consists of assembling those units which were dismantled by the manufacturer for shipping. Connections are made to electrical power sources or to gas lines, and such work as ducting installation or piping attachments to water or waste outlets is required. The appliance is then checked and the user advised on such features as the load capacity of a washing machine or the purpose of various controls.

Repair of major appliances requires skills in the use of a wide range of hand tools, small power tools, and testing devices. Major appliance installers and repairers, or their helpers, drive a light truck or car, keep records of parts used and hours worked, estimate costs, and may collect fees. They may also be engaged in the sale or promotion of new equipment. This requires a knowledge of small business practices, bookkeeping, and provincial or municipal regulations.

Small appliance repairers are employed in repair shops or the repair section of a retail store. They dismantle, repair, and overhaul such small appliances as frying pans, food mixers, and toasters. Depending on the employer's business, the



repairer either services a wide range of equipment or specializes in one — lawn-mowers, small power tools, vacuum cleaners, or sewing machines.

Repair procedures used by small appliance repairers are similar to those used by major appliance repairers. However, small appliances usually have simpler controls and fewer working parts.

The appliance repairer begins either as a helper or trainee, or, in some provinces, through an apprenticeship program. Classroom courses are provided by local distributors or manufacturers when new appliance models are placed on the market.

The length of time required to become fully efficient depends on the ability of the worker. Two or three years are usually necessary before a major appliance repairer is assigned to a district; small appliance repairers require about a year.

Major appliance repairers enter many kinds of homes and repairs may be done in awkward surroundings. Workers in sales outlets maintain normal store hours, and some repairers may be required to answer emergency calls outside these hours.

Opportunities for advancement include supervisory jobs in the larger repair shops and customer service manager in a sales outlet.

Heating System (Domestic) Installers and Repairers

The householder today has the choice of three heating systems — oil, gas, or electricity. Usually the type of system to be installed in a home is decided before construction begins since provision must be made for such structural features as oil tank location, ducting, and electrical wiring. This is done by heating-system mechanics working with architectural and engineering designers, plumbers, pipefitters, and other skilled workers — these are described in the booklet "Careers in Construction".

Domestic heating systems must be serviced to prevent breakdowns and to keep fuel costs at a minimum. This is the work of service people who specialize in either fuel-oil or gas-fired installations and who provide emergency repair services. Electrical heating systems are maintained by those trained in electricity rather than in mechanics.

Oil Burner Technicians

Fuel-oil suppliers, who provide their customers with servicing contracts, offer the main field of employment for oil burner technicians. Others are employed in independent shops where they work under contract to the fuel-oil suppliers or build up their own clientele.

Throughout the summer months, oil burner technicians travel to customers' homes using a truck fully equipped with tools, testing equipment, and spare parts. In the home, they clean, lubricate, and adjust the heating system components and replace fautly parts.

Major assemblies such as the oil burner are dismantled for servicing, fuel filters and air screens are either cleaned or replaced, motors are lubricated and tested for continuity or resistance, igniters are examined, and fuel nozzles are cleaned. Other assemblies including the flue pipes, chimney base, and heat exchanger

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are cleaned, pumps are purged of air, and leaking gaskets are replaced. Finally, tests are made to ensure that the system is working correctly.

Entry into oil burner occupations may be either through an apprenticeship program or by working under the direction of experienced tradesmen. There are now increasing numbers of preparatory courses available in vocational schools, community colleges, and institutes of technology. The average learning period is about two years for those who have taken pre-employment courses. In several provinces, oil burner technicians are required to obtain a provincial licence, renewable annually.

This is a time-consuming occupation which may appeal to those who prefer to work with a minimum of supervision, enjoy meeting people, and like to move around. Technicians in this field often work in very cramped quarters and may be on call for emergencies.

Prospects for advancement to service supervisor are good for those with above-average skills, and a number of these workers have opened their own repair businesses.

Gas Heating System Repairers

Gas heating mechanics service domestic installations or install, repair, and maintain gas systems in factories, businesses, and other large buildings. They are employed by large utility companies and home-heating contractors.

On an emergency call, the gas-heating system mechanics drive to the location in a truck equipped with testing equipment and spare parts. Such features as the pilot light may be examined, pipelines may be tested for leaks, and the electrical controls and fans cleaned and adjusted. With gas-fired installations, emphasis is placed on safety, and servicing can be done only by those who are provincially licensed.

Watch and Jewellery Repairers

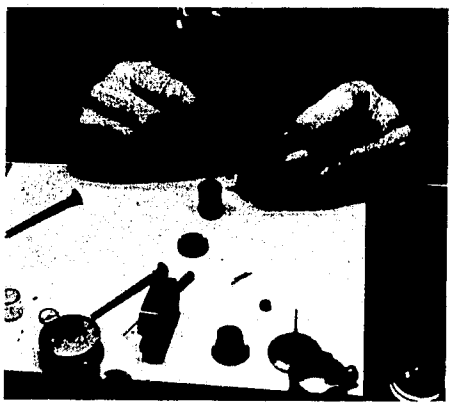
Continued developments have taken place in accuracy and design so that the modern timepiece is a highly complex mechanism which is vital to business operations, aircraft and ship navigation, television programming, and so on.

Timepieces must be lubricated and require periodic overhaul or "conditioning". This is the work of "watchmakers" or watch repairers who may also do engraving and simple jewellery repairs. In the following paragraphs, the term "watch repairer" has been selected although the old title of "watchmaker" is still used.

Watch repairers are employed by department stores, watch and jewellers' stores, and other retail outlets, wholesalers, trade shops, and separate repair shops, a high proportion of which are owner operated.

Typical of the duties in a repair shop are cleaning, lubrication, and the adjustment or replacement of defective watch parts. This is precise, delicate work demanding a high degree of manual dexterity. In sales outlets, the repairer's duties will also include cost estimation and possibly the promotion and sale of new items.

Cleaning usually consists of removing dirty and oily deposits by immersing the complete mechanism

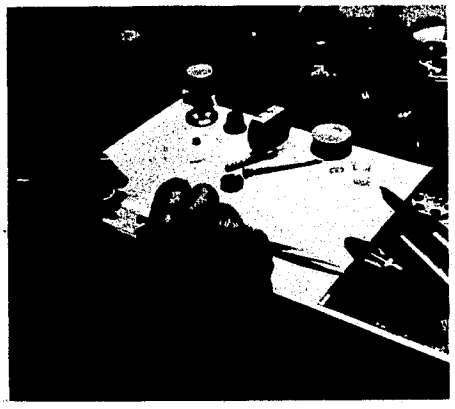


in a solvent bath, or by using an automatic or ultrasonic cleaning machine. Lubricating is done by applying oil on the bearing points.

Conditioning involves dismantling the mechanism into springs, balances, and other subassemblies with the aid of tweezers, pliers, screwdrivers, and similar small hand tools. The parts are then examined through a magnifying lens. Many other parts may require attention. The main spring may be overwound, or the winding mechanism may have become defective. The watch repairer may also repair electrically or electronically operated timepieces, transistorized controls, or timepieces having such units as day-date calendars.

It is normal practice to replace defective parts with new ones from stock. Adjustments may be required to ensure an accurate fit, but with the development of interchangeable parts the need to make new ones has been reduced. When new parts are not available, these must be made by hand. For this work, the repairer must have a knowledge of design drafting, material selection, treatment of metals, and skills in hand shaping with tiles and turning a watchmaker's lathe.

Entry into this occupation may be through either an apprenticeship program or on-the-job training. With both, it is necessary to obtain employment and such openings are limited in number. The route now generally recommended is to take courses offered in a number of trade schools.



The worker in this field must have a steady hand and a keen sense of touch. He must be able to concentrate for long periods of time on very fine work.

Watch repairers may move up to supervisory positions in larger repair shops, and some jewellery store owners require their managers to be experienced watch repairmen. Highly paid work is sometimes available in the scientific and technical fields making or repairing precision measuring equipment. Some watch repairers eventually open their own businesses.

Jewellery Repairers. Retail stores normally provide a customer repair service, offering a field of work for jewellery repairers. Their duties are often combined with selling jewellery, china, glassware, and other products. Jewellery repairers "size" rings (cut them to fit), solder pins and fasteners into position, reset stones in their claws or other mountings, replace clips and links, and clean or remove blemishes from jewellery.

For the more complicated types of repair, jewellery is sent to "trade shops" operated by wholesalers. Special pieces may be made or remodelled by hand; this requires a knowledge of design and of all aspects of jewellery-making — casting metal, shaping by hand, stone setting, polishing, and engraving. Old-fashioned jewellery may be modernized either from the jeweller's own designs or from those supplied by a specialist designer.

The skills of jewellers are also used in jewellery factories, where production is by assembly-line methods. There the jeweller often specializes in areas such as creating designs in metal. Tools and dies will be made from a sample by toolmakers,* and the jewellery manufactured by production workers such as press operators, metal casters, stone setters, polishers, painters, and enamellers.

Jewellery repairers learn this trade through apprenticeship or on-the-job training, though such opportunities for training are now extremely limited. Another method is to take courses through institutes of technology in design, model making, gemstone setting, repair work, metallurgy, finishing treatments, and the science of gemstones.

A high degree of manual dexterity is required for this occupation plus the ability to concentrate for long periods on close work. An artistic sense is necessary for all jewellery occupations, especially design work.

Workers may advance to department head in a trade shop manager of a retail store. Opening one's own business is another possibility.

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*Tool and die makers are described in the publication entitled "Metal Working Occupations."

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Field Service Representatives (Office Machines)

The substitution of mechanical equipment for clerical tasks once performed by hand has stimulated the growth of a group of occupations known as field service representatives or office machine repairers. They are responsible for keeping the equipment in good order and operating at maximum efficiency. Personnel are trained to service a wide range of machines rather than just one type. Because some machines are now electrically operated, a knowledge of electricity is increasingly necessary.

Office machine repairers are employed in the branch offices or service departments of equipment manufacturers and in independent shops, both of which may combine repair work with the sale of new equipment.

These repairers clean, lubricate, and overhaul equipment and, as necessary, dismantle and examine the component parts. In the manufacturers' service department, they are concerned with the manufacturers' products only; in independent shops, or shops where the volume of work is low, they may service several different makes of machines, but usually of the simpler variety.

It is normal practice for maintenance agreements to be made between the customer and the equipment supplier; other machines are supplied on a rental basis.

Office machine repairers are given a specific area to cover and are responsible for the routine check of equipment and for all the customer service calls in their territory. Machines requiring major repair are brought to the branch office location for shop repair. Skill in the use of hand tools, screwdrivers, pliers, drills, wrenches, soldering irons, and files together with micrometers, gauges, volt-ohm-micrometers, and similar testing equipment is a necessity.

Office machine repairers are also on call to make emergency repairs. These repairs, and major overhauls, usually involve dismantling the machine so components can be examined for defects or measured for excessive wear. This requires the ability to read and interpret mechical and electrical diagrams.

Workers are usually trained to service different kinds of machines, including typewriters, bookkeeping and accounting, dictating, and duplicating machines, and photocopiers. As well, machines used for cash registry, mail handling, and time recording require maintenance by office machine repairers.

Most employers, particularly those with planned training programs, consider high school graduation (or equivalent) the necessary entry requirement for work in this field. Preparation for entry into the occupation can be obtained through the increasing number of courses, such as typewriter or duplicating machine servicing, being added to the curricula of vocational schools, and institutes of technology.

Since training is given on the job, it is first necessary to obtain employment as a trainee with a business machine company or repair depot. The length of training depends on the ability of the trainee, but one year is usually the required length. It would take three to four years of working on various types of machines to become proficient on a manufacturer's full range of products. Further training courses are provided by the employer, particularly when new or modified equipment is placed on the market.

Opportunities for those with the

ability to get along with people and with proven merit include positions as supervisor (in charge of seven to ten office machine repairers) and branch or agency manager. Other possibilities include those in sales, as an instructor, or in factory work such as production planning.

Vending Machine Mechanics and Route Servicers

Within recent years there have been significant changes in the methods used to distribute consumer goods and services. Of particular interest to those examining mechanical repair occupations has been the growth, in both variety and numbers, of automatic vending machines. Vending machine mechanics and route servicers maintain and repair these complex machines, keeping them in working order and stocked with produce.

The main fields of employment are with coin-vending machine companies who operate concessions in factories, hospitals, and wherever large groups of people congregate. Other employment opportunities are with companies and concessionaires who sell and service coin-operated equipment in laundromats, dry-cleaning establishments, restaurants, and similar places of business.

Vending Machine Mechanics. Maintenance work is done by vending machine mechanics in accordance with the equipment manufacturer's handbooks. The mechanic first locates and isolates the trouble. Defects such as damaged mechanisms, leaking water or refrigerant pipes, and broken electrical connections are repaired. Defective parts are replaced, pipes may be soldered or brazed, and electrical connections secured. If more repair is necessary, the machine is returned to the concessionaire's or manufacturer's repair department for dismantling and overhaul.

Vending machine mechanics also undertake routine procedures to keep breakdowns to a minimum. Parts are cleaned and lubricated and electrical components removed for bench testing or overhaul.

This work requires a knowledge of mechanical principles, the ability to read mechanical and electrical drawings, and skills with wrenches, hammers, pliers, soldering and brazing equipment, and electrical testing devices.

Entry to this trade is through two or three years of on-the-job training. Employers usually require demonstrated mechanical ability obtained through vocational school training or previous employment. Short training courses are provided by concessionaires and equipment manufacturers.

Workers in this field may advance to senior mechanic or, in large companies, shop supervisor. Promotion to sales or advertising staff is another possibility.

Vending Machine Route Servicers. Vending machines are stocked with food, drinks, or other items by vending machine route servicers. This is primarily a sales and service

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job, and mechanical work is limited to simple repairs. However, this occupation can be considered an entry route to the position of vending machine mechanic.

Each day, route servicers load up a vehicle with supplies. At each location, they clean the machines, ensure that supplies already in the machine are in good condition, and add replacement stock. Visual checks are made of working parts, coin boxes are emptied, and change makers replenished. Machines are then tested for correct functioning. Minor defects found in these tests may be corrected by route servicers, but repair work is usually left to mechanics.

Vending machine route servicers are trained on the job by individual employers or by equipment manufacturers. This work will appeal to those who like moving around and meeting people. Route servicers have an assigned district which they cover, by car or light truck.

Opportunities for advancement in large companies include those of route or shop supervisor. Promotion to sales or advertising staff is another possibility.

Automatic Pinsetting Machine Repairers

Bowling lanes are often equipped with automatic pin setters to do the work formerly done by hand. These are customer-operated machines which pick up the pins in a scissors mechanism, sweep fallen pins and balls into return chutes, position the pins, and return the balls to the next bowler. The machines consist of a number of electromechanical assemblies which are maintained by pinsetting machine repairers and helpers who repair defects which occur while bowling is in progress. Repairers may also service and maintain automatic scoring devices.

To keep breakdowns to a minimum, mechanics carry out a program of routine repairs as outlined in the manufacturer's manuals. These routines include frequent cleaning or lubrication of moving parts, and visual or other checks of belts, springs, and cables. In addition, the motors, selector switches, relays, microswitches, and other electrical parts are cleaned, examined for wear, and adjusted as necessary.

Defects and suggested remedies are given in the maintenance schedule. The mechanic, however, will be confronted by other problems, and a thorough understanding of the principles of mechanical operation and associated electrical systems is necessary to make repairs. Defective parts are usually removed and returned to the manufacturer for overhaul. The mechanic is required to keep records of maintenance routines and to conduct correspondence with the manufacturer to report defects and order replacement parts.

Training for mechanics is through courses of instruction provided by the manufacturer and is usually one to two years in length. Learners must be sponsored by an employer and pass a mechanical aptitude test. Few employers will hire people under 20 years of age. Previous experience or training through vocational schools is an advantage in obtaining employment.

Bowling centres at times can be hot and noisy, and mechanics may be expected to work evenings and weekends. The larger bowling establishments offer opportunities as chief mechanic, supervisor, or manager of the centre.

Gun and Sporting Equipment Repairers

Gun and sporting equipment repairers or "gunsmiths" are employed in sporting goods stores and retail outlets to provide repair and overhaul services. Except for a short period at the outset of the hunting season, the amount of repair work is limited, and the worker is engaged primarily in the sale of sporting goods. Modern guns are guaranteed for a lifetime and are usually returned to the manufacturer if a defect appears.

Damaged and older or foreign-built guns, for which replacement parts may not be readily available, are returned to the gunsmith's store for servicing and overhaul. The gunsmith may fit new sights, remove excessive metallic and powder deposits, make adjustments, and lubricate the gun. The gun may be dismantled for an examination of its internal parts and cleaning. Replacements for broken parts may then be made by hand or machine and the gun reassembled and bench tested.

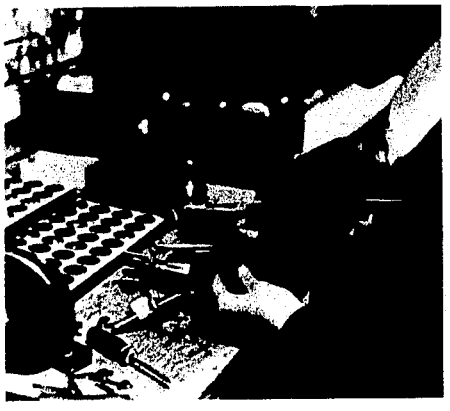
Apprenticeship is the preferable method of training as a gunsmith. Apprentices learn the principles of the craft from a master gunsmith and acquire skill with wood-working tools. In addition, they learn to operate lathes, milling machines, drill presses, boring machines, and grinders, and the techniques of forging, welding, brazing, and soldering. Some workers learn their trade as a spare-time helper to a gunsmith or by working in a retail store where repairs are carried out.

Lock and Safe Repairers

Lock and safe repairers are employed in hardware and other retail stores, or in repair shops attached to the store. Much of their time is spent opening locks for people who have mislaid their door or car keys. More specialized work includes opening safes in banks, opening or adjusting electrical and electronic burglar devices, and repairing locks damaged through force or containing a broken key. They install locks in building doors and frequently fit them with special safety devices.

Various methods are used to open locks, which may range from simple rim or mortise types to highly complex keyless combination devices. Some locks can be opened with master keys and other equipment together with manipulation and considerable "know-how", or experience on the part of the locksmith. Others may have to be drilled or dismantled with nose and core pullers, pin tweezers, probes, and shims. Damaged locks may then be repaired, and the locksmith cuts replacement keys from a stock of blanks in the repair shop.

Expertise in this field can be acquired only through working as a helper to a qualified locksmith. Trainees must expect to spend a year or so on routine work in the repair shop probably by duplicating keys, making keys from codes, and



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fitting keys to locks. Later they will make parts for locks, change combinations, and work on safes. Locksmiths can advance to supervisory positions in large companies or may in time open their own businesses.

Piano Tuners

Piano tuners work in music stores, piano repair shops, and similar outlets or may be self-employed. They service and maintain pianos in homes, schools, and theatres.

Their main job is to adjust the strings of pianos so that they conform to established pitches and relationships. Minor repairs are made such as reshaping hammers and vacuum cleaning the interior of the piano.

Training programs in piano-tuning techniques are becoming available in Canada at the present time under the sponsorship of private companies. Piano manufacturers occasionally have courses of training of one and a half year's duration followed by several weeks in the repair shops. A Grade 12 technical education is preferable as is some music experience.

Certain personal qualities are important to the piano tuner in addition to mechanical ability, in particular, patience, good hearing and excellent tone discrimination. The job involves considerable travelling, and the tuner should have the use of an automobile.

PREPARATION AND TRAINING

Students can begin their preparation and training for entry into mechanical repair occupations through shop courses, which may help them decide what type of mechanical repair work they like best. For those who have left school, both day and evening programs are available in institutes of technology, CEGEPS, and community colleges. These programs provide a usefui background for employment in a number of occupations.

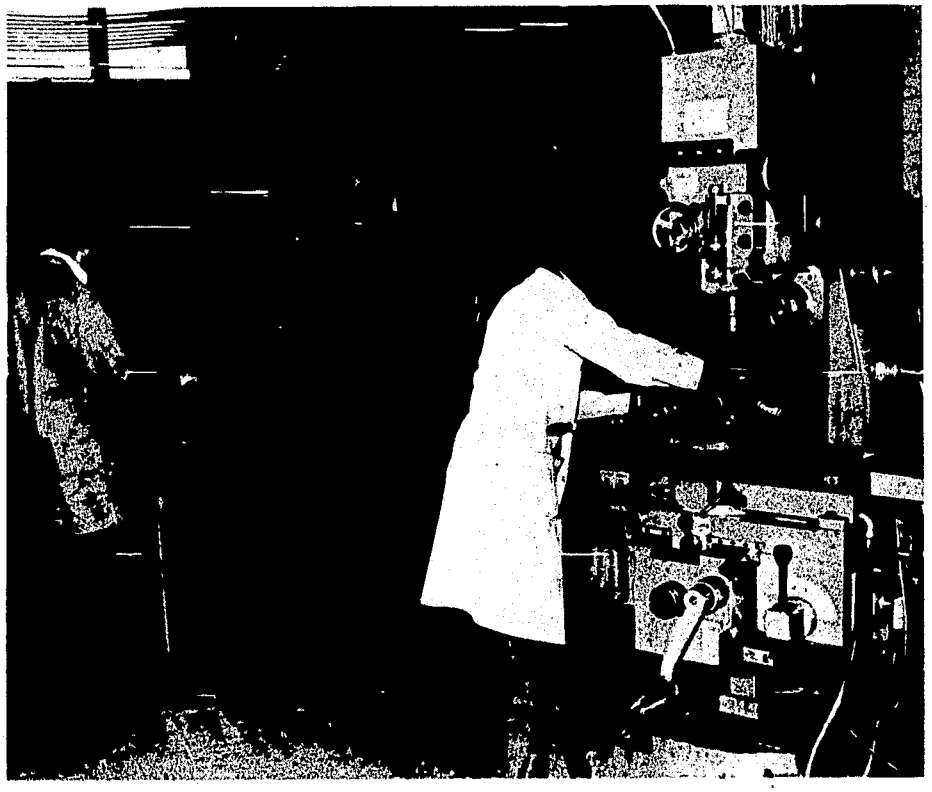
APPRENTICESHIP

Frequent reference has been made to apprenticeship training. This is a form of training where trainees (apprentices) learn their trade on the job under the guidance of qualified workers. A usual feature of this program is that trainees attend trade school for a number of weeks during each year of apprenticeship. This provides a period of classroom instruction in subjects related to their trade and to broaden their work experience. It should be noted that provincial governments have ruled that entry into some occupations is through a regulated apprenticeship program only; 'motor vehicle mechanic' is an example of such an occupation.

To get started it is necessary to find an employer willing to provide a training program. Usually an agreement is drawn up and signed which outlines the obligations of both employer and apprentice and such conditions as duration of apprenticeship and pay scales. Depending on the complexity of the occupation, the training period may be from two to five years. Completion of Grade nine or ten may be minimum education for entry, but employers usually prefer applicants who have completed secondary school.

On completion of apprenticeship, trade tests are given and successful apprentices are awarded certificates of qualification. Inter-provincial standards for examining graduating apprentices have been established for some trades and those who reach these standards are awarded a certificate which enables them to work in other provinces without taking further examinations.

Details of apprenticeship and vocational or other training offered in a particular area may be obtained from provincial Departments of Labour or Education, or from the local Canada Manpower Centre. Financial assistance for training may be available to approved applicants in the form of subsistence allowances and tuition fees.



WORKING CONDITIONS

As you read this booklet you will have noticed the great differences in duties and working conditions of mechanical repairers. These differences appear even within a single occupation, depending largely on the job. A good example of this is the heavy-duty equipment mechanic. One in a repair garage concerned with maintenance usually works an eight-hour day and can live at home; another may be responsible for on-the-job repairs at a construction site and work long hours when there is a breakdown.

Similarly, there is a great variation in earnings. This is due to a number of factors including the size of the shop and the policy of the employer. Geographic location, the degree of responsibility, and the level of training and specialization will affect a repairer's earnings. In addition, a number of workers in repair occupations supplement their income by the sale of new parts.

Readers should refer to such publications as WAGE RATES, SALARIES AND HOURS OF LABOUR IN CANADA, published annually by Labour Canada for current rates in a particular area.

PERSONAL QUALITIES

There are certain attributes, in addition to the personal qualities already given, which make the difference between the ordinary and the outstanding worker. Among these are honesty and integrity, cleanliness and orderliness – many repairers enter homes and other premises – and the ability to identify obscure faults quickly.

It is said that good workers are safe workers, and nowhere is this more true than in mechanical repair occupations. In many instances, they are not only responsible for their own safety but also for the safety of others – aircraft maintenance engineers may be responsible for a multimillion dollar aircraft and the lives of a hundred or more passengers – and must perform all work, down to the smallest detail, in a careful and conscientious manner.

If maintenance work is to be done efficiently, it is also essential that accurate records be kept. While repairers may not be required to do the clerical work, in most instances the information is originated by them – therefore the ability to write a clear, concise report of work done and to keep accurate records is essential.

FUTURE OUTLOOK

Preliminary findings indicate that employment in the occupations discussed in this booklet is expected to grow at a rate approximating the national average for all occupations to 1980, or 2.5 per cent. This means about 13,000 new openings. A high vacancy situation has persisted during the past several years relative to other occupations.

SEEKING EMPLOYMENT

Students while still in school should discuss their future plans with the school guidance counsellors. They are in a position to supply much more detailed information than can be included in a booklet of this size, especially on such subjects as the entry requirements and other details of trade and vocational schools, and training courses which are available in local areas. This is a continuing service, and information can be obtained from the guidance counsellors or placement officers of the Canada Manpower Centre.

Young people seeking their first job, and mature workers wishing to change occupations, can register with the local Canada Manpower Centre, where they will be given every assistance in locating suitable apprenticeships or training situations. These offices can also supply much additional information such as employment prospects, future outlook, working conditions, and pay scales in a particular area.

To obtain an apprenticeship, an applicant can, in addition to contacting the Canada Manpower Centre, pursue any of the following methods: consult the provincial Director of Apprenticeship or the regional Apprenticeship Board; locate an employer who is willing to hire an apprentice; or check want ads in daily and weekly papers. Those seeking an apprenticeship or other employment can also apply directly to likely employers without reference to a particular vacancy, and employment leads can be obtained from friends and relatives already working in the occupations.

RELATED PUBLICATIONS

This booklet in the CAREERS CANADA series has been designed to give you some ideas of the many opportunities in the world of work. To take advantage of these opportunities, it is necessary to plan your future, over as long a period as possible. Other booklets are available or in preparation; you may wish to read several in your career planning process.

Each booklet combines a number of occupations with similar characteristics. Mechanical repair occupations, for example, would appeal to people who, among other things, like working with their hands. You will find in this interest area occupations at various levels of ability; that is, requiring anywhere from Grade nine to one or more years of study after high school graduation.

It may be that after reading some of the material, you will be better able to select certain options which may be open to you in school, or through various training programs.

Such long-range planning, of course, is the ideal, but what about those who have left school or who wish to change occupations? They will need exact information about a particular occupation, and in their province. For this reason, a second series has been prepared under the title CAREERS PROVINCES. This series consists of a number of leaflets, each giving precise details for a single occupation, of preparation and training, of requirements concerning licensing or certification, and of pay scales. CAREERS PROVINCES leaflets are placed in our local Canada Manpower Centres and have been made available for use in high schools and other educational institutions. Because of the need for frequent revision of the material, distribution has had to be limited to these two sources.

As well, there are two standard publications, CANADIAN CLASSIFICATION AND DICTIONARY OF OCCUPATIONS, Volumes 1 and 2, containing, among other things, definitions for 6,700 occupations. These publications can be seen in Canada Manpower Centres, or can be ordered from Information Canada under catalogue number MP53-171/1 or MP53-171/2. The current price is $20 per copy.