

Audel™

**Machine Shop Tools
and Operations
All New 5th Edition**

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**Rex Miller
Mark Richard Miller**



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About the Authors

Rex Miller was a Professor of Industrial Technology at The State University of New York—College at Buffalo for over 35 years. He has taught on the technical school, high school, and college level for well over 40 years. He is the author or coauthor of over 100 textbooks ranging from electronics to carpentry and sheet metal work. He has contributed more than 50 magazine articles over the years to technical publications. He is also the author of seven Civil War regimental histories.

Mark Richard Miller finished his B.S. degree in New York and moved on to Ball State University where he obtained the master's and went to work in San Antonio. He taught in high school and went to graduate school in College Station, Texas, finishing the doctorate. He took a position at Texas A&M University in Kingsville, Texas, where he now teaches in the Industrial Technology Department as a Professor and Department Chairman. He has coauthored seven books and contributed many articles to technical magazines. His hobbies include refinishing a 1970 Plymouth Super Bird and a 1971 Roadrunner. He is also interested in playing guitar, which he did while in college as lead in The Rude Boys band.

Introduction

The purpose of this book is to provide a better understanding of the fundamental principles of machine shop practices and operations for those persons desiring to become machinists. The beginning student or machine operator cannot make adequate progress in his or her trade until he or she possesses a knowledge of the basic principles involved in the proper use of various tools and machines commonly found in the machine shop.

One of the chief objectives has been to make the book clear and understandable to both students and workers. The illustrations have been selected to present the how-to-do-it phase of many of the machine shop operations. The material presented here should be helpful to the machine shop instructor, as well as to the individual student or worker who desires to improve himself or herself in this trade.

The proper use of machines and the safety rules for using them have been stressed throughout the book. Basic principles of setting the cutting tools and cutters are dealt with thoroughly, and recommended methods of mounting the work in the machines are profusely illustrated. The role of numerically controlled machines is covered in detail with emphasis upon the various types of machine shop operations that can be performed by them.

This book is presented at a time when there is a definite trend toward expanded opportunities for vocational training of young adults. An individual who is ambitious enough to want to perfect himself or herself in the machinist trade will find the material presented in an easy-to-understand manner, whether studying alone or as an apprentice working under close supervision on the job.

Chapter I

Power Hacksaws, Power Band Saws, and Circular Saws

Power hacksaws, power band saws, and circular saws are very important to machine shop operations. A large number of power hacksaws and power band saws are in use in the metalworking industry.

Power Hacksaws

A power hacksaw is an essential machine in most machine shop operations. For many years a hand-operated hacksaw was the only means for sawing off metal. Power-driven machines for driving metal-cutting saw blades have been developed to make the task easier. The power hacksaw can do the work much more rapidly and accurately. The machinist should be familiar with these machines, the blades used on the machines, and the operations performed on them. One type of power hacksaw commonly found in machine shops is shown in Figure 1-1.

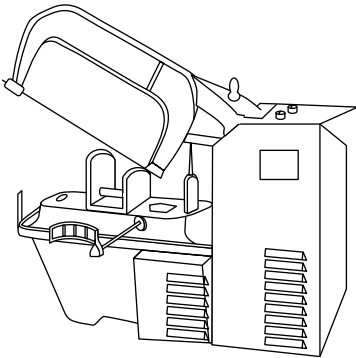


Figure 1-1 Power hacksaw.

Basic Construction

Power hacksaws are designed to make the sawing of metal a mechanical operation. The stock is usually held in a vise mounted on the base of the machine. An electric motor is used to supply power for the machine.

2 Chapter I

Drive Mechanism

The drive shaft is connected by a V-belt and gears to the electric motor mounted on the machine. The drive mechanism is shielded by guards for safety in operation.

Frame

A U-shaped frame is used on the smaller power hacksaws to support the two ends of the saw blade, which is under tension. The heavier machines use a four-sided frame and a thin backing plate for the blade of the saw.

Worktable and Vise

Most worktables are equipped with a vise that can be mounted either straight or angular to the blade. The worktable is usually mounted on a ruggedly constructed base. Many worktables are provided with T-slots for the purpose of supporting special clamping devices.

Special Features

Nearly all power hacksaws raise the blade on the return stroke. This feature prevents dulling of the blade by dragging it over the work as the blade is returned to the starting position.

Another important feature is a blade safety switch that automatically stops the machine if the blade should break during operation of the saw. The safety switch prevents any damage that could result if the machine continued operation with a broken blade.

Coolant System

Some power hacksaws are equipped with a coolant system that delivers a coolant to the hacksaw blade. The coolant passes from a receiving tank to a pump and then to the work. The machine is equipped with a trough to catch the coolant, which may be screened to remove any chips of metal.

Saw Capacity

Small power hacksaws can be used on square or round stock ranging from $\frac{1}{8}$ inch to 3 inches. The larger machines have a capacity ranging to 12 inches (square or round), or even larger.

The capacity of a machine for angular cuts is different from its capacity for straight cuts. The cutting surface is longer for angular cutting. Thus, the saw must be equipped not only with a swivel vise but also with a long enough stroke to make the angular cut.

Blades

High-speed tungsten steel and high-speed molybdenum steel are the most commonly used materials in power saw blades. If only the teeth are hardened, the blades are called *flexible blades*.

Power hacksaw blades are ordered by specifying length and width, thickness, and teeth per inch. For example, they are available in 12" \times 1" length and width at 0.050-inch thickness. The teeth per inch (TPI) would be either 10 or 14. The 14" \times 1" \times 0.050" blade is available in only 14 TPI. Blades also come in 17" \times 1" with a thickness of 0.050 inch and either 10 or 14 TPI. Blades with a thickness of 62 thousandths of an inch (0.062 inch) are usually 1¼ inches wide.

High-speed, shatterproof blades are designed to meet safety and performance requirements. The high-speed molybdenum blades are longer wearing and give the best results for general use. They, too, come in 12-inch, 14-inch, and 17-inch lengths with a 1-inch or 1¼-inch width. These blades are made in both 10 and 14 TPI sizes. Thickness of the metal being cut determines the number of teeth per inch chosen to do the job. There should be no fewer than two or three teeth touching the metal being cut.

Figure 1-2 shows the power hacksaw blade end with a hole for mounting in the machine and the pointed nature of the teeth.



Figure 1-2 Power hacksaw blade.

Hacksaw Operation

Straight cuts are made easily on power hacksaws. The vise is stationary, and the cut is made at a right angle to the sides of the stock.

Most machines are equipped with an adjustable vise. Angular cuts at any desired angle up to 45 degrees can be made by swiveling the vise.

To operate the power saw properly, the work should be fastened securely in the vise so that the blade will saw in the proper place. The blade will break if the work loosens in the vise.

The saw blade should be lowered onto the work carefully to start the cut. On some machines this is done by hand, but it can be done automatically on some saws. In either method, the points of the teeth will be broken or damaged if the blade is permitted to strike the work suddenly.

The machine should be watched carefully to make certain that the saw blade lifts about ⅛ inch on the return stroke. If the blade