

AudelTM
Mechanical Trades
Pocket Manual

All New Fourth Edition

Thomas Bieber Davis
Carl A. Nelson, Sr.



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Vice President and Executive Publisher: Bob Ipsen

Publisher: Joe Wikert

Executive Editor: Carol Long

Development Editor: Emilie Herman

Editorial Manager: Kathryn A. Malm

Senior Production Editor: Angela Smith

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Introduction

Mechanical Trades Pocket Manual is a concise reference for maintenance and mechanical craftspersons. It provides information for preventive maintenance and mechanical repair, and includes tricks of the trade that will help mechanics expected to perform the impossible to “get production running.” While the book is primarily concerned with installation, maintenance, and repair of machinery and equipment, it also covers other fields of activity. Current methods, procedures, equipment, tools, and techniques are presented in plain, easy-to-understand language to aid the mechanic in the performance of day-to-day activities. New sections on lubrication, vibration measurement, and PM inspection show troubleshooting techniques and help the mechanic fix the real problem—not just treat the symptoms of troublesome equipment.

Drawings, photographs, and tables are used throughout this book to illustrate the text and help you perform these activities. Discussions of principles and theory are limited to the key information necessary to understand the subject matter.

While this book covers topics from shafting to bearings, carpentry to welding, measurement to machine assembly; it is impossible to give the depth of detail for each and every subject in a small pocket manual. Readers who wish to learn more about these topics should consider the *Audel Millwrights and Mechanics Guide: All New Fifth Edition*, published by Wiley Publishing, Inc. This larger format book allows each subject to be explored to a greater depth.

—Thomas Bieber Davis
Maintenance Troubleshooting

I. SAFETY

It's hard to walk past the plant gate or the security office without seeing a sign indicating how many days since the last lost-time accident at the facility. Most employers take great pride in their safety record and preach safety as a way of life. This section includes some tips and information for keeping your operations safe.

OSHA

The *Occupational Safety and Health Act* (OSHA) in the United States covers workplace conditions for employees. If you are engaged in maintenance, repair, or installation activities, your employer probably has details on the particular parts of the OSHA standards that apply to you.

As a mechanical tradesperson, you might find yourself involved in many activities that require you to think out particular safety issues for your own special type of work. For example, you might be servicing a pump and have all the parts and the manufacturer's manuals, but it would make a great deal of difference in your approach to the job if the pump were handling acid instead of water. You have to consider the safety details for each job, using your trade skills combined with your knowledge of the process, location, or conditions.

Lock Out and Tag

When you shut down a machine, process, pipeline, or electrical apparatus to inspect or perform a repair, you need to *lock out and tag* a piece of equipment so that it cannot be accidentally started or energized. Usually, the start/stop of the switchgear controlling the piece of equipment is physically disabled with a lock (Fig. 1-1).

The employee working on the equipment usually holds the key to the lock. The lock itself has a tag identifying whose lock is being used. In the case of a pipeline, the valve controlling the flow into the line is closed and a lock placed

2 Safety

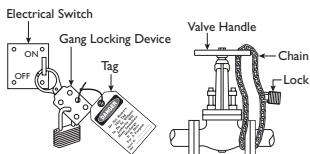


Fig. 1-1 Lock out and tag.

used to hold many locks on the job. In addition, it's a smart idea to try the local start/stop switch at the machine site or open the valve downstream from the locked main valve as a double check to make sure that the machine or process is "safed-out."

MSDA

Another safety issue for maintenance or installation personnel is the use of chemicals or hazardous materials. In the United States, *Material Safety Data Sheets* (MSDA) are used to identify the details of each particular chemical and list safe handling techniques. These sheets, usually available in the workplace, indicate if rubber boots, face shield, respirator, dust mask, or goggles might be required to work safely around a substance. Keep in mind that chemicals can be oil or grease, too. Removed parts of a machine often need to be cleaned after disassembly and require chemical degreasers or solvents.

Use of Protective Equipment

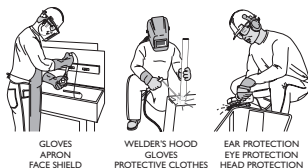


Fig. 1-2 Protective safety gear.

on the handle or bonnet with an appropriate tag attached. If two or more people are working at the same machine, then each additional person also places a lock on the equipment. A gang-locking device can be

used to hold many locks on the job. In addition, it's a smart idea to try the local start/stop switch at the machine site or open the valve downstream from the locked main valve as a double check to make sure that the machine or process is "safed-out."

Often the maintenance worker needs gloves, a hard hat, steel-toe shoes, earplugs, or other articles of apparel to guard against injury to the eyes, feet, head, or ears. Jobs such as grinding, drilling, nailing, painting, or welding mandate protective gear (Fig. 1-2).

2. THE BASIC TOOLBOX

The proper use of hand tools is the key to accomplishing many successful jobs. While each mechanical trade might require specialized tools, a group of basic tools will be the heart and core of any craftsperson's toolbox. This set will allow the mechanic to perform most basic repair and installation jobs.

Wrenches — Open End, Box, Combination

Wrenches are one of the most widely used hand tools. They are used for holding and turning bolts, cap screws, nuts, and various other threaded components of a machine. It is important to make sure the wrench holds the nut or bolt with an exact fit. Whenever possible, it is important to *pull* on a wrench handle and keep a good footing to prevent a fall if parts let go in a hurry.

Typical types of wrenches needed in the basic toolbox include box wrenches, open-end wrenches, and combination box/open-end wrenches from $\frac{1}{4}$ to $1\frac{1}{4}$ in. in increments of $\frac{1}{16}$ in. to accom-

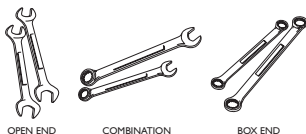


Fig. 2-1

plish most standard jobs (Fig. 2-1). The same types of wrenches in metric openings would span from 7 to 32 mm. Metric wrenches are stepped in 1-mm increments, but the basic toolbox would usually omit the 20-, 29-, and 31-mm openings because they are used so infrequently.

Socket Wrenches

Socket wrenches greatly speed up many jobs. The basic toolbox should contain sockets ranging from $\frac{5}{16}$ to $1\frac{1}{4}$ in. in $\frac{1}{16}$ -in. increments. Usually socket wrenches are sold in sets where the square drive of the ratchet is used to identify the set. Ratchets are typically made with $\frac{1}{4}$ -, $\frac{3}{8}$ -, $\frac{1}{2}$ -, $\frac{3}{4}$ -, and 1-in. square drivers. The larger the drive, the greater the capacity of the wrench set. For most work, the basic toolbox needs to have a

4 The Basic Toolbox

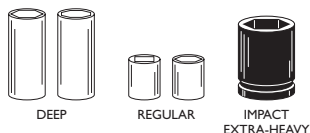


Fig. 2-2

these larger units is merited. Sockets are made in regular depth and extra deep (Fig. 2-2). Openings may be 12-, 8-, 6-point, or square for the type of work that the wrench set must handle. In addition, jobs that involve the use of an electric or pneumatic impact wrench need extra-heavy wall sockets that will hold up under heavy pounding from the tool.

Nut Drivers

Nut drivers are a must for electricians, but they are also handy for other jobs. A nut driver looks like a screwdriver but has a socket at the end of the shank (Fig. 2-3). The basic toolbox

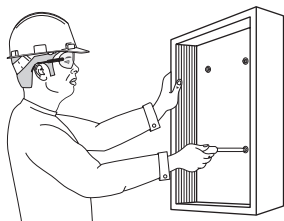


Fig. 2-3

should have a nut driver set, which includes the $\frac{3}{16}$ -, $\frac{1}{4}$ -, $\frac{5}{16}$ -, $\frac{11}{32}$ -, $\frac{3}{8}$ -, $\frac{7}{16}$ -, $\frac{1}{2}$ -, $\frac{17}{32}$ -, $\frac{9}{16}$ -, $\frac{5}{8}$ -, $\frac{11}{16}$ -, and $\frac{3}{4}$ -in. sizes. Often overlooked, these tools speed up the repair or adjustment of equipment and surpass the ability of a ratchet set for loosening or tightening light- to medium-duty assemblies.

Adjustable Wrenches

Adjustable wrenches are sometimes called “fits all” wrenches because they cover such a wide range of jobs. These tools are open-end wrenches with an expandable jaw that allows the wrench to be used on many sizes of bolts or nuts. They are available in lengths from 4 to 24 in. Some adjustable wrenches allow the jaw to be locked. These are available in lengths from 6 through 12 in. When using an adjustable wrench, always make sure you apply the force to the fixed jaw (Fig. 2-4).

Practically all manufacturers supply parts and repair kits to refurbish adjustable wrenches. The kits are relatively inexpensive, compared to the purchase of a brand new wrench. The basic toolbox should include adjustable wrenches with lengths of 4, 6, 8, and 12 in. These four sizes can cover a wide range of jobs.

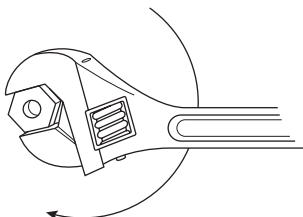


Fig. 2-4

Screwdrivers

Screwdrivers are the most used tools in a toolbox. They are intended for one simple use: driving and withdrawing threaded fasteners such as wood screws, machine screws, and self-tapping screws. Correct use of a screwdriver involves matching the size of the screwdriver to the job and matching the type of screwdriver to the head of the screw. The first screws that were developed had slotted heads. The proper screwdriver for these types of screws is called a conventional screwdriver, and it can be classified by tip width and blade length. Generally, the longer the screwdriver, the wider the tip—but not always. Cabinet screwdrivers have long shanks but narrow tips because they are used to drive screws into recessed and counterbored openings that are found in furniture and cabinets. Stubby screwdrivers are available that have very wide tips for use in tight spaces. Most conventional screwdriver tips are tapered. The tip thickness determines the size of the screw that the screwdriver will drive without damaging the screw slot. The taper permits the screwdriver to drive more than one size of screw.

The world of screwdrivers has radically changed since the slotted head screw. Probably the first “new” screw that was developed was the Philips head screw—a recessed slot design. The recessed slot screw allows a more positive non-slipping drive-up while attaching the fastener. The most common