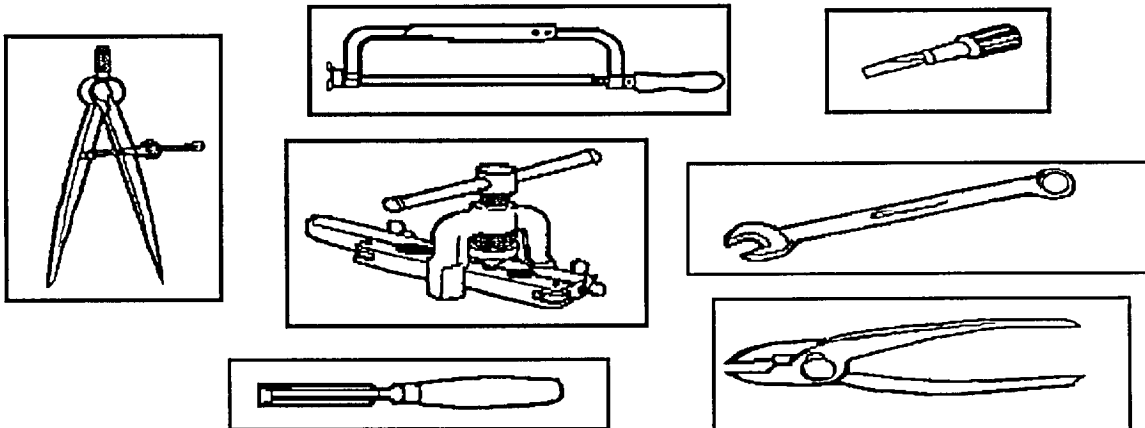


TECHNICAL MANUAL
FOR
USE AND CARE
OF HAND TOOLS AND
MEASURING TOOLS



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DEPARTMENTS OF ARMY, NAVY, AIR FORCE, AND MARINE CORPS
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USE AND CARE OF HAND TOOLS AND MEASURING TOOLS

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to publications and Blank Forms) or form 2028-2, which is located at the back this manual direct to: Director, US Army Armament, and Chemical Acquisition and Logistics Activity, ATTN: AMSTA-AC-NML, Rock Island, IL 61299-7360, Fax: DSN 793-0726, e-mail: AMSTA-AC-NML@ria-emh2.army.mil. A reply will be furnished to you.

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CHAPTER 1 INTRODUCTION

PURPOSE

This manual provides information on the use and care of selected hand tools and measuring tools. It will explain the types and uses of a large number of tools, a practical application of a selected group of tools, safety requirements, general care, and limited repair. A user must have, choose, and use the correct tools in order to do the work quickly, accurately, and safely. Without the proper tools and knowledge of how to use them, the user wastes time, reduces efficiency, and may face injury.

HOW TO USE THIS MANUAL

When you need information about a specific tool or operation, simply refer to the alphabetical index at the end of the manual and turn to the pages that apply. The introduction to each tool chapter will furnish information on: How to choose and use the tools covered, the various types of tools available, and an example of their use. Instructions on the care of tools and safety precautions follow.

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CHAPTER 2 SAFETY

SAFETY AND SAFETY EQUIPMENT

No matter how small the job, practice safety at all times. A tool may be efficient, essential, time saving or even convenient; but it is also dangerous. When using any hand tool you must use it correctly, following the methods prescribed in this manual. You must also be alert for any conditions that might endanger yourself or fellow workers. Take the time you need to learn the safety guidelines in this chapter. Remember, you are the most important part of safety procedures.

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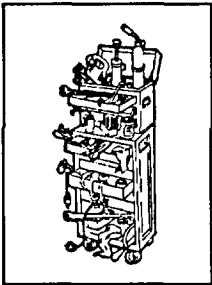
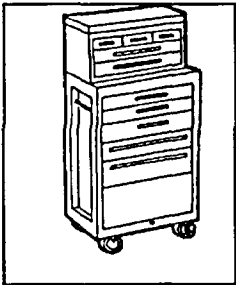
Section I. SAFETY RULES (GENERAL)

The shop area you work in will have a safety program to follow. The following safety rules are furnished as a guide.

1. SUPPORT your local safety program and take an active part in safety meetings.
 2. INSPECT tools and equipment for safe conditions before starting work.
 3. ADVISE your supervisor promptly of any unsafe conditions or practices.
 4. LEARN the safe way to do your job before you start.
 5. THINK safety, and ACT safety at all times
 6. OBEY safety rules and regulations-they are for your protection.
 7. WEAR proper clothing and protective equipment.
8. OPERATE only the equipment you are authorized to use.
 9. CONDUCT yourself properly at all times
 10. REPORT any injury to you supervisor immediately. Horseplay is prohibited.
 11. KEEP tools in a safe place. Never carry tools in pockets or leave them lying around. Stepping on a round screwdriver, for instance, could cause a bad fall.
 12. CLEAN UP the work area when the job is completed
 13. KNOW the location of all safety equipment and be familiar with its operation.

In addition to the above rules, there are other habits that will help you perform your work more efficiently as well as more safely.

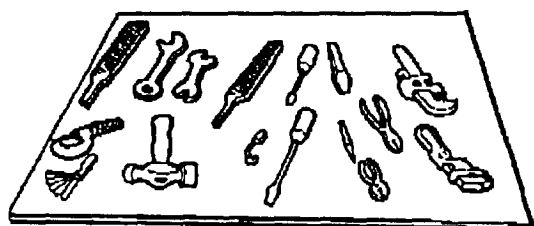
TOOL HABITS



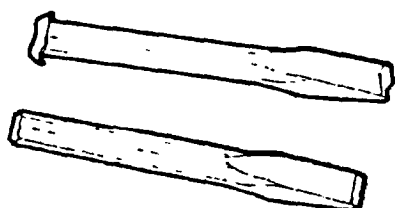
Keep tools in their proper place
"A place for everything and everything in its place" is just common sense. You cannot do an efficient, fast repair job if you have to stop and look around for each tool that you need. The following rules, if applied, will make your job easier.

TOOL HABITS Continued

KEEP YOUR TOOL SET COMPLETE. If you are issued a tool box, each tool should be placed in it when not on use. If possible, the box should be locked and stored in a designated area. Keep an inventory list in the box and check it after every job. This will help you keep track of your tools.



KEEP YOUR TOOLS IN EASY REACH—WHERE THEY CAN'T FALL ON THE FLOOR OR ON MACHINERY. Do not place tools above machinery or electrical apparatuses. If tools fall into running machinery they will cause serious damage.



KEEP YOUR TOOLS IN GOOD CONDITION. Keep them free of rust, nicks, burrs, and breaks.

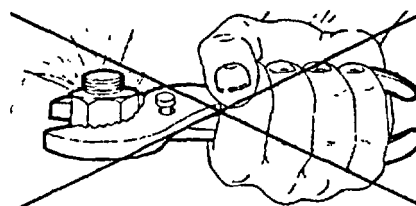
NOTE

Return broken tools to your section chief.

WARNING

NEVER USE DAMAGED TOOLS. Notify your supervisor of broken or

damaged tools. A battered screwdriver might slip and spoil the screw slot or cause painful injury to the user. A gage strained out of shape will result in



inaccurate measurements. USE EACH TOOL ONLY ON THE JOB IT WAS DESIGNED FOR. If you use the wrong tool to make an adjustment, you will likely have an unsatisfactory result. For example, if you use a socket wrench that is too big, you will round off the corners of the wrench or nut. If this rounded wrench or nut is not replaced immediately, the safety of your equipment may be endangered in an emergency.

REMEMBER, a workers efficiency is often a result of the condition of the tool being used. Workers are often judged by how they handle and care for their tools. You should care for hand tools the same way you care for personal property. Always keep hand tools clean --free from dirt, grease, and foreign matter. After use, return tools promptly to their proper places in the tool box. Improve your own efficiency by organizing your tools so that those used most frequently can be reached easily without sorting through the entire contents of the box. Avoid accumulating unnecessary items.

Section II. SAFETY RULES (POWER TOOLS)

Safety is a very important factor in the use of power tools and cannot be overemphasized. By observing the following safety guidelines, you can assure maximum benefits from the tools you use and minimize chances of serious injury.

1. Never operate power equipment unless you are completely familiar with its controls and features.
2. Inspect all portable power tools before using them. See that they are clean and in good condition.
3. Make sure the work area has plenty of light. Never work with power tools in dark areas where you cannot see clearly.
4. Be sure the tool switch is in the "OFF" position before connecting a power tool to a power source.
5. When operating a power tool, give it your FULL and UNDIVIDED ATTENTION.
6. DO NOT DISTRACT OR IN ANY WAY DISTURB another person while they are operating a power tool.
7. Never try to clear a jammed power tool until it is disconnected from the power source.
8. After using a power tool, turn off the power, disconnect the power source, wait for all movement

of the tool to stop, and then remove all waste and scraps from the work area. Store the tool in its proper place.

9. Never plug the power cord of a portable electric tool into a power source before making sure that the source has the correct voltage and type of current called for on the nameplate of the tool.
10. Do not allow power cords to kink or to come in contact with sharp objects, oil, grease, hot surfaces, or chemicals.
11. Never use a damaged cord. Replace it immediately.
12. Check electrical cables and cords frequently for overheating. If extension cords are needed, use only approved cords.
13. See that all cables and cords are positioned carefully so that they do not become tripping hazards.
14. Treat electricity with respect. If water is present in the area of electrical tool operation, be extremely cautious and disconnect the power tool if necessary.
15. Wear safety glasses when soldering or using power tools.

Section III. SAFETY EQUIPMENT

Safety equipment is for you. It will protect you from injury and could save your life. Some of the more common types of safety equipment are illustrated and described in this section.

Safety shoes



Safety shoes protect and prevent injury of loss of toes. Some safety shoes are designed to limit damage to your toes from falling objects.

A steel plate is placed in the toe area of such shoes so that your toes are not crushed if an object falls on them. Other safety shoes are designed for use where danger from sparking could cause an explosion. Such

danger is minimized by elimination of all metallic nails and eyelets and the use of soles that do not cause static electricity.

EYE PROTECTION



Proper eye protection is of the highest importance for everyone. It is necessary because of hazards caused by infrared and ultraviolet radiation, or by flying objects such as sparks, globules of molten metal, or chipped concrete and wood, etc. These hazards are always present during welding, cutting,

Section III. SAFETY EQUIPMENT -Continued

soldering, chipping, grinding, and a variety of other operations. It is absolutely necessary for you to use eye protection devices such as helmets, handshields, and goggles during eye-hazard operations. Appropriate use of goggles will limit eye hazards. Some goggles have plastic windows which resist shattering upon impact. Others are designed to limit harmful infrared and ultraviolet radiation from arcs or flames by the use of appropriate filter lenses. Remember, eye damage can be extremely painful. Protect your eyes.

HELMETS



Protective helmets (hard hats) come in a variety of shapes. They may be made of

tough polyethylene or polycarbonate, one of the toughest hat materials yet developed. When falling objects strike the hats, the shock absorbing suspension capabilities minimize injuries.

Regular hard hats must be insulated so that personnel may be protected from accidental head contacts with electrical circuits and equipment at comparatively low voltages. (less than 2200 volts).

Electrical workers requiring head protection necessary to their duties or to the working environment, must wear insulating safety helmets or all-purpose protective helmets which must be capable of withstanding 20,000 volt minimum proof tests.

GLOVES



Use gloves whenever you are required to handle rough, scaly, or splintery objects. Two types are shown above. Special flameproof gloves are designed for gas and electric welding in order to limit danger and damage from sparks and other hot, flying objects. Personnel working with electricity are usually required to wear insulating rubber gloves.

Be sure to follow all regulations prescribed for the use of gloves. Gloves must not be worn around rotating machinery unless sharp or rough material is being handled. If such is the case extreme care should be used to prevent the gloves from being caught in the machinery.

SAFETY BELTS AND SAFETY STRAPS

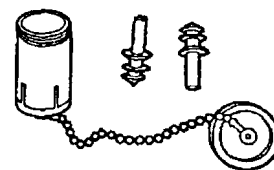


The safety belt and safety strap are a must when working in high places. the safety belt, strapped around the waist, contains pockets for small tools. it also has two D-rings used to attach the safety strap. The safety strap is a nylon-reinforced leather belt that is placed around the item to be climbed. It is then attached to the two D-rings in the safety belt. Detailed use of the safety belt and safety strap is described in chapter 49 of this manual.

EAR PROTECTION

Proper hearing protection is a must when working with or around certain

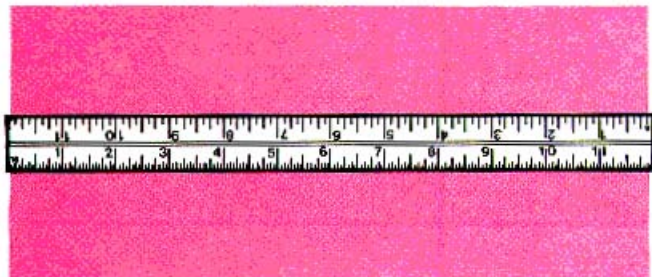
types of power tools. Some tools are capable of producing dangerously high noise levels which, if ignored, can result in serious hearing loss or injury. Use the hearing protection regularly.



CHAPTER 3 READING MEASURING SCALES

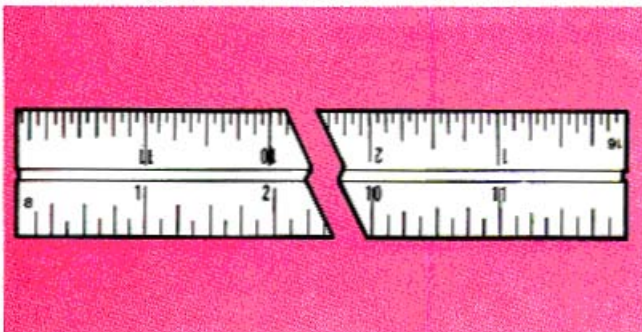
The following chapter is designed to provide a basic understanding of how to read scales, dials, and gages. It will not provide any information on the actual use of the tools. Reference to this chapter will be made throughout the remainder of the manual.

READING THE SCALE OF A RULE OR TAPE



The more common type rules and tapes are divided into fractions, inches, and feet. Explained here are the scales on a 12-inch steel machinist's rule.

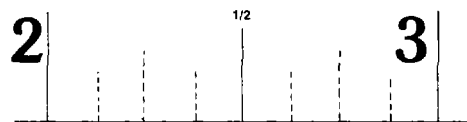
The rule is divided into twelve inches. The inches are further divided into eighths, sixteenths, thirty-seconds, and sixty-fourths.



Look at the rule. There is a small numeral marked on the end of the rule nearest the 1-inch mark. This numeral indicates the number of divisions per inch. When referring to fractions, always use the reduced name. This is the smallest numerator (top number) and denominator (bottom number). For example, $\frac{3}{6}$ can be reduced to $\frac{1}{2}$ by dividing both the top and bottom by 3. Generally, fractions may be reduced to their lowest forms by repeated division by 2 or 3.

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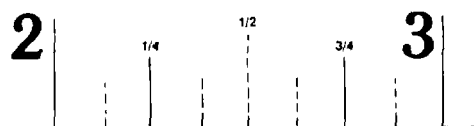
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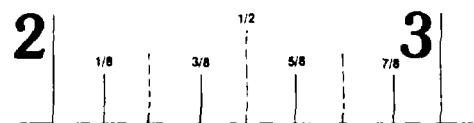
Look at the section between the "2" and the "3" on the edge marked with an "8" for eighths.

There are eight equally spaced lines. The lengths of these lines differ and indicate different fractions or parts of an inch.

The longest line is in the center and is equal to $\frac{4}{8}$ or $\frac{1}{2}$ inch.



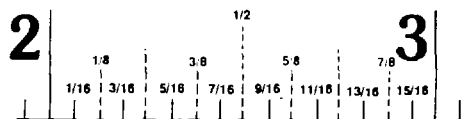
Each half-inch is divided in half by a slightly shorter line indicating $\frac{2}{8}$ or $\frac{1}{4}$ on the left and $\frac{6}{8}$ or $\frac{3}{4}$ on the right.



Each $\frac{1}{4}$ inch is divided in half by the shortest line which indicates $\frac{1}{8}$ inch, and will indicate $\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$ and $\frac{7}{8}$.

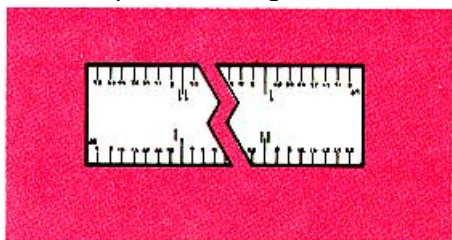
READING THE SCALE OF A RULE OR TAPE - Continued

Now turn the rule and look at the edge with a 16 marked on it.

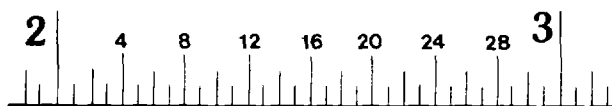


There are now 16 equal divisions between each inch. Since $2/16$ reduces to $1/8$, divide each $1/8$ into two equal parts producing $1/16$, $3/16$, $5/16$, $7/16$, $9/16$, $11/16$, $13/16$, and $15/16$.

Common tapes and rules usually are not graduated smaller than sixteenths. However, precision measurements require smaller graduations.



Look at the back of the machinist's rule. Find the edge marked 32 and once again look between the numbers "2" and "3."



To read this rule, remember:

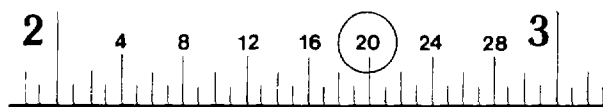
1. Sixteen divisions ($16/32$) are equal to $1/2$ inch.
2. Eight divisions ($8/32$) are equal to $1/4$ inch.
3. Four divisions ($4/32$) are equal to $1/8$ inch.
4. Two divisions ($2/32$) are equal to $1/16$ inch.

To read $2-5/8$ inches on the scale, first find the two inch mark, then determine the number of 32nds in $5/8$.

To determine the number of 32nds in $5/8$, remember four divisions or $4/32$ are equal to $1/8$ inch. If $1/8$ is equal

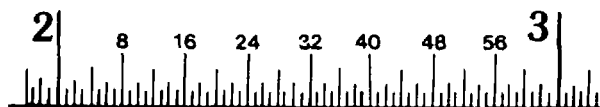
to $4/32$, then $5/8$ is equal to $20/32$ as shown:

$$\text{If } 1/8 = 4/32, \text{ then } 5/8 = 20/32 \\ (4 \times 5 = 20)$$



1. Find the $20/32$ reading on the scale as shown above.
2. Write the new fraction $2-20/32$ inches.

Finally, look at the edge marked 64. Each inch is now divided into 64 equal parts.



To read this rule, remember:

1. Thirty-two divisions ($32/64$) are equal to $1/2$ inch.
2. Sixteen divisions ($16/64$) are equal to $1/4$ inch.
3. Eight divisions ($8/64$) are equal to $1/8$ inch.
4. Four divisions ($4/64$) are equal to $1/16$ inch.
5. Two divisions ($2/64$) are equal to $1/32$ inch.

To read $2-3/4$ inches on this scale, first find the two inch mark. Next, determine the number of 64ths in $3/4$.