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Title of Study: A STUDY OF HOBBY SHOP SAFETY IN THE HOME AREA

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Major Field: Industrial Arts Education

Scope of Study: Library research in Psychology, Physiology, and Documented Accident Reports and Statistics have been made to determine the probable "Why" in the occurrence of Home Area Accidents, especially in the hobby shop activities. The study includes the human being as a "whole" living an active and productive life. The home area hobby shop is discussed; also, the unsafe environment it provides for the individual when the hazards and safe practices are unknown and not controlled. The invironment of the individual and the stimulus of the environment acting together as a cause factor has been discussed at layman level of understanding.

Findings and Conclusions: Disabling injury and fatal accidents have occurred throughout the years but the number has increased, especially since the new fix-it-yourself trend. In the fast moving technical culture man has in many cases neglected the well being of his fellow man. Flammable liquids are being used as thinners for hair spray; toxic solvents and cleaners are being used unsuspectingly by many hobbyists. Many unsafe acts are performed because the individual does not suspect a hazard until it has developed into an injury, fatality, or property damage accident. Many individuals have a fatalist complex, while some feel that "it cannot happen to me."

Greater emphasis should be placed on providing hazard and safe practice information to the individual concerning the hobby shop and home area activities. Many instruction guides give details of the materials and the tool for the job but fail to emphasize safety; this situation should be corrected.

ADVISER'S APPROVAL C. L. Hill

A STUDY OF HOBBY SHOP SAFETY

IN THE HOME AREA

DEDICATED TO MY MOTHER

A STUDY OF HOBBY SHOP SAFETY IN THE HOME AREA

By

ROBERT PAUL STUART

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1953

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for the degree of
MASTER OF SCIENCE
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A STUDY OF HOBBY SHOP SAFETY IN THE HOME AREA

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R. P. S.

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CHAPTER I

AN INTRODUCTION TO THE STUDY OF HOBBY SHOP SAFETY

Safety Education is receiving nation wide interest in the industrial, business, and public organizations. This interest probably evolved as the result of liability legislation, which was enacted making management responsible for safe working conditions. Safety education is a means of providing the knowledge required to participate safely in an activity. This safety knowledge may be acquired by the individual in one or both of the following ways: (1) Experience; which is the school of hard knocks, (2) the study of prepared information that is obtained by careful analysis of documented accident histories.

The safety program of organizations is proving very beneficial to the individual and the nation as a whole; although there are a few areas that have a tremendous number of injuries and fatalities each year. The area most in need of emphasized accident prevention is the home area; these home accidents are not deliberate instances, but rather are the end result of not knowing the hazards of the activity and the safe practices necessary to prevent unsafe acts developing into injury and property damage.

The hobby shop activities involve not only the bread winner, but those individuals that make the family circle; all should enjoy the benefits of leisure which has been made possible through improved technology.

Leisure time without purpose is boresome; therefore, many individuals find it advantageous to participate in some activity referred to as a hobby. The hobby selected is usually determined by the individual's interests and is limited in accordance to the economic situation. Man's curious and creative nature leads to the desire for design and construction of worthwhile products.

Construction or manufacturing types of hobbies usually involve the same kind of hand tools and power equipment used in industrial shops. Management and safety engineers know that there are many hazards involved in each type of activity; therefore, they have organized and implemented a safety program adequate to reduce and keep to a minimum monetary and man power losses.

Most hobbyists do not have a safety program implemented in their activities usually because the hazards involved have not been known or understood; these must be known before the safe practice may be applied to prevent the occurance of accidents. It is with these considerations in mind that the Study of Hobby Shop Safety is being made.

Origin of the Study. The beginning of an idea usually is not known, although most individuals consider that the idea has its beginning at the time they first become conscious of its existence. In some instances the idea may linger a while without much development, until a motivating stimulus is contacted. The development of the idea is dependent on the strength of the stimulus and the period of time it is in effect.

This writer feels that the idea for a study of hobby shop safety had a beginning in the humanitarian interest for his fellow man's well being. The stimulus for the development of the idea has been the results of personal observations of human beings and their unsafe acts; especially when

they are participating in hazardous activities. The idea has been further stimulated by local and national statistics and the personal analyses of some 600 disabling injury accident reports during the past two years. In almost every case there was an unsafe act or an unsafe condition, both of which probably could have been prevented.

Need for the Study. Many hobbyists are aware of the safety program for their occupational activities and realizing that it is beneficial they try to adopt safety into the hobby activity by transfer of knowledge. This method of transfer shows interest in accident prevention; but it is not adequate for the hobby shop, because the organization of the occupational safety program is unknown or not understood by the hobbyist. Also, the hobbyist usually is active in a hobby that is not similar to the occupation.

Many of the operation and production instructions do not include a safety program. Usually there are some cautions in a negative or positive manner which are in many cases ignored by the individual because the cautious have no emphasis of meaning other than a do or a don't. Man is curious and desires to know the "Why" of things only to find that the answer is a research problem.

Thousands are disabled or killed each year in accidents because some individual concerned failed to realize that the hobby shop tools, equipment, and other factors are similar to industrial considerations which require the implementation of a well-organized safety program to prevent accidents.

The hobby shop activities have been and are participated in by many individuals without any formal training - the operation instruction manual being the only guide; situations of this type places the individual

in a position of learning the hazards and safe practices through the school of hard knocks. In many cases the learning involves an accident which may result in a disabling injury or property damage or death.

Hobbyists need at least a general outline of a hobby shop safety program which may be compatable to the activity. In addition to these expressed needs for the study this writer feels the need for the study of hobby shop safety and the research involved which should assist in better organization and implementation of the safety program for which a responsibility exists.

Most safety information is written at the management level where skilled interpretation and organizing abilities are available; this information is usually presented to the worker in a series of do's and don'ts. These do and don't rules are expected to be adhered to.

There are many volumes of safety information available; each volume has some information adaptable to the hobby shop, but many hobbyists may not know which volume to read first for the particular activity.

Accident prevention involving the "Why" of an accident includes the psychological as well as the physiological factors that are usually interwoven into writings that are quite lengthy; the hobbyist may feel this is out of his reach. The extraction and re-writing of this information adapted to the laymen level, is a part of this study.

Purpose of the Study. Any activity without purpose is meaningless. Some activities may have a multiple purpose; this study is of that nature. The primary purpose of this study is to collect and tabulate valuable safety information in a logical manner that may assist in reducing the hobby shop accidents which is a part of the total home

area. Most individuals will agree that the victim of an accident has a right to protection from the acts of others; yet many valuable and skilled individuals may be involved in a home area accident sometime in the future, because they do not know the hazards and safe practices necessary to prevent injury.

This writer believes that this study will serve the purpose of stimulating further study of the home area accident problem, which includes the hobby shop, so that the tremendous annual monetary and manpower losses may be "reduced and held to a minimum."

The hobbyist may have found the safety aspects of the activity vague or lacking in the operating instruction and not being acquainted with the necessary techniques for research has been unable to acquire the desired and needed safety information. Usually the safety information desired is scattered and integrated into other written materials. This study is intended to study and consolidate that part of industrial accident prevention methods and techniques that may be adapted to the hobby shop activity as a suggested safety program.

Delimitations. Many of this nation's industrial and business activities are operating as specialists or groups of specialists; this causes much of the valuable safety information to be interwoven and scattered throughout many volumes of operating instructions. Another limiting factor is the vast amount of written physiology and psychology that is important in accident prevention is written in a manner that must be segregated, analyzed, and adapted to the accident prevention information in a logical manner for better understanding by the layman. Publications that might deal in an over-all way with hobby shop safety are virtually non-existent.

This writer will endeavor, as much as possible, to limit the material in this study to that which may apply to the hobbyist.

Methods of Research. The library method is the primary type of research used in preparing this study. It is selected, because this method is the most practical under existing conditions. Most hobby shops that were visited have a few rules posted that were extracted from text books and operating instruction manuals. In many cases the only phase of safety consisted of fire prevention equipment because of high insurance rates. Many supervisors of the hobby shop knew very little concerning accident prevention or the legal and moral responsibility involved; to them it was a job of preventing theft and collecting monies for materials used or equipment damaged.

Reviewing many good books on hobbies and handicraft disclosed that the hazards and safe practices elements of the activity were not present in most publications. In many publications the safety aspect of the activity is a negative or positive caution. Therefore, the only practical way to obtain the required data for this study is through scientific safety engineering research of the many industrial publications concerning the activities normally occurring in the hobby shop. Also, through personal visits and inspections in shops such as Frankhoma Potteries, Industrial Art shops, chemical laboratories, furniture repair shops that have a recognized workable safety program for each activity that may be found in the hobby shop.

Definitions of Significant Terms. This part of the study is presented for the purpose of familiarizing the reader with some of the terms used. This is necessary because the study includes the human element; those persons that have analyzed the human being from a mental,

physical, and biological viewpoint have applied scientific terms that need defining to the layman. Some common terms will be defined as a reminder.

"Accident." The term accident is used to refer to any event or series of events unforseen that may or may not result in property damage or body injury.

"Accident Prevention." Is used to express the methods and techniques used in preventing the recurrence or a similar accident.

"Attitude." The result of mental reaction to a stimuli.

"Cost." The actual dollar value involved.

"Chemical." The term applied to express a crystalline and liquid acid or alkali base substance, or substances that are toxic.

"Concentration." The term used in referring to the ratio of a mixture of a gas as one part and atmospheric air as one million parts; eg: 15 PPM is 15 parts per million. It also is used to express the ratio of other mixtures.

"Dermatitus." The medical term applied to an unhealthy skin condition that is brought about by contact with some detergent oils and other chemicals. Inflammation of the skin.

"Disabling Injury." The term used to express an injury that results in lost time from normal activities.

"Emotion." Any departure from the usual calm state of the organism as includes strong feeling, an impulse to overt action, any of the states designated as fear, anger, disgust, grief, joy, surprise, in short the agitation of the feelings or sensibilities.

"Emergency." This term refers to a circumstance which requires immediate action; also, less properly, exigency.

"Extrovert." Has reference to a person whose interest is centered in external objects and actions.

"Fault." A fault is a defect or imperfection. It may be a human fault, a material, or a mechanical fault.

"Injury." The term refers to body impairment; cut, bruise, fracture, or shock. It may be a mental or a physical injury.

"Introvert." The term for a person strongly inclined to introversion. Introspection, opposite to extrovert.

"Overt." Another behavior term meaning not secret, open to public.

"Psychology." The study of inner man, usually mental. "The supervisor and psychology" have a very important place in human relations and accident prevention.

"Regression." This term implies the opposite to progress or advancement.

"Statistics." Numerical figures arranged to represent facts.

"Tools." Any device used to accomplish a purpose. This study will consider the hand tools and power tools.

"Toxic." The term applies to substance that will through contact, ingestion, or inhaling cause illness or body impairment -- in some cases sudden death.

Review of Similar Studies. As could be determined by research through the indexed references at several prominent libraries, no study has been made of the hazards and safe practices in the hobby shop. Several studies were reviewed that are primarily concerned with type, quantity, quality, and use of tools and equipment in the school shops without any mention of accident prevention. One study reviewed relates to

the legal and moral problem of shop teacher liability; the statistics used in this study were to strengthen the protection to the teacher from legal liability. Another thesis was written at administrative level indicating responsibility for accident prevention. The particular one in the review is A Discussion of School Shop Safety by Stephenson, Leslie: 1952. The same common trend of passing over the hazard and safe practice aspects of shop activity in the text books and operating instructions is alarming to those that realize that printed materials of an educational nature is the only means of teaching many individuals concerning hazards and safe practices of an activity.

An Analysis of the Plan for Presenting the Material. It is proposed to present the findings which were obtained by means of the library method, personal visits, and inspection, employing the use of tables, and quotations with a descriptive account of each as it is presented. The findings will be divided into two chapters, namely: Chapter II which is divided; and is a discussion of The Shop, Hand Tools, Power Equipment, and the Human Element. Chapter III is a discussion of a suggested Hobby Shop Safety Program which has a part devoted specifically to Fire Protection.

CHAPTER II

THE HOME HOBBY SHOP

The hobby shop is used primarily for leisure time activities where the individual may develop his creative ideas, or to construct some worthwhile product from the ideas and examples of others. The hobby shop provides an opportunity for learning new skills. Many individuals have in the past developed the hobby shop activity into a profitable occupation. Here, also, in the hobby shop the art of self-discipline may be learned or improved. Emotional stability may be strengthened through hobby shop activities and in some cases an individual's attitudes toward the worthwhile purpose in life is developed or changed. The hobby shop also provides the opportunity for learning the hazards and safe practices relative to the everyday hobby shop activities.

The hobby shop may be found in many locations, such as: Upstairs in a spare room, in the basement, or in the garage. In some cases the hobby shop is a separate building especially designed to accomodate the desired equipment needed to satisfy the individual's hobby activity. In the latter case mentioned a safety program may be implemented with greater ease. Most hobbyists are not so fortunate; they find themselves in a small shop with a limited number of tools and equipment. Small shops and inadequate tools stimulate accidents, but good safe practices in the hobby shop will help overcome this situation.

Since the hobby shop is a place where the individual may use his

leisure time in relaxed, worthwhile activities, it is hoped that safe practice will have first priority. In the absence of formal shop training, the hobbyist may find that there are probable limitations that may be of interest to him, such as: (1) The phases of learning would mostly be self-taught, and the result would depend on the interpretations of the written and illustrated instructions. (2) Also, the instruction book may supply the required information concerning the selection of material, the method of construction and the tools that may be required, but the information may be void of any reference to the hazards and safe practices involved in the activity. (3) Another factor may be that the skill, knowledge, and interest may be increased until they have outgrown the present shop facilities. This, of course, may breed boredom, which in turn may cause the individual to be less alert to the known hazards. (4) In some cases the economic situation of the individual will limit the activity to such a degree that he cannot truly find himself. (5) In some instances the individual may become so engrossed in the hobby activity that it will effect his normal production activity which would be opposite to the desired results. This information is not written as a negative critism to hobby shop activities but to give a little insight into what may be a part of the contributing factors involved in an accident.

To satisfactorily discuss hobby shop safety it may be well to divide this chapter into three general parts; Part A deals with the location and modification of the hobby shop; in Part B is discussed tools, power equipment and materials; and in Part C is discussed some of the Human Elements involved in accidents.

Part A

Selection of Location and Modifications

Analyses of accident reports and statistical records reflect that the location and modifications of the hobby shop may have an important part in accidents; therefore, these are discussed so that the hobbyist may obtain a better understanding of some of the underlying principles in the location and modification.

Selection of the Location. There are several considerations of importance in the location of the hobby shop. Some of the considerations are:

1. Is the floor level desirable?
2. Is the floor below ground level?
3. Is the floor above ground level? (1,2,3, floor)
4. Is the floor at ground level?
5. Is the location a separate building?
6. Is it part of the dwelling?
7. Does it have good accessibility?
8. Is it within a fire department zone?
9. Will the location disrupt other normal activities?

The shop floor level is of importance in the following ways: If below ground level or in a basement, there may be flooding or dampness during wet weather. Floors that are above or below ground level usually involve stairways, which creates a problem of getting the material to the shop. Also, the hazard of falls is present. Many ground level garages have been converted into hobby shops. The garage or separate building for the hobby shop is preferable, because it has a ground floor

level and has more isolation from other family activities. Considering that the location has been decided, probably the next thing to consider should be the modifications that may be necessary.

Modifications. The subject of modifications for hobby shop activities is quite lengthy in detail, but this study will be limited to floors, available electrical power, overhead supports and storage, illumination and air conditioning in a general way so that the hobbyist may realize the importance for including these in the hobby shop planning.

Most garage floors are of concrete which was installed during the construction of the garage. Usually the hobbyist will use it "as is." Floors should meet certain general requirements, which include the following:

> Floors should have an even surface, level except in areas where drainage is necessary. Where liquids may be spilled or daily washing necessary, drains should be installed and floors properly pitched to facilitate drainage, to permit quick drying and to prevent leaking to the next floor. For normal drainage, the slope is usually 1/8 of an inch, but where cleanliness is of prime importance, the slope will vary up to 1/4 of an inch per foot. The floor should not have a slippery surface nor one which will become unduly slippery from use. (35 - Page 1)

Some of the hobby shop equipment is designed or modified so as to have casters which permits the equipment to be movable. If this is the case, the unevenness of the floor, puddles or pockets, may let the equipment creep or vibrate. Many individuals may desire to have a floor installed by a contractor according to the Safety Codes and Safe Practices that are going to be needed.

In those cases where the floor is already installed, but has low spots or holes present, a simple effective way to patch concrete is as follows:

(1) Erect a barricade around the area to be repaired. Cut away the concrete to a depth of at lease one inch, be sure to get down to clean solid concrete. Wet this surface thoroughly, and keep it wet for at least an hour before patching. If the floor is dry, several hours of wetting may be necessary.

(2) Mix a grout of water and cement, and brush this grout into all crevices and cracks. While the grout and the floor are wet, apply the concrete mortar (one part sand and one part cement mixed with water) into each crack and crevice, then finish filling the hole or depression. After a few hours, cover the patch with burlap or a one-inch thickness of sand and keep wet for several days. If quick-set cement is used, the floor may be used sooner. (35 - Page 2)

The cold chisel and hammer may be used for small jobs in the absence of the concrete cutter which is needed for larger jobs. To prevent the cement getting into the eyes and other natural openings of the body, wear goggles, gloves, and if possible use a respirator or cloth over the mouth and nose. Vinegar may help neutralize the causticness of the cement on the body after the soap and water wash.

This concrete patching job has been interjected, during the discussion on floors, to reflect the fact that small jobs have hazards that require safe practices. The job included guards, protective clothing and equipment, proper tools, proper methods, and a job procedure plan that could be followed for accomplishing the job safely. The floor should be constructed so as to handle the heaviest load anticipated.

Probably the next thing that should be considered is the source of electrical power. Most garages being wired for one or two 50-watt lights will require some modifications to satisfy the need and the Safety Codes of the locality. The available electrical power for the hobby shop equipment should be considered before purchasing the equipment, because in some communities the entire system is only 110 volts. The pow-

er company may be reluctant or unable to change the system to satisfy an individual's need or desires. In some special cases the transformer is designed to convert 110 volts to 220 volts; when this is done, the amperage available may be entirely too low to properly operate the equipment. Another consideration of available electricity is the wiring. Wire size and recommended maximum amperes are shown in Table I. The house may be wired for 220 volts to a switch box then at that point a division may be made. In some cases, 220 volts are available to the cook stove or special equipment with the rest of the home wired for 110 volts.

The following information may be beneficial to the hobbyist. Electrical wiring may be compared to a water pipe, the larger the pipe the more may pass through. Wire size is usually considered by number; for instance, the larger the number the smaller the wire. The shot guns are referred to by gauge number; 10 gauge, 12 gauge, 20 gauge. It may be seen that the larger the number, the smaller the bore of the gun, this holds true with electrical wire. Electric wiring is insulated in accordance with electrical safety codes to safely supply current recommended for a given size wire, and should be safe when properly installed and used. The wiring installed should be of sufficient size to adequately supply the maximum current needed. To determine the current needed a power survey should be made, always include a safety factor. The following may be of value in making the survey:

Volts x Amperes = Watts, set to formula, this is $V \times A = W$.

Amperes = $\frac{\text{Watts}}{\text{Volts}}$ or $A \frac{W}{V}$ for each item in the circuit.

Make a list of all electrical lights, appliances, and equipment. The volts will be either 110, 220, or 440. The 440 will seldom be found,

TABLE I

ELECTRICAL WIRE SIZE AND RECOMMENDED MAXIMUM AMPERES

	Types of Insulation											
	Rubber Type R, RWRU, RUW		Rubber Type RUH		Paper thermo Plastic Asbestos TA:Var-cam V:Asbestos		Asbestos Var-cam AVA AVL		Impregnated Asbestos AI,AIA		Asbestos Type A, AA	
Wire Size	Copper	Alumi-num	Copper	Alumi-num	Copper	Alumi-num	Copper	Alumi-num	Copper	Alumi-num	Copper	Alumi-num
14	15	--	15	--	25	--	30	--	30	--	30	--
12	20	15	20	15	30	25	35	25	40	30	40	30
10	30	25	30	25	40	30	45	35	50	40	55	40
8	40	30	45	40	50	40	60	45	65	50	70	55
6	55	40	65	50	70	55	80	60	85	65	90	75
4	70	55	85	65	90	70	105	80	115	90	120	95
3	80	65	100	75	105	80	120	95	135	100	145	115
2	95	75	115	90	120	95	135	105	145	115	165	130
1	100	85	130	100	140	110	160	125	170	135	190	150

except in industry. The equipment usually has an attached plate on which is printed the voltage and amperage. A power survey example is given in Table II.

TABLE II

EXAMPLE PROBLEM OF POWER SURVEY

Type of Item	Number of Items	Volts	Watts	Amperes each Item	Total Amperes
Lights	6	110	60	0.5	3.0
Lights	2	110	75	0.7	1.4
Lights	1	110	100	0.9	0.9
Electric iron	1	110		15.0	15.0
Probable Total for the Home Use (in this example)					20.3
Drill Press	1	110/220		7.5/3.7	7.5
Grinder	1	110/220		6.0/3.0	6.0
Jig saw	1	110/220		5.0/2.5	5.0
Overhead saw	1	220		14.0	14.0
Planer	1	110/220		5.6/2.8	5.6
Probable Total for the Shop Use (in this example)					38.1
Probable Total for the Home and Shop (in this example)					58.4

It may be seen, by this power survey example, that the home may be wired with two 15-ampere circuits, which may be adequate, but to tie the shop circuit into the home circuits may result in serious electrical trouble. Therefore, it is necessary to make a power survey so that the proper modifications may provide adequate safe source of electric power for the hobby shop. The value of skilled assistance in the electrical modification cannot be overly stressed.

This example is not presented as a lesson in electricity but to show the need for creating a safe electrical condition that could be provided during modifications. Also, the survey may assist in eliminating an existing unsafe condition. The equipment voltage and amperage

used in this example were obtained direct from the name plate on equipment that is used in the Industrial Arts Woodworking Shops at Oklahoma State University.

Illumination should not be overlooked in the modification planning, as the lighting in the shops may vary in accordance with the type of activity. Also, optical illusions through glare and shadows are sometimes present. Natural lighting is preferable, but this cannot always be obtained at a constant desirable candle power. Some shops may need to tint the glass of the windows or use shades, depending on the location and type of window. Glare and shadows are two factors which when neglected play a large part in shop accidents. Heinrich summarizes illumination and defective vision in relation to accidents in industry in the following points:

1. Defective illumination is a common and expensive cause of defective eyesight and accidents.

2. The major lighting defects may easily be recognized and in most cases eradicated.

3. The eradication of defective illumination is usually not only practically possible but economically profitable.

4. The best available statistics indicate that about 40 per cent of our industrial workers have defective vision due to ocular defects.

5. This number is probably being increased by unhygienic lighting conditions; and poor illumination augments the ocular deficiences already.

6. Refractive errors cause potentially dangerous situations by producing fatigue, reducing physical efficiency, and failing to give adequate warning of danger while there is yet time to avoid it.

7. Muscle imbalances lower the worker's resistance to fatigue and disturb his quick and accurate spatial preceptions which are essential to safe behavior among moving objects.

8. Organic diseases not only reduce vision, both central and

> peripheral, but by causing distortions, blind spots, illusions, handicap the worker's control of his physical activities. (6 - Page 302)

Improvement in illumination has been of primary concern ever since Edison invented the first light bulb. Many types of illumination devices have been placed on the open market for the consumer's purchase. Of the many types available Heinrich gives the following information:

> Of the several varieties of light sources, the fluorescent lamp has attracted much attention. Developed at first for supplimentary lighting, it has become available in the larger size for the field of general lighting. The fluorescent lamp produces both day light and colored light at high efficiencies and at low operating temperatures. The last-named characteristic has led to the use of the expression "cold light." Several of the features of the fluorescent lamp bear directly on the prevention of accidents, namely:
>
> 1. Higher over-all efficiency, which encourages the provision of more adequate amount of light.
>
> 2. Improved quality of light more closely approaching daylight.
>
> 3. Less sensitivity to voltage fluctuations that should tend to decrease eye strain.
>
> 4. Lower temperatures that permit a greater degree of comfort where persons must work close to the light source. (6 - Page 30)

At one period of the day natural lighting may produce a glare and at another time a shadow. The use of artificial lighting well controlled will, in most cases, compensate for the changeable natural lighting. At night, proper artificial lighting should be used.

Illumination may need to be considered from the standpoint of activity. Some shop activities require more light than other activities. Illumination requirements are listed in Table III, which has been prepared from the Accident Prevention Manual, using those activities that may be found in hobby shops.

TABLE III

ILLUMINATION REQUIREMENTS

Activity	Foot candles light at 30 inches above floor
Automobile repair:	30
	20
Clay products and cements:	
Grinding	5
Molding, color, and gluing	10
Enameling	15
Household:	
General laundry and cleaning	20
Pressing, machine	20
Pressing, hand	50
Alterations	50
Dress making, cloth product	20
Engraving:	100
Forge and Welding:	10
General construction indoors:	10
Glass works:	
Grinding	20
Fine grinding and inspection	50
Jewelry and watch making	100
Leather crafts:	
Vats	5
Tanning, stretching	10
Cutting, fleshing, sewing	20
Finishing and scarfing	30
Machine shop work:	
Rough work	20
Medium	30
Fine	50
Extra fine	100
Painting:	
Dip and simple spray	10
Rubbing and hand painting	20
Fine hand painting	50
Extra fine hand painting	100
Plating	10
Polishing and burnishing	20

TABLE III (Con'd)

Activity	Foot candles light at 30 inches above floor
Printing Plants:	
Presses	30
Proof reading	100
Photo engraving:	
Etching, staging	20
Blocking	30
Finishing, proofing	50
Tint laying	100
Sheet metal:	
Bench work	20
Tin plate inspection	50
Stairways	5
Toilet and wash room	10
Woodworking:	
Rough bench and saw work	15
Sizing, planing, sanding, gluing, veneering	20
Fine bench and machine work	50

(17 - Chapter 1, Pages 36-39)

Illumination modification cannot be adequately discussed without including some hazards at the source of artificial lighting. These hazards usually are centered around the light bulb or tube. The common light bulb breaks easily and should be guarded. The light bulb used around flammables or gases should be encased in a safety well which in turn is protected, to a degree, by a metal guard. This explosion-proof type of light should also be used in the paint booth. Some tube-type bulbs have a diffusing chemical on the inside, which may have a toxic effect on the individual if he breathes the gas or is cut by the glass, should the tube be broken. Care should be exercised in the bulb disposal. Illumination is important for good production and safe conditions. Natural lighting may enter the shop through a sky light or the windows which may need modification to provide natural lighting.

Windows may need to be relocated for better ventilation. Ventilation is a health factor and is of importance in accident prevention. Most hobby shops are not using air conditioning other than the fan-type air circulator. Three methods are in use, and in some shops all three have been installed. One method is the exhaust system. This system exhausts the air from the shop and in fact lowers the pressure inside so that outside air pressure rushed in through the windows and doors when they are open. Another system is the intake system in which the fan forces the outside air into the shop which increases the shop atmospheric pressure. If the windows are open, the air pressure will try to equalize itself by returning to the outside. In some shops it has been discovered that both of these methods create air streams from the inlet to the outlet, so a third system may be used. An internal shop fan circulates the air throughout the shop by breaking up the air streams and forcing the air into the corners and other parts of the shop that may be considered as air pockets. These corners may be proven to have high temperatures.

Air conditioning comfort is largely determined by the humidity present. Wood and wood products are effected by the humidity of the shop. If the humidity is too low, the woods will tend to shrink; on the other hand if the humidity is too high, the woods will expand. With these two factors in mind, it may be considered to have an effect on the workability of the wood. A saw blade may be ruined or the individual may be injured by trying to saw wet lumber. The same may be true in some cases of extra dry lumber that is under tensil strain from shrinking, which may suddenly split or pinch the blade. With these considerations in mind, it may seem that the heating problem, during the winter months,

may be lessened by having some type of air circulator in the shop. Cold, of course, is conducive to accidents, because it may effect the individual's reaction time. Cold may also effect the materials used and the function of some equipment. Frost may enter the tiny unseen pores of saw blades, grinding wheels and other tools that may cause the metal to have an additional brittleness; this unsafe condition may lead to severe injury.

The modification plans should include adequate storage facilities. Some of the considerations relative to storage are:

1. Does the storage space have good accessability?
2. Does the ventilation include the storage area?
3. Will there be excessive moisture present at any time?
4. Is the floor, wall racks, and shelving adequate for the need?
5. Is the space adequate for the purpose?
6. Will the storage location interfere with other safe shop practice?
7. Does it provide good security for the material?
8. Will there be any flammable or explosive liquids present?
9. Will there by any storage of unlike materials?

It is considered by most safety engineers that some paints and oils should be stored separately to prevent the chemical reaction developing which may create a fire or explosion.

Part B

Tools, Power Equipment, and Materials

The actual occupancy of the hobby shop should be pre-planned. First considerations should be given to the arrangement of equipment; analysis

of many shop accidents indicate that the arrangement of equipment is a contributing factor. Hand tools are involved in many thousands of injuries and some fatalities each year. Power equipment, although designed for maximum safety is still instrumental in shop accidents. Chemicals and solvents used in the everyday shop activity are health hazards. Housekeeping of the shop may be the difference between life and death. Material usually is harmless in itself, but through handling it becomes a very important factor in accident prevention.

Arrangement of Equipment. The arrangement of the equipment is of importance in accident prevention. Some of the arrangement consideration should include: Size and purpose of the equipment, work space, type and size of material to be used and the size of the end product constructed. Individuals who may not have formal training in the Industrial Arts shops may find it advisable to obtain the assistance of the local Industrial Arts instructor. Much valuable information concerning one's hobby shop and the hobby shop activities may be omitted in the planning, because proper guidance was not obtained. Most hobby shop equipment is identical to the equipment in the Industrial Arts shops. Therefore, the difference between hobby shop and Industrial Arts shop may be considered as being the size of shop, type of end product, the quantity of production, and supervised safety. This similarity being so, the requirements for safe arrangements of equipment in the Industrial Arts shops could be adapted to the hobby shop.

Production flow may be greatly influenced by the equipment arrangement. Industry and Industrial Arts shop supervisors have, through motion and time study, observation of the activities, research, and accident analysis determined that equipment arrangement is very compat-

ible to increased production and accident prevention. Good production flow provides for the right thing being done at the right time, also prevents bottle necks, and backtracking.

The arrangement planning may have its beginning when the type of hobby is selected; also the quantity of the end item may influence the arrangement; but regardless of the type or quantity of the end item produced, the following may assist in determining correct arrangement of equipment.

1. Provides for good production flow?
2. Assist in following safe practices?
3. Assist in good housekeeping?
4. Will it provide adequate work space?
5. Be adequate for the length of material?
6. Will arrangement permit passageway and access?
7. Permit repairs and adjustments to be made on the equipment under this arrangement?
8. Permit transfer of materials to be made from storage to machines?
9. Assist in providing for guarding of the hazard points?
10. Cause a fire hazard to be created or increased?
11. Will it permit emergency escape?
12. Will it limit the number of workers?
13. Does it provide ample head room?

This list may not include all the questions concerned in an activity, but it may be seen that a check list for the specific activity would be beneficial before the actual arrangement begins.

The value of accident prevention in proper arrangement of the

equipment may not be fully known unless there could be a special study made on the subject of accident cost and injury as the result of improper arrangement of equipment in the shop. One way of saying all this is illustrated in the following statement: "It's not the RIGHT way if it isn't SAFE." (39 - Page 15)

Obtaining recorded data concerning the hobby shop accidents is difficult since the hobbyist is not required to file an accident report of injury or damage.

The Institute for Safer Living did make a national survey of "fix-it-yourself" activities which included most types found in hobby shops that resulted in injury. The results of the survey is listed in Table IV.

TABLE IV

FIX-IT-YOURSELF POWER EQUIPMENT AND PER CENT OF OWNERS

Equipment owned or expected to own soon	Per cent of those inverviewed
Ladder	100
Power saw	33
Power drill	37
Power joiner	10
Power lathe	17
Power jigsaw	21
Power sander	22
Power spray gun	27
Blow torch	20
Electric hedge clipper	12
Power mower	51
Power snow shovel	2
Other equipment	4

It was found that the accidents followed this pattern:

Carpentry work	115,000
Making or repairing furniture	98,729
Replacing window glass	95,000
Painting outside of house	76,000
Repairing the roof	32,000

TABLE IV (Con'd)

Working on gutters	47,000
Repair or putting up storm windows	16,400

Of the total reported, 72,000 involved carpentry tools and 180,500 involved power tools.

(32 - Page 3)

Many persons understand that water consists of two elements, oxygen and hydrogen, but they don't know how to separate them from one another; the same may be said of the hobby activity. It consists of unsafe conditions and unsafe acts, but the person does not know how to exclude them. To one that is well versed in accident prevention and accident analysis, the answer seems quite simple: eliminate the unsafe act and the unsafe condition. This process of elimination is not that simple, because so few actually know how to go about it. To start the process of elimination, the hazard or unsafe condition must be known or suspected to be present, and then the action or safe acts must be applied.

Industrial accident statistics used in this study were selected because of the similarity in the activities and equipment used in hobby shops.

Reliable statistics reveal that hand tools are involved in a large number of disabling injuries and fatalities each year. The analyses of these accident reports indicate two primary reasons why the accident occurred: (1) Unsafe conditions, (2) Unsafe acts. (27 - Page 10)

> One study on accidents in 300 high school shops in ten states revealed the following: Of the 766 accidents occurring during a single school year, hand tools were responsible for 66 per cent, power-driven machinery - 23 per cent. Thirty-three accidents were reported that caused loss of some part of the body. (38 - Page 1)

Hand Tools. A combination of factors seems to be implied in the

large number of injuries each year as the result of using hand tools; (1) In many cases keeping up with the Joneses is not enough, some are trying to surpass and keep ahead of the Joneses, (2) Economy in many household budgets, (3) More mechanical devices that need minor repair, (4) The majority do not know how to use the tool properly or which tool to use for a safe job, this is emphasized by the National Safety Council.

> Despite the development of complicated machine tools, the hand tool is one of the most important tools of civilization. Every home has at least a hammer, screw driver and perhaps a pair of pliers. But not every person in the home knows how to use the tools they have nor how to take care of them. As the result, the misuse of hand tools is the cause of many injuries, sometimes quite serious ones. (37 - Page 1)

There may be some confusion between the term, improper tool for the job, and the term, improper use of the tool. The confusion may be clarified by stating that the pipe wrench used on a nut is actually an improper tool for the job; likewise, the same pipe wrench used on a round object is the right tool for the job; but when an extension is used on the wrench handle or the handle is hit with a hammer, the term, improper use of tool, is applied.

To better illustrate the improper tool for the job, a list has been prepared from the study on hand tools by Roland P. Blake. (12 - Page 158)

The following is an example of improper tools for the job:

1. Machinists' hammers being used to drive nails.
2. Carpenters' hammers being used to hammer metal.
3. Drills sharpened to drill steel used to drill brass or copper.
4. Screw drivers used as chisels.
5. Open-end wrenches used too large for the nut.

6. Pipe wrenches used on square objects.
7. Draw-knife used in place of the hand axe.
8. Emery wheel used to dress wood.
9. Wrenches used as hammers.
10. Files used as pry bars.
11. Ripsaw used for cut-off purposes.
12. Knife used as a screw driver. (2 - Page 160)

The items listed are only a few. In fact, any tool could be the improper tool for the job unless through self-discipline and knowledge of safe practices the right tool is always used. Many times the individual may state, "I just can't afford the right tool every time." This economic situation may exist, but to have an accident through using the improper tool will only make things worse. The National Safety Council states that:

> Because of the wide spread use of hand and powered hand tools and the severity of many injuries, it is important that control of tool accidents be made a part of every safety program. Each year hand tools are the source of about 7 or 8 per cent of all compensable injuries. Disabilities include the loss of eyes or vision due to flying chips from tools, severed tendons from knives and axes, broken bones due to slipping or defective wrenches, and infections resulting from puncture wounds. One study indicated that practically all of 1800 intro-ocular foreign bodies were steel particles, 80 per cent of which originated from mushroomed edges of cold chisels, drills or hammers. (17 - Chapter 12, Page 30)

It should be understood that statistics of this nature do not give the full picture because of the lack of accident reporting. These figures are enough to convince the average person that it could happen to anyone.

The 7 or 8 per cent that is mentioned by the National Safety Council is divided into four causes: (1) Improper tool for the job, (2)

Tool in an unsafe condition, (3) Tools improperly used, and (4) Tools not kept in proper place.

Hand tools may be divided into four classes; (1) cutting tools, (2) impact tools, (3) abrasive tools, (4) other hand tools, such as screw driver, pliers. This study will consider as cutting tools those tools that have a cutting edge that may be sharpened and whose primary purpose is cutting. This classification will include hand saws, bits, and cold chisels. Impact tools will be tools such as malls, hammers, mallets. Abrasive tools are those tools such as hand grinders, files, sanders. Some tools and their unsafe condition likely to be in the hobby shop are listed in Table V.

TABLE V

TOOLS AND THEIR UNSAFE CONDITION

Tools	Unsafe Condition
Abrasive tools:	
Grinding wheel	Out of round, cracked, improper grit, abrasive face not square.
Oil stones, sandpaper, and emery cloth	
Files and racks:	
Round, flat, half-round three-cornered, tapered	Improper size or type, dull, chipped, no handle or broken handle, cutting face filled with soft metals, greasy.
Awls:	Dull, improper temper, improper point angle, loose handle.
Bits and boring tools:	Improper temper, improper cutting angle for type of work. Improper lip angle, dull, improper size. Improper bit. Bent, crystallized, worn shank.
Chisels: cape, diamond point, cold chisel, wood chisels	Mushroomed head, dull, over-sharp, improper size or length, overly

TABLE V (Con'd)

Tools		Unsafe Condition
		hard or soft, improper for the job, loose handle, rusty or greasy.
Hammers:		Oval face, chipped face, crooked, loose, or split handle. Handle improper length, bad condition of claws, too light or heavy, oily face or handle.
Hatchets and Axes:		Cutting edge dull or overly sharp head loose on handle, improper temper.
Knives:	pocket, draw, putty	Loose blade or handles, dull, over-sharp blade too small or too long, improper temper.
Pliers:		Improper size, worn, rusty, not insulated for electrical work, improper type for the job.
Planes:	fore, jack, smooth	Dull, blade not square ground, loose handle, rusty, improper kind, cutting edge chipped or improperly ground.
Punches:	center, drift, taper, prick	Bent, worn point, mushroomed head.
Reamers:		Worn, dull, bent.
Saws:		Improper set, long or short teeth, bent, hot spots, cracks, improper gum, improper pitch, rusty, loose handles, worn blade, improper size, blade improperly ground, loose handle.
Screw drivers:	standard, Phillips, clutch head, spiral ratchet	Note: Some plastic handles have the tendency to ignite easily, also some handles exploded, scattering fire over the shop.

(19 - Pages 2, 3, 4)

Power Equipment. The exact number of power equipment accidents

each year is probably unknown, but the seriousness of these accidents is reflected in the analyses of the many cases of compensable injuries. Human beings performing activities in industry on the same type of power equipment found in the hobby shop have lost members of the body, received deep lacerations and severed tendons that left the individual partially or totally disabled for life. In many cases death was the result of the accident.

To give a better view of the seriousness of power equipment accidents, Table VI has been prepared from a study by Blake concerning the disability distribution per 1,000 injuries in the state of Massachusetts.

TABLE VI

DISABILITY DISTRIBUTION PER 1,000 INJURIES AND AVERAGE NUMBER DAYS LOST

Type of Machine	Disability Distribution Per 1,000 Injuries: Fatal and Permanent Total	Permanent Partial	Temporary Total	Average Number of Days Lost Per Temporary Total Injuries
Abrasive wheels	2.5	74.22	932.26	17.74
Polishing and buffing	3.47	41.66	954.86	20.32
Planers	(1)	152.77	847.22	19.72
Circular saws	(1)	155.17	844.82	(1)
Milling machines	(1)	147.46	852.53	32.76
Screw machines	(1)	246.15	753.84	(1)
Turret lathe	(1)	107.14	892.85	19.06
Lathes, all others	(1)	88.01	904.64	18.93
Boring Mills	(1)	79.63	920.63	22.68
Drills	(1)	57.25	942.74	26.41

(1) Rates not shown because base was less than 50.

(2 - Page 217)

To explain the table, using the abrasive wheel figures, there were two and one-half persons totally disabled or killed in every 1,000 abrasive wheel accidents. There were 74.22 persons that received partial permanent injuries such as lost fingers or a stiff joint of the body. There were 923.26 temporary total injuries for each 1,000 accidents involving the grinder, with 17.74 days lost time average for each injury.

It is noted in Table V that for 1,000 drill accidents there were approximately 57 permanent partial disabling injuries and 942 lost time accidents. The best rules to follow are the manufacturer's operating rules; and if these are not understood, do not hesitate to ask for help and advice from a qualified instructor such as the local Industrial Arts Shop Instructor.

In the majority of the power equipment accidents the individual was failing to abide by the rules of safe practices at the time of injury. Some unsafe practices that may lead to a serious injury or damage are listed:

1. Failing to make sure the equipment was free to move before turning on the power.
2. Not oiling and greasing according to the manufacturer's instructions.
3. Failing to remove excess oil and grease from the machine.
4. Not properly disposing of oily rags and papers after wiping the equipment.
5. Attempting to operate equipment that is not familiar.
6. Operating machine in glare, shadows, and insufficient light.
7. Failing to lubricate the equipment.
8. Attempting to adjust or repair machine while it is running.

9. Leaving the running equipment unattended.

10. Leaning against a machine that is running.

11. Operating machine without guards, or guards that are defective.

12. Wearing loose clothing, long sleeves, ties, or jewelry.

13. Not having an emergency stop switch within reach should the clothing become caught in moving parts.

14. Operating portable power equipment that is not grounded or when the footing is wet.

15. Not having material firmly secured.

16. Excessive exposure of the saw.

17. Insecure footing when operating power equipment.

18. Removing chips and excess cuttings with the hands or compressed air.

19. Using machine table for a work bench.

20. Failing to have a dielectric or insulation test for the extension and electrical cords.

21. Using spliced electric lines not in accordance with National Electric Codes.

22. Using portable power equipment that does not have spring loaded safety switch; the switch automatically stops the current if the operator loses his grip.

23. Using the equipment for work that it was not designed for. (25 - Page 19, Feb. 59)

The preceding list shows only a few general unsafe acts that lead to injury and damage. It may be well to discuss other hazards and unsafe acts more specifically with some of the various power equipment.

Drills. Drill presses and other power equipment that is belt driven may have a static electricity hazard. The discussion on static electricity is prepared from the Safe Practice Pamphlet:

1. The generation of static electricity is difficult

to prevent, but few hazards are involved in its generation. The hazard results when static accumulates to such an extent that a spark is discharged. The hazard can be controlled only by preventing static accumulation.

2. Static electricity can be dangerous should a spark be discharged to of from a human body in that it may so startle a person that he may fall or come in contact with dangerous equipment. Relatively high potentials (300 volts and over) may produce discharges which will ignite combustible material or cause muscular reactions in persons.

3. Hazards from static sparks are more severe in dry, cold weather than during humid, warm weather. During winter months, indoor surfaces in artifically heated buildings become dry because of low relative humidity. Consequently, many surfaces decrease in their conductivity and may permit static electricity to accumulate. During summer months when relative humidity is high, most surfaces are coated with a film of moisture which makes them comparatively good conductors, and usually permits the static to dissipate as it it generated.

(42 - Pages 2, 3, & 52)

Hand tool accidents are a high percentage in the accident rates, but the seriousness of these accidents usually involves smashed fingers, broken bones, lacerations and abrasions. This type of injury soon heals, with the person having lost only a few days' time. The eye injury from flying objects and particles of steel, wood, and the various chemicals is the most serious type of hand tool injury. Eye injury may be classified in the hazardous category the same as power equipment injuries where there is danger of losing members of the body, cutting arteries and blood vessels. Power equipment injuries as a rule are serious and the prevention of these accidents should receive emphasis.

Grinders. Grinders that are power driven have some specific hazards that are not visible to the casual view. Some of these hazards actually involve the individual's unsafe practice, some of which are listed:

1. Not wearing goggles.

2. Using an unbalanced stone.

3. Using the side of the stone, which may cause it to break.

4. Not permitting the stone to reach proper RPM and warm up.

5. Operating machine that is unguarded or improperly guarded.

6. Applying too much pressure to the wheel.

7. Improper type of wheel for RPM of machine, wheel may explode.

8. Improper position of work contact with wheel, too low or too high.

9. Wheel improperly mounted.

10. Improper location of stop switch causing operator to reach across machine.

11. Improper position of work rest.

> The abrasive grinding wheel is probably the most universally used power tool in all industry. Because of the wide and common usage of abrasive wheels and their frequent use under conditions where safety minded supervision is lacking, frequent injuries result from this operation. (25 - Page 16, May 58)

The abrasive wheel that has been purchased, stored, or not used should be tested. Blake gives a good description:

> Wheels should be inspected before being used of after remaining idle for any length of time. One method of testing is the ring test. When stuck by a wooden mallet, a vitrified or silicate wheel gives a clear metallic ring if the wheel is sound. A bursting abrasive wheel can cause great damage and loss of life, and every precaution must be taken to prevent injury that might cause one to burst. It is important that wheels be properly stored, mounted, and used. (2 - Page 228)

Joiners. Wood joiners are machines particularly designed to handle rather long material, nothing less than 12 inches in length. The machine is relatively simple to operate; and if the general safe practices

are followed, there should not be any damage or injury; some of these rules are:

1. Fasten knives firmly in place.
2. Keep the knives sharp.
3. Keep hands well away from knives.
4. Put the guards in place.
5. Keep the guards in place.
6. Be sure the debris is cleared away from around the machine in order to have good footing.
7. Check all special set-ups before the machine is turned on.
8. Do not wear gloves when operating the machine.
9. Do not oil machine while machine is in motion.
10. Hold work firmly against the fence.
11. Never stand directly in line with a piece being machined.
12. Do not use material that is split or has knots.

(4 - Page 183)

In addition to this list it may be well to use a push stick on all jobs that require it. Do not be distracted as long as the material is on the machine and the machine not shut off. To join end grain and made heavy cuts may cause an accident.

Buffers. Buffing and polishing machines are sometimes found in certain hobby shop activities. The buffer or polisher may look harmless but should the loose clothing become caught in the whirling buffer or polisher an injury could occur. A few simple safe practices are listed to assist the operator.

1. Wear close fitting clothing. On jobs where a wire mask or respirator, in addition to goggles, would increase your safety, always wear it.

2. Hold object to be polished against wheel at, or below, level of shaft or arbor. Any object caught by the wheel then will be thrown down - not toward the operator. If possible, do not work directly in line with revolving wheel.

3. Hold small pieces to be buffed in a simple jig. Do not wear gloves. Never hold work objects in corner of apron or other clothing when applying it to the wheel.

4. Two persons should not attempt to polish two objects on a wheel at some time. When a helper is necessary in holding some large object against wheel, use good team work.

5. When applying rough or tripoli to a revolving wheel, hold cake or stick lightly and apply its side to the wheel rather than its end. Do not use a file for truing the wheel or rubbing off rouge or tripoli.
(4 - Pages 5 & 50)

Shapers. Shapers are a valuable piece of equipment in the hobby shop, especially when the activity is furniture construction. Guards and safe practices is the answer to preventing accidents with these very dangerous machines. Each project may require a variety of work which necessitates the using of different guards, such as: ring guard, pressure guard, vertically adjusted guard, and cap guard. When the project is to be more than one item, each phase of the shaping should be completed on all like pieces; this eliminates the need for constantly changing guards. Remember that changing guards and obeying the safe practice rules may seem boresome, but past experiences in other shops show that to do the job right is to do it safely.

A few of the more important safe practices are listed for those who may have forgotten or do not know:

1. The set-ups should be thoroughly re-checked before any work is actually started.

2. Be sure the knives are sharp and well seated and

balanced before they are tightened.

3. Do not leave part of the blades in and remove one; take all of them out to prevent the knives shelling out in case the machine is accidentally started.
4. Be sure the wood covers the blade, readjust if necessary.
5. Use a jig for short material, keep hands away from blade.
6. Knots and cross grains will cause kick backs, always be watchful that the hands are not forced into the knives.
7. Short knives are dangerous, be sure the knives extend back two-thirds of the length of the grooves.
8. One-piece cutters are preferable to the multiple knives.

Saws. Saws have a colorful history dating back to the "hairy mammoth, wooly rhinoceros and saber-toothed tiger." It is estimated that the oldest saw dates back "6,000 or 7,000 years," almost "20 centuries before Abraham." (16 - Page 3) Although the saw has a colorful and interesting history, the possibility remains that it also has had a bloody past as well as a gory present. Blake indicates that in the circular saw field that 155 persons receive a life-time partial disability in each 1,000 circular saw accidents; this amounts to approximately 15 per cent.

In Hoffman's study of the Legal and Moral Problems of Shop Teacher Liability, many accident facts were discovered. The percentages of each type of shop equipment involved in the total number of power equipment accidents is reflected in Table VII.

TABLE VII

MACHINE TOOL ACCIDENTS

Machines	Percentage of Cases
Joiner	9
Saw, variety	7
Saw, band	6
Drill press	5
Lathe, wood	4
Saw, jig	4
Surfacer	1
Saw, radial	1
Saw, power hand	1
Sander	1
Lathe metal	1
Miscellaneous	1

(7 - Page 17)

As indicated in Table VII, the different types of saws were involved in 19 per cent of the total machine accidents. Heinrich states, in the publication, Industrial Accident Prevention, that "Accidents do not just happen; they are caused." This statement leads one to believe that when something is "caused," surely there is a preventative measure that may be applied. With this thought in mind, the logical thing to do is emphasize safe practices. Some safe practices in band saw operation are:

1. Check the tension of the saw before starting.
2. See that all guards are in place.
3. When turning off the machine, do not try to stop the saw by thrusting a piece of wood against the blade.
4. If the saw breaks, do not attempt to remove any of it until the machine has been turned off and stopped.
5. Do not feed the stock too fast.
6. Do not try to saw cylindrical stock.
7. Check to see that the correct width blade is used

for the job.

8. Operator must stay in the safety zone.

9. Never reach beyond the saw to get material on the other side.

10. Do not cut small pieces without special jig. (4 - Page 185)

It may seem that safe practices are actually a part of proper operating procedures which in many cases were never learned or were overlooked in the haste to get the project under way.

The circular saw comes in several types; the three most common types are: (1) the table saw, (2) overarm saw, and (3) portable power saw. Many of the general safe practices may be applied when using either type; but it must be remembered that each type has its own special safe practices that must be used if injury or damage is to be prevented.

The one big safe practice concerning any power saw is to shut the power off and let the blade come to a stop before any other action is taken. Some saws have a brake.

The table, or bench, saw has cutting teeth on the under side as well as on top, so remember not to clean the sawdust from under the table until the power is off and locked out. Many operators have lost fingers as well as hands because they tried to clean out the sawdust by hand while the blade was turning.

The Radial or overarm saw is fast becoming popular because of its many uses. With the overarm circular saw large or small wooden discs may be formed. The overarm saw may be used for crosscutting, bevel ripping, mitering, compound miter, angle cut off, ripping, and dadoing.

The saw blade may be used for sawing, or dadoing by simply removing the saw blade and mounting the dado head. After each setting recheck all items for tightness and correct setting.

Some of these overarm saws have a spring return and this must be remembered; the saw should always be under hand control until it is returned to the original position. Never reach under or behind the saw with the hand. There is a blade hazard in overarm saws, because more of the blade is exposed; therefore, the saw should not be forced across the wood. Make frequent inspections of the blade for gums and cracks. It pays to keep the blades sharp; they should be sharpened by an expert or by machine, hand sharpening may soon unbalance the blade of any saw.

The safe practice of wearing proper clothing and protective equipment for the activity has prevented many injury and damage accidents.

Materials. Materials may be classed as non-flammable, flammable, explosive and toxic. The non-flammable material presents a hazard problem in storage and handling procedure. Materials improperly stored and handled are a contributing factor in a large number of accidents. Statistics for a two-state survey, New York and Pennsylvania, indicate that during a five-year period "134,658 persons were disabled while handling objects; 22,823 of these injuries were acquired in manufacturing establishments." (27 - Page 22)

The hazard lies in the stacking and piling, lifting, transfer, and actual construction; this hazard may be controlled by safe practices some of which are:

1. Do not stack materials too high.
2. Tie the materials together with cross slats.
3. Round material should be well blocked on each layer or tier.
4. Have help on heavy or long material.
5. Stay from beneath high material when getting it down.

6. Lift with the leg muscles instead of the back.

7. Be sure feet are clear when lowering heavy material.

8. Do not handle sharp objects with bare hands, use gloves.

9. Handle the material with care.

The flammable materials are any materials that may burn when ignited. The materials should be handled so as not to present a fire hazard.

Solvents. Solvents and cleaners that are used around many shops may be considered a material by some individuals and as a tool by others. Many of the solvents and cleaners are toxic and are involved in many health injuries and fires. Emphasis on fire prevention has been very beneficial in lowering the injury and death rate. More emphasis should be placed on chemical and solvent hazards; for instance, many hobbyists in hair styling do not know that many of the hair setting sprays are very flammable and in some cases toxic to the skin. The same may be said concerning the solvents and cleaners used in the hobby shop. Some of these commonly used, but not understood, solvents and chemicals are listed from the Safety Chemical Chart series:

1. Ammonia, aqua. Hazard; this liquid will cause burns; the vapor is extremely irritating. Safe practice; avoid breathing the vapor. Avoid contact with eyes, skin, or clothing. All clothing should be cotton, also wear rubber boots, hat, and apron. Use only approved safety goggles. Do not store in sun, and keep away from heat. Use plenty of clear water to wash body in case of spillage.

2. Chlorine is classified an non-flammable. The maximum concentration for 8 hours exposure is 2 ppm. An exposure of 40 ppm is likely to cause fatal lung damage in 30 to 60 minutes. Special training is necessary to safe handling and use.

3. Benzene (Benzol) is extremely flammable and has a harmful vapor-poison. Is toxic by breathing, contact. Day by day exposure to even small concentrations may

develop into cronic poisoning-anemia. This chemical should not be used around sparking tools.

4. Trichloroethylene, also known as Perchlorethylene, is toxic by inhalation, by prolonged or repeated contact with the skin or mucous membranes or taken by mouth. Careless handling of the chemical may prove injurious. The chemical effects the lungs, skin, digestive system and the nervous system. Reacts violently with strong alkalies to form explosive mixtures.

5. Carbon Tetrachloride is toxic to the body by the same methods as Trichloroethylene except that it attacks the liver and kidneys. The symptoms are often mix- taken for heptititus. (34 - Series)

There are many more solvents and cleaners, both acid and alkaline which should be thoroughly understood so that the recommended safe practices may be applied. Some general safe practices are listed concerning solvents, cleaners, thinner, and paint removers.

1. Know the hazard of the chemical being used.
2. Wear the recommended protective clothing.
3. Avoid long exposures also some repeated short exposures will build up in the body over a period of time.
4. Avoid contact with chemical.
5. Use the proper neutralizer in case of contact.
6. In all cases provide plenty of ventilation and work on the windward side.
7. Take fire prevention precautions.

If all of these safe practices cannot be complied with, the job is not worth doing if the individual values his property, health, and life.

Goggles. Eye injuries and eye loss are receiving more recognition in the industrial activities, and since many hobby shop activities present a hazard to the eyes the following information on goggles is prepared from the Safe Practice Pamphlet:

1. It is estimated that about 100,000 industrial eye accidents, involving one or more days of lost time, occur every year. Of this number, approximately 5,000 result in permanent impairment. The total annual cost of such industrial eye injuries in the United States is between $12,000 and $15,000.

2. Reports of seven state labor departments show the average compensation cost of permanent eye injuries to be $1,600, not counting medical expenses, loss of time, loss of production, and other hidden costs. This cost can be reduced. A metalworking plant spent an average of $1,668 per year on eye accidents during a five-year period when goggles were required on hazardous jobs only. Goggles were required on all jobs, and this cost was reduced to $88 per year. By an enforced wearing of safety goggles, a coal mine reduced eye accidents in three months with an estimated saving of $30,000. In 166 steel mills, employing 100,000 workers, 2,397 eyes were saved over a two-year period with an estimated cash saving of more than four million dollars.

3. Nearly all eye injuries can be prevented by the use of goggles. However, eye injuries may be caused in so many different ways that it is difficult to say under what circumstances the worker may be safe without goggles. Men have lost their vision mixing mortar and plaster when small particles have entered the eye. Girls operating sewing machines have had needles break and destroy their vision. A man cutting a piece of wire off a coil in the stockroom lost his vision when the end of the wire sprang up and struck him in the eye. Another man changing storage batteries in a shop nearly lost his vision when the battery acid suddenly splashed into his eyes. In another case, a man was sitting at his desk breaking locker keys by holding them with a pair of pliers and striking them with a tack hammer, when a part of a broken key flew into his eye, injuring it badly. Metal shavings from a drill press struck a worker a glacing blow, causing loss of an eye. The use of a pair of corrected (non-case hardened) lenses in a worker's spectacles caused an eye loss. One of his glasses struck the frame of a drill press and caused the glass to shatter and enter his eye. Many workers have lost their vision due to nails flying from the hammers they were using, and also due to nails flying from a considerable distance in shipping rooms.

4. On the other hand, goggles saved the sight of a man who was tightening a half-inch cap screw on the side of a press. The screw broke and the spring washer

shot the screw head against his goggles with such force that the lens of one goggle was broken and the goggle frame bent, but his eye was not injured. In another accident a shim snapped from beyond the blade of a shear and struck a man across the face, cutting his nose and loosening several teeth. One goggle lens was broken, but the eye was uninjured.

5. Where there is a possibility that an eye accident may occur because of a certain operation, goggles or other suitable devices that will afford complete eye protection should be used. One prominent safety engineer of a large forging and stamping plant states that no one can determine when he will or will not need goggles. After a thorough study of conditions in his plant, it was concluded that not only must all shop employees wear goggles all of the time, but that all visitors to the shops must also wear goggles.

6. Goggles may be grouped into five classes according to the hazards against which they guard: (a) impact, (b) dust, (c) splash, (d) fumes or gases, and (e) glare and injurious light rays.

   There are over 40 types of goggles for as many types of work. (36 - Pages 1, 2)

Goggles are one of the many items of protective equipment that is obtainable by the individual. Utmost consideration should be given to providing one's self with those items that may protect from a possible permanent injury or fatality.

Housekeeping. Housekeeping is involved as a contributing factor in many accidents that would not have occurred with good housekeeping.

Good shop housekeeping assists in making the environment of the shop livable. Poor housekeeping rates high as an accident causative factor. Shop housekeeping may be divided into over 50 items, but this study will discuss only a few. Cleanliness which includes the floor as well as the tools and equipment is very important, although the process of housekeeping, if improper, may result in injury or damage. To illustrate some improper procedures that may result in injury and damage, the following unsafe acts and proper controls are listed:

1. Sweeping without proper floor sweep compound.
2. Washing the shop down with hose and water.
3. Cleaning grease from floor with flammable or toxic cleaning fluids.
4. Leaving windows open in dusty weather.
5. Failing to replace items to proper location or storage.
6. Delayed housekeeping.

The above list contains only a few of the many unsafe acts in housekeeping and the following is a list of hazards that may develop:

1. Dust explosion; fire, injury to lungs.
2. Electrical shock; slips and falls, rusty equipment.
3. Explosion; fire; toxicity; disabling injury.
4. Eye vision damage; equipment damage from grit; dusty atmosphere.
5. Tripping injury; bumping into, falling over, uncleanliness.
6. Delayed housekeeping results in dirty windows, tools, equipment, unsightly environment, slows production.

It may be seen that a simple unsafe act could develop into a very serious unsafe condition that may result in property damage, injury or death. The unsafe condition need not develop if the safe practice rule is applied to hobby activities. Some of the safe practices that could be applied in the six items are as follows:

1. Use a good fire resistant and a non-toxic floor sweep.
2. The vacuum cleaner may be useful in place of hose and water.

3. Use a non-toxic, non-flammable cleaner or solvent on the grease spot only, and then only after the excess has been removed by cloth rags or paper materials; here caution must be used in the disposal of these oily rags or papers. To avoid self-ignited fires, all oily rags, papers or other flammable material that is oily should be kept in an air tight metal container or at least a metal container that has a tight fitting lid. The closed lid prevents the circulation of air which is necessary for a flame, also the enclosed can will hold the smoke which in turn assists in smothering the flame.
4. Proper habits well developed will assist in replacing the items to proper location when they are not needed.
5. Delayed housekeeping is a habit, also, it makes final cleaning more difficult. Good housekeeping is a part of each day's activities; include it in the project planning.

The hobby shop is part of the individual's recreational life; therefore, the hobby shop should be a clean, pleasant place to relax. The housekeeping phase of accident prevention in the hobby shop activities has bearly been touched in comparison to the over-all value of good housekeeping.

Part C

The Human Element

Accidents thus far have been discussed from the viewpoint of unsafe conditions and unsafe acts. There is a logical answer to everything if the individual concerned could understand it. Probably the best place

to start in seeking a solution to a situation is to start by asking the question, "Why?" Why is it unsafe? Why does the unsafe condition exist? Why do persons perform unsafe acts? Why? Why? A uniform answer is indicated by Heinrich, Blake, Rosenstine, Bollinger and Weaver, Getsman, other safety specialists and psychologists as being the Human Element.

The human element usually involves; background, physical fitness, mental fitness and the environment within the individual; accident analysis reveals that one or more and sometimes all of these factors have contributed to the accident.

The Invironment. The background of some individuals starts during the pre-natal period in the form of heredity and fetus development, to the extent that approximately one out of 16 persons have a malformation handicap at the time of birth; this does not include the large number that receive permanent injury during the natal period. As some individuals progress through childhood and adolescent stages, economic circumstances cause poverty and malnutrition to such an extent that the physical and mental development is retarded. This physical and mental retarded individual will figure in the future accident rates. Also there are some that are, for one reason or another, overly developed physically or mentally.

Accidents sometimes are the result of how a person sees things. How things are seen by adults many times is brought about through the early training and experiences; this is somewhat explained by Peters:

> You never see anything merely as it is in itself. You always contribute something out of your mind by way of interpretation. ...What a thing means to us is determined very largely by what is in our own past experience. (9 - Pages 17 & 18)

This explanation by Peters implies mental seeing. The physical

seeing also is influenced by past experiences and many accidents are the result of errors in perception. This indication is illustrated by Lund as he presents two men, that have normal straight legs, standing behind a lattice work of diagonal construction; one man looks as if he is bow-legged while the other looks as if he has knock-knees. Lund's explanation of this illusion is thus:

> The environment provides only the stimuli or the physical agencies through which the perceptual act is set in motion. In some cases, the illusory response, when discovered, is easily corrected. In others, it persists in spite of our best efforts at readjustment, showing how well established are the habits upon which the perceptual process depends. (9 - Page 352)

> If perception is a matter of learning and experience, it must follow that our manner of perceiving a given object will vary in accordance to our experience with it, and in accordance to what we have been taught to see in it. (9 - Page 349)

The "I did not see" statement in some accidents may be true. Many accident reports contain a signed statement by the individual to the effect that "I did not see." This situation is quite frustrating to the individual as well as his supervisors. This period of not seeing may be referred to as psychological blindness, hypnotic blindness, or hysterical blindness. Some persons have been known to go totally blind and remain so for several years without any organic reasons. In some cases the blindness is only momentary but long enough for a danger to pass. The study of psychogenic blindness and its treatment is quite lengthy and cannot be justly and fully discussed except as a reminder that some individuals may use this mental mechanism in the presents of danger which in turn may lead to injury or damage. The individual may better understand himself if he will study <u>The Driving Force of Human Nature</u>, by Thomas Verner Moore. The book is very easy to understand.

Seeing is also effected by the color of the objects. The psychological effect of color determines in many respects what may be seen and the distance of its position.

> The effect of color on apparent distance was determined on the basis of findings of a research project at the Psychological Laboratory of the Johns Hopkins University Institute for Cooperative Research.
>
> In this investigation it was demonstrated that color does influence the apparent distance of a surface. The experiment shows that a bright surface appears closer than a dark one with a maximum average change in apparent distances of about 17 per cent. As much as 19 per cent change in apparent distance can be attributed to hue changes for saturated hues or deep colors. Less saturated hues - pastel colors - show the same effect but to a lesser degree.
>
> Hues of longer dominant wave lengths appear closer than hues of shorter dominant wave length. In general, highly saturated colors tend to appear closer than colors of low saturation. In this study it was conclusively demonstrated that color can definitely cause increase or decrease in the apparent size of the surface by at least 13.5 per cent. (25 - Pages 23, 33)

The hobbyist may be able to better understand why things in the shop are not where they seem to be. A situation of this nature should be remedied immediately because eventually the difference in apparent distance or size and the actual size or distance may result in serious injury or damage.

With these explanations in mind it may be seen that the individual involved in an accident may have a background of instruction and experiences influencing improper seeing habits which may be a contributing factor in the accident. Many hobby activities have been chosen with little or no consideration given to the individual's habits which largely effect safe practices.

Forming habits by the individual may be considered from Peters' viewpoint:

> They have allowed their mental content to crystallize in some definite shape, so that they can apperceive in only one definite way. Their minds have gravitated into a certain mold with time, just as a suit of clothes assumes with use a certain shape. You have doubtless seen how men, after they have looked at a matter for a long time in one way, can scarcely be brought to see it in any other light. If we do not constantly struggle to keep ourselves fresh and open minded we all fall, before we know it, into certain fixed and one-sided ways of looking at life's problems. (13 - Pages 121, 122)

Emotions are instrumental in causing accidents. Emotional control is largely habit that has been established through training and experiences. Before emotional control may be established it is well to understand just what emotions are. A descriptive definition of emotion is given by Lund:

> Under the influence of some unexpected and prepotent stimulus, the individual's bodily equilibrium tends temporarily to be disturbed. The exciting stimulus leads to profuse discharges within the somatic as well as the vetal and visceral systems. It is with these profound changes that the emotional state is usually identified. As experienced by the individual, it is a state of strong feeling and excitement. He is aware of increased heart beat and respiration, of unsteady shaking limbs, and of a strong impulse, as in the case of fear, to flee, or, in the case of anger, to strike. Many other changes occur, some of which are more apparent to the observer than to the emotionally responding individual. There are changes in facial expression and appearance, changes in digestion and circulation, and changes in metabolism and glandular secretion. (9 - Page 196)

This description leads one to believe that unless one had good emotional control there may be a number of unsafe acts performed by which an accident may develop. Lund further states:

> Without the objective there could be no emotion. You cannot love without having something to love, nor fear without having something to fear. Moreover, as we have noticed, it is not the emotion which varies so much as it is the stimulus condition. (9 - Page 197)

The stimulus condition in the shop should be recognized and a control im-

plemented which will prevent injury or damage.

Many individuals are excellent workers and may be able to follow precise details relative to the production but have very little ability for abstract thinking. Life and limb have been lost because the individual or some other person did not have the ability to do abstract thinking in an emergency; this is illustrated in a story of a man that needed a bucket to dip water but in the absence of finding a bucket discovered a sponge that he used. This principle of abstract thinking may be applied to accident prevention in the hobby shop using the general safety precautions as a guide.

Psychological factors are many and may carry over into the overt behavior to result in an accident. Jung considered individuals as being of three types; (1) Introvert, (2) Extrovert, (3) Average or Normal.

Some individuals involved in accidents have been discovered to be introverts or extroverts. Introvert persons usually devote a large percentage of their mental activity to introspection, such as feeling sorry for themselves, self justification for their attitudes and actions. The introvert usually spends much of his free time in isolation, condemning others, and will usually take defensive action in almost every instance; he thinks mostly of and for his own benefits, letting the majority alone. Also, if he sees a hazard or unsafe act, he will not mention it because he feels it is not his business. The extrovert is almost the opposite. This type individual is very gregarious to the extent that he is considered by many of his fellow men as being a busy body. Horse play, teasing, giving advice whether it is correct or not, are some of his favorite pastime activities. The psychologist, Jung, gives this consolation:

> The average person is not extrovert or introvert, but rather some place near the center between these two

> extremes with a tendency to cross the line in either direction for short periods of time, depending on the circumstances. (8 - Pages 14, 15)

Almost every shop and neighborhood has one or the other of this type individual that may, in an indirect way, be the cause of an accident to others.

The psychological factors are not fully the cause of accidents, but they do contribute to the individual's background and to some extent effect the process of learning safe practices that may prevent accidents. Merimann deals quite extensively with "learning" in his study, Psychology of Learning, dividing the study into memory, observational and associative learning. He states:

> For adults and children, it is more advantageous and it is psychologically and pedagogically more appropriate to learn every sort of material as a whole than to break it up into parts. (10 - Page 249)

This statement seems to hold true in learning accident prevention through safe practices. Some safe practices involve:

> (1) Dexterity and muscular co-ordination, (2) Technical information, (3) Development of judgment, (4) Standard of performance, (5) Recognition of degree of difficulty. ...A learner's achievements are best when he progresses from the simple to the complex. You must know what makes one operation easy and another hard to master in order to arrange operations in a difficulty sequence. (3 - Pages 45, 46)

It may be best for the individual to know himself as well as the equipment which he is to operate. The proper function of thought and muscles must be coordinated with the proper function of the equipment in preventing accidents.

Physical Unfitness may not be recognized, by the individual, as being of importance in the hobby shop activities and many an unsuspecting person will select a hobby that is not suited to his physical fitness.

In an effort to determine the physical fitness of the average male in the prime of life the Life Extension Institute made a survey of physical defects of males in the prime of life. The results are shown in the following quote and in Table VIII.

> A physical defect may be said to be any alteration in structure or function of an organ or a portion of the human body, considered to be a distinct deviation from the normal structure or function. In some instances and under some standards of diagnosis, a physical defect may also be a disease. (33 - Page 1)

TABLE VIII

PHYSICAL DEFECTS

(Examination of 100,000 Males in the Prime of Life)

Physical Defects	Percent of Total
Eyes and Ears:	
Defective vision uncorrected	27
Defective hearing	13
Nose and Throat:	
Enlarged, cryptic, buried tonsils	45
Hypertrophic rhinitis (enlarged turbinates)	37
Teeth:	
Heavy dentistry (X-Ray recommended)	39
Slightly infected gums	18
Carious teeth, septic roots	15
Pyorrhea, definite	6
Heart and Pulse:	
Functional murmer or irregularity	6
Enlargement	2
Organic Valvular lesions	4
Blood Vessels:	
Arterial, thickening	17
Varicose veins	6
Varicocele	9
Respiratory:	
Frequent colds	16

TABLE VIII (Con'd)

Physical Defects	Percent of Total
Stomach and Abdominal:	
Constipation	34
Hemorrhoids	13
Acid stomach	10
Gastric disturbances	8
Hernia	6
Genito - Urinary:	
Prostate enlarged, tender	8
Brain and Nervous System:	
Nervousness	7
Abnormal reflexes	8
Endocrine Disturbances:	
Goiter	2
Urinalysis (given to 79,126 men):	
Albumin	22
Pus	13
Sugar-traced or marked	7
Miscellaneous:	
Chronic skin infection	10
"Headache"	21
Dizziness	8

(42 - Page 1)

The hobby shop is fast losing its classification as a sanctuary for the individual: It must be considered that the hobby shop is becoming a part of all family members' activities. Therefore, education in the hazards and safe practices is necessary for all members of the family. This is emphasized in the statistics by the National Safety Council's publication, Accident Facts, which states that "27,000 persons of all ages were killed and 2,000,000 were injured in home area activities during 1959. The dollar cost in these home area accidents was approximately $14 million."

In the interest of home safety, the following information is given.

It is estimated that approximately 650,000 injuries a year evolve from the new "fix-it-yourself" trend. Of this total, 107,000 injuries were the result of painting activities in the home area. Those persons making or repairing their own furniture were involved in 98,729 accidents resulting in disabling injuries, and 95,000 were injured while replacing broken window glass. (10 - Nov. 54)

The owner of the hobby shop should take the position of management in prevention of accidents for the following reasons: (1) He is the owner and therefore responsible. (2) He will bear the brunt of the expense of injury or damage. (3) His humanitarianism dislikes to see undue suffering. (4) His life or the life of the family may depend on it.

Heinrich indicates in his writings that 98 per cent of all accidents are "caused." These 98 per cent are considered to be 88 per cent unsafe acts and 10 per cent unsafe mechanical or physical conditions. To further illustrate these percentages, Table IX is prepared from Heinrich's Basic Philosophy of Accident Prevention.

TABLE IX

CAUSE FACTOR IN ACCIDENTS

Man Failure (Knowledge - Attitudes - Fitness - Ability) Unsafe Acts 88 per cent	Unsafe Mechanical or Physical Condition, 10 per cent
1. Operating without clearance, failure to secure or warn.	1. Inadequately guarded, guards of improper height, strength, mesh.
2. Operating or working at unsafe speeds.	2. Unguarded, absence of required guards.
3. Making safety devices unoperative.	3. Defective, rough, sharp, slippery, decayed, cracked.

TABLE IX (Con'd)

Unsafe Acts 88 per cent	Unsafe Mechanical or Physical Condition, 10 per cent
4. Using unsafe equipment or equipment unsafely.	4. Unsafe designed machines, tools.
5. Unsafe loading, placing, mixing, combining, etc.	5. Unsafely arranged, poor housekeeping, congestion, blocked exits.
6. Taking unsafe position or posture.	6. Inadequately lighted, source of glare.
7. Working on moving or dangerous equipment.	7. Inadequately ventilated, impure air source.
8. Distracting, teasing, abusing, startling.	8. Unsafe clothing, no goggles, gloves or mask, wearing high heels, etc.
9. Failure to use safe attire or personal protective clothing.	

(6 - Page 27)

A close study of Table IX may reveal the fact that these items are within the human control; not controlling any one of these hazards through safe practices is inviting an accident. The lack of hazard control through safe practices is costing the populace billions of dollars, millions of disabilities, and thousands of lives each year. This is a drain on the nation's economy and a waste of human resources that could possibly end in bankruptcy.

The human element has been discussed more on the "Why" accidents occur rather than on the actual occurrence of accidents; this was done to enlighten the individual so that the understanding would be clearer and have more meaning when the operating and maintenance procedures are being studied.

Accident prevention is the same in small shops as it is in large shops, because the accident prevention program in large shops is imple-

mented to include individuals, unsafe acts, unsafe conditions.

Some of the basic fundamentals of a safety program are discussed in the following chapter.

CHAPTER III

SUGGESTED HOBBY SHOP SAFETY PROGRAM

The implementation of the accident prevention program usually is easier and more effective when the program is well planned and organized in tabulated outline form. The safety program has many detailed instructions concerning the hazards and safe practices in and around the hobby shop; the program outline is used as a guide for implementation and may be beneficial as a ready reference should the need arise.

Many organizations that have a safety program well outlined and documented feel that "it" is the shop bible. When "it" is understood and obeyed, the results are better health, safer working conditions, more job enjoyment, less actual and hidden accident cost, better quality and quantity production, and longer life with a happier home.

The blind, crippled, and diseased bear witness that unsafe conditions and unsafe acts do not pay except in suffering, poverty, and in many cases, broken homes. It is estimated that in some activities the frequency rate has been reduced approximately 45 - 50 per cent within a year after the implementation of a good accident prevention program.

Many injuries that originally were of a first aid nature developed, through infection and neglect, to disabling proportion resulting in permanent disabilities and sometimes death.

Through well organized implemented safety programs many of the physically handicapped individuals are finding a place in the industrial

life of the nation.

The Safety program usually is designed to include all accidents; in some instances the program has a section devoted exclusively to fire prevention. With this thought in mind it may be well to divide this chapter into two parts; in Part A the discussion gives consideration to hobby shop safety in general; Part B will be devoted to fire prevention.

Part A

Outling Accident Prevention

Accident prevention is usually centered around the environment and human elements; with adequate control emphasized the unsafe conditions and unsafe acts probably would not occur. In many instances the unsafe condition is the results of the human element; therefore, greater emphasis should be placed on the actions and sometimes lack of actions of the human being.

Most human activities to be successful involve good Leadership. Good leadership usually has organized Policies that govern the activity. These two subjects are paramount in the accident prevention program which includes Survey, Inspections, Investigations, Analysis, Controls, Appraisal, and Follow-up.

Management Leadership. The hobby shop accident prevention program should be implemented through good leadership; this is especially true when the hobby shop activities involve the family members. Good leadership should:

1. Recognize the need for accident prevention in the shop area and the responsibilities involved.
2. Be familiar with the State and Local Codes and explain

these codes to other members of the family where applicable.

3. Know the "know-how to do it safely" and put this "know-how" over to the other participants.
4. Practice safety, set a good example, and let it be known that accident prevention is not merely a life service.
5. Give position and authority to safety; have a good understanding of human nature and its drives.
6. Present the safety rules in a manner that can be understood by all members of the family that frequent the hobby shop.
7. Create and maintain interest in accident prevention.

Those responsible for good leadership may find it necessary to implement, what may be referred to as a sales program. This sales program may be as explained by Blake:

> A combination of advertising and information giving, and promotion of worker participation in the accident prevention program. This general program is directed at the major motivating characteristics that men have:
>
> 1. Instinct of self-preservation and comfort.
> 2. Desire for material gain.
> 3. Desire for praise, approbation, or distinction.
> 4. Fear of ridicule or disapproval.
> 5. Sense of humanity.
> 6. Sense of responsibility.
> 7. Sense of loyalty.
> 8. Competitive instinct.
>
> Civilized man tends to elevate motives he regards as nobler; but since this instinct is so deeply rooted in all of us, it will, if properly appealed to, prove powerfully stimulative of safe practices. (2 - Page 240)

It may be seen from these items, listed, that leadership has responsibilities which may:

1. Provide safe plant, or shop, equipment and tools.

2. Safeguard all machinery and hazardous materials.

3. Place no new machinery or equipment in operation unless full attention has been paid to its safety.

4. Plan all processes and operations with careful attention to safety.

5. Maintain a system of inspection to discover correctible hazards.

6. Maintain safety-minded supervision with continuous control.

7. Train, educate, and stimulate members of the family to follow safe methods of work and to take a sincere interest in the safety of themselves and the other members.

8. Investigate each and every accident to determine how best to prevent a recurrence. (27 - Page 27)

The individual may find that the responsibilities are not in many cases limited to being a private matter; but that in some cases the shop and the activity may be within the scope of local regulations which may include liability. In Heinrich's Basic Philosophy of Accident Prevention it is stated:

> Existing laws, rules, and ordinances require in varying degrees that work places, machinery, and equipment be maintained in a safe condition, that adequate first-aid facilities be provided, that accidents be reported, and that the employee be compensated when accidentally injured. ...and that a systematic effort, suited to the individual circumstances and conditions be made to eliminate, minimize, and control the physical and mechanical hazards and the unsafe actions of persons who have produced accidents or are likely to do so. (6 - Page 42)

Leadership and responsibility have been combined for discussion because usually the hobbyist responsible for the hobby shop is in a sense similar to industrial shop management and supervision which have similar responsibilities. It may be well for the hobbyist in this position to consider the possible laws relative to liability to non-family mem-

bers that may become injured while visiting or working in the hobby shop with the permission of the owner.

Many chapters have been written concerning leadership and supervisory responsibilities which are not fully discussed except to present them as a stimulus to the hobbyist so that further knowledge may be obtained which may be valuable in organizing the shop policies.

Policies. The policies for the hobby shop may be many in detail, but this discussion is limited to policies concerning supervision and operation. Some suggested policies are:

1. The individual responsible for the hobby shop should make sure that every person participating in hobby activities within the shop area understands the hazards and safe practices of the activity.
2. In case that a new hazard is integrated into the shop activities all persons concerned should be informed.
3. Visiting persons should not have free access to the hobby shop until all the shop hazards and safe practice knowledge has been acquired.
4. Safe practices should be a "condition" in continued shop participation.
5. Accident prevention should be of first importance in any production.
6. All persons involved should have a working knowledge of proper procedure in case of accident, to include explosion and fire.
7. All injuries, no matter how small or trivial, to receive first-aid care.

8. Experienced hobbyist should assume responsibility of assisting the less experienced hobbyist in difficult phases so that the proper learning of how to work safely may be thorough.
9. Physical examination should be obtained to determine individual limitations, such as: muscular dexterity, coordination, reflexes, seeing and hearing.
10. Housekeeping should be kept current and with no delayed action.
11. All accidents to be investigated and corrective action taken immediately.
12. The accident prevention program to be evaluated periodically, and revised to satisfy the changing needs.
13. Inspections should be made at intervals by some qualified person; because, in some cases, the hobbyist may psychologically justify his actions which eventually may become a subconscious unsafe habit.

These suggested basic policies have been formulated from information contained in the reference material (2 - Chapter 15).

These suggested policies are only a few that may be required in some hobby shops. With close consideration of these policies, it may be seen that they are very important in the accident prevention program and should receive emphasis.

Survey. A survey should be made of the hobbyist's property, equipment, and participating persons for tabulation of hazard areas. In case the hobby shop is a part of, or closely associated with the dwelling, the survey should include both. Some of the considerations that may be

included in the survey are:

1. Hazards in and around the dwelling that may effect the hobby shop.
2. Location of items that may be used in seeking assistance in case of emergency or serious accident.
3. Emergency escape routes and exits.
4. Hazardous material; quantity, type, and method of storage.
5. Data concerning the individual's qualifications.
6. Location and types of hazardous equipment.
7. Physical fitness of individuals; list each defect known or suspected.
8. Mental fitness; background, to include; training, experiences, disease, serious illness, and injuries.
9. Attitudes; which is a part of mental fitness but usually considered independantly, because it is involved in accidents as a contributing factor, such as: (1) Indifference - just doesn't care; lacks interest in "own" safety or in the safety of others, (2) Inattention - mind not on job, and many other reasons which include "victim" or habit.

The information obtained through a survey is valuable because: (1) in some instances errors in the original planning and organization are discovered, (2) some information of value may be forgotten when trusted to memory, (3) it is a part of the records system used in some hobby shops, (4) the information assists in planning the inspection procedure.

Inspections. There are three types of inspections: (1) one time, (2) periodical, (3) continuing or running; all three types have a pur-

pose in the accident prevention program.

The one time inspection is usually performed by local inspectors relative to codes in the electrical, fire, building, sanitation and health hazards and usually is done before occupancy of the building. On occasions there may be an additional inspection as a matter of follow-up and may or may not be a periodical inspection.

The periodical inspection may be made by those listed for one time inspections; also the periodical inspection may be made by the hobbyist responsible for the activity; this periodical inspection by the hobbyist should be made at least once a month using a prepared list. The individual may prepare the check list to include the general physical condition, housekeeping, equipment, tools, personal protective equipment, first-aid, fire, and health.

Information obtained from Safety Subjects Bulletin, No. 67, U. S. Department of Labor and the Accident Prevention Manual, third edition, National Safety Council has been compiled into an illustrative Inspection List that may be adequate for an organizational hobby shop which includes the automotive hobby.

INSPECTION

A. General Physical Condition
   1. Are benches and machines arranged so as to conform to good safety practices? Ex: Clearances.
   2. Aisles well marked and clear of rubbish and unnecessary objects?
   3. Floors in good condition, not slippery, strong enough, etc.?
   4. Safety zones well marked around hazardous areas?
   5. Windows clean, not broken and patched?
   6. Illumination good and without glare?
   7. Walls and partitions clear of obnoxious literature or objects that might fall?
   8. Ceilings or roof safe for type of work being done?
   9. Ventilation not smoky or with a stench?
   10. Heating comfortable to workers, controls properly working?

B. Housekeeping

1. Adequate and proper storage space, kept orderly?
2. Are tools and equipment in proper place?
3. Are corners clear and illuminated?
4. Work bench orderliness.
5. Are special tool racks at machines properly located?
6. Are scrap and trash containers properly located and kept?
7. Is there a delayed action in present housekeeping?
8. Are the new or used parts properly kept?
9. Are the tools and tool room equipment in proper place with adequate space?

C. Equipment
   1. Power Equipment
      a. Hoist wear and defects
         (1) Shive
         (2) Chain
         (3) Shaft
         (4) Hook safety
         (5) Carriage
         (6) Accessories
      b. Acetylene Generator
         (1) Away from other heat
         (2) Clean
         (3) Proper function of regulating mechanism
         (4) Hose condition
         (5) Safety zoned
      c. Electric Welders
         (1) Zoned, shielded area
         (2) Dry area
         (3) Proper maintenance
      d. Drill Press
         (1) Well guarded, but not overly guarded
         (2) Operation rules for operation
         (3) Anchorage
         (4) Location
         (5) Electrical wiring
         (6) Under foot
      e. Grinders
         (1) Anchorage
         (2) Electrical wiring
         (3) Guards in good condition
         (4) Goggles, face shields
         (5) Location
      f. Lathes
         (1) Cleanliness
         (2) Location
         (3) Type of work done
         (4) General condition
         (5) Electrical wiring
      g. Shapers; (Same as for Lathes) special emphasis on guards
      h. Power Saws
         (1) Location and clearances
         (2) General operation condition

(3) Electrical hook up
(4) Guards
(5) Operation warnings

2. Tools
   a. Wrenches in proper size and safe condition.
   b. Drills - straight, sharp, right sizes
   c. Punches - not burred.
   d. Chisels - not burred, sharp for purpose, right size
   e. Hammers - right size, no square face or over round
   f. Properly arranged in racks in tool crib
   g. Jacks and cribbing
      (1) Screw jacks not excessively worn
      (2) Hydraulic jacks not leaking oil and are holding loads all right
      (3) Proper location of jacks for lifting
      (4) Cribbing proper material and length

3. Personal Protective Equipment
   a. Goggles
      (1) Good condition
      (2) Proper quantity
      (3) Clear lens
   b. Gloves
      (1) Rubber
      (2) Leather
      (3) Canvas
      (4) Quantity and quality or condition depending on type of work done
   c. Hats
      (1) Machinist or mechanic caps - well padded, no bills or brim
      (2) Welder's hood No. 5 Lens, for arc
      (3) Welder's cap and goggles with No. 10 to 15 Lens depending on type of welding - light to heavy acetylene welding
      (4) Rubber hat for cleaning room - quantity and condition
   d. Rubber pants and coat for cleaning or acid work
   e. Antidote for any chemical or acid or alkaline (Location)

4. First Aid
   a. Splints - large, medium, small
   b. Blankets
   c. Dressings
      (1) Burns
      (2) Cuts
      (3) Abrasions
   d. Bandages
      (1) Triangular
      (2) Folded
      (3) Rolled
      (4) Tacked

(5) Compress
(6) Band-aids
e. Medication, antidotes, oils
f. Stimulant

5. Fire protection
   a. Extinguisher type - when filled last time, present condition, location and background
   b. Ladders - type and condition and location
   c. Respirators - type and condition and location
   d. Who knows what and how to use equipment?
   e. Trash containers, burning pit
   f. Open flame heating units
   g. Electrical
      (1) Grounds
      (2) Correct fuses
      (3) Wiring; insulation and overload factor
   h. Fuel, oil, chemical storage
   i. Smoking Area and No Smoking Zones
   j. Safety matches only

6. Health
   a. Rest room sanitation
   b. Fumes, stench, (internal, external)
   c. Ventilation - heating
   d. Drinking water facilities
   e. Noise
   f. Type of work worker is doing as limited by medical examination

Investigation. It may seem that there are accidents regardless of how good the program was originally planned and organized; this situation may be a reminder that accident prevention is a continuing activity. Accidents are the incidents that are unplanned and unexpected, therefore, it is necessary to investigate all accidents so that corrective action may be taken to prevent recurrence or similar accidents. The discovered hazard or unsafe practice, and sometimes a combination of the two, when properly controlled should cease to occur. Accidents have what is classified as a "cause" factor which is in many cases discovered only by thorough investigation.

There are several things that should be considered concerning the investigation; (1) Definition of investigation as applied to accidents;

(2) Need and purpose of the investigation; (3) Who makes it? (4) When and why should it be made? (5) What should the procedures be?

1. The definition: Accident investigation may be considered as a follow-up of the accident by patient inquiry, observation and examination of the facts. Every accident should be investigated.

2. The Need and Purpose is explained by Blake:

> The purpose of accident investigation is to discover the causative factors, the hazardous conditions and practices that brought the accident about, so that the proper action may be taken to prevent recurrence. The need is for full information as to cause - all the correctible causes that lead to the accident, not just the major cause; this point brings out the importance of eliminating the factor of fixing blame. If the purpose is to fix blame, or if the worker thinks it is, vital information will often be withheld or the facts will be destroyed. (2 - Page 100)

3. Who makes the investigation? There are several answers to the question which are discussed by authors of Accident Prevention Publications; probably the answer given by the National Safety Council sums it up in a short statement:

> Depending on the nature of the accident and other conditions, the investigation may be made by the foreman, the safety engineer, or inspector, the workmen's safety committee, or if the accident involves special features warranting consultation and assistance of such persons, by an engineer from the insurance company or state department. (17 - Chapter 25 - Page 11)

Some organizations feel that the person or persons making the investigation should be familiar with the activity in which the accident occurs; this indicates that the foreman or supervisor of the activity would probably make the investigation.

4. When should the investigation be made? As soon as the ac-

cident occurs or as soon after as practicable, because elements of the accident may not be available at a later date; witnesses may forget or unwarranted opinions may be formed. The injured or protection of property should have first consideration in any accident.

5. Procedures of investigation. Interviews with injured; getting his version of how it happened. Witness may have valuable information so get his story and observe all the visible physical elements. The investigation should be unbiased, confidential, and without formulated preclusions. Tabulate: the description of accident, facts for identification, causative factors, and facts that could cause recurrence or similar accident. The information obtained through investigation should be analyzed for causative and contributing factors so that controls and corrective measures may be implemented. "Accident investigation is in a sense a post mortem." (27 - Page 37) Accident analysis is more efficient after a good investigation that has included the human element; for instance, the emotional stability of the worker, the worker's reflexes, the comprehension of safety policies and procedures, the attitudes toward safe practices, and the worker's complexes - quiet, aggressive, pleasant, fear, worry.

Analysis: The analysis of the accident is very important. The facts are segregated from the implications and untruths; also, the organization of these facts may indicate the best possible controls and the possible

ways and means of implementing these controls. The analysis when properly made should show the following accident factors when they are present:

1. Inherent hazard; its type.
2. The location of the hazard.
3. Equipment in defective condition.
4. Unsafe tools; improper kind, type, and condition.
5. Poor design of equipment; many designs are not suitable.
6. Poor housekeeping; 50 or more items in housekeeping.
7. Failure to follow operating procedure.
8. Unsafe work practices.
9. Lack of individual alertness.
10. Systematic condition and its origin.
11. Insufficient knowledge of equipment.
12. Lack of proper supervision.

Accident analysis may be considered hind sight which usually permits one to see the errors in shop layout and activity planning. Probably the experiences of others in not emphasizing Job Analysis could help in the original planning so that the accident analysis will not be needed so often; in either case the analysis will assist in determining the corrective action and control that may be needed.

Control. Hazard controls may be considered as environmental and human controls; in both cases they may be implemented by the four E's: (1) Engineering (2) Education (3) Enforcement and (4) Enthusiasm.

1. Engineering may include new and safer designs, better personal protective equipment guards - in some places less guards, better inspections and maintenance proce-

dures, color identification of hazardous element, re-arrangement of equipment, better air conditioning and illumination, re-location of protective equipment, re-organized housekeeping, re-arrangement of work areas, and elimination of dust, fumes, vapors, or gases.

2. Education may include beginners training and progressive training, special training for more difficult activities, and review-training when the activity has not been participated in for some time. The individual should obtain an understanding in human nature and human behavior for better human relation with others. A good knowledge of hazards and safe practices is necessary.
3. Enforcement is best obtained through appeal to the individual's pride, creating a desire to belong to an accident-free shop, better worthwhile incentives and awards. The accidents may be prevented or reduced by the individual's application of self-discipline. Punishment should be the last resort.
4. Enthusiasm should start with the person responsible for the activity or program. Enthusiasm should be considered as contagious; therefore, everyone should be continuously exposed.

Some supplemental controls may be used, such as transfers, improved supervision, safety poster, films, safety pledges, safety committee, and safety contest.

Appraisal. The safety program should be appraised so that a value may indicate drastic deficiencies. Some of the considerations are:

1. Is everyone interested in the safety program and co-operating fully?
2. Are the accidents more frequent or severe?
3. Are inspections and investigations operating efficiently as indicated by the accidents?
4. Does the follow-up procedure indicate an adequate program?
5. Do the records include permanent and migratory individuals?
6. What are the present attitudes toward safety?
7. Are the methods and techniques of hazard control adequate?
8. Is the over-all safety program operating efficiently?

The weak points shown by the appraisal should be recorded and emphasized in the follow-up.

Most anything done in the way of checking to find out what is being accomplished concerning the rules, recommendations, suggestions, hazards, and safe practices may be accomplished through this suggested follow-up outline:

1. Interviews.
    a. Do the hobby shop participants understand the operating procedures for the equipment?
    b. Do the individuals feel a need for re-training in any phase of the activity or special study for advanced activities?
    c. Are all the policies for the shop remembered and understood?
    d. Is the attitudes improving concerning safe practices?
2. Observation.
    a. Has housekeeping improved?

b. Are protective equipment and clothing used more frequently?

c. Has glumness appeared in the personalities since the safety talk?

d. Is the production quality improving?

e. Are tools properly maintained and at the right time?

f. Are the proper type personal protective equipment used?

g. Is the over-all safety program accepted by all?

3. Safety Instructions.

a. Films - first steps in first-aid, grinding wheel safety, the voice of safety - what to do in case of an accident.

b. Individual and group training or new hazards and safe practice.

c. Books and pamphlets of safety in the activity - first-aid manuals - state and local safety codes.

d. Bulletin board - new posters - interesting news items, items of interest compatable to the activity.

Part B

Fire Prevention

The prevention of fires is in a sense a speciality because of the many different types of fires that require special methods and techniques in order to extinguish the flame without further injury. Fires start from so many different conditions that full discussion would be lengthy and detailed; therefore, fires will be discussed in Part B as a familiarization to the hobbyist.

Fires. In the past few years the general public has placed more emphasis on fire prevention which has resulted in lowering the National fire injury and death rate. Even with lowering of the rate, there is yet much to do in fire prevention; this fact is reflected in the 1958 Accident Facts, which shows that "6,400 persons died as the result of fire, burn or associated with fires." (24 - Page 6) The estimated United States building fire losses by cause, is shown in Table X.

TABLE X

1954 ESTIMATED UNITED STATES BUILDING FIRE LOSSES BY CAUSE

Cause Factor	Number of fires	Cost
Smoking and matches	121,300	65,400,000
Children and matches	27,100	13,900,000
Electrical fixed services, faulty equipment, misuse of equipment, faulty wiring	60,500	77,400,000
Power-consuming appliances	33,600	18,000,000
Flammable appliances, e.g. blow torch	4,400	2,460,000
Gas appliances, stoves, heaters	10,200	13,950,000
Spontaneous ignition	26,900	44,000,000
Lighting, overloaded circuits, etc.	43,200	43,600,000
Thawing pipes	2,000	2,400,000
Incendiary, suspicious	9,600	25,600,000
Explosion fires	10,500	23,050,000
Exposure, close to other fires	19,400	33,000,000
Miscellaneous	38,400	20,600,000

TABLE X (Con'd)

Cause Factor	Number of fires	Cost
Unknown	72,500	268,900,000
Totals	744,600	$875,450,000

(28 - Page 217)

Since the hobby shop is sometimes a part of, or adjoins the dwelling the hobbyist may be interested in fires of this type; the National Safety Council's Accident Facts reflects that in 1956 there were 523,500 dwelling fires with a cost of $260,000,000. This figure does not include hotels, apartments, boarding and rooming houses, motels or tourist cabins. Other fires that may be of interest to the hobbyist is that there were 4,700 woodworking fires with a cost of $39,556,000 and 15,100 garage fires with $25,473,000 damage. Other outbuilding fires numbered 32,400 with $16,510,000 loss. (24 - Page 22)

These statistical figures are given to assist the hobbyist in seeing the need for implementing fire prevention into the hobby shop safety program. Just the right place to start fire prevention may vary in some cases. One item that must not be overlooked is the fire department.

The local fire department has many types of extinguishing agents with which to use in combating various types fires. The fire department, also, has personnel well trained in rescue and life saving methods and techniques. Hobby shop participants should make themselves acquainted with the location of the nearest fire station and the approximate length of time for the fire equipment to reach the home shop. This information is valuable because if the distance requires a lengthy trip, it is advisable for the hobbyist to add the necessary emergency fire fighting equip-

ment to his shop list. The local fire department will furnish the estimated distance and time required to reach the shop in case of fire.

The fire chief or someone appointed by him may assist in setting up a fire prevention program for the home and the hobby shop. Many families do not realize they are just outside the protection of the fire department. Insurance is one way of recovering part of the loss, but it seldom covers the inconvenience loss, and it usually pays on the depreciation or use factor.

Types of extinguishing agents and their uses should be given adequate consideration, because many persons have perished as the result of using the improper extinguishing agent in extinguishing a fire. (7 - Page 2)

Sand and earth as an extinguishing agent may be used by some individuals, but the grit and dust may enter the working parts of the equipment and cause further damage. Water may be used on the Class A fire which involves the burning of paper, rags, trash, grass, and wood. The use of water as an extinguisher may involve some hidden hazards such as: electrocution if there is electrical equipment or wiring. Also, the use of water on oils and chemicals is not advisable because of the danger of spreading the flame, or of explosion. (29 - Page 1) The following is submitted in the interest of general home fire safety.

> Recent fires should serve as a reminder that home fire extinguishers should be checked annually. See that they are filled and in good working order. If a water line is available, keep a garden hose located conveniently. Other fire fighting equipment should include an axe, wrecking bar, and a steady ladder that will reach second story windows. In rural areas, an emergency water storage tank could be the means of saving the house. Remember to keep a first aid kit handy. (30 - Page 1)

Other commercial type extinguishers for Class A fires are: Air charged loaded steam, water pump type, gas cartridge, and dry chemical.

The air charged loaded stream type has an air pressure on the liquid which will expell the fluid when the valve is opened. The water pump type may be thought of as a combination similar to a tire pump in a container of liquid, and when the pump is worked, the pump expells the liquid instead of air. The gas cartridge type may be thought of as having a liquid that has a soda base (similar to soda and water) and in the top of the container is an acid or other chemical that will react with the liquid causing a gas pressure in the container, which will expell the liquid. The two reactors, soda and acid, are united when the container is turned upside down, and once started this type of container will empty itself. Water extinguishers need an antifreeze in winter.

The dry chemical is also used on Class A fires. In fact, the dry chemical extinguisher is the result of long, diligent research and development of an extinguishing agent adaptable to all classes of fires. In many industries and military departments, the trend is toward individual use of dry chemicals in fire fighting. Fire quenching agents are those that are primarily water. "The effect of the water is to lower the temperature of the material feeding the fire, which is in effect quenching the fire." (29 - Page 1)

Class B fires, are fires involving such substances as oils, greases, and paints. The ignition temperatures of oils and greases will vary in accordance with the type of oil or grease. Experience in the laboratories and in the shop prove the fact that water should not be added to hot oils or greases. This fact also holds true concerning most acids.

Oil and grease fires should have an extinguishing agent that will not cause explosion or spreading of the flame. The carbon dioxide (CO_2) is one of those recommended. Dry chemical agents are also excellent ex-

tinguishing agents. Vaporizing liquids, such as, carbon tetrachloride (CCl_4) have been used in the past; but recent studies have revealed that "since the fumes caused by using this type of extinguishing agent are very poisonous, it cannot be used safely in a closed room." (29 - Page 1)

The foam type extinguisher is used on oil and grease type fires, but in some cases the cleaning job is quite extreme after the fire is out. The dry chemical extinguisher is, also, good for Class B fires.

Class C fires are fires involving electricity, and the danger of electrocution is present, which requires a non-conductor type of extinguishing agent. The three common types most used on Class C fires are: Dry chemical, carbon dioxide, and vaporizing liquid.

The characteristics of these extinguishing agents will have one of the following qualities: quenching, smothering, or blanketing. Quenching is lowering of a combustion temperature. Smothering is accomplished by a vaporizing liquid which retards the available oxygen necessary for combustion. The blanketing effect provides a foam of carbon dioxide which covers the fire and excludes the air. (29 - Page 1)

It may be seen, by the study of the extinguishing agent's action on the fire, that the logical place to direct the extinguisher is directly at the base of the flame. Extinguishers should be located for easy access in case of a need. To better understand fire prevention and fire fighting it may be well to understand just what a fire is.

> Burning is essentially oxidation with the rapid evolution of heat. Every combustionable substance will ignite and burn if raised to a suitable temperature in the presence of air. The lower this ignition temperature, (of the material) the more likely it is to be reached; and therefore, the greater the hazard. Once ignition occurs, however, other properties of the substance in question have a bearing on the hazard. Fire prevention practices start, therefore, with the basic purpose of preventing the com-

> bustionables from reaching ignition temperatures. If the process necessarily involves heating to or above ignition temperatures, air must be excluded. (28 - Page 139)

Another hazard, besides electrocution, and toxic fumes, should not be overlooked. This hazard is smoke suffocation. The National Safety Council's Accident Facts states that, "More people die as the result of smoke suffocation than actually die of fire burn." (24 - Page 87)

To illustrate this fact, the story is told of how an old man living alone with his dog failed to save his own life. Some time during the night the old man was aroused only to find the house full of smoke. He made his way gropingly through the bedroom into the hallway where he became lost in the smoke. Fifteen minutes later the firemen found him crumpled on the hallway floor dead; the little dog was licking his master's face. Considering the facts involved, had the old man known the information about fire rescue and fire escape he would have stayed close to the floor as the dog did in his attempted exit, thereby being alive when the firemen arrived.

In concluding the discussion on fires, it may be seen that the old saying, "An ounce of prevention is worth a pound of cure," will hold true.

Most Fire Marshals, Safety Engineers, and fire research personnel will agree that most fires are preventable. The author of this study feels that fire prevention details may be numerous, but to state it briefly cannot be said much better than that stated in the Department of Labor Safety Bulletin:

1. Prevention of start of fire by construction, arrangement, control of operations, maintenance, housekeeping, and elimination of unsafe practices.

2. Prompt discovery and extinguishment. Except for the relatively few fires ignited by the explosive combustion of dusts, vapors, or other highly hazardous sub-

stances, all fires start small.

3. Limitation of spread. Provisions of suitable barriers and holding to a minimum the volume and value of combustibles present in a given fire area will limit the loss. Fire area is the area within effective fire stops. (28 - Page 217)

Accidents resulting in injury or damage usually involve the human being in some way. It may be that the individual involved or another person performed the unsafe act that resulted in the accident. Many things transpire within the human body that lead the individual to perform unsafe acts; these internal actions or reactions may be physicological or psychological. These may be functions which are unknown or not understood by the individual.

The suggested safety program has been presented so as to impress the hobbyist that the same hazards and safe practice problems in industrial activities are the same as those in the hobby shop. The hobbyist may be confronted with accident problems similar to those in the industries when the hobby shop conditions, activities, tools and equipment are similar to those in industry.

Industry may lose a human life now and then and still operate, but this cannot be afforded by the hobbyist. The hobby shop safety program should be well planned and enforced through self-discipline in the hobby shop. It is hoped that the suggested safety program may be used as a guide by the hobbyist to formulate and implement a safety program for the particular activity.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study was undertaken because of the realization that the average hobbyist does not have sufficient information available concerning the hazards and safe practices necessary to prevent the development of disabling injury and property damage accidents. The lack of this information is a basic contributing factor in many of the 28,000 fatalities and 2,000,000 disabling injuries that occur annually in the home area. Many hobbyists may not realize that the activity they choose as a hobby may be similar to an industrial activity which may be considered by thousands as an occupation.

The hobbyist may fail to realize that hazards are present in the home area probably because most persons are led to believe that the home is a safe place to be; basically this is true, but everyone should be aware of the fact that there is a difference between a secure place and a safe place; the underlying hazard in any activity is the unsafe acts of the individual. Many unsafe acts are the result of personal and shop limitations which should be recognized so that greater effort may be given to applying safe practices.

Individual hobbyists may feel that the unsafe condition is in the shop to stay; the unsafe condition usually is the result of improper actions or the lack of proper action at the proper time and may be corrected through safe practices. Formal training was discussed and some limiting factors in self-training were presented, such as, (1) the phase

of learning, (2) safety information usually is not a part of operating instruction, in many cases, (3) skill, knowledge and interest of the individual, (4) the economic situation and, (5) the negative results of some hobbies.

The location of the hobby shop is, in many cases, the primary contributing factor in accidents and in many instances the location discrepancies may not be corrected through modification. Modification of the hobby shop is an interesting activity when the many hidden hazards are known and corrected which will make the hobby shop safer; some of these modification factors are re-emphasized: The electric circuits and power survey, illumination, floor repair, ventilation and storage. Tables I, II, and III will be valuable to most hobbyists during planning and modification.

Hand tools, power equipment, and materials which are involved in many accidents have been discussed with the idea in mind that proper arrangement of the shop is compatible to accident prevention. Table IV is informative because it shows a national sampling of those Americans that own some type of fix-it-yourself equipment, also, the approximate number of disabling injuries for certain types of home area activities. The hand tools which are most important in our civilization are involved in many thousands of accidents; the improper tool for the job and the improper handling of tools and equipment has been discussed to emphasize the need for safe practices when handling hand cutting tools, impact tools, abrasive tools, and other hand tools such as the screwdriver.

A copy of Table V, which shows some types of tools and some of their unsafe conditions, may be beneficial to the hobbyist in preparing the shop inspection list. Table VI may be a constant reminder that it could happen

to anyone and that there is a need for controlling unsafe equipment.

Point of operation and power transmitting devices were discussed as the primary hazard areas in power equipment and the individual responsible for the activity should utilize all the necessary guards in conjunction with safe practices so the hazards may be controlled. Most power equipment activity involves hazards that necessitate personal protective clothing to be worn. These protective items should receive proper care. Proper work clothing was discussed so that the hobbyist may know that wearing loose, baggy, and sometimes overly tight clothing could result in a fatal accident.

Material factors in accidents should be remembered by the hobbyist, because many fires, explosions, and health disabilities are the results of improper handling and storage. Solvents in any form may have an ill effect on some human bodies and in many cases they have a cumulative latent characteristic which may cause total permanent disability or death.

Housekeeping was discussed in limited terms; therefore, the hobbyist should exercise care in the housekeeping of the hobby shop. The hobbyist may spend more leisure time in the shop activities than in any other activity in the home area.

The hobbyist as a human being has an invironment which needs as much attention, in many cases, as the environment. This study included the human element because it is felt that to understand one's self the unsafe practices may be recognized which is one of the first considerations necessary in implementing safe practices. The human element usually includes the physical man and the mental man; both being a part of the "whole" man and very instrumental in accident prevention. The information contained in Table VIII may assist the hobbyist in seeing what

may be some of the physical limitations. Unsafe acts and conditions were discussed as some of the cause factors in accidents; these factors and others need a control and the best place to start is by application of safe practices by the individual through self-discipline.

In the suggested safety program the need and value of safety was stressed; indications are that approximately 50 per cent of the accidents could be reduced in the first year the program is effective.

Conclusions. The indicated facts in this study stimulates one to believe the Heinrich theory of accident cause, "Physical faults and human faults" may be controlled through the 4 E's: Engineering, Education, Enthusiasm, and Enforcement. The use of the 4 E's may result in one of the following: Elimination of the hazard, isolation of the hazard, and guarding the hazard.

Engineering may be accomplished by: New and safer design, better arrangement and re-arrangement of equipment and production procedures; also, providing for better materials for the product and the storage of these materials. Engineering is only one factor in accident prevention and should not be relied on as a "cure all" for the problems involved.

Safety Education may be considered as the sum total of the processes in acquiring safe habits and knowledge which makes the individual a safer, efficient worker in the hobby shop, on the job, and in the community in which he lives. Safety education should include the human element in psychological as well as physiological terms; this will broaden the individual's understanding of himself and others.

Enthusiasm gives better results when it is constant; it should not let down when things are operating smoothly and flare up to unreasonable proportions. Enthusiasm may be compared to temperature; the hot and cold

temperatures are less effective than an average normal temperature. When the safety program is not sufficient for the need it is better to increase the average effort, that may be held at a constant; it is better not to become over-enthusiastic for a period of time and then relax completely.

Enforcement should be thought of as a process of training and self-discipline and not as punishment; this is a need that requires application to all family members. Many ways in which this may be implemented was discussed in how to reach the individual.

Recommendations. There are many detailed recommendations that could be made, but only a few important ones will be given. Probably the first concern should be given to reaching the individual hobbyist. One suggested way is the forming of a Hobby Shop Safety Club with a primary purpose of accident prevention. This organization could establish a general safety program and inspection team that may function on similar basis to the industrial safety section. A local club of this kind may function so as to improve the general safety in the home area.

Safety information, posters and general guidance could be easier to obtain as a group; as a group member the feeling of pride in the shop and in accident prevention may be stimulated. This same group may be a living example to the younger members of the locality.

Another recommendation that may be beneficial to the hobbyist and the populace in general is that the study of hobby shop safety be extended to include all the home area activities of a constructive or repair nature. The combined information of hobby shop safety and home area safety may be written in a booklet form and made available to those interested.

It is felt by this writer that when the populace is convinced that accidents are preventable through an adequate safety program for the home

area and that documented information is available in simple layman terms, then the home area accidents may be reduced and held to a minimum through self-discipline in the application of safe practices.

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