November 15, 1958

To the Graduate Council:

I am submitting herewith a thesis written by John Warren Carney entitled "Farm Shop Safety Program for Vocational Agriculture Departments in Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Education.

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Dean of the Graduate School

FARM SHOP SAFETY PROGRAM FOR VOCATIONAL AGRICULTURE DEPARTMENTS IN TENNESSEE

A THESIS

Submitted to
The Graduate Council
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

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by

John Warren Carney

December 1958

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CHAPTER I

INTRODUCTION

Purpose of the Study

This study was undertaken to improve safety in farm shop instruction in vocational agriculture in Tennessee.

The specific objectives of the study were:

1. To determine the general safety conditions in school farm mechanics shops in Tennessee.
2. To determine the rate, cause, and character of accidents in school farm mechanics shops during the period 1953 - 1956.
3. To develop a set of suggestions for a safety program in farm shop work in vocational agriculture in Tennessee.

Need for the Study

Over the period of the last fifteen years, machines, power equipment, and labor-saving devices have been purchased in ever-increasing numbers by the farmers of Tennessee. This increase in use of farm machinery was due partially to the scarcity of farm labor. Another contributing factor was the need for more efficient production which, reduced to simplest terms, is increased production per individual worker.

This increase in use of farm equipment has necessitated a radical change in the farm mechanics program of the vocational agriculture instruction in Tennessee. In order to meet the demand for increased competence in farm mechanics, it was necessary to devote more time to training in that phase of vocational agriculture. Adequate instruction in farm mechanics required the teaching of new skills, the operation of new shop machines and the development of methods for properly implementing this program.

While safety has always been an integral part of instruction in farm mechanics in vocational agriculture departments in Tennessee, it has become evident that safety instruction and practices have not kept pace with the new emphasis given the farm mechanics program. This conclusion is based on observations and study of this matter during supervisory visits to departments of vocational agriculture during the period 1951 - 1956. Routine and verbal reports from district supervisors and teachers of vocational agriculture to the State Department of Education during this period indicated a substantial increase in the number of accidents resulting from farm shop operations.

These observations and reports indicated an immediate need for a study to determine the adequacy of the safety instruction included in the farm mechanics shop program. This need was further substantiated by the fact that several teachers indicated that they did not have adequate safety programs. A smaller number of teachers indicated that they had neither safety programs nor necessary materials for teaching safety.

Interviews with five county superintendents of schools revealed that all recognized the need for school shop safety but that none had first-hand knowledge of whether or not schools under their supervision had safety programs and the extent to which such programs were functioning if present.

In the course of discussions of farm shop safety during supervisory visits and at other times, it became apparent that few teachers of vocational agriculture in Tennessee had much understanding of their legal responsibilities regarding safety instruction and practices in their farm shop work. Interviews with a sampling of twenty teachers revealed that none of them knew their full legal responsibilities to the students in their classes in the event of an accident.

Scope and Limitations of Study

The study was limited to departments of vocational agriculture in Tennessee, both white and colored, during the period 1953 - 1956.

It was also limited to safety conditions and accidents in the vocational agriculture farm mechanics shops of the schools.

Definition of Terms

1. Farm Mechanics Shop

   A room or area including facilities, equipment, materials and supplies used in the instruction of the farm mechanics phase of courses in vocational agriculture in Tennessee.

2. Severity of Accidents

a. Minor: Those accidents requiring only first aid which may be treated effectively without the aid of a physician.

b. Severe: Those accidents requiring the services of a physician, although first aid may be given to prevent loss of blood, or to make the patient more comfortable.

c. Serious: Those accidents resulting in loss, or loss of use, of a member of the body.

d. Fatal: Those accidents resulting in death that may be directly attributed to the accident.

Methods of Research

The following methods and procedures were used in collecting and organizing data:

1. A questionnaire (copy in Appendix D) was prepared in January 1956, and mailed to 334 teachers of vocational agriculture in Tennessee; 203 returned completed questionnaires. Prior to being mailed to the teachers for completion it was reviewed by ten teachers of vocational agriculture and suggested changes were incorporated. The questionnaire was designed to obtain the following information:

   a. The number of accidents requiring first aid occurring in the school farm shop during the period April 1953 to April 1956.

b. The number of accidents requiring the services of a physician occurring in the school farm shop during the same period.

c. Causes to which the accidents were attributed.

2. The National Standard School Shop Safety Inspection Check List (copy in Appendix E) was sent to 334 teachers of vocational agriculture in Tennessee; 155 usable replies were returned. This check list was recommended by the President's Conference on Industrial Safety. Its purpose is to determine the general safety situation in the shop. Is the shop a safe environment for instruction in the various areas recognized as necessary for proper instruction in Tennessee? This check list also included sections for determining the status of personal protection, safety instruction, accident records, and first aid. In addition, this check determined the general physical condition of school farm mechanics shops. In this study it was used specifically to determine the safety status in school farm mechanics shops at the time (December 1955) the teachers completed the safety check using the National Standard Shop Safety Check List in the areas of housekeeping, shop equipment, electrical installations, personal protection, safety instruction, accident records and first aid.

CHAPTER II

REVIEW OF RELATED LITERATURE

The problem of safety in farm shop instruction is apparently an important one among vocational agriculture teachers throughout the country as evidenced by the attention given the subject in writings and research studies.

Workers in industrial arts education and trade and industrial education have made many investigations into the subject and have produced some very worthwhile findings which have transfer value for vocational agriculture farm shop safety programs.

Studies of Safety in School Shops

Many of the studies of farm shop safety have dealt with the nature and causes of accidents. A study was conducted in Virginia in 1946 to determine the incidence of accidents and their causes during the previous five-year period.[1] The investigator surveyed 100 teachers in that State. They reported a total of 250 serious or severe accidents during the five-year period. The machines involved and the number of accidents with each, as reported in that study, are shown in Table I. Of the 250 accidents, sixteen resulted in loss of

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[1] Gordon Lee Baldwin, "The Development of a Safety Program for School Farm Shops" (Unpublished Master's thesis, Virginia Polytechnic Institute, 1946).

TABLE I

CAUSE AND FREQUENCY OF ACCIDENTS IN VOCATIONAL AGRICULTURE FARM SHOP WORK AS REPORTED BY 100 TEACHERS OF VOCATIONAL AGRICULTURE, VIRGINIA, 1940-45[a]

Machine or Tool	Number Accidents	Machine or Tool	Number Accidents
1. Jointer	99	11. Forge	5
2. Circular saw	28	12. Wood lathe	4
3. Grinder	25	13. Nails	3
4. Drill press	13	14. Acetylene welder	3
5. Hammers	11	15. Other metal working tools	2
6. Chisels	11	16. Farm machines	2
7. Band saw	10	17. Lumber	1
8. Arc welder	9	18. Blow torch	1
9. Other hand tools	7	19. Electric equipment	1
10. Other power tools	7	20. Miscellaneous	8
		Total	250

[a]Source: Gordon Lee Baldwin, "The Development of a Safety Program for School Farm Shops" (Unpublished Master's thesis, Virginia Polytechnic Institute, 1946).

a member of the body and 234 were classified as severe, requiring medical aid such as stitches or setting of bones.

A study by Lyday is significant in that it revealed the occurrence of 545 accidents in 150 school shops in Georgia during the period 1947-50.[2] A large majority of the accidents--390--required only first aid. One resulted in death. Only twenty of the 150 schools surveyed reported no accidents during the three-year period. The investigator concluded from his study that 95 per cent of the accidents reported could be attributed to lack of proper instruction and safety practices and that the number of accidents could have been materially reduced. This study and its findings are further significant because of the fact that Georgia shop teachers are legally responsible for accidents occurring in their shops while work is proceeding under their supervision.

Burns conducted a study with selected teachers of vocational agriculture in Pennsylvania to determine the nature of farm shop accidents, the tools (hand and power) with which the accidents were most frequently associated, and the most hazardous of commonly used farm shop tools.[3] He found that of the hand tools commonly used, the chisel accounted for five times as many accidents as any other hand

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[2] J. R. Lyday, "Developing Some Safety Measures That Can Be Used in High School Farm Shop Programs in Georgia" (Unpublished Master of Education problem, University of Georgia, 1951).

[3] Paul M. Burns, "Accidents in Vocational Agriculture Shops in Pennsylvania" (Unpublished Master's thesis, Pennsylvania State College, 1951).

tool in the farm shop. The bars, crow and tamping, rated second, with the wire steel brush as a close third. Among power tools, the jointer showed up on the scale as most dangerous and the tilting arbor saw third. Fewer accidents resulted in connection with the use of power tools than with hand tools, but the accidents that did occur were more fatal and maiming.

Another example of the incidence of accidents in shops is shown in Table II from a study of 233 schools in Illinois during the period 1932-36.

This table indicates that the three machines causing the highest number of accidents are: jointer, table saw, and band saw. All three have rapidly moving cutting edges; all three are provided with guards which may be removed. It should be pointed out here that the large number of accidents occurred with the jointer. This machine ranks either first or high on the list in all studies reviewed. The machine with which the fourth largest number of accidents occurred is the lathe. This machine, for all practical purposes, has no place in the farm mechanics shop and may just as well be eliminated, thus removing a larger potential cause of accidents.

In another study in Pennsylvania, Nordberg surveyed 185 schools to determine the nature and cause of farm shop accidents during the school year 1950-51.[4] Of the 185 schools surveyed, only forty-five

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[4]Carl O. Nordberg, "A Study Concerning Accidents and the Prevention of Accidents in Vocational Agriculture Farm Mechanics Shops in Pennsylvania" (Unpublished Master's thesis, Pennsylvania State College, 1952).

TABLE II

COURSE AND FREQUENCY OF SCHOOL SHOP ACCIDENTS REPORTED FROM A STUDY OF 233 SCHOOLS IN ILLINOIS DURING THE PERIOD 1932-1936[a]

Machine	Number of Machines	Number of Accidents
Jointer	172	92
Table saw	197	69
Band saw	162	25
Wood lathe	516	19
Grinder	198	16
Jig saw	69	11
Drill press	130	6
Motiser	60	2
Shaper	75	2
Tenoner	10	2
Buffer	28	1
Job press	28	1
Disc sander	9	1
Belt sander	37	1
Total	1669	248

[a]Source: Fred G. Lange, Handbook of Safety and Accident Prevention (Peoria, Illinois: Manual Arts Press, 1936), p. 88.

reported accidents occurring that year. A total of fifty-six accidents was reported. Thus, 140 vocational agriculture departments reported an accident-free record in farm shop work during the period covered in the study. Of the fifty-six accidents reported, over 60 per cent were cuts requiring stitches and approximately 11 per cent of the accidents were the result of burns. Sixty-five per cent of all accidents were found to have resulted from power tools. The circular table saw was the most dangerous--thirteen accidents resulted from the use of this machine. The jointer rated second as the most dangerous piece of equipment.

Nordberg also studied the nature and extent of farm shop safety instruction in farm shop work. He concluded that many instructors were not using enough visual aids such as films, charts and posters in their safety instruction. It was the belief of 151 teachers reporting that carelessness was the number one cause of accidents that occurred. They indicated interest in safety instruction but felt that more should be done to extend the use of practical safety practices and safety equipment. The investigator concluded that if more instructors took advantage of the various safety teaching aids available, there would be a marked decrease in the number and extent of accidents in farm shop work in vocational agriculture.

A study of shop safety in 107 schools in Texas in 1951 revealed a total of seventy-four serious and minor accidents during the previous

five-year period.[5] The study showed that fifty-four of these accidents were due to carelessness, thirteen to lack of knowledge, and five to disobeying orders of the instructors.

In another study of safety, conducted in South Carolina, the investigator attempted to associate a number of factors with incidence of accidents in farm shop work in vocational agriculture.[6] He found that first-year students were subject to more accidents than advanced students. He also found a higher rate of accidents in small shops than in larger shops. The lack of adequate lighting was reported to be the cause of some accidents. The lack of guards on some machines apparently accounted for some of the accidents in many of the shops surveyed. A significant finding in that study was the indication that the accident record was lower for teachers who had received the most college training in farm shop work.

The results of studies of accidents in farm shop work in vocational agriculture and their causes closely parallel reports of the National Safety Council regarding school shop accidents in general. That organization reports that about 90 per cent of all school shop accidents may be attributed to human inadequacies and the remaining 10 per cent to mechanical and other physical conditions. The National

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[5]Johnny E. Leathers, "A Study of the Safety Program in School Farm Shops in One Hundred Seven Schools in Texas" (Unpublished Master's thesis, Sam Houston State Teachers' College, 1951).

[6]W. G. Entrekin, "A Study of Some of the Factors which Affect Shop Safety in Vocational Agriculture" (Unpublished Master's thesis, Clemson College, 1952).

Safety Council concludes that accidents attributable to the human element may be grouped into the following five categories:[7]

1. Unsafe practices. Of all shop accidents reported, 61 per cent were attributed to this factor with unsupervised work, ignoring rules, taking chances, haste and horseplay occurring frequently.
2. Inability of the student. Seventeen per cent of all accidents were listed to this factor. Items of importance in this area are: inexperience, lack of skill and poor judgment.
3. Faulty instruction. This includes no safety instruction, instruction not enforced, and incomplete or faulty instruction. Of all accidents reported 5 per cent were traceable to this factor.
4. Lack of concentration. Accidents amounting to 3 per cent of the total were traced to this factor which included both inattention and lack of concentration.
5. Mentally or physically unfit. Included under this factor are physical impairments, weakness, mental or physical immaturity and fatigue.

The growing use of equipment in school shops, both in vocational agriculture and otherwise, that make it increasingly possible for students to suffer accidents makes safety a most important part of the instructional program. But are we keeping up with the demand for safety training? One view of this is summed up succinctly by Mays and Casberg in their book School Shop Administration.[8]

> Industry has long since accepted accident control in the factory as a major administrative function of management. The growing importance of safety as an instructional obligation of the public schools is rapidly becoming a matter of general public interest, but the administration

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[7] "Safety Education in the School Shop" (Chicago: National Safety Council, 1948), p. 47.

[8] Arthur B. Mays and Carl H. Casberg, School Shop Administration (Milwaukee, Wisconsin: Bruce Publishing Company, 1950), p. 114.

of effective accident control in the school itself is lagging far behind that of industry.

J. Warren Smith, State Director of Vocational Education in North Carolina, says that the accident rate in America is greater than any other country in the world. He points out that in recent years there has been a reawakening too of safety consciousness in all walks of life, due largely to the efforts of the National Safety Council. But, on the other hand, he adds:[9]

> The school shop has not kept pace with industry in promoting safety. Our industrial establishments discovered that the cost of mechanical safe guards soon paid for themselves in the reduced number of accidents and increased production. They also discovered that about 35 per cent of the accidents could be prevented by providing mechanical safeguards. The largest per cent of accidents were found to be caused by unsafe practices by the workers. The remedy for this then was education for the employed worker and a more careful selection of the new worker. Most industrial plants now have a well-organized safety program, headed by a safety engineer and committees in each different department.

There is ample evidence to support the need for adequate farm shop safety instruction in vocational agriculture. Studies show generally that teachers are not providing this needed instruction. For instance, a study of farm safety activities, including farm shop safety, in Nebraska showed that on the average, vocational agriculture teachers had given instruction in only seventeen of the 137 safety

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[9]J. Warren Smith, "Safety Education for Shop Teachers in North Carolina Schools" (North Carolina State College, Bulletin No. 2, 1939), p. 3.

activities listed on the questionnaire.[10] In addition, it showed that twenty teachers had given no safety instruction. When queried about safety instruction and how it might best be included in vocational agriculture, teachers generally agreed that it could best be accomplished through classroom instruction.

A study in North Carolina showed that teachers were teaching farm safety to a limited extent at the time of the study, but were of the opinion that considerable improvement could be made in their safety instruction.[11] They reported using group and individual instruction to teach safety. Much of the instruction was in the nature of demonstrations.

In the development of a list of recommended practices for operation of machines in vocational agriculture farm shop work, Smith studied the training and proficiency of teachers in West Virginia.[12] He found that teachers had received an average of five quarter hours of college training in farm mechanics; many had no training at all in the operation of power machines. In general, the teachers participating in the study did not feel adequately prepared to teach the proper

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[10]Chalmers A. Cromer "Recommended Farm Safety Activities for Vocational Agriculture Departments in Nebraska" (Unpublished Master's thesis, Colorado Agricultural and Mechanical College, 1951).

[11]Frank Rankin Craig "Safety and the Use of Power in North Carolina School Farm Shops" (Unpublished Master's thesis, North Carolina State College, 1951).

[12]David E. Smith "The Safe Use of Machines in Vocational Agriculture Shops in West Virginia" (Unpublished problem in lieu of thesis, University of West Virginia, 1947).

operation of all the machines in the high school shops. This lack of ability meant that some of the boys were permitted to operate machines on which they had not received proper training, which increased the number and seriousness of accidents suffered by students.

Most related literature reviewed dealt with the nature and cause of accidents occurring in school shops. A majority of studies reviewed indicate that while accidents occur in all areas of shop work, that by far, the majority occur in use of machines having rapidly revolving blades or wheels. Operation of this type equipment is also the area in which the more serious accidents occur. All items of equipment on which large number of accidents happen are protected by safety guards. In most instances these safety guards may be removed by the students to facilitate ease of operation, thus, increasing the chances of accidents. It is concensus of opinion of writers whose works have been reviewed, that the accident rate may be materially reduced by the proper teaching and enforcement of safety measures. Most authors found that carelessness was the number one cause of accidents that occurred. None defined carelessness but all inferred that this term indicated a failure to follow approved procedures and methods in operating the equipment.

Teachers' Legal Liability for Farm Shop Accidents

In addition to injury to students under their direction, teachers must be concerned with their legal liability for accidents occurring in

shops during work under their control. Although this is a secondary consideration, it merits the attention of teachers, administrators, and school boards.

The teacher's liability in cases of accidents occurring in the school shop is not clearly established in all states. Very few studies have been made into the legal aspects of accidents occurring in school shop work in agriculture or other trade and industrial education. From the few reports and writing published on the subject, it is apparent, however, that no single pattern exists in all or even a majority of the states.

Writing in the magazine School Shop, one writer points out:[13]

> There are relatively few accidents to pupils about the school which cause injuries requiring great expense for medical treatment. There are relatively few accidents for which teachers are held liable in court because of their negligence. These accidents are sufficiently numerous, however, to justify serious consideration by all states to provide the same protection for their teachers against liability as is true in several states.
>
> It has been well established that although an individual teacher may be liable for negligence or wrongs committed while in the exercise of his duty, the board of education most specifically is not liable. Therefore, the cost of defense in any legal action, together with the payment of damage would rest exclusively with the teacher. There are, however, four states in which the school district may assume the teacher's cost in defending himself in court, and also may pay the damages awarded if the case is awarded in favor of the plaintiff. The four states are Connecticut, California, New Jersey and New York.
>
> In the other forty-four states the school districts enjoy the sovereign right of immunity from liability for

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[13] E. W. Tischendorf, "Shop Teacher Liability," School Shop, 11:12, February, 1953.

> accidental injury to pupils while the pupils are under the jurisdiction of the school or any employees of the school district. It is in these states that the teacher is liable for the cost of defending himself in a legal action and for damages which might result from such action.

Garber, in his conclusions concerning tort liability of school boards and employees, says:[14]

> The general rule in the United States is that government agencies, such as school districts, are immune from tort actions. Some state constitutions prohibit suits against the government; others permit them either generally or under designated circumstances; still others are silent.
>
> Despite constitutional differences, legislators have imposed liability by the abrogation of the common law rule of immunity in many states for specific kinds of public services although not often for educational services. Despite constitutional and statutory provisions, many courts continue to follow the common-law rule.

Garber concludes that since courts are abrogating the common-law rule by awarding damages to the extent of liability insurance, they will continue to permit court actions when public funds are protected by insurance. He also indicates that probably the best course of action is for school employees to carry liability insurance protection and thus relieve the uncertainty of the injured from recovery in school cases.[15]

In Tennessee, there are at least two important legislative acts that cover teachers' liability for accidents occurring in school shops

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[14]Lee O. Garber, Law and the School Business Manager (Danville, Illinois: Interstate Printers and Publishers, 1957), p. 214.

[15]Ibid., p. 215.

under their control. Following a ruling by the Tennessee State Supreme Court that board of education members and their employees could be held responsible in case of negligence, the 1947 State Legislature enacted the Liability Insurance Act.[16] This Act specifies that minimum liability and property damage is not to be less than an amount determined by the State Board of Education.[17] The State Board of Education has set these liability amounts at $5,000 limit for bodily injuries to, or death of, one person and a limit of $5,000 for loss or damage in any one accident to property of others. The limits are further specified at not more than $25,000 for busses carrying up to seven passengers and not more than $100,000 for busses carrying thirty-one or more passengers.[18]

Attorney Arthur Crownover, a member of the Nashville, Tennessee, Bar Association, pointed out in an interview on May 9, 1956, that in the event of an accident, someone is responsible. It may be the student himself, the teacher, or some other person or group of persons. Common law, which we have inherited from England, holds that the king can do no wrong. Translated to our form of government, this common law would hold that our government officials can do no wrong which would

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[16] Tennessee Code, 1947, chapter 92, section 13.

[17] Rules, Regulations, and Minimum Standards (Tennessee State of Education, Nashville, Tennessee, July 1957).

[18] Ibid., p. 86.

mean that the local board of education could not be held liable for accidents occurring on school property or within their jurisdiction.

In order that this code of common law would be known and understood by all concerned, the 1955 State Legislature passed the following bill as an amendment to the 1950 Supplement to the Code of Tennessee:

PUBLIC CHAPTER NO. 287

SENATE BILL NO. 660

by

Shelby Delegation

AN ACT to amend Section 2397.2 of the 1950 Supplement to The Code of Tennessee.

Section 1. Be it enacted by the General Assembly of the State of Tennessee, That Section 2397.2 of the 1950 Supplement to the Code of Tennessee be and the same is hereby amended by adding to the beginning of said Section the words "No such Boards of Education, whether incorporated or unincorporated, and" so that the Section as amended will read:

> 2397.2 No such Board of Education, whether incorporated or unincorporated, and no member of any such Boards of Education, or other municipal or county school official, shall be held liable in damages for any injury to person or property resulting from such use of school buildings or property authorized by the next preceding Section."

Section 2. Be it further enacted, That this Act take effect from and after its passage, the public welfare requiring it.

In an interview June 6, 1956, Charles Cosner, member of the Nashville, Tennessee, Bar Association, stated that, in his opinion, a teacher could be held responsible if it was shown that he was negligent

and did not exercise proper supervision and guidance for the safety of those under his control. The teacher is responsible for establishing, acquainting students with, and reasonably enforcing adequate safety measures. It is recommended that teachers have a written procedure for safety in the classroom, shop, and other activities and that such be read to students at least once each month or before engaging in extra-curricular activities. Posters on safety should be placed near machines which might be dangerous. It is contingent upon the teacher to be certain that someone other than himself is aware that he is providing due and reasonable supervision.

Attorney Cosner pointed out that any accident in the school shop might result in the teacher being sued for medical care and damages. It must be proved to be sure that there was negligence on the part of the teacher for the court to award damages. This fact in no way helps the teacher pay the cost of defending himself and the mental strain of a court case. Proper safety instruction records, safety test and written and posted rules are the best defense exhibits according to Cosner.

In summary, it seems clear that the teacher of vocational agriculture cannot escape legal liability for accidents occurring in school shop work under his control, if it can be proved in the courts that such was due in any way to the negligence of the teacher. This would, presumably, include the failure of the teacher to provide adequate safety measures and precautions. This makes it especially

necessary for teachers to plan and implement a thorough safety program in an effort to take every measure feasible to prevent accidents occurring in their farm shop work instruction.

CHAPTER III

STATUS OF FARM SHOP SAFETY IN TENNESSEE

This chapter presents the results of findings of the status of safety in farm shops in Tennessee. The incidence of accidents in farm shops was secured with a questionnaire completed by 203 teachers of vocational agriculture in Tennessee covering the period April 1953 to April 1956. The status of general shop safety conditions and safety equipment was secured with the National Council's National Standard Shop Safety Inspection Check List, which was compiled by 155 teachers as of December 1955.

Causes of Accidents in Tennessee School Farm Mechanics Shops

A compilation of responses from 203 Tennessee vocational agriculture teachers to a questionnaire requesting information as to number, causes, and severity of accidents during the three-year period May 1953 to May 1956 is presented in Tables III through VII. These tables summarize the number, causes, and severity of accidents.

Table III presents a summary of sources of accidents showing the number of accidents that occurred which required only first aid, and the number that required the services of a physician. The data and summary were made by tool areas of the farm mechanics shop as it normally operates in Tennessee. These are: power woodworking tools, welding

TABLE III

SOURCE AND FREQUENCY OF MAJOR AND MINOR ACCIDENTS IN SCHOOL SHOPS

Source of Accidents	Number Accidents Requiring First Aid	Physician
1. Power Woodworking Tools		
a. Jointer	51	37
b. Circular saw	29	25
c. Drill press	27	3
d. Band saw	11	2
e. Planer	10	0
f. Wood lathe	9	1
g. Jig saw	3	0
2. Welding and Metal Work		
a. Forge	81	0
b. Arc welder	66	8
c. Power grinders or stones	38	11
d. Acetylene welder	29	5
e. Drill press	7	2
f. Other	2	1
3. Sheet Metal and Soldering		
a. Handling and working sheet metal	37	1
b. Sheet cutting and forming tools	31	0
c. Blow torches	18	3
d. Other	3	1
4. Hand Tools		
a. Saws	143	2
b. Hammers (wood and metal working)	119	2
c. Chisels	54	1
d. Nails and other fasteners	43	3
e. Screwdrivers	13	0
f. Other	4	10
5. Electrical and Wiring	4	0
6. Other (not included in foregoing)	1	0
Total	833	118

and metal work, sheet metal and soldering, hand tools, and electrical and wiring. Two tools in the hand tool area had, by far, the largest numbers of accidents requiring first aid. These were handsaws and hammers, with which 143 and 119 accidents, respectively, occurred. These were followed by the forge, arc welder, chisels, and jointer with eighty-one, sixty-six, fifty-four and fifty-one minor accidents, respectively. The jointer, with thirty-seven accidents requiring the services of a physician, was the source of the largest number of accidents of this severity. It was followed by the circular saw and power grinders with twenty-five and eleven, respectively.

In the area of hand tools, ten accidents requiring the services of a physician occurred with tools other than those listed. These accidents occurred with seldom used hand tools such as crowbars, metal staplers, pipe wrenches, and the like. Hand tools, as a group, was the source of 45.1 per cent of all accidents requiring first aid. In importance, welding and metal work followed with 26.5 per cent of accidents requiring first aid. The data further indicate that of a total of 118 accidents requiring the services of a physician, sixty-eight occurred with power woodworking tools. Welding and metal work were the sources of twenty-seven accidents, while seldom used hand tools accounted for eighteen accidents requiring a physician. As a check on teachers' scoring, the investigator personally visited twenty shops and scored their safety. These findings are given in Appendix A, Table XVII.

Table IV summarizes information relative to the severity of accidents as they occurred in the school farm mechanics shop. Of the 965 accidents reported, 847 or 88 per cent were considered minor, requiring only first aid. One hundred eleven or 11 per cent were classified as severe, requiring the services of a physician. Accidents considered serious which involved losing the use of a member of the body accounted for only seven accidents or slightly less than 1 per cent. While those accidents classified as severe and serious accounted for only 12 per cent of the total, the nature of these accidents indicate a need for a better safety program.

Table V indicates the frequency of minor accidents occurring in the use of tools or work areas in farm mechanics shops.

Of the 632 minor accidents reported, handsaws and hammers accounted for a total of 262 or 41.4 per cent. While there is no evidence to indicate that these tools were considered the most common and frequently used in the farm mechanical shop.

Two areas or tools involving heat--the forge and arc welder--accounted for a total of 147 or more than 23 per cent of the accidents.

Only two tools shown in Table V have rapidly revolving blades or wheels. These tools, the jointer and power grinder, ranked six and eight in the top nine tools with which minor accidents occurred.

Tools that accounted for the majority of severe or serious accidents have rapidly revolving wheels or blades which, when an accident occurs, are more likely to do more damage than hand operated tools.

TABLE IV

SEVERITY OF ACCIDENTS IN SCHOOL FARM MECHANICS SHOPS

Severity	Number	Percent
1. Minor - required first aid	847	88
2. Severe - required physician (stitches, setting bones, etc.)	111	11
3. Serious - lost use of member of body	7	1
4. Fatal - death due directly to accident	0	0
Total	965	100

TABLE V

FREQUENCY OF MINOR ACCIDENTS OCCURRING IN USE OF TOOLS IN FARM MECHANICS SHOPS

Tool or Area	Number	Percent
1. Handsaws	143	22.6
2. Hammers	119	18.8
3. Forge	81	12.8
4. Arc welder	66	10.5
5. Chisels	54	8.6
6. Jointer	51	8.0
7. Nails and other fasteners	43	6.8
8. Power grinders	38	6.0
9. Handling and working sheet metal	37	5.9
Total	632	100.0

Table VI shows the ten tools with which the highest number of severe or serious accidents occurred.

This table shows that the jointer accounted for thirty-seven of the ninety-eight reported accidents, followed by the circular saw involving twenty-five accidents, then the power grinder with which eleven accidents occurred.

These tools with rapidly revolving parts account for over 73 per cent of the total number of severe or serious accidents.

The tools which caused the majority of severe and serious accidents in Tennessee farm shops were jointers, circular saws, and power grinders; this was found to be true in most similar studies reviewed. These tools all have rapidly revolving wheels or blades and are normally safety guarded by one or more mechanical guards to protect the operator. The machines may be be operated without the guards, thus increasing the accident hazard.

Teachers were asked to list in the order of their importance the causes to which they attributed the accidents reported. Their responses appear in Table VII.

In interpreting Table VII, bear in mind that the data given are opinions of the teachers reporting. The teachers surveyed for data in the foregoing tables listed in the order of importance the causes of the accidents which had occurred in their shops. While it is felt the teachers' listings are significant and important in developing a safety program it should be borne in mind that differences of opinion would result in a difference of relative importance of the various

TABLE VI

NUMBER OF ACCIDENTS PER TOOL WITH THE TEN TOOLS CAUSING THE HIGHEST NUMBER OF SERIOUS AND SEVERE ACCIDENTS

	Tool or Area	Number	Percent
1.	Jointer	37	37.8
2.	Circular saw	25	25.5
3.	Power grinders	11	11.2
4.	Arc welder	8	8.2
5.	Acetylene welder	5	5.1
6.	Drill press	3	3.1
7.	Nails and fasteners	3	3.1
8.	Band saw	2	2.0
9.	Hammers	2	2.0
10.	Saws (hand)	2	2.0
	Total	98	100.0

TABLE VII

CAUSES OF ACCIDENTS IN SCHOOL FARM SHOPS

	Causes of Accidents	Number	Percent
1.	Carelessness	103	43.8
2.	Not observing present safety rules	37	15.5
3.	Not using guards	21	8.9
4.	Lack of proper instruction	18	7.7
5.	Improper use of tool	17	7.3
6.	Getting in hurry	10	4.3
7.	Boys crowded	9	3.9
8.	Defective equipment	8	3.4
9.	Horse-play	7	3.0
10.	Insufficient supervision	3	1.3
11.	Physical defect of pupil	2	0.9
	Total	235	100.0

causes listed. For example, not observing safety rules could have been reported as carelessness or not using guards.

The three most important causes in the order of their reported importance were: (1) carelessness, (2) not observing safety rules, and (3) not using guards. Of the total percentage, these three caused 43.8 per cent, 15.5 per cent, and 8.9 per cent, respectively.

The questionnaire contained "write in" spaces for the cause of accident terms. It is recognized here that without the benefit of term definition that some teachers probably listed carelessness as a cause, while some other teacher listed an identical accident under some other cause. A review of these indicates that only one cause is not readily apparent and capable of being controlled by the shop teacher.

Safety Conditions in Tennessee School Farm Mechanics Shops

The National Standard School Shop Safety Inspection Check List was mailed to 334 vocational agriculture teachers in Tennessee. This check list was prepared by a joint committee of the American Vocational Association and the National Safety Council. It covers the following areas in shop safety:

1. General physical condition
2. Housekeeping
3. Equipment
4. Electrical installation
5. Personal protection
6. Instruction

7. Fire control
8. Accident records
9. First aid

Of the 334 teachers who were asked to make a safety inspection of their shops, 156 responded with complete surveys. One teacher responded with an improperly completed list. Since it was apparent that he did not understand how the survey was to be made and reported, his report was not considered in the findings.

The key used in teachers' evaluations was as follows:

S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention).

The general physical condition of farm mechanics shops in the schools surveyed is shown in Table VIII. The five most important items, according to the national standard list on survey,[1] are shown in this table. These items involve, for the most part, the building itself. The three items reported by the teachers to be in the poorest physical condition were lighting, temperature control, and condition of floors, walls, and ceilings.

While teachers indicated more safe than unsafe items, the large number of items--337--reported less than satisfactory indicates that teachers felt that the general physical condition of their shops left something to be desired and could be improved. This is further evident by the fact that only thirty of the 155 teachers reporting gave their shops overall satisfactory ratings in this area.

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[1]See Appendix E.

TABLE VIII

GENERAL PHYSICAL CONDITIONS FOUND BY TEACHERS
IN SAFETY SURVEY OF THEIR OWN SHOPS

Physical Conditions	Frequency		
	S*	A*	U*
Lighting--natural and artificial	73	64	18
Temperature control	74	58	23
Conditions of floors, walls, ceilings	92	49	14
Ventilation	87	57	13
Condition of lumber and metal racks	114	30	11
Totals	440	258	72
Teachers overall rating of this area	30	114	11

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

Table IX presents a summary of the condition of housekeeping in the shops surveyed. Of the 155 shops reporting only fifteen had adequate waste cans and disposal facilities. Only thirty-four were considered satisfactory in general appearance and orderliness. Less than one-third of those reported had adequate storage space for supplies and materials and only approximately one-third of the shops had adequate tool storage. None of the shops rated satisfactory in the area of housekeeping.

Teachers' evaluations of equipment, placement, and condition in their own shop appears in Table X. Only fourteen of the 155 teachers reporting felt that equipment in their school shops was satisfactory from a safety viewpoint when placement and condition of the machines were considered. Also significant is the fact that only thirty-three locked off machines when they were out of the room, leaving the students operating the machines with no supervision. There is no evidence to indicate the number of shops having no method of locking off machines and thus leaving the teacher no alternative but to leave them on in the event he must leave the room.

Only fifteen of the 155 shops had danger zones marked and guarded in a satisfactory manner, while only approximately one-third of the teachers felt their machines were properly arranged.

According to data shown in Table XI, teachers' evaluations of the electrical installations in their shops are somewhat better than their equipment and housekeeping. In their overall rating, 58 per cent of the teachers indicated that electrical installations in their shops

TABLE IX

TEACHERS' EVALUATIONS OF HOUSEKEEPING IN THEIR OWN SHOPS

Housekeeping Conditions	Frequency		
	S*	A*	U*
General appearance and orderliness	34	121	0
Adequate storage of tools	53	64	38
Adequate storage of supplies and materials	46	22	17
Adequate waste cans and disposal	15	22	118
Totals	148	229	173
Teachers overall rating of this area	0	145	10

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

TABLE X

TEACHERS' EVALUATIONS OF EQUIPMENT PLACEMENT AND CONDITIONS IN THEIR OWN SHOPS

Equipment Placement and Conditions	Frequency		
	S*	A*	U*
Machines properly arranged	51	89	15
Danger zones marked and guarded	15	97	43
All saws, gears, moving cutters and belts guarded	69	58	28
Machines are "locked off" when instructor not present	33	42	81
Machines are in safe working condition	57	82	16
Totals	225	368	183
Teachers overall rating in this area	14	136	5

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

TABLE XI

TEACHERS' EVALUATIONS OF ELECTRICAL INSTALLATION IN THEIR SHOPS

Electrical Installation	Frequency		
	S*	A*	U*
Master control switch for all circuits	135	4	16
Electric circuits properly identified	83	61	11
All machine switches within reach of operators	96	32	27
No temporary wiring	121	26	8
Totals	435	123	62
Teachers overall rating in this area	64	77	14

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

needed attention and improvement. Approximately 42 per cent felt the electrical installations of their shops were adequate and satisfactory. The most significant item shown in Table XI is the fact that over 38 per cent of all machines did not have control switches within easy reach of the operator. This would preclude quick stoppage in the event of an emergency. This is especially important when an accident occurs in which wearing apparel is caught in the machine.

It is apparent in Table XII that most of the schools were very lax in requiring the wearing of proper wearing apparel for safety and requiring that it be worn in a prescribed manner. Only thirty-five of the 155 teachers reporting indicated that their shops were satisfactory in this area.

Fifty-six teachers indicated that protection of students' eyes where the nature of work so dictated was less than satisfactory in their shops. Provisions of shields and screens for electric welding was somewhat better with only twenty-eight shops being rated as less than satisfactory.

Data concerning the learning of safety by the students are presented in Table XIII. To determine the status of safety instruction given by teachers of vocational agriculture in Tennessee. The teachers were asked to evaluate their programs in this area on five points of procedure, including shop safety taught as an integral unit, safety rules given to students, safety test, safety posters, and student inspections of shop safety. Approximately one-third of the teachers reporting did not feel that their teaching of safety as an integral

TABLE XII

TEACHERS' EVALUATIONS OF PRESENCE AND USE OF EQUIPMENT IN THEIR SHOPS FOR PERSONAL PROTECTION OF STUDENTS

Equipment	Frequency S*	A*	U*
Goggles or shields provided and required for all work where eye hazards exist	99	31	25
Shields and screens required for electric welding	122	16	12
Proper wearing apparel properly worn required	35	76	44
Totals	256	123	81
Teachers overall rating in this area	19	100	36

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

TABLE XIII

TEACHERS' EVALUATIONS OF THEIR OWN INSTRUCTION IN SAFETY

Instruction	Frequency S*	A*	U*
Shop safety taught as integral unit	102	53	0
Printed or typed safety rules given each student	28	40	87
Use of safety test	18	41	96
Use of safety posters in shop	57	66	32
Periodic safety inspections of shop made by students	13	29	119
Totals	218	229	334
Teachers evaluation for total rating	5	44	106

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

unit could be rated as satisfactory. It should be pointed out here, however, that no teacher rated his instruction as unsatisfactory in this area.

Only eighteen of the 155 teachers reporting indicated a satisfactory use of a safety test. A still smaller number--thirteen--had satisfactory student safety inspections of their shops.

It is apparent from this table that while shop safety is being taught, the instruction stops somewhat short of that necessary to develop satisfactory safety habits of the students. One of the most satisfactory and practical methods of helping the student to become aware of safety hazards, that of student safety inspections, is not being used by 119 of the 155 teachers reporting. Only five of the 155 teachers reporting rated their safety instructional program as satisfactory. This appears to be somewhat low when compared with the much higher ratings indicated for unit items of the instructional program.

Table XIV presents a summary of teachers' evaluations of fire-control measures in their own shops. In the teachers' overall evaluations, thirty-seven felt that fire-control measures were satisfactory, forty-eight had fire-control measures in operation which were somewhat less than satisfactory, but were not considered unsatisfactory while seventy teachers rated their fire-control measures as being unsatisfactory. The outstanding finding in this instance is the fact that ninety-four of the 155 teachers reporting did not have adequate fire extinguishers of the proper type. Only twenty-three teachers indicated

TABLE XIV

TEACHERS' EVALUATIONS OF FIRE CONTROL MEASURES IN THEIR OWN SHOPS

Fire Control Measures	Frequency		
	S*	A*	U*
Adequate fire extinguishers of proper type	23	38	94
Safety cans are provided for flammable liquids	14	66	75
Bulk storage of dangerous materials is outside building	29	37	89
Machines are provided with overload controls	49	51	55
Totals	115	192	313
Teachers' evaluation of total rating in this area	37	48	70

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

that fire extinguishers in their shops were adequate. More than two-thirds of the teachers reported having machines with inadequate overload controls. Forty-nine teachers indicated that machines in their shops were equipped with overload controls.

It should be pointed out here that all items of fire control are to a large degree beyond the teacher's control. Fire extinguishers and safety cans should be provided by the board of education. The board should also provide suitable outside storage for inflammable materials. By the same token, if satisfactory overload controls are to be had, the board must purchase machines so equipped or modify present machines with safety controls.

Table XV reveals evidence of an important aspect of safety in so far as procedure for recording and keeping of records is concerned. The teachers were asked two questions in this area: (1) "Do you have a written procedure of preparing a record of an accident in the event a student is hurt?" (2) "Are adequate accident records kept in the department and, if so, do you have a satisfactory method of reporting accidents to higher authority?" Only thirty of the 155 teachers reporting evaluated their accident reporting procedures as being satisfactory. Of the remaining 125, eighty-three evaluated their procedures as unsatisfactory. A slightly larger number felt the records kept were satisfactory. Teachers' overall evaluations of accident records indicate that only twenty-four considered procedures and records satisfactory while 126 rated themselves as something less than satisfactory.

TABLE XV

TEACHERS' EVALUATIONS OF ACCIDENT RECORDS USED IN THEIR SHOPS

Accident Records	Frequency		
	S*	A*	U*
Written statement giving proper procedure: When and if a student is hurt	30	42	83
Adequate accident records and reporting	38	48	69
Totals	68	90	152
Teacher evaluation for total rating	24	54	72

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

To determine the situation in the area of first aid the teachers were asked to rate their departments as to adequacy of first aid materials and to what extent first aid could be administered by a qualified person. They were then asked to give an overall rating of their department in the area of first aid on the basis of their answers to the first two questions. Only forty-two of the 155 teachers reporting rated their departments as having adequately stocked first-aid cabinets. Fifty-one departments or approximately one-third were rated unsatisfactory. The ratings given their departments by the teachers relative to qualified persons available to render first aid were only slightly better than those given in first aid supplies. Fifty-three or approximately one-third of the teachers felt that first aid could be administered by a qualified person in their department. This leaves 102 or approximately two-thirds of the departments with persons to administer first aid who could not be rated as having satisfactory qualifications. When making the overall evaluation considering both supplies and qualified personnel for first aid, only thirty teachers rated their departments as being satisfactory in this area.

TABLE XVI

TEACHERS' EVALUATIONS OF PRESENCE OF SUPPLIES AND THE ADMINISTRATION OF FIRST AID

First Aid Resources	Frequency S*	A*	U*
Adequately stocked first aid cabinets provided	42	62	51
Qualified person for administering first aid	53	69	33
Totals	95	131	84
Teachers' evaluation for total rating	30	94	31

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

CHAPTER IV

SUMMARY AND CONCLUSIONS

The purpose of the study was to determine the status of safety in the school farm shops in Tennessee and to formulate the basis for a safety program to be used by teachers of vocational agriculture in Tennessee. In making this study attention was given to certain basic factors that contribute to the formulation of safety programs in school farm shops. To determine the need and the extent of safety programs it was necessary to determine the rate, cause, and character of accidents of school farm mechanics shops. It was also necessary to determine the general safety conditions in shops.

The method of research included two questionnaires, the first completed by the teachers of vocational agriculture to determine the number of accidents occurring during a three-year period from April 1953 to April 1956. This questionnaire was also used to determine the causes of accidents. A second questionnaire was sent to teachers in December 1955 to determine the general safety condition of the school mechanics shops in Tennessee.

Summary

The findings in this study indicate that accidents occurred with all tools and in all areas of shop work in Tennessee. While a high majority of accidents were minor ones, accidents of a severe or

serious nature were not uncommon, especially where power driven tools with rapidly revolving blades were involved. The general physical conditions of the shops were found to be lower than is considered adequate for safe working conditions. The equipment in most of the shops was not considered safe as to placement and condition. While safety is being taught the students in farm mechanics classes, it was found that this instruction was inadequate in most schools.

The data show that accidents happened while students were using all of the tools listed in the study. No attempt was made to list the relative danger of the various tools used in Tennessee farm mechanics shops. To do so would have involved a study of frequency and total time in the use of each tool. A large majority of accidents occurring in the shops were minor ones requiring only first aid. The four tools with which more minor accidents happened were as follows, in order of importance and the number of accidents happening with each: hand saws, 143; hammers, 119; forges, eighty-one; and arc welders, sixty-six. Since the hand saw and hammer are probably the most common and frequently used tools in the vocational agriculture shop program, no conclusions should be drawn as to their relative danger. It can be safely concluded that more accidents happened while students were using these two tools.

The four tools with which the most relatively severe accidents happened and the number of each was: jointer, thirty-seven; circular saw, twenty-five; power grinder, eleven; and the arc welder, eight. All of these accidents required the services of a physician in addition to first aid.

Eleven per cent of the 965 accidents reported were classified as severe. This group covers those accidents that required the services of a physician and required stitches and bone setting. Less than 1 per cent of the accidents involved loss of use of a member of the body. Approximately 88 per cent of the total injuries reported were minor requiring only first aid.

Minor accidents, whether they required first aid or not, occurred with all tools and in all areas. The jointer and power grinder accounted for only 8 per cent and 6 per cent of the minor accidents, respectively. Although minor accidents do occur with these machines, when an accident does occur it is more likely to be severe or serious. It was found that the source of most of the serious or severe accidents occurred with machines having rapidly moving parts. These were the jointer, with approximately 38 per cent; the circular saw, with approximately 26 per cent; and power grinder with approximately 11 per cent. It is significant that the two tools having the highest source of minor accidents, saws and hammers, provided the lowest source for serious or severe accidents with only 2 per cent of the total each.

An analysis of reasons for the accidents shows that almost all of these were avoidable. It could be concluded that a vast majority of the accident causes can be eliminated by the teacher through proper instruction and by the student through proper shop safety procedure. Only two causes, defective equipment and physical defect of the pupil, may be beyond immediate correction of the teacher. These two items, however, accounted for less than 5 per cent of accidents. It can,

therefore, be concluded, that the teacher, through proper training, management and supervision, can control and eliminate a high percentage of all causes of accidents in the school farm shop. A careful study of all the causes of accidents reported by the teachers indicates that they could be grouped under approximately one-half the number of headings named by the teacher and could be classified as lack of proper instruction, failure to enforce safety rules, and failure to incorporate safety as an integral part of job procedure.

While teachers rated their shops as generally being safe and satisfactory places to work, they indicated that the general physical condition in the shops was in need of attention and could be improved. This is evident by the fact that only thirty gave their shops overall satisfactory ratings in this area.

All authors whose works were examined indicated that there is a direct relation between shop housekeeping and the frequency of accidents. None of the teachers in this study rated their shops satisfactory in housekeeping.

Only fourteen of 155 teachers reporting felt that equipment in their school shops was satisfactory from a safety viewpoint when placement and condition were considered. Also significant is the fact that in a majority of cases machines were not "locked off" when the instructor was out of the room, leaving the students operating the machines with no supervision. There is no evidence to indicate the number of shops having no method of "locking off" machines, thus, leaving the teacher no alternative but to leave them on in the event he left the room.

It can be concluded that 38 per cent of all machines in the departments surveyed were potentially dangerous, because they did not have control switches within easy reach of the operator. This would preclude quick stoppage in the event of an emergency. This is especially important when an accident occurs involving wearing apparel being caught in the machine. In their overall rating, 58 per cent of the teachers reporting considered electrical installations in their shops to need attention and improvement.

Teachers' evaluations of the presence and use of equipment in their shops for protection of students may have justified a better overall rating than shown. Their rating of only nineteen satisfactory shops compared with 136 of something less than satisfactory in the area of personal protection, may be attributed to the rather low rating given to wearing proper apparel.

Reporting teachers did not consider their instruction in the area of shop safety satisfactory. Only five rated their safety instruction as being satisfactory. It is apparent that safety was being taught as an integral part of each teaching unit but the instruction and testing was apparently not being carried to the action stage. This is indicated by the fact that only twenty-eight of the 155 teachers reporting had printed or typed safety rules; only eighteen made use of a safety test; and only thirteen of 155 had periodic inspections of shop made by students.

The fact that fire control as a safety factor was not adequate in the reporting schools is well established. While the number of conditions that promote high frequency of fires was extremely high, it is significant that the means for satisfactory control ranked lower than all items with the exception of safety cans provided for inflammable liquids.

The fact that only thirty-eight of 155 teachers reported adequate accident records not only indicates negligence in this area, but has legal implications as well.

Sixty-two teachers indicated that they did not have adequate supplies to give first aid in the event of an accident; sixty-nine reported they had no qualified person to administer first aid. Only 19 per cent of the teachers felt that their first aid situation was satisfactory. This leaves 81 per cent with something less than satisfactory preparation for giving first aid.

The findings in both shop safety and accident surveys indicate the need for a standard safety program for farm shops operated in schools in Tennessee. The most forceful item of evidence here is the fact that the farm shops have a relatively high rate of accidents. These accidents are only 11 per cent severe or serious. Less than half of the reporting teachers had printed or written safety rules for the use of their students. Over two-thirds of the shops surveyed had never had a safety inspection.

Conclusions

Conclusions reached from this study are:

1. Accidents happen at the school farm shop in all areas and with all tools involved.
2. Most of the accidents occurring are minor ones requiring only first aid.
3. A sufficient number of severe and serious accidents occur to warrant positive and specific action for their prevention.
4. Most of the accident causes can be eliminated by practicing a systematic safety program.
5. Shop housekeeping in most of the school farm shops in Tennessee is not conducive to a low accident rate.
6. The condition and placement of tools cannot be considered satisfactory from a safety viewpoint.
7. Shop safety instruction is not considered adequate.
8. Adequate accident records are not being kept by a large majority of the teachers.
9. In view of the shop conditions and inadequate safety instruction many of the vocational agriculture teachers could be considered negligent by a court.
10. There is a definite need for a safety program in the farm mechanics phase of vocational agriculture instruction in the secondary schools of Tennessee.

11. There is a definite responsibility on the part of the State Supervisor of vocational agriculture to inform the teachers of their legal responsibilities and methods by which they may avoid being declared negligent in court by tort action.

CHAPTER V

A PROPOSED SHOP SAFETY PROGRAM FOR TENNESSEE SCHOOL FARM SHOPS

The following safety program has been developed for the specific needs of vocational agriculture farm mechanics classes in Tennessee. It was adopted from four safety programs that have been in operation over a period of years and have been proven to be sufficient and effective. The programs drawn from are Michigan, North Carolina, Pennsylvania, and the Safety Training program of The National Safety Council which is used by a number of trades and industrial school shops in Tennessee.

Safety Rules and Practices

A. General Safety Rules for Instructors[1]

1. Have a place for everything and keep things in their place.
2. Keep a clean shop, well lighted, and well ventilated.
3. Know all danger points in your shop and give proper instruction on how to perform all operations.
4. Allow no scuffling or horse-play in the shop.
5. Do not allow boys to congregate around a machine that is being used.
6. See that all materials are properly stored.

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[1]J. Warren Smith, "Safety Education for Shop Teachers in North Carolina Schools," Bulletin 2, North Carolina State College, Raleigh, North Carolina, 1939, p. 7.

7. Properly space machines when placing them in a shop, so that one operator does not interfere with another.
8. See that students are properly dressed for the work they are doing. Have uniforms if possible.
9. Make an inventory of your own knowledge and practices to make sure you are following and teaching correct and safe methods.
10. Keep up-to-date on mechanical safeguards, and see to it that all machines are properly guarded.

B. General Safety Practices

1. Know the operation of tools and machines and the purposes for which they are intended before attempting to use them.
2. Use all guards and safety attachments.
3. Stand "clear" of a machine that is in operation.
4. The attention of a machine operator should not be distracted.
5. Dress appropriately for the job to be done. The wearing of dangling ties, sleeves or loose garments may be caught by the machine endangering the operator.
6. Make set-up adjustments only when the machine is not running.
7. When not sure of an operation, adjustment or practice ask your teacher for instructions.
8. There is serious danger in pushing and other "horseplay." Good conduct is necessary in the shop to assure safety.
9. Avoid standing in line with the moving parts of any high speed machine.

C. Safety Practices for Jointer[2]

1. Always use the guard, except when rabbeting wide stock.
2. Keep hands away from area above cylinder head.
3. Do not attempt to join stock less than twelve inches in length.
4. Give your complete attention to work.
5. Avoid deep cuts.
6. Use tips of fingers, not flat of hand to propel stock.
7. Use jig for pushing end of stock past cutter blade.
8. Check lock screws in cutter daily before use.
9. Keep knives sharp and true.
10. Keep tools and other items off beds of machine.
11. Keep fence locked in place.
12. Run stock with grain not against it.
13. Be especially careful with curly and knotty stock.
14. Operate machine from left rear, pushing the work through, never pulling it.
15. Wear neither loose, ragged clothing or gloves.
16. Only a round head cutter should be used with the jointer.
17. The jointer must neither be used to plane stock thinner than one-half inch, nor to join stock narrower than one inch.

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[2]Ibid., p. 12.

D. Forge Safety Practices

1. Use only blacksmith coal. Dangerous air pollution may result when soft coal is used.
2. See that hood and blower are functioning properly.
3. Use tongs that fit the stock.
4. Air blower should be stopped when stock is put into or taken out of the fire.
5. Use only those tools with sound, securely fitted handles.
6. Use only tools that are well-dressed and free of mushroomed heads.
7. Strike hardened tool only with a soft hammer.
8. Strike soft stock with a hardened steel hammer.
9. Use the soft part of the anvil and a hardened hammer when cutting metal.
10. When cutting metal no one should be in the direction in which pieces may fly.
11. No one should be in line of the "swing" of tools.
12. Hot pieces of metal should be placed in cooling tank or on metal table. Table should be marked "hot".

E. Safety Practices for the Circular Saw[3]

1. Use push-stick on narrow stock.
2. Report a dull or improperly fitted saw to instructor.

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[3]Ibid., p. 9.

E. Safety Practices for the Circular Saw (continued)

3. Remove blocks from near saw with a wooden stick or stop machine to remove by hand.

4. Never reach over or behind a revolving blade.

5. Use clearance block when cutting multiple stock to length. The ripping fence should not be used for stop in cutting to length.

6. Allow blade to protude through stock only about one-fourth inch.

7. Always use the guard, unless the operation is impossible with the guard in place. If the guard must be removed ask permission of the instructor.

8. Always replace guard in position when leaving the machine.

9. If in doubt about any operation ask your instructor.

10. Always stop saw before making any adjustments.

11. Keep entire machine free of blocks and sawdust.

12. Give your complete attention to work being done.

13. Keep hand tools off saw table.

14. Keep saws sharp and properly set.

15. Stand to one side of the saw. Do not allow any other person to stand in line with the saw.

16. Reverse short boards, sawing from each end to the center, thus avoiding passing the hands by the blade.

17. A push tool for circular saws is outlined in National Safety Council instruction card number thirty-eight.

F. Safety Practices for the Power Grinder

1. Wear goggles and keep eyes out of line of the grinding wheel.
2. Be sure tool rest is properly adjusted.
3. Insure that wheels are of proper size and of proper running speed.
4. High speed stones should be used only with a guard.
5. Use the circumference of the wheel.
6. Avoid excessive pressure.
7. It is best not to use the side of the grinding wheel.
8. Stand out of line with the grinding wheels.
9. Do not permit hands to come in contact with the wheels.
10. Clearance between tool rest and stones should not exceed one-fourth inch.

G. Safety Practices for Arc Welders

The safety practices given here do not include low voltage electric shock. For safety in this area see item H.

1. Never strike an arc until everyone near is protected from the arc rays. Infra-red and ultra-violet rays given off by the arc will cause severe eye irritation and sunburn. The former is sometimes called "hot-sand-in-the eyes."
2. Wear a shield or helmet with a Number 10 shade lens which meets federal specifications.

   Oxyacetylene goggles lenses are not protective enough for rays of this intensity and they do not cover the face and neck. The

G. Safety Practices for Arc Welders (continued)

shield or helmet must cover all exposed parts of the face and the lens must protect the eyes.

3. All parts of the body must be protected from the rays. Be sure the shirt is buttoned up to the neck and that gloves and caps are worn. Thin shirts or trousers will permit rays to go through and burn the skin.

4. Wear heavy woolen clothing as protection against rays. Woolen clothing resist burning.

5. Protect cables from rubbing against sharp edges which will cause short circuiting.

6. Wear high top shoes or boots to prevent hot metal or scale sparks from falling in the shoes and burning the feet. Trousers should be cuffless to avoid catching hot metal.

H. Safety Practices for Hand Tools

1. Use only tools that are properly sharpened and in good condition.

2. Avoid carrying tools in the pockets. Use a tool box.

3. Use only tools with handles and free from broken or splintered parts. Be sure that hammer heads are secure on handles.

4. Chisels, hammers or other tools on which the heads have become burred should not be used.

5. Always use the tool for the purpose it was intended.

6. Avoid striking two highly tempered steel tools together.

7. When using an edged tool avoid cutting toward yourself or anyone near you.

H. Safety Practices for Hand Tools (continued)

8. When driving nails hold the nail near the head and keep the eyes above "flying nail" level.

9. Do not leave tools with exposed edges or points where they may be stepped on, sat on or bumped into

10. Use only those files that have been fitted with a handle.

11. Avoid using cold chisel or other tool with mushroomed head.

12. Keep hands away from points of contact when using a hand saw.

13. When using pipe or monkey wrenches be sure that the jaws are not sprung and that they are applied to the work so that the wrench handle will turn in the direction in which the jaws point.

14. Use open end wrenches properly sized for the job, properly applied to the nut or bolt head and pull if possible rather than push.

15. Use only screw drivers that are in perfect condition and appropriate type and size for the job at hand.

I. Safety Practices that Apply to the Wood Lathe

1. Be sure that the stock is properly centered and securely locked between the centers of the lathe.

2. Do not attempt to turn large, rough, or unbalanced stock at high speed.

3. Adjust the tool rest to give the most leverage for the tool.

4. Stop the motor when shifting belt on the cone pulley.

5. Be sure that stock is fastened securely to face plate.

I. Safety Practices that Apply to the Wood Lathe (continued)

6. Do not turn at high speed stocks which are likely to fly apart.

7. Do not adjust tool rest while stock is being revolved.

8. Remove tool rest when not actually in use, such as when sanding or polishing.

9. When scraping, point tool toward center of stock.

10. Do not wear any loose fitting clothing, such as neckties, loose sweater, or open shirt sleeves.

11. Give all of your attention to the work you are doing.

12. Do not allow screw heads to project above the surface of the face plate.

13. Lock tool rest, check clearance, and lock both tail center locks before applying power.

14. Never hold head or body in line of revolving stock fastened to face plate.

15. Never use materials with loose knots.

J. Safety Rules that Apply to the Drill Press

1. Hold work in vise or clamp for drilling.

2. Be sure that same workman operates both pressure lever and stock under bit or countersink.

3. Change bits while machine is at rest, and do not tighten chuck by grasping and switching on the motor.

4. Know and use the proper speed for the work being done.

5. Do not use chuck or head with protuding set screws.

J. Safety Rules that Apply to the Drill Press (continued)

6. Use drills properly sharpened to cut the right size.

7. Do not leave the chuck wrench in the chuck.

8. Use a stick or brush to remove chips from the drill--never use your fingers.

9. Be extremely careful when reaching around a revolving drill. Wear snugly fitting clothing.

K. Safety Rules that Apply to the Band Saw

1. Keep guards in place.

2. Do not have guides higher than necessary for clearance.

3. Back stock out only when necessary.

4. Do not bind saw blade.

5. Stand to the left of the saw blade.

6. Use blade suitable for job.

7. Be sure blade is running smoothly before starting cut.

8. Do not adjust guides while blade is moving.

9. Test blade for tension before throwing switch.

10. Keep tools and scraps off the saw table.

11. Keep saws well set and sharpened.

12. Do not saw stock after power has been cut off.

13. Remove blocks or chips near the saw with a stick, or wait until the saw stops.

14. Do not allow fingers to be in a direct line with the blade when nearing the end of stock.

L. The Safe Use of Oxyacetylene Welding Equipment

In view of the fact that accidents happening with this equipment, even though rare, are so potentially dangerous, the procedure given by The National Safety Council is reproduced here.[4]

(a) Acetylene Cylinders

1. Keep acetylene cylinders as far away from all fire as possible, particularly those in storage.
2. Keep acetylene cylinders away from any place where they may be exposed to sudden changes in temperature, such as near radiators, steam pipes, etc. Heat increases the pressure and may cause safety fuse plugs to melt or blow. No more than 2,000 cubic feet of fuel gas may be stored in any one room.
3. Leaking cylinders should be carried outdoors where the gas may escape without danger. If allowed to escape in a room or other confined place, an explosive mixture may be formed.
4. Open acetylene valves no more than about a quarter turn so that they may be closed quickly in an emergency.
5. Valve wrenches should always be in position on tanks so that they may be shut off quickly if necessary in an emergency.

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[4] "Safety Training for Vocational Schools and School Shops" (Chicago: National Safety Council, 1938), p. 50.

L. The Safe Use of Oxyacetylene Welding Equipment (continued)

6. Handle acetylene cylinders carefully. Rough handling, knocks, or falls are apt to cause damage to cylinders, valves, or safety fuse plugs and cause leakage and possible explosion. Never use tanks as rollers, anvils, or for any purpose for which they were not designed.

7. Do not lift tanks. Roll them on bottoms. If it is necessary to carry acetylene cylinders use a lifting device and ask for plenty of assistance.

8. Use acetylene tanks only in an upright position. This will prevent any acetone from flowing out.

9. Acetylene hose or line pressures should not exceed fifteen pounds per square inch.

10. Water seals should be used at the outlet end of manifolds if acetylene is piped to the welding station. This prevents torch flashbacks from reaching the supply cylinder.

(b) Oxygen Cylinders

1. Oxygen tanks should not be stored near combustible materials. Oxygen will not burn but it supports burning and will cause other materials to burn more easily in its presence.

2. Storage of oxygen tanks where they may be exposed to sudden changes in temperature is dangerous due to increased pressure. Keep them away from radiators, steam pipes, etc.

3. Handle all tanks carefully. Never use tanks as rollers, anvils, or for any purpose for which they were not designed.

L. The Safe Use of Oxyacetylene Welding Equipment (continued)

4. Protect tank valves with the regular safety caps when the tanks are not in use. If an unprotected tank should fall and the valve became damaged, the escaping gas may have sufficient pressure to make a projectile out of the tank.

5. Do not attempt to repair tank valves. Leaking tanks should be carefully removed outdoors where the gas may be allowed to escape in safety.

6. Open oxygen cylinder valves slowly. If the pressure is turned on too quickly it is likely to damage regulators and guages.

(e) Regulators

1. Regulators should always be used when operating with compressed gases. Safe operation demands a controlled and uniform gas pressure.

2. Dust and dirt should be thoroughly cleaned from tank valves before attaching regulators. This is called "cracking."

3. Regulator connections should be inspected for dust and dirt before attaching.

4. Stand to one side when opening tank valves so that no parts or particles will strike any part of the body in the event of a failure. Also be sure that no other persons are standing where they might be injured in this manner.

5. Do not force regulators on tank valves. If the thread

L. The Safe Use of Oxyacetylene Welding Equipment (continued)

does not run freely, either the wrong regulator is being used or the threads are defective.

6. Regulator connections should be tightened sufficiently to prevent leakage. Acetylene, when mixed with air or oxygen in proper proportions, produces an explosive mixture. The danger of explosion is especially great in confined spaces. Slight gas leaks have caused serious explosions in small rooms.

7. Adjusting screws should always be turned out or released when the equipment is not in use or when changing cylinders. If the screw is not released an excessive pressure may be built up which may damage the equipment and injure the operator.

8. Low pressure gauges should be operated at pressures not exceeding half the gauge dial reading.

9. "Creeping" regulators must be reported to the instructor. The maximum "creep" allowed is equal to the number of pounds of pressure needed for the size of tip used.

(d) Welding Hose

1. Always use red welding hose for acetylene. Always use black or green hose for oxygen. Never interchange hose from oxygen to acetylene or vice-versa.

2. Only hose in good condition should be used. Report all worn, cut, or charred hose. Serious burns may result from fires in leaky hose.

L. The Safe Use Of Oxyacetylene Welding Equipment (continued)

3. Due to the flammability of rubber, protect welding hose against sparks, molten slag, and hot metals.

4. Coil and arrange welding hose neatly and keep out of the way. Kinked or tangled hose may cause tripping.

5. Acetylene hose connections have left-hand threads; oxygen hose connections have right-hand threads; all connections should work freely.

(e) Welding Torches

1. Check for loose connections before using a torch A leaking torch will not operate properly. The gas may ignite at the point of leakage or may cause excessive backfiring.

2. Turn off the torch when leaving the work even for a very short time. An unattended lighted torch may cause a fire or an explosion. In accidental contact with the cylinder it might cause an explosion.

3. Backfiring of a torch is not only a disagreeable nuisance but is dangerous as well. Common causes of backfiring are allowing the torch to become too hot, holding the torch too close to the work allowing the torch to become corroded with slag, or having insufficient pressure for the size of tip used.

4. Torch flash backs are cases in which the gas in the hose becomes ignited. In such cases turn the oxygen needle

L. The Safe Use Of Oxyacetylene Welding Equipment (continued)

valve off first. This will reduce the intensity of the burning of the gas.

(f) Cutting Torch

1. Never use a cutting torch where its flame or the sparks from its cutting might ignite flammable materials near by.
2. Take cutting work to a location where there will be no possibility of setting fires or move the flammable materials a safe distance away.
3. Use sheet metal guards, sheet asbestos, or similar protection to confine sparks and molten slag.
4. Always guard the hose from contact with the torch flame or molten slag. Slight damage may cause a leak which might result in an explosion.

(g) Gas Welding Cylinders

1. Never use acetylene at a pressure in excess of fifteen pounds per square inch gauge pressure.
2. Never allow oxygen to come in contact with oil or grease.
3. Always refer to gases by their proper names. Do not refer to oxygen as "air" or acetylene as "gas."
4. Never use oxygen as a substitute for compressed air for pneumatic tools or similar devices.

L. The Safe Use of Oxyacetylene Welding Equipment (continued)

5. Never use pressure from an oxygen supply for clearing clogged oil lines.

6. Never use cylinders as rollers or to support work.

7. Do not tamper with safety devices on cylinders or cylinder valves.

8. Do not hang blowpipes from the regulators attached to cylinders.

9. Never attempt to transfer gas from one cylinder to another.

10. Never attempt to mix two gases in one cylinder.

11. Do not let hot slag fall on combustible materials or on the cylinders.

M. Safety Practices for Sheet Metal

1. Sheet metal in the school farm shop normally consists of the following: tin plate, galvanized iron, black iron, aluminum, zinc and copper. Over 90 per cent of the sheet metal accidents are caused by the careless handling of these materials. Carefulness in handling and working these shop supplies is therefore of utmost importance.[5]

2. Edges and corners are very sharp requiring not only due care of the handler for his own safety but also the safety of those individuals nearby.

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[5]Lester K. Ade, Safety Education in Industrial School Shops (Harrisburg: Pennsylvania Department of Public Instruction, 1938), p. 74.

M. Safety Practices for Sheet Metal (continued)

3. After cutting any kind of sheet metal dress edges with a file or stone to remove all slivers and ragged edges.

4. Electric Soldering Coppers

(a) Completely disconnect from electrical outlet when not in use.

(b) Place hot copper on metal stand marked "Hot" until cool.

(c) Inspect cord each time prior to use watching for worn insulation and breaks.

(d) Always disconnect from electrical outlet for cleaning and repairs.

(e) Place work to be soldered in such a place or position to avoid hot solder from falling on the clothing as in shoes.

(f) Avoid testing heat of copper with hands.

(g) Keep hands and work clean.

5. Gasoline and gas torches

(a) Be sure torch is clean, tight and in good condition before lighting.

(b) In lighting gas torches, first light match, then turn on gas.

(c) In lighting gasoline torches avoid over filling priming cup.

(d) Be certain torch is completely shut off when not in use.

(e) Avoid knocking torch on to floor by keeping well away from work when in use.

M. Safety Practices for Sheet Metal (continued)

(f) In the event a torch is accidentally dropped or tipped off a table it should be set upright, cut off and left on the floor to cool. All connections should be thoroughly inspected and tested before relighting.

6. Soldering Flux (Nokorod-Acid) (Muriatic Acid)

(a) Keep these supplies away from all other chemicals and cleaning agents. In case of breakage flush the acid with water and neutralize with sodium carbonate.

(b) Avoid getting flux on hands or body.

(c) Cut muriatic acid with zinc in glass or earthen containers.

(d) Keep flux containers well marked, well corked and in a safe place.

N. Safety Practices for Shop Electrical Systems

The low voltage circuits commonly found in all school farm shops is much more potentially dangerous than most teachers and students suspect.[6] This is probably due to the fact that most of us are accustomed to using electricity in the home on wood floors and with more or less automatic appliances. It is, therefore, important that the shop teachers should understand some of the principles involved in order that he may properly teach and safeguard his students.

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[6]James Montague, Tennessee Valley Authority, Electrical Development Department, personal interview, June 15, 1956.

M. Safety Practices for Shop Electrical Systems (continued)

An electric shock is received by a person whenever any part of his body becomes part of an electric circuit. Injury from electric shock always takes one of two forms, or both. These are nerve shock which can stop action of lungs or heart, or both; and from the heating effect of the current which can cause severe burns usually at the point where the current enters or leaves the body.

Since one-tenth of an ampere or less may cause death, all circuits usually found in the school farm shop have more than sufficient capacity to kill.

The severity of the shock and the resulting injuries depend upon the voltage, the amount of current, the course it takes through the body and total time of current flow.

For a given voltage the amount of current that will be carried by the body depends on the resistance offered by the circuit of which the body is a part.[7] Dry floors, dry hands, dry shoes without nails all offer high resistance to the flow of electrical current. A vast majority of shop floors are of concrete construction. This material when wet or damp provides an excellent electrical ground. This condition together with hands wet with

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[7]"Safety Subjects" (U. S. Department of Labor, Bureau of Labor Standards, Bulletin No. 67, Revised 1955), p. 157.

M. Safety Practices for Shop Electrical Systems (continued)

perspiration and improper shoes offers very little resistance and therefore provides an ideal path for a dangerous flow of current.

1. Be certain that all wiring and electrical installations meet the State Safety Code (a copy may be obtained from your local power distributor).
2. All electrical outlets should be three wire type which provides a built-in ground.
3. Be certain that all electrical machines, appliances and tools are properly grounded before using. Proper grounding is accomplished by a third wire from the frame of the machine to the third (ground) wire of the outlet.
4. Fuses and circuit breakers of the proper size and capacity must be in all electrical circuits. Their purpose is to protect the electrical system and appliances from current overloads. Fuses are sometimes known as the safety valve of electricity. A master switch with a locking device should control all machines in the school shop. If for any reason the teacher should leave the shop this switch should be locked in "off" position.

O. Heat, Light and Ventilation for the School Shop

The optimum shop temperature is 67.50° Fahrenheit for skills instruction. When students are engaged in actual manual labor a temperature of 63° Fahrenheit is considered adequate.

O. Heat, Light and Ventilation for the School Shop (continued)

Both of these temperatures are based on fifty per cent air humidity. A lower humidity reading will require a higher temperature for comfort.[8] Provisions must be made to insure adequate ventilation to remove air contaminants and remove excessive heat and humidity. Welding processes and forge fires, if not properly vented, will rapidly raise the carbon dioxide and carbon monoxide content of the air to danger levels. Even small amounts slow workers' reactions which may indirectly raise the accident rate.

Properly diffused light of not less than thirty foot candles on work tables is considered adequate for the school shop.[9]

P. Safety Rules for Fire Protection and Prevention

Fire safety in the school farm mechanics shop should be developed in three phases in the following order: A fire alarm or signal and exit plan for those in the shop in the event of a fire; the second phase is the development of a fire prevention plan; the last is a simple yet complete and adequate plan to extinguish a fire before it gets out of control.

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[8]"Safety Subjects" (U. S. Department of Labor, Bureau of Labor Standards, Bulletin No. 67, Revised 1955), p. 129.

[9]Wesley Pickel, Coordinator, School Buildings and Transportation, Tennessee State Department of Education, personal interview, October 22, 1956.

P. Safety Rules for Fire Protection and Prevention (continued)

The exit plan should be simple and completely familiar to all persons who may be in the shop. It should start with an alarm of simply the understanding on the part of all that the first person to discover the fire will yell "fire." All exits should be unlocked while students are working in the shop. Advantage should be taken of all exits by assigning an equal number of students to each as their line of exit. The plan should specify an assembly point outside where the roll can be quickly checked to determine if all students are out.

The fire prevention plan should be developed for each individual shop and the operations that will probably be conducted therein. The first consideration is the type of construction. Shops with concrete floors and masonry walls will require a much less elaborate plan than a shop with wood floor and framed walls. The wide variety of shop construction and operation in Tennessee requires that only very general rules for fire prevention be given here.

1. Make sure that all electrical wiring and appliances meet the State Code and that they are properly fused.
2. Store all inflammable supplies such as paint, grease, oil and hydrocarbon cleaners outside the building in a fire-proof structure.
3. Provide metal containers for all wiping cloths and other cleaning materials.

P. Safety Rules for Fire Protection and Prevention (continued)

4. Special precautions must be taken with the forge. All metal forges in Tennessee farm shops are operated with coal. This not only requires special fire precautions but safe removal of smoke and gases of combustion as well.

B. L. Wood indicates that the hazard of fire in a school room of any type is much more dangerous than the combustible content indicates because of the danger of hysteria and panic where groups of people are exposed to fire.[10]

A simple method for determining the potential fire hazard in a shop is to determine the number of pounds of combustible materials per square foot of shop area. The building and its contents are included in the estimate. The total pounds of combustibles per square foot should not exceed twenty pounds.

Q. First Aid

First aid and a competent knowledge of its application is a most important item in shop safety. There is a much higher mortality rate from infection from minor cuts and scratches than from major serious accidents.[11] This fact indicates the necessity for provisions for the emergency treatment of wounds. The shop

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[10] B. L. Wood, Fire Protection Through Modern Building Codes (New York: American Iron and Steel Institute, 1945), p. 18.

[11] Smith, op. cit., p. 4.

Q. First Aid (continued)

teacher or other person in the school should be qualified to give first aid by having completed a standard course in first aid.

Emergency treatment should be given regardless of how small or unimportant the injury may seem at the time. First aid consists of such aid and assistance as is necessary to completely treat the injury or to place the injured person under the care of a physician with the least possible danger of added injury. To do more than this may place the teacher in jeopardy of legal action on the part of the student's parents.

A first-aid cabinet of dust-proof construction should be located in an accessible place in each shop and should contain the following items:[12]

1. A Red Cross First Aid Book
2. Bandage scissors
3. Thumb forceps
4. Splinter forceps
5. Clinical thermometer
6. Sterile bandage
   (1" x 10 yards)
   (2" x 10 yards)
7. Gauze pads (3" x 3")
8. Band aids
9. Absorbent cotton--sterile
10. Adhesive plaster
11. Wooden applicators
12. Tongue blades
13. Safety pins
14. Triangular bandage
15. Rubbing alcohol

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[12]Adopted by The Davidson County Board of Education as prescribed by the County Health Department, September 1953.

Q. First Aid (continued)

16. Tincture of metaphen
17. Furacin (for burns)
18. Mineral oil in dropper bottle (for eye injuries)
19. Scales

School policies should be:

1. Teachers and other school personnel should not exceed the usual practice of competent first-aid in managing emergencies of sickness or accident. They should not diagnose and they should never administer medication of any sort except as prescribed by a physician.
2. Parents should be immediately notified. No sick or injured child should be sent home alone, unaccompanied by an adult.
3. There should be at least one teacher in each school trained in first aid.

Administering the Safety Program

The State Board for Vocational Education in Michigan recommends that a shop safety program be administered by the students in each class under the guidance of the teacher.[13]

The plan starts with the election of a safety engineer whose duties are to:

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[13] "Training for Safety" Bulletin No. 279 (State Board for Vocational Education, Lansing, Michigan, 1942), p. 18.

1. See that the shop is clean and orderly.
2. Insure that all students are wearing proper clothing.
3. Watch for neckties that may get caught in machines.
4. See that goggles are clean and are worn by all in eye hazard areas.
5. See that proper shields are used by welders.
6. Be on lookout for accident causing work habits.
7. Insure that all guards are in place.
8. Remind operators not to leave machines running.
9. Check machines for cleanliness and lubrication.
10. Check position of tool-rest on machines.
11. See that no defective tools are issued or used.
12. Report defective items to instructors for proper action.
13. Check fire extinguishers and record condition at regular intervals.
14. Be on lookout for fire hazards which may develop during shop operations.
15. Post safety bulletin board.
16. Inspect first-aid cabinet reporting deficiencies to the instructor.
17. Correct or report any violations of established rules.
18. Assist in completing on the spot a report in writing of all accidents.

The office of safety engineer should be rotated so that most every student will have an opportunity in the position during the school year.

A safety committee of students elected by their fellow students should be formed in each class. The group should be composed of not less than four members with the safety engineer as chairman. The replacement of one member per month will provide an opportunity for more students to participate and yet retain continuity.

The committee should act to promote safety among the members of the class and aid the instructor in making the shop a safe place in which to work. It should be responsible for keeping safety records, developing safety posters, investigating accidents with the help of the instructor and recommend safety improvements to both students and instructors.

Suggested Methods for Teaching Safety

All references examined seem to agree that the basic method of teaching safety is by the indirect method of good teaching in each job operation of the right way to do the job before the student has a chance to learn unsafe procedures by trial and error.

According to Florio and Stafford the basic goal of safety education, to insure correct behavior as is indicated above, is only valid when the student has not only developed adequate knowledge

and skill but has developed flexible behavior and proper attitudes as well.[14]

To gain these things the student must have the opportunity to participate at the doing level in class discussions, field trips, surveys, exhibits, demonstrations and actual job operations.

The teaching may be grouped in three patterns: direct teaching, correlation and integration. The direct teaching method is used in areas concerned exclusively with safety. By this method safety is taught as a subject.

In correlated teaching the instruction on some aspect of safety is an integral part of the subject matter taught and is given in the lesson at the most opportune time. This method should be used extensively in teaching shop safety as the content of the course blends naturally with the safety instruction to be included.

The principle of integrated teaching is to focus the whole learning process on one goal, to bring together all areas of learning in all shop jobs and thus avoid emphasizing specific, isolated objectives. This method requires much imagination and skill on the part of the teacher to insure that safety does not become merely incidental.[15]

A survey by the National Education Association showed that the

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[14] A. E. Florio and G. T. Stafford, Safety Education (New York: McGraw-Hill Book Company, 1956), p. 53.

[15] Ibid., p. 55.

following methods are commonly used with success in safety education throughout the United States.[16]

1. Safety discussion directly related to use of equipment in courses such as shop.
2. Audio visual aids on safety.
3. Visits to industrial plants with similar installations to observe safety practices.
4. Lectures and demonstrations by other than school people such as industrial engineers, firemen, etc.
5. Bulletin board displays on safety.
6. Safety contest and campaigns.

Safety Program Records and Reports

The volume of work done and the number of days devoted to farm mechanics in Tennessee does not warrant an elaborate set of records as would a full-time industrial shop.

Sufficient records should be kept to serve the two primary purposes for which safety records are made. These are (1) to serve as a guide in preventing accidents and (2) to fix responsibility. A third reason, although of lesser importance, is to have a pre-set guide to follow in the event of an accident.

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[16]"Safety Education Through Schools," Research Bulletin, Vol. 16, No. 5 (Washington: National Education Association, Research Division, 1939), p. 64.

To accomplish the above, the following minimum records and reports are suggested:

a. Student's Private Physician Card.

b. Safety Test Paper Signed by Student.

c. National Safety Council Accident Survey Form.

d. Standard Student Accident Report Form.

In view of the fact that both the National Safety Council's School Shop Accident Survey Form and the Standard Student Accident Report Form have been adopted by several states, they are included here in the interest of uniformity.

School Shop Accident Survey Form

1. Name of School_____ 2. City_____

3. Name of Injured 4. Grade____ 5. Age____

6. Occurred: Hour____; Day____; Month____; Year____

Place_____

7. Part of Body_____

8. Type of Injury:

Amputations_____

Bruises or Contusions_____

Cuts or Lacerations_____

Fractures or Concussions_____

Foreign Body in Eye_____

Sprains or Strains_____

Burns or Scalds_____

Infections_____

Other_____

9. Type of Accident:

Striking against_____

Struck by flying object_____

Struck by falling object_____

Caught in or between_____

Fall_____

9. Type of Accident: (continued)

Overexertion _____

Contact with electric current _____

Contact with heat _____

Other _____

10. Medical Attention:

	Time	Date
First aid	_____	_____
Doctor	_____	_____
Receiving hospital	_____	_____
Hospitalized	_____	_____

11. Machine or tool involved: _____

12. Damage to equipment - materials: _____

_____

13. Days lost from school: _____

14. Explain fully how accident occurred, describe circumstances, what the student was doing, etc. _____

_____

_____

_____

15. Did inadequate guarding contribute to the accident? _____

If "yes," how? _____

16. What defective tool or equipment, if any, was at fault?

_____

17. Was student using essential personal protective equipment required for this job?_____

18. In your opinion, how could the accident have been prevented?

_____

19. Where was the instructor at time accident occurred?

_____

20. Signature:_____
Student Safety Engineer

21. Signature:_____
Instructor

22. Signature:_____
Injured

23. Signature:_____
Witness

24. Signature:_____
Witness

Instructions for Use of Form

1. Reportable Accident:

Any accident causing an injury requiring first aid or medical attention is a reportable accident.

2. Place:

Indicate as to place exactly where the accident occurred. Be specific; for example, machine shop at lathe, wood-working shop at circular saw, etc.

3. Part of Body:

Be definite in reporting the part of the body injured. If the eye is injured, state which eye; if the finger,

3. Part of Body: (continued)

state which finger and which part of the finger.

4. Type of Injury - Type of Accident:

Check the type of injury and type of accident. If in either case the types do not fit the injury or the accident, check "other" and after the word "other" describe.

5. Explanation of Accident:

The full explanation of how the accident occurred is necessary. The following facts should be covered:

a. Name the type of tool, material, machine, etc., and tell what the injured person was doing.

b. Describe how he was injured.

c. What was defective or unsafe about the tool, etc.

d. Explain what the injured person did that was unsafe, (unsafe act or practice).

e. What personal protective equipment, such as goggles, etc., was not used.

f. What injury resulted?

6. Medical Attention:

Describe medical attention given.

7. Signatures:

The report should be signed by the injured person if it is at all possible to obtain his signature. Space is also provided for the signature of the student safety engineer. Where such a person is used in the class

7. Signatures: (continued)

organization, it is recommended that the student safety engineer read and sign the report. Space is also provided for witnesses. The value of these signatures is apparent in case of legal action or in case of an attempt to place responsibility. The investigator, who may be a division head, an instructor, or any person designated by the superintendent, is the person who has the responsibility of following through on accident reporting. No accident report is complete without the signature of the teacher.

8. Recommendations:

Recommendations for prevention should be based on an analysis of the accident as reported on the form.

9. Closing Report:

No report is complete until the date of the final recovery has been entered and the signature of the investigator is affixed.

Standard Student Accident Report Form

Part A. Information on ALL Accidents

1. Name:_____ Home Address:_____

2. School:_____ Sex: M__; F__. Age:____

Grade or classification:_____

3. Time accident occurred: Hour_____ A.M.;_____ P.M.

Date:_____

4. Place of Accident: School Building_____, School Grounds___,

To or from School____, Home_____, Elsewhere_____.

5._____

Nature of Injury:

Abrasion	_____	Fracture	_____
Amputation	_____	Laceration	_____
Asphyxiation	_____	Poisoning	_____
Bite	_____	Puncture	_____
Bruise	_____	Scalds	_____
Burn	_____	Scratches	_____
Concussion	_____	Shock (el.)	_____
Cut	_____	Sprain	_____
Dislocation	_____	Other (specify)_____	
		_____	

Part of Body Injured:

Abdomen	_____	Chest	_____
Ankle	_____	Ear	_____
Arm	_____	Elbow	_____
Back	_____	Eye	_____

Part of Body Injured: (continued)

Face	_____	Mouth	_____
Finger	_____	Nose	_____
Foot	_____	Scalp	_____
Hand	_____	Tooth	_____
Head	_____	Wrist	_____
Knee	_____	Other (specify)	_____
Leg	_____	_____	

Description of the Accident:

How did accident happen? What was student doing? Where was student? List specifically unsafe acts and unsafe conditions existing. Specify any tool, machine or equipment involved. _____

_____

_____

_____

_____

_____

_____

6. Degree of Injury: Death_____, Permanent Impairment_____, Temporary Disability_____, Nondisabling_____.

7. Total number of days lost from school:_____

(To be filled in when student returns to school).

Part B. Additional Information on School Jurisdiction Accidents

8. Teacher in charge when accident occurred (Enter Name):

_____

Present at scene of accident: No_____ Yes_____

9. Immediate Action Taken:

First-aid treatment _____ By (Name):_____

Sent to school nurse _____ By (Name):_____

Sent home _____ By (Name):_____

Sent to physician _____ By (Name):_____

Physician's Name:_____

Sent to hospital _____ By (Name):_____

Name of Hospital:_____

10. Was a parent or other individual notified: No:___Yes:___

When:_____ How:_____

Name of individual notified:_____

By whom: (enter name):_____

11. Witnesses: 1. Name:_____Address:_____

_____

2. Name:_____

Address:_____

12. Location:

Specify Activity-

Athletic field _____

Auditorium _____

Cafeteria _____

12. Location: (Continued)

Specify Activity-

Classroom _____

Corridor _____

Dressing Room _____

Gymnasium _____

Home Econ. _____

Laboratories _____

Locker _____

Pool _____

Sch. grounds _____

_____shop _____

Showers _____

Stairs _____

Toilets and washrooms _____

Other (specify) _____

Remarks-

What recommendations do you have for preventing other accidents of this type? _____

_____

_____

_____

_____

Signed: Principal: _____

Teacher: _____

The Student's Private Physician Card should be completed by the parents and filed at the time of registration and before the student begins his class work.

Student's Private Physician Card

(Front)

Child's Last Name _____ First Name _____ Middle Name _____

Home Address _____

Parent's Home Telephone _____ Parent's Business Telephone _____

Physician's Name _____ Physician's Address _____

Physician's Home Telephone _____ Physician's Office Telephone _____

Parent's Signature _____ Date _____

School _____

Student's Private Physician Card (Over)

(Reverse)

_____
Date

In the case of accident or serious illness, if the school is unable to contact me, I hereby authorize the school to take my child to the physician indicated on the reverse side of this card. If it is impossible to contact this physician, the school may take my child to a hospital authorized by the Board of Health.

_____
Parent's Signature

Recommendations

Based on the findings of the school shops surveyed using the National Standard School Shop Safety Inspection Check List and of teachers' reports of accidents during the three-year period April 1953 to April 1956, the following recommendations are Made:

a. That each teacher of vocational agriculture in Tennessee survey his shop, using the above mentioned form to determine the changes in physical equipment and procedures that are needed to make his shop a safe place for his students to work. In the event that he is unable to make the physical changes required without action by the local board of education, that he submit to the board in writing, with the approval of the principal, the changes to be made. This action will clear the teacher in the event of an accident due to faulty physical facilities.

b. That each teacher of vocational agriculture in Tennessee adopt the safety program given in this Chapter. This will insure that each student will have a thorough knowledge of the tools and machines with which he will work and of the safety measures to be taken to avoid accidents, not only while in high school but during their entire life time as well. The recommended forms and methodology should be adopted by all high schools who do not now have a safety program in operation.

In view of the legal responsibility of the teachers in Tennessee it is recommended that all records and reports shown in this chapter be adopted and used by all teachers having shop programs in Tennessee.

The relatively small amount of space devoted to methods and procedures to be used in teaching safety indicates a need for additional study and research in this area.

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APPENDICES

APPENDIX A

CHECK ON TEACHERS' SCORING

As a check on teachers' scoring of their own departments, twenty representative school shops in Tennessee were scored by the writer. Each general area was divided into items affecting safety.

Each item was rated as:

S - satisfactory;

A - adequate, but needs attention; and

U - Unsatisfactory, needs immediate attention.

The results are shown in the following table.

TABLE XVII

SAFETY CONDITIONS IN TWENTY SELECTED SHOPS AS DETERMINED BY THE WRITER

Item	Frequency		
	S*	A*	U*
General physical condition			
Lighting - natural and artificial	3	14	3
Temperature control	2	10	8
Condition of floors, walls, ceilings	6	13	1
Ventilation	18	1	1
Condition of lumber and metal racks	12	6	2
Housekeeping			
General appearance and orderliness	2	12	6
Adequate storage for tools	7	7	6
Adequate storage for supplies	4	14	2
Adequate and proper waste cans or boxes	1	2	17

TABLE XVII (continued)

SAFETY CONDITIONS IN TWENTY SELECTED SHOPS
AS DETERMINED BY THE WRITER

Item	Frequency		
	S*	A*	U*
Equipment			
Machines arranged for adequate work space and protected from other machines	5	11	4
Danger zones marked and guarded	2	8	10
All machines properly guarded	8	8	4
Machines are in good mechanical and safe working conditions	6	13	1
Provisions for locking off machines	3	0	17
Electrical installation			
Cut off switch within reach of operators	12	6	2
No temporary wiring	17	2	1
All machines grounded	3	4	13
Master control switch for shop	17	1	2
Personal protection			
Goggles or shields provided for grinding	14	4	3
Goggles, shields and gloves provided for welding	18	1	1
Use of proper wearing apparel for job being done	1	16	3
Instruction			
Shop safety taught as a teaching unit	13	7	
Printed or typed safety rules posted	2	3	13
Safety test given	2	4	14
Safety posters used	7	8	5
Safety inspections of shop made	1	3	16
Fire control			
Adequate number and type fire extinguishers	1	2	17
Proper storage and use of inflammable liquids		9	11
Metal containers for oil rags	3	5	12
Proper fuses for electrical circuits	6	6	8

TABLE XVII (continued)

SAFETY CONDITIONS IN TWENTY SELECTED SHOPS
AS DETERMINED BY THE WRITER

Item	Frequency		
	S*	A*	U*
First aid			
Adequately stocked first aid cabinet including a first aid book	2	15	3

*S - Satisfactory

A - Acceptable (but needs attention)

U - Unsatisfactory (needs immediate attention)

APPENDIX B

BULLETIN BOARD MATERIALS AND POSTERS

Safety display materials and posters are furnished free to schools by the following:

1. Aetna Life Affiliated Companies, Hartford, Connecticut
2. American National Red Cross, Washington, D. C.
3. Atlas Press Company, 1915 North Pitcher Street, Kalamazoo, Michigan
4. Crysler Corporation, Detroit, Michigan
5. General Motors Corporation, Detroit, Michigan
6. Great American Indemnity Company, New York, New York
7. Hartford Accident and Indemnity Company, Hartford, Connecticut
8. Metropolitan Life Insurance Company, New York, New York
9. National Board of Fire Underwriters, New York, New York
10. Ralston Purina Company, St. Louis, Missouri
11. Travelers Insurance Company, Hartford, Connecticut.

Materials may be secured from the following at minimum cost:

1. National Educational Association, Washington, D. C.
2. National Safety Council, Chicago, Illinois
3. United States Department of Commerce, Washington, D. C.
4. United States Department of Labor, Washington, D. C.
5. United States Department of Health, Education and Welfare, Washington, D. C.
6. Stanley Tool Company, New Britain, Connecticut.

APPENDIX C

Idaho teachers of vocational agriculture use the following test on which a student is required to make a satisfactory grade before he is permitted to work in the shop.

SUGGESTED SAFETY TEST FOR STUDENTS ENROLLED IN VOCATIONAL AGRICULTURE[1]

This test is a multiple-choice test. Pick out the answer best suited to make the statement logical and correct. Sign this test with your signature as it will be kept on file as proof of instruction given.

A. Woodworking Tools:

( ) 1. Use, care, and caution when starting a handsaw, especially when sawing on a (1) square, (2) diagonal, (3) table.

( ) 2. Be sure the heads of all hammers are securely (1) glued, (2) nailed, (3) wedged.

( ) 3. Never stand (1) in front, (2) behind, (3) to the side of anyone using a hammer.

( ) 4. Be sure nails are well (1) pointed, (2) straightened, (3) started with light strokes before heavy blows are struck.

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[1] Dwight L. Kindschy, "Can You Prove You Have Taught Shop Safety?" The Agricultural Education Magazine, 228, April 1952.

A. Woodworking Tools: (continued)

( ) 5. Always work away from (1) the grain of the wood, (2) your hand or body, (3) the wood vise, when using a wood chisel.

( ) 6. Keep hands away from the (1) bit, (2) handle, (3) cap, when using a Yankee drill.

( ) 7. Use care to avoid (1) finger marks, (2) slivers, (3) cuts, when sliding the bare hands over a board.

( ) 8. Do not leave (1) nails, (2) knots, (3) splinters projecting from boards, when tearing down a project or building.

( ) 9. All (1) saws, (2) bits, (3) scaffolding should be tested carefully when working on a building or roof.

( ) 10. Before you try to remove small pieces of wood from the blade of a power saw, the saw should be (1) turned below the table, (2) stopped, (3) cleaned with compressed air.

( ) 11. Never use the power saw unless the (1) room is empty, (2) shop is warm, (3) guard is in place.

( ) 12. Don't try to (1) force, (2) sharpen, (3) oil a dull power saw.

( ) 13. Always use a (1) steel rod, (2) wood pusher, (3) pair of gloves when sawing small pieces on a power saw.

A. Woodworking Tools: (continued)

( ) 14. Try not to stand directly (1) to the side, (2) in the light, (3) in line with the blade, when ripping with a power saw.

( ) 15. When sawing a large piece of material with a power saw, such as a 4' x 8' piece of plywood, always (1) clean off the table, (2) get someone to help, (3) have the saw projecting only one-half inch.

( ) 16. Keep the floor around the saw always clean of (1) sawdust, (2) wood shavings, (3) wood scraps.

( ) 17. Never adjust a power saw while (1) the saw guard is in place, (2) the saw is projecting above the table, (3) the saw is running.

( ) 18. When using a radial arm saw for ripping, always be sure the (1) kickback guard, (2) the saw clamp, (3) pusher stick is in place.

( ) 19. Always use (1) gasoline, (2) kerosene, (3) a non-inflammable solvent when cleaning paint brushes.

( ) 20. Always wear (1) a mask, (2) a respirator, (3) goggles when operating a paint gun.

B. Soldering and Sheet Metal:

( ) 1. Do not light a blowtorch that (1) leaks, (2) is plugged, (3) has no soldering iron rest.

B. Soldering and Sheet Metal: (continued)

( ) 2. If a blowtorch is plugged, don't continue to (1) knock it against the table, (2) pump air into it, (3) heat the burner.

( ) 3. Lighted blowtorches can be dangerous (1) if turned down very low, (2) if pointed near wooden cabinets or walls, (3) if turned open as far as possible.

( ) 4. The valve of a cold blowtorch should be opened only to (1) fill the priming cup, (2) squirt at someone across the room, (3) wash grease off the soldering iron.

( ) 5. Hot soldering irons should be (1) tinned, (2) cooled, (3) polished before storing or placing them where someone else can touch them.

( ) 6. When cutting out irregular shapes from sheet metal, always (1) bend over, (2) twist off, (3) trim off the sharp corners from the remaining stock before storing.

( ) 7. Remove sharp points from a freshly cut sheet metal project with a (1) hammer, (2) tin snips, (3) file to avoid injury to the hands.

( ) 8. If soldering acid is spilled on the hands or splashed into the eye, the best procedure is to (1) go to a doctor, (2) wash immediately with plenty of water, (3) dump on baking soda.

B. Soldering and Sheet Metal: (continued)

( ) 9. Don't use an electric soldering iron or any other electrical piece of equipment when standing on (1) a concrete floor, (2) a wood floor, (3) any floor that is wet or damp.

( ) 10. Don't use an electric soldering iron that (1) heats slowly, (2) has a damaged cord, (3) has a wooden handle.

C. Hot and Cold Metal Work:

( ) 1. Before using any metal-working hammer, you should check it for (1) trade mark, (2) loose head, (3) crooked handle.

( ) 2. The only hammer to use while working on an anvil is a (1) straight claw hammer, (2) ripping hammer, (3) blacksmith or ball pein hammer.

( ) 3. Never leave a hot iron where (1) it will chill too fast, (2) someone may touch or step on it, (3) it is in contact with ashes.

( ) 4. Be sure the blacksmith tong you are using (1) has a handle 3 feet long, (2) has a handle 1 foot long, (3) fits the iron you are trying to work.

( ) 5. Never hit directly with any hammer the (1) anvil face, (2) the head of a hot cutter, (3) the head of a cold cutter.

C. Hot and Cold Metal Work: (continued)

( ) 6. Keep the forge fire burning properly to avoid (1) soot, (2) ashes, (3) explosions, in the fire or blower pipe.

( ) 7. Always use (1) gasoline, (2) used crankcase oil, (3) shavings, to start a forge fire.

( ) 8. Never use a chisel with a (1) round, (2) mushroom, (3) flat head.

( ) 9. When chiseling metal, wear goggles and caution nearby students against flying (1) metal chips, (2) sparks, (3) glass.

( ) 10. When using a drill press, grip all large pieces with (1) a pliers, (2) your bare hand, (3) your hand with a glove on it.

( ) 11. When using a drill press, all small pieces should be gripped with (1) your gloved hand, (2) a pliers or drill press vise, (3) a monkey-wrench.

( ) 12. While drilling, do not leave the chuck-wrench of the drill press (1) in the chuck-wrench holder, (2) in the chuck, (3) on the drill press stand.

( ) 13. Wear (1) a mask, (2) an apron, (3) goggles, when using a grinder unless the grinder is equipped with transparent shields.

C. Hot and Cold Metal Work: (continued)

( ) 14. Hold small pieces with a (1) pliers, (2) gloves, (3) piece of wood when grinding them on a power grinder.

( ) 15. Keep the tool rest or support (1) at right angles, (2) at a 45 degree angle, (3) close to the grinding wheel.

D. Oxyacetylene Welding:

( ) 1. Always protect your eyes with the proper (1) sun glasses, (2) transparent shields, (3) welding goggles.

( ) 2. Never light the torch until you are actually ready to (1) line up the metal to be welded, (2) clean the tip, (3) weld.

( ) 3. Always (1) hang up, (2) turn down, (3) put out the torch when it becomes necessary to readjust the work.

( ) 4. In using the torch the flame should never be directed (1) directly on the metal, (2) against cast iron, (3) towards anyone who is near enough to be burned.

( ) 5. If possible, always weld away from your body because of the danger of (1) fire to your clothing, (2) torch pops, (3) burning the hose.

( ) 6. The acetylene pressure should not be regulated higher than (1) 9 lbs., (2) 14 lbs., (3) 18 lbs., as the gas can be ignited by friction above that pressure.

D. Oxyacetylene Welding: (continued)

( ) 7. If gas leaks can be detected or smelled at any time, (1) stop welding and tell your instructor, (2) tell your instructor after class, (3) look for the leak and stop it.

( ) 8. Never weld on a closed gas tank or empty oil barrel unless it is (1) cooled to 70 degrees, (2) taken outside, (3) filled with water.

( ) 9. If an acetylene generator is being used and it fails to generate gas when the carbide feeder is open, (1) tap the feeder with a hammer, (2) get everyone out of the building and get out yourself, (3) quickly shut it off and tell the instructor.

( ) 10. An acetylene generator should never be used after the (1) generator has just been charged, (2) when the temperature in the shop has dropped below freezing, (3) when it is out of carbide.

E. Arc Welding:

( ) 1. One of the most serious dangers in arc welding is (1) getting electrical shocks, (2) flash burns to the eyes, (3) getting burned from hot metal.

( ) 2. T-shirts are not recommended for welding because of (1) sunburn caused by the arc, (2) fire danger, (3) danger of burns from hot iron.

E. Arc Welding: (continued)

( ) 3. An arc welder should be used with caution around little children because (1) it will frighten them, (2) they will look directly at the arc, (3) they may get too close and be burned.

( ) 4. Never weld on a car where there is danger of (1) an overheated motor, (2) a tire blowing out, (3) a grease fire or gas explosion.

( ) 5. Always protect the eyes in a recommended way when (1) hooking on the ground clamp, (2) rolling up the cable, (3) chipping slag.

( ) 6. When arc welding always wear trousers with (1) heavy cuffs, (2) with no cuffs, (3) with no pockets.

( ) 7. Always pick up the electrode holder (1) before you stop the welder, (2) when adjusting metal, (3) by the insulated handle.

( ) 8. A big help to a welding operation is (1) rubbersoled shoes, (2) good leather gloves, (3) an air-cooled straw hat.

( ) 9. Avoid breathing the fumes (1) when welding in a forge, (2) from the cooling device in a direct current welder, (3) given off from the arc in arc welding.

( ) 10. Do not adjust the welding machine (1) when it is hot, (2) before it warms up, (3) when it is in operation.

F. Farm Machinery Repair:

( ) 1. Never clean equipment with an inflammable solvent unless (1) you use a brush, (2) you use a pressure spray, (3) you are outside.

( ) 2. Never get under a piece of equipment being repaired unless (1) it is held by a chain hoist, (2) it is held by a jack, (3) it is blocked securely with wood blocks or specially constructed horses.

( ) 3. Never operate a motor in a closed shop without (1) filling the gas tank, (2) checking the water, (3) providing proper ventilation.

( ) 4. Never crank a motor unless (1) your thumb is on the same side of the crank as your fingers, (2) the motor is cool, (3) the motor has a magneto.

( ) 5. Never start a tractor unless (1) the owner has given you his consent, (2) someone is sitting in the seat, (3) you are sure it is out of gear and the brakes are set.

( ) 6. Rags with grease or oil on them should be (1) stored in a metal container, (2) put out of sight in a drawer, (3) hung outside to dry.

( ) 7. Do not test a spark plug with a screw driver unless (1) the screw driver is at least 10 inches long, (2) you are standing on wood, (3) the screw driver has an insulated handle.

F. Farm Machinery Repair: (continued)

( ) 8. Never use wrenches that (1) are in poor condition or have rounded corners, (2) have an open end, (3) have a box end.

( ) 9. When working on machinery repair, (1) follow instructions in a book, (2) keep the floor clean from grease and oil, (3) keep a record of everything you do.

( ) 10. Do not use the mouth to (1) blow dirt from machines, (2) moisten glued back tape, (3) siphon gasoline that contains tetraethyl lead.

_____

Signature of Student

Key to Farm Mechanics Safety Test

A. Woodworking Tools:

1. (2)	5. (2)	9. (3)	13. (2)	17. (3)
2. (3)	6. (1)	10. (2)	14. (3)	18. (1)
3. (1)	7. (2)	11. (3)	15. (2)	19. (3)
4. (3)	8. (1)	12. (1)	16. (3)	20. (2)

B. Soldering and Sheet Metal:

1. (1)	3. (2)	5. (2)	7. (3)	9. (3)
2. (2)	4. (1)	6. (3)	8. (2)	10. (2)

C. Hot and Cold Metal Work:

1. (2)	4. (3)	7. (3)	10. (3)	13. (3)
2. (3)	5. (1)	8. (2)	11. (2)	14. (1)
3. (2)	6 (3)	9. (1)	12. (2)	15. (3)

D. Oxyacetylene Welding:

1. (3)	3. (3)	5. (1)	7. (1)	9. (3)
2. (3)	4. (3)	6. (2)	8. (3)	10. (2)

E. Arc Welding:

1. (2)	3. (2)	5. (3)	7. (3)	9. (3)
2. (1)	4. (3)	6. (2)	8. (2)	10. (3)

F. Farm Machinery Repair:

1. (3)	3. (3)	5. (3)	7. (3)	9. (2)
2. (3)	4. (1)	6. (1)	8. (1)	10. (3)

APPENDIX D

State of Tennessee
DEPARTMENT OF EDUCATION
Division of Vocational Education
Nashville 3, Tennessee

School_____ County_____

Years in present position_____ Name_____

1. Please indicate the number of accidents that occurred in your farm shop during the past three years. If you have been in your present position less than three years, list those accidents occurring during your tenure.

Area, Machine, Tool, etc.	No. accidents required	
	First Aid	Physician
A. Power Woodworking Tools		
1. Jointer		
2. Circular saw		
3. Band saw		
4. Jig saw		
5. Planer		
6. Drill press		
7. Wood lathe		
8. Other (specify)		
B. Welding and Metal Work		
1. Power grinders or stones		
2. Acetylene welder		
3. Arc welder		
4. Drill press		

	No. accidents required	
	First Aid	Physician
B. Welding and Metal Work (continued)		
5. Forge - (burns, etc.)		
6. Others (specify)		
C. Sheet Metal and Soldering		
1. Sheet cutting and Forming Tools		
2. Handling and Working Sheet Metal		
3. Blow Torches		
4. Other (specify)		
D. Hand Tools		
1. Saws		
2. Chisels		
3. Hammers (both wood and metal working)		
4. Nails and other fastners		
5. Screwdrivers		
6. Other (specify)		
E. Electrical and Wiring		
F. Other (specify)		

2. Please group the above as to severity of accident.

A. Minor - required first aid	Number
B. Severe - required physician (stitches, setting bones, etc.)	Number

C. Serious - lost use of member of body

D. Death - due directly to accident

Number	
Number	

3. Please list in the order of their importance the causes to which you attributed the accidents reported.

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

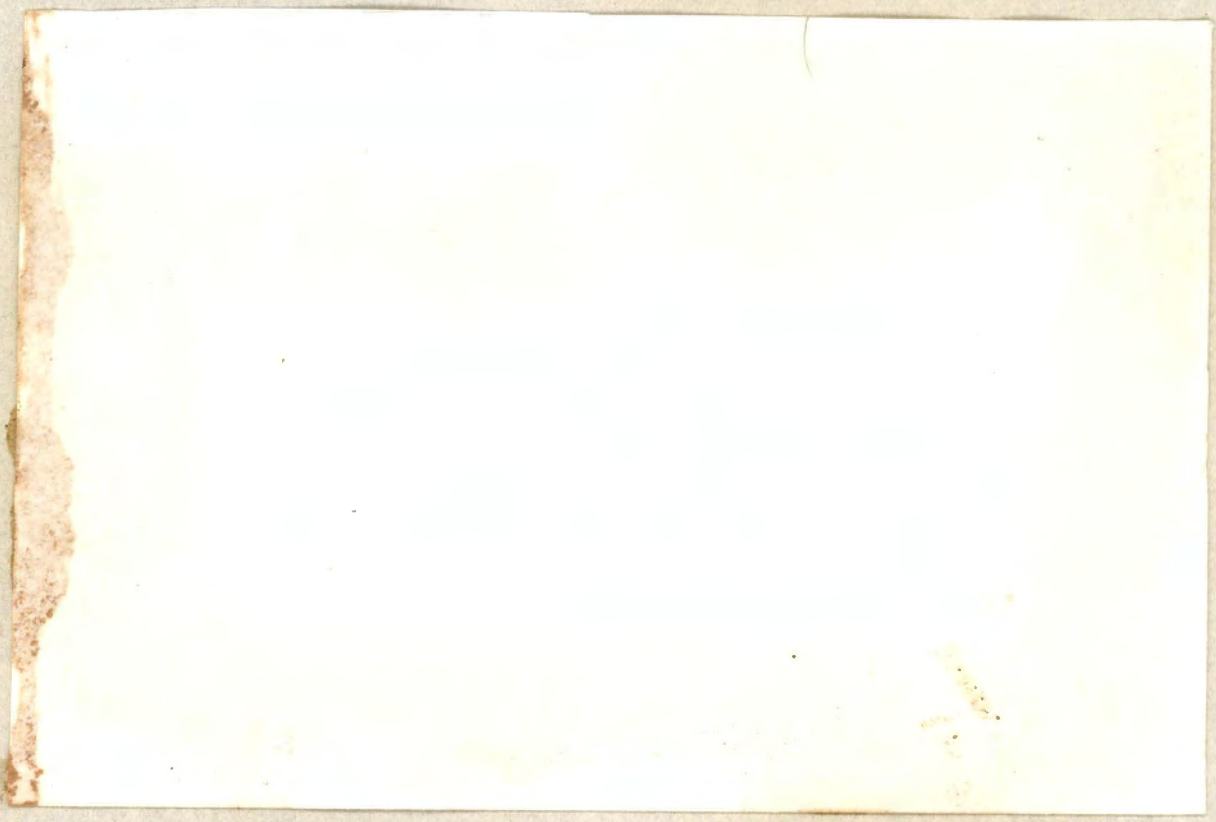
4. Are your students covered by an insurance plan? ____ Yes _____ No

If "Yes" please give -

A. Cost_____

B. Coverage_____

C. Name of company_____



H. ACCIDENT RECORD (continued)

4. A copy of each accident report is filed with the State Department of Education .... S A U

5. Accident reports are analyzed for instructional purposes and to furnish the basis for elimination of hazards.............. S A U

6. ________________________________ S A U

7. ________________________________ S A U

8. ________________________________ S A U

9. ________________________________ S A U

10. Evaluation for the total rating of H. ACCIDENT RECORDS. S A U

I. FIRST AID

1. An adequately stocked first aid cabinet is provided... S A U

2. The first aid is administered by a qualified individual S A U

3. The school has individuals qualified to administer first aid. S A U

4. ________________________________ S A U

5. ________________________________ S A U

6. ________________________________ S A U

7. ________________________________ S A U

8. Evaluation for the total rating of I. FIRST AID.... S A U

RECOMMENDATIONS

Code No.	

For additional copies in packets of 50 send $1.00 to National Safety Council, 425 North Michigan Avenue, Chicago 11, Illinois.

100M85502

(Printed in U.S.A.)

NATIONAL STANDARD SCHOOL SHOP SAFETY INSPECTION CHECK LIST

Prepared by the Joint Safety Committee of the
AMERICAN VOCATIONAL ASSOCIATION — NATIONAL SAFETY COUNCIL

________________________________ Date________________

____

INTRODUCTION

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through *regular* and *frequent* inspections by school personnel—administrators, teachers and students. Safety inspections are to determine if everything is satisfactory.

Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel.

The National Standard School Shop Safety Inspection Check List, recommended by the President's Conference on Industrial Safety is an objective inspection procedure for the school shop.

DIRECTIONS

WHO INSPECTS?

This will depend upon local policies. It is recommended, however, that shop teachers, and students—the student safety engineer and/or student safety committee—participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

WHEN TO INSPECT?

As a minimum, a safety inspection should be made at the beginning of every school term or semester. More frequent inspections may be advisable.

HOW TO INSPECT?

Inspections should be well planned in advance.

Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked.

Inspection reports should be clear and concise, but with sufficient explanation to make each recommendation for improvement understandable.

FOLLOW-UP

The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers.

Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures.

A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions.

The inspection report can be used to advantage as the subject for staff and class discussion.

CHECKING PROCEDURE

Draw a circle around the appropriate letter, using the following letter scheme:

S — Satisfactory (needs no attention)
A — Acceptable (needs some attention)
U — Unsatisfactory (needs immediate attention)

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable (as B-2).

In most categories, space is provided for listing of standards, requirements or regulations which have local application only.

A. GENERAL PHYSICAL CONDITION

1. Machines, benches, and other equipment are arranged so as to conform to good safety practices.......................... S A U

2. Condition of stairways.................................. S A U

3. Condition of aisles .... S A U

4. Condition of floors .... S A U

5. Condition of walls, windows, and ceiling................ S A U

6. Illumination is safe, sufficient, and well placed....... S A U

7. Ventilation is adequate and proper for conditions..... S A U

8. Temperature control .... S A U

9. Fire extinguishers are of proper type, adequately supplied, properly located and maintained.......................... S A U

10. Teacher and pupils know location of and how to use proper type for various fires.................................... S A U

11. Number and location of exits is adequate and properly identified .... S A U

12. Proper procedures have been formulated for emptying the room of pupils and taking adequate precautions in case of emergencies S A U

13. Lockers are inspected regularly for cleanliness and fire hazards. S A U

14. Locker doors are kept closed.......................... S A U

15. Walls are clear of objects that might fall............ S A U

16. Utility lines are properly identified.................. S A U

17. Teachers know the procedure in the event of fire including notification of the fire department and the evacuation of the building. S A U

18. Air in shop is free from excessive dust, smoke, etc.... S A U

19. ________________________________ S A U

20. ________________________________ S A U

21. ________________________________ S A U

22. ________________________________ S A U

23. Evaluation for the total rating of A. GENERAL PHYSICAL CONDITION .... S A U

B. HOUSEKEEPING

1. General appearance as to orderliness..... S A U
2. Adequate and proper storage space for tools and materials. S A U
3. Benches are kept orderly..... S A U
4. Corners are clean and clear..... S A U
5. Special tool racks, in orderly condition, and provided at benches and machines ..... S A U
6. Tool, supply, and/or material room is orderly..... S A U
7. Sufficient scrap boxes are provided..... S A U
8. Scrap stock is put in scrap boxes promptly..... S A U
9. Materials are stored in an orderly and safe condition.. S A U
10. A spring lid metal container is provided for waste and oily rags. S A U
11. All waste materials and oily rags are promptly placed in the containers ..... S A U
12. Containers for oily rags and waste materials are frequently and regularly emptied ..... S A U
13. Dangerous materials are stored in metal cabinets..... S A U
14. Machines have been color conditioned..... S A U
15. Safety cans are provided for flammable liquids..... S A U
16. Bulk storage of dangerous materials is provided outside of the main building ..... S A U
17. A toe-board or railing around a mezzanine used for storage or washing facilities ..... S A U
18. Materials are stored in an orderly and safe condition on this mezzanine ..... S A U
19. Flammable liquids are not used for cleaning purposes S A U
20. Floors are free of oil, water and foreign material..... S A U
21. Floors, walls, windows, and ceilings are cleaned periodically. S A U
22. _____ S A U
23. _____ S A U
24. _____ S A U
25. _____ S A U
26. Evaluation for the total rating for B. HOUSEKEEPING S A U

C. EQUIPMENT

1. Machines are arranged so that workers are protected from hazards of other machines, passing students, etc..... S A U
2. Danger zones are properly indicated and guarded..... S A U
3. All gears, moving belts, etc., are protected by permanent enclosure guards ..... S A U
4. All guards are used as much as possible..... S A U

C. EQUIPMENT (continued)

5. All equipment control switches are easily available to operator. S A U
6. All machines are "locked off" when instructor is out of the room. S A U
7. Brushes are used for cleaning equipment..... S A U
8. Nonskid areas are provided around machines..... S A U
9. Machines are in safe working condition..... S A U
10. Machines are guarded to comply with American Standards Association and local state code..... S A U
11. Adequate supervision is maintained when students are using machines and dangerous tools..... S A U
12. Tools are kept sharp, clean and in safe working order S A U
13. All hoisting devices are in safe operating condition... S A U
14. Machines are shut off while unattended..... S A U
15. Adequate storage facilities for tools, equipment, etc., not in immediate use ..... S A U
16. _____ S A U
17. _____ S A U
18. _____ S A U
19. _____ S A U
20. Evaluation for the total rating for C. EQUIPMENT.. S A U

D. ELECTRICAL INSTALLATION

1. All switches are enclosed..... S A U
2. There is a master control switch for all of the electrical installations ..... S A U
3. Electrical outlets and circuits are properly identified.. S A U
4. All electrical extension cords are in safe condition and are not carrying excessive loads..... S A U
5. All machine switches are within easy reach of the operators. S A U
6. Electrical motors and equipment are wired to comply with the National Electric Code..... S A U
7. Individual cut-off switches are provided for each machine. S A U
8. Machines are provided with overload and underload controls by magnetic pushbutton controls..... S A U
9. No temporary wiring in evidence..... S A U
10. _____ S A U
11. _____ S A U
12. _____ S A U
13. _____ S A U
14. Evaluation for the total rating for D. ELECTRICAL INSTALLATION .....S A U

E. GAS

1. Gas flow to appliances is regulated, so that when appliance valve is turned on full, the flames are not too high..... S A U
2. Gas appliances are properly insulated with asbestos or other insulating material from tables, benches, adjacent walls, or other flammable materials ..... S A U
3. No gas hose is used where pipe connections could be made. S A U
4. Gas appliances have been adjusted so that they may be lighted without undue hazard..... S A U
5. Students have been instructed when lighting gas appliances to light the match first before turning on the gas..... S A U
6. There are no gas leaks, nor is any odor of gas detectable in any part of the shop..... S A U
7. Shop instruction has been given concerning the lighting of gas furnaces operating with both air and gas under pressure.. S A U
8. When lighting the gas forge, goggles are worn..... S A U
9. When lighting the gas furnace, the following procedure is used: (a) light the match; (b) turn on the gas; (c) drop the match in the hole in top of the furnace..... S A U
10. In shutting down the gas furnace, the gas valve is closed before the air valve..... S A U
11. _____ S A U
12. _____ S A U
13. _____ S A U
14. _____ S A U
15. Evaluation for the total rating for E. GAS..... S A U

F. PERSONAL PROTECTION

1. Goggles or protective shields are provided and required for all work where eye hazards exist..... S A U
2. If individual goggles are not provided, hoods and goggles are properly disinfected before use..... S A U
3. Shields and goggles are provided for electric welding.. S A U
4. Rings and other jewelry are removed by pupils when working in the shop..... S A U
5. Proper kind of wearing apparel is worn and worn properly for the job being done..... S A U
6. Leggings, safety shoes, etc., are worn in special classes such as foundry, etc., when needed..... S A U
7. Respirators are provided for dusty or toxic atmospheric conditions such as when spraying in the finishing room..... S A U
8. Provisions are made for cleaning and sterilizing respirators. S A U
9. Students are examined for safety knowledge ability.. S A U
10. Sleeves are rolled above elbows when operating machines. S A U
11. Clothing of students is free from loose sleeves, flopping ties, loose coats, etc. ..... S A U
12. _____ S A U

F. PERSONAL PROTECTION (continued)

13. _____ S A U
14. _____ S A U
15. _____ S A U
16. Evaluation for the total rating for F. PERSONAL PROTECTION. S A U

G. INSTRUCTION

1. Shop Safety is taught as an integral part of each teaching unit. S A U
2. Safety rules are posted particularly at each danger station. S A U
3. Printed safety rules are given each student..... S A U
4. Pupils take a safety pledge..... S A U
5. Use of a safety inspector..... S A U
6. Use of a student shop safety committee..... S A U
7. Use of safety contests..... S A U
8. Motion and/or slide films on safety are used in the instruction. S A U
9. Use of suggestion box..... S A U
10. Use of safety tests..... S A U
11. Use of safety posters..... S A U
12. Talks on safety are given to the classes by industrial men. S A U
13. Tours are taken of industrial plants as a means of studying safety practices ..... S A U
14. Periodic safety inspections of the shop are made by a student committee ..... S A U
15. Men from industry make safety inspections of the shop S A U
16. Student shop safety committee investigates all accidents S A U
17. A proper record is kept of safety instructions which are given, preferably showing the signature of student on tests given in this area ..... S A U
18. Rotate students on the Shop Safety Committee so that as many students as possible have an opportunity to participate... S A U
19. _____ S A U
20. _____ S A U
21. _____ S A U
22. _____ S A U
23. Evaluation for the total rating of G. INSTRUCTION S A U

H. ACCIDENT RECORDS

1. There is a written statement outlining the proper procedure when and if a student is seriously hurt..... S A U
2. Adequate accident statistics are kept..... S A U
3. Accidents are reported to the proper administrative authority by the instructor ..... S A U