The new course 32, Teaching and Managing in a Technical Laboratory is a revision of the original course 32, Technical Laboratory Layout and Management. Some of the information in the original course is incorporated into the new course, especially information that dealt with learning environments and management routines. All of the information in session VI, Safety Program and Behavioral Management is included in the new course 32.

Feedback information from participants indicated that instructors are not usually involved in the layout and development of educational specifications of a technical laboratory. However, this information is very valuable for instructors to have in the event that they are asked to provide input into renovating an existing facility or the design of a new one. In addition, instructors can use this information to reorganize their laboratory facility to make it a better learning environment.

This portion of the book includes formation from the original course 32 dealing with laboratory layout, equipping the laboratory, facility management, and instructional management.
GENERAL PRINCIPLES OF CLASSROOM AND LABORATORY ORGANIZATION AND MANAGEMENT

An attractive and organized classroom and laboratory sets the tone for learning and is a motivational factor for students. Bulletin boards, posters and displays strategically arranged in the classroom and lab can also be motivational. Classrooms that have furniture flexibility that allows students to occasionally rearrange seating arrangements can be motivational and support learning. A well-planned and managed classroom and laboratory provides a learning environment in which individuals can develop the knowledge and skills needed in the electrical occupation. Both the classroom and laboratory should promote learning by making it an environment where learning is a pleasant and satisfying experience. Laboratories that simulate occupational conditions prepare students for the real world and thus become a learning experience themselves.

“Characteristics of Well-Organized Laboratories”

Well organized laboratories have the following characteristics:

- They are efficient
- Provide a safe and healthy environment for learning
- Meet psychological needs of learners
- Allow instructor to be in control at all times
- Accessible to all students including those with disabilities
- Provide security for equipment and materials

“Characteristics of Well-Organized Laboratories”

Well organized laboratories have the following characteristics:

- Are visually pleasing in color, texture, patterns, space and light
- Have workstations, equipment, tools and materials used in the electrical trade
- Everything is appropriately located to support instruction
- Management routines are established and followed
- Auxiliary areas are provided to store tools, student work, and meet student needs
- Arranged for flexibility to allow a wide range of different instructional strategies
CHARACTERISTICS OF WELL-ORGANIZED LABORATORY

There are several important characteristics of a well-organized laboratory including the following:
1. It should be efficient. Learners and instructors should be able to work with maximum productivity and a minimum of wasted time and energy.
2. It should provide a safe and healthful environment in which to work and learn. The laboratory must have appropriate lighting, proper ventilation, atmospheric control, a minimum of noise, safe equipment and an attractive environment.
3. It should meet the psychological needs of learners. The environment should be one that supports desirable attitudes and promotes mental well-being, that presents a feeling of order and security, and that presents a feeling of pleasantness and comfort that promotes the desire to learn.
4. It should allow the instructor to be in control of the laboratory at all times. The lab should be organized so that teachers can have lines of sight to all parts of the laboratory and be able to hear equipment as it is being operated by learners. Instructors must have unobstructed traffic lanes so they can move quickly to any area of the laboratory.
5. It should be accessible to all students including those with physical and emotional disabilities.
6. It should provide security for all the equipment, machines, tools, and supplies that are essential to laboratory organization.
7. It should be visually pleasing with appropriate use of color, light, texture, pattern, and space to stimulate and accommodate learning.
8. It should have the furniture, equipment, machines, tools and work stations to enable learners to develop the skills of the electrical occupation.
9. It should be well-managed with established routines, a place for everything and everything in its place.
10. It should have appropriate auxiliary areas to store tools and materials and to meet the personal needs of learners.
11. It should be designed with flexibility to allow for different types of learning approaches to meet the unique needs of diverse learners.

“Simulation Principle”

A general principle for laboratory planning is to simulate occupational conditions so that learners experience the actual conditions of the workplace and perform their work to occupational standards.
“Why Follow the Simulation Principle”

A laboratory that follows the simulation principle:
- Can more effectively prepare learners for the job
- Minimize the adjustments learners will need at the workplace
- Create positive associations between working and learning

SIMULATION PRINCIPLE

A general principle for planning and organizing technical classrooms and laboratories is to attempt to simulate occupational conditions so that learners can experience the actual conditions in the working world and perform their work to occupational standards. Laboratories that are similar to actual working environments can more effectively prepare learners for the job, minimize the adjustments needed as they enter the occupation and create positive associations between working and learning. To organize or reorganize a technical laboratory so that it simulates real-world conditions, instructors need to draw on their own personal experience and perhaps supplement their knowledge by visiting work sites and technical laboratories in schools, technical colleges and training centers.

“Ways to Simulate Work Conditions”

- Select similar equipment and tools currently used at worksites
- Use materials and supplies like those used in the electrical field
- Arrange workstations, machines and equipment in similar patterns as found on the job

Technical laboratories can be made to simulate occupational conditions in the following ways:

1. Select the same types of equipment and tools currently used in the electrical occupation in terms of size and capability, function and mode of operation
2. Use materials and supplies that are comparable with those used in the electrical occupation
3. Arrange machines and equipment in patterns similar to those on the job
4. Create an environment similar to that in the electrical occupation by carefully selecting colors schemes, furnishings and laboratory arrangements.

“Environmental Factors Affecting Learning”

- Lighting, ventilation and heat
- Color, sound and aroma
- Attractive, up-to-date equipment used in electrical occupations
- Materials and supplies currently used in electrical field
- Established work and learning routines
- A balanced amount of novelty and change
“Environmental Factors Affecting Learning”

- Nutrition and wellness of the learner
- Arrangement of furniture such as tables, chairs and desks
- Work stations
- State of the art trainers, computers, and learning modules
- Safety stations such as eye wash, sinks, and bathroom facilities

“Illumination”

Lighting needs to be adequate for the work to be performed. Insufficient lighting can:

- Be depressing
- Cause fatigue
- Be a safety hazard
- Lead to work that does not meet standards

ILLUMINATION

It is important that the general and specific lighting of the classroom and laboratory be adequate for the work that is to be done there. Insufficient or improper illumination can be depressing to learners, cause fatigue, be a safety hazard and lead to work that does not meet standards. Good lighting is needed for classrooms, reading and assembly processes. High-level or very bright lighting is needed for extra-fine assembly, color identification, and severe visual tasks.

Not only the amount of light is an important factor for learning but the quality of light should also be considered. Natural light is in general excellent for laboratory or classroom work but weather conditions and the time of the day can affect this source of lighting. Recent trends in reducing window sizes of buildings has led to increased dependency on general lighting systems such as well-designed fluorescent lighting systems. The color characteristics of the light can be regulated by selecting appropriate tubes such as “cool white” types for general classroom illumination and “warm white” or “daylight” tubes can be selected to simulate natural noon light. Good general lighting is free of glare. There are illumination tables available showing the recommended standards for almost all fields of work.

“Heating, Cooling and Ventilation”

- Learning environments that are too hot, too cold or badly ventilated raise learner discomfort and adversely affect learning.
- Atmospheric environment with contaminants such as molds and gases can pose serious health threats to learners and instructors.
**“Ideal Atmospheric Environments”**

- The best laboratory environments feature air which is clean, odorless, and free of gases that is constantly moving without sharp drafts.
- The ideal humidity is around 30 percent and the temperature range for classrooms is around 72-78 degrees and 65-70 degrees for the laboratory.

**HEATING, COOLING AND VENTILATION**

Classrooms and laboratories that are too hot or too cold, are badly ventilated, or have humidity that is too high or low can cause learners to be uncomfortable and affect learning adversely. The atmospheric environment of the classroom or lab can even pose a serious threat to the health of students and teachers alike if such factors as fumes, molds, dust particles, and gases are not controlled. Obviously, the best laboratory environment is one in which the air is clean, odorless, free of harmful gases and is continually moving without sharp drafts. In the ideal environment the humidity level in the room will be in the comfortable range (around 30%) and the temperature will be appropriate for the activity in which the learner is engaged with a temperature of around 65 to 70 degrees for the laboratory and from 72-78 degrees for the classroom.

Problems of ventilation and air quality can be controlled through dust collection systems, exhaust systems and metal collector hoods and fans over areas where welding is performed or painting, adhesives and chemicals are applied. Dust masks can be worn to control airborne dust particles and fibers. Appropriate respirators must be worn when working in environments that have gases, fumes and vapors.

**“Controlling Sound”**

Continuous sounds of machines and equipment that are at levels that distract from regular communication can cause irritability, inability to concentrate, fatigue and even ear damage. To control excessive noise in the laboratory consider the following:

- Move noisy equipment such as air compressors outside of possible.
- Use acoustical materials.
- Require students to use ear protection which is good preparation for them at the workplace where the environment is sometimes very noisy.

**CONTROLLING SOUND**

When students are actively working with machines and tools noise will be generated. Generally electrical workers do not use machines and equipment that generate noise levels that distract from regular communication or cause fatigue or harmful ear damage. However, many actual job sites are very noisy with heavy equipment and air and power tools being operated. If excessive noise is generated in a laboratory such as when an air compressor is operating, learners need to learn how to use ear-protection devices which will be good preparation for them to control noise levels at the work site. There are
several different types of ear-protection devices such as inexpensive foam-type earplugs, canal caps that are pre-molded plastic caps attached to a headband, or specially designed earmuffs. Excessive noise levels can cause irritability, tension, inability to concentrate, temporary hearing loss and eventually permanent ear damage.

Sound can also be controlled by the appropriate use of acoustic materials. Hard surfaces such as concrete, tile, metal sheets reflect sound and increase echoes. Appropriate placement of carpets, draperies and acoustic materials are the general remedy for reflecting sounds. Today, many classroom floors are carpeted and acoustic materials are used in ceilings and walls to help control reflected sound.

“Attractive Environments”

Learners fell more comfortable and motivated in attractive environments.

- Colors have an important affect on the appearance of the classroom and laboratory and set the mood for learning.
- Some colors stimulate and excite, other tend to sooth and relax, and still others trend to depress and irritate.
- Colors also affect the lighting factor with lighter colors having higher reflective value.
- Colors can also be used to communicate certain information (color code)

ATTRACTION ENVIRONMENT

Learners feel more comfortable and motivated in surroundings that are attractive and well organized. Colors have an important affect on the appearance of the classroom or laboratory. Some colors stimulate and excite, others tend to sooth and relax, and still others tend to depress and irritate. Research has shown that yellow appears cheerful, reds are stimulating, blues calm and appears cool, and green is associated with nature. Lighter colors applied to the classroom and laboratory tends to make them appear larger while darker colors make them appear smaller. Lighter colors also reflect light making the room appear to be brighter. Warm colors such as the yellows, browns and reds suggest hospitality, friendliness and security; on the other hand, greens and blues are associated with efficiency and accuracy. Teachers can influence the psychological environment by carefully selecting color schemes for various parts of the classroom and laboratory. Laboratory floors, if painted, are generally painted light gray to gain some reflective value from lighting. Painted floors are very hard to maintain and can be slippery unless they use slip resistant paint. Laboratory walls are generally painted light, pastel colors such as ivory or off-white, and ceilings are painted white. Colors are also used in color codes as indicators for safety considerations which will be covered in another session.

In addition to color, walls can be made more attractive by appropriate placement of pictures, posters, bulletin boards and signs that also can have educational value. Plants can be placed on windows enhancing an otherwise sterile environment.
AROMAS

Technical labs generally have a unique aroma due to the chemicals, materials and processes used in them. More attention has been given to the affects of different aromas on the mind and body in recent years. There is a developing treatment program for specific individuals called aroma therapy. Aromas stimulate the part of the brain that affects emotions. For example, serotonin is believed to counteract anxiety and endorphins reduce pain. A balanced emotional state can have a therapeutic effect on physical problems, especially those that are stress-related. Commercial cleaning agents used in schools and training centers have distinct aromas that are perceived by most individuals as pleasant and refreshing. The main point here is that aromas affect people in different ways and teachers need to be sure that aromas are not affecting individuals in adverse ways that affect learning.

“Placement of Furniture and Equipment”

- Placement of furniture and equipment, as well as colors, also affects students psychologically
- Furniture and equipment arrangements must allow work to go on efficiently, safely and pleasantly.
- Learners must be able to move about the laboratory in established traffic lanes and have adequate work space around workstations and equipment.

PLACEMENT OF FURNITURE AND EQUIPMENT

The placement of furniture and equipment can also affect students psychologically as well as enhance learning. Furniture and equipment must be placed in an arrangement that allows work to go on efficiently, conveniently, safely, and pleasantly. Learners need to have adequate space to move about the classroom in established lab traffic lanes. Instructors need to have sight lines that allow them to observe those working in a classroom, especially when they are operating dangerous equipment. Learners also need adequate space around work stations, machines and equipment to perform the work safely. Additional information on how to plan and organize technical labs will be presented in another session.

“Auxiliary Areas”

Special designated areas of the laboratory are required to support instruction. These include:
- Instructors' offices or spaces
- Learning centers
- Demonstration areas
- Tool and equipment storage
- Materials and project storage
- Bathrooms and wash areas
- Student lockers
- Safety areas
AUXILIARY AREAS

There are a number of auxiliary areas that are designed to supplement the capabilities of the classroom and laboratory. These areas are usually highly specialized on the basis of purpose and equipment. Auxiliary areas include instructor offices, design centers, laboratory learning and reference centers, demonstration areas, display area, project storage rooms, materials storage rooms, tool and equipment storage rooms, toilet and lavatory rooms, wash area, and student lockers. Student lockers allow learners to store their materials and personal goods in a secure manner which is important to part-time students like apprentices. Students feel more comfortable if wash areas are provided in the lab and bathroom facilities are either in the lab or nearby. More will be presented on auxiliary areas in another session.

“Context Affects Learning”

Context factors that affect learning include:
1. Number and kinds of learners
2. Class and classroom size
3. The availability of instructional materials and equipment
4. Time to impart instruction
5. The nature of the lessons and skills to be taught
6. Instructional technology available to support learning
7. Prevalent views about teaching and learning

LABORATORY LAYOUT

INTRODUCTION:

In the previous section you learned how important the environment is to learning. This section focuses in on how to design, plan and layout technical laboratories. The typical classroom teacher has to organize and manage one learning space that usually has a few desks, tables, chairs, white boards, media equipment, bulletin boards, and instructional materials. A growing number of instructors who work with apprentices and electrical workers must assume responsibility for a technical laboratory that has a number of pieces of expensive equipment, many small tools or instruments, and a wide variety of materials used in electrical occupations. Classrooms and laboratories must be designed to support the instructional programs that will be housed there. A well-planned and organized laboratory makes it much easier to prepare workers for the electrical occupation. Probably no other single factor is more important to capturing the interest of students than the quality of the laboratory. Students are more interested in the instructional program and learn better when the physical facility looks good, functions well, and has up-to-date equipment and materials.
INSTRUCTOR’S ROLE IN LABORATORY PLANNING

“Instructor’s Role in Laboratory Planning”

- Serve as a member of a facility planning committee
- Develop educational specifications and requirements for a new laboratory
- Evaluate an existing laboratory, document deficiencies, and develop an improvement plan

Instructors may be involved in designing and planning laboratories in several different ways. Instructors may be a member of a planning committee composed of instructors, educational facility planning specialists, architect, training supervisors and others that are working out the requirements of a new facility or expanding an existing facility. They may be asked to draw on their technical and teaching experience to write educational specifications, assist in designing the floor plan, identify auxiliary areas, identify general and special utilities, and specify tools, equipment and workstations.

It is more likely, however, that instructors will be assigned an existing classroom and laboratory that may need to be improved to support instruction. In this case instructors will need to evaluate the classroom and laboratory, document any deficiencies, and develop an improvement plan that can be submitted to administrators. Of course if the existing facility poses a threat to the safety and well-being of students or interferes with instruction, instructors must identify such deficiencies and make them know to administrators as soon as possible. Instructors should consider the following questions when evaluation a laboratory.

“Questions for Evaluating Facilities”

1. What would an ideal classroom and laboratory consist of?
2. How adequate is the existing classroom and laboratory in supporting instruction?
3. How current and complete is classroom and laboratory equipment?

“Questions for Evaluating Facilities”

Other evaluations include:

4. What technological advancements will likely occur in the foreseeable future?
5. How will student enrollment and the nature of students change in the future?
6. What should be the highest priority in the improvement plan?
7. What is an estimated cost of needed improvements and what is the likelihood that funds will be made available?

Instructors may feel that their authority is limited, but there is usually much that can be done to make the classroom and laboratory a more efficient and pleasant place in which to work and learn. For example, instructors may not be able to expand their classroom
and laboratory space, but they can usually rearrange their furniture and equipment, improve the way tools and materials are stored and disseminated and control lighting and ventilation to improve the learning environment. They usually can get permission to paint the walls of the facility, get rid of out-dated equipment and furniture, color code their equipment and machines, repair broken machines and equipment and even purchase some new tools and equipment on a schedule to update the classroom and laboratory.

CONSTRUCTING A PLAN OF IMPROVEMENT

Once instructors have evaluated their existing facility, they will need to consider the following planning facility planning factors:

“Facility Planning Factors”

1. Information about technological advances that are likely going to be incorporated into the program in the near future.
2. Projections about student enrollment and how the facility will be used.
3. Decisions on changes in the instructional approach to delivering the program.
4. Ideas from many sources concerning how best to improve the facility.

IMPROVEMENT PLAN COMPONENTS

Instructors can use laboratory evaluation information to develop an improvement plan. The improvement plan should include the following types of information

“Improvement Plan Components”

Facility improvement plans should contain the following components:

1. Statement of the occupational area
2. Statement of purpose for the improvement plan
3. Specific plan
4. Supporting information

“Other Improvement Plan Components”

5. Alternative designs or plans
6. Financial considerations
7. Priorities
8. Suggested implementation procedures

1. Statement of the occupational area—Identify the occupational program that will be conducted in the facility and develop the goals and objectives of the program as well as a listing of the tasks and competencies which form the basis for instruction.
2. Statement of purpose for the improvement plan—This should be a justification of the need for improvement of the facility. Cite present capacity, projected student enrollment, characteristics of students, and the need to incorporate technological changes that have made the present facility obsolete.

3. Specific plan—Describe how the improved facilities will differ from the present ones in terms of space, equipment, arrangement of equipment, tools, auxiliary areas and other characteristics.

4. Supporting information—Include any other documents, report or data that support the need to change the existing facility, including recommendations by facility planning experts.

5. Alternate designs—Include sketches of possible floor plans which might be adopted to change the facility and meet the statement of purpose. Plans could be developed to reflect the ideal and others could reflect minimal requirements. Every attempt should be made to include illustrations from periodicals or copies of plans used to construct other similar facilities. Include pictures of the existing facility and pictures of an improved facility if possible.

6. Financial considerations—Include any data which is essential to estimating the cost of each alternative facility improvement plan. Be sure to describe the cost of facility renovation as well as the equipment and furniture cost.

7. Priorities—Indicate which items in the improvement plan are essential to accomplishing the instructional objectives of an improved program. The plan should clearly indicate all additions, modifications and deletions needed to implement an ideal program.

8. Suggested procedure—Make recommendations as to the steps that could be taken to implement the improvement plan. It is essential that facility planner follow accepted procedures at your training institution.

LOCATION OF LABORATORIES

“Laboratory Location Considerations”

- Outside accessibility
- Away from academic areas if laboratory will generate loud noise
- Located on ground floor to move heavy equipment and materials
- Room for expansion
Instructors who may serve on a facility planning committee may be involved in a discussion as to where laboratories should be located within a building. There a number of considerations in locating a technical laboratory. Most laboratories need to be accessible from the outside for evening classes and for receiving equipment and materials. If they are likely to generate disturbing noise levels, they should be located away form academic areas such as general classrooms. Laboratories that have heavy machinery should be located on the ground floor and they should be clustered with other laboratories that have heavy equipment. Laboratories should be located so that expansion is possible. Future laboratory expansion is facilitated when laboratories are located adjacent to open space, have non-load bearing partitions, have underground utilities and other features that make expansion possible.

SIZE AND SHAPE OF THE LABORATORY

“Size and Shape Considerations”

General considerations for determining size and shape of laboratories include:

- Long-term view for facility planning
- Technological change
- Multi-purpose
- Accreditation and occupational standards
- Architectural standards
- Governmental standards

The size and shape of a laboratory depends to a great extent on the nature of the occupation for which students are being prepared. Certainly a laboratory in which electrical workers will be prepared will be different than one to prepare heating, ventilation and refrigeration workers. However, there are common considerations in planning and organizing technical laboratories. One of these is to take a long-term view to facility planning for other instructors will be using the facilities in years to come. Technology will most certainly change not only the equipment and materials used in the electrical occupation but also the way in which instruction is delivered. The laboratory in particular will often need to be multi-purpose so flexibility and changeability must be guiding principles. Another is to be sure that the classroom and laboratory meets accreditation agency and occupational training standards as well as architectural standards required by federal regulations such as those found in the Americans with Disabilities Act. Instructors should also be aware of governmental and occupational regulations such as Occupational Safety and Health Administration (OSHA) as they pertain to the occupational program and Environmental Protection Act (EPA) standards as they relate to air quality and sound control.
SHAPE OF CLASSROOMS AND LABORATORIES

“Laboratory Shape Guidelines”

- Rectangular in shape
- Minimum width of 35 feet with a length much greater
- Acceptable ratios of width and length: 3:5, 2:3, and 1:2.

Laboratories are usually rectangular in shape, which is considered the best shape for instructors to supervise and control the entire work area from any point in the room. A generally accepted minimum width for technical laboratories is 35 feet. When laboratories are less than 35 feet it is nearly impossible to maintain traffic lanes of five feet and laboratories must be longer to provide sufficient floor space to accommodate equipment and machines. This layout presents a problem because a long, longitudinal spread interferes with efficient movement of students and materials. Acceptable ratios of width to length are 3:5, 2:3, 1:2.

For many years, laboratory size was determined by recommended total square footage values determined by experience. For example, square footage values ranged from 50 square foot for students in a drafting laboratory to 150 square feet in a heavy laboratory such as a machine shop. The total square footage was determined by multiplying the square footage value by the number of students. Today, these square footage values are used as a starting point but a more accurate method is used to determine facility space requirements that requires instructors to define the instructional space more precisely.

THREE-STEP PLANNING PROCESS

“Three-Step laboratory Planning Process”

Three steps to follow in planning laboratories are:
1. Identify equipment and furniture needed to support instruction
2. Determine “safety” or “operator” zones for each piece of equipment and furniture
3. Determine free space for aisles of travel in the laboratory

The recommended three-step method for determining classroom and laboratory space is to calculate the space required for basic items of equipment and furniture, operator room and safety zones around each piece of equipment and furniture, and free space needed for aisles of travel in the classroom and laboratory.

These steps are as follows:

1. Identify each piece of equipment and furniture necessary to support the anticipated program and its curricula. After the equipment and furniture is identified, consult equipment catalogs for the size (in terms of floor space occupied) of each piece of equipment and furniture. Where different makes of furniture and equipment vary in size, average them to arrive at the floor space needed.
2. Determine the “safety zone” or safe working area required for each piece of equipment and furniture. This is fairly easy to determine in the classroom for a general rule of thumb is to allow a minimum of two feet around furniture such as tables and chairs, desks and chairs, and so forth. The general rule of thumb for safety zones around major pieces of equipment in a laboratory is to allow a minimum of three (3) feet. There will be exceptions to this rule for some pieces of equipment such as a drill press are often located near a wall and will not require three feet in back of it while a table saw will require additional operator space in front as well as in back to feed materials into the saw and retrieve the processed materials. In determining the space required for safe working areas the following factors should be considered.

“Considerations for Determining Safety Zones”

- The usual processing and fabricating tasks students are required to perform.
- The type and nature of instructional activities (projects, work samples, products) to be employed
- The type of materials most frequently used in making or servicing products
- Placement of the equipment in the laboratory (against a wall, assessable from all sides, etc.).
- The traffic patterns of individuals during equipment operation

3. Determine the additional “free space” for aisles of travel in the laboratory. The commonly accepted minimum width of aisles in a laboratory is four (4) feet but 5 feet is even better. A square footage value for determining aisle space has been determined through experience which is to allow for an additional 20 percent of floor space beyond that which is required for the equipment and safety zones or operator space.

There are some advantages in determining laboratory size requirements by the three-step approach. Among these are the following:

1. It requires instructors to define an instructional program more precisely.
2. It forces instructors to devote attention to long range planning in terms of maximum student loads as well as for program expansion with subsequent purchase of additional equipment.
3. It is an extremely flexible approach that allows instructors to enlarge or reduce the space required for his/her instructional needs.
4. It provides for precise determination of floor space which can be justified with the administration and/or architect.
5. It is the most accurate and efficient method of determining floor space that can be used for almost any type of laboratory.
AUXILIARY AREAS

“Definition of Auxiliary Areas”

Auxiliary areas are supplemental areas to the main laboratory work areas that are usually highly specialized on the basis of purpose and equipment.

“Auxiliary Areas”
- Instructor offices or operation centers
- Demonstration area
- Laboratory reference center
- Student lockers
- Tool and equipment storage room(s)
- Material storage room
- Project storage room
- Toilet and lavatory rooms
- Wash and safety area

Technical laboratories need to have supplemental areas to the main work area and these areas are highly specialized on the basis of purpose and equipment. These support areas are called auxiliary areas and include instructor’s offices, demonstration areas, laboratory reference centers, student lockers, tool and equipment storage rooms, project storage rooms, materials storage rooms, toilets and lavatory rooms, wash areas and safety areas. These areas may or may not be in a separate room. For example, tools and equipment need to be kept securely and free from a dusty and dirty environment. Therefore they are usually kept in a separate room with a Dutch door that will allow tools and equipment to be disseminated by a tool room clerk without allowing individuals to enter the room. On the other hand, wash and safety areas may be located openly in the laboratory.

Instructor’s Office:

It is desirable that every instructor have access to a place of privacy in which they can prepare instructional materials, evaluate student progress, confer with students, keep records, and keep up with correspondence. Since space is a premium in most facilities, sometimes two or more teachers are assigned to the same office space. Office efficiency drops markedly when an office is shared. A one instructor office should contain around 140 square feet while a two instructor office should contain a minimum of 200 square feet.

In some facilities offices are placed in a central block while others are located in the laboratory. Each location has its advantages and disadvantages. If the office is located in the laboratory, it should be given a central location, preferable along the ends of main work areas; and it should be separated with glass or clear plastic so that instructors can maintain visual contact with main work areas when they must be in their offices for short
periods during class time. Offices should not be passage ways between two laboratories. Offices should be wired for telecommunications or have a wireless capability.

Demonstration area:

Some laboratories use a separate demonstration area which is usually an open space where the entire class can stand or sit for short periods of time. To conserve space, folding chairs and tables can be used to good advantage. Instructors or guest presenters can demonstrate how to use some new piece of equipment or a new occupational process.

Laboratory Reference Center:

With the increasing use of individualized and computerized instruction, there is an even greater demand for a learning reference center to supplement the separate classroom. Learning reference centers should be able to accommodate about one one-fourth of the students in the class at one time and be large enough to provide forty square feet of floor space for each student. Learning carrels with glass or clear plastic partitions are ideal that allows instructors to observe students as they do independent work. The centers will also need to have shelves and storage cabinets to house instructional materials.

Student Lockers:

It is recommended that a minimum of two cubic feet of locker space be provided for students enrolled in occupational programs. While student lockers are usually located in hall ways for academic students, they should be located in the laboratory for occupational students. The number of lockers needed is dependent upon the maximum number of students enrolled in any one class and the number of classes that will meet at least once each week.

There are two major types of lockers available for laboratories, the cabinet base type and the standard tiered wall lockers. Many different modifications of these two types are available. Lockers should be clustered into two or three groups to reduce congestion, yet placed as near the main entrance to the lab as possible. Recessed wall lockers are the preferred choice by most instructors because they eliminate housekeeping problems. All lockers should be vented and contain a locking system that features access by qualified people with a master key.

Tool and Equipment Storage Rooms:

Most occupational laboratories need to have a separate tool and equipment storage room located near the main work areas of the laboratory. Tool rooms should have a 26” Dutch door which is a door that is halved to allow the top and bottom of the door to be opened separately. Many instructors assign a student to distribute tools early in the class by handing tools to students through the opened upper door thereby keeping unauthorized students out of the tool room. Tools and equipment are stored in different ways such as
on peg board, cabinets, shelves and drawers. More will follow later in another session on how to configure and manage a tool room.

Materials Storage Room:

Most occupational laboratories need to have a separate materials storage room for storing bulk quantities of materials and supplies. This room is usually located near to the main outside access door to the laboratory and should contain two thirty-six wide doors that open to a width of six feet into the laboratory area. Vertical and horizontal storage devices need to be provided in the room along with a number of fixed and moveable storage devices to store irregular shaped and smaller materials such as switches, receptacles, outlet boxes and so forth for an electrical occupation program. For example, bins, pigeon holes, drawer cabinets, shelves, racks, tote boxes, lockers, basket racks, and combination devices can be used to store smaller materials.

Project Rooms:

Lockers can be used to store smaller projects but some occupational programs require students to construct or work on larger project and they need to be stored in a secure room if possible. This project storage room should be located close to the main work area of the laboratory and adjacent to a paint room if one is available. Like the material storage room, the project storage room will need to be equipped with a variety of storage devices such as adjustable shelving, portable carts, etc.

Toilet and Lavatory Rooms:

Some facilities have constructed separate toilet/lavatory rooms for each laboratory. In the past separate restrooms were provided for men and women. Today, there is a trend to provide unisex restrooms to utilize space and reduce construction costs.

Wash and Safety Areas:

Occupational laboratories need to provide a wash area and a near-by safety area. Wash areas should be located near the bench section of the main laboratory and away from electrically operated devices and distribution systems. At the same time, it needs to be easily accessible to students working in all parts of the laboratory. The two main types of wash equipment for laboratories is the standard wall-hung or counter-mounted was bowl and the wash fountain. Wash fountains may be either the circular or semi-circular form. Semi-circle wash fountains are the preferred choice by most instructors because they allow the wash area to be mounted against the wall and are foot operated and may even automatically dispense soap. Wash areas will need to be equipped with one or more soap dispensers if the wash fountain is not equipped with a soap dispenser. A paper towel dispenser or an electric hand dryer should also be located near the wash equipment as well as waste receptacle. An angle-stream drinking fountain should be located near the wash area.
A safety emergency area should be located near to the wash area and it should be equipped with a first aid cabinet and an eye-wash station. If chemicals are used in the laboratory, a six-inch shower head with a pull chain control and a floor drain should be provided at the safety area. This shower is used in case of an emergency where large volumes of water are required to dilute chemicals.

STANDARDS FOR TECHNICAL LABORATORIES

Over the years governmental agencies have developed standards for the construction of expensive technical laboratories which are contained in school facility planning and construction guides. The following are some of the important standards for technical laboratories.

Location:

“Location Standards for Technical Laboratories”

General standards for locating technical laboratories include:

- Ground floor, preferably in a wing of a building or separate building with covered walkways
- Away from academic areas to control possible noise factors
- Clustered with other heavy and noisy laboratories
- Adjacent classroom between laboratories can serve both laboratories but must be sound-proofed

“Location Standards for Technical Laboratories”

- Designed for future expansion
- Overhead doors and paved access roads if vehicles are to enter laboratory and deliver bulky equipment and materials
- Accessible outside through double 3-foot doors with removable mullion to allow students to enter after regular school hours

The following are recommended standards regarding location:

1. Technical laboratories should be installed on the ground floor, preferably in a one-story wing of a main building or in a separate building with covered access ways
2. Technical laboratories should be located at a distance from main academic instructional areas to control the noise factor
3. Technical laboratories should be clustered in the same general area and if classrooms are adjacent to these laboratories they should be sound proofed and located to serve two or more laboratories
4. Laboratories should be designed for future expansion with non-load bearing partitions, under ground utilities, and other features that facilitate change.
5. Provisions need to be made for delivery of bulky equipment and supplies. In some cases this may mean a loading dock, wide doors and ramps must be provided.
6. In laboratories that require power driven vehicles to enter and exit a facility, overhead doors and paved driveways will need to be provided.
7. Laboratories that are to be operated in evenings and on Saturdays should be accessible through outside entrances which eliminate the need to unlock and light the main facility which improves security and reduces operating costs.

Physical Requirements:

“Standards for Size and Shape”

- Determined by educational requirements of occupational programs
- Rectangular in shape with width to length ratios of 1:2, 2:3, and 3:5.
- Free of columns, post and blind corners that obstruct the instructor’s view

The size and shape of the facility is determined by the educational requirements of the occupational programs to be offered there. Technical laboratories are usually of rectangular in shape and should be free of columns, posts, blind corners, and other obstructions that could interfere with the safe handling of materials and would obscure the instructor’s sight.

Ceiling Heights and Doorways:

“Standards for Ceiling and Doorways”

- Dependent on the nature of the occupational program
- Light-duty laboratories have ceilings of around 9’ – 3”
- Heavy-duty laboratories have ceiling heights of 14’ - 0”
- All laboratories must have at least two exits with outside doors of either 4’ – 0” or two 3’ – 0” doors separated with a removable mullion.
- Overhead doors should be roll-up type with a minimum width of 10’ – 0” with heights sufficient to allow expected vehicles to enter safely.

The ceiling heights of laboratories will vary with the nature of the occupational program to be offered there. High ceilings facilitate the safe movement of materials and help to eliminate the excessive construction of dust. Ceiling heights of light duty laboratories such as drafting are usually around 9’-6” in height. Heavy-duty laboratories such as construction, metal fabrication and automotive or power laboratories usually have ceiling heights of around 14’-0”.

Every room with 2,000 square feet or more in area should have at least two exits as remote from each other as feasible. An outside exit is recommended for laboratories consisting of a single door of no less than 4’-0” or a double 36” door with a removable mullion so that large equipment can be moved in and out. Interior doors should be a minimum of 30”. Overhead doors should be the roll-up type with a minimum width of
10'-0”. and a height to accommodate the height of vehicles that may need to enter and exit the laboratory.

Utilities:

“Standards for Utilities”

- Utility needs are dependent upon the nature of the occupational program
- Most heavy-duty laboratories will need 3-phase service as well as standard service
- Emergency power cut-off switches must be installed strategically on walls
- Power and light controls should be in a locked master control panel with a “power on” pilot light located near to the entrance door of the laboratory

“Standards for Utilities”

- Electrical outlets should be spaced no greater than 8 feet around walls
- Overhead recoil type extension cords should be installed to accommodate portable power equipment
- Compressed air outlets should be regulated and strategically located on walls with the compressor located outside the building
- Hot and cold water should be provided to bathrooms and wash areas

The electrical and gas service will be dependent upon the nature of the occupational program to be offered in the laboratory. Many laboratories will be serviced with at least three-phase, four-wire, 208-220 volt service. Most motors of over ½ horse power should be three-phase and confirm to the Fire Underwriters and N.E.M.A. codes. Emergency cut-off switches with preferably the mushroom type push buttons should be strategically located on each wall of the laboratory so that the instructor will always be within 25 feet of the emergency cut-off switch. Power and light controls should be centralized on a flush-mounted, locked master control panel with “power on” pilot light and should be located near the entrance door of the laboratory. Electrical outlets should be a minimum of 12” off the floor and spaced no greater than on 8’-0” centers along the wall of the laboratory. Locations of special electrical outlets should be planned well in advance to enable the architect to include these services in plans. Overhead recoil type extension cords are recommended for laboratories that use portable electric equipment.

Only specialized occupational programs like welding will require manifold gas systems. Gas outlet locations will need to be specified in the educational specifications so that architects can include them in building plans.

Each laboratory should have both hot and cold running water to the wash area and it is desirable to have at least one hose connection in the laboratory, usually located near the exterior door.
Compressed air should be provided through piping from an outside compressor located in a secure and protected location. Compressed air outlets must be clearly marked and should have an in-line regulator and filter to control the pressure so that no more than 30psi can be used for general cleaning, yet more pressure can be regulated to operate air-powered tools.

Illumination:

“Standards for Illumination”

- Lighting should be through both natural light as well as electrical lighting
- General laboratory should be at least 50 foot candles with 100 foot candles for more precise work.
- Overhead fluorescent lighting is the most commonly used but new halogen lights are another option that eliminates the stroboscopic affect on moving objects.
- Light colors should be used on walls to increase reflective value

In session one illumination was shown to be a factor that impacts learning. Instructors should take full advantage of natural lighting but must control glare and direct sunlight. The recommended light intensity of 50 foot-candles is recommended for general laboratory lighting and double that or 100 foot-candles for areas that require more precise work. Special work lights will be needed for certain machines and processes. Overhead fluorescent lighting is the common choice for laboratories but the type of lighting that prevents dangerous stroboscopic effect should be used where equipment has moving wheels, blades, etc. that may appear still when they are actually moving under regular florescent lighting. Remember that shades of color reflect light or absorb it so light colors should be chosen for ceilings and walls to reflect light back into the laboratory.

Walls and Windows:

“Standards for Walls and Windows”

- Recommended window height should be a minimum of 6’-0” from the floor
- Windows should have adjustable shades to control direct sunlight
- Walls should be painted a light, dynamic color to refract light
- Partitions between laboratories should be non-load bearing
- Partitions adjacent to classrooms and instructor’s offices need to be acoustically treated or insulated.
- Instructor’s offices should have a window facing the laboratory
- Each laboratory should have a 10’ white board installed on a wall and a six-foot bulletin board

The recommended window height should be a minimum of six feet from the floor to allow for equipment to be placed under windows. All walls should be painted a dynamic color to refract the light and to provide the greatest safety, visual comfort and efficiency.
Partitions between laboratories should be non-load bearing to allow for expansion of the laboratory at some future date. Partitions used to form the reference center and the instructor’s offices should be constructed of acoustical materials to minimize sound. The wall of the instructor’s office facing the laboratory should have glass or clear plastic windows so instructors can monitor class activity while in the office for a short time period. Each classroom and laboratory should have a 10-foot white board located strategically to support instruction. A six foot bulletin board is also desirable.

Floors:

“Standards for Floors”

- The type of floor is dependent upon the occupational program
- Heavy-duty laboratories usually have sealed concrete floors
- Light duty laboratories are either carpeted or use composite tile.
- Laboratories where water is used should have a sloped floor drain

The type of floor is dependent upon the instructional program. In clean laboratories like computer laboratories and drafting and design, carpet is the preferred choice. In heavy laboratories where heavy equipment will be moved about, floors should be treated concrete to prevent dust and slipping. In laboratories where floors are subject to spilled liquids, floor should be sloped toward a floor drain. In automotive laboratories lifts should be permanently installed in the floor.

MAKING THE LABORATORY LAYOUT

“Steps in Making a Layout”

- Draw a floor plan to ¼” scale showing size and shape of the laboratory and walls, windows, doors, and auxiliary areas
- Identify furniture and equipment and make card stock templates
- Move templates around on the drawing until a satisfactory arrangement is made
- Develop transparent overlays showing utilities, aisles, operator zones, and other special features
- Develop a special requirement sheet describing floors, walls, lighting, and so forth

Laboratory layouts can be done in one of several ways. One way is to use templates for laboratory furniture and equipment and the other is to use actual three-dimensional models placed on the floor plan. Still another is to use special computer programs to perform the layout. The most commonly used method is the card stock template method and the use of a floor plan drawn on 1/4” graph paper with ¼ inch representing each foot of laboratory space. The size and shape of the laboratory is drawn on the graph paper as a floor plan showing walls, doors, windows, and auxiliary areas. Card stock templates are made for each item of furniture and equipment that is to be placed in the laboratory. Dimensions for furniture and equipment can be obtained from school supply catalogues,
trade catalogues, or by obtaining manufacturer’s specifications on the internet. Standard laboratory furniture and equipment templates may be available from publishing companies. Templates can be made to include operator zones in addition to the actual size of furniture or equipment but these spaces are generally shown using a clear plastic overlay sheet. The card stock templates are moved about the drawing until a satisfactory arrangement is obtained. Once the planner is satisfied, the templates are cemented to the drawing with rubber cement or taped using clear tape. The names of furniture and equipment can be drawn or cemented on the templates or each template can be given a number so that a legend can be developed to identify furniture and equipment.

Another method is to use a metal-faced board with a floor plan drawing taped to it showing the size and shape of the laboratory and the location of walls, doors, windows, and auxiliary areas. Card stock templates are made for each item of furniture and equipment as in the previous method but magnetic film is cemented to the templates so that they can be positioned without shifting. There are also magnetic backed printable sheets that can be used to create template outlines using computers. Using the magnetic templates eliminates the need for cementing or taping and cuts the amount of time required to arrive at a satisfactory layout.

The method that will be used in this course is using white boards and clear transparent film that is printed with ¼ inch grids. Templates will be cut out of stick-on film, numbered to identify the type of equipment, and placed on the grid film.

In the template layout method, transparent or clear plastic sheets are used to show the location of utilities such as lighting, electrical outlets, compressed air, floor drains, telecommunication outlets, and other special utilities. Other clear plastic sheets may show operator zones around furniture, machines, and equipment as well as showing aisles and traffic lanes for the laboratory. Transparency pens are needed to draw on the clear plastic sheets.

A special sheet should be developed containing additional information describing the layout. This information would include acoustic material treatments; types of floors, walls, ceilings, lights, doors, and windows; and the color scheme for the lab. This sheet may also contain the furniture and equipment legend if the templates are numbered instead of labeled. Any other special requirements would be included in this sheet such as locations of bulletin boards, white boards, signs, and so forth.
SUMMARY QUESTIONS

1. Why are laboratories and most rooms rectangular in shape?

2. What are some questions to ask when evaluating an existing laboratory?

3. Why must all laboratories have at least two exit doors?

4. Why are heavy-duty laboratories usually located on the ground floor and away from academic areas?

5. Why are auxiliary areas needed in a laboratory?

6. What are the three steps in the laboratory planning process?

SUMMARY

The size, shape, content and layout of technical laboratories vary widely, depending upon the nature of the occupational program for which students are being prepared. Over the years, experience has yielded a number of generally agreed on standards for the location for heavy-duty laboratories, the width to length ratios of laboratories, and the auxiliary areas that are needed to support instruction. Standards have also been developed for physical aspects of the laboratory such as the placement of windows, type and sizes of doors, type of walls and floors, utilities required, types of illumination, and even color schemes. Laboratory layouts are developed using the template method with transparent plastic overlays to show the location of furniture, equipment, auxiliary areas, utilities, operator zones, aisles, traffic lanes, and lighting. Before templates can be developed, it is necessary to determine the furniture and equipment needs of the laboratory and that is the topic of the next session.
EQUIPPING THE LABORATORY

Introduction

Session two dealt with information on the instructor’s role in facility planning, laboratory improvement plans, locating technical laboratories, factors in determining the shape and size of laboratories, three-step process for determining laboratory floor space, auxiliary areas, and standards for technical laboratories. This session will provide additional information needed to plan and arrange a technical laboratory including identifying and securing equipment and supplies, writing specifications and purchase orders, placing machines, equipment and work stations, identifying and locating utilities, and making the laboratory layout plan. A firm understanding of these topics is essential for instructors who are involved in designing a new technical laboratory or for improving an existing one.

SETTING UP WORK STATIONS AND SELECTING AND PLACING MACHINE AND EQUIPMENT

"Considerations for Equipping Laboratories"

1. Nature of the curriculum
2. Maturity and experience level of students and number of students
3. Approximate floor space of the laboratory
4. Location of laboratory (ground floor or upper level)
5. Accessibility to laboratory (door size openings, passageways, elevators, driveways)
6. Comparable equipment and supplies used in electrical occupations

"Considerations for Equipping Laboratories"

7. Amount budgeted for equipment needs
8. Precision required by students
9. Durability or the degree that equipment will hold up
10. Modern design, features needed, and quality of materials and workmanship
11. Safety features
12. Size, weight and amount of space needed for storage

“Considerations for Equipping Laboratories”

13. Availability of repair parts and service
14. Power consumption
15. Adequate variety of makes, styles, and sizes selected to maximize student exposure
16. Mounting difficulties (electrical, plumbing, ventilation, mechanical, etc.)
17. Obsolescence schedule
18. Tools, equipment and supplies on hand.
Once instructors have developed a layout or plan for a new laboratory or a laboratory improvement plan for an existing one, they will need to establish work stations and select and place the pieces of equipment needed to accomplish instructional tasks. When developing a layout or plan for a laboratory, instructors must also consider needed operating space or ‘safety zones around machines and equipment and space for traffic lanes for safe student movement in the laboratory. The effectiveness of an occupational program and its continuing success depends, to a large extent, on realistic work stations and the tools, equipment, and supplies available for instruction. The constant change of the way work is performed in an occupation due to advances in technology makes it necessary to continuously update work stations and replace tools and equipment when they become obsolete as well as when they become worn.

A major responsibility of technical instructors is to select the machines, tools, equipment, materials and supplies required to teach the tasks and jobs of the electrical occupation. Electrical occupations require the development of skills to accomplish tasks and tools and equipment for the laboratory should be comparable to those used on the job.

A starting point for identifying the tools, equipment and supplies is to analyze the tasks to be taught in the program. An analysis of the tasks to be taught in the program will reveal needed work stations and provide a rather complete listing of equipment and supply needed. The number of pieces of equipment and tools needed is dependent upon the number of students that will be using the laboratory at any one period of time. Instructors should consider the following when establishing work stations and selecting equipment, tools and supplies for the laboratory:

Establishing Work Station:

The very nature of many technical training programs requires endless student practice of the tasks that they will be expected to perform on the job. Instructors should try to simulate industry conditions by establishing realistic work stations. Work stations may be portable such as those that require a certain set of tasks that are performed on a bench or they may require a specific laboratory location with in-school apparatus and equipment such as a wiring center. Typical work stations with in-school apparatuses and equipment include the following:

Instructor Tip:

You may want to conduct a brain storming session at this point to get participants actively involved in identifying work stations for an electrical program laboratory. Have one student become a recorder to write down suggested work stations on a flip chart or on a white board.

1. Transformer work station—Different types of high-voltage transformers are placed in an area to be tested and wired by students.
2. Motors and motor control station—Various types of motors are located on benches or tables and motor controls are placed on panels for students to troubleshoot and wire.

3. One or more residential rooms equipped with service heads, service entrance cable, electric meter, main service panels, sub-panels, and many branch circuits leading to outlets, switches, ground fault interrupters, etc.

4. PLC trainer or PLCs placed in an area for students to troubleshoot and make functional

5. A major appliance center—One or more major appliances such as a heat pump, furnace, dryer, etc located in an area for students to troubleshoot and wire.

6. Conduit bending station—An electrical conduit bender for students to practice bending conduit and a work area large enough for them to practice with hand conduit benders.

7. Pipe cutting/threading machine—A pipe cutting and threading machine to process heavy pipe for mechanical coupling

8. Pulling conductors in EMT station—An area of the lab with EMT fastened to a panel or wall that will allow students to practice pulling conductors through EMT

9. A materials estimation station—An area of the classroom or laboratory where reference materials are available and schematics can be laid out to determine what electrical supplies and materials will be needed for a job.

10. A telecommunication panel stations—A telecommunication panel installed in a wall or panel that student can practice on to make telecommunication connections

11. A fiber optic center—A special area of the laboratory with panels equipped with fiber optic equipment for student to practice their installation skills

12. Craft Certification Performance Evaluation stations—Modules created by the NECB (National Electrical Certification Board) that involve written and hands-on examinations for certification purposes.

**Selecting Laboratory Machines, Equipment and Tools**

**“Common Selection Mistakes”**
- Selecting equipments and tools that was used when they were students
- Selecting equipment and tools based solely on past experiences with them
- Selecting only highly-advertised, “brand name” equipment and tools
- Obtaining equipment and tools from only one company
- Selecting equipment and tools that cost less than others
Instructors often disagree over the type and quality of laboratory tools and equipment that should be purchased for the laboratory. They base their selection of equipment on past experiences. For example, instructors may favor tools and equipment that was used when they were students in the program or perhaps the tools and equipment they used on the job. Making decisions on tool and equipment selection based on past experiences may not be the best policy for such purchases may have been poor selections for any of a variety of reasons such as surplus, economic, only thing available at the time and so forth. Instructors should avoid a common mistake of ordering all of their tools, equipment and supplies from one company without considering competing companies. A second mistake is selecting tools and equipment solely on the most advertised “name brands.”

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“Better Practice for Obtaining Laboratory Equipment”

A better practice for obtaining furniture, equipment, and tools for a laboratory is to:

- Develop criteria based on general considerations for the selection of equipment
- Investigate what a number of tool and equipment companies can provide
- Utilize the expertise of other craftsmen when selecting equipment and tools.

There are a number of school supply companies that handle a wide variety of tools, equipment and supplies. These companies list their items in large catalogs that are free to schools. There is also a number of general as well as specialized tool and equipment companies that also have catalogs and most of them now have on-line catalogs. Instructors need to investigate carefully these sources of tools, equipment and supplies before making selections.

General Considerations

“General Selection Considerations”

1. Handles, grips, switches and other devices adequate and ergonomically designed
2. Easy to operate machine and easy to change cutting tools
3. Graphic devices such as dials, gauges and scales are easy to read
4. Adjustments can easily be made and accuracy of settings maintained
5. Work surface large enough to permit accurate work
“General Selection Considerations”

6. Equipment or machine bases rigid and designed so operation can be done safely
7. Equipment and machine capable of being operated with different power sources and have enough power to perform work tasks continuously
8. Guards and housings are provided or can easily be obtained for the equipment
9. Electrical switches are appropriately located and have accidental engagement protection. Portable power tools are double insulated
10. Equipment and machines are rugged enough to work continuously and last for years without major repair.

There are a number of general considerations to weigh when selecting equipment, machines, and equipment. These general considerations include the materials used to construct the equipment, how the equipment is powered, ease of operation, equipment adjustments and accessories, and the overall quality of the equipment. A number of these general considerations are as follows:

Electrical Considerations:

“Electrical Considerations”

1. Heavy-duty rubber-covered power cords with three-prong grounded type plugs
2. Power cords of sufficient length and protected from abrasion by passing through rubber grommets installed in metal surfaces of equipment.
3. Power cord storage devices that protect cords

“Electrical Considerations”

4. Power cords with appropriate wire gauge to handle power consumption requirements
5. Over-current tripping devices for switches and motors and adequate ventilation for electric motors
6. High-impact plastic housings to reduce the danger of electric shock

It is very important that electric factors be considered when selecting equipment and tools for switches and electric motors are usually the components that are the first to break down. If tools and equipment are operated with electrical power there are considerations that instructors should attend to such as the following:

Equipment Design Considerations

“Equipment Design Considerations”

1. Enclosed, rigid bases to facilitate ease of cleanup.
2. Base has leveling devices and is designed for attachment of central dust control system
3. Base houses motor which is insulated from frame so it remains clean but is still easily accessible for service
4. All adjustments to equipment and installation of accessories are easily made and accuracy of adjustment is ensured
5. Equipments is high-quality but when parts wear out they can easily be replaced without sending unit back to factory

Machines and equipment in technical laboratories are operated by many different operators throughout the instructional day. Machines should be designed to maximize operator safety, allow for ease of cleaning, and allow access to major operating parts to facilitate adjustment and repair. Some equipment design considerations are as follow

**Manufacturer’s Considerations**

“Manufacturers’ Considerations”

1. Is the guarantee satisfactorily inclusive with respect to no-cost protection to the purchaser?
2. Is the guarantee unequivocal and does the guarantee cover an adequate time period?
3. Who will make repairs and replacement specified by the guarantee? Where will repairs and replacement be made?
4. Is operating and service literature furnished? Are installation instructions furnished?
5. Is expert assistance for installation and repair easily obtainable?

“Manufacturer’s Considerations”

6. Will repair parts be available during the expected life of the equipment?
7. Does the manufacturer make modifications available to purchasers of earlier models so that equipment can be updated?
8. Are enough attachments furnished and options offered to permit the broadest possible use of the equipment?
9. Does the manufacturer make available various kinds of literature that can be helpful to students such as safe operation procedures?

Tools and equipment purchased for technical laboratories must last for a reasonable length of time. They should be high quality and be backed by manufacturer’s warranty. Instructors need to be aware of manufacturer’s consideration like the following:
Cost Considerations

“Cost Considerations”

1. Initial cost
2. Power cost
3. Maintenance cost
4. Probable life span
5. Amount of floor space consumed
6. Probable daily use

It is no easy task to identify and secure the appropriate quantity and quality of machines, tools, and equipment required to offer a sound instructional program to prepare workers for the electrical occupation. In many cases, competing brands or lines of equipment will be found with similar features. Probably few pieces of equipment will have all the desired features, leaving instructors to make decisions as to what pieces of equipment will have the most value for their programs and which of them have the fewest design limitations. Some design problems can be corrected without much additional cost; but others can not be remedied easily and the cost could be prohibitive. Funds are almost always limited for the purchase of tools and equipment so the initial cost factor is a major one. However, the initial cost of machines, tools and equipment should not be the only factor considered. The following aspects of cost should also enter into the decision making process:

Hand Tool Considerations

While battery-operated, electricity-operated, and air-operated power tools are replacing hand tools to perform many work tasks, instructors will need to select and purchase a number of hand tools. There are special considerations that should be given to the selection of hand tools like the following:

“Hand Tool Considerations”

1. Types commonly used in the electrical occupation
2. Special hand tools used or desired
3. Tasks, jobs and projects performed in the instructional program
4. Number of students in the class at one time
5. How tools will be stored and distributed
6. Number and condition of tools on hand
7. Budget devoted for hand tool purchases
8. Breakage and wear factor
9. Standardizing where possible
10. Quality of hand tools
11. Lifetime guarantee or warranty

**Check Points for Power Tool Purchasing**

**“Power Tool Considerations”**

1. Quality — There is a range of quality power tools available from light to heavy duty
2. Safety — Safety is more than double insulated construction
3. Power — Power tools may be operated by battery, electricity or compressed air
4. Availability of accessories
5. Availability of parts and service
6. Availability of instructional aids like posters, CD’s Videos, etc.

Quality power tools are expensive and it may not be feasible to completely equip a technical laboratory at one time. Basic power tools should be purchased and then others on a priority basis until all needed power tools are on hand. It may be wise to focus on the quality of power tools rather than quantity for cheap power tools usually do not last long and the end result will be extended cost in the long run for the program. Instructors should consider the following in selecting power tools:

1. Quality—A growing number of power tool companies are producing power tools that are rated for light-duty home use and others for heavy-duty commercial or industrial use. It is important to choose the later line of power tools for they are designed for heavy use and for extended tool life. Don’t confuse “best value” and “best price” slogans in catalogs with power tool quality; instead rely on the reputation and integrity of the manufacturer and the experience of others with these power tools.

2. Safety—Power tool safety is more than double-insulated construction of high impact strength plastic and three-prong grounded plugs. It is how the power tool is designed to allow the operator to engage or disengage power in the event of a problem in operation. It is also design that has guards that function well. Instructors must consider the experience of student operators and safety features of equipment when selecting power tools.
3. Power—Advances in battery technology has led to an increasing number of power tools being cordless. However, most of the heavy-use power tools are still powered by electricity or air. In selecting battery operated power tools, the voltage rating of the tools is an important factor to consider. Heavy-duty rated power tools generally have batteries with higher voltage ratings. Another important factor to consider is how rapidly power tool batteries can be recharged and how long will the batteries last during normal tool operation. Power tools that used electricity are rated by horse power (hp) or they are rated by amperage (amps). These rating are important for they determine how heavy a task that these tools can handle. For example, a drill motor tool rated at 3 amps would be suitable for general or home use but tools that will be used to drill concrete or thick metals will need higher amperage ratings.

4. Availability of Accessories—Manufacturers of power tools purchased should offer a complete line of accessories. This makes it possible for the power tool to be used to its maximum without the use of unsafe or makeshift arrangements. The accessory should be designed to work with the power tool and be easily attached and detached.

5. Parts and Service—Replacement parts should be readily available through local dealers and franchised parts distributors or service centers geographically located throughout the state or nation. Service should be available through local dealers and trained factory field men. It is important that all power tools be shipped with operating instructions and with information about maintenance and repair of the power tool.

6. Instructional Aids—Most manufacturers provide or make available for purchase instructional materials regarding the safe operation of their power tools. Some companies have videos/DVDs in addition to printed materials that cover safe operation of their power tools.

WRITING SPECIFICATIONS AND PURCHASE ORDERS

“Specifications and Purchase Orders”

Tool and equipment distributors need to have complete, accurate descriptions of tools and equipment written in the same form as that used in catalogs, brochures, or on the internet.

Purchase orders must have well-written specifications and be submitted in a timely fashion to distributors if desired equipment and tools are to be obtained in time for instruction.

Tool and equipment manufacturers and distributors want to fill orders completely and accurately and provide the tools and equipment ordered. To make this possible, distributors and venders need complete, accurate descriptions of the tools and equipment using the same terminology found in catalogs, brochures and internet information. The manufacturer or vendor cannot fill an order correctly if the order lacks important descriptive information and does not give a reasonable amount of time for shipment.
Publicly supported technical schools must place orders for tools and equipment through a competitive bidding process which is also used by some companies and organizations. Generally, Instructors must write equipment specifications without stating a brand name that they must have. If specifications are written completely, instructors will generally get the preferred brand names. However, if orders are poorly written and lack specific information, the business office may select the lowest bid even though the tool or piece of equipment is not what was expected. Business office personnel generally know little or nothing about the industrial sector and must depend upon qualified personnel such as training directors or instructors to make specific requests for tool and equipment purchase.

Development of Purchase Orders and Requests

Competitive bids to supply equipment and supplies are usually formed from purchase request which are prepared by instructors and submitted by training directors or other administrators. The procedure for purchasing differs from one training program to another. Some training centers permit the listing of supplier’s names, catalog numbers, brand names, and trademarks on purchase request; others do not. Some permit the listing of brand names if they are followed by the phrase “or equivalent.” Regardless of the purchasing procedures used, it is always desirable to list the features of the item so exactly that it alone can be purchased. This procedure will greatly increase the chances of getting the preferred brand name even though stating the brand name is not permitted.

The following types of things should be considered in writing specifications:

“Contents of Specifications”

1. Construction materials
2. Types of finishes
3. Colors
4. Surface treatment
5. Dimensions
6. Functional features
7. Power ratings
8. Manufacturing techniques
9. Manufacturer’s name (if permitted).
10. Supplier’s catalog numbers (if permitted).
11. Quantity wanted and accessories to be included

12. Safety features

13. Electrical features

14. Special features

15. Work to be performed

Sources of Information for Specifications

Instructors can find information to write tool and equipment specifications from school-supply catalogs, manufacturers’ catalogs, manufacturers’ brochures, and manufacturer’s and tool supplier/vender websites. Be sure to include the following information in all specifications:

Sample Power Tool Specification

<table>
<thead>
<tr>
<th>FEATURES:</th>
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</thead>
<tbody>
<tr>
<td>One-half (1/2”) 13mm heavy duty cordless right angle drill kit (stud and joist drill) to be rated industrial, not utility or domestic and have 100% ball bearing construction for trouble-free operation and long working life. It should have two speed levels and have a mechanical clutch in low gear to prevent bit lock-up and to provide control of reactionary torque. It must have an adjustable front handle and two-position side handle to provide maximum leverage and control. It must have a keyed chuck. It should feature triple gear reduction to provide increased torque and reduce gear stress. It should be approximately 21’ overall in length to provide greater control and leverage. The body of the drill should be constructed of high impact strength plastic. It should have a heavy-duty kit box made of high impact plastic. The weight of the drill should not exceed 15 lbs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPECIFICATIONS:</th>
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<tbody>
<tr>
<td>Chuck size</td>
</tr>
<tr>
<td>No load speed</td>
</tr>
<tr>
<td>Amps</td>
</tr>
<tr>
<td>Max Watts Out</td>
</tr>
<tr>
<td>Clutch</td>
</tr>
<tr>
<td>Capacity in wood (spade bit)</td>
</tr>
<tr>
<td>Gear Reduction</td>
</tr>
</tbody>
</table>
Capacity in wood (self-feed) 4-5/8”
Capacity in wood (hole saw) 6”
Capacity in wood (auger bit) 1-1/2”
Capacity in steel (twist bit) ½”
Capacity in steel (hole saw) 5”
Tool weight 13.5lbs

INCLUSIONS:

Chuck key holder
2-position side handle
Bail handle
Heavy-duty kit box

It should be comparable to the DeWalt DW124K Heavy-Duty ½” (13mm) Stud and Joist Drill Kit that can be found at the website www.tylertool.com/dewdwheavdut10.html.

TAKE HOME TIP
Selecting and ordering the best and most functional tools and equipment is a paramount concern. Ask colleagues and search the net for user reviews and technical specifications. Remember, brand name tools are not always the best quality and reliability available.

Purchase Requisitions:

Instructors will need to obtain purchase request forms and follow the procedures established for completing and submitting them. The purchase order should include specifications like the sample one described previously. Purchase orders will have logistical information such as the date the requisition was received, the date it was sent to the company, and expected delivery date. Instructors should expect that purchase orders will take time to process and they should check to be sure that they were sent out to suppliers in a reasonable time period. They should also plan purchase orders well in advance of the time when the tool or piece of equipment will be needed for it will take time for suppliers to ship the item. If the item shipped does not meet expectations, follow procedures for contacting suppliers and negotiating settlements.

SECURING SUPPLIES

“Supplies and Materials Considerations”

1. The quantity and kinds of items needed
2. Where items can be obtained
3. The approximate cost of items
4. Requisitioning the supplies
5. The amount of money budgeted for supplies.
One of the responsibilities of laboratory instructors is to secure supplies needed to support the instructional program. This is an important responsibility for when instructors fail to order the needed supplies in a timely fashion and makeshift arrangements have to be made, instruction tends to be less effective. It is important, therefore, that instructors determine what supplies are needed and order sufficient quantities in advance so that they are available at the appropriate time to support instruction.

When instructors prepare to secure supplies they are usually interested in the following five things:

**Quantity and Kinds of Items Needed**

*Considerations for Determining Quantity of Supplies*

- Review of instructional materials (lesson plans, activity sheets, etc)
- Number of students to consume materials in practice activities
- Ten percent (10%) waste factor for human error
- Instructional materials needed to produce learning materials
- Laboratory maintenance materials (lubricants, solvents, cleaning materials, etc)

Instructors must review learning activities in their lesson plans to identify what supplies will be needed for students to apply what they have learned in practice activities. Instructional support materials such as instruction sheets (job sheets, assignment sheets, laboratory activity sheets, project sheets) and progress charts give clues as to what supplies are needed. Obviously, the number of student involved in practice activities will need to be taken into account. In addition, instructors need to estimate how many additional supplies will be needed to compensate for student error and waste. The usual figure for determining waste is around 10%. Then instructors will need to consider the supplies needed to operate the program such as instructional supplies (media and reference materials, writing materials, paper, printer cartridges, etc). Finally instructors must consider supplies necessary to maintain equipment such as lubricants, solvents, abrasives, cleaning materials, and finishing materials.

Another way to identify needed supplies is to refer to copies of past requisitions if the instructional program has remained constant. Instructors will need to check what supplies are on hand against what was ordered in the past to estimate the amount of supplies needed for a given time period. Of course new instructors will need to rely on the first approach to identifying needed supplies. However, they can ask to see supply lists generated by other teachers that often help new instructors identify items that they may have left off their tentative lists. Once supply lists are developed, they need to be carefully organized and kept to make subsequent ordering of supplies an easier task. A sample expendable supply form is show below
SAMPLE EXPENDABLE SUPPLY FORM

Name of Item__________________________________________ Item No. __________

Charged to:   (A) Instruction ____; (B) Replacement ____; (C) Resale ____
(D) Capitol Outlay____

Program____________________________________ Instructor____________________

VENDOR:

No. 1 Vendor_____________________________________________________________

Address_________________________________________________________________

No. 2 Vendor_____________________________________________________________

Address_________________________________________________________________

<table>
<thead>
<tr>
<th>Complete Specifications</th>
<th>Ordering Unit</th>
<th>Estimated Unit Cost</th>
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<tr>
<th>Vendor No.</th>
<th>Date Filed</th>
<th>Yearly Need</th>
<th>Quantity on hand</th>
<th>Quantity Ordered</th>
<th>Estimated Total Cost</th>
<th>Actual Unit Cost</th>
<th>Actual Total Cost</th>
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Where Can Items Be Secured?

“Sources for Obtaining Supplies”

- Review list of companies listed in a supplier file
- Look for suppliers listed in trade journals and on the internet
- Use the yellow pages to identify local suppliers
The second task for instructors in securing supplies is that of finding a source from which needed supplies can be ordered. Technical instructors have all had the problem of trying to find a supplier for a certain item. Fortunately, however, it is not too difficult to find a supplier for most items if instructors develop and use a supplier file. Instructors who attend training conferences can visit exhibits and obtain materials provided by vendors that can be used to build the supplier file. In addition, trade journals also have vendor references and instructors can contact these suppliers and obtain descriptive materials on the supplies available from them. Of course some supplies can be obtained locally and the yellow pages of the telephone book can be used to identify potential suppliers. Instructors need to develop a relationship with local suppliers for often they can provide supplies for training programs at a reduced cost because they want to be a partner in the training of skilled workers.

“Develop a System for Securing Supplies”

Instructors will make the task of obtaining supplies and materials much easier if they develop a supply system by developing the following two resources:
1. A supply requisition form
2. Suppliers File

Of course, searching for sources of supplies is only one step in the process for instructors need to obtain information as to what supplies these firms handle, quantity of supplies on hand, the quality of supplies, price, and the adequacy of delivery services. Once instructors get this information on a company or vendor, they need to file it for they almost certainly will need this information again. Instructors need to develop a system for securing supplies and materials. Such a system can be developed using two basic devices:

There are many formats for supply requisition forms and the expendable supply form previous shown is one format. Basically such forms need to contain logistical information such as name of program and instructor, date filed, date needed, approved by, date ordered, and date received. The recommended vendor’s name and address should be written on the form and an alternate vendor’s name and address should also be provided. The account that the item should be charged to should be checked on the form such as charged to (1) instruction, (2) replacement, (3) resale, and (4) capital outlay. Finally the information shown in the table below should be included on the form.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Estimated Unit Cost</th>
<th>Estimated Unit Costs</th>
<th>Use</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>
Supplier File

The second part to this approach is that of systematically filing supply catalogs, brochures, fliers, website printouts, price lists, etc. While there are many ways that these materials can be filed, probably the best way is to file all materials in a filing cabinet in folders indexed with the name of the supplier or company. Of course large catalogs will need to be kept on a shelf or in a bookcase but the cover of the catalog should be kept in the file for immediate reference to address and contact information. When materials are filed in this manner the instructor can quickly access the supplier from the supply requisition sheet and easily find the supplier or vendor’s information in the supplier file.

PLACING MACHINES, EQUIPMENT AND WORK STATIONS

“Major Factors for Placing Equipment”

- Facilitates instruction
- Equipment can be operated safely
- Management of the laboratory is facilitated

One of the important tasks in preparing educational specifications for architects to follow when planning technical facilities is to select machines and equipment and locate them within a determined space so that auxiliary areas and utilities can be designed by the architect. Organizing or arranging machines, benches, and other pieces of equipment is an exacting task. Three fundamental factors must be considered when organizing any technical laboratory. These are:

1. Equipment must be placed so that its arrangement facilitates instruction

2. Equipment must be placed with safety as a key consideration

3. Equipment must be arranged so that it aids the instructor in managing the laboratory and the instructional program. Many management problems such as issuing tools and materials, record keeping, machine maintenance, inventory control, and cleanup are aided greatly by good equipment organization.

Equipment Location

Major pieces of equipment and furniture are generally located in a fixed position in a technical laboratory and placement must be carefully considered by the instructor. Instructors must carefully think through the following characteristics which affect location of certain items.
“Considerations for Placing Fixed Equipment”

1. Material Flow
   (1) Where is it brought into the laboratory?
   (2) How is it brought into the laboratory?
   (3) Where is it stored?
   (4) Is intermediate processing required before or after storage?
   (5) Where is it consumed?

2. Traffic Flow
   (1) Student traffic patterns in the laboratory
   (2) Student traffic to tool and materials storage rooms or areas.
   (3) Student traffic to learning resource centers or study areas
   (4) Material traffic through the laboratory

3. Location of Utilities
   (1) What utilities are needed to operate equipment?
   (2) What utilities need to be permanently mounted?
   (3) What utilities need to be moveable?

General Guidelines for Placing Equipment and Furniture

In locating equipment and furniture instructors need to consider the following factors:

“Guidelines for Placing Furniture and Equipment”

1. Locate processing equipment close to material storage
2. Arrange equipment for logical processing of materials
3. Locate equipment where utilities are accessible
4. Arrange furniture and equipment so that distinct traffic lanes are established
5. Arrange equipment so that entrances and exits are not blocked and the flow of materials is not blocked
6. Arrange furniture and equipment to create safe operator zones
7. Group similar pieces of equipment together in clusters
8. Arrange equipment where the best possible lighting is available

In locating equipment and furniture instructors need to consider the following factors:

1. Locate processing equipment close to materials storage—Keep the transportation of heavy bulk materials from storage to machines at a minimum. For example, conduit and pipe cutters and thread cutters should be placed as close to the storage area as possible.

2. Arrange equipment for logical processing of materials.—Make every effort to minimize the time and motion required in:
moving materials from storage to machines and equipment, between machines and work areas, and from work areas to storage areas;
(b) securing tools and equipment;
(c) going to and from machines and equipment; and
(d) going to and from lockers.

3. Locate equipment where necessary utilities are available—Equipment that needs ventilation needs to be placed under a ventilation hood or other venting apparatus.

4. Arrange equipment so that distinct traffic lanes are established between frequently used areas such as tool rooms or panels, machine areas, project storage, material storage, work benches, etc.—Students should be able to enter a laboratory and move easily to all areas without having to walk around pieces of equipment that are not located properly. Equipment should be arranged in order to permit safe and convenient student passage from place to place. Traffic lanes should be no less than four (4) feet. Safety white lines approximately four inches in width can be painted on the floor to denote traffic lanes.

5. Avoid placing equipment and furniture that blocks material flow or movement and blocks entrances or exits. A common violation of equipment organization is to place equipment where it interferes with the opening and closing of doors or with visibility of bulletin boards and whiteboards.

6. Orient equipment for safe operation to the user and others in the vicinity—Machines such as table saws are capable of expelling stock violently from their infeed or outfeed sides into traffic lanes, bench areas, and other work areas. Such machines should be isolated and laboratory policies must be established to keep students away from the infeed and outfeed areas when dangerous machines are in operation. Remember, that a general rule of thumb is to allow a minimum of three feet of space around each piece of equipment.

7. Group similar pieces of equipment together in clusters.

8. Organize equipment to take advantage of the best possible lighting.—Equipment and machines should be arranged at right angles to a natural light source but sometimes this is impossible.

9. Arrange equipment with housekeeping and maintenance in mind—Machines should be placed no less than twelve inches away from walls, partitions, and columns to permit cleanup and reduce the effects of vibration on structures.

IDENTIFYING AND PLACING UTILITIES

There are five utility services that are needed in most technical laboratories. They are electricity, water, gas, compressed air and telecommunications. Electrical service is by far the most important. Detailed, scaled floor plans and lists of equipment keyed to equipment placement, provides the basis for planning utility service systems.
Electrical Service

Every laboratory should be provided with 115 v single phase, 230 volt single-phase and 230 volt 3-phase electrical service. Motors larger than one-half horse power should be operated on 230 v service.

Machines and convenience outlets must be separated from each other and from lighting circuits. Each major piece of equipment installed permanently should be on its own circuit. No more than three convenience outlets should be on the same circuit and they should not be placed adjacent to each other. Convenience outlets should be mounted at a minimum of 42” off the floor. Outlets should be located on 8’-0” centers along walls. A waterproof exterior outlet should be located outside each overhead door of laboratories.

Power circuits in a laboratory should be controlled by a switch panel that contains one circuit breaker for each branch circuit and a master switch that controls the current to all branches. Each piece of stationary equipment should be controlled also by a switch box containing “off” and “on” magnetic type push-button switches, a circuit breaker, and a manually operated external switch that disconnects the motor from the circuit. An emergency cut-off switch, preferable the mushroom type push button should be strategically located on each wall so that an instructor will always be within 25 feet of the emergency cut-off switch. These emergency switches must be clearly marked and are to be activated only in case of emergencies.

All permanently mounted, electrically operated pieces of equipment must have its framework effectively grounded. Machines and equipment that are located away from the wall must have either underground service or be serviced through a junction box with rigid conduit securely braced and bracketed extending to the electrical control box of the machine.

Six types of electrical distribution systems can be useful in technical laboratories. They are rigid conduit, flexible conduit, metal raceways, underfloor raceways, bus ducts, and wireways. All are essential means of enclosing electrical conductors and leading them to the point of utilization. Rigid conduit should be used to enclose lighting circuits as well as convenience outlets. Flexible conduit should be used to connect electrical service to machines that vibrate. Bus ducts provide a very good way of distributing electrical current to stationary power-operated devices.

There are special electrical consideration in laboratories that utilize flammable liquids and gases such as explosion-proof switches and explosion-proof lighting fixtures. Other special electrical consideration is the installation of overhead recoil type extension cords for laboratories that use portable power tools.

Water Service

Water must be available in laboratories for drinking, washing, operation of urinals and toilets, emergency showers and for some equipment operation and processing. Water
service should ensure a constant supply, have a good distribution system and effective controls and an efficient drainage system. Water controls should use hand-operated valves at several points in the laboratory so that service does not have to be shut down for the entire laboratory to make modification to the supply system. Rigid copper pipe should be at least one inch in diameter and be joined with soldered fittings. All laboratory drains should be at least three inches in diameter but the preferred size is four inches. Each drain should be equipped with a gooseneck trap of some kind of cleanout trap. Underground drain pipe should be constructed of cast iron. One drinking fountain, preferable the refrigerated type, should be provided in the laboratory and when possible these fountains should be recessed in a wall. Of course all modern commercial buildings must have a sprinkler system installed for fire protection.

**Gas Services**

Some laboratories will be heated with natural gas and gas distribution systems must be carefully designed and constructed to ensure safety. Detailed floor plans should show the location of any needed gas service outlet. Welding laboratories in the past have utilized gas manifold systems that allowed acetylene and oxygen gas cylinders to be stored outside of the laboratory for safety reasons. Today, acetylene and oxygen cylinders secured to portable carts is the most common type of gas service for welding laboratories. Basically, oxyacetylene is primarily used for heating and cutting today rather than welding. Extra oxygen and acetylene gas cylinders should be stored in a fenced in, secure area outside the laboratory.

**Compressed Air Services**

Most laboratories can make good use of compressed air in a variety of cleaning, testing, finishing, and production activities. A compressed air system includes three important components: compressing machinery, a distribution system, and a variety of utilization devices. Compression machinery includes an air compressor, an electric motor or internal combustion engine, a drive system, a main storage tank with control devices, and a variety of protection devices. The pressure supplied by a compressed air system should be adequate to operate the device that has the highest pressure requirements. Compressed air is usually distributed through galvanized pipes assembled with threaded fittings or through rigid copper pipes assembled with soldered fittings. The size of pipe varies from three-quarters of an inch to and inch or two depending on the pressure demands. Generally pressures in the distribution system do not exceed 125 psi. Compressed air outlets should have control devices with filters to remove excess moisture and to regulate air pressure for utilization devices. Remember, air pressure cannot exceed 30 psi for cleaning purposed.

**Telecommunications**

Today another utility must be installed in a technical laboratory and that is telecommunication cables. Learning resource center that utilize computers will need access to the internet for learning. Intercom systems provide a convenient way for the
administration office to communicate with instructors. Some modern facilities use special cabling to hook computers to a centrally located printer in another part of the building and computers hooked directly to an automatic copy machine to duplicate instructional materials. Advances in technology will undoubtedly expand the use of telecommunication cabling.

**SUMMARY QUESTIONS**

1. What things should be considered when equipping a lab?
2. What things should be considered when setting up a lab work station?
3. List some common considerations when selecting machines, equipment, and power tools.
4. What factors should be considered when placing machines and equipment?
5. What should be considered when selecting suppliers for machines and equipment?

**SUMMARY**

One of the continuing challenges of laboratory instructors is to provide the training stations and equipment required to support the instructional program. These work stations and equipment take up floor space and must be arranged so that work can be done efficiently and safely. Most laboratories have several auxiliary areas such as tool and equipment rooms, storage rooms, and instructor’s offices that also must be considered in the laboratory layout. A three-step process of identifying furniture and equipment, safe operator zones round each piece of furniture and equipment and creation of aisles or traffic lanes is used to develop laboratory layouts. There are a number of considerations that go into the selection of tools and equipment and instructors must assist in developing equipment specifications to ensure that the quality of equipment purchased is similar to that used in the electrical trades and will last for many years with appropriate maintenance. Utilities such as electricity, water, and compressed air must be provided to operate equipment. Laboratory layouts are developed with input from instructors and submitted to architects who design the facility to accommodate an electrical trades program.

Many of the facility describing the following components: You should use the following items as a guide for developing your layout presentation.

(1). Size and shape of laboratory

(2). Description of each auxiliary area to include what will be in auxiliary rooms i.e. tools stored on silhouette panels, storage cabinets, on shelves, and in drawers.

(3). Description of what is adjacent to the four walls of the facility

(4). Description of traffic patterns in the facility
(5). Description of safety equipment and its location

(6). Listing of all major pieces of machines, equipment and furniture

7). General description of hand tools and other small pieces of equipment

(8). Description of general and special utilities and how they are to be controlled

(9). Description of any storage areas not already covered in auxiliary areas

(10). Description of the type and color of floors, walls, and ceiling in the facility

(11). Description of environmental devices such as heating, ventilation, and air condition along with locations of their controls

(12). Description of materials and supplies needed to operate the technical laboratory and instructional program for one year.
SESSION #4 DEVELOPING A LABORATORY MANAGEMENT SYSTEM

INTRODUCTION:

In the previous sections information was presented about how facilities impact learning and how to layout and equip a technical laboratory. In this session and the two that follow, information will be presented on how to set up and implement a management system that provided a safe and effective learning environment for students.

One of the major responsibilities of the instructor is to manage their technical facility and classes so that instruction is efficient and effective and students learn the attitudes, knowledge, and skills required to enter and be successful in electrical occupations. To do this instructors must develop specific management procedures for storing and distributing tools and materials, keeping records and reports on the instructional program and facility, and establishing routines and procedures for laboratory operation.

Disorganization is the instructor’s greatest enemy for it steals valuable time away from helping students earn and may lead to accidents. Instructors who fail to develop a management system that involves students will find themselves overwhelmed with daily responsibilities. Teaching will not be rewarding and students will not learn important organization skills they can use in their work and family life.

The purpose of this section is to help instructors understand the many duties and responsibilities that they have in setting up a management system that allows them to work effectively and students to develop competencies required to become successful workers.

RATIONALE FOR A LABORATORY MANAGEMENT SYSTEM

“Reasons Why Laboratory Management Is Important”

1. Fosters student learning
2. Facilitates instruction
3. Provides a safe learning environment
4. Investment in training is protected
5. Demonstrates professionalism of the instructor

A well-organized and managed classroom and laboratory can be a source of great personal satisfaction for instructors and a real asset to students as they work to learn the attitudes, knowledge and skills of the electrical field. A clean and bright classroom and laboratory with everything in its place, equipment and furniture gleaming from constant care, and students working on activities and moving about like clockwork by following
established routines and procedures may be the dream of every instructor. Technical classrooms and laboratories are expensive to equip and maintain and it is essential that they be managed well to protect the large investment in them and to ensure that they can be used to prepare future students for work. There are many reasons why good classroom and laboratory management is important. The following are some of the important ones:

1. Fosters student learning -- Probably the most important reason for a well-organized and managed classroom and laboratory is that it supports student learning. Students want to work in facilities that are clean, comfortable, safe, and stimulating. Students develop a sense of ownership and pride in a facility that they like and will work to help maintain classrooms and laboratories in great condition.

2. Facilitates instruction—A classroom and laboratory where equipment and furniture are in order, the environment is clean and comfortable, and students self-manage themselves by following routines and procedures facilitates instruction. In a well-organized and managed classroom and laboratory instructors can work effectively for they know where everything is and have instructional materials close at hand to deliver instruction in a timely manner. Instructors who have developed an effective management system will be able to work with minimum stress, maximum productivity and a minimum of wasted time and energy. They will derive a great deal of satisfaction from developing a learning environment that looks good and functions well.

3. Provides a safe learning environment—A well-organized and managed laboratory provides a safe setting for instructors and students to work. Laboratories are safer when equipment is maintained in good operating condition, tools are properly sharpened, floors are clean, benches and counter tops are free from unnecessary items, lighting is adequate, the environment is controlled, and everything is neatly stored.

4. The large investment of funds for training are protected—Technical facilities and equipment is expensive and administrators want to be sure that their investment in training equipment and materials is protected. They want to be sure that expensive equipment and supplies are well-managed and maintained so as to ensure years of instructional use and that every effort is made to control loss and damage.

5. Students learn good work habits and procedures—In well-organized and well-managed classrooms and laboratories, students begin to acquire an understanding of the responsibilities they have for maintaining their own work stations in the laboratory as well as on the job. They learn the expectations of employers on the job to keep work areas free of objects and waste materials that could present a safety hazard. If students are given the responsibility to actively participate in the management system, they will develop positive attitudes toward efficiency, craftsmanship, and the care of tools and equipment. They will also see firsthand how important organization is to the operation of an efficient work environment. In attractive, organized environments, students tend to enjoy learning and want to continue to work and learn in their occupation.
6. Well-organized and managed laboratories speak volumes about the instructor—The way that a classroom and laboratory is arranged and maintained is a reflection on the professionalism of the instructor. From time to time administrators and special guests visit the classroom and laboratory and they draw positive conclusions about the competence of the instructors when they find a pleasant, well-organized and well-managed classroom and laboratory.

MANAGEMENT DUTIES AND RESPONSIBILITIES

“Instructor Management Duties”

1. Developing a laboratory management plan
2. Managing the storage and distribution of tool and equipment
3. Managing the storage and distribution of supplies and materials
4. Maintaining auxiliary areas
5. Maintaining tools and equipment
6. Establishing routines for beginning class, monitoring learning activities, clean-up, and dismissal
7. Establishing and maintaining a filing system for program materials
8. Planning and implementing a student personnel system
9. Developing and implementing a safety inspection plan
10. Controlling the learning environment
11. Scheduling laboratory use
12. Developing a work station rotation system
13. Establishing and implementing an inventory system
14. Providing for student safety needs
15. Developing emergency and first aid procedures
16. Color coding the laboratory and laboratory equipment
17. Developing a personal time management system
18. Organizing for instruction

Technical instructors perform many duties and assume many responsibilities in the management of a laboratory. Technical facilities are expensive to build and equip and difficult to maintain. Instructors will spend a considerable amount of time in maintaining the laboratory so that teaching is effective, students can learn the skills of electrical workers in a safe environment, and security will be provided for equipment and supplies. The following is a list of major management duties and responsibilities of technical instructors:

MANAGING THE STORAGE AND DISTRIBUTION OF TOOLS AND EQUIPMENT

“Three Methods of Storing Tools”

1. Tool room
2. Tool crib
3. Open tool panel or lockable cabinets
One of the most frustrating management problems confronting instructors is the loss of tools and materials due to theft. Instructors would prefer to place students on their honor and allow them free access to tools and materials. It is hard to imagine that some individuals would take advantage of instructors by stealing tools but it happen unless reasonable precautions are taken. Tools and equipment need to be stored securely and there must be a supervised system for issuing tools and retrieving them at the end of class. There are three basic methods of storing laboratory owned tools: tool crib, tool room, and open tool panels or lockable cabinets.

**Tool Room**

- Room adjacent to laboratory large enough to store portable equipment and tools
- Room has a lockable Dutch door with a wide serving top on the bottom section
- Tools stored on silhouette panels and in other special storage devices such as unit tool boxes
- Room is managed by a student for an assigned time period
- Tool Room clerk performs maintenance on tools and equipment

The tool room is the preferred storage area for tools. This is a special room adjacent to the laboratory where adequate space is provided for the storage and issuance of tools. It is accessible by only one door and is kept locked unless someone is placed in charge of it like a tool room clerk. The type door used is a Dutch door that has a lower portion with a handle and lock with a top wide enough to lay tools on until they are processed. The upper part of the Dutch door also has a handle and lock and is usually kept open when a tool clerk operates the tool checkout system. Tools can be stored individually on silhouette panels and in other storage devices or in unit tool boxes equipped with necessary tools to do work at a specific work station. Tool rooms should have a stool for the clerk to use and a small tool maintenance bench with appropriate equipment and supplies for tool repair.

**Tool Crib**

- Fenced off storage area in the main laboratory with a lockable door
- Tools and equipment are visually displayed on silhouette panels or stored in other devices such as unit tool boxes

Tool crib is managed by an assigned student for a specific time period

The tool crib is a “fenced off” portion of a laboratory where tools are stored and issued to students. It is also kept locked unless someone is placed in charge of it during instruction.
Setting Up Tool Rooms and Tool Cribs

The preferred facility for storing tools and equipment is the separate tool room but when separate rooms are not available, tool cribs with heavy-duty wire netting is the best next alternative. The facility should be large enough to provide adequate shelving to store large or heavy tools and equipment, adequate wall space to install tool silhouette panels or tool cabinets, adequate lighting to see clearly every item, and a Dutch door with a shelf or a wire-mesh door with a window. The tool storage room must be secure from entry from the ceiling and have a locked door. Tool rooms and tool cribs should be centrally located in the laboratory.

The only way to maintain tight security of tools when the laboratory is in operation is to assign a student as a tool room clerk on a rotating basis. The tool room should have a chair or stool for the clerk to be comfortable when not issuing tools. Provisions must be made to enable the tool room clerk to maintain records of inventory and checkouts.

There are several methods of storing tools and equipment in tool rooms and cribs. The most common are as follows:

1. Unit tool boxes
2. Tool silhouette panels
3. Tool cabinets
4. Tool bins and drawers
5. Shelving to lay out individual tools and equipment

Each storage device has some advantages and disadvantages. The most troublesome problem is security and the ability to do an instant visual inventory of tools and equipment. Tools issued in unit tool boxes must be checked out and inventoried on each return. This is a time-consuming process and it is easy to overlook small items such as sockets. In addition, unit tool boxes may contain a number of tools that are not required for the assigned work activity. Such a system removes tools not in use from service, thus requiring a larger supply of tools. The tool cabinets have the same visual inspection disadvantages as tool boxes unless they can be opened in such a way as to display the contents without blocking the view of other stored tools. Tool bins and drawers group all similar tools of the same type in a batch and a quick inventory of tools stored this way is nearly impossible. Laying out tools on a shelf requires more space than is usually available and visual inspection is difficult. The tool silhouette panels require a large amount of wall space.

The most efficient method is the tool silhouette panel. Tools can be visually inspected and tool checks can be used as a control device very effectively. Large or heavy tools and equipment can be openly displayed on shelving. The effectiveness of tool silhouette
panels centers on visual inspection of every tool which has a designated space on the panel with a painted silhouette of the tool to be stored. Disadvantages of the silhouette panel system rest in the amount of space required to display a sufficient number of tools for twenty or more students working on work stations or projects. There is also a moderate cost involved in buying or making silhouette panels. It takes time to paint the outlines of tools and to install hooks or other storage devices.

The next most effective method uses shelving to lay out individual tools and equipment. Tools and equipment are placed in a specific location on shelves and the shelves could have painted silhouettes on them to facilitate visual inspection. Shelves could also have specially constructed holding devices for tools with sharp cutting knives such as a power plane or a router with bit installed.

**Open tool panels or lockable cabinets**

- Open tool panel where silhouettes or tool outlines are painted on peg board or plywood panels to store tools
- Cabinets with lockable doors that open up to display silhouetted tools
- Both open panels and cabinets are strategically located in the laboratory to reduce the amount of time to obtain tools and equipment.
- Honor system is used to distribute tools but instructor checks panels and cabinets at the end of class.

Open tool panels or cabinets are specially constructed panels or storage cabinets that store necessary tools for instruction. They are usually located strategically in the laboratory to reduce the amount of time involved in securing tools. Panels and cabinets use silhouetted tool outlines for quick visual check of contents.

**Student Owned Toolboxes**

- Students purchase a set of basic hand tools and meters with their names placed on them
- Tools may be stored in labeled tool boxes, tool buckets or in tool bags
- Tools usually brought to Lab daily, but can be stored in student lockers or in a separate room on occasion.
- Both laboratory and student owned tools and equipment must be engraved for identification and color coding is recommended for visual identification

Another option for tools and small equipment storage is in tool boxes owned by students and kept in their lockers, their vehicles or stored in the tool room in a special place. Adult electrical occupation students will probably be required to purchase a set of basic tools and small equipment like meters because they will need them in order to enter employment. Students that are in formal apprenticeships will most likely have a set of basic hand tools and equipment for they work during the day in electrical occupation jobs.
and attend related classes in the evenings at the training center. If students can afford to purchase their own hand tools and small equipment, a new problem is introduced in a laboratory situation and that is keeping tools separated from tools provided in the laboratory and other students’ tools. If student can bring their own tools they should be required to keep their tools and equipment together in labeled tool boxes, tool buckets or tool bags. In addition they should engrave their names on all tools and some will elect to paint special colors on their tools for easy identification. Tools and equipment that belong to the laboratory should be engraved with the name of the training center and color coded as well.

Managing Storage and Distribution of Tools

“Two Methods for Storing and Distributing Tools”

- Use the honor system  (Not recommended)
- Use a tool room clerk or tool room director

There are two main methods used by instructors to manage the storage and distribution of tools and equipment. One method is to permit free access to tools using the honor system. The second is to utilize a tool clerk or a tool room director.

The free access (honor system) has been used successfully by some instructors, especially when tools are placed on silhouette panels that allow the instructor to do a quick visual check at the end of class before students are dismissed. However, this method has been troublesome for many instructors because of poor control and is not recommended.

“Tool Room Clerk Responsibilities”

- Issue and retrieve all tools and equipment and maintain records
- Learn the name and functions of all tools and equipment
- Inspect and maintain tools and equipment in good working order
- Learn how to assume and manage an assigned responsibility

The second method of using a tool room clerk or director is the preferred method of storing tools and equipment. The tool room clerk is responsible for all tools and equipment kept in the tool room, tool crib or in panels and cabinets. The tool room clerk is provided with an opportunity to study the names and uses of tools and equipment in his or her care. The tool room clerk also can be asked to inspect tools and equipment and to recondition tools and equipment when needed. The tool room clerk has the opportunity to experience firsthand an effective and efficient system for handling and accounting for tools and equipment.

There are times when an instructor becomes very sensitive to principles and practicalities of organizing and operating tool and equipment storage rooms, tool cribs and panels and cabinets. These occasions are:
1. When tools and equipment are lost or stolen because of poor housekeeping or management practices.

2. When valuable instructional time is being wasted because of inefficient operation of tool storage systems.

3. When a new laboratory is being added or revamped and is being used by more than one instructor daily.

Tool Room Management Considerations

“Five Tool Room Management Considerations”

1. Checking tools and equipment in and out effectively
2. Method of maintaining record of who has what
3. Security of tools and equipment
4. Monitoring the inventory of tools and equipment
5. Repair and maintenance of tools and equipment

The development of an efficient system for managing tool rooms and cribs requires careful thought by instructors. There are five main considerations that help shape an efficient management system. These are:

Tool and Equipment Check Out Systems

The most efficient system for storing tools, including using silhouette panels, will be useless if a system of checking in and out items is not developed and enforced. Imagine the following situations:

1. Where students are free to wander in and out of the tool room or tool crib with no constraints or supervision;

2. Where the tool room clerk is not held accountable for missing items at the end of class;

3. Where blame for missing items is contested by both the student assigned the tool and the tool room clerk; and

4. Where funds are limited and missing and lost tools and equipment cannot be replaced until a new budget year.

In an effective tool control system, no student is permitted access to the tool room except the authorized tool room clerk, and then only after he or she has received instruction for operating the tool room and is given total responsibility of everything in it and made accountable for any tools or equipment which turns up missing. Basic to an effective system of tool and equipment control is the need to be able to visually and quickly
account for everything in the tool room, tool crib, and tool panels and cabinets. Three fundamental methods are in use to do this. These are the paper-pencil method, a variation of the pencil-paper method, and the tool check method.

“Three Tool Checkout Systems”

1. Pencil-paper system
2. Modified pencil-paper system
3. Tool check system

Pencil-paper/computer Method

“Pencil-Paper System”

- Clerk issues tool request form to student who completes paper or computerized tool/equipment request form
- Clerk retrieves tool and gives to the student then maintains written request form on some holding device or saves in a computer file until tool is returned
- When tool is returned, clerk initials form or computer screen and saves request information for a check by instructor
- Instructor checks with clerk on tool return status and does a visual inspection of the tool room at the end of class

In the pencil-paper/computer method the student list his or her name on a tool/equipment request form in custody of the tool room clerk that has the student’s name, class, name of tool or equipment, quantity, estimated time of use, time issued, time returned, and a place for the student requesting the tool to sign their name or initial and a place for the tool room clerk to do the same. The tool request form is maintained by the tool clerk on a clip board or some other type of holding device or electronically if the processes is computerized. A sample tool/equipment requisition form is shown below.
When the student returns the tool, the tool room clerk initials the form indicating that the tool was returned. A visual check of silhouette panels and shelves can identify any tools not returned which is a check against the clerk’s accuracy in processing request forms. This system requires students to spend a few moments in recording information about the name and size of tool or piece of equipment which often results in students lining up to get the tools they need at the beginning and end of class. This situation results in lost instructional time daily. One advantage of this tool distribution system, however, is that students must know the names of tools and tool sizes and it encourages them to develop a list of the tools they need before they approach the tool room clerk. It is an important skill for workers to plan ahead for the tools and equipment needed for a work task.

### Modified Pencil-paper/Computerized Method

- Students complete card-type request forms found in box outside of tool room and request tools
- Clerk issues tool(s) and files card in student locator file
- Clerk retrieves tool card when tool is returned and initials it
- Tool request card is filed for record of tool usage

Instructor checks on tool return status from clerk and does a visual

The second system for issuing and retrieving tools is a variation of the pencil-paper method. Rather than the tool room clerk issuing tool request forms, a box is situated outside the tool room that holds tool request cards (2” X 4” or 3” X 5”) that are preprinted with a space for the students name and/or number, and space for describing the tool, tool size, and estimated time the tool is needed. A space is also included on the tool request card for the tool room clerk to acknowledge that the tool was returned. The
completed tool request cards are presented to the tool room clerk who fills the order. The tool request cards are stored in a student locator file (for easy retrieval) or cards can be stored in pockets located near the tool storage site if an individual card is filled out for each tool. If a computer is used in this system, students complete the computer form and prints it out to give to the tool room clerk. The student requesting the tool saves the tool request form in their file folder which makes it possible to a running list of the tools checked out to a given student.

When the tool is returned the clerk signs his name or initials on the tool request card and deposits them in a box for a permanent record of who had what tool each day. Like the pencil-paper method, instructors can visually check tools on silhouette panels and shelves as well as check to see if any cards are still in pockets near the missing tools or in the student locator file. The tool room clerk can be easily cleared at the end of the class.

**Tool Check Method**

- Student is given a set of numbered metal or metal bordered paper tags each period
- Student request tool from clerk and surrenders a tag that is placed on a metal pin or in a cup near the tool issued.
- When tool is returned, clerk returns the tag so that the set of issued tags can be returned to the clerk and reported to the instructor.

The third method utilizes a tool check which is a distinctive metal tag with a hole punched in it and the school’s name and a number stamped or engraved on it in such a way that makes duplication unlikely. Students are assigned a number and instructors make at least ten numbered tags for each student in a class. These tags are clipped together on a large safety pin or curtain hanger and issued to students by the tool room clerk at the beginning of each period daily. At the end of the period or class, all checks must be accounted for by the tool room clerk and returned to a numbered storage panel or box.

Whenever a student needs a tool, a request is made verbally to the tool room clerk and the tool is exchanged for a metal tag which goes on a metal tag screw or nail next to the tool or in a cup adjacent to the tool. Upon return of the tool, the clerk returns the numbered tag to the student so that the student can turn in clipped metal tags to the tool room clerk at the end of the period. The number of tools that can be checked out at any one time is controlled by the number of metal tags available. Some instructors use a key tag which is a round paper tag with a metal frame on which the name of the school and number are printed. Obviously the tool check system is much more efficient and all but eliminates the problem of students congregating at the tool room door for extended period of time and it does not require printed consumable materials.

Occasionally the use of tool kits or boxes is the preferred method for issuing tools. The metal tag system can be used to check out these tool kits and boxes but the tool room clerk must be sure that all boxes are checked to be sure all listed tools are contained in them when they are checked out and again when they are checked in. It is a good idea to
use some type of paper document for each student to acknowledge that the tool box was complete when it was issues and complete when it was returned.

**Tool Room Clerk Responsibilities**

- Issue tool request forms and tags
- Issue and retrieve tools using the check system
- Become familiar with names and functions of tools
- Inspect tools and do minor maintenance when needed
- Engrave or color code new tools not already marked
- Check the inventory of tools and equipment

Regardless of the tool check out system selected, the tool room clerk is a key player in making the system work. At first students resent being assigned to the tool room for a time period for they claim that their time is wasted as they watch others engaged in learning activities and projects. This will certainly be the case if the instructor does not make this assignment a valuable learning experience. Assuming responsibility for the distribution of tools and equipment is a valuable learning experience in itself. Tool room clerks will be very busy at the beginning of class and at the end of class; but what will they do with the idle time in between?

Students need to spend time getting familiar with the names of tools and equipment. They can be given tool catalogs so they can become familiar with the tools available for electrical workers. Students can also learn how to inspect tools and equipment for damage, corrosion, or for dull cutting edges. Such maintenance functions as removing rust on tools, cleaning files that are clogged, sharpening drill bits, replacing brushes in power tools, lubricating tools, painting tools, and others can be performed by the tool room clerk with a little instruction. New tools need to be marked or engraved with the school name on them and some instructors color code tools to make sure that they belong to a certain laboratory when multiple laboratories are available in a facility. It is a good idea to color code tools in a tool box which makes visual inspection much easier and discourages students from substituting another student’s tools for ones they have lost or stolen.

When students spend time inspecting and maintaining tools and equipment, they are learning valuable skills which will pay off in later years. As students stay busy with tool room duties, time passes more quickly. If all maintenance duties have been completed, students can always work on their reading or planning assignments. Some rearrangement of the tool room may be necessary to facilitate tool and equipment maintenance. For example, a small bench or table with a grinder placed on one end will be necessary to sharpen tool edges. Of course fine cutting edges will need to be honed with whetstones or other sharpening devices. Some tools will need to be held for maintenance and the bench could also be equipped with a vise. Perhaps the most important consideration is to develop a repeatable tutorial lesson that can help the tool room clerk learn his or her duties and responsibilities.
MANAGING MATERIALS AND SUPPLIES

One very important responsibility of instructors is to manage materials and supplies. This involves the tasks of:

- Ordering the right types and sufficient quantity of supplies and materials
- Storing and distributing supplies and materials tools in systematic manner
- Keeping a running inventory of supplies and material on hand to support instruction.

One very important responsibility of laboratory instructors is to manage materials and supplies. Instructors in most technical laboratory programs must order, store, distribute and keep a running inventory of a wide variety of supplies and materials and this would certainly be the case in an electrical occupations program. It is important that an adequate amount of consumable supplies and materials be on hand at all times to support instruction. If this is not the case, then students’ instructional time is wasted and instructors are forced to change instructional plans. One way to ensure that an adequate amount of supplies and materials is on hand is to keep a running inventory. Instructors should ensure that an inventory of supplies and materials is done at the beginning of a course and again at the end of a course. Then they need to implement a system requiring students to complete requisition forms identifying the supplies and materials needed for learning activities or projects. These requisition forms can then be used to keep a running inventory of the supplies and materials on hand and provide a record of consumption for a course.

Identifying and Ordering Supplies and Materials

“Considerations for Ordering Supplies”

- Review instructional materials to identify needed supplies and materials
- Realize that student learners will make mistakes so include a 10% waste factor
- Include the materials that instructors will consume when demonstrating tasks
- Check budgets and funds available for obtaining supplies
- Check policies for charging students a fee for consumable supplies

Instructors must review their course planning materials like syllabuses, courses of study, unit plans, lesson plans, and instruction sheets (assignment and project) to identify the consumable items needed to support instruction. They will have to consider the maturity and experience level of students and the number of students in the course to determine the quantity of supplies and materials needed. It is important to realize that students are learners and not experienced craftsmen and they will waste or damage some supplies and materials. The rule of thumb for increasing the quantity of supplies and materials needed to compensate for damage and waste is to add 10 percent to the order or requisition. One other factor to consider is that some supplies and materials will be consumed by the instructor as he or she develops instructional materials and demonstrates how to do the tasks of the electrical occupation.
Instructors will need to check with their supervisor or administrator to find out the exact procedures for obtaining supplies and materials. It is important to review any budgets that have been developed to support the instructional program. Instructors need to consider the following questions that govern obtaining supplies and materials:

1. What funds are available for the purchase of instructional resources?

2. What policies govern the collection of student fees and the selling of supplies to students for items that will be taken home?

3. What policies and procedures exist for charging customers for service work?

**Supply Forms**

**“Supply Form Information”**

- Name of item
- Quantity required per student
- Quantity needed per course or term
- Quantity on hand
- Quantity to be ordered
- Vendor information
- Unit cost and total cost

Most technical institutions or training centers will have a form for ordering supplies and materials like the one shown below. If they need to develop one, the following information will need to be included on the form.

**SAMPLE PROJECTED SUPPLY FORM**

Program: ______________________ Course: ________________ Time Period: ____________

Instructor: ______________________ Date: __________ Number of Students: ____________

<table>
<thead>
<tr>
<th>Item</th>
<th>Required Per Student</th>
<th>Quantity Needed Per Term</th>
<th>Quantity On Hand</th>
<th>Quantity To Be Ordered</th>
<th>Vendor</th>
<th>Unit Cost</th>
<th>Total Cost</th>
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</table>
Instructors need to identify and maintain a file of vendors or companies that can fill orders for the supplies and materials needed for the electrical program in a competitive and timely manner. Supplies and materials represent a substantial part of the budget for a technical training program and therefore it is essential to control how supplies and materials are issued to students and to eliminate or substantially reduce the misuse or indiscriminate use of supplies and materials.

Storing and Distributing Supplies and materials

“Storing Supplies and Materials”

- Ideally, supplies and materials should be stored in lockable rooms or cribs
- Storage rooms will need a variety of storage devices (racks, shelves, bins, drawers, transparent top plastic boxes, spools, etc.)

Special storage racks located on a wall will be necessary

To control supplies and materials instructors need to have a secure place for storage. An ideal storage space for supplies and materials is one that can be controlled and can be behind a locked door or wire mess cage. For some long items such as conduit or pipes, it may not be possible to store these items in a secure room but they can be stored in areas where only the supply clerk is cleared for access. Some instructors have developed storage racks along the wall for long items and have constructed a wire mess cage around the base of the rack with a locked gate for security.

A supply room, like the tool room, will need a variety of storage devices including vertical and horizontal racks, shelving, cabinets, drawers, metal bins, plastic topped storage box with partitions for storing small items like wire nuts, bolts, screws, etc. Electrical cables may be stored in coils on shelves or stored on spoils that allow cable to be removed and measured as needed. Flammable materials and solvents must be kept in an approved container in a ventilated area. Oily rags must also be kept in approved containers and in a ventilated area. Waste materials are not to be overlooked in organizing for material storage. Electrical conductors that are no longer long enough for projects should be kept in containers to be recycled.

“Distributing Supplies and Materials”

- Students need to complete requisition forms for supplies and materials much like they do in requesting tools.
- A student clerk needs to distribute and maintain records of supplies and materials issued by compiling requisition forms to keep a running inventory.
Consider that few employees on the job are given access to material and supplies and permitted indiscriminate use of anything they want. If instructors want to prepare students to be good employees and economize on the use of supplies and materials, they need to help them develop the practice of using materials efficiently in the laboratory. Students need to learn how to request the supplies and materials they need just like they needed to request tools and equipment. Instructors need to develop and implement a supplies and materials requisition process that also provides a way to account for the items issued to students. The first step is to develop a requisition form that provides space to record the quantity to be used, a description of the supply or material item, a unit cost per item, and the total cost per item. A sample supply and material requisition form is shown below.

**SUPPLY AND MATERIAL REQUISITION**

Name _________________________________ Period or Class ____________________

Course _______________________________ Project/Activity ____________________

<table>
<thead>
<tr>
<th>Quantity Needed</th>
<th>Unit</th>
<th>Description</th>
<th>Unit Cost</th>
<th>Total Cost</th>
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It is important to teach students the approximate cost of supplies and materials so that they will be able to estimate electrical repair or installation jobs. Instructors will need to develop and maintain a unit cost for each supply and material item needed for activities and projects. Students can then look up the unit cost of each item they need and place it on the requisition form. If a requisition form such as the one shown above is used, a perpetual inventory of supplies and materials is possible. The form could be printed on a sheet of paper or on 3 X 5 cards and completed forms could be stored in a loose-leaf notebook or in a card file. Of course the forms could also be completed on a computer if one is available and stored in a designated file folder.

Periodically completed requisitions are posted to lower the inventory of supplies and materials. When new purchases of supplies and materials arrive, the supply room clerk raises the inventory count for each respective item. When the inventory count reaches a predetermined level, a new purchase order or request is submitted following procedures established by the training center administration. The process of supply and material inventorying will be presented in greater detail in session five.

**Storing Student Projects and Control**

“Considerations for Storing Student Projects”
- Student’s locker if the project will fit
- Secure room or crib where other students can not access another student’s work
- On-going large projects in the laboratory such as wiring assignments must be scheduled carefully so that no other student can work on them until they are completed
- Special marked storage containers for parts coming off work in progress
- Live work policy for any work brought into the laboratory or work outside the laboratory

Electrical Trades students must learn to do a wide variety of instructional tasks and Instructors try to simulate industry conditions with in-house projects and bench work for beginning students and eventually “life work” projects for the faculty, student body, or from the community as regulated by administrative policy. Instructors must consider how to provide storage and security for incomplete student work and for projects. Two problems must be addressed. One is concerned with where the in-school apparatus that students are working on can be stored securely so that tampering, robbing of parts, and intentional or incidental abuse by other students does not occur. The second problem is how to store apparatus that is brought in from outside sources that has value to the owner and is to be returned when it has been repaired or reconditioned.

Beginning students rarely have the knowledge and skills that instructors would deem necessary for them to do competent work on apparatus brought in by the public. Fundamental logic should dictate that skills are best learned in uncomplicated and perhaps in less-than-total service and repair activities. This means that instructors must devise training apparatus and projects for in-school use. One type of apparatus is to use electronic trainers that are capable of performing many different functions. Eventually, however, students need to apply their knowledge to actually perform manipulative procedures on apparatuses that simulate real-world conditions.

Whether the student is working on an in-school apparatus or on a “life work” item brought in from the community, instructors need to devise a plan that insures that whatever activity a student starts on, he or she should have the opportunity to finish without being hampered by interference of others. Ideally, the best place to store apparatus used in on-going learning activities is in the student’s locker if it will fit but the next best option is to store it in a separate, locked room or fenced in area. For very large appliances or equipment that cannot be stored in locked rooms or cages, instructors will have to establish rules that prohibit students from accessing this apparatus during class time unless they are assigned to work on it. Of course such items should be locked inside the laboratory or in a fenced in, covered area outside of the laboratory.

Incidental to the problem of keeping apparatuses secure is to provide safe storage for parts and bolts and nuts which come off the apparatus. Parts lying around invite both intentional and unintentional tampering which can disrupt a student’s progress in completing the learning activity. Small parts not properly stored can easily be lost during clean-up of the laboratory if they are left on benches or fall to the floor.
The use of in-school apparatus is a matter of making sure that two or more students are not assigned to the same item at the same time unless they are assigned to do team work. Of course, instructors will need to check student work to be sure that the apparatus is functional when the student(s) completes the work. If “live work” activities are allowed, instructors need to accept these projects only when students are capable and the time is right for them to practice on things brought in from outside the school. In the case of “life work”, instructors usually need to provide specific directions as to what students are to do, monitor their progress closely, and check and double check the finished work. Most instructors who accept “live work” require the client to complete a live work form that states that the work will be performed by students and it is subject to errors. The form also states that the client must pay for all parts that are used in the repair, plus a laboratory fee to take care of incidental items such as lubricants, nuts and bolts, paint, etc.

MAINTENANCE OF LABORATORY EQUIPMENT

Reasons for Maintaining Equipment

“Reasons for Maintaining Equipment and Tools”

- Equipment and tools must be in good working condition to do quality work
- Equipment and tools not in good condition can result in accidents
- The professionalism of an instructor is revealed in how tools are maintained

If students are to learn the skills of the electrical occupation to the best extent possible, the tools and equipment of the laboratory must be in good working condition. Craftsmen can not do good quality work with tools and equipment in poor condition and neither can students. It is important for instructors to model professional behavior at all times and this is especially true when it comes to how they select and maintain tools and equipment. The old saying “a dull tool is a dangerous tool” is a true statement. The safety of the instructor and students can be compromised if electrical wiring is old and frayed, machine parts are broken or missing, or tools are not maintained in good working condition. When tools and equipment are kept in top shape, students’ attitude toward the care and use of tools will be positive and they will want to learn how to maintain this equipment themselves.

“Instructor Duties for Equipment Maintenance”

1. Make regular inspections of all tools and equipment in the laboratory
2. Develop a schedule for regular care of laboratory tools and equipment
3. Establish a plan for the repair of tools and equipment
4. Involve students in the inspection, maintenance and minor repair of tools and equipment

Instructors need to establish routines and procedures for the regular inspection and maintenance of tools and equipment. Certainly instructors should include information about the care and use of tools and equipment when they are demonstrating their use. But that alone will not be enough to ensure that tools are properly cared for. There are a number of duties that instructors must assume in maintaining laboratory tools and equipment. These are as follows:

**Inspecting tools and equipment**

One of the instructor’s duties is to inspect laboratory tools and equipment regularly and frequently. For tools and equipment that present a hazard, this may mean daily inspections. For example, if an oxyacetylene cart is part of the laboratory equipment, daily inspections of gauges and hoses is in order. For other tools and equipment, a weekly or monthly check is all that is required. If everything appears to be in order, no special care may be needed until the next scheduled maintenance service check. However, if problems are detected, they should be dealt with immediately. If it is power equipment, it needs to be taken out of service and an out-of-service safety sign or tag that has white letters printed on a safety blue background should be visible on the equipment. Instructors will have to draw on their own experience to determine how often routine maintenance checks need to be made, how thorough they need to be, and what parts need to be inspected.

**Provide for Routine Care of Tools and Equipment**

*“Considerations for Routine Care of Equipment”*

1. Regular cleaning of tools and equipment
2. Lubrication of tools and equipment according to manufacturers’ recommendations
3. Minor adjustments and calibrations
4. Replacement of disposable parts such as air filters on air compressors
5. Sharpening of cutting edges on tools and equipment
6. Re-painting of tools and equipment to maintain color codes

A second major duty of laboratory instructors is to provide routine care for laboratory tools and equipment. The purpose of routine maintenance is to prolong tool and equipment life, prevent breakdowns, and keep tools and equipment in working order. This is often called “preventive maintenance” because it focuses on preventing wear and equipment failure. Routine care includes the following things:
Usually manufacturers’ of each tool or piece of equipment will have worked out a maintenance schedule and will provide detailed maintenance instructions in the operations manual. It is very important that instructors maintain a file on each tool and piece of equipment in the laboratory. Some pieces of equipment have strict requirement for maintenance such as air tools that require lubrication before use or air compressor tanks that have to be drained of moisture on a scheduled basis.

Making Minor Repairs to Tools and Equipment

“Considerations for Making Minor Repairs”

- Keep a file of manufacturer’s information on all tools and equipment
- Have available lubricants, cleaning supplies and sharpening tools
- Keep a supply of parts and items that frequently need to be replaced on equipment
- Teach students how to perform minor repairs on tools and equipment

Even when tools and equipment are well maintained, some items will breakdown and minor repairs will be needed to keep tools and equipment functioning. For example, guards will stick, switches will become defective, lamps will burn out, cords will become snagged or frayed, air nailers will get jammed, and belts will break. It is frustrating to students who want to complete their learning activities but cannot do so because some piece of equipment or tools they need is out of order.

Instructors who have the knowledge, skills, and experience can make minor repairs or if they lack this expertise, need to have a plan for getting tools and equipment repaired in a timely manner locally when possible. In order for instructors who are qualified to make minor repairs, they need to have spare parts for items that need them on hand. For example, instructors should maintain an inventory of fuses, lamps, switches, drive belts, brushes, hoses, hose fittings, etc.

Making Major Repairs

“Considerations for Making Major Repairs”

- Keep a file of tool and equipment manufacturers and service providers
- Write a requisition for repairs
- Contact the service provider and arrange for service
- Check the service performed to be sure equipment is repaired correctly

Making arrangements for major repair of tools and equipment is the instructor’s responsibility, though the repair work is almost always done by a factory trained technician or qualified outside service personnel. The instructor must maintain a file of tool and equipment repair service providers, write a requisition for repairs, call the service provider, and check to be sure the repair was done satisfactorily. Some educational institutions enter into a yearly contract with a commercial firm for service to
major pieces of equipment but this is usually on general laboratory equipment such as water fountains, water coolers, heating and air conditioning units, etc.

Involving Students in Inspecting, Maintaining and Making Minor Repairs to Tools and Equipment

“Instructing Students in Tool Maintenance”

Instructors need to teach students how to do the following maintenance tasks:

- Inspect tools to be sure they are in good condition and operating properly
- Lubricate moving parts such as guards, fences, sliding parts, etc
- Remove corrosion from tools and equipment
- Sharpen tool bits, drills, blades and cutting edges
- Repaint tools
- Replace power cords plugs
- Store tools and power cords correctly

Instructors of electrical occupations should include students in the maintenance and repair of tools and equipment for they will be expected to perform these tasks on the job. If students are trained in how to inspect, maintain and make minor repairs to tools and equipment, they will develop desirable work habits and attitudes toward care of their tools and equipment. There is a saying that “you can tell a craftsman by the way he or she cares for their tools” and this is often a very true statement. Craftsmen take pride in their tools and equipment and spend time maintaining them so they work properly and keep on working.

In the discussion of responsibilities for tool room clerks, information was presented regarding inspecting, cleaning, re-painting, lubricating, and sharpening tools. All students in the electrical trades should receive instruction in the care of tools and equipment and at least be able to tell the difference between a tool that is functioning properly and one that is out of adjustment, overstressed, damaged or dull.

Developing a Maintenance Schedule

“Developing a Maintenance Schedule”

- Prepare a list of all tools and equipment needing regular maintenance
- Review manufacturer’s information to determine maintenance requirements for tools and equipment
- Prepare a maintenance record for tools and equipment needing regular maintenance
- Develop a maintenance schedule and plan for maintaining tools

Technical laboratories have many tools and pieces of equipment to maintain and tool care will be more efficient and effective if a scheduled maintenance plan is prepared and implemented. To do this, instructors need to prepare a list of all tools and equipment that
require regular maintenance. For each tool or piece of equipment, prepare a maintenance record with a description of the maintenance service requirements that indicates the service interval (e.g. maintenance required before use, maintenance required once a week, etc.). Instructors will need to consult their manufacturers’ operating instructions for maintenance information. The maintenance schedule sheet should also have a space for recording when the last service was performed on each tool or piece of equipment and who did it. Other information on this form could be the manufacturer or vendor who provided the equipment with names and addresses of who to contact for service. The maintenance plan should identify who is responsible for performing maintenance such as instructors, students, school maintenance personnel, and commercial firms. Finally, instructors would find it helpful to establish a budget for the maintenance and repair of tools and equipment as well as replacement when the life of the tool or piece of equipment is reached. A sample maintenance record/inventory is shown in the form below:

**MACHINE.TOOL/EQUIPMENT MAINTENANCE RECORD & INVENTORY FORM**

**Tool/Equipment Maintenance Record and Inventory Form**

**Tool or Equipment Item**

**Type**__________________________ **Size**__________________________

**Manufacturer**

**Manufacturer’s Address/Phone/Web Address**

__________________________

__________________________

**Serial No.**_________________ **Model No.**____________________

**Company Where Item Was Purchased**

**Company’s Address/Phone/Web Address**

__________________________

Purchase Date______________ Cost________

**Maintenance Schedule and Record**

<table>
<thead>
<tr>
<th>Date Service is Needed</th>
<th>Date Service Performed</th>
<th>Service Needed</th>
<th>Service Performed</th>
<th>Serviced By</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
Involving Students In Managing Laboratories

“Benefits of Using a Student Personnel Organization”

1. Develops initiative in students
2. Develops self-control
3. Develops a sense of responsibility
4. Increases interest in laboratory activities
5. Develops dependability
6. Develops pride in work
7. Teaches observance of lines of authority through experience in delegated responsibility
8. Develops cooperativeness
9. Develops perspective
10. Develops diplomacy

Instructors want to maintain a clean and fully functional laboratory and this requires the active participation of students. It would be difficult at best for instructors to assume all of the responsibilities for distributing tools and materials, monitoring student learning, and cleaning up the laboratory at the end of class. In technical laboratories many activities are occurring at the same time, a student personnel organization is almost a necessity if effective instruction is to occur. Many instructors believe that maintaining a clean and orderly work station is part of the job that students will perform once they are employed. They content that students should learn the work habits expected to be demonstrated on the job while they are in the classroom and laboratory. Some of the responsibilities they will have to assume on the job include caring for tools, keeping their work areas free of hazards and orderly, working cooperatively with others, and preventing waste of supplies. A student personnel organization provides many benefits to students and instructors. The following list contains many of the most obvious benefits:
“Benefits of Using a Student Personnel Organization”

11. Relieves instructor of minor duties
12. Emphasizes the value of honesty and integrity in everyday affairs
13. Makes proper use of the competitive spirit
14. Increases outside employment possibilities
15. Brings out the need for using trade terms correctly
16. Discloses weaknesses of individuals
17. Develops leadership skills
18. Develops judgment
19. Develops supervisory and administrative ability
20. Aids substitute instructors to conduct regular laboratory activities

Considering the list of benefits above is easy to see that instructors who plan and implement a student personnel system are actually providing a valuable learning experience for their students in that they can learn some of the general responsibilities of their occupation and they can develop some specific management skills. When rotated among management positions, students learn firsthand laboratory management skills and develop a feeling of personal and group responsibility and solidarity. If all students are assigned specific management duties, the duty of any one student will not be a burden. For example, when several students are assigned to clean floors, no one student will have to clean more than a portion of the laboratory.

“Two Ways to Clean Up the Laboratory”

- Have all students pitch in and clean up the Laboratory at the end of class
- Implement the student personnel organization (PSO)

Students can participate in laboratory management in two basic ways. They can take measure responsibility for routine laboratory cleanup of the laboratory at the end of the class period with everyone pitching in to help and they can participate in personnel positions that are part of the day-to-day running of the laboratory. Some instructors of adults feel that all that is needed is to inform the class what needs to be done and adult students will voluntarily pitch in and do what is needed. Experience has shown,
however, that some adults will not fully participate and do their part which causes resentment among other students. Adults actually prefer to know what is expected of them and they respond favorably to a personnel management system.

In establishing a personnel organization for managing the laboratory instructors will have to identify the cleanup and maintenance duties in which they want their students to participate. The following duties are typical for most technical laboratories:

“Clean-Up Duties”

1. Clean major pieces of equipment and machines
2. Replace small tools, instruments, hand operated power tools, small equipment such as meters, and other devices in designated storage areas like tool and supply rooms
3. Put away supplies and materials in proper storage areas
4. Straighten out storage areas for bulk materials (i.e. materials kept in large quantities such as conduit)
5. Clean work surfaces such as counters, benches, tables, cabinets, etc.
6. Put away and store student projects
7. Check and organize the library or reference center in the classroom and laboratory
8. Clean wash areas such as sinks, water fountains, and bathrooms
9. Shut down special equipment such as heating devices, air compressors, computers and other continuous operating equipment when required
10. Provide maintenance on small tools, equipment and instruments
11. Secure all valuable or hazardous materials and supplies
12. Check floors and aisles for any unsafe conditions such as items obstructing a walkway or water on a floor
13. Sweep floors or scrub them with a mop if needed
14. Vacuum-clean or dust light fixtures, window sills, etc
15. Oil or wax bare metal machine surfaces to prevent corrosion if the laboratory will not be in operation for a week or more.
16. Perform a safety inspection of the classroom and laboratory
17. File any printed materials such as instruction sheets, equipment operation manuals, code books, etc.

In some facilities the regular custodial staff performs certain classroom and laboratory cleanup duties so instructors will have to go over the list of duties with them to determine which of them they will do. Most instructors do not want custodial staff to have access to tool and supply rooms because they do not want people who have not been trained to use tools and equipment or to deplete the inventory of materials that is intended for instruction. One of the challenges of instructors is to devise a system that distributes cleanup and management tasks fairly and gives all students an opportunity to assume responsibility for laboratory management functions. The student personnel organization will have to be explained so that students understand it and agree to it. Students need to understand how their participation in the student personnel system will benefit them and provide a safe working environment. They also need to see that the work associated with laboratory management is fair and equitably distributed.

Instructors will not only have to identify the laboratory management duties but they will also have to determine the amount of delegated authority positions they will allow. Some may only want to appoint a student foreman; others may appoint a foreman and an assistant foreman, or a foreman and a tool room supervisor; still others may want to add a supply room supervisor, a safety engineer, a cleanup foreman, etc. Some of the leadership positions that can be established as part of the student personnel organization are as follows:

“Positions in a Student Personnel Organization”

1. Tool room clerk/supervisor
2. Supply room supervisor
3. Shop foreman
4. Safety engineer
5. Personnel assistant or director
6. Record clerk
7. Maintenance director
8. Cleanup supervisor
9. Environmental engineer

An efficient student personnel organization must include a listing of specific duties to be assigned to supervisor personnel. These duties need to be posted or distributed to all
students so each member will know the specific duties required for each job. The following is a suggested listing of the duties or responsibilities for some personnel positions:

1. Foreman or Superintendent
   (1) Oversees the entire personnel system
   (2) Checks cleanup
   (3) Keeps a list of needed materials and supplies
   (4) Keeps a responsibility chart up-to-date
   (5) Assist instructor when necessary
   (6) Checks environmental conditions of classroom and laboratory at the close of class
   (7) Meets visitors and answers the phone when instructor is out of the laboratory
   (8) Settles any minor disputes among students regarding their responsibilities

2. Assistant Foreman
   (1) Assist foreman if required
   (2) Take over duties of foreman when he or she is absent
   (3) Do specific assigned duties not assigned to another individual

3. Safety Engineer
   (1) Check and report condition of machines and equipment (guards in place, etc.)
   (2) Monitors student activities to be sure that safety regulations and precautions are being observed
   (3) Report any unsafe practices being done by other students
   (4) Check first aid supplies to be sure they are adequate and report info to instructor
   (5) Report all injuries promptly no matter how minor they may be
   (6) Conducts scheduled safety inspections of the laboratory

4. Tool Foreman or clerk
   (1) Checks to be sure all tools are accounted for and in place at the beginning of the class period and at the end of the class period
   (2) Checks the condition of tools and submits report to instructor
   (3) Checks out tools to students and keeps records of transactions
   (4) Performs minor maintenance and repairs to tool and equipment of qualified
   (5) Keeps tool panels, shelves, cabinets and other holding devices organized

5. Supply and materials room clerk
   (1) Keeps stock racks, stock drawers, and stock shelves organized
   (2) Checks and stores materials and supplies when delivered
   (3) Checks to be sure that all flammable or caustic materials are stored properly
   (4) Issues supplies and materials according to set procedures
   (5) Maintains an inventory of materials and supplies

6. Cleanup Foreman
(1) Oversees all clean-up personnel
(2) Makes substitutions for absent clean-up personnel
(3) Checks all clean-up work at the end of the period and reports to the Laboratory foreman
(4) Given signal for clean-up (verbally, flip lights, etc.)
(5) Check to see the clean-up equipment and supplies are available, neatly organized and in good shape

7. Maintenance Director
   (1) Oversees maintenance duties assigned to students
   (2) Makes recommendation regarding maintenance to foreman

8. Environmental Engineer
   (1) Checks and regulates heating, cooling, and ventilation
   (2) Checks and regulates lighting
   (3) Checks walk ways and work areas of the laboratory for obstructions, etc

9. Personnel Director
   (1) Assist instructor in taking role
   (2) Checks library books, magazines, and other resources in and out to students
   (3) Organizes all resource materials

10. Records Clerk
    (1) Places all materials to be filed in filing baskets or boxes
    (2) Assist instructor with filing duties
    (3) Labels all printed materials
    (4) Assist the instructor in duplicating instructional materials

Organizing the Student Personnel System

“Considerations for Setting up a Student Personnel Organization”

There are three main factors to be considered when organizing and operating a student personnel organization. These are:

1. Should students be selected for positions on the basis of merit, elected by the class, appointed by the instructor, or chosen by a combination of the foregoing?

2. Should all students be given an opportunity to perform duties in all positions of the organization?

3. How often should students be shifted to other positions and how?
“Selecting Students for the PSO”

There are four techniques used by instructors to select students to serve on a student personnel organization. These are:

1. All students are selected for positions by the instructor
2. Students are selected for positions by the class
3. The instructor or class selects the foreman or superintendent and he or she chooses students for other positions
4. Students retiring from their positions select their own successor.

The customary practice is to have students serve positions for not less than one week and not more than two weeks. Students need to be left in their positions long enough to achieve a degree of competence. The length of time students serve in a position is dependent upon the maturity of students and the number of students in the class. Only the instructor benefits when a student is left in a position for a long period of time after he or she reaches a level of efficiency.

“Two Ways to Rotate Student Positions”

1. Post an organizational Chart with student personnel organization assignments
2. Develop and use a roulette wheel with positions and student numbers

It is educationally desirable to rotate all class members through the various positions of the student personnel organization. Students need to learn employability skills such as giving and receiving supervision, following orders, and working cooperatively with others. It is essential that the instructor post the specific duties of each position so that new position holders can learn their job responsibilities as quickly as possible.

There are several methods used for rotating students in the personnel organization. One method is to post an organizational chart listing the student’s names or numbers along with the positions that each will hold for a designated period of time. This requires the instructor to make a new organizational chart each time the positions change and it is subject to making errors in assignments.
A second method and the one most widely used are to develop and use an assignment or roulette type wheel such as the sample one shown below. The inner part of the wheel contains numbers representing students to be assigned to head major positions in the personnel organization. The adjacent or next larger ring moving outward contains the remaining student numbers usually grouped in sets of two to allow for at least two students to be assigned a specific duty. The outer ring of the wheel lists the various housekeeping tasks of the personnel organization such as work stations, tool room, floors, and so forth. For example, you may have an outer ring space labeled tool room with the
innermost rings labeled with student no. 1 and the adjacent ring labeled with numbers 2 and 3. This means that student number 1 is the tool room foreman or clerk and the students with numbers 2 and 3 will assist in making sure tools are returned to the tool room by the user. When positions are to shift, the inner part of the wheel is moved one space to the right or in a clockwise direction. Instructors need to record the position of the wheel each time it is officially rotated in the event the wheel is moved by some student who may not like his or her position.

**SUMMARY QUESTIONS**

1. What some of the major laboratory management duties for instructors?

2. What are some reasons why instructors should consider using tool room clerks for distributing and retrieving tools and equipment?

3. Why should students be taught to maintain tools and equipment?

4. Why should students take the time to request needed supplies and materials?

5. How can instructors maintain an adequate supply of supplies and materials on hand to support instruction?

6. Why should instructors consider implementing a student personnel system to assist in managing a laboratory?

**SUMMARY**

Instructors who develop and implement a management plan that involves students as key contributors make their job less stressful and more enjoyable, increase the effectiveness of instruction, and help their students develop important managerial knowledge and skills to become future leaders in the electrical field. Technical laboratories are expensive to equip and operate and instructors must develop management practices that provide security for tools, equipment, supplies and student projects to protect this investment. Laboratory activities are very diverse and it is nearly impossible for instructors to assume all management responsibilities. Instructors who implement a student personnel system will spend less time in maintaining laboratory activity and have more time to work with students who need assistance to complete laboratory assignments.
INSTRUCTIONAL MANAGEMENT – LABORATORY ROUTINES, FILING & RECORD KEEPING

INTRODUCTION

In the previous section, information on the storage, management, and maintenance of tools was presented along with information on how to issue supplies, store projects and plan and implement a student personnel organization. This section is designed to help instructors develop and use forms to gather information, develop a record keeping system, and develop management strategies that maximize student learning in the laboratory.

DEVELOPING FORMS TO MANAGE LABORATORY INFORMATION

“Two Categories of Forms and Records”

1. Forms and records required by the administration to meet regulations and company policy (attendance, student progress, accident forms, requisition and inventory forms, etc)
2. Forms and records needed by instructors to manage the laboratory and instructional program (tool and supply requisition forms, inventory forms, project forms, etc).

Technical classrooms and laboratories, like a business, require a well-developed management plan with accompanying regulations and procedures if they are to operate efficiently. In order to meet regulations and follow established procedures, instructors will need a variety of forms and records such as attendance forms, student progress charts, accident forms, requisition forms, inventory forms, tool and equipment request forms just to name a few. Generally there are two categories of forms and records needed to manage a classroom and laboratory, those required by the administration to meet specific regulations and those needed by the instructor to manage the instructional program and facilities efficiently. For the first class of forms and records, instructors will need to contact their supervisor and administrators to identify the forms already available for managing student records and for operating the classroom and laboratory. Most training centers or schools will have special forms that are to be used to record attendance, grades, and inventories of tools, equipment, supplies and materials on hand. The second class of forms and records are those that need to be designed and implemented by instructors.

Administration Forms and Reports

“Forms Needed by Administration”

1. Professional leave form
2. Physical examination form
3. Application for Employment form
4. Travel expense form
5. Long distance call report form
6. Standard accident report form
7. Student Attendance form
8. Student permanent record form
9. Student course/program drop form
10. Purchase requisition form
11. Central supply form
12. Equipment inventory form
13. Safety inspection checklist

Instructors should be knowledgeable about the forms and records required by the administration for these are usually explained in an orientation session and are contained in a faculty handbook with directions on how to complete and submit them. These forms and records may be maintained electronically and instructors will need to know how to access them and how to complete and submit them electronically. It is important to recognize that administrators must report certain information to funding and regulatory agencies and they generally attempt to hold instructor record keeping to a minimum so that time for instruction can be maximized. Some of the forms that administrators may need from instructors are as follows:

1. Professional leave form - Required to gain permission to attend a professional meeting or to enroll in a special training program to improve professional competencies

2. Physical examination form - Required to record the state of health of an instructor

3. Application for employment - Used to gather data from a potential employee of the training center

4. Expense form - Used to record expenses for registration fees, travel, lodging and meals to attend an official meeting that was approved by the administration

5. Long distance telephone call form - Used to record telephone calls that are made in conducting official business

6. Standard student accident form - Use to record the events and circumstance which took place before, during, and after an accident has occurred in a laboratory or classroom

7. Attendance form - Used to record student attendance during a set time period which is usually monthly (see appendix)

8. Permanent record form - Used to record pertinent information on students that are kept as part of the permanent file
9. Drop form - Used to report a student who has dropped a course for various reasons including voluntary withdrawal, involuntary withdrawal, and lack of attendance

10. Purchase requisition form - Used to secure tools, equipment, supplies and materials needed for instruction

11. Central-supply form - Some training centers may keep a supply of common instructional materials like paper, printer cartridges, staples, etc. This form records information necessary to obtain items from central supply

12. Inventory form - Used to record specific information on tools, equipment, furniture, supplies and material that must be maintained to support instruction

13. Safety inspection checklist - A specially created safety inspections checklist for all laboratories in the training center to ensure that the laboratory is being maintained in a safe manner.

Instructor Devised Forms and Reports

“Instructor Devised Forms”

1. Daily attendance form
2. Student personal information form
3. Accident report form
4. Machine and equipment operator’s permit
5. Project or activity planning form
6. Tool and Equipment inventory form
7. Supplies and materials inventory form
8. Student Supply/Materials Card or Form
9. Student Tool/Equipment Card or Form
10. Machines/Tools/Equipment Maintenance Forms
11. Library Resource Check Out Form
12. Telephone List and Log
13. Student Progress Forms
14. Daily Planner Form
15. Learning Logs
16. Note taking forms

Instructors need to give careful thought on how they plan to manage instruction and maintain classrooms and laboratories. They will need to identify the forms and reports they will need to do this efficiently. The following information deals with common, teacher devised forms and records.
Keeping Daily Attendance

“Four Ways to Take Attendance”

1. Standard class record book – Use symbols to indicate tardiness, absence, excused absence, and leaving early
2. Attendance chart – Use symbols like the system for standard record book
3. Student check in using a clipboard or time clock
4. Computer program which reports attendance to administration daily

Instructors must keep a daily account of student tardiness, absence and leaving class early. Many instructors record these things in their regular class record book. One system for doing this is to use symbols to record the appropriate information. For example, a diagonal line drawn through the appropriate square in the class record book could indicate tardiness; a second line drawn through the box in the opposite direction forming an X could stand for absence. A small “0” placed in the left corner of the square could indicate an excused absence and the same symbol marked in the right part of the box could indicate a student leaving early. It is a good practice to keep paper records of attendance but a growing number of instructors will keep attendance using records on the computer.

Another system used for recording attendance is to develop and use an attendance chart. This is a record in table form that has the names of students on the left side and the days/dates of classes on the top of the form. Instructors use symbols to mark the squares such as the one mentioned previously or another preferred one. For example, a small diagonal line drawn in the upper left part of the box indicates an absence, a small diagonal line drawn in the lower right corner of the box indicates unexcused. Instructors darken in the absence symbol if the student was just tardy and darken in the lower right symbol if the absence was excused.

Instructors could also use a sign-in sheet on a clipboard or a student time card where the student sign in and out as he or she enters and leaves the laboratory. This system prepares students for what they may be asked to do at the worksite. If an electronic time recording system is available, attendance can be recorded easily and students will learn how most businesses manage employee attendance.

The training center usually has a system for reporting students who are tardy, absent, and leave early. Public schools require teachers to report attendance date during the first part of a period either on paper forms or on the computer. This information is then circulated to all teachers so they know who is tardy or absent from school. Instructors should follow the system established by training center administrators.
Keeping Pertinent Information on Students

“Personal Information Record”

Some instructors keep personal information sheets on students that include:

- Name, address, phone numbers, e-mail addresses, and emergency contact number
- Employer and employer information
- Educational background
- Summary of attendance and progress
- Interests and hobbies

Some instructors keep pertinent information about each of their students in their own records. This record could include background information for each student, hobbies, interest, employment experiences, educational background, summaries of attendance information, grade point averages, comments on student progress, etc. Of course this record will contain logistical information such as name, address, work phone number or cell, home phone number, e-mail address, person to contact in case of emergency and phone number, etc. This information could also be kept on a computer for ease of updating and access.

Accident Report Forms

Most training centers have probably adopted the National Safety Council Accident Reporting Form but some may have developed their own. The National Safety Council website has a wealth of information about accidents, accident investigations, and how to prevent them. A copy of each accident report form that is completed must be kept in the instructor’s file and reviewed as part of the laboratory safety program. (see appendix for a sample form)

Machine and Equipment Operators Permit

Some instructors issue operator’s permits or cards once students have demonstrated that they can operate a dangerous machine or piece of equipment safely. This card has the student’s name, the machine or equipment that was operated, the date the student was checked out on equipment operation, and a place for the student and instructor to sign their names or initials. A sample operator’s permit is shown below

TOOL/MACHINE/EQUIPMENT OPERATOR’S FORM

<table>
<thead>
<tr>
<th>OPERATOR’S PERMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name ______________________    Tool/Machine/Equipment __________________________</td>
</tr>
<tr>
<td>Date Student Was Checked __________    Evaluator _______________________________</td>
</tr>
<tr>
<td>Comments:</td>
</tr>
<tr>
<td>Student Signature/Initials ______________________    Instructor Signature/Initial ______________</td>
</tr>
</tbody>
</table>

“Contents of a Project Sheet”

- Name, course, Level
- Name of activity or project and source of idea
- Estimated time to complete project with beginning and ending time recorded
- Place for student instructor to initial approval
- Sketch of project or picture
- Bill of materials and steps of procedures to complete activity or project

Some instructors require students to demonstrate that they have given careful though to planning an activity or project by having them complete a planning form. This form may require students to sketch or draw a picture of what they plan to construct or service, develop a bill of materials, and list the steps of procedure they will follow in completing the activity or project. The form should include logistical information such as name of student, name of project, source of idea for activity or project, estimated time to complete, actual completion time, grade, and space for instructor to okay the project and date the approval. A sample project planning sheet is shown below

**PLANNING SHEET**

Directions: This form must be carefully filled out and approved before beginning work

Name ___________________________ Class _____________________ Grade _____

Name of Activity/Project __________________________ Source Of Idea __________________

Estimated time to complete _______ Start time _____ Actual time to complete _________

Instructor approval __________________________ Date/Time __________________
Draw a free hand sketch of the finished project or job in this space and include dimensions and all important information including a bill of materials and steps of procedure for servicing or construction the project.

Bill of Materials

<table>
<thead>
<tr>
<th>No. of Pieces</th>
<th>Part Name</th>
<th>Materials</th>
<th>Finish Size</th>
<th>Rough Size</th>
</tr>
</thead>
</table>

Tool and Equipment Inventory Form

“Contents of Top Part of Tool and Equipment Inventory Form”

- Name and description of item
- Serial number, model number and item number
- Purchase date and purchase price
- Supplier or vender
- Warranty date
“Contents of Table Part of Tool and Equipment Inventory Form”

- Date inventory was taken
- Condition statement
- Present value
- Replacement cost
- General comments

Instructors need to keep a record of all available tools, machines, and equipment in their files and most administrators want copies to keep in their files as well. Usually administrators will want instructors to do a complete inventory of the contents of their classrooms and laboratories once a year. If instructors keep a current or running account of this information, they can save a great deal of time in complying with administrative requests and they will have a record for recording the condition of the tools, machines and equipment for planning future budgets. An inventory form should have the following information on the top of the form: name and description of item, serial No., item No., purchase date, purchase price, supplier or vendor, warranty date, No. on hand, accessories for item, and general comments. The table part of the form should have the date inventory was taken, condition statement, present value, replacement cost, and general comments. A sample tool and equipment inventory form is show below.

SAMPLE TOOL/EQUIPMENT INVENTORY FORM

Item___________________________________________________________________

Item Description_________________________________________________________

Serial No._____________ Model No.________________ Item No.__________________

Purchase Date__________ Purchase Price___________ Warranty Date______________

Supplier or Vendor________________________________________________________

Number on Hand______ Accessories for Item __________________________________

<table>
<thead>
<tr>
<th>Date Inventoried</th>
<th>Condition of Item</th>
<th>Present Cost</th>
<th>Replacement Cost</th>
</tr>
</thead>
</table>
Supply/Materials Inventory Form

“Contents of Supply/Material Card”

- Name, date and class
- Description of supplies or materials needed
- Amount or quantity needed
- Estimated cost of supplies or materials

A supply inventory form should also be kept current at periodic intervals so that instructors can see at a glance what supplies and materials are on hand and have the necessary information required to order additional quantities when needed. A sample laboratory supply and material inventory form is shown below.

LABORATORY SUPPLY AND INVENTORY FORM

Program ________________________ Instructor ______________________________

Inventory Date_________ Sheet No.____ Person Inventorying____________________

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>No. On hand</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Student Supply/Materials Card or Form

Some instructors have found it useful to issue supplies and materials to students only upon written request. This system usually requires a student to supervise the supply room and issue supplies and materials. This individual can keep a running account of supplies and materials on hand by using a supply inventory form. The student supply/materials request card or form should have the student’s name, date, class, description of supplies/materials needed, amount, and estimated cost of items. A sample supply and materials requisition form was shown in session four.
Student Tool/Equipment Card or Form

Instructors who use a tool room supervised by a tool clerk will need to devise and use a tool/equipment card or form. Students complete this card or form and present it to the tool room clerk who fills the order and signs out and signs in tools and equipment. A tool/Equipment Request Card or Form should have the student’s name, class, name of tool or equipment, quantity, estimated time of use, time issued, time returned, and a place for the student requesting the tool to sign their name or initial and a place for the tool room clerk to do the same. A sample tool/equipment requisition form was shown in session four.

Machines/Tools/Equipment Maintenance Forms

Instructors should have a planned maintenance program for their tools and equipment which includes a schedule for inspecting, lubricating, adjusting, and repairing them when necessary. A sample maintenance record inventory form was shown in session 4.

Library Resource Check Out Form

National Electrical Code books and other reference books are expensive and need to be closely monitored if they are allowed to be checked out of the library or reference center. This will require instructors to devise and use a reference check out form. A sample reference form is shown below.

<table>
<thead>
<tr>
<th>REFERENCE CHECK OUT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME______________________ Class __________ Date__________</td>
</tr>
<tr>
<td>Reference Title__________________________</td>
</tr>
<tr>
<td>Author(s)________________________ ISBN No.__________</td>
</tr>
<tr>
<td>Date to be returned_________ Date Returned__________</td>
</tr>
<tr>
<td>Signature of Borrower________________________</td>
</tr>
<tr>
<td>Signature of Librarian or Reference Center Clerk</td>
</tr>
</tbody>
</table>

Telephone List and Log

Most administrators require instructors to keep records of all long distance calls and submit records of them periodically. Instructors should keep records of all calls made and received to meet administrative requirements but to aid them in using the telephone effectively and saving valuable time. Almost everyone has spent considerable time...
looking for a phone number written on the back of an envelope or on a note pad or sticky note. A solution to this problem is to develop a phone list and a phone log for calls attempted, made, and call backs. A sample phone list and a sample phone log is shown below.

### PHONE LIST

<table>
<thead>
<tr>
<th>NAME</th>
<th>Business Phone</th>
<th>Home Phone</th>
<th>Cell Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PHONE LOG

<table>
<thead>
<tr>
<th>Date</th>
<th>Person called</th>
<th>Phone Number</th>
<th>Call Completed</th>
<th>Answering machine</th>
<th>No Response</th>
<th>Call Back</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Student Progress Forms**

**“Two Student Progress Forms”**

1. Standard class record book and use of a symbol system to record information
2. Progress chart and use of a symbol system to record information

Instructors use a number of different ways to record student progress in their classes. One way is to use the standard class record book as the recording device. Another is to devise a student progress chart. Regardless of the recording device used, instructors need to develop an easy-to-use symbol system. For example, some instructors record a daily grade indicating that the students put forth effort and participated actively in class activities. The box in the standard class record book or a box in a progress chart could be divided in half with a horizontal line and a number indicating the student’s daily grade placed in the upper half of the box. For example, if the daily grade is to range from “0” indicating no participation to “3” representing outstanding participation, then a “2” marked in the upper half system would stand for above average participation. If instructors wanted to use the same box for recording a score earned on a written or performance test, they could draw a vertical line in the lower portion of the box and place a w-1 for the first written test administered and a p-1 for the first performance test given.
in the left part of the lower box and place the actual numerical score earned in the right hand part of the lower box.

Instructors need to also devise and use an activity/project chart to monitor student progress in relation to expected performances. This progress chart is not intended too record grades, only to record information about which activities or projects have been completed and something about the student’s performance. The typical progress chart is one that has the student’s names down the left hand side of a table and the assigned learning activities or projects listed across the top part of the table. Of course a table has horizontal and vertical lines that form boxes to record information. Instructors will have to determine a coding system to record appropriate information indicating student progress. The simplest system of coding is to simply place a check in the appropriate box indicating that the student has completed the task. An improved coding system focuses on how many times a student has performed an operation or completed an activity or project. Using this coding system the instructor divides the box with a vertical and horizontal making four small boxes. If the student performs the task one the lower left hand corner of the box is darkened in; if twice the lower right hand box is darkened in. If the student performs the task three times the upper left corner is darkened in and if the students performs the task four or more times, the upper right hand corner of the box is darkened resulting in the entire box being filled in.

Another coding system used by some instructors to record student progress consider whether the task was performed with supervision, was performed along, considerable skill was developed, and expert skill was developed. For example, if a student competed the task under limited supervision, then a diagonal line is drawn from the upper left corner to the lower right corner. When the student is capable of performing the task alone another diagonal line is drawn forming an X. If the student exhibits considerable skills in performing a task, then the right hand side of the X is darkened in. When the student demonstrates expert skill in performing the task, the total box is darken in by pencil or pen.

**Daily Planner Form**

Instructors have many management responsibilities in a technical classroom and laboratory. Time is a premium for there are things that must be done daily, appointments to make, calls to make, supplies to be ordered, tests to be administered and scored, etc. Instructors soon learn to use a daily planner to help them manage their time wisely. There are a number of different daily planners available commercially but the instructor can devise their own using a computer. The following is a sample page from a daily planner.
Learning Logs

Learning logs are becoming a popular way for instructors to help learners organize their thinking and learning. There are many different forms with the simplest one being a two column chart where students make comments about what they learned, what they want to learn, and how they might use what they have learned. This format is open ended and students simply write in the blank spaces on the form. A form that uses stem sentences to help student organize their thinking and record responses is shown below.

**LEARNING LOG**

**DIRECTIONS:** Record your thinking and learning by completing the stems that apply to the learning experience.

The main thing I’ll remember is:

Something new to me was:

I really understood:

**DAILY PLANNER**

<table>
<thead>
<tr>
<th>Things to do today</th>
<th>Must do by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appointments</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. To Call</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>
I’m confused about:

Something I can use beyond school is:

Connections I am making with other things I know are:

Note Taking Form

Some instructors help their students with note taking by developing a note taking form on their lessons. The typical note taking form includes an outline of the lesson content on the left column of the form and a place for students to record notes on the right column. A sample form is shown below.

<table>
<thead>
<tr>
<th>NOTE TAKING FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOPIC ____________________ Student ____________________</td>
</tr>
</tbody>
</table>

**DIRECTIONS:** Record notes or information about each content item in the spaces to the right of each item presented

<table>
<thead>
<tr>
<th>Electrical Boxes</th>
<th>Notes</th>
</tr>
</thead>
</table>

I. Electrical Boxes and Installations

A. Nonmetallic Device Boxes

B. Metallic Device Boxes

C. Installing Devices

D. Outlet and junction boxes

E. Electrical box requirements
KEEPING RECORDS AND REPORTS

“Instructor Duties in Keeping Records”

- Know what information to gather and devise forms
- Set aside time daily to collect information and organize it
- Develop and implement a filing system

Designing record-keeping forms is the easy part of record keeping; the hard part is collecting information, allotting time to complete the forms, and filing the information where it can easily be found.

The starting point of good record keeping is to know what information to gather. Instructors should review each form and make mental notes of information that will need to be obtained and eventually filed. Instructors will then need to set aside regular time periods for record keeping tasks.

The best time to complete record forms, process them and file them is when they are used to gather information. This is usually not possible because the demands of the instructional program are too great. A good practice to follow is to set aside a regular time period each day to complete or process report forms and use this time for the intended purpose. It is very easy too set aside time for record keeping tasks and then use it for other purposes. This practice will result in an accumulation of “paper work” that can reach mountainous proportions. Make record keeping a routine task and it will seem insignificant in terms of an instructor’s time.

Some instructors set aside time for record keeping at the end of a class and before another one begins. Others use the time at the end of the day to keep records and reports. Each instructor will need to choose the most appropriate time to take care of the record keeping responsibility which will result in a more efficient operation of the instructional program.

Devising a filing system

“Filing System, Everyone Has One”

- Some disorganized instructors pile papers on top of their desk or on tables
- Some have a box or even a file drawer where they place materials waiting to be filed
- Effective instructors file materials daily in an easy-to-use filing system

Every instructor needs a functional filing system to keep forms, records, and reports for future reference. A good filing system will enable instructors to handle curriculum and instructional materials and to manage and maintain program and student information. It is time consuming to develop and implement forms and records to gather pertinent
information and instructors will surely want to take time to preserve these materials for future use.

Everyone has a filing system of one kind or another. Some disorganized instructors simply pile materials on their desks and on tables and sometimes they place materials in a box or a filing cabinet drawer with the intentions to organize these materials some day. These instructors can usually find a specific item if given enough time. Obviously this system of filing is not recommended. Instructors need to devise a system to manage both program and student records in a businesslike manner.

An effective filing system has a number of features. Some of these are as follows:

“Characteristics of an Effective Filing System”

1. It is flexible enough to allow for the storage of a wide variety of program and instructional materials

2. It is designed to meet the personal needs of the instructor

3. It should eliminate or seriously reduce clutter and help make the classroom and laboratory an orderly and attractive environment.

4. Once established, it should be easy to maintain for filing systems require periodic updating, reorganizing, and discarding of materials.

5. It utilizes a variety of different equipment and supplies that make it possible to keep materials neatly organized and easy to retrieve.

Once instructors decide to start a filing system; the next step is to give thought to the following questions:

“Questions That Need Answered About Filing Systems”

1. What materials need to be filed?

2. How should the materials be filed?

3. Where should materials be filed?

4. What filing equipment and supplies are available?

5. What additional filing equipment and supplies will be needed?

6. When will filing tasks be performed?
7. How is materials screened for filing?

8. When will material be filed?

9. How can the filing system be maintained?

**Filing equipment and supplies**

**“Equipment and Supplies for Filing Systems”**

- Four drawer metal filing cabinet with lock
- Horizontal file (Open pigeon hole type of lockable drawer type)
- Desk tray (wood or plastic stackable boxes or plastic horizontal file)
- Transfile Cabinets, drawers or closets
- Hanging folder frames
- Cardboard or plastic filing boxes
- Card index files
- Floppy discs and DVD/CD storage boxes, racks, or cabinets
- Cardboard or plastic tubes
- General supplies (File guides, manila folders, folder labels, expandable folders, etc.

Most instructors will have some type of filing equipment provided in their classrooms and laboratories. They will need to determine whether this equipment is adequate to meet their filing needs. If not, they will need to request additional equipment or make use of inexpensive temporary equipment such as plastic hanging file boxes. The best filing systems are not necessarily those that use expensive equipment such as multi-drawer filing cabinets. Filing cabinets are available in different drawer widths (standard-size and legal-size and with a different number of drawers (two, three and four-drawers). These filing cabinets can be purchased in a variety of colors as well as the traditional colors of black, green, beige, and gray. Obviously the recommended filing cabinets will be lockable.

Some other types of filing equipment are as follows:

1. Horizontal files - Used for storing flat materials such as pamphlets, handouts, and worksheets. They may be the pigeon hole type which are open or the drawer-type that can be closed and locked.

2. The desk tray - A type of horizontal file that is usually used to store materials temporarily until they can be more securely filed. They can be just a single wooden or plastic box or they may be multi-level.

3. Transfile - Boxes or drawers made of cardboard, metal or plastic that are frequently used to store materials that have been removed from the active file. The transfile is
usually easily transported and is the preferred choice for instructors that move from classroom to classroom.

4. Cabinets, drawers and closets - Used to store large, irregular shaped teaching materials and equipment like projectors, tape recorders and so forth. They are also used for storing paper and large quantities of teaching materials like handouts.

5. Hanging folder frame - Used to support hanging file folders in metal file drawers. This frame allows for the storage of materials vertically in a file cabinet drawer. Today there a wide variety of colored, hanging file folders that make it easier to organize the filing system.

6. Boxes, cases and cartons - Used to store materials of different sizes and shapes. There is a wide variety of these storage devices available and instructors need to review an office supply catalog or go on-line to review such products. Special filing boxes are made to store materials placed in file folders which makes it easy to separate materials.

7. Card index file - Used for a variety of purposes such as checking in and out tools, supplies, references and keeping an inventory of tools, equipment and supplies. The boxes are made of plastic or metal and come in standard sizes of 3” X 5”, 4” X 6”, and 5” X 8”. Files guides are available in different colors to separate stored cards.

8. Floppy discs and DVD/CD storage boxes and racks - Used to store a variety of computer discs.

9. Cardboard or plastic tubes - Used to store drawings, maps, posters, signs, and other large paper and plastic materials

10. General filing supplies – A wide variety of filing supplies are available to organize the filing system including file guides, expandable file folders, file folders of many different colors, colored file folder labels, plastic file tabs, envelopes of different sizes, colored dots and rectangular shaped stick-on identifiers, felt-tip markers, paper clips and clamps, notebooks, stapler and staples, plastic and cloth tape, and others. Instructors can visit one of the office supply stores in their area to see the wide variety of supplies available to help them organize their filing system.

Materials to be filed

- Resource and reference material
- Charts and posters
- Bulletin board materials
- Handouts
- Instructional materials
- Attendance and grade records
Materials to be filed

- Student records
- Occupational information
- General management records
- Computer discs, DVDs and CDs
- Small materials such as cards and pictures

Technical program instructors have a wide variety of materials that need to be filed. Some of these are:

1. Resource and reference materials - Books, magazines, and pamphlets require special storage. Books are usually stored on shelves and color coded for special purposes. Magazines are usually stored vertically in metal or cardboard boxes that are designed to hold them so that the volume numbers and dates are readable.

2. Charts and posters - Instructors use a variety of charts and posters to present special information to students and these are either displayed on a flat surface such as a wall or cabinet door or kept in tubes or on a flat shelf in a portfolio or protective device.

3. Bulletin board materials - Bulletin board materials are usually stored in cardboard boxes in an organized manner so they can be retrieved and used again.

4. Handouts - Duplicated materials such as instruction sheets are usually stored in vertical file folders according to subject matter areas. Large quantities of handouts are stored on cabinet shelves to keep them secure.

5. Instructional materials - Courses of study, syllabuses, unit plans, lesson plans, and supporting materials are usually stored in loose-leaf notebooks with master copies stored by course in a hanging file folder in a filing cabinet. Of course such materials are also kept electronically on computer hard drives and on discs.

6. Attendance and grade records - These records are kept in a secure filing cabinet drawer and usually stored in a hanging file folder.

7. Student records - Personal data sheets student progress reports, observation reports and the like are stored in the same manner as attendance and grade reports; in a locked filing cabinet drawer.

8. Occupational information - Instructors should establish a file for students to use that stores information about careers and jobs.

9. General management records - Forms like requisition and inventory forms need to be kept together for easy access.
10. Computer discs - Today more information is stored electronically than ever before and computer hard drives are capable of storing huge amounts of information but it is always as safe practice to back up important information on to computer discs, CDs, flash drives and even DVDs. These devices require special storage in an air conditioned room.

11. Small materials such as calling cards, pictures, etc - These small items can be stored in metal or plastic file boxes or in labeled envelopes that can be stored in vertical file folders. Pictures can be cemented to backing materials and placed in scrapbooks or in picture albums.

**Basic filing methods**

There are a number of methods for filing materials such as the alphabetic, numeric, and subject filing methods.

**“Three Filing Methods”**

1. Alphabetic
2. Numeric
3. Subject

**Alphabetical**

**“Rules for Filing Alphabetically”**

- File by person’s last name, first name and middle initial
- File in dictionary order—where second letter is the same, go to next letter
- Use full names rather than nick names
- Numbers and abbreviations are filed as is they were written out in full
- Names with prefixes like McGee are filed as if one word
- Ignore words such as “and”, “or” and “the.”
- File new materials in front of folders (Chronically)

Filing materials alphabetically is perhaps the simplest and most common method. In this method, the file is divided into sections, using file guides or folders labeled A through Z. Materials are then filed alphabetically. There are some basic rules that if followed, will make this system more effective. These are:

**Numeric**

**“Numeric Filing System”**

This is the arrangement of materials in consecutive number by order. In this system instructors:
• Prepare a number of numbered file guides, a numeric key and a miscellaneous file guide
• Assign numbers to major headings, subjects, or topics
• Additional numbers are assigned to subheadings, subjects, or topics

“Example Numeric Filing System Code”

Code: 0041.10
Interpretations: 00 = Instructional Materials, 4 = lesson plan, 1 = electrical theory course, and 10 = lesson plan #10.

Another filing method used by some instructors is the numeric system. In its simplest form, this is the arrangement of materials in consecutive order by numbers. In this system, the instructor prepares a series of numbered file guides, a numeric key, and a miscellaneous file guide for materials that defy all attempts at classification. Then instructors assign numbers to major group headings, subjects, or topics. In addition, a second group of numbers can be assigned to subgroup headings, subjects, or topics. If needed a third subset of numbers can be assigned and so forth. The following is an example of a numeric key guide for the major headings.

00 – Instructional Materials
10 – Student Files
20 – Manage Files
30 – References and Resources
40 – Occupational Information Files
50 – Administrative Records
60 – Personal files

Instructors will probably want to devise subgroup headings to make it easier to retrieve materials. For example, instructors may want to assign the following subheadings with numbers to the first major heading of instructional materials:

1. Courses of study
2. Course syllabuses
3. Unit plans
4. Lesson plans
5. Instruction sheets
6. Handouts
7. Learning activities/projects
8. Assessments

Then if instructors wanted to file a lesson plan, they would file it under the first major heading numbered 0 and the number 4 for the subheading of lesson plans. Then a third subgroup of lesson plans could be established for different courses. Occasionally a file
folder will get full and a second file folder will be needed. This is accomplished by assigning it a number as a decimal. Using the example for filing lesson plans, instructors could assign a second folder the decimal number of 041.1. It is important to post a copy of the major heading and subheadings either on the filing cabinet or on a clip board or wall for reference in filing materials.

**Subject Matter Filing**

Another filing method which is used extensively by most technical instructors involves filing materials alphabetically or numerically behind subject matter or course file guides. Generally colored labels or colored file guides and/or folders are used for different subject areas or courses. Then file folders can be assigned names for the alphabetical system or numbers for the numeric system.

**Steps in Filing**

1. Read all materials before filing
2. Classify all desirable materials and number them
3. File new materials in front of file folder
4. File materials daily and weekly for sure
5. Avoid keeping old revisions and duplicates in file
6. File catalogs and other large materials on shelves
7. Avoid cross referencing materials
8. Staple multiple pages instead of using paper clips
9. Use colored folders, tabs and labels
10. Prepare all materials to be paper size (8 ½ X 11)
11. Purge and revise the filing system as often as needed

Once a filing system is established, instructors need to follow certain steps in filing materials. These are:

1. Read all materials before filing. Because of the large volume of materials that can accumulate, instructors need to screen materials to be sure they want to keep them.

2. Classify all desirable materials. Use a thin felt-tip marker to write the appropriate number in the upper right corner so the material will be placed in the correct folder on the initial and subsequent filings.

3. File new materials in the front of file folders

4. File accumulated materials daily if possible and weekly for sure. Set aside time each day to file materials and honor this assigned time.

5. Don’t keep old revisions and duplicate materials in your files. If it is desirable to keep duplicate copies, establish a separate storage area for these materials.
6. File catalogues and other large materials on a shelf. A good practice is to make a copy of the title and author page of a large reference, mark where the item is stored on this copy, and then file just this page in your filing system.

7. Avoid cross referencing materials since this increases folder contents and promotes mistakes.

8. Use staples rather than paper clips to hold multi-page materials together

9. Use colored folders, tabs, or labels to arrange materials when available

10. Prepare all items for a folder to be the same size. This means that small items like articles clipped out of a paper or magazine should be cemented to an 8 ½” X 11” paper. If legal size papers are to be filed, they will need to be folded appropriately.

11. Revise the filing system as often as needed.

ESTABLISHING ROUTINES FOR BEGINNING CLASS, MONITORING CLASSROOMS AND LABORATORY ACTIVITIES, AND CLEAN-UP AND DISMISSAL.

“Four Categories of Routines”

1. Routines for preparing the classroom and laboratory
2. Routines for beginning class
3. Routines for Instructing, supervising and monitoring learning
4. Routines for ending class

Technical program instructors are managers of learning and supervisors of the classroom and laboratory. The supervisory duties can be simplified considerably by well-established daily routines and the use of a student personnel organization. Instructors need to consider what routines are necessary to begin classes, monitor learning activities and end classes with clean-up and dismissal. They also need to involve students in these routines in a formal way by using the student personnel organization.

Preparation before classes begin

The environment of classrooms and laboratories has a significant affect of student attitudes and the amount and quality of work they complete. A few degrees difference in classroom or laboratory temperature beyond the optimum will tend to slow down student learning and laboratory activity. A reduction in the amount of light will likewise have a measurable affect on student production. The conditions of the laboratory in terms of good housekeeping practices will set student attitudes and habits toward an orderly environment or in the other direction. Therefore, teachers need to develop a routine of
checking the physical conditions of the classroom and laboratory before students arrive. Some of the following practices should be part of the preparation routine:

1. Set the temperature if possible – The optimum temperature of classrooms should be around 72 degrees but the preferred temperature for laboratories varies according to the type of activities that are carried on there. The optimum temperature in most technical laboratories is 67 degree. Instructors will need to experiment with these temperatures by asking students about their comfort levels.

2. Check the lighting – Instructors need to turn on necessary lights in the laboratory and auxiliary rooms and, if windows are equipped with blinds and shades, raise, lower or otherwise control them to allow adequate light to enter.

3. Check the ventilation – The ventilation system in classrooms is usually centrally controlled as part of the heating, ventilation and air conditioning system but if laboratories are not part of this system, instructors will need to turn on the ventilation system to allow outside air to enter and circulate.

4. Check the condition of the classroom and laboratory for the following:
   (1) location of desks, tables, chairs, and portable equipment
   (2) Placement of reference materials and the organization of the reference center
   (3) Preparation of audio-visual equipment such as overhead projectors, computer projectors, computers, computer printers, screens, and other equipment
   (4) Preparation and organization of instructional materials (lesson plans, record forms, assessments, handouts, and so forth.
   (5) Preparation of laboratory work assignments
   (6) Preparation of the white board with the objectives of the lesson plan written on it as well as other appropriate information like a “bell ringer” activity. This is a creative statement that gets the class to begin thinking about the subject such as a probing question, a problem to solve, a reaction to a quote or statement made by a famous person, and so forth.
   (7) Organization of the instructor’s desk and/or podium if one is used.
   (8) Preparation of storage areas where student material like notebooks are maintained such as plastic file boxes, book shelves, cabinets, etc,
   (9) Conditions of laboratory bench tops, counter tops, tables, and other work stations in the laboratory
   (10) Conditions of floors and walkways
   (11) Organization and preparation of the tool room, supplies and materials room, and other auxiliary rooms and areas. These separate rooms and areas need to have their doors unlocked.
   (12) Conditions of the wash and safety areas

5. Prepare yourself by being at the door when students arrive and greet them with a smile, acknowledging their names and sharing a friendly comment.
“Routines for Beginning Class”

- Take attendance
- Make announcements
- Use a “Bell Ringer” or “focusing” activity—question, food for thought, etc
- Give a short motivational talk or feedback on the previous day’s work
- Set aside time for student questions
- Introduce lesson or make assignments

Instructors also need to establish routines for beginning classes. Some common practices are:

1. Taking attendance – Instructors use a variety of ways to take attendance. Some of these are:
   (1) Have the personnel assistant of the student personnel organization take attendance.
   (2) Complete attendance sheets or computer screens after observing the class
   (3) Conduct a role call
   (4) Record symbols for attendance in the instructors student record book
   (5) Use a time check in and check out system similar to ones used in business and industry
   (6) Have assigned seating and observe vacant seats.

2. Making announcements – Make announcements on student affairs, training center affairs, and community events that affect students.

3. Attending to “Bell Ringer” activity – Have student work on the “bell ringer” activity written on the white board near the lesson objectives. Give them a few minutes to think about what they will say if asked, then, call on them for responses.

4. Giving a short talk – Some instructors give a short talk of five minutes or less about class or laboratory routines, changes in classroom or laboratory practices, safety practices, motivational comments, evaluative comments, and areas of concern.

5. Setting aside time for questions – Many instructors start the class by setting aside a short time to respond to any student questions about homework assignments, class and laboratory routines, work of the day, and so forth. If the student is asking a question about a personal problem, handle that question privately.

6. Introducing the lesson – The final beginning practice is to introduce the lesson for the day or make laboratory assignments if there is no formal lesson scheduled for the day. Students need to be informed as to exactly what they should do when they enter the laboratory. In introducing the lesson, a creative introduction needs to be given to generate student interest, followed by verbalization of the purpose and objectives of the lessons, presentation of the content, summary of what was presented, question time, and assignments.
There is no such thing as standard routines used by most instructors. Some follow the routines just presented, others involve student in their personnel system to do some of the beginning class tasks, and others give students considerable freedom to begin work on their own. It is the instructor’s responsibility to establish routines for beginning class in a quick and efficient manner.

**Instructing, Supervising and Monitoring**

*“Routines for Instructing, supervising and monitoring”*

- Present instruction
- Assist students in planning their work and getting started
- Provide individual assistance as needed
- Assess student performance and give specific feedback
- Supervise laboratory activity according to the management plan

The most demanding portion of the class period is the instruction and practice components. It is during this time that the instructor needs to be all things to all people, and be everywhere at the same time. Some of the instructional, supervisor, and monitoring duties are as follows:

1. Presenting instruction to individuals and to large and small groups by
   - (1) demonstrations
   - (2) illustrated lectures
   - (3) discussion
   - (4) cooperative learning
   - (5) individualized instruction
   - (6) many other methods

2. Assisting students in planning and completing their work by
   - (1) Selecting work tasks or projects
   - (2) drawing sketches
   - (3) determining operations and steps of procedures to follow
   - (4) estimating materials
   - (5) selecting tool and equipment needed

3. Providing individual assistance by
   - (1) giving demonstration over again
   - (2) asking and answering questions
   - (3) helping a student select tools, equipment and materials
   - (4) helping a student with personal problems
   - (5) encouraging a student
   - (6) coaching a student
(4) Assessing student performance and giving specific feedback by
   (1) Observing students as they work paying attention to their work habits, attitudes, progress, appropriate language, interaction with others and so forth
   (2) Giving constructive criticism on areas of student weaknesses such as conduct and appearance, rate of progress, work habits and procedures, etc.
   (3) Evaluating student progress through written tests, performance tests, project assessments, graphic organizers, portfolios, and so forth
   (4) Catching students doing something right and giving them specific feedback as to what they did better than every before
   (5) Recording student achievement on appropriate forms such as progress charts, class record books, classroom or laboratory report forms, etc.

5. Supervising the orderly operation of the classroom and laboratory by
   (1) controlling student behavior
   (2) detecting student frustration and fatigue
   (3) assisting students to stay on task
   (4) assisting students in keeping their work areas and work station organized
   (5) observing for correct operation of power tools and dangerous equipment
   (6) moving about the laboratory, keeping student in the line of sight at all times
   (7) making adjustments for student absences when group work is assigned
   (8) checking to be sure safety protective equipment is being used by students.
   (9) inspecting the laboratory for hazards such as liquids on the floor, waste materials on the floors, etc.
   (10) supervising the student personnel system like checking on the activities of those assigned to tool and supply rooms
   (11) greeting all visitors and issuing safety glasses for anyone entering the laboratory
   (12) rendering assistance to student with their work when asked

Clean-up and class dismissal

“Routines for Ending Class”

- Give signal for clean-up
- Direct student attention to assigned duties (Posted or clean-up wheel)
- Supervise the clean-up
- Check the condition of auxiliary areas and the laboratory
- Move to the door and dismiss students

The classroom and laboratory with all of its tools, equipment, machines, and materials must be returned to proper organization at the close of each class so that it is ready for the next class to use. Some teachers use a bell or buzzer to signal clean-up; others give a voice command; still others blink the lights. Some instructors notify the laboratory foreman or superintendent who gives the signal. Some teachers give only one signal about five to ten minutes before the close of the class period. A better practice is to give a warning signal about ten minutes before the class ends followed by an actual work
stoppage signal around five minutes before the end of class. Instructors will find that ten minutes needs to be the amount of time allotted for clean-up for about the first week of classes and then as student become more familiar with clean-up procedures, reduce the amount of time accordingly.

A clean-up wheel like the one that was mentioned in session four will inform students as to what their duties are for the day. Of course, the duties for each position on the wheel are posted so that students will know exactly what they are to do in their positions. However, all students are responsible for cleaning up their work areas and for returning tools, equipment and supplies to designated storage areas. Some of the clean-up duties are:

1. Return tools to tool room
2. Store work apparatuses and projects
3. Return unused materials and supplies to the storage room or storage areas in the laboratory
4. Clean machine and equipment and return portable power equipment to proper location
5. Clean off work benches
6. Sweep floor and perhaps mop them
7. Place protective clothing and other devices such as safety glasses and ear protection in proper storage areas such as lockers, safety glass cabinets, etc
8. Return keys, checks, forms and slips to laboratory foreman to be turned in to the instructor
9. Return all reference materials to proper storage
10. Wash hands
11. Move to assigned closing stations (class seats, designated area near the door, etc)

If a student personnel organization is used, receive reports from the laboratory foreman or superintendent who should have reports from special foremen. Make a final check of the laboratory with the foreman including a check of (1) the tool room, crib, or open panels, (2) the supply and materials room, (3) machine and equipment to be sure they are clean, guards are in place and power is off, (4) learning resource center is organized, and (5) wash area is clean and organized.
The final class ending duty I to dismiss the student and this should be done by instructors who give a voice command as they stand by the door of the laboratory. This enables the instructor to share personal comments with students as they leave the classroom or laboratory. Signal devices such as the bell should not be allowed to dismiss students.

In summary, the technical program instructor must perform a variety of duties in preparing for class before student arrive; beginning class; providing instruction, monitoring activities, and supervising the classroom and laboratory; and clean-up and ending class. Instructors must acknowledge and perform the following responsibilities:

“**Instructor Duties for Every Class**”

1. Control classroom and laboratory behavior
2. Set a good example of personal appearance, work habits, communication skills, and enthusiasm for learning and work
3. Motivate students to enhance their learning
4. Exemplify and encourage cooperative relationships
5. Present quality instruction
6. Demonstrate efficient organization and working methods
7. Expect quantity and quality work
8. Insist on safe work habits
9. Demand proper care of tools, machines, and equipment
10. Require respect for school and student property
11. Evaluate student progress and achievement and give specific feedback
12. Be enthusiastic toward students and demonstrate concern for the welfare of each one
13. Be willing and available to render special assistance to learners.
SUMMARY

Instructors want a well-organized and managed laboratory where students know what to do by following established routines. Instructors need to establish routines for preparing for class; beginning class; instructing, supervising and monitoring laboratory learning; and ending class. One of the continuing duties of instructors is to gather appropriate information using forms and to classify and file this information so it can be used to facilitate instruction and manage the laboratory. Some forms are used to provide information to the administration but most forms are those devised by instructors to manage the laboratory. Laboratory instructors have to deal with a variety of instructional and managerial materials and to store these materials so they can easily be retrieved when needed. This requires a simple, effective filing system that follows specific rules for the organization of materials.