TRADE & Industrial Education

Facility Guidelines

Instructional Materials Service

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Trade and Industrial Education Facilities Guidelines

Introduction

The *Trade and Industrial Education Facility Guidelines* provides information regarding the physical requirements for some of the most popular T&I instructional programs. The purpose of this publication is to guide teachers, administrators, architects, and other professionals in building or converting Trade and Industrial Education instructional laboratories to train students in the knowledge, skills, and processes commonly found in today's industry. However, these guidelines do not purport to be all-inclusive. These guidelines are designed to begin answering the questions that normally arise during the construction or remodeling of Trade and Industrial facilities. Teaching styles, the desired facilities, and the nature of the programs will dictate adjustments and additions to any program recommendations.

To the extent possible, the recommendations in this publication came from national program standards, such as those from National Automotive Technician Education Foundation (NATEF) or the American Welding Society (AWS) and the Associated General Contractors (AGS) for the facility, equipment, and tool recommendations. However, national program and facility standards were not available in all Trade and Industrial clusters or program areas, so recommendations from community colleges, other states, and/or teachers were used in the development of these guidelines.

Some aspects of all Trade and Industrial education programs and facilities are similar in nature; a brief discussion of each of these similarities follows. Subsequent sections focus on the unique requirements of individual courses within each of the seven Trade and Industrial Clusters.

Facility Design for Flexibility and Expandability

Designing school facilities is a challenge; providing desirable learning environments for the myriad of trade and industrial education programs includes particularly complex issues, as industry is constantly changing. Trade and Industrial Education facilities have at least two important characteristics.

The first characteristic is the high cost of space and equipment, relative to most other teaching spaces in a school. Most laboratories may require up to six times more space than required for academic teaching space. Equipment costs for some programs may be a hundred times greater.

Second is the inflexibility of some laboratory designs. Facilities for some Trade and Industrial Education programs require a large floor space with a high ceiling and special wiring, plumbing, air handling, and acoustical treatment. These facilities may be expensive to renovate and poorly located for other uses. It is, in general, easier to convert outdated laboratories into other laboratories than into spaces for academic use.

Flexibility is an important concept in planning laboratory facilities. A modular system of layout permits the greatest possible exchange of workstations and other laboratory work areas. Modular lighting, heating, air conditioning, and ventilation will allow reduction or expansion of spaces without affecting the environment. The use of non-load-bearing partitions between adjoining areas increases the flexibility of laboratory areas. Position utilities on permanent walls and structural components.

Future expansion using multiples of needed workstations rather than general additional square footage extend the useable life of a facility and more simply accommodates changes in programs and curricula. The site configuration is an important consideration in minimizing restrictions to additions and renovation to the existing building.

Flexibility encourages space sharing that increases utilization of existing facilities and reduces costs. Dressing rooms, showers and clothing locker areas, where required can be shared effectively. Multiple laboratories sharing a common work or fabrication areas is an additional approach to space sharing.

Trade and Industrial Education Training Spaces

The following identifies design considerations that are common to most Trade and Industrial Education program facilities.

Classrooms

Each Trade and Industrial program requires access to classroom space sufficient for anticipated student enrollments. Safety glass windows provide a clear view of the laboratory area while providing acoustical insulation of the classroom from the laboratory noise. Control of natural light is necessary to permit the use of television and other audiovisual media. Classroom lighting needs to consider the needs of students with visual disabilities, as well as the use of media.

The typical classroom space has a dry marker and tack boards, adequate seating equipment, teacher desk with chair, and a demonstration/planning table. Ample built-in storage for audiovisual equipment and materials, printed instructional resources, and teacher-maintained student files are important to providing classroom instruction.

Tables and chairs are preferable to traditional student desks because of their flexibility in meeting a variety of instructional needs and strategies. Computer workstations with Internet access are an integral part of classroom instruction.

Laboratories

Trade and Industrial laboratories are custom designed for specific classes or programs and provide a simulated-work environment for the practical applications of instruction and skills practice, effectively and safely. The unique purposes and nature of instruction in the specific program determine the floor area; however, a minimum of 100 square feet per student, exclusive of storage and other support areas, is a good planning figure. Ceiling heights will range from 12'0" to 14'0" depending on the square footage of the laboratory. Each laboratory should have a communications system, including a telephone, for informational and emergency use.

Carpeting is an appropriate floor treatment for light-duty laboratories and in areas where noise control is desirable, such as drafting. Vinyl tile is effective for light-duty areas such as electronics and cosmetology, where maintenance is likely to be an issue. Medium to heavy-duty laboratories generally have hardened, sealed concrete floors, as they are often subject to abuse from heavy equipment and oils and acid. Floor drains are necessary in areas subject to spilled liquids or where floors are scrubbed or hosed down. Where spillage of volatile liquids is likely, drains should have suitable interceptors.

Tool and supply storage should be convenient to work areas to minimize travel and congestion. There should be wide aisles between workstations, in front of storage cabinets, and around equipment. Equipment such as lathes, planers, or presses have a tendency to vibrate and will need to be bolted to the floor. Mounting pads placed under the machine feet also reduce vibration.

Machines and equipment should be located to allow for ease of cleaning around the base, and cabinets should fit flush to walls for the same purpose. Walls should be smooth with no ledges to collect dust in those areas that generate dust. Laboratories that generate excessive dust or other airborne pollution must have an exhaust system.

Windows can provide natural lighting which, at times, may be sufficient for student activities and thereby reduce energy cost. Natural lighting is also advantageous in circumstances where color distortion from artificial lighting is an issue and for a way out of the building during power failures or other emergencies. Windows are necessary in laboratories or rooms housing hazardous equipment. Natural ventilation may be sufficient during much of the school year, can reduce energy costs, and is useful when mechanical systems fail.

Windows may not be practical in medium and heavy-duty laboratories with expensive equipment or tools, due to the security issues they generate. If regular windows are impractical, small, inoperable windows high above the floor and glazed with wire glass or covered with grilles are an option. Windows should be a minimum of 48 inches above the floor and 72 inches where wall space is valued. If windows are used, orientation of the building on the site should reduce glare.

Teacher Office/Conference

Teachers should have an office/conference room that has a desk or lighted desk-height work surface with a computer terminal and telephone, chairs, file cabinet, and storage for teaching

materials and personal items. The teacher's office/conference area should be adjacent to the classroom and laboratory and the adjoining wall made of glass so that the teacher can observe activities within the classroom and laboratory while in the office.

Storage Areas

Storage is required for tools, materials, student work, and teacher materials and supplies. Storage rooms can isolate noisy laboratories from adjacent quiet areas. Inexpensive tools, equipment, or utensils frequently used can be stored on wall panels or cabinets for easy accessibility and inventory. The more expensive items, especially those used occasionally, require a lockable room or cabinet.

Materials storage requirements vary with the types of activities, but should be located convenient to the materials receiving door and should provide an orderly flow of materials into the laboratory work areas. Storage should accommodate materials necessary for the programs. For example, lumber comes in lengths up to 20', while steel stock is 20 feet in length and steel pipe is 21 feet long. For security reasons, tool and materials storage rooms should not have windows or skylights. Masonry wall construction and doors without louvers are appropriate. Storage should also be available for safeguarding student work and projects.

Outdoor Spaces

Spaces outside the building are essential to the successful implementation of certain Trade and Industrial education programs, either as staging or instructional areas. Such spaces are tailored to meet the needs of the curriculum of specific courses or programs. These spaces include outdoor storage for welding and automobile storage spaces for Automotive Technology or Collision Repair and Refinishing.

Lighting

A well-lit laboratory includes both natural and artificial lighting. An artificial lighting system should provide a uniform distribution of shadow-free, glare-free illumination of the laboratory. In addition to ceiling-mounted fixtures, supplemental lighting may be necessary for some pieces of equipment. Illumination levels will vary with activities; however, in general, 60-100 foot-candles is appropriate for classroom and general laboratory areas and 200 foot-candles is adequate for laboratories where close or detailed work is performed, such as in a drafting laboratory.

Local lighting should be used for certain activities, such as grinding and machining operations. Lighting systems must also be designed so that stroboscopic effects, which would make turning machines appear to be still, are not present.

A uniform color scheme should be used throughout the laboratory. Ceilings should be white. Walls should reflect about 60%- 70% of the light that strikes them.

Electricity

An electrical system for a laboratory should be planned after the identification of the equipment and where it is to be located. However, planners need to assume that changes will occur from time to time in the use of the facility.

Duplex receptacles (120-volt) should be located at 12' intervals on perimeter walls and should be placed 48" above the floor. Double duplex outlets should be located on columns. Where debris on the floor is common, outlets mounted in cast boxes on rigid conduit at least 12" above the floor are recommended. Outlets, which must be placed on the floor under student furniture, should be in surface-mounted, tombstone fixtures.

In medium to heavy-duty shops where equipment is often driven by electric motors, 208- or 240-volt, three-phase current should be provided. Magnetic switches should be installed on equipment with large motors. Where flexibility in equipment location is desirable, overhead drop cords are generally more flexible than the expensive overhead bus duct system. The instructor will need to be able to disconnect each piece of equipment from its power source; therefore, the use of outlets for each machine is appropriate.

As a safety factor, the instructor should be able to disconnect and lock the electrical service to all equipment from a master panel that is easily accessible. Code all machinery at the power panel so the circuit can be killed quickly in an emergency. Automotive or other laboratories where volatile liquids or vapors will be present require special safety considerations. State and local building codes should be consulted.

Security and Safety

Security in Trade and Industrial Education facilities and equipment is of primary concern from economic, accountability, and liability perspectives. The design of the facility should assure controlled access to classroom, file server, laboratory, and support areas.

No consideration in facility planning is more important than safety. While various points related to safety are alluded to throughout this publication, the following are specific points to consider:

1. Machinery should be located to allow the operator protection from traffic patterns.
2. Kickback areas for machines should be oriented away from student work areas.
3. Electric equipment should not be located near sinks or water fountains.
4. Welding booths and curtains should be fire proof or fire resistant. Exhaust hoods should be provided in welding areas. Curtains on booths should adequately screen the welding area.
5. An engine exhaust system should be provided in automotive areas.
6. Motors, switches, and electric fixtures located in spray booths should be explosion-proof.
7. U.L.-approved safety containers should be provided for flammable liquids and rags.
8. Storage cabinets for eye protection devices should be provided.

9. Eyewash fountains should be provided where students or staff are likely to get chemicals or debris in their eyes. Emergency showers may be needed in some laboratories.

School planners should keep abreast of current statutes and codes related to building and occupant safety as they relate to the design of Trade and Industrial Education programs and facilities.

See Appendices for information on Safety Zones and Color Coding and OSHA Regional Offices.

Determining Space Requirements

The development of instructional space needs can no longer be determined by calculating the total number of square feet needed per student times the number of students. Changes in curriculum, equipment, and instructional tasks require a facility that can adapt to change in the curriculum reflected by the changes in industry.

School planners need to take in consideration the (1) space required to carry out the goals and objectives of the program, (2) the equipment necessary to complete the objectives, and (3) additional space adequate to provide a safe instructional environment.

The calculation of space requirements should be based the following:

1. The adopted student-teacher ratio maximum (recommended not to exceed 22 students per laboratory class);
2. The type of activity to be performed and the frequency of that particular activity.
3. Safe working conditions, with adequate space around each piece of equipment relative to the learning activity being performed;
4. The required working, storage, and assembly areas.
5. The size, quantity, and type of equipment used in the industry.
6. The size of the related classroom/instructional area.
7. The area required for instructor's offices.
8. The amount of space necessary for each student workstation.
9. Storage space for projects, materials, visual aids, tools and portable equipment, files and reference books.
10. Space for students of both sexes to change their clothing, to clean up, and to store personal belongings.
11. Any additional requirements necessary for instruction of special education students.
12. Other auxiliary space needed to meet curriculum needs, industry-standards, and the types and shapes of project development.

To establish accurate space requirements, the teacher should:

1. Prepare a list of equipment for each work/training station.
2. Prepare a list of each auxiliary item of equipment.
3. Prepare scale models or templates of each item of equipment.
4. Attach each model/template to the model/template of the work areas and necessary safety space.

5. Prepare models/templates of required work, and assembly or demonstration areas that do not include equipment.
6. Prepare models of auxiliary space requirements such as storage spaces.
7. Place models/templates on planning board with consideration for such factors as work flow, distribution of work/training stations, visibility, safety, traffic, materials handling, relationships of probable mechanical and utility service locations, consistent with standard industry practices.

Selection of Equipment

The program goals and objectives determine equipment needs. While the teacher is the logical source of information regarding equipment and tools, the program advisory committee is an excellent resource for this important activity. While the advisory committee's services are unofficial, their recommendations and opinions should carry the weight of practitioners with industry experience.

The tools and equipment should be of the type, size, and purpose to that used by the industry. To facilitate the acquisition of the necessary program equipment, a workstation list of tools and a list of auxiliary tools will be helpful. It is helpful to everyone in the planning process, if the lists contain the following information:

1. Name and type of equipment
2. Size and capacity
3. Attachments and accessories
4. Electrical and/or other utility specifications
5. Preferred manufacturer and model
6. Delivery costs
7. Estimated installation cost
8. Life estimate, depreciation, and maintenance allowance

Schools should provide for equipment maintenance in the planning stage of facilities planning and before the money is expended.

General Considerations for Trade and Industrial Education Facilities

General considerations in connection with trade and industrial education programs include, but are not limited to the following:

- Corridor doors into laboratories and related classrooms should be wide enough to accommodate large items of equipment other than the machinery used for instruction.

- General and specific illumination in all areas should be appropriate to the instructional/learning tasks of the specific program and over-all facility design to provide balanced lighting conditions.

- There should be a master key for main laboratories and related classroom, but special keys for auxiliary rooms in each laboratory.

- Fire extinguishers should be located in all laboratory/shop areas and should be appropriately distributed according to local fire codes.

- The master power panel in each laboratory should be situated in a convenient location; it should be designed and/or located so that only the instructor or an authorized person can turn the power on/off.

- Master emergency "stop" switches should be located in a number of convenient locations in laboratories utilizing electrically powered equipment. Emergency disconnect switches should be in place for all equipment and outlets except lights.

- Adequate provisions are made for the handling and disposal of environmentally and biologically hazardous materials.

- Air compressors serving the laboratories should be mounted separately, if possible, outside the building to eliminate vibration and prevent noise interference with instruction and/or communication.

- Circuits for hazardous machines and tools in laboratories/shops should be controlled via "kill switches" with pilot lights.

- Classrooms should be arranged for ease of monitoring by staff and should include visual access to the laboratory and, in some instances, to the corridor.

- Placement of windows five feet or more above the floor of the laboratory/shop increases the amount of useable wall space.

- All electrical outlets should be polarized.

- Concrete floors in the laboratory areas should be treated and toweled smooth.

- Plan "expansion joints" in concrete floors so equipment with small casters can be moved about easily. Sawed joint or equivalent preferred.

- Plan for an appropriate sonic environment in laboratories.

- Air handling should be adequate for the type of instruction conducted.

- Safety measures should meet or exceed state and federal requirements.

- Major aisles should be four feet wide.

- A minimum of three feet on each side of stationary power machinery is recommended.

- Machines normally used for rough stock should be placed near the material storage area; this reduces the hazard of moving large pieces of stock through the laboratory.

- Special attention should be given to the direction of chip throw or kickback and these danger zones marked.

- Machines that exceed four feet in height should be placed in close proximity to walls to avoid obstructing the teacher's vision.

- Emergency eyewash and/or showers should be provided in each T&I laboratory area, as appropriate.

Organization of Specific Facilities Recommendations:

Specific facility, equipment, and tools recommendations are organized by the Trade and Industrial Education seven (7) systems and forty-six (46) general course or industry categories.

Because laboratory layouts will vary depending on funds available, resources, equipment needs, space requirements, workflow, and safety operating procedures, layouts are not provided, only the recommended facility, equipment, and tool needs.

Specific recommendations are provided for those programs in bold type.:

1. **Communication and Media Systems:**
   Advertising Design
   Architectural Drafting
   Architectural Interior Design
   Commercial Photography
   Computer-Aided Drafting
   Graphic Communications Technologies (Graphic Arts/Printing)
   Mechanical Drafting (Drafting)
   Media Technology

2. **Construction-Maintenance Systems:**
   Building Maintenance
   Building Carpentry
   Concrete Laying and Finishing
   Painting and Decorating
   Building Electrical Trades
   Heating, Ventilation, Air Conditioning, and Refrigeration (HVAC-R)
   Masonry Trades

Mill and Cabinetmaking
Piping Trades and Plumbing

3. **Electrical/Electronic Systems:**
   Business Machine Repair Services
   Industrial Electronics
   Major Appliance Repair Services
   Computer Technologies (Electronics and Computer Maintenance Technician
   Instrumentation
   Telecommunications Services.

4. **Industrial and Manufacturing Systems:**
   Ceramic Manufacturing
   Foundry Operations
   Hydraulics and Pneumatics
   Petrochemical Processing
   Plant Maintenance
   Plant Processes
   Plastics Technology
   Power Technology
   Quality Control

5. **Metal Technology Systems:**
   Machine Shop
   Metal Trades
   Sheet Metal,
   Welding

6. **Personal Service Systems:**
   Cosmetology Services
   Furniture Repair and Upholstery Services
   Leather Trades Services
   Protective Services.

7. **Transportation Systems:**
   Aircraft Services
   Automotive Services
   Automotive Collision Repair and Refinishing Services
   Diesel Services
   Marine Services
   Small Engine Services,

A coordinated **work-based learning** component at the local level provides students opportunities for on-the-job training through cooperative education, internships, apprenticeship training, and preceptorships in each of the forty-six general course or trade categories. Mentorship and job shadowing provide supplemental training experiences.

References

American Welding Society. *Guide for the Design of a Welder Training Facility*, Miami, FL, 1998.

The Associated General Contractors of America. *Industry Guidelines for Vocational Education Construction Craft Programs*

North Carolina Department of Public Instruction. *Workforce Development Education Facilities Planner*. Raleigh, NC, 1997.

Deluca, V. William and W. James Haynie, III. Safety System Design for Technology Education, International Technology Education Association, Reston, VA, 2000.

Communication and Media Systems

Drafting

Recommended Drafting Laboratory/Classroom Facility for a maximum of 24 students:

Type/Use of Area	Recommended Square Footage
Laboratory/Classroom	1800-2400
Storage Area, lockable (supplies, tools, equipment)	200
Teacher Office/Conference	150
Clean-up/Lockers – Boys	40-50
Clean-up/Lockers – Girls	40-50
Emergency eyewash and drench shower	16 minimum

Special Considerations:

1. Deep sink with hot and cold water supply.
2. Appropriate ventilation for Diazo printer
3. 100-foot candles of artificial lighting required for drawing.
4. Perimeter electrical outlets above counter height.
5. Accessible to local school network and Internet.
6. Light dimmers near teacher station for use of projectors and T.V. monitors

Equipment and Materials List
Basic Drafting

Adjustable triangle
Ames-type lettering guide
ANSI standards for drafting
Blueline pencil machine
Braddock Rowe triangle
CADD software with operator's manual
CADD system hardware
Cleaning pad
Common templates (circle, arrowhead, etc.)
Compass
Computer work stations
Computer projection device
Counter space for a size "A"-"D" plotter or printer, a Diazo reproduction machine and paper cutter
Diazo paper
Diazo print machine
Divider
Drafting machine or parallel bar
Drafting tables to accommodate "C" paper and stools
Drafting tape

Drawing media (vellum and polyester film)
Drawing storage (large) with shallow drawers; one set per class recommended
Electrostatic (xerigraphic) machine
Erasers for ink and pencil
Erasing brush
Erasing shield
Film cleaner and cloth
Ink
Ink filler bottle
Irregular curves
Lead (various weights)
Lead holder or mechanical (mm) pencil
Lead pointer
Leroy-type lettering instrument (optional)
Lint-free cloth or tissue
Metal rule
Microdisk (high density, 1.4MB)
Pen cleaning solution
Plotter or printer, size "D"
Plotter paper
Protractor
Safety gear
Scales: architect, metric, civil, mechanical
Standard fit tables
Standard triangles, 30º, 60º ,45º
Storage shelves for drawing and reproduction media up to size "D" sheets
Storage shelves for student models and projects
Storage for Diazo machine filters and ammonia
Teacher drawing table
Technical pen set

Recommended Drafting Tool Kit

Lead holder/pencil
Protractor
Lead pointer
Eraser
Erasing shield
30-60-90 Triangle
45-45-90 Triangle
Drafting Tape
T-square/parallel bar
Architect's scale
Engineer's scale
Metric scale
Civil scale

Instrument set (compass, divider, etc.)
Lettering guide
Templates (circle, arrowhead, etc.)
Drafting tape
Dusting brush
Dusting powder

Graphic Arts/Printing

Facility

Type/Use of Area	Recommended Square Footage
Laboratory	2000-2800
Classroom/Instruction	700*
Storage	600
Storage for flammables	
Darkroom	200
Teacher Office/Conference	150
Clean-up/Restroom/Lockers – Boys	40-50
Clean-up/Restroom/Lockers – Girls	40-50

* State requirement, Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities

Special Considerations:

1. Should be located on a ground level floor, with direct outside access for moving large equipment and printing supplies
2. Should have zoned temperature control
3. Computer workstations with printers and scanner
4. Adequate ventilation
5. Dedicated telephone line for Internet access
6. Hot and cold water supply
7. High pressure spray booth for screen printing, if applicable
8. Interior walls windowed
9. Overhead power access to 240V
10. Acoustical ceiling tile
11. Compressed air
12. Anti-glare exterior light source
13. Non-glare classroom lighting
14. Emergency disconnect switch for all equipment and outlets except lights

Tools, Equipment, and Materials List

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Orientation, Composition, and Paste-Up
Black ink
Black paper
Burnishing roller
China marking pencil
Clean-up solvents
Clear acetate film and rubylith
Computers: monitor, CPU, keyboard, mouse
Cotton pads, clean
Developed offset plate
Drawing boards or light tables
Eraser
Find-tipped black pen
Grid or base sheets
Laser printer
Line gauge
Masking tape
Mechanical films
Non-reproducing light blue pencil or pen
Opaque white paint or correction fluid
Phototypesetting machine
Plain white or coated paper
Preservatives
Processor and chemicals
Proportional scale
Rubber cement
Ruler, metal
Tissue or tracing paper
Triangle
Trim board
T-square
Type image carrier
Vertical camera
Water bottle
Waxer
Work table
X-Acto knife
Electronic Prepress and Publishing
Backup utility and user's manual
Black-and-white photographs to be scanned

Blank CDs
Calculator
CD burner
CD burning software and user's manual
Continuous tone color image
Density guide or densitometer
Disk labels
Eight-page document
Electronic clip art
EPP document and instructions
EPP magazines and newsletters
File compression utility and user's manual
Floppy disks
Font-management software and user's manual
Graphics to be scanned
Illustration software and user's manual
Image-editing software and user's manual
Imagesetter and film processor
Internet access
Line art to be scanned
OCR software and user's manual
Page-layout software and user's manual
Paper, 11" x 17" or 12" x 18"
Pen and pencil
Preflight software and user's manual
Printer (laser or inkjet)
Processed film (from imagesetter)
Proportional scale
Removable mass storage or tape drive
Removable media
Scanner, flatbed
Scanning software and user's manual
Scan target, gray ramp, or imagesetter test sheets
Telecommunications software and user's manual
Type gauge
Word-processing software and user's manual

Process Camera, Stripping, and Platemaking
Absorbent paper
Acetate overlays
Activator
Amberlith or rubylith
Black fine and medium point pens
Black felt tip pens
Black photographic tape
Blueline or daylight copy proofing material
Bond
Cardboard
Card stock, various colors and white
Cheese cloth
Color key
Contact film
Contact frame/vacuum printer
Contact screens
Darkroom equipment
Darkroom timer
Developer
Diffusion transfer activator
Diffusion transfer gray contact screen
Diffusion transfer negative paper
Diffusion transfer processor
Diffusion transfer receiver paper
Duplicating film
Film hole fitters
Filter holder
Filters
Fixer solution
Flash lamp, 7 ½ watt bulb
Flats
Glass cleaner and wipes
Graduate
Graphic arts film
Graphic file
Gray scale
Halftone film
Illustration board
Kodak Color Separation Guide
Kodak Direct Screen Calculator, 1-10B
Kodak Q15 Exposure Computer
Kodak 24-Step Reflection Density Guide, 1-16
Litho film
Magnifier, 10-power

Masking sheets, ruled and unruled
Masking tape
Negatives
Offset plates
Opaque brush and solution for opaquing pen
Panchromatic film
Paper pad
Paper towels
Paste-up equipment
Photo-direct platemaker
Plate exposure device
Plate processing chemicals
Pre-angled chipboard
Pre-sensitized subtractive plate
Process camera
Protractor
Register marks
Register punch and pins
Scissors
Screwdriver
Sink
Spacer material
Sponge or pad applicator
Squeegee
Stop bath
Storage containers
Stripping equipment
Stripping knife
Tape dispenser
Templates
Text file
Thermometer
Transparent tape
Trays
Triangle
T-square
Vacuum exposing unit
The Press and Finishing Processes
Abrasive cleaner
Adhesive perforation and scoring material
Adjustment wrench
Allen wrench
Blanket powder
Bond paper
Box end wrench

Carbonless paper
Chipboard
Center punch
Chrome cylinder cleaner
Cleanup mats
Cleanup solvent
Collator
Dampening gauges, .005
Deglazer
Degreaser
Distilled water
Electronic pH meter
Envelop stock
Folding machine
Fountain solution
Ink knife
Ink scale
Installation sleeve
Jogging machine
Mixing containers and tools
Molleton cover, new
Offset blankets
Offset plates
Offset press with operator's manual
Offset press inks (various colors)
Padding brush
Padding compound
Padding press with operator's manual
Paper stock (variety)
Paper cutter
Paper drill with operator's manual
pH test strips
Photo-direct and/or electrostatic plates
Plate cleaner
Plate etch
PMS color formula guide
Preservatives
Press with additional color head
Press with operator's manual
Printed press sheet
Roller conditioner-cleaner
Saddle stitcher
Scoring machine
Shop towels
Solvent/oil mixture
Sponge rubber buffer

Standard tools
Stapler
Standard tools for additional color head
Talcum powder
Water miscible cleaner
Wood block

Construction-Maintenance Systems:

The Associated General Contractors of America (AGC) provides the following guidelines to assist in the planning and implementation of Construction-Craft programs.

Facility Types. The types of facilities required for a training program will depend upon the type of training offered and on the number of students in training. The training facilities must be accessible to the population being served and should include a classroom, laboratory, tool and material storage area, and an office for the teacher(s). Facilities should provide a large enough space for special skill projects. Facilities should have adequate lighting and air circulation; the office and classroom should have sufficient heat and air conditioning to maintain an environment conducive to working and learning. The entire facility should be organized with security in mind. To the extent possible, the facility should provide an environment as similar as possible to that found on the job site.

Facility Space and Equipment. Facility space and equipment must effectively accommodate the number of students to be included in the program, the teacher(s), and any required support staff. Facilities and equipment inventory must reflect stated program training goals and objectives. Duplication of essential tools and equipment is necessary so that all students will have ready access to them at all times.

Safety Provisions. Adequate provision must be made for the safety of the students and the instructional staff.

Laboratories. It is crucial that laboratories for construction-craft programs are designed to simulate the industrial setting. The equipment must duplicate that used in the industry, and the training conducted on live or simulated projects, as much as possible. Future expansion and adaptability of the programs should be included in the planning/design phase. The size of the laboratories will depend on the program and on the training objectives of the program. Careful planning will permit maximum usage of the laboratory. Most trade and industrial programs require as much wall space as possible. Wasted wall and floor space are as expensive as usable space.

Teacher's Office. AGC recommends that each teacher have office space available. Office space should not be part of the laboratory or the classroom. It is best if one wall of the office adjoins the laboratory area and that the adjoining wall be glass so that the teacher can observe activities within the laboratory while in the office.

Classroom. AGC recommends that the classroom be separate from the laboratory but adjacent to it to permit ease of demonstrations with equipment and to require a minimum of students' time in travel from the classroom to the laboratory.

Personal Facilities. Personal facilities such as restrooms, locker area, and washrooms are a vital part of the total program facility. AGC recommends that personal facilities be close to the laboratory area to allow teacher supervision and to help eliminate possible

discipline problems. Large wash fountains that will accommodate up to six people are normally preferred, and it is advisable to locate wash-up areas within the laboratory itself.

Facilities for Students with Disabilities. It is important to keep in mind the needs of students with disabilities in order to make the facilities as accessible and usable for these students as possible. Each program will need to purchase, adapt, or modify any equipment needed for students with disabilities.

Lighting. The lighting should be planned to substantially reduce the energy consumed by the lighting system while still providing students with the quality and quantity of illumination required to perform their tasks. Effective lighting must be achieved in a manner consistent with student and program requirements, such as productivity and visual comfort; aesthetics, and federal, state, and local codes and ordinances. AGC recommends the Illumination Engineering Society's *IES Lighting Handbook* as the most appropriate resource to determine lighting for trade and industrial programs.

Teaching Aids and Equipment. The training program must be equipped with appropriate teaching aids, audiovisual equipment, and electronic equipment. The quantity of this type of equipment depends on the number of students.

General Building Trades

Facility

AGC recommended general Building Trades facility to accommodate 16-20 students:

Type/Use of Area	Recommended Square Footage
Laboratory	2200-2800
Outside construction area/project site	5000
Classroom/Instruction	700*
Storage (materials and equipment)	750
Tool room	200
Finish room	600
Teacher Office/Conference	150
Clean-up/Locker-room	200

* State requirement, Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities

Other Space Considerations:

- Laboratory design should facilitate supervision of students.
- Assembly space is required to allow construction of trusses, wall sections, door units, etc.
- Doors and entryways should facilitate use of wall space.
- Space around machinery and work areas should allow for traffic flow.
- A simulating area is required to allow for framing, wiring, plumbing, and masonry projects.

Climate-control Considerations:

- AGC recommends evaporative cooling with rust-prevention maintenance required on machine and tools.
- Room temperature should be kept at an acceptable level to enhance learning.

Noise-control Considerations:

- Classroom should be isolated from laboratory by location, insulation, or other sound proofing means.
- Equipment-noise levels should conform to OSHA noise-level regulations.

Vibration-control Considerations:

- Floor-mounted and wall-mounted machines should be equipped with vibration-dampening devices.

Illumination Considerations in finish area:

- Explosion-proof light fixtures are required.
- Recommended lighting level is 150 foot-candles at 30 inches off floor.

Plumbing Considerations:

- Water plumbing required in the following areas:
  Service sink in wood-gluing area required hot- and cold-water plumbing.
  Finish room requires cold-water plumbing.
  Water fountain requires cold-water plumbing.
  Hose bibb near overhead door requires cold-water plumbing
  Washbasin in clean-up area requires hot-and cold-water plumbing.
- Compressed-air plumbing required in the finish room as per the following:
  1 outlet regulated from 0psi to 50 psi
  4 outlets regulated from 0psi to 120 psi
- 3-inch minimum diameter drain required in the following areas:
  Finish room
  Clean-up area
  Masonry area

Communication Requirements:

- Telephone located in teacher's office; signal must be audible in laboratory areas; sound must be audible when machines are in use.
- Intercom located in teacher's office, in laboratory, and in classroom; sound must be audible when machine are in use.
- Bell/alarm system located in classroom and in laboratory; sound must be audible when machines are in use.

Electrical Requirements:

- Outlets, 120-volt, on 12-foot centers, located 48 inches above floor level.
  Note: If three-phase outlets are not used, 120-volt and 240-volt must be used.
- Motors must be over ½ horsepower, 240-volt, three-phase or 208-volt.

Electrical-system Recommendations:

- Overhead bus bars, most flexible, 120- and 240-volt
- In-floor grid, least flexible, 120- and 240-volt
- Master-switch shut-down should provide easy access for emergency shut-down system.
- Means of locking "power off" completely.

Security Requirements:

- Security locks required in laboratory, material storage area, supply room, and teacher's office.
- Burglar alarm system required throughout facility.
- 10-foot chain link fence with 6-foot double gates required for outside construction area.

Windows, Doors, and Floor Requirements:

- Windows on outside walls must be located a minimum of 72 inches above floor level.

- Window or glass walls on inside partitions must be placed a maximum of 42 inches above floor level.
- Sliding mesh window and counter required in tool crib.
- All interior doors must be arranged for safe and efficient traffic flow when door is open.
- Service door, 10 'x 12', is required for material an storage areas.
- Personnel door should be located adjacent to the service door.
- Double doors with no center support required in finish area, construction area, and tool storage area.
- Sealed concrete floors required in laboratory.
- Nonskid flooring material required around machines and in masonry area.

Aesthetic Requirements:

- Walls should have a 6' wainscot of glazed brick, tile, epoxy paint, or semi-gloss enamel.
- Ceilings should reflect light and absorb sound.
- Ceilings should adhere to 12' minimum height guidelines.

Service-area Requirements:

- Overhead door should be located so that it is convenient to assembly area and construction-tool storage.
- Access drive to overhead door required for material and project loading and unloading.
- Parking space should be adequate for bringing or removing projects or materials.

Safety Requirements:

- Safety precautions must be adequate for providing a safe environment for students and teacher.
- Approved fire extinguishers required in all areas of facility.
- Metal cabinets required for storage of flammable liquids.
- Approved self-closing metal containers required for storage of oily waste or rags.
- Fire blanket should be located in finish room.
- Exhaust system required to discharge fumes and dust.
  Note: An explosion-proof system is required in the finish area.
- Overhead exhaust systems recommended in all facility areas.
- Traffic lanes should be marked and left uncluttered.
- Cabinet for safety glasses required for sanitizing goggles and glasses.
- Lockable storage required for storage of hazardous materials.
- Safety glass required for doors, windows within 12 inches of doors, and window walls.
- Sprinkler and fire-detection systems required as specified by state fire codes.

Power Tools and Equipment

A well-equipped, general Building Trades program should have all of the following tools and equipment for general laboratory work. They should be readily available and in sufficient quantity to provide quality instruction.

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum

Radial-arm saw, 12”
Band saw, 20”, 1 horsepower, 240-volt, 3-phase
Table saw, 10” heavy-duty
Contractor’s saw, 10”
Brick saw
Tilting-arbor saw, 10”, 3 horsepower, 240-volt, 3-phase
Masonry saw, 14”, 3 horsepower, 120/240-volt
Jointer, 8” long bed, 1½ horsepower (minimum), 240-volt, 3-phase
Shaper, with various cutters
Surface planer, 18” x 6”, 5 horsepower, 240-volt, 3-phase
Bench grinder, 6”, ½ horsepower, 120-volt
Dado head
Hammer/tacker staple gun
Drill press, 15”, 1 horsepower, 240-volt, 3-phase
Trowel, gasoline, 44” diameter, 3-horsepower
Mortar mixer, 5½ horsepower, 120/240-volt
Air compressor, 60-gallon tank, 5 horsepower, 240-volt, 3-phase
Dust-collection system (connected to all woodworking machines), 240-volt, 3-phase
Exhaust fan (for finish room), explosion-proof, 24”, ½ horsepower, 120-volt
Saw blades: 7¼”, 10”, and 12”
Electric Hand Tools
Portable circular saw
Reciprocating saw
Belt sander, 3 x 21
Sanders: vibrator, bloc, and belt/disc
Compressed-air nailers, finish, box, and staple
Screw gun
Air hose, 3/8” x 50’
Rotary hammer drill
Hinge-butt router template
Portable power plane
Miscellaneous Equipment
Four-station work bench with vise, 1½”, maple top
Glue-clamp bench, 30” x 72”

Electrical work bench
Plumbing work bench
Rebar storage rack
Lumber storage rack
Plywood storage rack, flat storage required
Pipe storage rack
Extension cords: 25", 50", and 100'
Power supply, 4-way
Step ladders: 6', heavy duty; 8'; 10', heavy duty
Extension ladder, 24'
Scaffolding set, 5'
Woodworking vise
Shop table, hardwood-topped

Hand Tools and Equipment

Hammers: claw, trim, frame, shop, ball-peen, and cross-peen
Sledgehammer
Saws: 8- and 10-point, coping, and keyhole
Hacksaw
Pipe wrenches: 10", socket set, Allen wrenches, and combination end wrench set, ¼" to 1 1/8"
Screwdrivers: #1, #2, and #3 standard
Screwdrivers: #1, #2, and #3 Phillips
Torx®-head screwdriver -lock
Pliers: 8" standard, lineman, long-nosed, channel
Vise grips, 10"
Utility knife
Putty knife
Butt gauges: 3½" and 4"
Square-head (Roberson's) screwdriver
Side-cutting pliers
Combination slip-joint pliers
Adjustable wrench
Pipe wrench
Spud (structural) wrench
Ratchet and sockets
Squares: combination, tri-, and framing
Steel framing square, rafter-table
Aluminum walk boards
Levels: 24", 48", torpedo, line, and aluminum – 24" and 48"
Builder's level
Mason's level, 48"
Shovels: square-point, D-handled scoop; round-point, long-handled scoop; and square-point, long handled
Spade (sharp shooter)

Bolt cutter
Wrecking bar
Metal snips
Mattock/grubbing hoe
Pick
Roofing hatchet
Half-hatchet
Axe
Sawbuck (sawhorse)
Bench vise
Wheelbarrow
Brick and tile barrow
Planes: block and jack
Hand brace
Brace bits, set
Wrecking bar, 30”
Wonder bar
Cat claw
Steel measures: 50’ and 100’
Tape measure, ¾” x 16’
Files; various sizes
Rasps: various sizes
Scratch awl
Sliding T-bevel
Nail set, 1/32
Lock set kit
Wrenches: adjustable, open-end, 12” and pip, 14”
Pliers: slip-joint and plug-nose
Dresser, diamond-point
Drill bits, 1/32” to ½”
Wood bits, ¼” to 1”
Wood chisels, ¼” to 1”
Expansion bit
Hydraulic jack, 5-ton

Specialty Tools

Painting/staining equipment
Airless sprayer
Spray guns/cups
Paint pot
Filter/regulator
Fresh-air breathing system
Concrete tools
Trowels: 12” x 3”, 12” x 4”, 14” x 4”
Margin trowels, 5” x 2”

Wood darby: 30” and 48”
Magnesium darby, 30”
Magnesium float, 16” x ½”
Wood float, 18” x 1½”
Rubber or cork float, 8” x 4”
Magnesium bull float, 42” x 8” with six sections of 6” fiberglass handles
Fresno trowel with handles: 24” to 30”
Jitterbug tamper, 36” or 46”
Jointer (groover), 6” x 4½” with 1” bit
Edgers: 6” x 2½” with 3/8” radius; 6” x 3½” with 3/8” radius; and 6” x 4” with ½” radius
Concrete rake, come-along, or placer with handles
Masonry (scaling) hammer
Rubbing brick, 8” x 3½” x ¾”
Knee pads
Nylon texture broom, 18” to 36”, long-handled
Wire texture broom, 36”, long-handled
Exposed-aggregate broom
Floor squeegee, rubber
Water hose: 50’ lengths with regular and fogging nozzles
Buckets: 3-gallon and 5-gallon
Concrete saw, 6-horsepower or larger
Air-compressor, portable
Dry-Wall Tools
Dry-wall compound mixer
Dry-wall T-square
Taping knife
Finishing knives
Mud pan
Corner trowel
Dry-wall sanding tool
Shoe jack
Hawks
Stilts
Acoustical hopper and gun
Banjo
Baby duster
Commercial Forming Tools
Pre-fab wall forming system
Column clamps
Turn buckles
Steel stakes
Wire heads
Purlin splicers
Snap ties

Shore clamps, Ellis
Scaffold brackets
Cam locks
Grasshoppers
Surveying Equipment
Builders level
Transit
Tripod
Leveling rod
Plumb bob
Safety Equipment
Hard hats
Safety glasses
Goggles

Masonry Trades

Facility

AGC recommended Bricklaying facility to accommodate 15-20 students:

Type/Use of Area	Recommended Square Footage
Laboratory plus storage bins for sand, brick, etc. A portion of the floor space consists of a dirt floor.	4000
Outdoor construction area	2000-4000
Storage (tool and small equipment)	300
Storage	200
Classroom/Instruction	700*
Teacher Office/Conference	150
Clean-up/Lockers – Boys	300
Clean-up/Lockers – Girls	300

* State requirement, Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities

Other Space Considerations:

- Space around projects should allow for adequate traffic flow.
- Room design should facilitate supervision.
  Note: Avoid blind spots. Office and classroom should have glass walls facing the laboratory area.
- Door and entryways should facilitate use of wall space.
- Project area should provide adequate space for required projects and practice.
- Facility should be located close to other construction-trades facilities.

Climate-control Considerations:

- Classroom and laboratory should be air-conditioned to keep room temperature at an acceptable level to enhance learning.
- Laboratory should be heated to maintain temperature at 68 degrees during winter months.

Noise-control Considerations:

- Classroom should be isolated from laboratory by location, insulation, or other sound proofing means.
- Noise levels should be kept as low as possible; all equipment should conform with OSHA noise-level requirements.

Illumination Considerations:

- Recommended lighting level for general tasks is 50 to 70foot-candles at working surfaces.

Plumbing Considerations:

- Water plumbing required at the following areas:
  Clean-up area requires hot-and cold-water plumbing.
  Laboratory requires floor drain with sand trap.
- Compressed-air plumbing requires an outlet regulated to 100 psi.

Communications Requirements:

- Telephone located in the teacher's office, signal must be audible in the laboratory.
- Intercom located in teacher's office and in laboratory.
- Clock located in laboratory and classroom.

Electrical Requirements:

- Wall outlets, 110-volt on 12-foot centers, located 48" above floor level.
- Special outlets
  110-volt, 100-amp
- 220-volt, 30-amp

Utility Considerations:

- Dust collectors
- Closed circuit television
- Personal computer

Security Requirements:

- Security locks required in laboratory, material storage area, supply room, and teacher's office.
- Burglar alarm system required throughout facility.
- 10-foot chain link fence with 6-foot double gates required for outside construction area.

Window, Door, and Floor Requirements:

- Windows on outside walls must be located a minimum of 72 inches above floor level.
- Window or glass walls on inside partitions must be placed a maximum of 42 inches above floor level.
- Arrange all interior doors for safe and efficient traffic flow when door is open.
- Service door, 10' x 12', is required for material an storage areas.
- Personnel door should be located adjacent to the service door.
  Note: All walk-in personnel doors should be 40".
- Materials storage-bin doors should provide access from outside service area as well as from inside laboratory.
- Floors: sealed, hardened-concrete, deal-level floors are required in the laboratory.

Aesthetic requirements:

- Walls should have a 6' wainscot of glazed brick, tile, epoxy paint, or semi-gloss enamel.

- Ceilings should reflect light and absorb sound.
- Ceilings should adhere to 12’ minimum height

Service-area Requirements:

- Overhead door should be located so that it is convenient to assembly area and construction-tool storage.
- Access drive to overhead door required for material and project loading and unloading.
- Parking space should be adequate for bringing or removing projects or materials.

Safety Requirements:

- Safety precautions must be adequate for providing a safe environment for students and teacher.
- Approved fire extinguishers required in all areas of facility.
- Metal cabinets required for storage flammable liquids.
- Approved self-closing metal containers required for storage of oily waste or rags.
- Exhaust system required to discharge fumes and dust.
- Traffic lanes should be marked and left uncluttered.
- Approved goggles or glasses required for every student.
- Glasses cabinet required for sanitizing goggles and glasses.
- Lockable storage required for storage of hazardous materials.
- Safety glass required for doors, windows within 12 inches of doors, and window walls.
- Sprinkler and fire-detection systems required as specified by state fire codes.

Power Tools and Equipment

A well-equipped Bricklaying program should have all of the following tools and equipment for general laboratory/shop work. They should be readily available and in sufficient quantity to provide quality instruction.

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Masonry saw, 14" or 20"
Portable masonry saw
Portable tile saw
Portable quick-cut saw
Concrete saw
Skill saw
Blades, carborundum, all sizes
Blades, diamond, all sizes
Skill-saw blades
Drill, ½" and , 7/8
Hammer drill
Mortar mixer
Tuck-pointer grinder
Welder, electric
Troweling machine
Fork lift
Dump flatbed, 1-ton

Hand Tools and Equipment

Note: The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Bricklayer's Hand Tools and Equipment
Tool bag or toolbox
Skate rake
S-jointers, Concave and V
Sled runner, Concave
Sled runner, V
Level, 2' and 4'
Brick set
Chalk line
Mason's line
Line blocks
Line pin and trigs
Trowel, pointing
Brick hammer

Tuck-pointer assortment
Rule, modular
Rule, brick spacing
Steel measure, 100’
Pencil
Hand saw
Rubber gloves
Tin snips
Plumb bob
Chisel, cold
Chisel, plugging
Tile marker
Ceramic/Tile Hand Tools and Equipment
Tile cutter
Trowels, V-notch, all sizes
Trowels, square-notch, all sizes
Hand float, rubber
Nippers, carbide-tipped
Chisel, ¼”, 3/8”, carbide-tipped
Tile hammer, carbide –tipped
Rubbing stone
Aluminum level, 30”
Laboratory Equipment
Shovels, round-point, short-handled and square-point, short-handled
Mortar hoe
Mattock/grubbing hoe
Pick
Pry Bar
Sledgehammer
Brick tongs
Scraper
Mortarboard stand and boards
Mortar box
Brick and tile barrow
Brick dolley
Manual lift pulley
Rope
Ladder
Scaffolding and scaffold planks
Story poles
Speed leads
C-clamps
Acetylene cutting torch
Hydraulic stone cutter

Soap stone
Builder's level
Mechanical maintenance-tool assortment
Wire brush
Acid brush
Shop broom
Rubber boots
Gas can, 2-gallon
Water hose
Extension cord, 100'
Brick, Block, Tile, and Stone Supplies
Common brick
Face brick, king-sized and modular
Lightweight blocks, all sizes
Concrete blocks, all sizes
Decorative blocks, all types
Glass blocks, all sizes and types
Wall and floor tiles (for wet and dry areas), all sizes
Structural tile, all types
Mortars (mastics), dry-set, all types
Grout, all types
Stone, all types (rubble, cut, precast, slate, marble, granite)
Concrete all types
Lumber Supplies
Plywood for mortarboard, ¾"
Scaffold planks, 2" x 12" x 10', #2 yellow pine or better
Mixing Materials
Masonry cement
Portland cement
Hydrated lime
Sand
Gravel
Hardware cloth (for screening)
Steel Supplies
Angle iron, all sizes
Anchor and foundation bolts, all sizes
Rebar (for reinforcement), all sizes
Wall Ties Supplies
Cavity-joint reinforcement, various sizes
Corrugated veneer, various sizes
Dovetail anchors, various sizes

Rectangular ties, various sizes
Z-ties, various sizes
Miscellaneous Supplies
Flashing materials, all types
Flue-lining materials
Line nylon
Nails, assorted sizes
Waterproofing compound
Cleaning solution

Concrete Laying and Finishing

Facility

AGC recommended Concrete Masonry facilities for 16-20 students.

Type/Use of Area	Recommended Square Footage
Laboratory	3600
Equipment Storage room	400
Materials storage room	400
Outdoor construction area	5000
Classroom/Instruction	700*
Teacher Office/Conference	150
Clean-up/Locker area	100

* State requirement, Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities.

Other Space Considerations:

- AGC recommends that one-half of the floor space consist of dirt floor.
- Avoid blind spots. Office and classroom should have glass walls facing laboratory area.
- Assembly space required for the construction of wall sections, forms, etc.
- Doors and entryway placement should facilitate use of wall space.
- Space around power equipment should allow for traffic flow.

Climate-control Considerations:

- Evaporative cooling recommended, with rust-prevention maintenance required on machines and tools.
- Heating and air-conditioning should be provided in classroom and teacher office areas to keep room temperatures at acceptable levels to enhance learning.

Noise-control Considerations:

- Classroom should be isolated from laboratory by location, insulation, or other sound proofing means.
- Equipment should conform to OSHA's noise-level regulations.

Illumination Considerations:

- Lighting levels should be adequate to meet requirements for both daytime and nighttime uses in laboratory, classroom, and storage areas.

Plumbing Considerations:

- Water Plumbing:
  Hose bibb near mixing area requires both hot-and cold-water plumbing.
  Finish area requires cold-water plumbing.
  Water fountain requires cold-water plumbing.

Hose bibb near overhead door requires cold-water plumbing.
Washbasin in clean-up area requires both hot- and cold-water plumbing.

- Compressed-air Plumbing:
  1 outlet regulated from 0 psi to 50 psi and equipped with a water separator.
  4 outlets regulated from 0 psi to 120 psi
- Floor drain required in laboratory.

Communications Requirements:

- Telephone located in the teacher's office, signal must be audible in the laboratory.
- Intercom located in teacher's office and in laboratory.
- Clock located in laboratory and classroom.
- Bell/alarm system located in classroom and laboratory must be audible when machines are in use.

Electrical Requirements:

- 110-volt, 200-amp outlets located conveniently throughout laboratory.

Security Requirements:

- Security locks required in laboratory, material storage area, supply room, and teacher's office.
- Burglar alarm system required throughout facility.
- 10' chain-link fence with 6' double gates required in outdoor construction area.
- Windows on outside walls must be located a minimum of 72 inches above floor level.
- Window or glass walls on inside partitions must be placed a maximum of 42 inches above floor level.
- Sliding mesh window and counter required in tool crib.
- Arrange all interior doors for safe and efficient traffic flow when door is open.
- Service door, 12' x 14', is required in laboratory.
- Personnel door should be located adjacent to the service door.
  Note: All personnel doors should be 48".
- Double doors with no center support required in finish area, construction area, and tool-storage area.
- Laboratory floors are required to be sealed, hardened concrete.

Aesthetic requirements:

- Walls should have a 6-foot wainscot of glazed brick, tile, epoxy paint, or semi-gloss enamel.
- Ceilings should reflect light and absorb sound.
- Ceilings should adhere to 12' minimum, height

Service-area Requirements:

- Overhead door should be located so that it is convenient to assembly area and construction-material storage.

- Access drive to overhead door required for material and project loading and unloading.
- Parking space should be adequate for bringing or removing projects or materials.

Safety Requirements:

- Safety precautions must be adequate for providing a safe environment for students and teacher.
- Approved fire extinguishers required in all areas of facility.
- Metal cabinets required for storage of flammable liquids.
- Approved self-closing metal containers required for storage of oily waste or rags.
- Fire blanket should be located in finish room.
- Exhaust system required to discharge fumes, smoke, and dust.
  Note: Overhead exhaust systems are recommended in all facility areas.
- Traffic lanes should be marked and left uncluttered.
- Approved respirators required for every student.
- Approved ear protection required for every student.
- Safety helmet required for every student.
- Overshoes or boots required for every student.
- Rubber gloves required for every student.
- A cabinet for safety glasses is required for sanitizing goggles and glasses.
- Lockable storage required for storage of hazardous materials.
- Safety glass required for doors, windows within 12 inches of doors, and window walls.
- Sprinkler and fire-detection systems required as specified by state fire codes.
- First-aid kit should be located for easy access in emergencies.

Hand Tools and Equipment

A well-equipped Concrete Masonry program should have all of the following tools and equipment for general laboratory/shop work. They should be readily available and in sufficient quantity to provide quality instruction.

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Form-setting Tools (Standard Tool Kit)
Toolbox or tool bag
Claw hammer
Sledgehammer
Cross-cut saw
Hacksaw
Half hatchet
Magnetic nail driver
Side-cutting pliers
Adjustable wrench

Folding rule, 6’
Steel tape, 12’ to 16’
Steel tape, 100’
Dry line (stringline)
Chalk box and reel
Framing square
Combination square
Spirit level, 24” to 48”
Torpedo level
Pencil and keel
Finishing Tools (Standard Tool Kit)
Tool bag
Trowel, 12” x 3”
Trowel, 12” x 4”
Trowel, 14” x 4”
Margin trowel, 5” x 2”
Magnesium float, 16” x 3½”
Wood float, 18” x 3½”
Rubber (or cork) float, 8” x 4”
Jointer (groover), 6” x 4½” (with I” bit)
Edger, 6”x 2½” (with 3/8” radius)
Edger, 6” x 3½” (with 3/8” radius)
Edger, 6” x 4” (with ½” radius)
Masonry (or scaling) hammer
Chisel, ¾” x ¾” bit
Chisel. 10” x 1 7/8” bit
File, 12” or 14”
Rubbing brick, 8” x 3½” x ¾”
Knee pads
Knee boards
Work gloves
Miscellaneous Tools
Mortar hoe, heavy-duty
Pick (or mattock)
Single-bit axe
Compressed-air sprayer
Caulking gun, cartridge-type
Screed (straightedge), 4’ to 16’
Paver’s straightedge, 10’ to 12’
Magnesium bull float, 42” x 8” (with six sections of 6” fiberglass handles)
Fresno trowel (with handles), 24” to 30”
Wood darby, 30”
Wood darby, 48”
Magnesium darby, 30”

Jitterbug tamper, 36” or 46”
Jointer
Lathe
Molder
Miter box
Concrete rake, come-along, or placer with handle
Nylon texture broom, 18” to 36”, long-handled
Wire texture broom, 36”, long handled
Exposed-aggregate broom
Floor squeegee, rubber
Water hose, 50” lengths with regular and fogging nozzles
Bucket, 3 gallon
Bucket, 5 gallon
Extension cord, heavy-duty
Mud and epoxy mixer blades
Safety belt and harness
Twist-drill bits
Masonry bits
Speed-bore bits
Mortar box
Wood clamps
Stair gauge (angle)
Plane
Mallet
Framing square
Ladder

Power Tools and Equipment

Bench-top tilt-arbor saw, 10”
Concrete saw, 6 horsepower or larger
Radial-arm saw, 3 horsepower or larger
Portable circular saw, electric, heavy-duty, 7¼” to 8”
Jigsaw
Band saw
Saber saw
Scroll (stroke) saw
Disc sander
Belt sander
Combination disc/belt sander
Portable disc sander
Portable belt sander
Oscillating spindle sander
Sander/grinder, heavy-duty, 2.25 horsepower or larger
Portable hand-held vibrator/sander
Hand-held hammer drill, electric, 3/8”

Hand-held drill moor, electric, 3/8”
Hand-held drill motor, electric, ½”
Utility drill
Rock drill
Grinder, heavy-duty, ½ horsepower or larger
Concrete grinder, flexible-shaft, electric-engine or 3 horsepower, 4-cycle, air-cooled gasoline engine
Hand-held planer
Thickness planer (surfacer)
Mortiser
Router
Portable router
Press
Shaper
Stapler/tacker
Rotary hammer, heavy-duty, 2½” kit
Screw gun, electric
Trowel (with float and trowel blades), 36”
Trowel (with float and trowel blades, 42”
Tilting concrete mixer, 6-cubic foot capacity or larger
Screed
Vibrator, electric-engine or air-cooled gasoline-engine
Paving breaker
Demolition tool
Generator, air-cooled gasoline engine
Sprayer, electric
Wet/dry vacuum cleaner

Supplies

Form Materials:
2x4s, 8’ 10’, 12’ and 16‘
2x6s, 12’ and 16’
2x8s, 12’
2x10s, 12’
1x4s (for braces and stakes) 16’
Plywood, 4” x 8”, ¾” BB, class I and II
DFPA
Expansion Materials:
½” x 4” x 5’
½” x 6” x 5’
½” x 8” x 5’
Concrete Ingredients:
Portland cement

Masonry sand
Pea gravel (aggregate), ¼” or less
Coarse aggregate, ¾”
Crushed stone
Reinforcing Steel:
Welding-wire fabric, 6 x 6 W2.4 x W1.4 rolls
Reinforcing rods, 3/8” (0.375)
Reinforcing rods, 5/8” (.0625)
Surveying Equipment
Transit
Combination level/transit
Builder’s level
Tripod
Leveling rod
Plumb bob

Electrical Trades
Residential Electrical Wiring

Facility

AGC recommended Electrical Technology facilities to accommodatre16-20 students.

Type/Use of Area	Recommended Square Footage
Laboratory	5000
Tool Crib	200
Storage Room	500
Classroom/Instruction	700*
Teacher Office/Conference	150
Clean-up/Locker Room	200

* State requirement Chapter 61 School Districts § CC. Commissioner's Rules Concerning School Facilities.

Other Space Considerations:

- Electrical Trades/Residential Electrical Wiring laboratory should be located near the welding area to share a common fabrication space.
- Office and classroom should have glass walls facing laboratory area to facilitate supervision.
- Doors and entryways should facilitate use of wall space.
- Space around power equipment and work areas should allow for adequate traffic flow.

Climate-control Considerations:

- Laboratory should be heated to maintain room temperature at 68 degrees during winter months.
- Classroom and teacher's office should be heated and air-conditioned to maintain room temperature at an acceptable level to enhance learning.

Noise-control Considerations:

- The electrical technology laboratory is a medium noise-level areas and the design and location of the laboratory should facilitate keeping noise levels at or below the medium level.

Illumination Considerations:

- General task lighting should be maintained at 50 to 70 foot-candles at the working surface.

Plumbing Considerations:

- Water Plumbing required in the following areas:
  Restroom and dressing areas require both hot-and cold-water plumbing.
  Water fountain requires cold-water plumbing.
  Wash basin in clean-up area requires both hot- and cold-water plumbing.

Eyewash area in lab requires cold-water plumbing.
- Drain located in laboratory area.

- 100 psi compressed-air plumbing required in laboratory area.

Communications Requirements:
- Telephone located in the teacher's office, signal must be audible in the laboratory.
- Intercom located in teacher's office and in laboratory.
- Clock located in laboratory and classroom.

Electrical Requirements:
- Regular wall outlets, 110-volt on 8' centers, located 42" above floor level.
- Special outlets required include: 120-volt and 240-volt, 100-amp; 277-volt and 480 volt, 200-amp, with transformer capacity for any construction.
  Note: Other heavy power requirements should be determined after approval of equipment lists.
- Keyed master-switch shutoff switch, panic button, GFCI-protected 110-volt.

Security Requirements:
- Security locks required in storage room provided with supplies and in tool crib, where tools and test equipment will be stored.

Window, door, and floor Requirements:
- Windows on outside walls must be located a minimum of 72 inches above floor level.
- Window or glass walls on inside partitions must be placed a maximum of 42 inches above floor level.
- Sliding mesh window and counter required in tool crib.
- All interior doors must be arranged for safe and efficient traffic flow when door is open.
- Service door, 10' x 10', is required in laboratory.
- Personnel door should be located adjacent to the service door.
  Note: All personnel doors should be 48".
- Laboratory floors are required to be sealed, hardened concrete.

Aesthetic requirements:
- Walls should have a 6-foot wainscot of glazed brick, tile, epoxy paint, or semi-gloss enamel.
- Ceilings should be painted a light neutral color.
- Super-graphics may be used to identify various facility areas.
- Ceilings should adhere to 12' minimum height.

Service-area Requirements:
- Overhead door should be located so that it is convenient to assembly area and construction-tool storage.

- Access drive to overhead door required for material and project loading and unloading.
- Parking space should be adequate for bringing or removing projects or materials.

Safety Requirements:

- Safety precautions must be adequate for providing a safe environment for students and teacher.
- Approved fire extinguishers required in all areas of facility.
- Metal cabinets required for storage of flammable liquids.
- Approved self-closing metal containers required for storage of oily waste or rags.
- Exhaust system required to discharge fumes, smoke, and dust.
  Note: An explosion-proof system is required in the finish area.
- Traffic lanes should be marked and left uncluttered.
- Approved goggles or glasses required for every student.
- A cabinet for safety glasses is required for sanitizing goggles and glasses.
- Lockable storage required for storage of hazardous materials.
- Safety glass required for doors, windows within 12 inches of doors, and window walls.
- Sprinkler and fire-detection systems required as specified by state fire codes.
- First-aid cabinet should be located for easy access in emergencies.
  Note: The first-aid cabinet should be accessible only to teacher.
- Outside and inside facility warning signs for people wearing contact lenses that electrical arcs will immediately dry out surface of the eyes and fuse contact lens to eye surface.

Tools and Equipment

A well-equipped Electrical Technology program should have all of the following tools and equipment for general laboratory/shop work. They should be readily available and in sufficient quantity to provide quality instruction.

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Training Equipment and Instrumentation
Student wiring boards
DC ammeter, 0-3-30 amps
DC voltmeter, 0-1.5-15-150-volt,
AC voltmeter. 0-2.5-25-250-volt
Universal galvanometer
Reference standard meter, DC amp-1/2%
Reference standard meter, AC amp-1/2%
Demonstration meter, 1 movement, 10-½" scale, c/w interchangeable scales, 2 DCA, 2 DCV, 1 ACA, 1 ACV, 1 Galvo, 1 ohm
Demonstration meter, DC voltmeter, ranges 0-15-150-volt
Meter movement demonstrator, AC ammeter, ranges 0-1-5-amp, moving vane
Meter movement demonstrator, Wattmeter, ranges 0-750-1500
Portable wattmeter, single-phase, 0.5-2.5-amp, 60/120-volt, AC
Insulation tester
Stop watch
Lab Equipment
Drill, ¼" and ½"
Drill-bit set, ½" x 1/16"
Drill press, 15", hand-fed
Bench grinder, 6"
Planer, 13" x 6"
Jointer, 6"
Radial-arm saw, 10"
Table saw, 10"
Saber saw, heavy-duty
Skill saw, 7"
Reciprocating saw, electric
Power miter saw
Power router kit, heavy-duty
Belt sander, heavy-duty, 4" x 24"
Steel tape, 100'
Claw hammers, 13 oz .and 6 oz.
Hammer, #4
Hand brace, heavy-duty
Wood bit set, ¼" through 1"

Expansion bit, 7/8” through 3” hole
Aluminum levels, 24” and 48”
Builder’s level
Steel framing square, rafter-table
Combination square
Aluminum walk boards
Pipe wrench, 14”
Wrench, adjustable, open-end, 12
Pliers, slip-joint and plug-nose
Dresser, diamond-point
Pipe vise
Soldering gun, heavy-duty
Flaring set
Rubber mallet
Propane torch
Compressed-air nailing gun
Punch and chisel set
Airless paint rig
Safety glasses or goggles

Electrician’s Basic Tool Kit

Tool pouch and belt
Hard hat
Safety glasses
Wrenches, 8” adjustable and 16” pipe
Allen wrench set, large
Drill, electric, ½”,
Drill, ¾”- or 1”, ship auger
Drill, hand brace
Pliers, 10” slip-joint, diagonal, lineman’s and needle-nosed
Screwdrivers, 4”, 6”, 8”, and 12” Standard (flat-blade), plastic-handled
Screwdrivers, 4” and 6” Phillips, #1 and #2 point
Screwdrivers, Kline, 3/16”, ¼”, and 5/16” blades
Awl, metal
Pipe bender, ½” and ¾”
Portable band saw
Bolt cutter, small
Chisel, wood
Crimper, terminal
Hacksaw
Hammer, straight-claw
Hole-saw set
Knife, electrician’s
File, rat-tail, 3-corner, flat
Nut driver

Puller, fuse
Wire strippers
Rule, folding
Tape measure
Multimeter, volt/ohm/amp

Supplies

Abrasives:
Aluminum-oxide cloth, 100- and 240-grit sheets
Emery cloth, coarse (#12 to #24), sheet-type
Emery cloth, medium (#30 to #60) sheet-type
Emery cloth, fine (#70 to #120) sheet-type
Adhesives:
Electrical tape
Masking tape
Plastic cement
Cutting:
Blades, hacksaw, 18-teeth and 24-teeth
Cutting oil
Lighting devices:
Ballast, Fluorescent, 40-watt, 115-volt
Bulb, Incandescent lamp, 40-, 60-, 100-, and 150-watt, 155-volt
Lamp, Fluorescent, 40-watt, 48" x 1 ½" bipin preheat-type
Lamp, Fluorescent, 40-watt, 48" x 1½", bipin rapid start
Lamp, Infrared, 250-watt, 120-volt, medium base
Spot lamp, Incandescent, 150-watt, 115-volt
H. I. D. lighting
Fixtures:
Bases, lamp, medium
Bases, lamp, miniature-screw type
Boxes, conduit, ½" size, 4" x 2 1/8"
Boxes, outlet, ½", ¾", 1" K.O.
Boxes, receptacle, single duplex
Boxes, switch, 2 1/8" x 4", ½", ¾", and 1" K.O.
Receptacles, duplex and single
Electrical Control:
Circuit breakers, various sizes
Fuses, cartridge, renewable-type, 15-, 20-, 30-, 40- and 55-amp
Fuses, plug, 5-, 25-, 20-, and 30- amp
Starters, fluorescent, to-watt, 115-volt, reset
Starters, fluorescent, 40-watt, 155-volt, standard

Switches, single-pole, T-rated, 10-amp, 125-volt
Switches, 3-way, T-rated, 10-amp, 125-volt
Switches, 4-way, T-rated, 5-amp, 125-volt
Fittings:
Conduit, EMT, ½", ¾", and 1'
Conduit, Flexible-steel, ½", ¾" and 1"
Conduit, Rigid ½", ¾" and 2" galvanized
Conduit, PVC, ½", ¾", 1" and up to 3"
Conduit, ENT, ½"and ¾"
Connectors, B-X cable, ½"
Connectors, EMT, ½", ¾" and 1" set-screw-type
Connectors, EMT, ½", ¾" and 1" 2-piece steel
Connectors, Flexible-steel, ½", ¾" and 1" squeeze-type
Connectors, Split-bolt, assorted
Connectors, ENT
Couplings, EMT, ½" ¾" compression-type
Couplings, EMT, ½", ¾" and 1" indenter-type
Couplings, ENT
Insulators, EMT, ½", ¾" and 1" insulated-throat, compression-type
Steel straps, EMT ½", ¾" and 1", one-hole type
Soldering
Acid swab
Flux, non-corrosive-paste type
Muriatic acid
Sal ammoniac
Solder, Acid-core, 50/50 and 60/40
Solder, Rosin-core, 50/50 and 60/40
Wire
Cable, entrance, #6
Masking tape, 1" and 1½"
Plastic tape, ½", 1", and 1½"
Wire, single conductor, #12 and #10 Thhn, black
Wire, #3, #3/0, and #2/0 Thhn
Wing nuts, 451, 452, 453
Cable, NM 12/2-, 12/3- 10/2-, 10/3-, 8/2- 8/3- and 6/2 w/gr

Heating, Ventilation, Air Conditioning, and Refrigeration

Facility

AGC recommended Heating/Air Conditioning facilities for 16-20 students:

Type/Use of Area	Recommended Square Footage
Laboratory	4700
Tool Room	300
Storage, materials and supplies	400
Clean-up/Locker Room	300
Classroom/Instruction	700*
Teacher Office/Conference	150

* State requirement Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities.

Other Space Considerations:

- Office and classroom should have glass walls facing laboratory area to facilitate supervision.
- Doors and entryways should facilitate use of wall space.
- Space around power equipment and work areas should allow for adequate traffic flow.

Climate-control Considerations:

- Classroom and laboratory should be provided with heat and air conditioning systems to keep temperatures at an acceptable level to enhance learning.
- Refrigerated cooling is recommended with rust-prevention maintenance required on machines and tools.

Noise-control Consideration:

- Equipment with a high-operational noise level should be located in secure area outside the laboratory.
- Large industrial equipment should meet OSHA noise-level regulations and be installed following manufacturers' recommendations.

Illumination Considerations:

- Lighting must be adequate to meet requirements of both daytime and nighttime uses of laboratory, classroom, and storage areas.
- Natural lighting (skylights) should be used to provide energy-efficient illumination whenever possible.
- Artificial lighting must not affect coloration determination.

Plumbing Considerations:

- Water plumbing as follows:
  Outlets on each wall in laboratory require both hot- and cold-water plumbing.

Manifold with plugged-tee fittings every 3' requires cold-water plumbing running entire length of commercial equipment.
Freeze-proof hose bibs located in outside storage area require cold-water plumbing.

- Compressed-air plumbing as follows:
  Laboratory requires a minimum of three (3) locations on each wall.
  Outside laboratory requires an air station with hose storage adjacent to outside regulator.
  Each student workstation requires low-pressure air that is filtered and dried before distribution.
- Drains as follows:
  Commercial equipment area requires 4" (minimum size) floor drains for every 100 square feet of floor space.
  Each student workstation requires a 2" plugged drain to be used only as condensate drain
- Natural gas plumbing as follows:
  Laboratory requires outlets on each wall.
  Outside storage area requires stud-outs to facilitate installation of gas-fired refrigeration unit.

Communications Requirements:

- Telephone located in the teacher's office; remote signaling device should be located in laboratory and storage areas.
- Intercom/paging system should be located in teacher's office, laboratory and storage room.
- Clock (72" diameter, set and synchronized centrally) located in laboratory and classroom.
- Intrusion, fire, and high water alarm system should be located in teacher's office, classroom, and laboratory.

Electrical Requirements:

- Outlets required in laboratory:
  240-volt, single-phase outlet with grounded neutral conductor
  220- and 240-volt, three phase
  120-volt
  208-volt
- Each student workstation requires a 240-volt single-phase outlet and a 120-volt outlet.
- Commercial-equipment area requires a 200-amp, 240-volt, three-phase breaker panel.
- Each piece of heavy-current draw equipment requires additional disconnect panel.
- Teacher's office requires a minimum of two panic electrical-system switches on all four walls.

Security Requirements:

- Security locks required on laboratory storage, and teacher's office.

- Keyed locks required on door from classroom to laboratory to allow use of classroom without access to other facility areas.
- Burglar-alarm system recommended throughout facility.

Windows Doors, Floor, Wall, and Ceiling Requirements:

- Windows should be provided in classroom, laboratory, and office areas.
- High windows and skylights are recommended in the laboratory.
- Windows are not recommended in storage areas that require high security
- Windows in the classroom should be shaded to allow for effective viewing of audiovisual presentations.
- Double doors with a minimum of 6' of open access required in the laboratory.
- A-grade, level 10' x 10' overhead open access recommended in laboratory.
- Sealed concrete floors recommended in laboratory.
- Tile floors recommended in classroom and teacher's office.
- Concrete floors preferred in outside storage and work areas.
- Walls in classroom and laboratory should have a 6' wainscot of washable, high-impact resistant epoxy-based paint.
- Suspended-panel ceiling with recessed lighting and climate-control venting required in classroom and tool-storage area.
- Ceiling height in classroom should facilitate use of overhead projection system.
- Ceiling height in laboratory should facilitate ductwork and service drops to student workstations.

Safety Requirements:

- Safety glass required on doors, windows within 12" of doors, and windows walls.
- Sprinkler and fire-detection systems required as specified by start fire codes.
- Exhaust system required above arc-welding area and oil-fired trainer area.
- Ductwork to the outside required at each gas-fired furnace.
- A minimum of 48" wide lanes for material transport is required around student workstations.
- Safety aisles required around each piece of laboratory equipment.

Hand Tools and Equipment

A well-equipped Heating/Ventilation/Air Conditioning/Refrigeration program should have all of the following tools and equipment for general laboratory/shop work. They should be readily available and in sufficient quantity to provide quality instruction.

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Drill motor, variable speed, reversible
Drill bits set, 1/64" to 3/8"
Hacksaw and blades
Soldering gun, 200-325 watt
Tape, 12'
Ace-Oxg welding set, portable
Halide torch
Flaring tool and swaging set, ¼" to 5/8"
Junior tube cutter
Tubing cutter, 1/8" to 1 1/8"
Gauge manifold set complete with 36" charging hoses
Fin combs, complete set
Heat gun, 500-degree to 700-degree range
Pinch-off Tool
Pocket thermometer, 20 to 180 degrees F.
Pair of scales, up to 250 pounds
Simpson 260-6P meter
Amprobe, RS-3
Amprobe voltprobe VT-124, 24-volt to 600-volt
Vacuum pump, 3 cubic inch
Silver solder, 3 T.O., 45%
Stay silver, 1 pound, #15 brazing rod
Stay flux
Plumber abrasive
Leak lock
Set of 9 screwdrivers
Starting screwdriver
Plum level, 6"
Set of combination box end and open end wrenches ¼" through 1 /1/8"
Pitman arm separator
Set of Allen wrenches, short
Set of Allen wrenches, long
Ratchet wrench, ¼"
Set of valve stem sockets
Adjustable wrenches, 4", 6", 8", 10" 12"
Pliers, vice grip, 7"
Pliers, common, 7"

Pliers, side cutters, channel lock, and lineman
Oil can
Flashlight
Mirror
Tape, duct, plastic, friction
Refrigerant oil, 150 and 300
Hand cleaner
Copper, ¼" 3/8", ½", and 5/8"
Flare nuts and fitting, assortment
R-12, 30-pound cylinder
R-22, 25-pound cylinder
R-11, 25-pound cylinder
R-502, 25-pound cylinder
Millivolt meter
Tube benders, ¼", "3/8", ½", and 5/8"
Tin snips, left-handed and right-handed
Offset screwdriver, slotted and Phillips
Screwdrivers, set, 3/16", ¼", 5/16" 11/32" 3/8"
Extension cord, 25' and 50'
Trouble light
Solder, rosin core and 95.5
Service bed on pickup
Hard start kit, 115-volt and 230-volt
Acid tester
Temperature recorder, 20 degrees to 200 degrees
Wire connectors, assortment
Roll of 5 wire control wire
Test light screwdriver
Liquid line driers, assortment
Seal tight Greenfield and connectors, ½" and ¾"
Solid wire, #10, #12, #14, #8
Sweat fittings, copper assortment of popular sizes
Clipboard
Drive socket sets, ¼", 3/8", ½"
Pipe wrenches, 6", 12", 14", 18", 24"
Wrench, 15" adjustable
Fox tail brush
Drop cloths
Hand rags, ample supple

Piping Trades/Plumbing

Facility

AGC recommended Plumbing facilities for 16-20 students:

Type/Use of Area	Recommended Square Footage
Laboratory	3000
Outdoor Construction Area	3000
Secured Outdoor Storage Area	1000
Tool Crib	250
Storage Room	500
Clean-up/Locker Room	300
Classroom/Instruction	700*
Teacher's Office/Conference	150

* State requirement Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities.

Other Space Considerations:

- Laboratory design should facilitate supervision; blind spots should be avoided.
- Office and classroom should have glass walls facing laboratory area.
- Doors and entryways should facilitate use of wall space.
- Laboratory space should be sufficient to accommodate skills practice.
- Classroom design should facilitate effective use of media equipment.

Climate-control Considerations:

- Classroom and teacher's office should be provided with both heating and air conditioning adequate to maintain room temperature at an acceptable level to enhance learning.
- Laboratory should be heated to maintain room temperature at 68 degrees in the winter months.

Noise-control Considerations:

- Classroom should be isolated from laboratory by location, insulation, or other sound proofing means.
  Note: The plumbing lab is a high-noise level area and should be isolated as much as possible from parts of the facility where a quieter environment is required.
- Equipment-noise level should conform to OSHA noise-level regulations.

Illumination Considerations:

- The recommended lighting level is 50 to 70 foot-candles at working surface.

Plumbing Considerations:

- Water plumbing required in the following areas:
  Service sink requires both hot- and cold-water plumbing.
  Half-round basin in clean-up area requires both hot- and cold-water plumbing.

Hose bibb near overhead door and in mock-up area requires cold-water plumbing.
Classroom requires cold-water plumbing.
Water fountain requires cold-water plumbing.

- Compressed-air plumbing is laboratory requires four outlets regulated from 0 psi to 120 psi.
- Drains throughout laboratory require 3" minimum diameter.

Communication Requirements:

- Telephone located in teacher's office; signal must be audible when machines are in use.
- Intercom located in laboratory and in classroom.
- Clock located in laboratory and classroom.
- Bell/alarm system located in classroom and in laboratory; sound must be audible when machines are in use.

Walls, Doors, Floor, and Ceiling Requirements:

- Walls should be painted with a flat, low-gloss enamel and have a 6' wainscot of high-impact epoxy.
- Arrange all interior doors for safe and efficient traffic flow when door is open.
- Service door, a 10' x 12' overhead door, is required in laboratory area.
- Personnel door should be located adjacent to service door.
  Note: All personnel doors should be 48".
- All ceilings should adhere to a minimum-height requirement of 12'.
- Floors should be sealed, hardened concrete.

Service-area Requirements:

- Overhead door should be located so that it is convenient to assembly area and construction-tool storage.
- Access drive to overhead door required for material and project loading and unloading.
- Access drive should be adequate to allow for easy maneuverability of heavy equipment.
- Parking space should be adequate for bringing or removing projects or materials.

Safety Requirements:

- Safety precautions must be adequate for providing a safe environment for trainees and teacher.
- Approved fire extinguishers required in all areas of facility.
- Metal cabinets required for storage of flammable liquids.
- Approved self-closing metal containers required for storage of oily waste or rags.
- Exhaust system required discharge fumes and dust.
- Overhead exhaust systems recommended in all facility areas.
- Approved goggles or safety glasses required for every student.

- A cabinet for goggles or safety glasses is required for sanitizing goggles and safety glasses.
- Lockable storage is required for storage of hazardous materials.
- Safety glass required for doors, windows within 12” of doors, and window walls.
- Sprinkler and fire-detection systems required as specified by state fire codes.

Power Tool and Equipment

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Arc-welding unit, 180-amp, 50-cycle stick welder with accessory kit
Acetylene welding unit, Smith SS315 (complete)
Oxyacetylene torch
Propane torch (#LP-99)
K1 turbo torch kit and tank
Cylinder truck
Welding curtains with 4.4.4 wings
Hot-air torch
Bench grinder, 7", ½ horsepower, complete with stones
Grinders, pedestal and portable
Face shield
Rotary hammer drill
Drill, ½", heavy-duty, electric
Drill-bit set
Expansive bits, 7/8" to 3"
Ladle, 4"
Pipe die set, 1/8" to 2"
Pipe machine
Flaring and swaging set
Asbestos lead joint runners
Power saw, super-duty, 7 ½"
Reamer unit
Soldering gun
Personnel hoist or lift
Pipe taps
Pipe-threading dies
Pipe vise
Air compressor and attachments
Test pump
Test equipment
Mercury gauge (gas-testing)
Melting furnace
LP 253 bench base
LP 852 furnace with hood
LP 912, #29 cylinder
LP 3028 hose, 12"
Lead pots, 8"
Post-hole digger/boom/backhoe/bucket/blade
Ratchet level hoist, 3-ton
Power machine
Sewer machine

Rodding equipment
Handlebar (walk-behind) trencher
Backhoe
Closet auger
Pipe reamer
3-way pipe threader
Pipe cutter
Wheel-strand unit for pipe master
Reamer for pipe master (slide-in)
Band saw
Porta-band
Nipple chucks
Portable generator
Portable chop saw
Space heater
Heat fusion tool (for PE-gas piping)
Polybutylene-pipe crimping tool
T-handle torque
Caulking and packing irons
Chain-pipe tong
Chain vise
Dividers or trammels
Surveying Equipment
Transit
Tripod
Plumb bob

Hand Tools and Equipment

Wrenches: assorted sizes, 3/8” to 1¼”, combination box- to open-end
Wrench set, offset hex
Tub socket wrench
Strap wrench
Pipe wrenches, straight, 12”, 14”, 24”, and 36”
Pipe wrench, offset, 14”
Crescent wrenches, 6”, 10”, 12”, and 16”
Specialty basin wrench
Chisels: ¾” and 1”, all-steel
Wood chisel set
Slip joint pliers: 10’, 12”, and16”, grooved-joint
Diagonal-cutting pliers, heavy-duty, 7”
Side-cutting pliers, 8”, crescent
Pliers, 3-way wire-cutting/slip-joint combination, 8”
Ball-peen hammers: 12 oz. and 16 oz.
Rip-claw hammer, 15 oz.

Slag hammer
Punches: ¼", 5/16", 3/8", ½", and 5/8"
Four-in-one screwdrivers: assorted sizes, regular and Phillips
Tubing cutters: 3/16" to 1 1/8" (#20)
Tubing cutters: 1/8" to1" (#10)
Tubing cutter, close-quarter, small
Pipe cutters
Soil pipe cutter, 2" to 6"
Saw, 26"
Hacksaw, adjustable, pistol-grip handle
Plumber's hole-saw kit
Reciprocating saws, all sizes
Plastic-cutting saw
Compass saw, 12" blade
Level, 24" aluminum
Spirit level
Steel tape, 12' and 100'
Rules, circumference and folding
Squares: framing, combination, and carpenter's
Tin snips, 10" and bulldog
Oil can, 7/8-pint capacity
Shovels, assorted sizes
Wheelbarrows
Mortar-mixer hoe, 2-hole
Auger
Scaffolds
Ladders
Sling and hoist
Putty knives
Files, assorted sizes
Chalk line
Pipe threader
Marking awl or scratch awl
Shears
Mattock
Plumber's wood-bit set
Tri-stand with vise
Bench vise, large
Seat dresser
Caulking iron
Packing tool
Clean-out, 3/8" x 50' and 1½" to 3'
Scriber
Vacuum plunger
Turnbuckles and clamps
Assorted fastenings

ELECTRONICS SYSTEMS

Electronics

Facility

Type/use of space	Recommended Square Footage
Laboratory	2000-2400
Classroom/Instruction	700*
Storage	300
Teacher Office/Conference	150
Clean-up/Restroom/Lockers – Boys	40-50
Clean-up/Restroom/Lockers– Girls	40-50

*State requirement Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities.

Special Considerations:

1. Work benches that accommodate computer-based instruction with storage for circuit boards and other materials.
2. Quadraplex outlets 6' on center on work benches along side walls
3. Room-darkening shades for use with LDCs.
4. Compressed air supply

Equipment List
Basic Electronics Core Curriculum

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

	DC Circuits	AC Circuits	Semiconductor Devices	Digital Fundamentals
Bench Equipment:				
Optimal: 1 station per student				
Acceptable: 1 station per 2 students				
Dual DC power supply	X	X	X	X
Function generator		X	X	X
Dual trace oscilloscope		X	X	X
10 X probes for oscilloscope 2 each		X	X	X
1 X probes for oscilloscope/signal generator		X	X	X
Leads for DC source, 2 sets	X	X	X	X
Digital Trainers				X
Logic probe				X
22-24 gauge, solid wire, several colors	X	X	X	X
Optional Equipment:				
LCR meter, 2 for program		X	X	
Hand Tools/ Equipment:				
Protoboard	X	X	X	X
Digital meter with leads	X	X	X	X
Clip leads, 14 " length, w/mini chips	X	X	X	X
Scientific calculator	X	X	X	X
Needle nose pliers, 3"and 4"	X	X	X	X
Screwdriver, 1/4" blade x 4" shaft	X	X	X	X
Screwdriver, Phillips #4	X	X	X	X
Wire strippers, size 22-30 gauge	X	X	X	X
Graph paper, 10/inch	X	X	X	X
Convenience Hand Tools:				
5 ' diagonal cutting pliers	X	X	X	X
Ruler, 12" with metric	X	X	X	X
Low wattage soldering iron w/ stand	X	X	X	X
Desoldering braid	X	X	X	X
Solder, ½ lb. Spool, 60% tin, 40% lead	X	X	X	X

Heat sink	X	X	X	X
Nutdriver set	X	X	X	X
Mini IC clip with leads	X	X	X	X
Personal Protection Equipment:				
Safety glasses, ANSI Z87.1-1989	X	X	X	X
(one pair per student required)				
Components: as recommended by lab manual				
Resistors, fixed and variable	X	X	X	X
Inductors		X	X	
Capacitors	X	X	X	
Transformers		X	X	
Diodes			X	
Transistors, NPN, PNP			X	
Digital chips				X
Operational amplifier IC chips			X	
LEDs, various colors		X	X	X
Seven segment displays				X

Computer Maintenance Technology

Facility

Type/use of space	Recommended Square Footage
Laboratory	2000-2400
Classroom/Instruction	700*
Storage	300
Teacher Office/Conference	150
Clean-up/Lockers	100

*State requirement Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities.

Equipment

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Safety Glasses with side shield (to meet ANSI Standard Z87.1-1989)
Safety Glasses Cabinet with Ultraviolet lamp
Anti-static wrist strap, desk mats, and floor mats
Computer Maintenance Certification Equipment
Computer Maintenance Certification Reference Materials
Digital Multimeter (optional)
First Aid or CPR Course Certification (optional)
Hand Tools:
Phillips screwdrivers, #0, #1, #2
Flathead screwdrivers, ¼" , 3/8", 7/16"
Diagonal cut pliers, large and small
Slip joint pliers
Set of Torx® Drivers
Drill and bits
Set of Nutdrivers
Wire Cutters
Wire Crimper – Coaxial and RJ45 and 11
Non-Metallic Drivers
Soldering pencil, 25W (optional)
Desoldering Wick (optional)
Desoldering Pump (optional)
Solder 60/40 Rosin Core (optional)
Jacob's Ladder
Micro2000 (optional)
Pocket Post (optional)
Pocket PC Reference
Van-De-Graaf Generator (optional) Ion field generator can be obtained from a physics class

Industrial and Manufacturing Systems

No specific program facility standards or recommendations available for the courses in the Industrial and Manufacturing Systems.

Metal Technology Systems

The Associated General Contractors of America (AGC) provides the following guidelines for to assist in the planning and implementation of all Construction-Craft programs.

Facility Types. The types of facilities required for a training program will depend upon the type of training and on the number of students to in training. The training facilities must be accessible to the population being served and should include a classroom, laboratory, tool and material storage area, and an office for the instructor(s). Facilities should provide a large enough space for special skill projects. Facilities should have adequate lighting and air circulation; the office and classroom should have sufficient hear and air conditioning to maintain an environment conducive to working and learning. The entire facility should be organized with security in mind. To the extent possible, the facility should provide an environment as similar as possible as that found on the job site.

Facility Space and Equipment. Facility space and equipment must effectively accommodate the number of students to be included in the program, the instructor's, and any required support staff. Facilities and equipment inventory must reflect stated program training goals and objectives. Duplication of essential tools and equipment is necessary so that all students will have ready access to them at all times.

Safety Provisions. Adequate provision must be made for the safety of the students and the instructional staff.

Laboratories. It is crucial that laboratories for construction-craft programs are designed to simulate the industrial setting. The equipment must duplicate that used in the industry, and the training conducted on live or simulated projects as much as possible. Future expansion and adaptability of the programs must also be considered in the planning/design phase. The size of the laboratories will depend on the program and on the training objectives of the program. Careful planning will permit maximum usage of the laboratory. Most trade and industrial programs require as much wall space as possible. Wasted wall and floor space are as expensive as usable space.

Instructor's Office. AGC recommends that each instructor have office space available. Office space should not be part of the laboratory or the classroom. It is best if one wall of the office adjoins the laboratory area and that the adjoining wall be glass so that the instructor can observe activities within the laboratory while in the office.

Classroom. AGC recommends that the classroom be separate from the laboratory but adjacent to it to permit ease of demonstrations with equipment and to require a minimum of students' time in travel from the classroom to the laboratory.

Personal Facilities. Personal facilities such as restrooms, locker area, and washrooms are a vital part of the total program facility. AGC recommends that personal facilities be close to the laboratory area to allow instructor supervision and help to eliminate possible discipline problems. Large wash fountains that will accommodate up to six people are normally preferred, and it is advisable to locate wash-up areas within the laboratory itself.

Facilities for Students with Disabilities. It is important to keep in mind the needs of students with disabilities in order to make the facilities as accessible and usable for these students as possible. Each program will need to purchase, adapt, or modify any equipment needed for students with disabilities.

Lighting. The lighting should be planned to substantially reduce the energy consumed by the lighting system while still providing students with the quality and quantity of illumination required to perform their tasks. Effective lighting must be achieved in a manner consistent with student and program requirements, such as productivity and visual comfort; aesthetics, and federal, state, and local codes and ordinances. AGC recommends the illumination Engineering Society's *IES Lighting Handbook* as the most appropriate resource to determine lighting for trade and industrial programs.

Teaching Aids and Equipment. The training program must be equipped with appropriate teaching aids, audiovisual equipment, and electronic equipment. The quantity of this type of equipment depends on the number of students.

Sheet Metal

Facility

AGC recommended Sheet Metal facility for 15-20 students:

Type/Use of Area	Recommended Square Footage
Laboratory	3600
Fabrication area	1200
Drafting area	100
Welding area	100
Storage, secured	300
Storage, materials and tool room	200
Classroom/Instruction	700*
Teacher's Office/Conference	150
Clean-up/Locker-room	150

* State requirement, Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities

Other Space Considerations:

- Sheet metal laboratory should be located near the welding area to share a common fabrication space.
- Office and classroom should have glass walls facing laboratory area to facilitate supervision.
- Doors and entryways should facilitate use of wall space.
- Space around power equipment and work areas should allow for adequate traffic flow.

Climate-control Considerations:

- Ventilation in laboratory should comply with OSHA standards for machine, foundry, welding, soldering, and finish areas of rooms.
- Classroom temperature should be kept at an acceptable level to enhance learning.
- Recommended temperature in laboratory is 68 degrees.

Noise-control Considerations:

- Classroom should be isolated from laboratory by location, insulation, or other sound proofing means.
- Equipment-noise levels should conform to OSHA noise-level regulations.

Vibration-control Considerations:

- Floor-mounted and wall-mounted machines should be equipped with vibration-dampening devices.

Illumination Considerations in finish area:

- Explosion-proof light fixtures are required.

- Recommended lighting level is 150 foot-candles at 30 inches off floor.
- Lighting should show true color to allow for correct color determination.

Plumbing Considerations:

- Water plumbing required in the following areas:
  Finish room requires cold-water plumbing.
  Water fountain requires cold-water plumbing.
  Half-round washbasin in clean-up area requires both hot- and cold-water plumbing.
- Drains
  Floor drain required in finish area.
  4" drain required in basin in clean-up area.
- Gas plumbing should be provided for the following:
  Soldering furnace
  Furnace
  Forge
  Heat-treating furnace
- Compressed-air plumbing:
  All outlets regulated to 125 psi.
  Note: Airflow must be regulated so as not to exceed accepted standard for job at hand.
  Spray-finish outlet regulated to 50 psi and equipped with a water separator.
  6 outlets for impact-tool operation regulated to 100 psi and equipped with a water separator and oil.

Communications Requirements:

- Telephone located in the instructor's office, signal must be audible in the laboratory.
- Intercom located in instructor's office and in laboratory.
- Clock located in laboratory and classroom.

Electrical Requirements:

- Outlets, 120-volt outlets on 10-foot centers, located 36 inches above floor level.
  Note: If three-phase outlets are not used, 120-and 240-volt outlets are not required.
- Motors must be over ½ horsepower, 240-volt, three-phase or 208-volt.
- Recommended electrical systems:
  Overhead bus bars, most flexible, 120- and 240-volt.
  Overhead conduit with drops, acceptable, 120- and 240-volt
- Master switch shutdown should provide easy access for emergencies.
  Note: There should be a minimum of two panic buttons in the emergency shutdown system.
- Means of locking off power completely.

Security Requirements:

- Security locks required in laboratory, material storage area, supply room, and instructor's office.
- Burglar alarm system required throughout facility.

Window, Door, and Floor Requirements:

- Windows on outside walls must be located a minimum of 72 inches above floor level.
- Window or glass walls on inside partitions must be placed a maximum of 42 inches above floor level.
- Sliding mesh window and counter required in tool crib.
- Arrange all interior doors for safe and efficient traffic flow when door is open.
- Service door, 10' x 12', is required in laboratory.
- Personnel door should be located adjacent to the service door.
  Note: All personnel doors should be 48".
- Laboratory floors should be sealed, hardened concrete.

Aesthetic requirements:

- Walls should have a 6' wainscot of glazed brick, tile, epoxy paint, or semi-gloss enamel.
- Ceilings should reflect light and absorb sound.
- Ceilings should adhere to 12' minimum height guideline.

Service-area Requirements:

- Overhead door should be located so that it is convenient to assembly area and construction-tool storage.
- Access drive to overhead door required for material and project loading and unloading.
- Parking space should be adequate for bringing or removing projects or materials.

Safety Requirements:

- Safety precautions must be adequate for providing a safe environment for students and instructor.
- Approved fire extinguishers required in all areas of facility.
  Note: Avoid water extinguishers as they are unsuitable for use on electrical fires.
- Metal cabinets required for storage of flammable liquids.
- Approved self-closing metal containers required for storage of oily waste or rags.
- Fire blanket should be located in finish room.
- OSHA-approved manifold system required in laboratory.
- Exhaust system required to discharge fumes, smoke, and dust.
  Note: An explosion-proof system is required in the finish area.
- Acetylene and oxygen bottle must be secured to a wall or rack.
  Note: Acetylene bottles must be stored at least 20 feet from oxygen bottles and both types of bottles should be stored outside behind a divider wall.
- Overhead exhaust systems recommended in all facility areas.
- Traffic lanes should be marked and left uncluttered.
- A cabinet for safety glasses is required for sanitizing goggles and glasses.
- Lockable storage required for storage of hazardous materials.
- Safety glass required for doors, windows within 12 inches of doors, and window walls.
- Sprinkler and fire-detection systems required as specified by state fire codes.
- Eyewash area required in laboratory.

Power Tools and Equipment

A well-equipped Sheet Metal program should have all of the following tools and equipment for general laboratory/shop work. They should be readily available and in sufficient quantity to provide quality instruction.

The following are required beginning basic tools and may change and expand to keep pace with changing technology, industry, and curriculum.

Surface grinder, 24", 3-horsepower, 240-vold, 3-phase
Pedestal grinder, 7", ½ horsepower, 120-vold
Pedestal grinder, 19", 1½ horsepower, 240-volt, 3-phase
Band saw, 14", ½ horsepower, 120-volt
Band saw, 20", 1 horsepower, 120-volt, 3-phase
Band saw, horizontal, 7" x 10", ½ horsepower, 120-volt
Cornice break, 36"
Break, 10", 16-gauge
Press break, 8', ¼"
Box and pan break, 36"
Shear, 10", 16-gauge
Squaring shear, 36"
Floor shear, ½"capacity
Floor shear, 30"
Angle shear, 3/16" x 2" x 2" capacity
Ring and circle shear
Electric shear, 13 gauge capacity
Cradle for electric shear
Arc welder, 250-amp, 240-volt, 3-phase
Arc welding booth and table (with curtains), 60" x 60" x 75"
Oxyacetylene welding booth and table, 36" x 108" x 35"
Spot welder, 240-volt, 3-phase
MIG welding machine
TIG welding machine
Welding exhaust fan, ½ horsepower, 120-volt
Soldering iron, #2
Marble slab, 14" square
Acid brushes
Soldering scraper
Universal bending machine
Buffer, 7", ½ horsepower, 120-volt
Pedestal wire brush, 12". 1½ horsepower, 240-volt, 3-phase
Drill press, 17", 1 horsepower, 240-volt, 3-phase
Drill press, 20", 1½ horsepower, 240-volt, 3-phase
Double seaming machine
Burring machine
Belt sander, 6" x 48", 1 horsepower, 240-volt, 3-phase

Disc sander, 14”, 1 horsepower, 240-volt, 3-phase
Rotary machine with die assortment
Soldering furnace
Air compressor (located outside laboratory), 60 gallon tank, 5 horsepower, 240-volt, 3-phase
Spray booth (explosion-proof), 24” fan, ½ horsepower,120-volt
Foundry exhaust fan, ½ horsepower, 220-volt
Anvil with stand, 100 lb.
Bench machines and equipment
Adjustable bar folder, 30”
Wiring machine
Burr, large
Turner, small Buffalo
Elbow edging faces (for small turner)
Setting-down machine wit stand
Beader with stand
Crimping rolls (for beader)
Groover, 30”
Slip roll former, 2” x 30”
Stationary vise, 3½” jaw

Hand Tools and Equipment

Snips, straight-cut, right-cut, and left-cut aviation
Hollow-punch set, 3/8”, ½”, ¾”, and 1”
Solid-punch set, 5/32”, 9/64”, and 9/32”
Portable lever punch
Prick punch
Hammers. raising #3, setting, and riveting
Pliers, 6” round-nosed and flat nosed
Screwdrivers, 4”, 6”. and 8” plastic-handled
Bench shear
Rivet sets, #0 and #5
Grooving-tool sets, #3 and #5
Cutting nippers
Countersink (for metal)
Wire gauge
Steel square, 2”
Wing divider with solid-steel legs, 8”
Benches
Sheet metal bench
Bench for bar folder and forming machine, 4’ x 3’, 28” high
Stake bench with stake assortment
Hexagonal bench (for other machines), 6’ across
Bench for soldering, 2½’ x 18’

Racks
Sheet metal rack, 96” x 50” x 24”
Bar stock rack, 240” x 48”
Bar stock rack, 120” x 48”
Stakes
Bead horn stake, #2
Double seaming state, #1
Blowhorn stake
Creasing stake with horn
Needle case stake
Hatchet stake, #3
Bottom stake, #1
Solid mandrel, #0
Bench plates, #1, 8” x 37”
Common square stake
Basic Tool Set for Sheet Metal Workers
Toolbox
Awl
Bulldog shears
Combination shears
Grooving tool
Hacksaw
Aviation snips, left-cut and right-cut
Pliers
Regular vise grips
Screwdrivers
Prick punch
Tinner’s hammer
Straight tongs
Rivet set
Quick set (dividers)
Combination square
Folding-inside measuring rule
Steel measuring tape
Chalk line
Plumb bob
Gloves
Apron
Safety glasses, OSHA requirements

Machine Shop

Facility

Type/Use of Area	Recommended Square Footage
Laboratory	4200
Precision Measurement	500
Classroom/Instruction	700*
Storage	500
Teacher Office/Conference	150
Clean-up/Lockers – Boys	40-50
Clean-up/Lockers – Girls	40-50

* State requirement, Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities

Welding

The American Welding Society (AWS), recognizing the need for competent welding specialists, prepared the *Guide for the Design of a Welding Training Facility* to give guidance in building or converting facilities to train welders to produce welds using the manual and semi-automatic welding processes commonly found in industry. These guidelines do not purport to be all-inclusive. Modifications should be made to best accommodate the facilities and budget of the institution that is implementing a welding instructional program.

Laboratory
The various work stations in a laboratory should (1) provide a place at which students can develop skills and techniques necessary to develop welding competencies; (2) provide an area in which power sources, equipment, and projects may be secured and serviced; (3) provide special fixtures and production work mock-ups to adequately demonstrate the production work expected of various industries; and (4) provide an area where the teacher may demonstrate the skill and techniques necessary to develop welding competencies. A minimum of 100 square feet of laboratory floor space per individual is considered a good general planning figure, exclusive of washroom, storage, office space, and the classroom. Local and state requirements should be taken into account. Tools and supplies should be located as near to work areas as practical to reduce travel and interferences.

Classroom
Ideally, the room for instruction should be adjacent to the laboratory. It should be acoustically insulated from laboratory noise. The classroom should provide a clear but protected view of the laboratory area. T his space should have chalk and tack boards, a demonstration table, adequate classroom seating and work areas, and provision for darkening (for use with visual aids.) A bulletin board should near the main entrance. Adequate storage for audio-visual equipment, charts, models, samples, reference texts, etc., should be provided. Exhibit cases have strong appeal to parents and observers, especially when located to permit viewing from the outside corridor.

Storage
Decentralized storage should help conserve space and increase efficiency by reducing individual traffic. A storage area of at least 25' long with a door centered at both ends permits both the economical purchase of steel in long lengths and wall storage within the room. Use of horizontal or vertical racks depends on space limitations and personal preference. Storage of bulk supplies (adequately secured) should be located adjacent to an outside service door for convenient delivery.

Adequate filler metal storage should be considered and should be controlled. Rod, wire, and fluxes, depending on their nature, must be maintained under certain storage conditions. The materials of higher value or requiring temperature control will require tighter controls to ensure that product quality is retained. Acquisition of an electrode storage oven is highly recommended.

Open tool cabinets in each process area helps conserve personnel time and travel while helping them associate proper tool selection and application with a particular activity. Space

underneath benches and tables is excellent for storage of hardware, small amounts of raw stock or even small projects. Storage of welding projects and personal belonging is always a problem and should be well thought out.

Cylinder storage should be located near the laboratory but accessible to truck traffic. All volatile materials should be stored outside in an identified, isolated area to minimize the potential hazards involved. Cylinder storage should follow the guidelines set forth in ANSI/ASC Z49.1 Safety, Cutting, and Allied Processes, Part II Specific Processes,, 10.8.2 Cylinder Storage.

One door in the storage area should open directly to the outside from this room so that stock may be loaded into the room with no interference to laboratory activities. Scrap storage can be located near this entrance. Materials storage areas or rooms should be located conveniently for issuing materials to the students, for cutting large stock to project size, and for the unloading of delivery trucks.

Personal Services
Personal services should be planned into the laboratory, for both convenience and efficiency. Individual lockers for books and clothing should be near the entrance to keep these items out of the main instructional area. A wash-up sink and water fountain and, where possible, a lavatory for both genders should be included near the entrance.

Budget
Adequate financial resources should be provided to not only maintain the program, but also enhance it. Funding for power sources, filler metals, gases, and fluxes along with power equipment an hand tools covers just the basics. Additional funds should be available to provide for the pedagogical materials needed for welding instruction. The budget should also include release time , travel, etc., for teachers to participate in their technical and professional development.

Lighting
The absolute minimum lighting recommended for general work in any laboratory is 100 foot-candles, while 140 foot-candles is recommended for more difficult or inspection work. The use of indirect lighting or semi-indirect lighting to avoid glare, provide shadow-free light, and evenly diffuse the light is recommended. When needed, individual machines can be lighted by lamp attachments or through their own built-in lighting systems. Each booth should have adequate lighting as well.

Electricity
Electrical power should be supplies with adequate voltage and amperage for each power in source in the laboratory and classroom. Electrical service should be 200/208-volt, 230/240-volt, single-phase or three-phase, and 60 cycle (60 Hertz), alternating current. Current capacity of 75% more than the estimated demand should be provided for expansion in the welding facility. Electrical outlets of 110/120-volt service should be placed at convenient locations every 12 feet (3.7 meters) and in every booth.

Ground fault interrupters should be provided throughout the laboratory. The use of magnetic starters on all rotary equipment is an additional safety feature that gives a machine

motor overload protection as well as low-voltage and no-voltage protection. After a power failure has been corrected, the machine will not start (even if it was running when the failure occurred) until the operator presses the start button.

A disconnect switch that can be locked out, must be provided to cut off all power equipment, including power sources, in the laboratory. Panic switches should be strategically located around the entire laboratory and their locations known by all students. They shall be wired to cut off power to every machine. Fused disconnect switches should be provided for each power source and there should be no exposed wiring.

Ventilation

Individual, movable exhaust hoods are highly desirable at the work site. Welding station exhaust should be separate form other laboratory exhaust systems. The minimum required air velocity at the zone of welding is 100' per minute (.5 meters per second) when the hood is at its farthest position from the joint being welded. The hood size and height can be reduced to lower the required capacity of the exhaust system. The use of a qualified heating, ventilation, and air conditioning (HVAC) contractor is strongly recommended, rather than having an inexperienced sheet metal firm perform the construction. Fire resistant, safety yellow, strip curtains can be lowered to form a booth when greater exhaust efficiency is desired at the demonstration area.

For the single welding booth, it is practical to design a hood exhaust system. Where there are a large number of booths being used, it is more practical to provide exhaust at the arc than for the entire room. However, the loss of heat during the cold months is a serious objection to the room ventilation method unless a heated air intake system is used. To avoid this heat loss, an air filtration system, which cleans the exhausted air and reintroduces it back into the laboratory to save heat and air conditioned air, should be used. These units need careful placement as welding creates more than most industry applications due to large numbers of units in a contained work area.

Heating

Heating and cooling capacity must take into consideration the provision for a supply of fresh, clean incoming air. The laboratory heating system should automatically maintain a temperature of 68ºFahrenheit (20º Celsius) measured 60" above the floor. The classroom and the office should be kept at 70º Fahrenheit (21º Celsius) measured 30" (762 millimeters) above the floor. A system of even heat distribution should be kept within 5% of these temperatures for health reasons and for stability of equipment and stored materials

Water

Hot and cold running water, along with a suitable drinking fountain in the laboratory, and convenient, sanitary restrooms nearly are necessities. Washing facilities of either the half round or trough type sink are essential and, as a rule, should be adequate to accommodate one quarter of the students at one time. Location of the washing facilities should be as near the door as feasible. A safety shower and eyewash station should be located within the laboratory area. Proper drainage should be included, as needed.

Safety

All safety features of the laboratory and its support systems must conform to any local state, or federal governing codes. The school must be able to pass an inspection of the local and state Fire Marshall and posses a certificate of conformance from the regional OSHA engineer.

Information regarding safety can be found in ANSI Z49.1 (Safety in Welding and Cutting), AWS F2.2 (Lens Shade Selector), AWS F3.1 (Guide for Welding Fume Control), AWS F4.1 (Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances), as well as all other applicable local, state, and federal regulations. Equipment must conform to the OSHA requirements for “lockout and tagout.”

Welding

Facility

American Welding Society (AWS) recommended Welding Facility to accommodate 16-20 students:

Type/Use of Area	Recommended Square Footage
Laboratory	2000 or 100 sq. ft. per student
Demonstration area	100
Welding booth(s)	6" x 6"
Classroom/Instruction	700*
Storage (tools and equipment)	400
Storage (Bar stock)	25" long x 7" wide
Storage (Scrap)	60
Storage, OSHA-approved Outdoor, (gas cylinders)	60
Teacher Office/Conference	150
Clean-up/Restroom/Lockers – Boys	40-50
Clean-up/Restroom/Lockers – Girls	40-50
Emergency eyewash and drench shower	16 minimum

* Start requirement, Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities

Special Considerations-Primary Structure(s):

1. Building should be fireproof; walls should be smooth, with no ledges to collect dust.
2. Floors should be fire resistant, waterproof, and contain adequate floor drains.
3. Walls should be prepared with a low reflective paint to reduce ultraviolet radiation. "Cool" colors – blues or greens - recommended.
4. Doors should be large enough to permit easy entry of large pieces of equipment or overhead door.
5. Machines and equipment should be enclosed in "safety zones" painted on the floor.
6. Wide aisles (3 feet) between benches, machines, in front of tool cabinets and storage areas.
7. Designate aisles of travel by painted lines similar to those used in industry.
8. Non-skid surfaces such as sand on shellac should be applied to the floor in the area around machines to minimize danger of slipping.
9. Welding/process booths must be constructed of fire resistant material, with the walls open at least 12 inches at the bottom to permit air circulation. All four sides of the welding booth shall provide complete protection from harmful rays and hot sparks.
10. A disconnect switch that can be locked out must be provided to cut off all power equipment including power sources in the laboratory/shop.
11. Panic switches should be strategically located around the entire laboratory/shop and their locations known by all welding personnel. They should be wired to cut off power to every machine.
12. Fused disconnect switches should be provided for each power source and there should be no exposed wiring.

13. Individual, movable exhaust hoods are highly desirable. Welding station exhaust should be separate from other laboratory exhaust systems. The minimum required air velocity at the zone of welding is 100 feet per minute when the hood is at its farthest position from the point being welded. Refer to ANSI/AWS Standard F3.1-89, *Guide for Welding Fume Control*.
14. Fire resistant, safety yellow, strip curtains could be lowered to for a booth when greater exhaust efficiency is desired at the demonstration area.
15. Outside and inside facility warning signs for people wearing contact lenses that electrical arcs will immediately dry out surface of the eyes and fuse contact lens to eye surface.

Instructional Equipment

The number of welding workstations should exceed the number of welding students enrolled. Ideally, there should be 25 percent more welding stations than there are welding personnel to provide for expansion of enrollment.

Most workstations should be equipped with multi-purpose, retractable power sources.

Stationary Power Equipment
Iron worker (1/2" x 12")
Pedestal drill press (Multi-speed, geared-head) 18" x 36"
Vertical band saw (12" x 12")
Horizontal band saw (6" x 6")
Pedestal grinder with wire wheel (12" x 2" arbor)
Pedestal grinder with wire wheel (10" x 2" arbor), wire wheel
Bench grinders, (7" x 5/8" arbor),
Belt and disc sander
Track type cutting torch
Rod and flux oven (300 pounds)
Bend test jig
Power shear (3/8" x 48") (optional)
Press break (3/16" x 48") (optional)
Power roller (1/4" x 24") (optional)
Monorail or overhead crane (1 ton) (optional)
Hydraulic arbor press (5 tone) (optional)
Rotary table (200 lbs.) (optional)
Pattern cutter (12" x 35") (optional)
Portable Power Equipment
7" disc-type hand grinders, 3 each
4" disc-type hand grinders, 3 each
6 " wheel-type hand grinders, 2 each
5" belt sander
Nibbler
3/8" electric drill, 3 each
½" electric drill
Pneumatic air grinder (optional)
Pneumatic air wrench set (optional)
Impact wrench set (optional)
Portable band saw (optional)
Minimum Individual Equipment
Safety glasses with side shields or safety goggles, ANZI /a87-1-1989 (one per student)
Hearing and/or ear protection
Welder's hat or skullcap

Welder's protective clothing (leather cape with sleeves and bib or leather coat)
Leather gauntlet welding gloves (for other than GTAW)
Leather gauntlet welding gloves (for GTAW)
High-top leather shoes (steel-toed safety shoes recommended)
Welding helmet with #10/#12 filter plate/lens and protective cover plate/lens in a flip or slide front
Welding helmet/face shield/goggles with appropriate #5/#7 filter plate/lens with protective cover plate/lens for OAW-#5, OFC-#5, and PAC-#9.
Spare spatter and filter lenses/plates for arc welding helmet and oxyacetylene goggles
Pocket calculator
Stop watch
Lead pencil and/or ball point pen
Soap stone with holder
Scribe with magnet
Combination square set
English/Metric Bench Rule
Steel tape measure, 10 foot
Fillet weld gauge
Ball peen hammer, 16 oz. (.45 kilogram)
Center punch
Cold chisel
Adjustable wrench, 10" (254 millimeters
Vice grips, 10" (254 millimeters)
Vice grip clamp, 10" 254 millimeters)
Allen wrench set
Combination pliers, 10" (254 millimeters)
Side cutting pliers or diagonal cutting pliers, 6" (152 millimeters)
Needle nose pliers, 6" (152 millimeters)
Mill file (bastard cut), 10" (254 millimeters)
Chipping hammer with or without wire brush
Carbon steel wire brush
Stainless steel wire brush
Copper plate for balling tungsten
Temperature indicting sticks
Oxygen fuel tip cleaner
Oxygen fuel striker

Training Materials

As it is impossible to include a complete listing of all training materials since new ones are constantly being developed, current ones improved and older ones withdrawn, instructors and administrators should augment this list on a regular basis and keep files on up-to-date training materials. Industry publications feature or advertise sources for equipment and training materials.

Base Metals for Welding Practice
Carbon steels
Stainless steel
Aluminum alloys
High strength, low alloy steels
Alloy steels
Cast irons
Copper alloys
Gases
For oxyfuel gas processes:
Acetylene and one other
For shielding gases:
Carbon dioxide
Argon
For plasma arc cutting, Air carbon arch cutting, and pneumatic tools:
Compresses air (90 lbs per square inch at 300 cubic feet per hour to each booth in lab)
Filler Materials and Fluxes
All appropriate filler metals and fluxes for the base metals listed above
Rod oven(s) shall be available for low hydrogen filler metals and appropriate SAW fluxes.

Cosmetology

89.53 Minimum Requirements for Both Private and Public Cosmetology Schools.
Texas Occupations Code Chapter 1602 and Its Companion General Rules and Regulations including Sanitary Rulings. Texas Cosmetology Commission, April 2000.

Facilities

Type/Use of Area	Required Square Footage
Cosmetology Department	2200 minimum
Laboratory	1200, minimum
Dispensing/Storage	50 contiguous, minimum
Classroom, adjacent to laboratory	700*
Teacher Office	150
Lockers/Dressing rooms-Boys	40-50
Lockers/Dressing rooms/-Girls	40-50

*State Requirement Chapter 61 School Districts, § CC. Commissioners Rules Concerning School Facilities.

Special Considerations:

1. GFI electrical receptacles on each work station
2. Shelf and closed cabinet on wall above ach shampoo bowl.
3. Emergency disconnect switch to all equipment and outlets except lights.
4. Telephone in teacher's office.
5. Requires accessibility to the public and to public parking to accommodate client movement to and from the laboratory.
6. Classroom must be separate from the laboratory area by walls extending to the ceiling.
7. Dispensary must have a double sink with hot and cold running water and space for storage and dispensing of supplies and equipment.
8. Proper ventilation with exhaust fan or air-filtering device extracting fumes and gases out of the facility must be provided.

Classroom Equipment

One chalkboard
Desks and chairs or table space for a minimum of 10 students (plus space for additional students enrolled and in attendance per theory class
Textbook for each student enrolled
Charts:
Bones
Muscles
Nerves
Skin
Nails
Medical Dictionary
Visual Aids: VCR/monitor at a minimum

Laboratory Equipment

Type	Minimum Quantity*
Styling stations with mirrors	16
Hydraulic or swivel	
Formica or similar material	
Shampoo bowls with chairs	6
Hair dryers with chairs	8
Heat cap or therapeutic light	1
Cold wave rods	8 dozen
Electric curling irons	3
Mannequins with sufficient hair	12
Table or attached to styling stations	
Day/date formatted computer time clock	1
Professional hand clippers	1
Professional hand held hair dryers	3
Manicure tables with tools	4
Closed cabinet for clean towels	1
Covered container for soiled towels	1
Covered trash cans in lab area	4
Wet disinfectant soaking container	1 large
Dry storage container for disinfected implements	1

Facial Course Equipment

Facial chair
Magnifying lamp
Woods lamp
Dry sanitizer
Steamer
Brush machine for cleaning
Vacuum machine with spray device
High frequency for disinfect ion, product penetration, stimulation
Galvanic for de-incrustation, product penetration
Paraffin bath and paraffin wax

Transportation Systems

NATEF Facilities Standards

The National Automotive Technicians Education Foundation (NATEF) recommends that the physical facilities be adequate to permit achievement of the program goals and performance objectives.

Standard 1-Training Stations. Training stations (bench and live work) should be available in the type and number required for the performance of task outlined in the program goals and performance standards.

Standard 2-Safety. The facilities should meet all applicable safety standards and an emergency plan should be in place and posted in all classrooms and laboratory/shop areas.

Standard 3-Maintenance. A regular maintenance program should be used to ensure facilities are suitable when required for instruction.

Standard 4-Housekeeping. The classroom, laboratory/shop, and support areas should be kept clean and orderly.

Standard 5-Office Space. An area separate from the laboratory/shop should be available and convenient for the instructor's use as an office.

Standard 6-Instructional Area. A classroom convenient to, bur separate from, the laboratory/shop area should be available for instruction and other non-laboratory/shop activities.

Standard 7-Storage. Storage areas for tools, parts, supplies, and automobiles should be sufficient to support the activities outlined in the program goals and performance objectives. Security should be provided to prevent pilferage and vandalism.

Standard 8-Support Facilities. Restrooms, clean-up areas, and lockers should be provided for both male and female students and should be convenient to the instructional area.

Standard 9 Ventilation. An adequate exhaust removal system should be in place and operational. When appropriate, heating and cooling systems should be used to provide sufficient comfort for learning.

Standard 10-First Aid. A first aid kit should be in place and comply with local regulations.

Standard 11-Facility Evaluation. The Advisory Committee should conduct an annual evaluation of the facilities to assure adequacy to meet program goals.

Tools and Equipment

The National Automotive Technicians Education Foundation (NATEF) recommends that tools and equipment used in the Automotive Technician program address the following issues:

1. **Safety** – Equipment and tools must have all shields, guards, and other safety devices in place, operable, and used.
2. **Type and Quality** – The tools and equipment used in an Automotive Technician program must be of the type and quality found in industry. The must also be adequate and in sufficient quantity to meet program goals and student performance objectives.
3. **Consumable Supplies** – Supplies should be in sufficient quantity to assure continuous instruction. Consumable supplies, such as solvents, sand paper, etc., are not included in the Tools and Equipment Lists.
4. **Maintenance** – A preventive maintenance schedule should be used to minimize equipment down time.
5. **Replacement** – A systematic schedule for replacement should be used to maintain up-to-date tools and equipment at industry and safety standards. Information from student program evaluations as well as advisory committee input should be used in the replacement process.
6. **Inventory** – An inventory system should be used to account for tools, equipment, parts, and supplies.
7. **Parts Purchasing** – A systematic parts-purchasing system should be used, from work order to supplier.
8. **Hand Tools** – Each student should be encouraged to purchase, or arrange for a mentor to provide each student, a hand tool set during the period of instruction.
9. **Storage** – Adequate storage of tools should be provided. Space for storage of students' hand tools should provided.

Automotive Technology

Facility

NATEF recommended Automotive Technology Facility to accommodate 16-20 students.

Type/Use of Area	Recommended Square Footage
Laboratory/shop	2800-3600
Fenced area adjacent to laboratory for storage of automobiles	1200
Engine Overhaul	500
Classroom/Instruction	700*
Storage (tools and equipment)	400
Storage (Oil)	40-50
Teacher Office/Conference	150
Clean-up/Restroom/Lockers – Boys	40-50
Clean-up/Restroom/Lockers – Girls	40-50
Emergency eyewash and drench shower	16 minimum

* State requirement Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities.

Special Considerations:

1. Direct access to service drive with separate entrance and exit doors (unless space is designed so that each service stall opens directly onto service drive).
2. Electric overhead doors.
3. Convenient or direct access to Collision Repair and Refinishing laboratory and to welding laboratory, if offered.
4. Bays should provide for at least half with hoist and half without hoist.
5. Provision should be made for one enclosed wash rack with drain.
6. Adequate lighting, 100-foot candles, in car stalls with units parallel to stalls.
7. Workbenches require adjustable task lighting.
8. Two each 110-volt single phase current with appropriate grounds located at 101 intervals, no outlet less that 4' above floor; 220-volt 3-phase current in stall areas only.
9. Grease and oil traps or other provisions for handling grease and oil.
10. Accommodations for oil and coolant recycling.
11. Provide hazardous materials storage.
12. Positive exhaust system to remove fumes and smoke from shop.
13. Exhaust system in floor with at least two exhaust units in each car stall and one at each engine stands. Connecting tubes must be rust resistant and have easy means of recess or be of the type that is not injured when driven over. Must be designed for easy cleaning of exhaust system.
14. Provide gutter system beneath all automobile working stations; design system for easy cleaning. Water must be available for flushing or other arrangement that concentrates and drains water from cars; provide sediment trap.
15. Hose bibbs inside and outside.

16. Water for floor washing and for test-stand-cooling of engines to eliminate pans but requires floor drains with grease traps.
17. Free area with space to work on mock-ups and other related activities.
18. Compressed air available at all work stations, 100-150 psi, with water separator in line to remove all moisture from air.
19. Computer terminals in laboratory and classroom/instructional area.
20. Optional overhead hoist system should serve entire laboratory/shop area.

General Laboratory Equipment

A well equipped Automotive Technician program should have all of the following tools and equipment for general laboratory/shop work. They should be readily available and in sufficient quantity to provide quality instruction.

Air Chisel Set with various bits
Air Compressor and Hoses
Air Pressure Regulator
Air Ratchet, 3/8" drive
Automotive Stethoscope, electronic recommended
Axle Stands (Safety Stands)
Battery Charger
Battery/Starter/Charging System Tester
Bearing Packer, hand operated
Belt Tension Gauge
Bench or Pedestal Grinder
Compression Tester
Personal Computer (PC) with interface capability for on-board diagnostics (OBD II compliant recommended or Computer Scan Tool (hand held)
Coolant/Combustion Gas Detector, recommended
Coolant Tester
Cooling System Pressure Tester and Adapters
Constant Velocity Joint (CV) Service Tools:
Boot Installation Tool
Boot Clamp Pliers or Crimping Ring
Creeper
Cylinder Leakage Tester
Dial Indicator with Flex Arm and Clamp Base
Digital Multi-meter with various lead sets
Drain Pans
Drill, 3/8" variable speed, reversible
Drill, ½" variable speed, reversible
Electric Heat Gun
Engine Coolant Recovery Equipment or Recycler or Coolant Disposal Contract Service
Extension Cords
Face Shields
Fender Covers

Floor Jack, 1½ ton, minimum
Hand-held Vacuum Pump
Hoist(s)
Hydraulic Press with adapters
Impact Socket Sets:
3/8" Drive, standard and metric
½" Drive (7/16"-1 1/8")
½" Drive (12mm-24mm)
½" Drive Deep (30mm, 32mm, 36mm)
Impact Wrenches: ½" Drive and 3/8" Drive
Jumper Cables
Master Puller Set
Micrometer (Depth)
Micrometers: 0-1", 1-2", 2-3", 3-4", 4-5"
Oil Filter Wrench
Oxy-Acetylene Torch
Parts Cleaning Tank and Gloves (non-solvent based cleaner recommended)
Remote Starter Switch
Screw Extractor Set
Seat Covers
Snap Ring Pliers Set – External
Snap Ring Pliers Set - Internal
Soldering Gun
Soldering Iron, 25-watt pencil tip
Spark Plug Boot Puller
Tach/Dwell Meter
Tap and Die Set – Standard
Tap and Die Set – Metric
Thread Repair Insert Kit
Tier Inflator Chuck
Trouble/Work Lights, fluorescent preferred
Tube Quick Disconnect Tool Set
Tubing Cutter/Flaring Set, double tap and ISO
Twist Drill Set, 1/64"-1/2"
Valve Core Removing Tool
Vernier Calipers: o-6" and 0-125mm
Waste Oil Receptacle with extension neck and funnel
Workbenches with vises

Hand Tools

(Contained in individual sets or the tool crib in sufficient quantities to permit efficient instruction.)

Adjustable Wrenches: 6” and 12”
Air Blow Gun, meeting OSHA requirements
Allen Wrench or Socket Set: Standard (.050”-3/8”)
Allen Wrench or Socket Set: Metric (2mm-7mm, 10mm, 12mm)
Battery Post Cleaner
Battery Terminal Pliers
Battery Terminal Puller
Brake Spoon
Chisels: Cape 5/16”, Cold 3/8”, ¾”
Chisel Holder
Claw Type Pickup Tool
Combination Wrenches:
Standard (¼”-1¼”)
Metric (7mm-24mm)
Crowfoot Wrench Sets – Metric and Standard
Ear Protection
Feeler Gauge (Blade Type): .002”-.040” and .006mm-.070mm
Files: Coarse 6” and 12”, Fine 6” and 12”, Half Round 12”, Round 6” and 12”
Flare Nut (tubing) Wrenches: 3/8”-3/4” and 10mm-17mm
Flashlight
Fuse Puller
Hack Saw
Hammers: 16 oz. Ball Peen, Dead Blow Plastic Mallet, Plastic Tip, Rubber Mallet
Inspection Mirror
Jumper Wire Set with various adapters
Magnetic Pickup Tool
Pliers: Combination 6”, Hose Clamp, Locking Jaw, Needle Nose 6”, Side Cutting, Slip Joint (Water Pump)
Pry Bars: Rolling Head and Straight
Punches: Center, Brass Drift, Pin 1/8”, 3/16”, ¼”, 5/16”, Taper 3/8”, ½”, 5/8
Safety Glasses, ANZI A87.1-1989 (one per student)
Scrapers: Carbon 1” and Gasket 1”
Screwdrivers, Blade type: Stubby, 6”, 9”, 12”, Offset
Screwdrivers, Phillips: Stubby #1, #2, 6”, #1, #2, 12” #3, Offset #2
Screwdriver, Impact Driver Set
Screw Starters: Phillips and Standard
Socket Set ¼” drive:
¼”-½” standard depth
¼”-½” deep
6mm-12mm standard depth
6mm-12mm deep

Flex/Universal Type
Ratchet
Socket Set-3/8: d rive:
5/16”-3/4” standard depth (6point)
3/8”-3/4” deep (6 point)
10mm-19mm standard depth
10mm-19mm deep
3”, 5”, 10” extensions
Flexhead ratchet
Ratchet
Spark Plug Sockets, 5/8” and 13/16”
Universal joint
Flexible Socket Set 3/8”-3/4”
Flexible Socket Ser 10mm-19mm
Socket Set-1/2” Drive:
7/16” –1 1/8” Standard Depth
7/16” 1 1/8” Deep
10mm-24mm Standard Depth
10mm-24mm Deep
3”, 6”, 12” Extensions
Flex Handle (Break Bar)
Ratchet
Spark Plug Feeler Gauge (Gap tool)
Tape Measure-Standard and Metric
Test Light (12V)
Tire Pressure Gauge
Torque Wrenches: 3/8” Drive (10-250 lb.), 3/8” Drive (5-75 lb. ft.), ½” Drive (50-250 lb.ft.)
Torx® Set (screwdrivers and/or sockets)

Specialty Tools and Equipment

This tools and equipment are specialized for use in the Automotive Specialty areas and must be available in the laboratory/shop or to the program. Specific types or brands are not identified, as they will vary in each local situation.

Suspension and Steering
Ball Joint Press and other special tools
Brake Pedal Depressor
Hand Grease Gun
Inner Tie Rod End Tool
Pitman Arm Puller
Power Steering Pump Pulley Special Tool Set (appropriate for units being taught)
Shock Absorber Tools
Spring/Strut Compressor Tool
Steering Column Special Tool Set (appropriate for teaching units being utilized)

Tie Rod Puller
Tire Mounting Machine (rim clamp suggested)
Wheel Alignment Equipment-4 wheel (including alignment tools)
Wheel Balancer – Electronic Type
Wheel Weight Pliers
Brakes
Brake Bleed, pressure
Brake Disc Micrometer
Brake Drum Micrometer and Calibration Equipment
Brake Lathe with disc and drum service attachments (mobile or stationary)
Brake Shoe Adjusting Gauge
Brake Spring Remover/Installer
Brake Spring Pliers
Bearing Seal and Race Drive Set
Heating and Air Conditioning
A/C Compressor Clutch Service Tools
A/C Service Port Adapter Set
Leak Detector (SAE Standard)
Manifold Gauge Set, (R-12 and HFC-134) or equivalent
Refrigerant Charging Station (R-12 and HFC-134A) or equivalent
Refrigerant Identification Equipment (suggested)
Refrigerant Recovery/Recycling Machine (R-12 and HFC 134)
Thermometer
Engine Performance
Dual Trace Lab Scope
Engine Analyzer with ignition display capability
Four or Five Gas Exhaust Analyzer
Fuel Injection Cleaner
Fuel Injection Pressure Gauge Sets with Adapters
Injector Pulse Tester
Logic Probe (suggested)
Oxygen Sensor Socket
Pinch-off Pliers
Sending Unit Socket(s)
Spark Plug Thread Tap
Spark Tester
Static Wrap
Timing Advance Light
Vacuum/Pressure Gauge
Automatic Transmission/Transaxle
Hydraulic Pressure Gauge Set
Front Wheel Drive Engine Support Fixture

Transaxle Removal and Installation Equipment
Transmission Jack(s)
Transmission/Transaxle Holding Fixtures
Transmission/Transaxle Special Tool Sets (appropriate for the units being taught)
Electrical/Electronic Systems
Battery Hydrometer
Connector Pick Tool Set
Headlight Aimer or Screen
Wire and Terminal Repair Kit
Manual Drive Train and Axles
Clutch Alignment Set
Clutch Pilot Bearing/Bushing Puller/Installer
Front Wheel Drive Engine Support Fixture
Transaxle Removal and Installation Equipment
Special Tools for Transmissions/Transaxles (appropriate for units being taught)
Transmission/Transaxle Holding Fixtures
Transmission Jack(s)
Universal Joint Tools
Engine Repair
Ball (Small Hole) Gauges
Cam Bearing Driver Set (suggested)
Cylinder deglazer
Dial Bore Indicator
Engine Stands/Benches
Inside Micrometer Set; 0-6” and 0-125mm
Oil Pressure Gauge or equivalent
Oil Priming Tool (oil pump drive)
Outside Micrometer Set: 0-6” and 0-125mm
Portable Crane, ½ ton
Ridge Reamer
Ring Compressor
Ring Expander
Ring Groove Cleaner
Straight Edge
Telescopic Gauge Set
Torque Angle Gauge
Transaxle Remover and Installation Equipment
V-Blocks
Valve and Valve Seat Resurfacing Equipment
Valve Guide Repair Tools
Valve Spring Compressor
Valve Spring Tester

NATEF Collision Repair & Refinishing Facilities Standards

The physical facilities must be adequate to permit achievement of the program goals and performance objectives.

Standard 1. Training Stations Training stations (bench and live work) should be available in the type and number required for the performance of task outlined in the program goals and performance objectives.

Standard 2. Safety The facilities should meet all applicable safety standards and an emergency plan should be in place and posted in all classrooms and laboratory/shop areas.

Standard 3-Maintenance. A regular facilities maintenance program should be used to assure facilities are suitable when required for instruction.

Standard 4-Housekeeping. The classroom(s), laboratory/shop, and support area(s) should be kept clean and orderly.

Standard 5-Office Space. An area separate from the laboratory/shop should be available and convenient for the instructor's use as an office.

Standard 6-Instructional Area. A classroom convenient to, but separate from, the laboratory/shot must be available for instruction and other non-laboratory/shop activities.

Standard 7-Storage. Storage areas for tools, parts, supplies, and automobiles should be sufficient to support the activities outlined in the program goals and performance objectives. Security should be provided to prevent pilferage and vandalism.

Standard 8-Support Facilities. Restrooms, clean-up areas, and lockers should be provided for both male and female students and should be convenient to the instructional area.

Standard 9-Ventilation. An adequate exhaust fume removal system should be in place and operational. When appropriate, heating and cooling systems should be used to provide sufficient comfort for learning.

Standard 10-First Aid. A first aid kit should be place and comply with local regulations.

Standard 11-Facility Evaluation. The Advisory Committee should conduct an annual evaluation of the facilities to assure adequacy to meet program goals.

Tools and Equipment

The National Automotive Technicians Education Foundation (NATEF) recommends that local employer needs and the availability of funds are key factors for determining the structure and operation of each Collision Repair & Refinishing program. While not all programs have the same needs nor do all programs teach 100% of the NATEF tasks, the each training program should be as thorough as possible using the tools and equipment necessary for students to attain course objectives.

While referring to the tools and equipment lists for Collision Repair & Refinishing, please note the following:

1. The organization of the tool list is not intended to dictate how a program organizes its tool crib or student tool sets (i.e., which tools should be in a student set, if utilized, and which should be in the tool crib or laboratory/shop area.)
2. Quantities of each tool or piece of equipment are determined by local program needs; however, sufficient quantities to provide quality instruction should be on hand.
3. For Specialty Tools and Equipment, the program need only have those tools for the areas being taught in the specific program.
4. Programs may meet the equipment requirements by borrowing special equipment or providing for off-site instruction (e.g., in a dealership or independent repair shop).
5. No specific brand name for tools and equipment are specified or required; however, the tools and equipment should be of the type and quality found in industry.
6. Industry surveys indicate that most (90%) of employers require that a candidate for employment provide his/her own basic hand tool set in order to be hired as an entry-level automotive technician. Students should be encouraged to begin to build their own individual tool sets prior to entry into the industry.

Collision Repair and Refinishing

Facility

NATEF recommended Collision Facility to accommodate 16-20 students.

Type/Use of Area	Recommended Square Footage
Laboratory	3700
Paint booth	300
Fenced area adjacent to Laboratory	1200
Classroom/Instruction	700*
Storage (tools and parts)	500
Storage (paint)	100
Teacher Office/Conference	150
Clean-up/Restroom/Lockers – Boys	40-50
Clean-up/Restroom/Lockers – Girls	40-50

* State requirement Chapter 61 School Districts, § CC. Commissioner's Rules Concerning School Facilities.

General Laboratory Equipment

The tools and equipment on this list are used in general laboratory/shop work but are not considered to be individually owned hand tools. A well-equipped program should have all of these general tools and equipment readily available and in sufficient quantity and capacity to provide quality instruction.

Air Blow Guns – OSHA Standard
Air System – Air Compressor
Air Hoses, with quick release couplings:
Air Lines
Regulator
Water Extractors
Air Transformer/Regulators
Corrosion Protection Application Equipment
Creepers
Exhaust Fans
Grounded Extension Cords
Heat Lamps
Jack Stands
Overhead Ventilation, for welding area
Oxy-acetylene Torch Set
Portable Floodlights
Powered Vehicle Mover (recommended)
Service Jacks
Shop Brooms
Dust Pans
Floor Squeegee

Floor Mop and Bucket
Storage Cabinets
Trash Cans in accordance with local, state, and federal regulations
Work Benches, steel top with vice
Work Stands, portable
Special Safety Items **(All must meet or exceed federal, state, and local regulations)**
Blood-born Pathogen Kit
Ear Protection, for students, instructors, and visitors
Eye Wash Basin
Eye Wash Station, portable (saline)
Fire Blankets and Case
Fire Extinguishers, by type as required
First Aid Kit
Flammable Materials Storage Locker, meeting fire and building codes
Hazardous Spill Response Kit
OSHA "Right to Know" Compliance Kit
Protective Gloves and Clothing, for handling paint and related chemicals
Respiratory Protection Equipment, as required by OSHA
Safety Cans, for solvents, rags, etc.
Safety Glasses, Clear and Tinted Face Shields, and Goggles, for students, instructors, and visitors
Safety Shoes, as required*
*Safety Shower, as required
Vacuum System, for air sanders (recommended)

Hand Tools

(Contained in individual sets or the tool crib in sufficient quantities to permit efficient instruction)

Common Hand Tools
Adjustable Wrenches, 6" and 12"
Allen Wrench Set, Standard (.050"-3/8")
Allen Wrench Set, Metric (2mm-7mm)
Anti-freeze Drain Pan
Battery Post Cleaner
Battery Terminal Pliers
Battery Terminal Puller
Brake Spoon
Chisels: Cape 5/16", Cold 3/8", ¾"
Combination Wrenches: Standard (¼"-1"), Metric (7mm-19mm)
Crowfoot Wrench Set, Metric
Crowfoot Wrench Set, Standard
Digital Multimeter
Drill Motors, 3/8" and ½" variable speed, reversible

Feeler Gauge (Blade Type): .002”-.040” and .006mm-.070mm
Flare Nut (tubing) Wrenches: Standard 3/8”-3/4” and Metric 10mm-17mm
Flashlight and batteries
Hack Saw and blades
Hammers: 16 oz. Ball Peen, Brass, Dead Blow Mallet, Plastic Tip, Sledge, Soft Faced, Rubber Mallet
Ignition Wrench Set, Standard and Metric
Impact Wrenches, 3/8” and ½”
Inspection Mirror
Jumper Wire Set (with various adapters)
Oil Drain/Storage Pan
Oil Filter Wrenches
Pickup Tool, magnet and claw type
Pliers: Combination, Hose Clamp, Locking Jaw, Needle Nose, Side Cutting, Slip Joint (Water Pump),
Plier Set, Snap Ring, internal and external
Power Reciprocating Saw and blades
Punches: Center, Brass Drift, Pin: 1/8”, 3/16” ¼”, 5/16”, and Taper: 3/8”, ½”, 5/8”
Screwdriver, Blade type: Stubby, 6”, 9”, 12”, Offset
Screwdrivers, Phillips: Stubby, #1, #2, 6”: #1, #2, 12” #3, Offset #2
Screwdrivers, Posidrive Set: #1, #2, #3, #4
Screwdrivers:
Torx® Set: T-8, T-10, T-15,T-20, T-25, T-27, T-30,T-40, T-55
Torx® External Set: E-4, E-5, E-6, E-8, E-10, E-12, E-14, E-16
Torx® Tamper Proof Set: T8, T19, T15, T27, T30, T40, T45, T50, T55
Screw Extractor Set
Screw Starter: Standard and Phillips
Socket Set, ¼” drive:
¼”-½” standard depth
¼”-½” deep
6mm-12mm standard depth
6mm-12mm deep
Flex/Universal Type – standard and metric
¼” Universal Joint
3”, 6” Extensions
Ratchet
Socket Set - 3/8” drive:
5/16”-¾” standard depth (6 point)
3/8”-3/4” deep (6 point)
9mm-19mm standard depth
9mm-19mm deep
3”, 6”, 12”, 18” Extensions
Flexhead Ratchet
Impact Sockets – 3/8”-¾” standard
Impact Sockets – 10mm-19mm
Impact Driver

Ratchet
Speed Handle
Universal Joint
Socket Set - ½" Drive:
7/16"-1 1/8" Standard Depth
7/16"-1 1/8" Deep
10mm-25mm Standard Depth
10mm-25mm Deep
5", 10" Extensions
Flex Handle (Breaker Bar)
Impact Sockets Standard: 7/16"-1 1/8"
Impact Sockets 12mm-32mm
Impact Driver
Ratchet
Torque Wrenches (Sound /Click and Impulse Type):
3/8" Drive lb. (30-250)
3/8" Drive lb. ft.(5-75)
½" Drive lb. ft. (50-250)
Miscellaneous Tools
Caulking Gun
C-clamps – assorted
Files – for steel and aluminum
Hole Saw Set, ½"–2"
Lug Wrench
Oil Can (Pump type)
Rivet Guns, heavy duty blind and large for 3/16" and ¼"
Pry Bar Set
Putty Knife
Sanding Tools, assorted
Scrapers
Scratch Awl
Tap and Die Sets, Standard and Metric
Tape Measure, Standard and Metric
Tin Snips
Tire Pressure Gauge
Tire Inflator
Twist Drill Sets:
Standard: 1/64"-¼" by 1/16" and Metric Equivalent
Standard: ¼"-½" by 1/16" and Metric Equivalent
Wire Brushes, hand and powered
Special Removing and Releasing Tools:
Door handle removing tool
Door hinge spring and pin remover
Miscellaneous interior and exterior trim removing tools
Reveal moulding tools

Spring lock coupler tool set
Stationary glass removal tools
Windshield wider removing tool
Body Working Tools
Assorted Files, for metal and plastic finishing, including:
Body Files
Body Filler Shaping Files (Cheese Grater/Shredder)
Hand Sanding Pads
Metal Files
Sanding Blocks (short and long)
Sanding Boards (short and long)
Body Hammers:
Cross Chisel
Door skin Hammer
General Purpose Pick
Large Face Finishing
Long Pick
Short Utility Pick
Shrinking
Dollies:
Bumping File
Dinging Spoon
Door skin Dolly
Fender Dolly
Inside Heavy Duty Spoon
Inside High Crown
Inside Medium Crown
Spoon Dolly (“Dolly on a stick”)
Toe Dolly
Universal Dolly
Filler Spreaders and Applicators, assorted types and sizes
Picks, assorted
Punches and Chisels, assorted:
Air Chisel Set, various bits
Center Punch
Flat Chisels, ¼”-3/4”
Long Center Punch
Long Pin Punches, 1/16”-3/8”
Long Flat Chisels, ¼”-3/4”
Long Tapered Punches, 3/8”-5/8”
Pin Punches, 116”-3/8”
Punch/Chisel Holder
Round Nose Cape Chisel
Short Tapered Punches
Starter Punches, 1/16”-3/8”

Specialty Tools and Equipment

The following list covers the tools and equipment a laboratory/shop should have for training in any given specialty area. This equipment is specialized and it must be available in the laboratory/shop or to the program. No specific types or brand names are identified because they will vary in each local situation.

Non-Structural Analysis and Damage Repair
Abrasive Cut-off Tool and Discs
Abrasive Disc Shaper
Anchoring System
Car Lift (capable of totally lifting the vehicle)
MIG Welders and accessories
Plasma Cutting Torch (recommended)
Portable Hydraulic Ram with attachments
Pressure Washer
Portable Power Tools:
Abrasive Blaster and appropriate personal safety equipment
Die Grinder with attachments
Grinders
Metal Shears
Nibbler
Sanders
Pulling and Holding Equipment Set including:
Body Clamps
Cable or Chain Ratchet
Slide Hammer, complete with attachments
Stationary Power Tools: Bench Grinder and Drill Press (recommended)
Step Ladder
Structural Adhesive Guns (dispenser, two component)
Vacuum Cleaner
Welding Safety Equipment including:
Aprons
Face Shields
Gloves
Goggles
Helmets
Jackets
Respirators
Safety Glasses
Welding Blanket
And all appropriate safety equipment
Weld-on Pulling Tool and attachments

Structural Analysis and Damage Repair
Everything listed under Non-Structural Analysis and Damage Repair plus:
Frame/Unibody Straightening Equipment:
Bench/rack or floor-mounted system with multiple pull capacity
Self-centering Gauges
Universal Measuring System with minimum capacity to measure 2/3rds of the total vehicle using:
3 self-centering gauges
1 tram gauge
Strut tower measurement capability to simultaneously measure length, height, and width OR incorporating a mechanical (to include strut tower gauge assembly) Laser OR Computerized measuring system
Tram Gauges
Mechanical and Electrical Components
Refrigerant Recovery System for R12 and 134
Air-conditioning gauges, lead detector, and vacuum pump
Ball-joint Fork
Battery Bleeder, vacuum assisted
Chassis Lubricator
Connector Pick Tool Set
Cooling System Pressure Tester
Crane/Hoist, portable, 2-ton capacity
Gear Puller Set, heavy duty with attachments
Headlamp Aiming Equipment
Heat Gun
Hydraulic Press with adapters
Pitman Arm Puller
Soldering Gun/Iron
Spring/Strut Compressor Tool
Tie Rod Puller
Wheel Alignment System – 4-wheel+
Wire and Terminal Repair Kit
Plastics and Adhesives
Plastic Welder
Die Grinding Tool Set
Disc Grinder, 3”
Heat Gun
Structural Adhesives Guns (dispenser)-two-component
Painting and Refinishing
Air Cap Test Gauge
Air Sanders
Color-matching Light System
Dry Film Thickness Gauge with a + or 1/10th of a mil thickness capabilities

Enclosed Paint Spray Booth to comply with local, state, and federal regulation (downdraft booth recommended)
Hand Sanding Pads
Hazardous Material Spill Kit
Masking Equipment: Car covers paper and tape dispenser wheel covers
Paint Mixing Bank with measuring equipment
Paint Shaker
Paint Storage Room/Locker in accordance with local, state, and federal regulations
Personal Safety Equipment (painting gloves, suits, hoods, respirators, etc.)
Portable Paint Curing Equipment (infrared)
Prep Station (recommended)
Sanding Blocks (short and long)
Sanding Sponges
Spray Guns, HVLP/LVLP (high volume, low pressure/low volume low pressure)
Spray Gun Cleaning equipment in accordance with local, state, and federal regulations (Enclosed recommended)
Squeegees, assorted sizes
Supplied Air Respirator (SAR)
Variable Speed Buffer/Polisher
Waste Disposal/Recycling program in accordance with local, state, and federal regulations

Work-Based Learning

Type/Use of Area	Recommended Square Footage
Classroom/Instruction	700*
Storage	50
Teacher Office/Conference	150

Special Considerations:

1. Teacher office/conference areas should be contiguous to the classroom area and should provide visual access to the classroom.
2. Full-height adjustable shelving in storage room.
3. Bookcases and files cabinets in both classroom and teacher's office.
4. Tack or bulletin boards on available wall space.
5. Computer workstations with overhead shelving for storage.
6. Tables with rolling chairs should be considered in lieu of traditional student desks.
7. Dedicated Internet line.
8. Telephone in teacher's office.
9. TV/VCR
10. Overhead-mount AV screen

Color Coding

The way equipment and furniture is arranged in a laboratory is important. Many accidents occur from being in the wrong place or from conflicts in traffic flow. Color-coding improves the safety of the laboratory establishing boundaries, which identify safe or unsafe areas. Color-coding is a method of communication that tells the student where safety zones and equipment are and what is or is not safe.

Red – Identifies fire protection equipment, danger, and emergency stops for equipment. Fire extinguishers and fire alarm housing should be red to identify their location. Safety cans and containers of flammable liquids must be painted red with a clearly visible identification, either in the form of a yellow band around the container bearing a contents label or the contents clearly printed on the container in yellow. Danger signs and emergency power switches must also be painted red.

Orange – Alerts users to hazardous parts of machines that may shock, cut, crush, or injure. Use orange on exposed edges of cutting devices, pulleys, gears, inside surfaces of guards, transmission cases, and fuse boxes.

Green and White – Used to identify first aid and safety equipment. Use on first aid equipment and personal protective equipment storage areas.

Blue – Indicates precaution and is used to mark equipment or controls that should not be used.

Purple – Denotes radiation hazards.

Black and White – Used separately or in combination to denote housekeeping areas, such as the location of waster containers, brooms, and other clean-up materials.

For official information on use of colors, consult OSHA Standard 1910.144, which may be found at: www.osha-sl.gov/OshStd_data/1910-0114.html

OSHA Offices

The following list of national, regional OSHA and state offices for labor/industry should be helpful if you have questions concerning laboratory safety on topics such as hazardous materials, personal protective equipment, machine guarding, hazard communication, blood-borne pathogens, safety and health programs, lockout/tagout, electrical, fire protection and means of egress and walking/working surfaces and related topics.

The offices are listed numerically by OSHA region with the state offices listed alphabetically within each OSHA region.

U.S. Department of Labor
Occupational Safety and Health Administration (OSHA)
200 Constitution Avenue, N.W
Washington, D.C. 20210

OSHA Region 1
Regional Office
JFK Federal Building, Room E340
Boston, Massachusetts 02203
(617) 565-9860
(617) 565-9827 Fax

Connecticut Department of Labor
200 Folly Brook Boulevard
Wethersfield, Connecticut 06109
(860) 566-5123
(860) 566-1520 FAX

Division of Occupational Safety and Health
38 Wolcott Hill Road
Wethersfield, Connecticut 06109
(860) 566-4550
(860) 566-6916 Fax

North Boston Area Office
Valley Office Park
13 Branch Street
Methuen, Massachusetts 01844
(617) 565-8110
(617) 565-8115 Fax

South Boston Area Office
639 Granite Street, 4th Floor
Braintree, Massachusetts 02184
(617) 565-6924
Fax: (617) 565-6923

Massachusetts Area Office
1441 Main Street, Room 550
Springfield, Massachusetts 01103-1493
(413) 785-0123
(413) 785-0136 Fax

Bangor Area Office
202 Harlow Street, Room 211
Bangor, Maine 04401
(207) 941-8177
(207) 941-8179 Fax:

Portland District Office
100 Middle Street, Suite 410 West
Portland, Maine 04101
(207) 780-3178
(207) 780-3171 Fax

New Hampshire Area Office
279 Pleasant Street, Suite 201
Concord, New Hampshire 03301
(603) 225-1629
(603) 225-1580 Fax

Rhode Island Area Office Area Office
Federal Office Building
380 Westminster Mall, Room 243
Providence, Rhode Island 02903
(401) 528-4669
(401) 528-4663 Fax

Vermont Department of Labor and Industry
National Life Building - Drawer 20
National Life Drive
Montpelier, Vermont 05620-3401
(802) 828-5098
(802) 828-2195 Fax

OSHA Region 2
Regional Office
201 Varick Street, Room 670
New York, New York 10014
(212) 337-2378
(212) 337-2371 Fax

New Jersey Department of Labor
Division of Public Safety and Occupational Safety and Health
225 E. State Street
8th Floor West
P.O. Box 953
Trenton, New Jersey 08625-0953
(609) 292-3923
(609) 292-4409 FAX

Albany Area Office
401 New Karner Road, Suite 300
Albany, New York 12205-3809
(518) 464-4338
(518) 464-4337 Fax

Long Island Area Office
4240 Bell Boulevard
Bayside, New York 11361
(718) 279-9060
(718) 279-9057 Fax

Buffalo Area Office
5360 Genesee Street
Bowmansville, New York 14026
(716) 684-3891
(716) 684-3896 Fax

Long Island Area Office
1400 Old Country Road, Suite 208
Westbury, New York 11590
(516) 334-3344
(516) 334-3326 Fax

Manhattan Area Office
6 World Trade Center, Room 881
New York, New York 10048
(212) 466-2482
(212) 466-2939 Fax

Syracuse Area Office
3300 Vickery Road
North Syracuse, New York 13212
(315) 451-0808
(315) 451-1351 Fax

Tarrytown Area Office
660 White Plains Road, 4th Floor
Tarrytown, New York 10591-5107
(914) 524-7510
(914) 524-7515 Fax

Puerto Rico Area Office
BBV Plaza Building
1510 FD Roosevelt Avenue
Guaynabo, Puerto Rico 00968
(787) 277-1560
(787) 766-5646 Fax

Division of Occupational Safety and Health
Virgin Islands Department of Labor
3021 Golden Rock
St. Croix, Virgin Island 00840
(340) 772-1315
(340) 772-4323 Fax

OSHA Region 3
U.S. Department of Labor/OSHA
The Curtis Center-Suite 740 West
170 S. Independence Mall West
Philadelphia, PA 19106-3309
(215) 861-4900
(215) 861-4904 Fax

Baltimore/Washington Area Office
1099 Winterson Road Suite 140
Linthicum, Maryland 21090
410-865-2055/2056
410-865-2068 Fax

Wilmington Area Office
Caleb Boggs Federal Building
844 North King Street - Room 2209
Wilmington, Delaware 19801
(302) 573-6518
(302) 573-6532 Fax

Maryland Department of Labor, Licensing and Regulation
1100 North Eutaw Street, Room 613
Baltimore, Maryland 21201-2206
(410) 767-2999
(410) 767-2986 Fax

Allentown Area Office
850 North 5th Street
Allentown, Pennsylvania 18102-1731
(610) 776-0592
(610) 776-1913 Fax

Erie Area Office
3939 West Ridge Road, Suite B12
Erie, Pennsylvania 16506-1857
(814) 833-5758
(814) 833-8919 Fax

Harrisburg Area Office
Progress Plaza
49 North Progress Avenue
Harrisburg, Pennsylvania 17109-3596
(717) 782-3902
(717) 782-3746 Fax

Philadelphia Area Office
US Custom House, Room 242
Second & Chestnut Street
Philadelphia, Pennsylvania 19106-2902
(215) 597-4955
(215) 597-1956 Fax

Pittsburgh Area Office
Federal Office Building, Room 1428
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222-4101
(412) 395-4903
(412) 395-6380 Fax

Wilkes-Barre Area Office
The Stegmaier Building, Suite 410
7 North Wilkes-Barre Boulevard
Wilkes-Barre, PA 18702-5241
(570) 826-6538
(570) 821-4170 FAX

Maryland Occupational Safety & Health (MOSH)
(410) 767-2215
(410) 767-2003 Fax

Virginia Department of Labor and Industry
Powers-Taylor Building
13 South 13th Street
Richmond, Virginia 23219
(804) 786-2377
(804) 371-6524 Fax

Health Compliance
(804) 786-0574
(804) 371-6524 Fax

Safety Compliance
(804) 786-2391
(804) 371-6524 Fax

Charleston Area Office
405 Capitol Street, Suite 407
Charleston, West Virginia 25301-1727
(304) 347-5937
(304) 347-5275 Fax

OSHA Region 4

Regional Office
61 Forsyth Street, SW
Atlanta, Georgia 30303
(404) 562-2300
(404) 562-2295 Fax

Birmingham Area Office
Todd Mall
2047 Canyon Road
Birmingham, Alabama 35216-1981
(205) 731-1534
(205) 731-0504 Fax

Mobile Area Office
3737 Government Boulevard, Suite 100
Mobile Alabama 36693-4309
(334) 441-6131
(334) 441-6396 Fax

Fort Lauderdale Area Office
8040 Peters Road, Building H-100
Fort Lauderdale, Florida 33324
(954) 424-0242
(954) 424-3073 Fax

Jacksonville Area Office
Ribault Building, Suite 227
1851 Executive Center Drive
Jacksonville, Florida 32207
(904) 232-2895
(904) 232-1294 Fax

Tampa Area Office
5807 Breckenridge Parkway, Suite A
Tampa, Florida 33610-4249
(813) 626-1177
(813) 626-7015 Fax

Atlanta East Area Office
LaVista Perimeter Office Park
2183 N. Lake Parkway, Building 7, Suite 110
Tucker, Georgia 30084-4154
(770) 493-6644
(770) 493-7725 Fax

Atlanta West Area Office
2400 Herodian Way, Suite 250
Smyrna, Georgia 30080-2968
(770) 984-8700
(770) 984-8855 Fax

Savannah Area Office
450 Mall Boulevard, Suite J
Savannah, Georgia 31406
(912) 652-4393
(912) 652-4329 Fax

Kentucky Labor Cabinet
1047 U.S. Highway 127 South, Suite 4
Frankfort, Kentucky 40601
(502) 564-3070
(502) 564-5387 Fax

Frankfort Area Office
John C. Watts Federal Office Building
330 West Broadway, Room 108
Frankfort, Kentucky 40601-1922
(502) 227-7024
(502) 227-2348 Fax

Jackson Area Office
3780 I-55 North, Suite 210
Jackson, Mississippi 39211-6323
(601) 965-4606
(601) 965-4610 Fax

North Carolina Department of Labor
4 West Edenton Street
Raleigh, North Carolina 27601-1092
(919) 807-2900
(919) 807-2855 Fax

Raleigh Area Office
Century Station Federal Office Building
300 Fayetteville Street Mall, Room 438
Raleigh, North Carolina 27601-9998
(919) 856-4770
(919) 856-4183 Fax

Columbia Area Office
1835 Assembly Street, Room 1468
Columbia, South Carolina 29201-2453
(803) 765-5904
(803) 765-5591 Fax

South Carolina Department of Labor
Koger Office Park, Kingstree Building
PO Box 11329
Columbia, South Carolina 29210
(803) 896-4300
(803) 896-4393 Fax

South Carolina Department of Labor
Licensing and Regulation
3600 Forest Drive
PO Box 11329
Columbia, South Carolina 29204
(803) 734-9644
(803) 734-9772 Fax

Nashville Area Office
2002 Richard Jones Road, Suite C-205
Nashville, Tennessee 37215-2809
(615) 781-5423
(615) 781-5426 Fax

Tennessee Department of Labor and Workforce Development
710 James Robertson Parkway
Nashville, Tennessee 37243-0659
(615) 741-2582
(615) 741-5078 FAX

OSHA Region 5

Regional Office
230 South Dearborn Street, Room 3244
Chicago, Illinois 60604
(312) 353-2220
(312) 353-7774 Fax

Calumet City Area Office
1600 167th Street, Suite 12
Calumet City, Illinois 60409
(708) 891-3800
(708) 862-9659 Fax

Chicago Area Office
701 Lee Street - Suite 950
Des Plains, Illinois 60016
(847) 803-4800
(847) 390-8220 Fax

Fairview Heights Area Office
11 Executive Drive, Suite 11
Fairview Heights, Illinois 62208
(618) 632-8612
(618) 632-5712 Fax

North Aurora Area Office
344 Smoke Tree Business Park
North Aurora, Illinois 60542
(630) 896-8700
(630) 892-2160 Fax

Peoria Area Office
2918 W. Willows Knolls Road
Peoria, Illinois 61614
(309) 671-7033
(309) 671-7326 Fax

Indianapolis Area Office
46 East Ohio Street, Room 423
Indianapolis, Indiana 46204
(317) 226-7290
(317) 226-7292 Fax

Indiana Department of Labor
State Office Building
402 West Washington Street, Room W195
Indianapolis, Indiana 46204-2751
(317) 232-2378
(317) 233-3790 Fax

Bureau of Safety, Education and Training
Division of Labor, Room W195
402 West Washington
Indianapolis, Indiana 46204-2287
(317) 232-2688
(317) 232-3790 Fax

Lansing Area Office
U.S. Department of Labor- OSHA
801 South Waverly Road, Suite 306
Lansing, Michigan 48917
(517) 327-0904
(517) 327-1973 Fax

Michigan Department of Consumer and Industry Services
Bureau of Safety and Regulation
P.O. Box 30643
Lansing, Michigan 48909-8143
(517) 322-1814
(517) 322-1775 Fax

Minneapolis Area Office
U.S. Department of Labor – OSHA
300 S. 4th Street, Suite 1205
Minneapolis, Minnesota 55415
(612) 664-5460
(612) 664-5464 FAX

Minnesota Department of Labor and Industry
443 Lafayette Road North
St. Paul, Minnesota 55155-4307
(651) 296-2342
(651) 282-5405 Fax

Consultation Services
Workplace Safety Consultation
443 Lafayette Road North
St. Paul, Minnesota 55155-4307
(651) 297-2393
(651) 297-1953 Fax

Cleveland Area Office
Federal Office Building
1240 East 9th Street, Room 899
Cleveland, Ohio 44199
(216) 522-3818
(216) 771-6148 Fax

Toledo Area Office
Ohio Building
420 Madison Avenue, Suite 600
Toledo, Ohio 43604
(419) 259-7542
(419) 259-6355 Fax

Eau Claire District Office
1310 W. Clairemont Avenue
Eau Claire, Wisconsin 54701
(715) 832-9019
(715) 832-1147 Fax

Milwaukee Area Office
Henry S. Reuss Building, Suite 1180
310 West Wisconsin Avenue
Milwaukee, Wisconsin 53203
(414) 297-3315
(414) 297-4299 Fax

OSHA Region 6
Regional Office
525 Griffin Street, Room 602
Dallas, Texas 75202
(214) 767-4731
(214) 767-4137 Fax

Baton Rouge Area Office
9100 Bluebonnet Centre Blvd, Suite 201
Baton Rouge, Louisiana 70809
(225) 389-0474
(225) 389-0463 Fax

Cincinnati Area Office
36 Triangle Park Drive
Cincinnati, Ohio 45246
(513) 841-4132
(513) 841-4114 Fax

Columbus Area Office
Federal Office Building
200 North High Street, Room 620
Columbus, Ohio 43215
(614) 469-5582
(614) 469-6791 Fax

Appleton Area Office
1648 Tri Park Way
Appleton, Wisconsin 54914
(920) 734-4521
(920) 734-2661 Fax

Madison Area Office
4802 E. Broadway
Madison, Wisconsin 53716
(608) 441-5388
(608) 441-5400 Fax

Little Rock Area Office
TCBY Building, Suite 450
425 West Capitol Avenue
Little Rock, Arkansas 72201
(501) 324-6291
(501) 324-5243 Fax

Albuquerque Area Office
Western Bank Building, Suite 820
505 Marquette, NW
Albuquerque, New Mexico 87102
(505) 248-5302
(505) 248-5301 Fax

New Mexico Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, New Mexico 87502
(505) 827-2850
(505) 827-2836 Fax

New Mexico Environment Department-OSHA
525 Camino de Los Marquez, Suite 3
PO Box 26110
Santa Fe, New Mexico 87502
(505) 827-4230
(505) 827-4422 Fax

Oklahoma City Area Office
420 West Main, Suite 300
Oklahoma City, Oklahoma 73102
(405) 231-5351
(405) 231-4389 Fax

Austin Area Office
903 San Jacinto Boulevard, Suite 319
Austin, Texas 78701
(512) 916-5783
(512) 916-5793 Fax

Corpus Christi Area Office
Wilson Plaza, Suite 700
606 N Carancahua
Corpus Christi, Texas 78476
(361) 888-3420
(361) 888-3424 Fax

Dallas Area Office
834 East RL Thornton Freeway
Suite 420
Dallas, Texas 75228
(214) 320-2400 (2558)
(214) 320-2598 Fax

El Paso Area Office
Federal Building C
700 E. San Antonio, Room C-408
El Paso, Texas 79901
(915) 534-6251 (6252)
(915) 534-6259 Fax

Fort Worth Area Office
8713 Airport Freeway
Suite 302
Fort Worth, Texas 76180-7610
(817) 428-2470
(817) 581-7723 Fax

Houston North Area Office
350 North Sam Houston Parkway East
Suite 120
Houston, Texas 77060
(281) 591-2438
(281) 591-1058 Fax

Houston South Area Office
17625 El Camino Real, Suite 400
Houston, Texas 77058
(281) 286-0583 (0584)
(281) 286-6352 Fax

Lubbock Area Office
Federal Office Building
1205 Texas Avenue, Room 806
Lubbock, Texas 79401
(806) 472-7681 (7685)
(806) 472-7686 Fax

OSHA Region 7
Regional Office
City Center Square
1100 Main Street, Suite 800
Kansas City, Missouri 64105
816) 426-5861
(816) 426-2750 Fax

Des Moines Area Office
210 Walnut Street, Room 815
Des Moines, Iowa 50309
(515) 284-4794
(515) 284-4058 Fax

Iowa Division of Labor Services
1000 E. Grand Avenue
Des Moines, Iowa 50319-0209
(515) 281-6432
(515) 281-4698 Fax

Wichita Area Office
271 W. 3rd Street North, Room 400
Wichita, KS 67202
(316) 269-6644
(316) 269-6185 Fax
{KS Residents Only) 1-800-362-2896

Kansas City Area Office
6200 Connecticut Avenue, Suite 100
Kansas City, Missouri 64120
(816) 483-9531
(816) 483-9724 Fax
{Missouri Residents Only} 1-800-892-2674

St. Louis Area Office
911 Washington Avenue, Room 420
St. Louis, Missouri 63101
(314) 425-4249
(314) 425-4289 Fax
{Missouri Residents Only) 1-800-392-7743

Omaha Area Office
Overland-Wolf Building
6910 Pacific Street, Room 100
Omaha, Nebraska 68106
(402) 221-3182
(402) 221-3188 Fax
{Nebraska Residents Only} 1-800-642-8963

OSHA Region 8
Regional Office
1999 Broadway, Suite 1690
P.O. Box 46550
Denver, Colorado 80201-6550
(303) 844-1600
(303) 844-1616 Fax

Denver Area Office
1391 Speer Boulevard, Suite 210
Denver, Colorado 80204-2552
(303) 844-5285
(303) 844-6676 Fax
Toll free: 1-800-755-7090

Englewood Area Office
7935 East Prentice Avenue, Suite 209
Englewood, Colorado 80111-2714
(303) 843-4500
(303) 843-4515 Fax
Toll free: 1-800-669-5771

Billings Area Office
2900 4th Avenue North, Suite 303
Billings, Montana 59101
(406) 247-7494
(406) 247-7499 Fax
Toll free: 1-800-488-7087

Bismarck Area Office
Federal Office Building
1640 East Capitol Avenue
Bismarck, North Dakota 58501
(701) 250-4521
(701) 250-4520 Fax
Toll free: 1-800-473-7419

Salt Lake City Area Office
1781 South 300 West
Salt Lake City, Utah 84115-1802
(801) 487-0680
(801) 487-1190 Fax

Utah Labor Commission
160 East 300 South, 3rd Floor
PO Box 146650
Salt Lake City, Utah 84114-6650
(801) 530-6901
(801) 536-7906 Fax

Wyoming Department of Employment
Worker's Safety and Compensation Division
Herschler Building, 2nd Floor East
122 West 25th Street
Cheyenne, Wyoming 82002
(307) 777-7786
(307) 777-5850 Fax

OSHA Region 9
71 Stevenson Street, Room 420
San Francisco, California 94105
(415) 975-4310 (Main Public - 8:00 AM - 4:30 PM Pacific)
(800) 475-4019 (For Technical Assistance)
(800) 475-4020 (For Complaints - Accidents/Fatalities)
(800) 475-4022 (For Publication Requests)
(415) 975-4319 Fax

Industrial Commission of Arizona
800 W. Washington
Phoenix, Arizona 85007-2922
(602) 542-5795
(602) 542-1614 Fax

California Department of Industrial Relations
455 Golden Gate Avenue - 10th Floor
San Francisco, California 94102
(415) 703-5050
(415) 703-5114 Fax

Hawaii Department of Labor and Industrial Relations
Consultation and Training Branch
Dept of Labor and Industrial Relations
830 Punchbowl Street
Honolulu, Hawaii 96813
(808) 586-9100
(808) 586-9104 Fax

Nevada Division of Industrial Relations
400 West King Street
Carson City, Nevada 89710
(775) 687-3032
(775) 687-6305 Fax

Occupational Safety and Health Enforcement Section (OSHES)
1301 N. Green Valley Parkway - Suite 200
Henderson, Nevada 89014-6197
[Las Vegas] (702) 486-9044 / FAX (702) 990-0358
[Carson City] (775) 687-5240 / FAX (775) 687-6150

OSHA Region 10
Regional Office
1111 Third Avenue, Suite 715
Seattle, Washington 98101-3212
(206) 553-5930
(206) 553-6499 Fax

Anchorage Area Office
301 W Northern Lights Boulevard, Suite 407
Anchorage, Alaska 99503
(907) 271-5152
(907) 271-4238 Fax

Alaska Department of Labor
P.O. Box 21149 (Mailing address)
Juneau, Alaska 99801-1149
1111 W. 8th Street, Room 304
Juneau, Alaska 99801-1149
(907) 465-2700
(907) 465-2784 Fax
Labor Standards & Safety, Anchorage
(907) 269-4919
(907) 269-4992 Fax
Juneau
(907) 465-4855
(907) 465-3584 Fax

Boise Area Office
1150 North Curtis Road, Suite 201
Boise, Idaho 83706
(208) 321-2960
(208) 334-9407 Fax

Portland Area Office
Federal Office Building
1220 Southwest 3rd Avenue, Room 640
Portland, Oregon 97204
(503) 326-2251
(503) 326-3574 Fax

Oregon Occupational Safety and Health Division
Department of Consumer & Business Services
350 Winter Street, NE, Room 430
Salem, Oregon 97310
(503) 378-3272
(800) 922-2689 Toll Free in Oregon

Bellevue Area Office
505 106th Avenue NE, Suite 302
Bellevue, Washington 98004
(206) 553-7520
(206) 553-0106 FAX

Washington Department of Labor and Industries
PO Box 44001
Olympia, Washington 98504-4001
(360) 902-4200
(360) 902-4202 Fax

Compliance Statement

Title VI, Civil Rights Act of 1964; The Modified Court Order, Civil Action 5281, Federal District Court, Eastern District of Texas, Tyler Division
Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action NO. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;
(2) operation of school bus routes or runs on a non-segregated basis;
(3) nondiscrimination in extracurricular activities and the use of school facilities;
(4) non discriminatory practices in the hiring, assigning, promoting, paying, demoting reassigning, or dismissing of faculty and staff who work with children;
(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;
(6) nondiscriminatory practices relating to the use of a student's first language; and
(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

Title VII, Civil Rights Act of 1964; Executive Orders 11246 and 11375; Title IX, 1973 Education amendments; Rehabilitation Act of 1973 as amended; 1974 Amendments to the Wage-Hour Law Expanding the Age Discrimination in Employment Act of 1967; and Vietnam Era Veterans Readjustment Assistance Act of 1972 as Amended in 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulations by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs or activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.