# TABLE OF CONTENTS

1. INTRODUCTION: ........................................................................................................................................ 4
   A. SUPERVISORS ........................................................................................................................................ 4

2. GENERAL SHOP / WORK AREA SAFETY: ................................................................................................. 5
   A. EMPLOYEE TRAINING .......................................................................................................................... 5
   B. PERSONAL PROTECTIVE EQUIPMENT .............................................................................................. 5
   C. SHOP LAYOUT ..................................................................................................................................... 7
   D. ILLUMINATION ..................................................................................................................................... 8
   E. EXITS AND EXIT MARKINGS ................................................................................................................ 9
   F. HOUSEKEEPING .................................................................................................................................. 10
   G. FIRE PREVENTION .............................................................................................................................. 10
   H. MATERIAL STORAGE ......................................................................................................................... 11
   I. USE OF TOOLS ................................................................................................................................... 12
   J. USE OF COMPRESSED AIR SOURCES ............................................................................................... 13
   K. WORKING SAFELY AT ELEVATIONS ............................................................................................. 15
   L. ROOFTOP WORK ............................................................................................................................... 20
   M. SHORING AND TRENCHING ............................................................................................................. 20
   N. BARRICADES .................................................................................................................................... 21

3. ELECTRICAL INSTALLATIONS AND EQUIPMENT .................................................................................... 21
   A. HAZARDS ........................................................................................................................................... 21
   B. REQUIREMENTS ............................................................................................................................... 21
   C. INSPECTIONS .................................................................................................................................... 22
   D. CONTROL OF HAZARDOUS ENERGY (LOCK-OUT/TAG-OUT) .......................................................... 22
   E. TRAINING ........................................................................................................................................... 26

4. MACHINERY ............................................................................................................................................ 26
   A. GENERAL ........................................................................................................................................... 27

5. PLUMBING MAINTENANCE: ..................................................................................................................... 31
   A. HAZARDS ........................................................................................................................................... 31
   B. PERSONAL PROTECTIVE EQUIPMENT .............................................................................................. 31
   C. HOT OPERATIONS ............................................................................................................................. 31

6. CARPENTRY AND STRUCTURAL MAINTENANCE ..................................................................................... 34
   A. HAZARDS ........................................................................................................................................... 34
   B. GENERAL CARPENTRY .................................................................................................................... 35
   C. VENTILATION SYSTEMS .................................................................................................................... 36
   D. STORAGE AND HANDLING OF LUMBER ...................................................................................... 36

7. WELDING AND METAL FABRICATION .................................................................................................... 36
   A. HAZARDS ........................................................................................................................................... 36
   B. OPERATING PRECAUTIONS .............................................................................................................. 37
   C. PERSONAL PROTECTIVE EQUIPMENT ............................................................................................ 39
   D. FIRE PREVENTION AND PROTECTION (HOT WORK PERMIT PROGRAM) .................................... 40
8. REFRIGERATION AND AIR CONDITIONING MAINTENANCE .................................................. 45
   A. HAZARDS .................................................................................................................. 45
   B. GENERAL REQUIREMENTS.................................................................................. 45
   C. STORAGE AND HANDLING............................................................................... 46
   D. FLUOROCARBONS ............................................................................................... 47

9. HEATING SYSTEMS AND BOILER PLANT MAINTENANCE .................................................. 48
   A. BOILER OPERATIONS ...................................................................................... 48
   B. BOILER SAFETY ............................................................................................. 48
   C. BOILER WATER TREATMENT TANKS ........................................................ 52

10. PAINTING OPERATIONS ............................................................................................ 54
    A. HAZARDS .......................................................................................................... 54
    B. SAFETY ........................................................................................................... 55
    C. HEALTH ......................................................................................................... 55
    D. AIR AND WATER POLLUTION ..................................................................... 56
    E. FIRE PREVENTION AND PROTECTION .................................................... 56
    F. VENTILATION SYSTEMS ............................................................................... 57
    G. STORAGE AND HANDLING ........................................................................ 57
    H. ELECTRICAL .................................................................................................. 58
    I. LOCATION OF PAINT SHOPS AND SPRAY FINISHING OPERATIONS .......... 59
    J. AIRLESS PAINT SPRAYING ........................................................................... 59
    K. PAINT SPRAY BOOTHs .................................................................................... 60
    L. PORTABLE PAINT SPRAY EQUIPMENT ....................................................... 60
    M. AEROSOL SPRAY PAINT CANS .................................................................... 61
    N. PROCEDURES FOR THE IDENTIFICATION, SAFE REMOVAL, AND DISPOSAL OF LEAD-BASED PAINTS .......... 62

11. LANDSCAPE/GROUNDS MAINTENANCE .................................................................... 66
    A. MOWING ........................................................................................................... 66
    B. FUEL CAN STORAGE ....................................................................................... 67
    C. CHAINSAW SAFETY ....................................................................................... 67
    D. POWER EQUIPMENT SAFETY ..................................................................... 72
    E. TRACTOR OPERATIONS ............................................................................... 72
    F. HEAT RELATED ILLNESS ............................................................................... 73
    G. COLD WEATHER SAFETY ............................................................................ 76
    H. FLOWER BED AND SHRUB MAINTENANCE ............................................. 76
    I. FERTILIZER STORAGE AND HANDLING .................................................. 77
    J. HERBICIDES .................................................................................................. 77

12. CUSTODIAL SERVICES .............................................................................................. 77
    A. RESPONSIBILITY ............................................................................................ 77
    B. PROTECTION FROM BLOOD BORNE PATHOGENS. HIV, AND OTHER HAZARDOUS ........................................ 78
1. INTRODUCTION:

This section is specifically designed to meet the safety requirements of the MSU Physical Plant Department. However, all departments engaged in any activities addressed in this section shall comply with the safety and health requirements set forth herein.

Responsibilities:

A. Supervisors

Supervisors must recognize those factors in the workplace with accident potential. The supervisor shall provide frequent inspections of job sites, work methods, and materials/equipment used. Any unsafe equipment/material shall be tagged and rendered inoperative or physically removed from its place of operation. The supervisor shall permit only qualified personnel to operate equipment and machinery according to safe work practices.

Supervisors are responsible for:

1. Ensuring safe working conditions
2. Providing necessary protective equipment
3. Ensuring that required guards and protective equipment are provided, used, and properly maintained.
4. Ensuring that tools and equipment are properly maintained and used.
5. Planning the workload and assigning employees to jobs which they are qualified to perform. Ensuring that the employees understand the work to be done, the hazards that may be encountered, and the proper procedure for doing the work safely.
6. Taking immediate action to correct any violation of safety rules observed or reported to them.
7. Ensuring workers exposed or potentially exposed to hazardous chemicals/materials have access to appropriate Material Safety Data Sheets (MSDS).
2. General Shop / Work Area Safety:

A. Employee Training

Employees shall be thoroughly trained in the use of protective equipment, guards, and safeguards for chemicals and safe operation of equipment, machines, and tools they use or operate. Only employees who have been trained and those undergoing supervised on-the-job training (OJT) shall be allowed to use shop equipment, machines, and tools.

B. Personal Protective Equipment

Personal protective equipment (PPE) is not a substitute for engineering controls or feasible work or administrative procedures. While these controls are being implemented, or if it has been determined that control methods are not feasible, personal protective equipment is required whenever there are hazards that can do bodily harm through absorption, inhalation, or physical contact. This equipment includes respiratory and hearing protective devices, special clothing, and protective devices for the eyes, face, head, and extremities. All PPE shall be of a safe design and constructed for the work to be performed and shall be maintained in a sanitary and reliable condition.

1. Eye Protection

Eye protection is required when there is a possibility of injury from chemicals or flying particles. Examples of operation requiring the use of eye protection include, but are not limited to:

- Chipping, grinding, and impact drilling.
- Breaking concrete, brick, and plaster.
- Welding or helping in welding of any type.
- Cleaning with compressed air.
- Tinning or soldering lugs or large joints.
- Riveting, grinding, or burning metals.
- Handling chemicals, acids, or caustics.

Face shields shall be thoroughly washed with soap and water before being worn by another person.
2. Hearing Protection

Appropriate hearing protection shall be used where employees are in designated hazardous noise areas with operating noise sources, or using tools or equipment which are labeled as hazardous noise producers. The Office of Environmental Safety shall be contacted for noise level surveys and guidance on the type of hearing protection required.

3. Hand Protection

Rubber protective gloves shall be worn by personnel working in automotive shop or areas where acids, alkalies, organic solvents, and other harmful chemicals are handled.

Electrical worker's gloves are designed and shall be used to insulate electrical workers from shock, burns, and other electrical hazards. These gloves shall NOT be the only protection provided and will never be used with voltages higher than the insulation rating of the gloves.

Multi-use gloves shall be worn to protect the hands from injuries caused by handling sharp or jagged objects, wood, or similar hazard-producing materials. These gloves are usually made of cloth material with chrome leather palms and fingers or synthetic coating. All-leather gloves are also acceptable.

4. Foot Protection

Non-skid shoes shall be worn where floors may be wet or greasy. Where there is reasonable probability of foot or toe injury from impact and compression forces, safety footwear shall be worn.

5. Respiratory Protection

There are various airborne hazards, e.g., organic vapors, particulates, fumes, etc., that personnel may encounter and respiratory protection may be required. Additional information is available in the Respiratory Protection Program. The Office of Environmental Safety shall be consulted for guidance on the type of protection required.

6. Head Protection

Hard hats shall be worn by all personnel working below other workers and in areas where sharp projections or other head hazards exist.
7. Body Protection

Natural or synthetic rubber or acid-resisting rubberized cloth aprons shall be worn by personnel handling irritating or corrosive substances. Aprons shall normally be worn with acid sleeves and gloves for greater body protection against skin injuries.

8. Insulated Matting

Insulating matting shall be used by workers for additional resistance to shock where potential shock hazards exist, such as:

- Areas where floor resistance is lowered due to dampness.
- Areas where high voltages (above 600 volts) may be encountered.
- Areas with electrical repair or test benches.

9. Other

Shop supervisors shall ensure that personnel use the protective clothing and equipment that will protect them from hazards of the work they perform. It is the responsibility of workers to keep their PPE in a clean, sanitary state of repair and use the equipment when required.

Workers shall keep their hands and face clean, change clothes when they are contaminated with solvents, lubricants, or fuels, and keep their hands and soiled objects out of their mouth. No food or drink shall be brought into or consumed in areas exposed to toxic materials, chemicals, or shop contaminants. Workers shall wash their hands before eating or smoking after exposure to any contaminant.

Workers shall not wear rings, earrings, bracelets, wristwatches, or necklaces near operating machinery and power tools. Additionally, long full beards, unrestrained long hair, and loose clothing can become caught in tools or machinery and cause serious personal injury. Highly combustible garments or coveralls made of material such as nylon shall not be worn in or around high temperature equipment or operations such as boiler operations, welding, and any other work with open flame devices.

C. Shop Layout

Proper layout, spacing, and arrangement of equipment, machinery, passageways, and aisles are essential to orderly operations and to avoid congestion.
Equipment and machinery shall be arranged to permit an even flow of materials. Sufficient space should be provided to handle the material with the least possible interference from or to workers or other work being performed. Machines should be placed so it is not necessary for an operator to stand in a passageway or aisle. Additionally, machine positioning should allow for easy maintenance, cleaning, and removal of scrap. Clear zones shall be established and should be of sufficient dimensions to accommodate typical work. Marking of machine clear zones may be yellow or yellow and black hash-marked lines, 2 to 3 inches wide. Machines designed for fixed locations shall be securely anchored. If a piece of stock to be worked exceeds workplace/clear zone floor markings, rope/stanchions may be used to temporarily extend the workplace. Machines with shock mounting pads shall be securely anchored and installed according to manufacturer's instructions.

Passageways/aisles shall be provided and marked to permit the free movement of employees bringing and removing material from the shop. These passageways are independent of clear zones and storage spaces. They shall be clearly recognizable.

Where powered materials handling equipment (forklift) is used, facility layout shall provide enough clearance in aisles, on loading docks, and through doorways to permit safe turns. Aisles shall be at least 3 feet wider than the widest vehicle used or most common material being transported.

D. Illumination

Adequate illumination shall be provided to ensure safe working conditions.

a. Portable lamps shall have UL approved plugs, handles, sockets, guards, and cords for normal working conditions.

b. For work in boilers, condensers, tanks, turbines, or other grounded locations that are wet or may cause excessive perspiration, a low voltage lighting system should be used, either from a battery system or low-voltage lighting unit. In situations where these lighting systems are not available, a vapor-proof 110 volt lighting system shall be used. All lighting and electrical service outlets will be routed through a ground fault circuit interrupter (GFCI).

c. Flashlights for use near energized electrical equipment and circuitry shall have insulated cases.

d. At least 50 foot-candles of illumination shall be provided at all work stations. However, fine work may require 100 foot-candles or more. This can be obtained with a combination of general lighting plus supplemental lighting.
E. Exits and Exit Markings

1. Every exit shall have "EXIT" in plain legible letters not less than 6 inches high with the strokes of the letters not less than three-quarters of an inch wide.

2. Doors, passageways, or stairways which are neither exits nor ways to an exit (but may be mistaken for an exit) shall be clearly marked "NOT AN EXIT" or by a sign indicating their actual use, for example: "STORAGE ROOM" or "BASEMENT."

3. When the direction to the nearest exit may not be apparent to an occupant, an exit sign with an arrow indicating direction shall be used.

4. Exit access shall be arranged so it is unnecessary to travel toward any area of high hazard potential in order to reach the nearest exit (unless the path of travel is effectively shielded by suitable partitions or other physical barriers).

5. Exit signs shall be clearly visible from all directions of egress and shall not be obstructed at any time. If occupancy is permitted at night, or if normal lighting levels are reduced at times during working hours, exit signs shall be suitably illuminated by a reliable light source.

6. A door from a room to an exit or to a way of exit access will be the side-hinged swinging type. It will swing out in the direction of travel if 50 or more persons occupy the room or the exit is from an area of high hazard potential.

7. Areas around exit doors and passageways shall be free of obstructions. The exit route shall lead to a public way. No lock fastening device shall be used to prevent escape from inside the building.

8. Where occupants may be endangered by the blocking of any single exit due to fire or smoke, there shall be at least two means of exit remote from each other.

9. Exits, exterior steps, and ramps shall be adequately lighted to prevent mishaps. Separate lighting will not be required if street or other permanent lighting gives at least one foot-candle of illumination on the exit, steps, or ramp.
F. Housekeeping

Good housekeeping shall be maintained in all shops, yards, buildings, and mobile equipment. Supervisors are responsible for good housekeeping in or around the work they are supervising. As a minimum, the following requirements shall be adhered to:

1. Material shall not be placed where anyone might stumble over it, where it might fall on someone, or on or against any support unless the support can withstand the additional weight.

2. Aisles and passageways shall be kept clear of tripping hazards.

3. Nails shall be removed from loose lumber or the points turned down.

4. Ice shall be removed from all walkways and work areas where it may create a hazard or interfere with work to be done. If ice cannot be removed readily, sand or other approved materials shall be applied.

5. Trash and other waste materials shall be kept in approved receptacles. Trash shall not be allowed to accumulate and shall be removed and disposed of as soon as practicable, at least once per shift (or more often if needed).

6. Disconnect switches, distribution panels, or alarm supply boxes shall not be blocked by any obstruction which may prevent ready access. All such devices shall be kept clear of combustible materials within 36 inches.

7. Machinery and equipment shall be kept clean of excess grease and oil and (operating conditions permitting) free of excessive dust. Pressure gauges and visual displays shall be kept clean, visible, and serviceable at all times. Drip pans and wheeled or stationary containers shall be cleaned and emptied at the end of each shift.

G. Fire Prevention

All engineering services personnel shall receive fire prevention training as part of their general training.

1. Supervisors in charge of operations where fuels, solvents, or other flammable liquids are used shall be constantly alert for hazards and unsafe acts. Fuels such as gasoline shall never be used to clean floors or clothing, and open solvent or gasoline containers shall not be kept near electrical equipment. The use of low flashpoint petroleum solvents shall be avoided whenever possible. Open flames, open element heaters, equipment not
properly grounded, and nonexplosion-proof electrical equipment used in the presence of flammable or combustible liquids shall be avoided.

2. Fire extinguishers of at least 20 BC or greater rating shall be installed in shop areas. The number of extinguishers depends upon the size and layout of the facility. Fire extinguishers shall meet the following OSHA requirements:

a. Be kept fully charged and in their designated area.

b. Be located along normal paths of travel.

c. Not be obstructed or obscured from view.

d. Be visually inspected at least monthly to ensure that they:

   a. Are in their designated places.

   b. Have not been tampered with or actuated.

   c. Do not have corrosion or other impairments.

   d. Are accessible and not obstructed.

e. Be examined at least yearly and/or recharged or repaired to ensure operability and safety.

f. Be hydrostatically tested.

g. Be placed so the maximum travel distance, unless there are extremely hazardous conditions, does not exceed 75 feet for Class A or 50 feet for Class B locations.

h. Supervisors shall ensure that employees remove construction debris and rubbish from the job site upon completion of the job, or daily if extended beyond one day. Hazardous materials shall not be left at job sites unless properly stored. Work being performed on job sites shall not endanger building occupants (e.g., exits blocked, fire alarm devices disconnected, etc.).

**H. Material Storage**

All unnecessary accumulation of materials and supplies in the shop area shall be avoided. The presence of unnecessary material in the shop could cause such incidents as tripping, falling, or slipping. This could be especially hazardous around equipment that is in operation. The only material in the shop area shall be
that actually in work. The only place that materials should accumulate in quantity are in storerooms and material holding areas.

1. The storage of materials shall not, of itself, create a hazard. Materials stored in tiers shall be stacked, strapped, blocked or interlocked, and limited in height so they are stable and secure against sliding or collapse. Storage racks shall have sufficient capacity to bear the loads imposed on them.

2. Stored materials shall not obstruct fire extinguishers, alarm boxes, sprinkler system controls, electrical switch boxes, machine operations, emergency lighting, first aid or emergency equipment, or exits.

3. Heavy materials and equipment should be stored low and close to the ground or floor to reduce the possibility of injury during handling.

4. All passageways and storerooms shall be maintained clean, unobstructed, dry, and in sanitary condition. Spills will be promptly removed.

5. Where mechanical handling equipment, such as lift trucks are used, safety clearance shall be provided for aisles at loading docks, through doorways, and wherever turns or passages must be made. No obstructions that could create a hazard are permitted in aisles.

I. Use of Tools

1. Handtools

Incidents at the job site involving hand tools are usually the result of misuse. Hand tools are precision tools capable of performing many jobs when used properly. Prevention of incidents involving hand tools on the job site becomes a matter of good instruction, adequate training, and proper use.

1. Hand tool safety requires that the tools be of good quality and adequate for the job. All tools shall be kept in good repair and maintained by qualified personnel.

2. Racks, shelves, or tool boxes shall be provided for storing tools which are not in use.

3. When personnel use hand tools while they are working on ladders, scaffolds, platforms, or work stands, they shall use carrying bags for tools which are not in use. Workers shall not drop tools.

Supervisors shall frequently inspect all hand tools used in the operation under
their supervision. Defective tools shall be immediately removed from service. Some common tool defects are:

**Handles**

When handles of hammers, axes, picks, or sledges become cracked, split, broken, or splintered, they shall be immediately replaced. Tool handles shall be well-fitted and securely fastened by wedges or other acceptable means.

Wedges, always used in pairs, shall be driven into the handle when repairing a sledgehammer or maul, to prevent the head from accidentally flying off if the handle shrinks.

**Tangs**

Files, wood chisels, and other tools with tangs shall be fitted and used with suitable handles covering the end of the tang. Ends of the handles shall not be used for pounding or tapping.

**Mushroom Heads**

Cold chisels, punches, hammers, drift pins, and other similar tools have a tendency to mushroom from repeated poundings. They shall be dressed down as soon as they begin to crack and curl.

a. When dressing tools, a slight bevel of about three-sixteenths of an inch shall be grounded around the head. This will help prevent the heads from mushrooming.

b. When tool heads mushroom, the material is highly crystallized and, with each blow of the hammer, fragments are likely to break off.

2. Portable Power Tools

Portable power tools increase mobility and convenience but are frequently more hazardous to use than their stationary counterparts. Personnel who are required to use portable power tools in their work shall be thoroughly trained in safe operating practices. Safe operating procedure shall be set up for each type of tool consistent with the manufacturer's instructions.

**J. Use of Compressed Air Sources**

Compressed air has the appearance of a relatively harmless gas. However, to
avoid accidents, compressed air must be used correctly. The improper or inadvertent connection of items not designed for shop air pressure, i.e., equipment, storage vessels, or containers, to a shop air supply may cause serious personal injury and more than likely will damage the item being connected.

The maximum air pressure approved for general use in the shops and laboratories is 30 psi (pounds per square inch). This pressure is sufficient for most shop and laboratory operations and is not significantly hazardous. Use discretion and good judgement when using compressed air, even at this low pressure.

The following rules and practices are suggested to avoid personal injury, equipment damage, and potential environmental impact:

1. All personnel assigned to shops with air compressors shall be familiar with compressor operating and maintenance instructions.
2. Compressed air is not to be used to blow dirt, chips, or dust from clothing.
3. Air compressors shall be maintained strictly in accordance with the manufacturer's instructions.
4. Do not use compressed air to transfer materials from containers when there is a possibility of exceeding the safe maximum allowable working pressure of the container.
5. The maximum working pressure of compressed air lines shall be identified in psi. Pipeline outlets shall be tagged or marked showing maximum working pressure immediately adjacent to the outlet.
6. Do not use compressed air to transfer materials from standard 55-gallon drums. Use a siphon with a bulk aspirator on a pump.

**WARNING**

It is dangerous to pressurize any container not designed for that purpose.

7. Never use compressed air where particles can be accelerated by the air stream.
8. Do not use compressed air to clean machinery or parts unless absolutely necessary. Where possible, use a brush. If necessary, use a minimum pressure and provide barriers or clean the area of personnel. Wear goggles to protect your eyes.
9. Never apply compressed air to any part of a person's body.
10. Do not use a compressed air line that does not have a pressure regulator for reducing the line pressure.
11. Keep the hose length between tool housing and the air source as short as possible.

12. Where possible, attach a short length of light chain between the hose and the housing on air-operated tools. This keeps the hose from whipping should the hose-tool coupling separate.

13. Inspect air supply and tool hoses before using. Discard and label unfit hoses. Repair hoses where applicable.

14. Turn valve off and vent pressure from a line before connecting or disconnecting it. Never work on a pressurized line.

15. Do not connect air supply respirators or supplied-air suits to the compressed air supply system of any building. Such compressed air is unsafe to breathe.

16. Do not attach pneumatic tools, process, or control instruments to breathing air lines. The potential contamination to personnel and systems is hazardous.

K. Working Safely at Elevations

These procedures are designed to prevent the injury of MSU personnel due to falls or slips any time personnel are working on portable stairs, ladders, or scaffolding, or at elevations or more than four (4) feet above grade. Applicable OSHA standards include 29 CFR 1910.21-68.

1. Ladders

A. Hazards

Falls are the primary hazard associated with the use of ladders. Falls result from a number of unsafe acts and conditions such as:

1) Ladders being set on unstable surfaces.

2) Personnel reaching too far out to the sides.

3) Personnel standing too high to maintain balance.

4) Personnel using defective ladders (e.g., broken rails, rungs, missing hardware).

These hazards are minimized if workers adhere to proper ladder safety practices and if supervisors ensure equipment is used, inspected, and maintained in good condition. Tasks that require frequent use of ladders and involve significant climbing effort must be accomplished by workers capable
of the physical exertion required under these conditions.

B. Requirements

1. Procurement:


2. Allowable Lengths: The maximum allowable lengths of portable ladders are:

   Stepladders: 8 feet
   Platform stepladders: 12 feet
   Straight ladders: 20 feet
   Extension ladders: 36 feet – with minimum overlap of 3 feet

3. Wooden Ladders

   Wooden parts used in construction of ladders should be straight-grained; thoroughly seasoned; smoothly dressed; and free of sharp edges, splinters, checks, decay and other defects. Rungs must be parallel, level and uniformly spaced. The spacing shall not be more than 12 inches.

   Wooden ladders will be coated with a suitable protective coating such as boiled linseed oil, clear varnish or clear lacquer. Wood ladders shall not be painted with an opaque coating, since possible defects may be covered up.

4. Non-slip Bases

   Portable ladders shall be equipped with nonslip bases such as safety feet or spikes, depending upon the type of usage.

5. Electrical

   Personnel shall not use portable metal ladders when performing work on or near electrical equipment. The side rails of metal ladders will be stenciled in 2-inch (or smaller is necessary to fit on the side rails) red letters: “DANGER - DO NOT USE AROUND ELECTRICAL EQUIPMENT.” Wood or reinforced plastic ladders shall be used for work on or near electrical equipment. They will be kept clean. Remove all surface buildup or dirt, grease, or oils to avoid creating a ready path for electrical current.
6. Care of Ladders

a) Handle ladders with care. Do not drop, jar or misuse them.

b) Ladders shall be stored in a manner that will provide easy access for inspection and will permit safe withdrawal for use. They shall not be stored in a manner that presents a tripping hazard not where they can fall on someone. They should be stored in a manner that will prevent sagging. They should be secured to a stationary object to prevent falling if bumped.

c) Lubricate metal bearings of locks, wheels, pulleys, etc., as required to keep them working.

d) Replace frayed or badly worn rope.

e) Keep safety feet and other parts in good condition to ensure they work.

f) Maintain ladders in good usable condition. Inspect ladders prior to use.

g) Ladders with defects that cannot be immediately repaired, shall be removed from service for repair or destruction, and shall be tagged with a danger tag. Do not attempt to straighten or use a bent ladder.

h) Rungs or steps on metal ladders that are not corrugated, knurled, or dimpled will have skid-resistant materials applied.

C. Proper Use of Ladders

The correct procedures for using ladders are as follows:

1) Where possible, portable nonself-supporting ladders will be used at such a pitch that the base of the ladder is placed a distance from the vertical wall that is one-fourth of the working length of the ladder. The ladder shall be placed to prevent slipping, or it will be lashed or manually held in position.

2) Ladders shall not be used by more than one person at a time. Ladders specially designed to support greater loads shall be used in combination with ladder jacks and scaffold planks when an operation requires more than one person.

3) Place portable ladders so that the side rails have a secure footing. The top rest for portable rung and cleat ladders will be reasonably rigid and will have adequate strength to support the applied load.

4) Ladders shall not be placed in front of doors opening toward the ladder unless the door is blocked open, locked, or guarded.
5) Do not place ladders on boxes, barrels, or other unstable bases to obtain additional height.

6) To support the top of the ladder at a window opening, attach a board across the back of the ladder, extending across the window to provide firm support against the building walls or window frames.

7) When ascending or descending, users shall face the ladder and use both hands.

8) Ladders with broken or missing steps, rungs, or cleats, broken side rails, or other defects shall not be used. Do not make improvised repairs.

9) Do not splice short ladders together to provide long sections.

10) Do not use ladders made by fastening cleats across a single rail.

11) Do not use ladders as guys, braces, skids, horizontal platforms or scaffolds, or for other than their intended purposes.

12) Do not use a ladder to aid access to a roof unless the top of the ladder extends at least 3 feet above the point of support, at eave, gutter, or roof line.

13) Always raise extension ladders so that the upper section overlaps and rests on the bottom section. The upper section will always overlap on the climbing side of the extension ladder.

14) Non-slip bases are not intended as a substitute for care in safely placing, lashing, or holding a ladder that is being used upon oily, metal, concrete, or slippery surfaces.

15) The bracing on the back legs of step ladders is designed solely for increasing stability and not for climbing.

16) Hooks may be attached at or near the top of portable ladders to provide added stability.

17) When the ladder can be knocked over by others who are working in the area, the ladder will be securely fastened. As an alternative, someone will be assigned to steady the bottom, or the area around the ladder will be roped off.

18) Workers shall not stand higher that the third rung/step from the ladder top and shall not attempt to reach beyond a normal arm’s length.

2. Scaffolding and Elevated Platforms

Only tube and coupler or tubular welded frame scaffolding shall be used by MSU
personnel. It shall be erected according to OSHA standards, as specified in 29 CFR 1910.22, .23, and .28.

a. All platforms or scaffolds shall be inspected by the supervisor before use.

b. All elevated platforms shall be surrounded by a standard guardrail, securely fastened to a stationary object, and have a floor capable of withstanding a working load of 75 pounds per square foot.

c. Scaffolds with wheels constructed on the base (bottom) section shall not be used unless all wheels are intact and at least one wheel on each side is locked to prevent movement.

d. The following are general scaffolding rules:

1) Know scaffolding safety rules prior to set up, during operations, and for dismantling of scaffolding. Ensure manufacturer's instructions and safety warnings are legible and remain on scaffolding.

2) Inspect the equipment before use for damage or deterioration.

3) Keep equipment in good repair.

4) Inspect erected scaffolds regularly to ensure they are maintained in a safe condition.

5) Provide adequate sills and posts and use base plates.

6) Anchor wall scaffolds securely between structure and scaffold.

7) Use caution when working near power lines. Never be any closer than 10 feet to electrical power lines.

8) Use adjusting screws instead of blocking to adjust for uneven grades. Use outriggers where so equipped.

9) Equip all planked areas with proper guard rails and toe-boards.

10) Do not ride rolling scaffolding.

11) Do not leave materials and equipment on the platform when moving scaffolding.

12) Do not try to move rolling scaffolding without help.

13) Do not extend adjusting screws over 12 inches.
14) Do not let working platform height exceed four times the smallest base dimension unless guyed or otherwise stabilized.

15) Do not overload scaffold.

16) Do not use ladders or makeshift devices on top of scaffolds to increase height.

17) Ensure the footing and anchorage for scaffolds are sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Do not use unstable objects such as barrels, boxes, loose bricks or concrete blocks, etc., to support scaffolds or planks.

L. Rooftop Work

If the rooftop to be worked on is not provided with an adequate guardrail, the following procedures shall apply:

- No employee shall come within 10 feet of the roof’s edge without wearing a lifebelt or harness securely attached to a securely anchored rope or line, with the entire system being capable of supporting a minimum dead weight of 5,400 pounds.

- No employee shall work on the rooftop if the windspeed exceeds 20 miles per hour.

M. Shoring and Trenching

The walls and faces of excavations and trenches over 5 feet, where workers may be exposed to danger, shall be guarded by a shoring system, sloping of the ground, or some other equivalent means. Trenches less than 5 feet deep with hazardous soil conditions also shall be effectively protected.

The following guidelines are provided:

1. Appropriate trench boxes and/or shields may be used in lieu of shoring or sloping.

2. Tools, equipment, an excavated material shall be kept 2 feet or more from the lip of the trench. Where employees are required to be in or work in trenches 4 feet deep or more, an adequate means of exit such as ladders or steps shall be provided within 25 feet of travel and used.

3. Daily inspections shall be made of trenches and excavations by the supervisor in charge to ensure adequate slopes, shoring and bracing, and that there is no evidence of possible slides or cave-ins. More frequent inspections may be necessary as work
progresses or after inclement weather conditions, such as rain, or where loose compacted or unstable materials are present.

4. Workers shall take extra care when hand excavating in close proximity to utilities to preclude interruption of services an personnel injury and/or equipment damage which can result from breaking electrical, gas, and steam lines.

N. Barricades
Whenever a common area is disturbed by maintenance, repair, or construction operations and presents a hazard to personnel working in or near, or traveling through the area, care shall be taken to warn these personnel and other engineering services personnel of the potential hazard. Appropriate barriers shall be erected around excavations, open manholes, open electrical panels, etc., whenever they are to be left unattended.

3. Electrical Installations and Equipment

A. Hazards
The extreme hazard of electrical equipment is the potential for personnel electrocution from contacting energized systems. Electrical equipment can also cause catastrophic property damage because of its potential as an ignition source for causing fire or explosion.

Fire is frequently caused by short circuits, overheating equipment and failure of current limiters, thermal sensors, and other safety devices. Explosions may occur when flammable liquids, gases, and dusts are exposed to ignition sources generated by electrical equipment.

B. Requirements
1. Electrical installations and utilization equipment will be in accordance with the current edition of the National Electrical Code, National Fire Protection Association (NFPA 70); American National Standards Institute (ANSI) Standard C1. This code will also apply to every replacement, installation, or utilization equipment.

2. Equipment or facilities designed, fabricated for, and intended for use by MSU will be procured to meet the requirements of the National Electric Code.

3. Frames of all electrical equipment, regardless of voltage shall be grounded.
4. Exposed non-current carrying metal parts of electrical equipment that may be come energized under abnormal conditions shall be grounded in accordance with the National Electrical Code.

5. Wires shall be covered wherever they are joined, such as: outlets, switches, junction boxes, etc.

6. Parts of electrical equipment which in ordinary operation produce arcs, sparks, etc., shall not be operated or used in explosive atmospheres or in close proximity to combustible materials.

7. Equipment connected by flexible extension cords shall be grounded either by a 3-wire cord or by a separate ground wire (except double insulated equipment).

8. Ground fault circuit interrupters (GFCI) shall be used on all 120-volt, single-phase, 15- and 20-ampere receptacle outlets at job sites when the receptacles are not a part of the permanent wiring of the building or structure. Receptacles on a two wire, single-phase portable or vehicle-mounted generator rated not more than 5 kilowatt, where the circuit conductors of the generator are insulated from the generator frame and all or the grounded surfaces, need not be protected with GFCIs.

C. Inspections

Supervisors will insure that work areas are inspected for possible electrical hazards.

Sufficient workspace shall be provided and maintained around electric equipment to permit safe operations and maintenance of such equipment.

D. Control of Hazardous Energy (Lock-Out/Tag-Out)

The procedures specified in this section comply with the requirements for the isolation or control of hazardous energy sources set forth in the OSHA standard (29 CFR 1910.147 - proposed). The accidental release of energy during maintenance work can and frequently does cause severe injuries, amputations, and death. Energy can be present in the form of electricity, potential energy (due to gravity) stored in elevated masses, chemical corrosivity, chemical toxicity, or pressure.

The only exceptions allowed by OSHA to these requirements are those situations involving "hot tap" operations. For this exception to be valid, the MSU personnel involved must demonstrate that the continuity of services is essential, that shutdown of the energy source is impractical, and that documented (written)
procedures and special equipment have been implemented that will provide proven effective protection.

These procedures apply to all maintenance or installation operations conducted at MSU facilities.

1. Tag-out Devices

Tags affixed to energy isolating devices are warning devices that do not provide the physical restraint on those devices that a lock would provide. Any tag so attached to an energy isolating device must not be removed without authorization of the person attaching it, and it must never be bypassed, ignored, or otherwise defeated. Tags must be legible and understandable in order to be effective. Tags must be made of materials which will withstand environmental conditions encountered in the workplace. When utilized, tags must be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use. Tag-out devices must be substantial enough to prevent inadvertent or accidental removal.

Tag-out devices must warn against hazardous conditions if the machine or equipment is energized and must include appropriate warnings such as:

   DO NOT START
   DO NOT ENERGIZE
   DO NOT OPEN
   DO NOT OPERATE
   DO NOT CLOSE

2. Lock-out Devices

Lockout devices and practices vary by nature and function. Several effective lockout devices and practices are listed as follows:

a. Padlocks. Key operated padlocks are recommended and should be assigned individually.

b. Multiple lock adapters will enable more than one worker to place their own padlock on the isolating device to guarantee that the machine or equipment will remain deactivated until each and every employee completes their own task, and only then will the last padlock be removed.

c. Chains or other commercially available devices should be used to prevent
valves from being opened or, in some cases, closed. The principle of multiple lock adapters still applies even when chains or other devices are used on operations requiring more than one employee.

3. Procedures

a. General:

If energy-isolating devices are not capable of being locked out, they must be modified so that they are capable of being locked out whenever major replacement, repair, renovation, or modification of the machine or equipment takes place. Whenever new machines or equipment are installed, energy-isolating devices for such machines or equipment must be designed to accept a lockout device.

If an isolating device cannot be locked out for any reason, then additional steps must be taken to assure full employee protection such as removing fuses, blocking switches, blanking off lines, etc.

If the machine or equipment is not capable of being locked out, a tag-out procedure must be documented and utilized. The tag-out procedure must provide full employee protection equivalent to a lockout system. For full employee protection, when a tag-out device is used on an energy-isolating device, the device must be attached at the same location that the lockout device would have been attached, and must demonstrate that the tag-out device will provide a level of safety that is equivalent to that of a lockout system.

4. Plug/Cord and Hose-Connected Type Equipment

When servicing or installing plug/cord or hose connected electrical, pneumatic, or hydraulically powered equipment, the cord or hose shall be disconnected from the equipment to be worked on, prior to starting the work. A tag warning against reconnecting the plug or hose shall be affixed to the plug or hose end.

Any stored energy (e.g., capacitor voltage, hydraulic pressure) shall be safely released prior to the start of maintenance or installation work.

5. Electrically Powered Equipment

Electrically powered equipment shall be de-energized and their source of electricity manually disconnected from them prior to the removal of protective covers or the start of other maintenance or installation work. It is important to recognize that locking and tagging on/off switches is often not sufficient to prevent accidental start up or prevent voltage from being present in the equipment. If the equipment is not wired properly (i.e., the polarity is reversed) or
the switch is of the single pole type, voltage can be present even if the operating
switch is in the off position. For these reasons, manual disconnects must be placed
in the off position and/or the equipment's power fuses removed from the motor
control center.

The lock-out/tag-out procedure is as follows:

a. Each person working on the circuit or piece of equipment shall place a padlock and
warning tag on the electrical isolation device (e.g., disconnect switch).

b. Each person working on the circuit or piece of equipment shall attempt to energize or
start the piece of equipment prior to starting work. Each on/off switch capable of
energizing the equipment must be "tried."

c. If the try step reveals that the equipment is capable of being energized, the proper
disconnects must be located and locked out and the try step repeated.

d. As each person completes his or her task, they shall remove their padlock and tag
from the energy isolating device.

e. All protective covers or panels shall be securely re-attached prior to energizing the
equipment after work is completed. In the event that protective covers must be
removed to make adjustments on energized equipment, appropriate guards must be
constructed and attached in such a manner as to prevent employee contact with live
circuitry capable of causing human injury. Such guards must be of durable
construction, adequate to prevent injurious contact, and remain in place at all times
that the equipment is energized.

6. Chemical and/or Pressurized Lines

Prior to working on any pressurized line or a line containing a toxic, flammable,
reactive, or corrosive material, the following procedure must be implemented:

1. The line to be serviced must have two block valves upstream of the work
area or device to be serviced or installed, placed in the closed position and
tagged. The bleed valve (between the two block valves) shall be opened
and tagged so that leakage of the valve upstream would be readily
obvious. The line shall be depressurized or drained in a safe manner. Lines
shall be broken in such a manner as to release pressure away from the
employee. All solids or liquids drained shall be safely collected. This
procedure is called "double block and bleed."

2. If it is possible for pressure or line material to enter the work area from
more than one direction, the line in each direction of travel shall be
"double blocked and bled" as described above.
3. In the event that "double block and bleed" procedures are infeasible (i.e., the line is not provided with adequate valving), alternative measures shall be implemented. One alternate measure is to place a solid "blind" in a flange located between the available upstream valve and the work area. If blinds are used they shall be sufficiently corrosion and pressure-resistant to ensure that if the valve leaks, the blind will stop the material or pressure from reaching the work area.

- Stored Mechanical Energy

In situations where equipment to be worked on has stored mechanical energy (e.g., in a flywheel or drop hammer), the stored energy must be released or blocked in a safe manner before starting maintenance or installation work. Effective blocking practices may include the installation of safety blocks or adequate supports. Under no circumstances will "bumper jacks" or "scissor jacks" be considered to be adequate blocks.

E. Training

The purpose in providing training to employees is to ensure that they understand the purpose and function of the lock-out/tag-out program and procedures, and that they have the knowledge and skills required for the safe application, usage, and removal of energy controls.

1. Personnel who work around electrical equipment but who do not perform a primary duty of electrical system installation or maintenance will be briefed by their supervisor on the hazards of electricity and the proper precautions to observe.

2. Each authorized employee who will use a lock-out/tag-out procedure must receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for isolation and control.

3. Employees must be retrained whenever there is a change in their job assignment; a change in machines, equipment, or processes that present a new hazard; or when there is a change in the lock-out/tag-out procedures.

4. Machinery

All mechanical motion is potentially hazardous. Motion hazards, such as rotating devices, cutting or shearing blades, in-running nip points, reciprocating parts, linear moving belts and pulleys, meshing gears, and uncontrolled movement of
failing parts, are examples of motion and peculiar to any one machine or job operation. Personnel working within areas where they are exposed to machinery or equipment hazards must be aware of the potential for accidents. Machine operators and others are exposed to moving parts and can get clothing or body parts caught in the machinery.

**A. General**

1. **Personnel Training**

Personnel should be trained to safely operate each machine they will be required to use; to recognize potential accident producing situations; and to know what to do when hazards are discovered. Only personnel who have been thoroughly trained, or those who are undergoing supervised on-the-job training on the equipment, will be permitted to operate machinery.

2. **Personal Protective Equipment**

   a. Eye protection or face shields will be worn by all personnel within areas where machines are operated.

   b. Loose fitting clothing, neckties, rings, bracelets, or other apparel that may become entangled in moving machinery will not be worn by machine operators or their helpers.

   c. Hair nets or caps will be worn to keep long hair away from moving machinery.

   d. Gloves will not be worn where there is a chance of them being caught in machinery.

   e. Ear plugs or muffs will be used when required for worker protection.

   f. The Office of Environmental Safety should be contacted to assist supervisors in determining personnel protective equipment needs.

3. **Environmental**

   a. Machines designed for fixed locations will normally be securely fastened to the floor or other suitable foundation to eliminate all movement or "walking." Machines equipped with rubber feet, non-skid foot pads, or similar vibration dampening materials will be installed according to the manufacturer's recommendations. Machines that have the potential of tipping or falling over
will be firmly secured.

b. Machines that develop fine dust and fumes will be equipped with effective exhaust hoods, connected to an effective exhaust system. An interlocking device should be installed to link the machine's power supply and the exhaust system to prevent the operation of machines without the exhaust system operating.

c. Machines will never be left unattended with the power on unless the worker is operating more than one machine in a battery of machines. In this latter instance, the clear zone will be appropriately marked to include all machines in the group.

d. No attempt will be made to clean any part of a machine until the moving parts have come to a complete stop. Chips will not be removed from machinery by hand. Hand brushes should be used but compressed air may be used when reduced to less than 30 psi and then only with effective chip guarding and personal protective equipment.

e. Brushes, swabs, lubricating rolls, and automatic or manual pressure guns will be used by operators to lubricate material, punches, or dies. This equipment will be used so that operators are not required to reach into the point of operation or other hazardous area.

f. Housekeeping

1) Floors will be kept in good repair and free of chips, dust, metal scraps, and other slipping and tripping hazards.

2) Waste containers will be emptied daily or more often, if necessary, to prevent excessive waste accumulations.

3) All materials, including usable scrap, will be stored so that they will not present a hazard.

4) Drip pans will be used whenever equipment must be oiled. Machinery will not be in motion when being lubricated unless lubrication is automatic or a long gravity flow spout is used, enabling the oiler to remain in the clear while performing this task.

5) Material Handling

a) Trucks used for scrap disposal will not be overloaded, and scrap will not extend beyond the ends or sides of trucks.
b) When materials are of a weight or size, which makes manual lifting hazardous, mechanical handling equipment, will be used.

6) Maintenance/Repair

a) When maintenance or repair is needed, machines will be completely shut down and the control switch(es) locked and tagged in the "OFF" position.

b) Cutting tools will be kept sharp and forming tools well dressed and free from accumulations of chips, dust, and other foreign matter. Where two or more cutting tools are used in one cutting head, they will be properly adjusted and balanced.

c) Damaged cutting tools will be removed from service and will not be used until repaired.

7) Usage

a) Machines will be used only for work within the rated capacity specified by the machine manufacturer.

b) Machines will be maintained so that while running at full or idle speed, with the largest cutting tool attached, they are free of excessive vibration.

c) Machines will be completely stopped before attempting to clear jammed work or debris.

d) No saw blade, cutter head, or tool collar will be placed or mounted on a machine arbor, unless it has been accurately sized and shaped to fit the arbor.

8) Electrical Safeguards

a) The motor "START" button will be protected against accidental/inadvertent operation. "START" buttons will not be wedged for continuous operation.

b) The wiring and grounding of machinery will be in accordance with the National Electric Code.

c) Each machine will have a positive electrical disconnect or isolation switch which can be locked out.

d) Electrically driven machines will be equipped with undervoltage protective systems to preclude automatic restart after either a power failure or other undervoltage condition.

9) Controls
a) Foot pedal mechanisms will be located and guarded so that they cannot be activated by falling objects or other accidental means. A pad with a non-slip contact area will be firmly attached to the pedal.

b) Controls will be available to the workers at their operating positions so that they do not reach over moving parts of the equipment. Control functions will be identified by printed words and color coding. Controls will not be wedged for continuous operation.

c) Power controls must have a way of locking out electrical power. Disconnecting or isolating switches will be mounted on a visible side of, or near, the machine and will be used to lock out power to the machine during repairs or adjustments. When the power is locked out, the isolating switch will be tagged.

B. Guards

Many accidents are caused by machinery that is improperly guarded or not guarded at all. Important factor that must be kept in mind relative to machinery guarding is that no mechanical motion that threatens a worker’s safety should be left without a safeguard.

The following areas of machinery will be provided with barriers and/or enclosures that will effectively prevent personnel from coming in contact with moving components:

- Point of operation exposures such as blades, knives and cutting heads.

- Power transmission exposures such as belts, pulleys, shaft, gears, etc.

- Top, bottom and backside exposures, such as the underside of table saws and the wheels on band saws.

- When a point-of-operation guard cannot be used because of unusual shapes or cuts, jigs or fixtures which will provide equal safety for the operator will be used. Upon completion of an unusual operation, the guard will be immediately replaced.

- Whenever a guard is removed for other than an operational requirement, the machine will be shut down and the control switch(es) locked and tagged in the "OFF" position.

- Guards will be affixed to the machine. Where possible, they will be of the hinged type to enhance maintenance or adjustments.
5. Plumbing Maintenance:

A. Hazards

Plumbing maintenance normally includes the installation, preventive maintenance, and repair of water supply systems, sewage and water disposal systems, natural liquefied petroleum gas (LPG) or other gas supply systems (to include gas appliances), and oxygen supply systems. These systems and the maintenance of them contribute to the total well-being of MSU facilities. Hazards that may be encountered during plumbing maintenance include, but are not limited to, entry into an oxygen deficient atmosphere (confined space), fire or explosion by introducing an ignition or flame source into a hazardous environment, falls, cave-in of excavated area, burns from heat producing equipment, strains and sprains of the back or other muscle group, and cuts and/or bruises. Working in confined spaces, handling heavy and awkward materials, being subjected to numerous obstructions in limited working space, and health related hazards are conducive to producing accidents. Plumbing maintenance workers need to be knowledgeable of these potential hazards and conditions and take reasonable actions to prevent incidents before they occur.

B. Personal Protective Equipment

Personal protective equipment worn during plumbing maintenance operations normally consists of eye and/or face protection, work or chemical resistant gloves, and safety-toe shoes. A bump cap or hard hat may be required under conditions that could result in head injuries, e.g., work in manholes and in close spaces with low overhead pipe or other obstructions. Eye or face protection is required while working plumbing connections, with chemicals, or where an eye hazard could exist while using tools or machines, and while working on pressure systems. Rubber gloves and face shields may be required when working on sewage related systems to prevent infection of biorganisms.

C. Hot Operations

1. Torches and Furnaces

Only essential fire prevention items pertaining to the operation of blowtorches and plumber's furnaces are included. Work and storage areas for this equipment shall be well ventilated. All Hot Operations within facilities or confined spaces will comply with the Hot Work Permit Procedures.

a. No one shall be permitted to use a torch or furnace until the user is trained on its use and is familiar with the operating instructions.
b. Where flammable or explosive vapors or dust may be present, torches and furnaces shall not be used until the atmosphere has been vented and the sources of such vapors or dust removed.

c. Gasoline blowtorches and furnaces shall not be used in small, unventilated spaces since they could cause explosions. Acetylene gas shall never be brought in contact with metal powders such as copper or silver as the combination may produce flashes which can ignite explosive atmospheres.

d. Combustible materials in locations where torches or furnaces are to be used shall be protected or kept far enough away to prevent their being subjected to sparks or dangerous temperatures. Appropriate fire extinguishers shall be available.

2. Soldering and Brazing

Soldering and brazing is the joining of metal parts by melting a fusible alloy. When solders used have a melting point above 800 degrees F, the procedure is called brazing.

a. Improper equipment and/or unsafe practices may cause lead poisoning, irritation from fluxes, burns, electric shock, or fires.

b. The concentration of toxic fumes and irritants at the breathing level of the operation shall be checked. Where required because of toxic fumes, a respirator or adequate ventilation shall be provided. Lead-tin, zinc, silver, cadmium, and antimony-tin solders can pose moderate to serious health hazards. Soldering, particularly with lead-tin, in a confined space where ventilation is not adequate to remove toxic fumes may require the use of a self-contained breathing device. The Office of Environmental Safety shall be consulted for evaluation of potential health hazards and recommendations on respiratory protection during welding, soldering, and brazing operations. Electric soldering irons shall be grounded unless of double insulation construction. All soldering irons shall be placed in suitable non-combustible receptacles when not in use.

c. When required, "Hot Work" permits shall be obtained for these operations.

d. Appropriate safety eyewear shall be worn during all soldering and brazing operations.

3. Open Storm Drains

Plumbing personnel are not likely to be exposed to the hazards that are associated with sewer systems while working on open storm drains. However, there are certain hazards associated with that type of drainage system. Some of these hazards and their associated incidents are:
a. Manhole covers

Manhole covers are heavy and closely fitted to the manhole opening. Never attempt to lift a cover without using proper pry bar tools, special lifting tools, and additional help where needed. Ensure that fingers and toes do not remain under manhole covers when putting them down.

b. Hazards

Insects, animals, and snakes have been known to nest or den in storm drains. Hazards encountered are:

1) Stings from wasps, spiders, and ants that could lead to toxic shock.
2) Bites from animals that could lead to rabies.
3) Bites from poisonous snakes that could be fatal or cause gangrene.

c. Requirements

Prior to working in storm drains, inspect and clear the drains of dangerous insects, animals, or snakes. Seek assistance from an exterminator or County Animal Control Department when necessary.

Wear proper protective clothing, hard hats, boots, and gloves while working in storm drains.

4. Gas Systems

Maintenance of gas systems include natural gas, LPG, and oxygen. Shop personnel shall be familiar with the properties of the gases in the systems they maintain. Until proved otherwise, all escaping gases shall be considered flammable. Prior to entering an area where a gas leak is suspected, the area shall be properly vented and purged of existing gas. Personnel entering the area shall be suited with proper protective clothing and self-contained breathing devices. For oxygen deficient atmospheres, air supply systems with a special emergency escape air supply are required and shall be used. Tools used to repair leaks in or perform maintenance on gas lines shall be spark-free and protective clothing shall be static-free. When working on oxygen dispensing lines, workers shall not use tools and equipment that are coated with lubricating substances or grease.

5. Tunnels, Pits, and Sumps

a. Where shop personnel are required to work in utility tunnels, pits, and sumps, the atmospheric conditions shall be checked for explosive atmosphere or oxygen deficiency before allowing them to enter. Personnel shall be suited with proper
protective clothing and respiratory protective devices, when required, while performing maintenance to underground utilities. All tunnels, pits, or sumps known to be contaminated shall be tagged or identified for the information of work crews. Workers shall be assigned in pairs for work performed on underground utilities and all known contaminated tunnels, pits, and sumps shall be ventilated while work is in progress.

b. When a manhole or vault is open, at least one member of the crew shall be stationed at the surface. This person shall not, under normal circumstances, leave for any purpose.

NOTE: UNDER NO CIRCUMSTANCES SHALL A PERSON ENTER A SUBSURFACE STRUCTURE FOR ANY REASON WITHOUT A SECOND PERSON TO ACT AS A GUARD AND TO OBTAIN ASSISTANCE IN THE EVENT OF AN EMERGENCY.

In areas where removal of a victim would be difficult, an approved lifeline, equipped with a wrist harness, shall be worn by the person entering the area to facilitate rapid removal in case of an emergency.

6. Compressed Air

Plumbing workers should be trained and authorized to inspect, maintain, or install compressed air systems. Before opening a compressed air line, workers shall ensure the line has been completely drained of existing air to prevent a sudden release of air, which will cause the line to whip. The reverse is also true; when personnel have installed a new compressed air system, all parts of the system shall be secured together before air is put into the system. Workers shall wear eye and face protective equipment while working on compressed air systems.

6. Carpentry and Structural Maintenance

A. Hazards

Personnel performing duties in carpentry and structural maintenance are potentially exposed to a variety of hazards in many different environments and locations. Potential hazards include exposures to flammable and combustible adhesives, dusts, hazardous noise, eye hazards, working at heights above ground level, lifting hazards, electric and pneumatic power tools, and working with unfinished material which could expose them to splinters. Many tasks are performed in areas of high pedestrian traffic; therefore, an additional hazard of possible distraction from the job task arises. Potential physical and health hazards can be effectively controlled by proper work procedures and controls, and by
using required personal protective equipment.

**B. General Carpentry**

1. Workers shall not leave a woodworking machine running unattended nor shall they attempt to clear, clean, or repair the machine while it is operating. When maintenance is necessary, the machine shall be completely shut down, its control switches locked and tagged in the "OFF" position. Supervisors shall ensure that periodic inspections are accomplished on all shop equipment. Chips or dust shall never be removed from machinery by hand. Machine guards shall not be removed or made inoperative except for authorized maintenance. When guards are removed during machine repair, power control switches shall be locked in the "OFF" position and properly tagged. The machine shall remain locked until the guards are replaced.

2. Personal protective equipment worn while operating machinery, equipment, and saws within the shop and on job sites normally consists of eye protection, safety-toe shoes, and hearing protection. Other safety related personal protective equipment are dust masks where workers are exposed to dust at the point of operation. The Office of Environmental Safety shall be consulted to determine the need for dust masks. Hard hats are required on job sites where the potential exists from being struck by falling object(s), e.g., roofing and construction.

3. See General Shop / Work Area Safety Section of this chapter for general guidance that applies to both carpentry and structural maintenance work methods and tools.

4. The following specific guidance applies to table saws:
   
   a. Keep hands out of the line of cut when feeding table saws. Use a push stick when close to the blade.
   
   b. Adjust saw to expose the least amount of saw blade above table and material being cut.
   
   c. Always stand out of line of stock being ripped.
   
   d. Hold stock being cut against a gauge when cutting with a circular table saw.
   
   e. Always use the appropriate saw for the cut (it would be unsafe to rip with a crosscut saw or to crosscut with a rip saw).
   
   f. Avoid crosscutting long boards on a table saw.
   
   g. Never adjust the saw or fence gauge while the saw is operating. Designate the line of cut on the table top with a permanent mark when setting the gauge of a
table saw without removing the guards.

h. Always use a brush or stick to clean or scrape sawdust from a saw.

C. Ventilation Systems

1. **Application:** Machines that develop fine dust or other airborne contaminants shall be equipped with effective industrial exhaust ventilation. In shops where small numbers of installed machines are not continuously in operation, portable collection systems may be used.

2. **Exhaust Ducts and Pipes:** These shall be constructed and sized to minimize clogging. They shall discharge into an enclosed container.

3. **Refuse:** Refuse shall be removed daily in all operations that are not required to have an exhaust system or where the refuse cannot be handled by an exhaust system.

D. Storage and Handling of Lumber

1. Storage areas for lumber and other building materials can be potentially hazardous. For example, when lumber is stored upright, precautions shall be taken to prevent it from falling into aisles or passageways. Lumber stored in tiers shall be stacked, blocked, and interlocked and the stacks shall be limited in height so they are stable and secure against sliding or collapse. Furthermore, storage areas shall be kept free of accumulations of materials that constitute tripping, fire, or explosion hazards.

2. When heavy stock cannot be safely handled by workers, suitable mechanical lifting devices shall be used.

3. Gloves shall be worn by workers to reduce injury potential to the hands from splinters or from being pinched between the stacks. The accidental movement of the stacked material can cause serious injuries. Caution shall be taken not to disturb other tiers when removing partial stacks for use.

4. Manual handling is relatively safe if the proper lifting and carrying positions are used. Balanced handling is the key to safe handling.

7. Welding and Metal Fabrication

A. Hazards

Welding, cutting and brazing operations present a series of hazardous situations
with potential exposure to burns, eye damage, electrical shock, crushed toes and fingers, and the inhalation of vapors and fumes. Many welding, cutting and brazing incidents in industry result from:

- Inadequately trained personnel.
- Poor housekeeping practices.
- Poor shop layout.
- Inadequate lighting and ventilation.
- Improper storage and movement of compressed gas cylinders.
- Exposure of oxygen cylinders and fittings to oil or grease creating a fire or explosive hazard.
- Pointing welding or cutting torches at a concrete surface causing spattering and flying fragments of concrete.
- Electric shock when motors, generators and other electric welding equipment are not grounded.
- Inhalation of toxic fumes or vapors from welding metals or alloys.

Fires, explosions, and injuries can occur resulting from:

- The proximity of combustible solids, liquids, or dusts.
- The presence or development of possible explosive mixtures of flammable gases and air.
- The presence or nature of an oxygen-enriched atmosphere in locations where hot work is performed.

Cutters, welders, and other exposed personnel are also susceptible to eye injury from infrared light and ultraviolet radiation.

**B. Operating Precautions**

The following provides minimum guidance on operating precautions and procedures.

1. Provide ventilation in shops or rooms where work is to be performed but avoid strong drafts directed at the welding work.
2. Do not place work to be welded or heated on a concrete floor. Concrete, when heated, may splatter and fly exposing the welder to possible burns and throwing hot particles a considerable distance.

3. Provide appropriate protection for welders and helpers when working on elevated surfaces. Welding areas shall be kept neat, clean, and free from tripping hazards.

4. Provide approved personal protective equipment for welders who must enter confined spaces, manholes or other space restricted areas. Also, provide a means to ensure their quick removal in case of an emergency.

5. Do not perform cutting and welding operations in sprinkler equipped buildings when the sprinkler system is inoperable; in explosive atmospheres or where explosive atmospheres may develop; or, within 50 feet of storage of large quantities of exposed, readily ignitable materials.

6. Before lighting the torch for the first time each day, allow enough of each gas to flow through its respective hose to purge any flammable gas mixture. Purge hoses in open spaces and away from ignition sources. Light the torch with a friction lighter or stationary pilot flame keeping a safe distance between the torch and the welder's hands. Point the torch away from persons or combustible materials when lighting. Do not attempt to light a torch from hot metal.

7. When working in a confined space, the fuel gas and oxygen supply shall be located outside the confined space. The torch and hose should be removed from confined spaces when not in use.

8. Fuel gas and oxygen torch valves shall be closed and the fuel gas and oxygen supply to the torch shall be shut off during lunch or break periods, when not in use for extended periods, and when unattended.

9. Welding torch hoses must be protected from damage by contact with hot metal, open flames, corrosive agents or sharp edges. Pressure on hoses will be released at the end of each workday. Hoses must be visually inspected for damage at the beginning of each shift. Hose showing leaks, cuts, burns, worn spots or other evidence of deterioration must be repaired or replaced prior to use. Replacement hoses or fittings must be approved for use with acetylene equipment.

10. Shielding shall be provided to protect personnel from heat, sparks, slag, light, and radiation.
11. A fire watch will be maintained for at least 30 minutes after completion of cutting or welding operations to detect and extinguish possible smoldering fires.

C. Personal Protective Equipment

Key portions of OSHA Standard 1910.252 covering protective equipment are included here. Personnel engaged in or exposed to welding, cutting, or brazing activities will be provided and use personal protective equipment to include eye and face protection, head protection when in a hard hat area, foot protection, and body, arm, and hand protection.

1. Eye Protection

a. Helmets shall be used during all arc welding or arc cutting operations. Goggles should also be worn during arc welding or cutting operations to provide protection from injurious rays from adjacent work, and from flying objects. The goggles may have either clear or colored glass, depending upon the amount of exposure to adjacent welding operations. Helpers or attendants shall be provided with proper eye protection. Helmets shall be arranged to protect the face, neck, and ears from direct radiant energy from the arc.

b. Goggles or other suitable eye protection shall be used during all gas welding or oxygen cutting operations. Spectacles with side shields and suitable filter lenses are permitted for use during gas welding operations on light work, for torch brazing or for inspection. Goggles shall be ventilated to prevent fogging of the lenses as much as practicable.

c. All operators and attendants of resistance welding or resistance brazing equipment shall use transparent face shields or goggles, depending on the particular job, to protect their faces or eyes, as required.

d. Eye protection in the form of suitable goggles shall be provided where needed for brazing operations.

2. Protective Clothing

a. All welders should wear flame-resistant gauntlet gloves and shirts with sleeves of sufficient length and construction to protect the arms from heat, UV radiation, and sparks.

b. All welders should wear fire-resistant aprons, coveralls, and leggings.

c. Clothing should be kept reasonably free of oil or grease. Front pockets and upturned sleeves or cuffs should be prohibited, and sleeves and collars should
be kept buttoned to prevent hot metal slag or sparks from contacting the skin.

3. Respiratory Protection

The Office of Environmental Safety shall be consulted to determine appropriate levels of respiratory protection to be worn by personnel performing welding operations.

D. Fire Prevention and Protection (HOT WORK PERMIT PROGRAM)

1. When welding or cutting operations are conducted indoors, written description of the work to be performed will be submitted to the Supervisor in charge of the operation. The supervisor will then file a Hot work Permit with the Physical Plant Office via the on-line form on the Environmental Safety web page: http://www.mwsu.edu/~safety

2. The welding operation environment shall be free of flammable liquids and vapors. Combustible materials within a radius of 35 feet of the operation will be protected from activity residue (flame, heat, sparks, slag, etc.).

3. Fire watcher procedures shall be implemented whenever welding activities are conducted within 35 feet of combustible materials, regardless of protection provided. A qualified individual proficient in the operation of available fire extinguishing equipment and knowledgeable of fire reporting procedures shall observe welding or cutting activities. His or her duty is to detect and prevent the spread of fire produced by welding or cutting activities.

4. Whenever there are cracks or other floor openings within 35 feet of the welding or cutting that cannot be closed or covered, precautions shall be taken to remove or otherwise protect combustible materials on the floor below that may be exposed to sparks. The same precautions shall be observed with regard to cracks or openings in walls, open doorways, and open or broken windows.

5. Fire extinguishing equipment shall be maintained, ready for use, while welding or cutting operations are being performed. Equipment may consist of pails of water, buckets of sand, hose, or portable extinguishers depending upon the nature and quantity of the combustible material exposed.

6. Where sprinkler protection exists, it shall be in full service while welding or cutting work is being performed. If welding or cutting is to be done within three feet of automatic sprinkler heads, noncombustible sheet material or damp cloth guards will be used to temporarily shield the individual heads.
E. Welding and Cutting Tanks, Cylinders, or Containers

The procedures described below apply only to tanks too small to be entered. Compressed gas cylinders are excluded as are pipelines. Cutting and welding on containers that have held flammable liquids or gases shall be under the direct supervision of knowledgeable personnel.

1. Inspection: BEFORE any tank, cylinder, or other container is cut, welded, or other hot work is performed, the item shall be purged or made inert. New containers shall also be made inert as they may contain a flammable preservative which could form explosive vapors when heated. Welders shall also ensure that there are no substances such as grease, tars, or acids which, when subjected to heat, might produce explosive or toxic vapors. Any pipe lines or connections to the drums, cylinders, tanks, or other containers shall be disconnected or blanked.

2. Purging and Inerting:
   a. Purging with Water: Where the liquid or gas previously contained is known to be readily displaced or easily soluble in water, it can be removed by completely filling the container with water and then draining. When hot work is performed on containers filled with water, extreme care shall be used to eliminate any vapor accumulation by proper venting or positioning of the container during the filling operation.
   b. Purging with Air: Hazardous vapors may be displaced from inside containers by purging with air. A safe atmosphere shall be maintained by continuous ventilation.
   c. Inerting with Gas: Inert gas may be used to displace flammable gas from the container. Adequate ventilation shall be maintained during the operation to ensure gas concentrations remain below hazardous levels. Examples of inert gases are carbon dioxide and nitrogen.
   d. Venting: All hollow spaces, cavities, or containers shall be vented to permit the escape of air or gases before and during preheating, cutting, or welding.

F. Arc Welding

1. Arc welding equipment shall conform to the design and installation criteria of OSHA 29 CFR 1910.252, "Welding, Cutting, and Brazing." The frame or case of the welding machine (except engine-driven machines) shall be grounded under the conditions and according to the methods prescribed in OSHA Standard 1910, Subpart S, "Electrical", and 1910.252.

2. Before starting operations, all connections to the arc welding machine shall be
checked. The work lead shall be firmly attached to the work; contact surfaces of the magnetic work clamps shall be free of metal splatter particles. Coiled welding cable shall be spread out before use to avoid serious overheating and damage to insulation. Work and electrode lead cables shall be inspected for damage and wear before use. Cables with damaged insulation or exposed conductors shall be replaced. Electrode cables shall be joined and insulated in accordance with approved methods.

3. Grounding of the welding machine from shall be checked. Special attention shall be given to the ground connections of portable machines.

4. Electrode holders, when not in use, shall be placed where they cannot make electrical contact with persons, conducting objects, fuel, or compressed gas cylinders.

5. When it is necessary to splice cables to extend their length, only certified electricians shall make the splices. Cables with splices within 10 feet of the electrode holder shall not be used. The welder shall not coil or loop welding electrode cables around parts of their body.

6. Welders shall not place welding cables and other equipment where it will obstruct passageways, ladders, and stairways.

7. Machines that have become wet shall be thoroughly dried and tested before being used.

8. When welders are working close to one another on one structure where they may touch the exposed parts of more than one electrode holder simultaneously, the machines shall be connected to minimize shock hazard as follows:
   a. All direct current (DC) machines shall be connected with the same polarity.
   b. All alternating current (AC) machines shall be connected to the same phase of the supply circuit and with the same instantaneous polarity.

G. Resistance Welding

1. Thermal Protection: Every pair of ignition tubes used in resistance welding equipment shall be equipped with a thermal protection switch. When used in a series-connected water line, a single switch shall be adequate if related to the downstream tube.

2. Control Safeguards: Controls, such as push buttons, foot switches, retraction, and dual-schedule switches on portable guns, etc., shall be arranged or guarded to prevent inadvertent activation.

3. Guarding Welding Machines: Multi-gun welding machines shall be effectively
guarded at the point of operation. Devices such as an electronic eye, latches, blocks, barriers, or two-hand controls shall be installed. All chains, gears, operating bus linkage, and belts shall be protected by adequate guards.

4. **Electrical Hazards:** All external weld-initiating control circuits shall operate on low voltage, not over 120 volts for stationary equipment and not over 36 volts for portable equipment. All electrical equipment shall be suitably interlocked and insulated to prevent access by unauthorized persons to live portions of the equipment. Only non-ferrous welding clamps should be used to prevent magnetic induction during actuation of the equipment.

H. **Welding in Confined Spaces**

The guidance below has been extracted for OSHA 29 CFR 1910.252.

1. Confined space means a relatively small or restricted space such as a tank, boiler, pressure vessel, mixing vat, sump, or pit. Ventilation is a prerequisite to work in confined spaces. All welding and cutting operations carried on in confined spaces shall be adequately ventilated to prevent the accumulation of toxic materials, possible oxygen deficiency, or explosive atmosphere.

   This applies not only to the welder but also to helpers and other personnel in the immediate vicinity. All air replacing that which is withdrawn shall be clear and respirable. Oxygen shall never be used as makeup air.

2. In such circumstances where it is impossible to provide such ventilation, respirators or hose masks approved for this purpose by NIOSH shall be used. In areas immediately hazardous to life, hose masks with blowers or self-contained breathing apparatus shall be used.

3. Where welding operations are carried on in a confined space and where welders and helpers are provided with hose masks, hose masks with blowers, or self-contained breathing apparatus, a worker shall be stationed on the outside of the confined space to ensure the safety of those working within.

4. When welding or cutting is being performed in any confined space, the gas cylinders and welding machines shall be left on the outside. Before operations are started, heavy portable equipment mounted on wheels shall be securely blocked to prevent accidental movement. All gasoline, diesel and LPG powered equipment shall be placed in locations that will prevent exhaust fumes from entering the confined space.

5. Where a welder must enter a confined space through a manhole or other small opening, a means shall be provided for quick removal of the worker in case of emergency. When safety belts and lifelines are used for this purpose, they shall be
attached to the welder's body in a way that ensures his or her body cannot be jammed in a small exit opening. A wrist harness assembly shall be used. An attendant with a preplanned rescue procedure shall be stationed outside to observe the welder at all times and shall be capable of putting rescue operations into effect.

6. When arc welding is to be stopped for any substantial period of time, such as during lunch or overnight, all electrodes shall be removed from the holders and the holders carefully located so accidental contact cannot occur. The machine shall be disconnected from the power source.

7. When gas welding or cutting, the torch valves shall be closed and the fuel-gas and oxygen supply to the torch positively shut off at some point outside the confined area whenever the torch is not to be used for a substantial period of time, such as during lunch or overnight. Where practicable, the torch and hose shall also be removed from the confined space.

8. All confined spaces shall be monitored for oxygen content, combustible vapors, and toxic material prior to entry and periodically throughout the operation. Periodic testing shall depend on the type of space being entered.

The Office of Environmental Safety shall be consulted for guidance for all confined spaces.

I. **Portable Gas Units**

   Portable gas welding, cutting, and brazing equipment must be of a type approved for the use intended.

   1. Cylinders of compressed gas must have pressure-reducing regulators installed.

   2. Cylinders in use or in a transport must be stored in an upright position and secured to prevent them from falling.

   3. Pressure hoses shall be secured to prevent whipping.

   4. Oxygen cylinders and fittings shall be kept free of grease and oil at all times.

   5. Cylinders shall be kept away from external sources of heat at all times.

   6. Cylinders shall not be dropped or handled roughly. Cylinders or welding sets in excess of 40 pounds total weight shall be transported to and from work sites by pushcart or motorized vehicle.
J. Portable Electric Units

1. Circuits shall be de-energized before testing, checking or transporting.

2. Motor-generator sets and other electrical welding equipment shall be grounded prior to use.

3. Rotary and polarity switches shall not be operated while the equipment is under an electrical load.

4. Arc welding equipment shall be inspected periodically and inspected prior to use following relocation. Power cables and electrode holders shall be inspected prior to every use.

K. Sheet Metal

1. Machines shall be guarded in accordance with manufacturer’s requirements.

2. Supervisors shall ensure sharp metal is stored in an area that will not pose a hazard to machine operators or personnel walking through designated aisles.

3. Work gloves shall always be worn when working with metal and metal scraps.

4. Hearing protection shall be worn when working in designated hazardous noise areas with noise sources operating or when using hand tools labeled hazardous noise producers.

8. Refrigeration and Air Conditioning Maintenance

A. Hazards

Refrigeration and air conditioning maintenance personnel, as with many other Engineering Services activities, perform duties in many different locations and environments. Not only must these workers be aware of the hazards of the tasks they are performing, but also tasks being performed around them. Potential hazards include hazardous noise, electrical hazards, exposure to refrigerants, lifting hazards, and compressed gases and cylinders. Potential physical and health hazards can be effectively controlled by proper work procedures and controls, and by using required personal protective equipment.

B. General Requirements

1. Equipment rooms where air conditioning equipment is installed shall be kept free and
clear of all trash and clutter that could present tripping or fire hazards. Refrigerant piping shall be properly insulated, both to improve operating efficiency and to prevent injury to workers who may accidentally be exposed to it. Equipment rooms are not normally designed for, nor intended for, storage of materials.

2. All belts, pulleys, and rotating shafts shall be guarded to prevent accidental contact. Large valve handle stems, which can present a bump or trip hazard, shall be marked (color-coded) for easy recognition.

3. Electrical parts of the equipment and controls shall have all covers and plates in place. Wiring shall be properly secured to the equipment or structure.

C. Storage and Handling

Storage and handling of cylinders of compressed gas refrigerants can be a source of injury to workers.

1. Workers shall ensure that containers are legibly marked with the type of gas contained and stored with minimum intermingling of types of refrigerant. Cylinders shall be stored separately from flammable gases and oxygen.

2. Where caps have been provided for valve protection, they shall be kept in place at all times until the cylinder is actually in use. Valves shall be kept closed at all times except when the cylinder is in use.

3. Cylinders shall not be used as rollers or supports. Their only use is to contain the gas.

4. Non-refillable containers, such as Department of Transportation (DOT) -2P, DOT 2Q, and DOT 39 containers, shall not be refilled with any material after use of the original contents. They shall be disposed of in accordance with the container manufacturer's or filler's instructions.

5. Cylinders shall not be dragged, slid, dropped, or allowed to strike each other or solid objects violently. Whenever possible, a suitable hand truck or roll platform shall be used.

6. Containers shall never be lifted by the valve. Cylinders shall not be suspended by chains, ropes, or slings unless the manufacturer has provided appropriate attachment points.

7. Storage areas shall be legibly marked with the names of the gases being stored. Full cylinders and empty cylinders shall be segregated and the full ones arranged so the oldest stock can be removed first with a minimum of handling. The storage area shall be kept as dry as possible and away from exposure to salt or other corrosive chemicals or materials. Cylinders shall be secured by a metal securing device or rack.
specifically designed to prevent damage.

8. The rules above apply to all refrigeration and air conditioning maintenance work centers that use and store compressed gases.

D. Fluorocarbons

The fluorocarbons are relatively inert, in general are non-flammable, and are low in toxicity. Shipped as liquefied compressed gases under their own vapor pressures, they are colorless as liquids and gases under their own vapor pressures, they are colorless as liquids and freeze to white solids. The fluorocarbons are odorless in concentrations of less than 20 percent by volume in air but some have a faint and ethereal odor in higher concentrations. The fluorocarbons are unusually stable for organic compounds. Resistance toward thermal decomposition, in general, is high but varies with each product. When decomposition does occur, toxic products are very irritating and usually give adequate warning of their presence in very low concentrations in air. Hot work should never be performed on charged systems.

1. Large Liquid Leaks: Large liquid leaks in fluorocarbon systems may be detected visually. As the material escapes, moisture in the air surrounding the leak condenses and then freezes around the leak due to the refrigerating effect of the vaporizing fluorocarbons. The frost thus formed is readily apparent. Smaller leaks may be located with the use of:

a. A solution of liquid detergent in water applied directly to the area being tested. The formation of bubbles indicates a leak.

b. Electronic leak detectors, capable of sensitivities far greater than the other methods - often in terms of fractions of an ounce of fluorocarbon per year. When the probe of the instrument is placed near a leak, positive identification of the leak is indicated by a flashing light, meter deflection, or by audible means.

NOTE: The vapors of these fluorocarbons are all much heavier than air and in the absence of good ventilation will tend to collect in low areas, thus possibly displacing available air. The vapors will undergo decomposition when drawn through a flame or if in contact with very hot surfaces. The products of decomposition include hydrogen fluoride and hydrogen chloride and, perhaps, small quantities of carbonyl compounds such as phosgene. The halogen acids are both toxic and intensely irritating to the nose and throat. The irritating action of these decomposition products is readily noticeable before hazardous levels are reached. If such a situation develops, the affected areas should be vacated, the heat sources and leaks eliminated, and the area well ventilated before resuming
work.

2. Recovery of Fluorocarbons During Maintenance Work

(Refer to Central Plant procedures, EPA regulations)

9. **Heating Systems and Boiler Plant Maintenance**

**A. Boiler Operations**

Written operating procedures and detailed checklists for operator guidance shall be posted in all equipment rooms. It is important that all functions be included, whether manual or automatic. The basic objectives or safe boiler operations are:

1. Require the minimum number of manual operations.

2. Standardize routine operation procedures for normal start-up and on-line operation. Ensure the use of interlocks to minimize improper operating sequences and to stop sequences when conditions are not proper for continuation. Establish and rigidly enforce purge procedures with necessary interlocks.

**B. Boiler Safety**

1. **Water Level:** Water in boilers shall be checked and kept at proper levels. Water columns shall be monitored to ensure connections are clear and water returns to the proper level in the gauge glass when drain valves are closed. When water is not visible in the gauge glass, all stresses on the boiler shall be gradually reduced.

2. In boilers fired by fuels burned in suspension (fuel oil, gas, or pulverized coal), stop the fire immediately, shut off all air flow, close steam outlet valve, and shut off feed water supply. Proceed as in a normal shutdown. Inspect the boiler thoroughly, including a hydrostatic test, before returning it to service.

3. **Lighting Gas and Oil Fired Furnaces:** Before lighting gas and oil fired furnaces, boilers and breeching shall be ventilated to remove explosive vapors. Burners shall not be lighted if there is oil on the floors or combustion chamber, around the burners, or in front of the boilers. If the flame of a gas or oil-fired burner goes out, the fuel shall be immediately cut off and the furnace passages ventilated before it is re-lit.

4. **Cleaning and Maintenance Procedures:**

a. Whenever a boiler is taken out of service for a prolonged period, it should be cleaned promptly and inspected for defects by an authorized boiler inspector.
b. For boilers in continuous service, planned and scheduled boiler shutdowns for preventive maintenance if far safer than risking an extensive shutdown caused by boiler failure. At least once a year, the boiler, the flame safeguard supervisory system, and other safety controls shall be inspected during a scheduled shutdown by an authorized boiler inspector who is accompanied by the area supervisor. Defective parts shall be repaired or replaced. For inspection, boilers shall be cool, handholes and manholes open, and the boiler shall have been ventilated. Adequate lighting and protective equipment for work in the boiler should be provided.

c. Proper and convenient drain connections shall be provided for draining boilers. Unobstructed floor drains, properly located in the boiler room, facilitate proper cleaning. Infrequently used drains should have water poured into the traps, as required based on local conditions, to prevent the entrance of sewer gases and odors into the boiler room. If there is a possibility of freezing, an antifreeze mixture should be used in the drain traps.

d. When cleaning a boiler, employees shall wear protective clothing, hats, goggles, heavy leather-palm gloves, safety shoes, and approved respirator and hearing protectors if conditions warrant.

5. Steam Piping and Valve Maintenance:

a. All 4-inch and larger steam valves or main steam valves to any building shall be operated only by qualified heat systems personnel.

b. High pressure steam valves located in confined areas shall not be turned off until the valve controlling the steam is turned off at the main steam plant. After the valve in the confined area has been closed, the valve in the steam plant may be reopened to distribute steam to other areas.

c. When a valve in any confined area is to be opened, the operator shall close the main valve at the steam plant before opening the steam valve in the confined area. The operator shall ensure that all pressure has been bled off prior to opening the steam valve in the confined area. The operator shall open the steam valve in the confined area and move away from the confined area before the main valve at the steam plant may be reopened.

d. Routine operations, maintenance, and repair in steam pits and other confined areas may be accomplished on electric circuits, controls, motors, pumps, receivers, condensate lines, and vent fans while steam pressure is in the steam line, providing conditions and temperatures are acceptable. However, no operational changes, repair, or maintenance shall be accomplished on steam lines while there is steam pressure on the lines.
e. Operating personnel shall open drain valves and remove water from the steam line prior to opening a high pressure steam valve. Operating personnel shall familiarize themselves with the location of these drain valves to ensure that the water accumulations are drained from the distribution lines.

f. When bypass lines and valves are installed around a high pressure steam valve, the bypass valve shall be opened first. When the steamline becomes heated or the steam pressure equalized on both sides of main steam valve, the main steam valve may then be opened.

g. All high pressure steam valves shall be opened very slowly and everyone shall remain at a safe distance while valve positions are being changed.

h. When dismantling a valve for maintenance, the worker shall ensure pressure has been relieved through all possible means. The valve body shall be checked for a removable plug to relieve pressure. Bolts shall be carefully removed. Personnel shall never position their body over the valve or in line with the direction of travel, in case the bonnet blows.

6. Vaults, Manholes, and Tanks

a. All enclosed areas shall be considered hazardous until tested. They will be tested with oxygen deficiency and combustible gas indicators prior to entry.

b. Atmospheres containing 19.5 percent or less of oxygen by volume should not be entered without the use of an air supplied respirator.

c. Only manhole cover hooks or other methods approved for this purpose shall be used when removing or replacing manhole covers. When replaced, the covers shall be properly seated. The bearing surfaces shall be free from dirt or ice, which might prevent proper seating of the cover.

d. Personnel shall enter and leave manholes or vaults only by means of a ladder; they will not step on cables, cable hangers, or pipes.

e. Personnel shall not throw tools or materials into or out of manholes or vaults. They will use canvas buckets, handlines, or other approved methods for lowering and removing tools and equipment.

f. Working on energized equipment is especially hazardous in subsurface structures and will be performed by an electrician.

g. When a manhole or vault is open, at least one member of the crew shall be stationed at the surface to act as a safety observer and take appropriate actions in case of emergency.
h. Cool vests or other heat reducing equipment should be made available to workers who enter vaults or manholes under high heat conditions (e.g., steam leak repair).

7. Central Heating Plants

a. Boiler Safety

1) As a minimum, each boiler shall be equipped with steam and water gauges, gauge cocks, safety and blow-off valves, and low water cutoff devices. Safety valve inspections shall be as outlined in the National Board Inspection Code published by the National Board of Boiler and Pressure Vessel Inspectors. Boiler feedlines shall be equipped with check and cutoff valves placed as close as possible to each boiler. Water gauge glasses, less than 15 feet from the floor or water tender's platform, will be carefully guarded to prevent accidents resulting from breakage or blowouts. High-pressure gauge glasses will be drawn down on each shift. Low-pressure gauge glasses will be checked at least weekly.

Pressure gauges shall be inspected and tested every 12 months by heating plant personnel.

2) No boiler shall be operated unless equipped with a safety valve, calibrated to the boiler manufacturer's recommendations unless normal boiler operating pressures are changed. In the latter case, the maximum operating pressure then becomes the controlling factor on safety valve selection. NO other valves, shall be placed between the safety valve and the boiler or between the safety valve and the end of its discharge pipe. Safety valves shall be manually tested on steam or hot water systems at least monthly for proper operation. If it is not practical to test safety valves every month for high temperature hot water boilers, the valves should be removed from the boiler, tested, and reset (if required) at a properly equipped safety relief valved testing facility by the valve manufacturer or by a certified ASME shop. Valves should be tested and reset at least once a year for high temperature hot water boilers.

3) When applicable, spark arresters shall be installed on boiler stacks to prevent flying sparks.

4) No boiler shall be operated at pressures higher than determined safe by the most recent boiler inspection. Boilers shall not be operated at greater pressures than those specified on the manufacturer's stamped instructions. The lower of these two pressures will govern boiler operation. The instruction stamped by manufacturers on boilers shall not be covered or obliterated.

5) If safety valves do not pop when pressures rise above valve settings, or the
valves cannot be opened by hand when tested, the boiler shall be taken out of service until the valves have been repaired or replaced.

6) When fires are banked, boiler tenders shall make certain that draft is sufficient to prevent accumulations of flammable gases.

7) When a boiler is returned to full operation, all external drains between the boiler and main header shall be left open until the boiler is on the line. The stop valve shall be kept closed until boiler pressure is equal to that in the steam main. The stop valve shall then be gradually opened; if no jars or disturbances occur in the line, the valve may be opened completely. If jarring or rumbling occurs during cutting-in, the stop valve shall be closed immediately.

8) Steam shall be introduced into cold pipes very slowly until they have warmed enough to preclude damage.

9) Boiler tenders shall stand to one side when opening fire doors to protect themselves against flarebacks.

10) When not in use, all boiler room tools shall be stored in suitable racks. Tool racks shall be constructed and located so personnel cannot accidentally touch hot surfaces or knock tools from racks while passing by.

11) Adjustments shall not be made to valves or valves removed to increase discharge pressure.

12) Hoistways, driving machinery, conveyors, worm gears, and reciprocating pumps shall be properly guarded.

C. Boiler Water Treatment Tanks

Some of the chemicals used to treat boiler water are hazardous and shall be handled properly. The following safety precautions shall be observed:

1. Acids

Tests for chemical residuals involve small quantities of acid. the risk is small if spillage is avoided and bottles containing acid are not broken.

Greater risks are involved in the handling of sulfuric acid in the hydrogen-zeolite, demineralizing, and direct-acid treatment processes. Observe the following precautions when handling sulfuric acid:

a. Do not permit diluted or strong sulfuric acid to come in contact with the eyes, skin, or clothing.
b. Always wear full-face shields, chemical safety, goggles, neoprene gloves, and a neoprene apron.

c. Never add water or caustic solutions to concentrated acid since a violent reaction will result.

d. Ensure supervisor observes all cleaning and repairing of tanks. Observe instructions about entering and cleaning tanks, including

e. Wash down spills with plenty of water. Never use combustibles such as cloths, sawdust, or other organic materials to mop up spilled sulfuric acid. Neutralize spills with soda ash before washing down.

f. In the event of accidental contact, remove all contaminated clothing immediately and wash affected areas with water for at least 15 minutes. Have medical personnel examine affected areas to determine if further treatment is necessary.

2. Caustic Soda:

   Never add water to caustic soda (the proper method is to add caustic soda to water) because sufficient heat may be generated to cause the solution to boil and spatter. Personnel may be injured if they are exposed to the spattering, since caustic soda has a marked corrosive action on body tissue. Injury to the upper respiratory tract and lung tissue can result if the dust or concentrated mist from caustic soda is inhaled.

   a. Never store food or eat near caustic soda or in the work area where it is handled.

   b. Do not depend upon creams or ointments for protection from caustic soda.

   c. Ensure that all personnel exposed to caustic soda wear full face shield, close-fitting chemical safety glasses, neoprene gloves, apron, and coveralls which fit snugly at neck and wrist.

3. Application of Chemicals:

   a. Always drain the feeder before introducing chemicals into it. Before opening the drain valve, close all pressure connections to the feeder to prevent injury to the operator from hot water or chemicals.

   b. Never place dry chemicals in a chemical feeder or pump. This practice plugs the chemical feed lines in a short time.

   c. Wherever possible, mix chemicals at floor level to minimize the possibility of
injury to eyes and face.

d. Check specifications, temperature, pressure, and materials of construction of piping, valves, and pumps, to determine whether they can be used safely with the chemicals.

4. Safety Equipment:

Inspect all safety equipment regularly, including safety eyewash and shower, to ensure that they are in working condition at all times. Post operating instructions at the emergency eyewash fountain and the safety shower. Periodically instruct personnel in the use of these facilities.

5. Chemical Storage/Handling:

a. Store all large quantities of chemicals used for boiler or condensate water treatment in locations where accidental spills will be contained and where drainage will not be hazardous to personnel or the environment.

b. Conspicuously post warning and handling instructions where use of toxic chemicals are necessary.

c. Train personnel who handle chemicals in safe chemical handling practices.

d. Practice neutralization and containment techniques and disposal instructions. Consult with the Office of Environmental Safety as needed.

6. Chemical Laboratories:

a. Ensure that chemical testing laboratories associated with water treatment have operable mechanical ventilation, when required.

b. Maintain chemical test kits and test instructions in a current and usable state.

c. Conspicuously post appropriate warning instructions.

d. Train personnel who conduct chemical tests in use of the chemicals and hazards involved.

10. Painting Operations

A. Hazards

Painting and paint removal present hazards requiring effective controls. Hazards include exposure to toxic materials and flammable or explosive mists, particulates, and vapors. Inhalation of mists and vapors from nearly all paints,
solvents, thinners, cleaning chemicals, strippers, and epoxies can be injurious depending upon the agent's toxic characteristics and the amount and method of exposure. Further, many can physically injure the skin and eyes, or be absorbed through the skin. Potential physical and health hazards can be effectively controlled by appropriate work procedures, controls, facility design, protective clothing, and equipment.

B. Safety

1. **Pressure Equipment:** Pressure equipment used in painting operations is hazardous because of the compressed air component; therefore, the supervisor shall assure that spray painting equipment is in serviceable condition. On all air-type spraying equipment a pressure regulator valve shall be installed in the airline between the compressor and painting equipment. A pressure relief valve and a pressure gauge shall be installed between the pressure regulator and pressurized paint containers and/or spray guns. Pressure relief valves shall be set to open at pressures not more than 10 pounds above the required working pressure.

2. **Other Equipment:** Painter's ladders, scaffolds, and other equipment shall be inspected prior to use to be certain they are in safe condition.

3. **Paint Mixing:** Paint mixing shall be done in designated, adequately ventilated rooms constructed of fire-resistant materials. All sources of ignition shall be prohibited in mixing areas. All electrical fixtures or equipment in or within 20 feet of designated paint preparation areas shall meet the requirements of the National Electrical Code (NFPA #70) for Class I Division 2 locations.

4. **Housekeeping:** Good housekeeping is essential to safe operations in paint shops. Paint rooms, booths, etc., shall be kept clean with equipment stored in a proper and orderly manner. All solvent or paint soiled rags shall be placed in approved self-closing metal containers plainly marked to indicate the contents. At the end of each day, these containers shall be emptied or removed to an approved location for pickup and disposal.

C. Health

1. **Personnel Exposures:** There is a wide application of organic solvents in painting. All organic solvents have some effect on the central nervous system and the skin. The principal modes of personnel exposure are inhalation of vapors and skin contact and absorption. Personnel engaged in painting operations should review Material Safety Data Sheets (MSDS) in order to acquaint themselves with the properties and hazards of the solvents that are used. Skin contact with solvents may cause dermatitis, ranging in severity from a simple irritation to actual damage to the skin.

2. **Protective Equipment:** Personnel engaged in painting and paint removal shall wear
protective clothing, respiratory devices if required, and appropriate face, eye, and hand protection. Eye or face protection is required during scraping or paint preparation (abrasive techniques). Clothing shall be changed, as needed, to minimize body contamination.

3. **Respiratory Protection:** The Office of Environmental Safety should be consulted for specific advice on respiratory protection required for specific painting activities.

4. **Personal Hygiene:** The hands and face shall be kept clean, clothes shall be changed when contaminated and hands and soiled objects shall be kept out of the mouth.
   - No food or drink shall be brought into, or consumed, in paint shops.
   - Personnel shall wash their hands prior to smoking or consuming food.

D. **Air and Water Pollution**

1. **Pollution Prevention:** Painting and paint removal operations can cause air and water pollution problems that can impact the local community. Liquid, solid, and gaseous waste products from painting and paint removal operations shall be disposed of in accordance with federal and state air, water, and solid waste pollution control laws and as specified and approved by the Office of Environmental Safety.

2. **Spills:** All spills of flammable or combustible liquids shall be cleaned up promptly. With major spills, remove ignition sources, evacuate, ventilate the area, and provide appropriate protective equipment to cleanup personnel. These liquids shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

E. **Fire Prevention and Protection**

1. **Fire Prevention:** Painting operations of particular concern are those having a fire potential; i.e., paint removal, solvent wipe and paint application by means of spray apparatus. Certain paints, lacquers, varnishes, shellacs, solvents, and thinners are very flammable. Others, under certain conditions, will burn violently. These, for the purpose of control, are classified as being flammable. Solvent materials selected to do the residual clean up, after the initial removal, shall have a flash point of 140°F or above.

2. **Spray Painting:** Spray painting presents varying degrees of fire hazards, depending on the materials used. Any material having a flash point below 140°F should be handled very carefully, and precautions are in order even for those having a flash point higher than 140°F.

3. **Sprinklers:** Fire suppression sprinklers installed in spray finishing areas shall
conform to NFPA 13, provisions for extra hazardous occupancy. Dry chemical, carbon dioxide, or halogenated extinguisher systems may be installed where automatic sprinkler protection is not available.

4. **Extinguishers:** Portable fire extinguishers shall be installed near all paint spraying areas. The Office of Environmental Safety shall determine the type of extinguisher that is appropriate.

**F. Ventilation Systems**

1. **Ventilation:** Ventilation and exhaust systems shall be in accordance with the standard for Blower and Exhaust Systems for Vapor Removal, NFPA 91. Mechanical ventilation shall be in operation while spraying operations are being conducted and for a sufficient time thereafter to assure vapors are completely exhausted. Adequate conditioned make-up air must be provided.

2. **Fan Unit:** The fan-rotating element and its casing shall be non-sparking. Ample clearances shall be provided to prevent friction-caused fire hazards. Fan blades shall be mounted on a shaft rigid enough to maintain alignment when the fan is operating under full load.

3. **Exhaust Ducts:** Exhaust ducts shall be protected against mechanical damage, properly supported, and will normally have a separation of at least 18 inches from combustible materials. Ducts shall be periodically inspected for accumulation of paint deposits and shall be cleaned as needed.

4. **Exhaust:** Air exhaust from spray operations shall be directed so that it will not contaminate make-up air being introduced into the spraying area or other ventilation intakes. Unless the spray booth exhaust duct terminal is from a water-wash spray booth, the terminal discharge point shall be at least 6 feet from any combustible exterior wall or roof.

5. **Motors:** Electric motors driving exhaust fans shall not be placed inside booths or ducts. Drive belts shall not enter the duct or booth unless the belt and pulley within the duct or booth are enclosed or guarded.

**G. Storage and Handling**

1. **Storage**
   a. The quantity of paints, lacquers, thinners, solvents and other flammable and combustible liquids kept near spraying operations shall be the minimum required for operations but shall not exceed 1 day's supply.
   
   b. Bulk storage of these liquids shall be in a separate building detached from other
buildings or in rooms specifically designed and constructed to meet flammable storage room requirements.

c. No storage of open containers of solvents is permitted. Open containers may only be used for cleaning of painting materials after which the solvent shall be transferred back to a closed container for retention or disposal.

d. Supplies of flammable and combustible liquids shall be stored in approved fire-resistant safety containers equipped with flash screens and self-closing lids.

e. Operations involving water base latex paints are exempt from the above requirements.

2. Containers

Original closed containers, approved portable tanks, and approved safety cans shall be used for bringing flammable or combustible liquids into spray finishing rooms. Open or glass containers shall not be used.

3. Liquid Transfer

The withdrawal of liquids from containers and the filling of containers, including portable mixing tanks, shall be done only in a mixing room or in a spraying area when the ventilating system is in operation. Precautions shall be taken to protect against liquid spillage.

4. Grounding

Whenever flammable or combustible liquids are transferred from one container to another, both containers shall be effectively bonded and grounded. This practice prevents electrical discharge from the accumulation of static charge because of the transfer process.

H. Electrical

1. Electrical Wiring:

Electrical wiring and equipment shall conform to the provisions of the National Electrical Code (NFPA 70). Electrical wiring located in spray areas must be rigid metal conduit, Type MI cable, or in metal boxes or fitting containing no taps, splices or terminal connections. There are alternative electrical wiring in options when the location is adjacent to (rather than inside) a spray area (NFPA 33).

2. Electrical Equipment:

Electrical equipment outside of, but within 20 feet horizontally and 10 feet vertically, of any spraying area and not separated from it by partitions extending
at least to the boundary of the Division 2 location shall be of non-spark producing
design. This equipment shall also conform to the provisions of NFPA 70, for
Class I or Class I, Division 2 locations as applicable. If spraying operations are
confined to an enclosed spray booth or room, the space adjacent to the booth or
room shall be considered non-hazardous except for the space within three feet in
all directions from any opening in the booth or room.

3. Grounding:

All metal parts of spray booths and exhaust ducts conveying flammable or
combustible liquids or aerated combustible solids shall be electrically grounded.

I. Location of Paint Shops and Spray Finishing Operations

1. Paint Shops:

Paint shops may be located in specially constructed rooms if they are separated
from other operations by fire resistant walls. Paint shops shall be provided with
automatic sprinkler protection. Avoid locating these shops near ignition sources.

2. Spray Booths:

When possible, paint spray booths shall be located in the paint shop. All spray
booths shall be installed to conform to NFPA 33.

3. Prohibited Locations:

Spray finishing operations shall not be conducted in a building classified as
administrative or public assembly unless a room is specifically designed for that
purpose, is protected with an automatic sprinkler system, and is separated
vertically and horizontally from such occupancies by not less than two hour fire
resistance construction.

J. Airless Paint Spraying

1. Never point an airless spray gun at any part of the body. Paint can be hypodermically
   injected into the body by the high operating pressures.

2. Do not disconnect the gun from the fluid hose or the hose from the pump until the
   pressure has been released from the hose. This is accomplished by first closing off the
   main line air pressure to the pump and then bleeding off the pressure in the fluid hose
   by triggering the gun before disconnecting it.

3. When handling the gun but not actually spraying (such as while changing parts or
   work position), hold the gun by the grip and remove the fingers from the trigger. This
will prevent the gun from being activated if the operator should inadvertently tighten his hold due to slipping or stumbling. Guns should be equipped with trigger guards and a safety lock. The lock should be in the non-operating position except when the gun is actually in use.

4. Check all hose connections, fittings to make sure they are tight, and not leaking. The fluid hose must be designed to withstand the high pressure to which it is subjected. The hose, gun, and pressure vessel should be equipped with special fittings that are not interchangeable with low-pressure fittings.

5. Check the fluid hoses to be sure that there are no weak or worn spots. Make certain the hose does not contact moving parts of machinery, lie over or around sharp edges and corners, or come near objects that would damage it. Check for deterioration caused by exposure to chemicals or wear and tear. High-pressure leaks from the hose or from the connections can also cause hypodermic injection.

6. Never pass the finger over the gun orifice to clean it, as this will result in hypodermic injection of paint into the finger. Consult the manufacturer's operating manual for cleaning procedures.

7. The object being sprayed as well as the spray gun, should be grounded to prevent static electricity from being created. Periodic continuity checks should be performed to ensure the hose ground wire is intact.

8. The operator shall wear eye protection and gloves to guard against accidental contact with the spray. Respiratory protective equipment shall be worn if exhaust ventilation is not available. The Office of Environmental Safety shall be contacted to determine appropriate protective equipment needed for the operation.

K. Paint Spray Booths

1. Extinguishers: Provide portable fire extinguishers adequate to handle the most flammable of the coating materials being used. The Office of Environmental Safety shall be consulted for appropriate extinguishers needed.

2. Floor Covering: It is desirable that the floor of paint spray booths be covered with a non-combustible mat, removable for cleaning or disposal.

3. Hoses and Couplings: Pressure hoses and couplings shall be regularly inspected and shall be replaced as needed. When positive displacement pumps are used, a relief valve shall be installed in the discharge line to prevent overpressure.

L. Portable Paint Spray Equipment

1. Description: Such equipment consists of an air compressor, paint spray gun and
hose. The paint reservoir on most portable spray guns holds one quart of fluid or less. When a considerable amount of paint is to be applied, a 2 1/2 or 5 gallon pressure tank is usually employed.

2. **Compressor:** The air compressor shall be equipped with an ASME rated air tank, a visible pressure gauge on the tank, a pressure reducer with its own gauge, a guard fully enclosing the drive belt and pulleys, and a pressure limiting switch to shut down the compressor when the system's working pressure has been reached. The equipment should be securely mounted on a wheeled carriage for portability. For interior painting only electric motor-driven equipment shall be used.

3. **Overpressure Protection:** When separate paint pressure tanks are used, they shall be equipped with a gauge and a relief valve to prevent overpressure. Hoses shall be rated for the maximum working pressure of the system.

4. **Maintenance:**
   
a. A preventive maintenance program shall be implemented to cover periodic inspection and testing of all components.
   
b. Storage of compressors, hoses, paint pressure tanks and spray guns shall be in areas designated and approved by the supervisor in conjunction with the Office of Environmental Safety.

**M. Aerosol Spray Paint Cans**

The same general safety and health precautions apply to spray painting from pressurized cans as to spray painting by other means. The following specific items are noted:

1. **Storage:**
   
a. Pressurized cans of spray paint are to be considered flammable materials and stored in appropriate locations.
   
b. Office desks are not to be used for the storage of pressurized cans of spray paint.
   
c. Office store rooms are not to be used for the storage of pressurized cans of spray paint unless the storage area has been designated safe for the storage of flammable materials by the Office of Environmental Safety.

2. **Disposal:**
   
a. Disposal of malfunctioning paint spray cans still containing paint under pressure shall be in accordance with the Office of Environmental Safety.
hazardous waste disposal procedures.

b. Office waste cans shall not be used for the disposal of cans of spray paint nor for the disposal of wiping rags and other waste material.

c. Disposal of wiping rags and other waste materials shall be in self-closing metal containers labeled to indicate the contents. All such items will be collected and transported to the Paint Shop for proper disposal.

3. Protective Equipment:

The same general rules governing the use of personal protective equipment apply to painting with pressurized cans.

N. Procedures For the Identification, Safe Removal, and Disposal of Lead-Based Paints

Due to the potential exposure of personnel to lead released during abatement of lead-based paint, proposed EPA regulatory authority over lead abatement activities in public buildings, and existing regulatory mandates governing the disposal of hazardous wastes, the following procedures shall be adopted in order to reduce the possibility of human exposure and contamination of the environment.

1. Identification of Lead-Based Paints:

Lead-based paints have been used in the past in MSU buildings. The presence of lead on existing painted surfaces shall be determined by sequential use of the following methods:

a. First, knowledge by painters, maintenance personnel, or contractors of a specific paint that has been applied where the manufacturer's Material Safety Data Sheet documents there is greater than 1% lead in the paint.

b. Second, all "red or rust-colored", and gray primer coats are assumed to contain lead.

c. Third, presence of lead as determined by "lead swabs" or any other direct reading procedure or instrument. Test swabs are available at the Environmental Safety Office.

d. Fourth, analysis by a contracted analytical laboratory by the AIHA Environmental Lead Laboratory Accreditation Program.
2. Training of Personnel

The Federal EPA has established specific disciplines and training for lead-based paint activities. The disciplines are: Inspector Technicians, Inspector/Risk Assessors, Workers, and Supervisors. Additionally, numerous OSHA requirements govern the activities associated with lead exposure. To that end, prior to involvement in lead removal activities, successful completion of the following training must be documented:

a. OSHA hazard communication training specific to lead and any hazardous materials used during the paint removal process.

b. Respiratory protection training and fit testing.

c. Maintenance supervisors responsible for causing the removal of lead-based paints should attend an accredited lead abatement course for supervisors.

d. Hazardous waste training pursuant to 40 CFR 265.16 and 262.34.

3. Work Practices

a. Interior building surfaces

1) All work areas where paint removal or scraping is to be conducted must be sealed off from other work areas. This step includes placing barrier tape across all access areas to the work site and taping 6-mil plastic over all vents, doorways, windows, and other openings into the work site.

2) Personnel shall be instructed not to grind or sand painted areas known to contain lead. Hand scraping is permitted.

3) The work area shall be cleaned periodically during the day by using a combination of a HEPA-filtered vacuum and wiping down the area using damp cloths.

b. Exterior building surfaces

When removing lead-containing paint from the exterior of MSU buildings, the following occupational health/environmental guidelines shall be followed:

1) Special precautions shall be taken when working near air intakes, doors, and windows. Air intakes shall be protected by construction of a wood frame and plastic sheeting barrier and shall be of such a size to ensure that air is pulled from uncontaminated areas. Door and windows shall remain closed and shall be sealed with duct tape and/or plastic sheeting.
2) Physical barriers shall be set up around the work area to prevent pedestrian traffic through the work site.

3) Loose and flaking paint should be removed by manually scraping the surfaces of the building. Sanding or grinding will not be permitted.

4) A drop cloth shall be placed directly and completely under the work area. Paint chips shall be collected periodically throughout the day and at the end of the work day and shall be placed in a container with a tight fitting lid or sealed in a plastic bag (6-mil).

c. Abrasive blasting units

1) Removal of paints containing lead or other heavy metals must be conducted in a sealed abrasive-blasting unit equipped with a high efficiency particulate air (HEPA) filter.

2) The abrasive blasting media should be used fully prior to disposal.

3) Institute the protective measures listed below when cleaning out an abrasive blasting unit.

d. General Practices

1) Personnel shall remove contaminated clothing prior to leaving the work site for breaks, lunch, and at the end of the workday.

2) All surfaces shall be maintained as free as practicable of accumulation of lead-based paint debris.

3) All waste materials, including used disposable clothing, respirator cartridges, plastic, etc. shall be placed in a plastic bag or other container as appropriate and sealed.

4) All tools and equipment used on the project shall be wet-wiped prior to removal from the work site.

5) After the waste containers are sealed, the outside of the container shall be wiped off for any residual dust that may be present prior to being taken off-site for disposal.

4. Protective Measures

a. All personnel shall wear respiratory protection (half-mask, dual cartridge with HEPA filters, as a minimum) and full-body disposable clothing. Personnel shall have a current (<12 months) medical clearance to wear a respirator. They
must have been fit-tested with their respirator within six months or as prescribed by the Respiratory Protection Program.

b. Personnel shall also be provided and instructed to wear face shield or vented goggles, gloves, head coverings, and disposable shoe coverlets.

c. Personnel are not permitted to eat, drink, or smoke in or near the work area.

d. Personnel shall be instructed to wash their face and hands before eating, drinking or smoking and before leaving the work area for breaks or lunch.

e. All personnel involved in lead-based paint removal shall shower at the end of the shift before going home to prevent contamination of their vehicle and exposure of family members and others to lead-containing dust.

f. The Office of Environmental Safety requires that MSU personnel participate in the personal air monitoring program in order to determine their potential exposures to lead dust. The results of this monitoring will also be used to determine if personnel need to be enrolled in a medical surveillance program for lead. Contact must be made with OES (x4827) prior to the start of the project to coordinate the sampling effort.

g. Contractors are responsible for meeting OSHA personnel air monitoring, personal protective equipment, and medical surveillance requirements for lead exposures (29 CFR 1910.1025, or 29 CFR 1926.62, as appropriate).

5. Waste Disposal

a. Hazardous wastes

The Office of Environmental Safety (x4827), shall be contacted prior to the initiation of a lead-based paint removal project. OES can assist in determining whether or not a material is a hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA), as well as specific requirements on proper waste reduction and disposal. OES will dispose of hazardous wastes generated by in-house maintenance personnel only. Contractors are responsible for disposing of all waste materials that they generate in the course of their work/contract obligations. Specific wastes generated during lead-based paint removal can include, but is not limited to:

- Paint chips/dusts
- Solvents used to remove paints
- Media using in abrasive blasting units
b. Other wastes

Materials known to have been painted with a lead-based paint such as scrap metal (old filing cabinets, HVAC ducts, etc.) should be turned in for recycling. Contact OES (x4827) if there are any questions on disposal of other materials.

11. Landscape/Grounds Maintenance

A. Mowing

Maintenance of MSU grounds involves the use of various sizes and types of lawn mowers. The most significant dangers are being struck by the blade or a foreign object thrown by the high-speed blades and noise-induced hearing loss.

1. Personal Protective Equipment and Safeguards

Workers shall wear face shields or safety goggles or glasses with side shields, safety-toe boots, and hearing protection during the operation of all lawn mowers. Gloves may be worn when using walk-behind mowers. Bump caps should be worn when using a riding or towed mower around tall brush and low handing tree limbs. All mower discharge chutes shall be guarded with shields or approved grass catchers to deflect or stop foreign objects during operation.

2. Operating Practices Applicable to Push, self-propelled, and Riding Mowers

a. Operators shall be trained and qualified to operate the different type(s) of mowers available. Manufacturer's instructions and operating procedures shall be followed.

b. Prior to mowing, operators shall clear the area to be mowed of all people and inspect for foreign objects, raised sprinkler heads, holes, soft ground, and obstructions.

c. The mower shall not be left running unattended. For riding mowers, the engine shall be shut off and all drives disengaged prior to getting off the mower. No riders are permitted on riding lawn mowers. The engine on push and self-propelled mowers shall be turned off while moving to another job location or while passing over curbs, loose gravel, or other similar obstructions. Power to attachments shall be disengaged on riding or towed mowers while passing over similar obstructions and when travelling over unobstructed areas and roads on the way to the next job site or return to the shop.

d. Mower blades cutting height should normally be set as near to 2 inches as possible. Blades shall never be set lower than 1 1/2 inches.

e. When mowing hills and slopes, operators shall know the special precautions to follow. Slopes, hills, or banks exceeding a 30-degree angle shall be mowed with a
push or self-propelled walk-behind mower in a horizontal (across) direction.

f. Electric hedge clippers shall be inspected, cleaned, oiled, and sharpened as required when in use. A grounded power cord shall be used if the tools are not double insulated. The cord shall be inspected before use and daily for condition. The cord shall be kept away from the cutting surface and out from under the feet of the operator. The cutting teeth of the clipper shall not be pointed toward the body of the operator. The unit shall be shut off and unplugged while moving from job to job. Gloves shall be worn when operating hedge clippers. No electric power tool shall be operated in rain, sprinklers, or any kind of precipitation.

3. General Rules for Maintaining Lawn Care Equipment

a. Always refuel with engines off and allow the engine to cool first. Do not permit smoking in the area. Refuel mowers prior to use versus refueling prior to storing inside a building. Complete refueling outside, at least 10 feet away from the building or any open flame.

b. Use boards or ramps to load and unload mowers from vehicles ensuring the engine is off and the spark plug wire is disconnected. Always shut off the fuel supply line when parking mowers inside or outside at the end of the day. As storage space permits, leave 1 to 3 feet separation space between parked gasoline-operated riding mowers.

c. Clean mowers or perform other maintenance on mowers only after turning engine off and disconnecting the spark plug wire.

d. Use manufacturer's guidelines for operation and use of mowers.

B. Fuel Can Storage

Store all motor fuel in safety cans. Safety cans shall be stored in the designated fire cabinet in the Grounds Maintenance Shop.

C. Chainsaw Safety

Chainsaws can be dangerous. Each year, many people are injured through chainsaw accidents. Most of these can be avoided. The hands, knees, feet and head are vulnerable to being cut by the saw chain.

If you use a chainsaw often, there are also health risks. The noise of the saw can lead to permanent hearing loss. Vibration can cause permanent damage to the hands. The carbon monoxide exhaust gases from the saw cause poisoning if used in enclosed spaces. And the fire risk from fuel spillage or hot sparks can cause burns to chainsaw operators.
These hazards mean that chainsaws are potentially one of the most dangerous pieces of grounds maintenance equipment.

However, with the use of modern equipment, correct protective clothing, and proper work practices, they can be used safely.

Over the next few pages you'll find plenty of information about operating a chainsaw safely. There is a check-list of the safety features on your saw. Tips on the protective clothing you should wear, and suggestions for safe work methods.

1. General safety precautions.
   a. Read the owners manual for your saw model. It will tell you the safety features of your chainsaw and the correct way of operating it.
   b. Check your chainsaw thoroughly before use. Make sure that your bar, chain and sprocket are in top condition and that all safety devices are working.
   c. Regularly service your chainsaw.
   d. Always wear suitable protective clothing.
   e. Do not start cutting until you have a clear work area, secure footing, and a planned retreat path from the operating area.
   f. Keep other people and animals well away from the working area.
   g. Make sure there is a second person within calling distance.
   h. Do not operate the saw beyond your ability.
   i. Use the saw only to cut wood.
   j. Do not be distracted. Stop if somebody starts speaking to you. If tired, rest a little. Chainsaw operation requires constant attention. Tired operators have more accidents.

2. Maintaining your chainsaw.
   a. A chainsaw is designed to meet various safety requirements. Use the diagrams to check and understand the safety features of your saw.
   b. If possible, use a saw with all of these safety features, even if they may be optional extras when you buy it.
   c. Never operate a chainsaw that is damaged, not properly adjusted or wrongly assembled. Your chainsaw requires regular maintenance.
d. Before you start work, check that:
   - the machine is in good repair (no leaks, wear or damage);
   - the throttle trigger, safety throttle lock and stop switch operate correctly;
   - the chain is lubricated, sharp and the tension is correct;
   - the carburetor idle adjustment is correct.

e. After finishing work, or daily:
   - clean the chainsaw (particularly the air filter, cooling inlets, and sprocket cover).

f. Regularly:
   - Sharpen your saw chain;
   - Check the guide bar for burring;
   - Check the sprocket for wear;
   - Clean the chain brake mechanism (if it is mounted in the sprocket cover clean regularly during use, as they can clog up with oil, sawdust and may malfunction);
   - Have the saw serviced by a professional mechanic on a regular basis.

3. Personal safety equipment.

A safety helmet with visor or goggles, ear muffs, gloves, protective leggings and safety boots should be worn to protect from chainsaw injury.

4. Preventing kickback

Kickback is a sudden upward and backward movement of the saw. It occurs when the tip of the bar nose contacts a log, branch or nail. It can cause serious injury.

To prevent injury from kickback:
   - Ensure your machine is fitted with a chain break (preferably inertia activated);
   - Ensure the break mechanism is clean and operates effectively;
   - Use low kickback chain types and avoid lowering the depth gauges too much when sharpening;
   - Hold the chainsaw firmly, making sure that the left hand encircles the top handle with
the thumb underneath;

- Avoid bringing the upper quadrant of the guide bar into contact with any foreign object;
- Wear correct head protection and safety pants at all times;
- Don't cut above shoulder height;
- Never hold the saw in one hand or by the one handle only;
- Always begin your cut at peak rev's.

5. Preventing Raynaud's Disease and Occupational Overuse Syndrome

The vibration from chainsaws can cause damage to the hands if used for long periods at a time. Raynauds Disease or "whitefinger" produces numbness and burning sensations in the hand and may cause nerve tissue and circulation damage. Occupational Overuse syndrome (O.O.S.) or Repetitive Strain Injury (R.S.I.) can involve persistent pain in the neck, shoulders and arms.

- Ensure your chainsaw has anti-vibration mountings which isolate handles from the engine;
- If possible use a saw with ergonomically angled handles. These greatly reduce uneven and undue pressure on the hands;
- Take regular rest breaks from continuous operations;
- Wear gloves, especially in cold weather;
- Sharpen your chain regularly (it ensures smoother cutting and less vibration).

6. Preventing noise induced hearing loss.

Most chainsaws emit noise levels which can cause permanent damage to your hearing if used for long periods at a time.

- Always use ANSI approved ear muffs or plugs designed for high noise applications;
- Ensure your muffler is in good condition;
- Ensure your engine is tuned to manufacturers specifications.
7. Preventing exhaust poisoning

The exhaust gases from your saw contain poisonous elements such as carbon monoxide.

− Ensure your muffler is in good condition;
− Do not work in confined spaces.

8. Preventing fires.

Chainsaws have potential to catch on fire or to catch on fire. Precautions are to be taken to prevent this from happening.

− Don't smoke while filling or operating the saw;
− Refuel in a clean area;
− Refuel the saw only after the engine has cooled down;
− Make sure fuel caps are screwed on tightly and any fuel spillage is wiped off;
− Move at least 10 feet away from the refueling area before starting the saw;
− Only use safety approved fuel containers;
− Keep a fire extinguisher and shovel nearby.
− Ensure your muffler is in good condition and is equipped with a spark arrestor.

9. Training and supervision.

Chainsaw operators should be properly trained. Training may be on-the-job or through a recognized training course. It should contain instruction on:

➤ Safe working techniques;
➤ Operating conditions, including unusual or dangerous conditions;
➤ Basic information about the chainsaw including its controls, attachments and components, design, capacity, stability and limitations;
➤ Correct stopping and starting techniques;
➤ Cleaning and servicing;
➤ Being alert for the possibility of kickback;
Chain sharpening techniques.

Less experienced operators should be carefully supervised.

Certain operations are extremely dangerous and should only be undertaken by professionals. These include removal of branches from standing trees, the removal of trees hung in wire, cutting trees thicker than the guide bar length, and working in windblown areas.

D. Power Equipment Safety

1. Follow all manufacture's guidance on equipment operation.

2. Keep hands, feet and other body parts away from moving parts and cutting blades.

3. Wear appropriate ear and eye protection.

4. Wear full body clothing to protect you from cuttings and burns.

5. Wear gloves to protect hands and reduce vibrations.

6. Keep aware of work conditions and conditions around you at all times.

7. Do not use power equipment around others unless they are involved in the work activity. Ask others to leave the work area or schedule the work for times when other are not present.

8. Place barricades at all approaches to the work area when using trimmers and other rotating cutting device equipment. Unprotected persons should not be within 10 feet of the equipment when in operation. It is the responsibility of the operator to make sure others are not in the work area when the equipment is being used.

9. Avoid becoming too tired when working with equipment. Work safe and smart at a steady pace. Take appropriate breaks and alternate work procedures to avoid becoming too tired to properly operate the equipment.

E. Tractor Operations

1. Rollover protective structures (ROPS) are required on tractors used for landscape maintenance. Seat belts shall be installed on all ROPS-equipped tractors and used whenever the vehicle is in motion.

2. When pulling a load, operators shall hitch only to the draw bar. The draw bar hitch shall be kept at least 13 inches, but less than 17 inches, off the ground.

3. When moving a front load, the load shall be kept low to the ground and the rear
wheels as level as possible.

4. Operators shall avoid holes and obstacles; both on the ground and overhead. Speed shall be reduced with heavy loads when vision is limited or when operating on rough terrain.

5. When stuck, operators shall try carefully to back out. Increasing engine speed or fastening a post to the rear wheels greatly increases the chances of tipping over backward; therefore, these methods shall not be used. Operators shall get help if needed.

6. Grass shall not be mowed with a tractor on slopes greater than a 4-inch rise or drop per foot of travel. Lower gears shall be used when going down hill and the wheels shall be allowed to control the tractor speed.

7. The engine shall be shut off before the operator dismounts from the tractor or makes adjustments to either the tractor or towed equipment.

8. Riders shall not be allowed on tractors, on the draw bar, or on towed equipment, except where the equipment is specifically designed to allow riders or passengers.

9. Fenders are guards for the worker's protection. Fenders shall be kept in place at all times.

10. Tractors shall only be left on an incline after the engine has been turned off, gearshift has been placed in park position (or the lowest gear if standard transmission), and the wheels have been braked and blocked. Where possible, tractors shall be parked on level ground.

11. The power take-off guard shall always be in place.

12. Hearing protection and safety-toe shoes shall be worn by the operator, when required. The Office of Environmental Safety should be consulted to determine the need for respiratory protection.

**F. Heat Related Illness**

Grounds Maintenance personnel are exposed to the elements on a regular basis. The requirements of the following section shall be observed in relation to the reduction of heat related injuries and illness.
HEAT INDEX CHART

<table>
<thead>
<tr>
<th>TEMP (°F)</th>
<th>Relative Humidity</th>
<th>Values</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
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<td>80</td>
<td>85</td>
<td>&lt; 90 are considered comfortable</td>
</tr>
<tr>
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<td>70</td>
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<td>&gt; 90 are considered extreme</td>
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<tr>
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<td>60</td>
<td>98</td>
<td>&gt; 100 are considered hazardous</td>
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<tr>
<td>100</td>
<td>50</td>
<td>106</td>
<td>&gt; 110 are considered dangerous</td>
</tr>
<tr>
<td>105</td>
<td>40</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>30</td>
<td>123</td>
<td></td>
</tr>
</tbody>
</table>

1. Body Temperature Regulation

Regulation of body temperature is a constant balancing act - heat input from ambient
temperature, metabolism, physical work, and sunlight, and heat output from radiation,
evaporation, conduction, and convection.

Normally radiation accounts for about 2/3 of heat loss, and evaporation about 1/3. If you
are very hot or working hard and sweating, evaporation can become a major factor in heat
loss unless it is very humid, in which case evaporation cannot help. Conversely, in water
conduction may become a major cause of heat loss. Immersed in water one can lose
significant body heat unless the water is almost body temperature. Diveskins or wetsuits
prolong the time you can stay in water by providing insulation, and in winter, getting out
of wet clothes is the first major step of warming up. Consumption of alcohol increases
vasodilatation, and can contribute to radiation and conductive heat loss in the winter.
Infants and very young children lack effective heat regulatory mechanisms and are more
at risk for heat or cold related injuries.

2. Heat Disorders

Heat Cramps

These are painful cramps following exercise, often effecting the major muscles such as in
the calves and thighs. Stretching often helps, maintaining good hydration and electrolyte
balance may help, as will becoming acclimated to the heat.
Heat Syncope

This is a faint, often after prolonged standing or upon standing. It responds quickly to fluid replacement. Older individuals and those on anti-hypertension medications are most at risk.

Heat Exhaustion

This entity is caused by dehydration and depletion of electrolytes, or body salts. It is manifested by weakness, headache, dizziness, nausea, vomiting, and diarrhea. An increased body temperature and pulse rate may be present. The treatment of heat exhaustion is to rest, get out of the heat/sun, sponging the body with water and fanning it, and aggressively replacing fluids and salts. This can be something fancy such as a sports drink, or it can be water and salty snacks. If not taken seriously, this can progress to heat stroke.

Heat Stroke

In this condition the body loses its ability to regulate temperature and the body temperature soars, often to above 106 degrees. Sweating may or may not be present. The hallmarks of heat stroke are physical collapse and mental deterioration ranging from confusion to coma. This is a medical emergency and must be treated aggressively with rapid cooling and IV fluids if available. If not, death or permanent damage to the kidneys, heart, or liver may result. Emergency treatment can consist of cooling in whatever water is available or removing clothing and wetting/fanning the body. If able to drink, give the victim water, a sports drink, or oral rehydration formula. If no disinfected water is available, give any water.

3. Preventing Heat Illness

Even marginal dehydration interferes with the body's ability to regulate temperature. It also makes a mild diarrhea illness more likely to become serious. In hot climates, you should always consume enough water so that you must urinate every two to three hours. If your urine becomes dark yellow it means that you are getting dehydrated (or that you are getting jaundiced!).

Acclimatization by working - or working out - in the heat encourages the body to adjust to a hot climate. Until acclimatized, heavy exertion should be limited to 30-90 minutes per day, avoiding the hottest part of the day.

Clothing should be lightweight, light in color, and a loose weave. A wide-brimmed hat will help keep you cool and prevent sunburn.

Be aware of humidity! Even in relatively cool (75 degrees) temperatures marked exertion
in very high humidity can lead to heat illness due to failure of evaporative cooling.

**Temperature Conversions:**

To convert Celsius to Fahrenheit:  \( F = \frac{9}{5} \times (C + 32) \)

To convert Fahrenheit to Celsius:  \( C = \frac{5}{9} \times (F - 32) \)

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**G. Cold Weather Safety:**

How to Prevent Frostbite and Hypothermia

Prolonged exposure to low temperatures, wind or moisture can result in cold-related illnesses such as frostbite and hypothermia. The National Safety Council offers these tips to help you spot and put a halt to these winter hazards:

**How to detect and treat cold-related illnesses**

- **Frostbite** is the most common injury resulting from exposure to severe cold. Superficial frostbite is characterized by grey or yellowish patches on the affected areas. The skin remains soft and pliable, but becomes red and flaky after thawing. Treat superficial frostbite by taking the victim inside immediately and warming the affected areas with warm, not hot, water. Deep frostbite usually affects the feet or hands and is characterized by waxy, pale, solid skin which may turn blue or purple upon thawing. Large blisters may also appear. Treat deep frostbite by moving the victim indoors and seeking medical attention immediately.

- **Hypothermia** occurs when the body's temperature drops below 98.6 degrees Fahrenheit. Symptoms of this condition include uncontrollable shivering, impaired speech and clumsy movements. Severe hypothermia may produce rigid muscles, dark and puffy skin, irregular heart and respiratory rates, and unconsciousness. Treat hypothermia by protecting the victim from further heat loss and calling for immediate medical attention. Carefully remove the victim's clothing if it is wet, but avoid rubbing the victim's skin. Give artificial respiration or CPR (if you are trained) as necessary.

**How to prevent cold-related illnesses**

Avoid frostbite and hypothermia when you are exposed to cold temperatures by eating a well-balanced diet and drinking warm, non-alcoholic, caffeine-free liquids to maintain fluid levels.

Avoid becoming wet, as wet clothing loses 90 percent of its insulating value. Think ahead and wear warm clothing underneath rain gear.

**H. Flower Bed and Shrub Maintenance**

Workers shall wear clothing and gloves that will protect their hands and arms
from thorns and leaves which may cut or puncture the skin. Dust masks may be required to prevent reactions to fine dust or pollen. Personnel shall not work on flower or shrub beds within 24 hours after application of herbicides.

Shovels, hoes, and cultivators shall be kept sharp, used in moist soil, and placed where stepping on the cutting surface will not cause the handle to strike a person.

I. Fertilizer Storage and Handling

Fertilizer can become a very combustible material and, at temperatures in excess of 130 degrees F, it may explode. When fertilizers become wet and start to decompose, they give off a gas that will burn. Some fertilizers give off a very toxic gas when burning. No more than 2,500 tons of fertilizer shall be stored in a building unless that building is equipped with an automatic sprinkler system.

When spreading fertilizer, pellets shall not be directed toward other personnel. If personnel enter the area, the spreader shall be turned off. Fertilizer spreaders shall be cleaned and lubed daily. Safety glasses and gloves shall be worn during fertilizing spreading operations.

J. Herbicides

The use of herbicides for weed and grass control poses a significant potential safety and health hazard. Herbicides shall be applied per manufacturer’s instructions and used only by certified personnel. Due to the absorption properties of herbicides, coveralls shall be worn during application, in addition to safety goggles and appropriate respiratory protection, as required.

12. Custodial Services

Working as custodian was once considered a straightforward job. In the last decade that assessment has drastically changed. Today custodians are charged with a variety of responsibilities. These have been brought about by social changes as well as changes in technology. Along with the changes there has developed additional hazards to the position. Custodial personnel area at risk to exposure to chemicals, asbestos, slips trips and falls, lifting heavy loads, machinery, biohazards and many other hazards. This section will highlight some of the safety procedures to be utilized by custodial personnel.

A. Responsibility

As an employee providing custodial services for the MSU campus there are two very important responsibilities. The first responsibility is to make sure you provide safe and healthy facilities for fellow employees, students and guest. The second is to make sure you,
the custodial worker, are adequately protected from injury or other health problems.

This custodial safety guide will cover the following issues on custodial safety:

1. Avoidance of contact with blood borne pathogens.
2. What you should know when working with and handling chemicals and disinfectants.
3. Cleaning restrooms.
4. How to prevent back injuries from occurring on the job.
5. Steps to avoid slip and falls.
6. What you should know when working with power equipment.

B. Protection from Blood Borne Pathogens, HIV, and other Hazardous Materials

Refer to the Bloodborne Pathogen Program for complete rules and requirements. The following provided as a guidance for this document only.

1. One of the most common occurrences during a typical workday is a request for a custodial worker to clean up a spill. This could mean that you will be cleaning up a spill that contains blood borne pathogens such as the HIV virus or Hepatitis.

2. HIV and Hepatitis are deadly diseases and it is for this reason that strict precautions must be adhered to. That is why you must be equipped with the proper personal protective equipment.

3. Gloves are one of the most important pieces of protective equipment you need to be equipped with. Gloves are one of the most important lines of defense you have. All custodial personnel shall wear gloves when dealing with body fluids or surfaces contaminated or potentially contaminated with bodily fluids.

4. Remember, blood to blood contact can cause exposure to AIDS and HEPATITIS. Make sure you are protected at all times. An open sore, a cut, or any kind of puncture can result in your exposure to a bodily fluid. Also check your gloves thoroughly to make sure they are free of any rips or tears. Gloves are to be inspected before and after each use. Dispose of damaged gloves immediately in appropriate disposal container.

5. When cleaning bodily fluids, take special care not to soil clothing or touch your face or skin with contaminated gloves or cleaning equipment.

6. Paper towels, sponges or similar products can be used to soak up bodily fluids. Be
sure to have a leak tight plastic disposable bag handy so the soiled paper towels can be disposed of safely. Never reuse cleaning cloths or sponges that have been used to clean up bodily fluids. Dispose of such items in appropriate disposal container.

7. After an area has been cleaned up thoroughly, scour it using a disinfectant such as household bleach. Let the disinfectant settle in for a few minutes before wiping it clean. It is important to wait approximately 10 minutes to allow most disinfectants to kill all bacteria and virus on the surface. Care is to be used when selecting a disinfectant when treating carpets and material covered items. Mix disinfectants as per manufacture's recommendations.

8. After the area has been completely cleaned with the disinfectant, you can carefully remove your gloves. You must be careful not to contaminate your hands when removing the gloves. Follow the following procedure for decontamination:
   a. Grasp the top of a glove cuff and pull it over your hand, turning the glove inside out. Pull the glove over the hand until only the lower half of the fingers and thumb remain in the glove.
   b. Grasp the other glove cuff with the glove-protected fingers of the hand with the partially removed glove and repeat the process of peeling the glove off the hand. Taking special precaution to avoid touching the contaminated surface of the glove.
   c. Once the gloves are removed place them in a sealed disposable bag and make sure that it's placed in a safe refuse container.
   d. Proceed to a sink for washing your hands.
   e. Place paper towels over
   f. Thoroughly wash your hands. You should use liquid soap, not a bar.
   g. Be careful to remove rings or jewelry to avoid any contamination caught between your fingers and your jewelry. Dry your hands with an electric dryer if possible, if not use paper towels and avoid turning the faucet off with your bare hands.

9. Another area where you need to exercise extreme caution is whenever you are required to pick up and dispose of a condom. Remember that the HIV virus can be transferred through your skin if there are any open cuts or punctures. Therefore, go towards the side of caution and follow steps to properly pick up and dispose of a condom.
   a. If possible use tongs or other mechanical device to pick up the condom by the
end with the opening. Place in a plastic bag. Seal the bag and immediately dispose of the bag. Be careful not to spill the contents of the condom or the bag. Avoid touching any object with tongs until they are cleaned and disinfected completely. Properly disinfect your tongs by placing in an approved disinfectant or a 50/50 bleach and water solution. Leave disinfectant on tongs for a minimum of ten minutes.

b. Even if there is no apparent fluid in or on the condom, avoid any contact between the condom and your skin or clothing.

c. If mechanical tongs are not available, don protective plastic or latex gloves. Carefully inspect the gloves for holes and stressed areas. Pick the condom up by the end with opening and place in a plastic bag. Then follow the hand cleansing and glove removal procedure as defined in the previous subsection.

d. After placing the condom in the bag, immediately seal the bag and place it in a waste disposal dumpster.

10. Another common custodial job that is performed on a daily basis is emptying trashcans. Wearing gloves, work boots, and long sleeve shirts is normally proper protection, but not in every case. When changing garbage make sure you never physically push the garbage down with your hands. There could be a needle, which could puncture your skin even through gloves and infect you with the AIDS virus.

11. We all know that protection against AIDS is a complicated subject; however, for workers like yourself here are three points to remember when working in environments where there is a chance of exposure.

a. Always wear protective clothing so that you minimize the chance of your skin contacting any bodily fluids.

b. After cleaning up a spill or coming into any direct contact with a bodily fluid, make sure to thoroughly wash and scrub any parts of your body that could have been contacted.

c. Contact Environmental Safety for proper disposal of any blood or blood contaminated items. Do not attempt to clean the area without having been properly trained in the cleaning procedure. If you aren't sure about this procedure or any other one, check with your supervisor.
C. Safety Guidelines for Handling, Mixing and Labeling of Chemicals

1. Always know where the Material Safety Data Sheets are located. Read them before starting to use any chemical that you aren't familiar with.

2. Read the labels on the chemicals you are about to use. They provide accurate information on dilution ratios and contain excellent safety reminders.

3. Follow the manufacturer's dilution ratios. Take particular care to make accurate measurements. Solutions that are made too weak won't get the job done. If they're made too strong, you are wasting money by using too much of the concentrated solution. Some solutions if mixed improperly or used full strength present a health or safety hazard to you and others that might be exposed to the chemical or vapor from the chemical.

4. It is also a very good idea to wear eye protection and gloves. In the unlikely event that concentrated chemicals get on your skin or in your eyes, immediately wash it off unless the MSDS states differently. If you get chemicals in your eyes, you should flush them thoroughly with water. Report all contact with chemical to your supervisor.

5. Anytime you pour contents of a solution into an unlabeled bottle make sure to clearly label it with permanent marker or label. Monitor all labeled bottles and verify that all labels are legible at all times. If you aren't sure about the contents of a solution because it has no label, do not use it and safely dispose of it.

6. Always work in well-ventilated rooms.

7. Eating, drinking, or smoking should never be done when you are working with chemicals. Do not store foodstuffs in the same area as cleaning chemicals. DO NOT STORE YOUR LUNCH IN THE CUSTODIAL CLOSET. Accidentally transferring chemicals to your mouth could result in severe poisoning.

8. Rubberized gloves are a great protection against chemical contamination, however you should always wash and dry your hands after mixing or handling chemicals.

9. Always decontaminate gloves after each use. Place them in a clean area where they will dry and stay clean when not in use.

10. Never mix bleach and ammonia. Care should be taken when mixing chemicals. Not all chemicals are compatible. Mixing bleach and ammonia can cause the creation of a deadly gas. They should never be combined. Also be careful to clean up any bleach or ammonia spills, so these two compounds can never be accidentally combined.
D. Cleaning Restrooms

1. When cleaning restrooms, a properly stocked and well-organized custodial cart is important. You should have all of your disinfectants, cleaning products, and accessories ready to use.

2. Emptying trash is a good place to start. Remember to grab the trash bag by its sides and then empty it into the barrel. DON'T reach into the trash bag and squash it down if its overflowing. There could be hazardous substances such as sanitary napkins or needles. Your gloves will protect you most of the time, but you should still err on the side of caution.

3. Sinks should be thoroughly sprayed with a disinfectant approved by your supervisor. The disinfectant should be left in place for about 10 minutes. Go on to other chores while the disinfectant is in place. Once the 10 minutes has elapsed wipe down your sinks.

4. Use the toilet brush in combination with the cleanser when cleaning the urinal. There is no reason for you to use your hands. The brush can clean into hard to clean spots. It's also hygienically much better to use the brush than your hands. The same cleaning technique should be applied to the toilet bowls. This is also a convenient time to replace paper products.

5. Before you mop down the floor, make sure that it's clean of all debris. Also, check and make sure that you've put out barrier signs so no one runs into the bathroom and slips on the wet floor.

6. Make sure to properly mix the mopping cleanser with water. Too little cleanser will not effectively cleanse the floor. In addition, too much cleanser may leave the floors slippery after they dry.

7. When mopping, you should be wearing shoes with slip resistant soles. Mop in small circles and make sure not to strain your back when ringing out the mop. Follow the technique shown in the Custodial Safety Training video.

8. Once you are done, load all your equipment back on to the custodial cart and you've finished properly cleaning up the bathroom. Make sure to never leave equipment or supplies laying around the rooms or halls.

E. Back Injury Prevention

Custodial back injuries are one of the highest employees on the job injury. This is due to many factors. All of these factors can be reduced with effort from you and other custodial employees. Custodial back safety is something you are going to deal with every day. Here are several practical examples of how to safely deal with lifting or pushing. We'll
start with the custodial cart.

1. The custodial cart can be one of the causes of back injury when it isn't properly loaded. For example, if there is too much weight on the top it can make it hard to push and unsteady. When the cart is properly balanced it's a lot easier to push and reduces the chance of back strain.

2. When moving heavy objects use the team approach. Trying to pull, wrestle, or lift a heavy object is a sure prescription for a pulled muscle or severe back strain.

3. When lifting up a trash can try to determine how much it weighs. If it's too heavy get some help.

4. When lifting up a trash can by yourself, make sure you use proper body mechanics. Place one foot behind the other - bend your knees - keep your back straight - tuck in your chin - use palms of your hands not fingers - draw object close to you, arms and elbows tucked in - extending both legs lift with thrust of left foot.

5. When emptying trash cans that are filled with paper products, don't try and mash the trash down with your foot or your hand. Sharp objects, including infected needles could be in the can and you could easily receive a puncture wound. Always make sure you are wearing proper personal protective equipment when emptying trash barrels.

6. When reaching and pulling down heavy objects without being properly balanced, you can cause strain to your back or even be hit by the falling object.

7. A good solution is to get a stool or ladder and ask for help so you can down load the object without having to strain your back.

Back problems are the number one cause for injury among custodial workers. Following the techniques required by this document and demonstrated in training videos, will help you to avoid a debilitating back injury. Remember your health as well as your livelihood depends on it.

F. Steps to Avoid Slips and Falls, Safety Tips for Working with Power Equipment, and other Important Safety Considerations

Although not as common as back injuries, slips and falls nevertheless are another major cause of injury.
1. Wetting down steps or using water, anywhere carries a certain risk. Exercise caution when using water or find an alternate way to clean up steps. Never spray or splash water on electrical outlets or equipment.

2. Don't leave hose or electrical cords unattended. Never leave cords or hoses across floors. If you must lay a hose or cord across the floor, place warning signs at all approaches to the area. Make sure that the hose or cord is laying flat on the floor and not in loops that might cause someone to trip. Store them in a safe place after you're through using them.

3. When mopping an area that is close to children or pedestrians, block the area off with barriers. After you're through mopping it will take some time for the area to dry, so make sure that all effected areas warn of the wet and slippery surface.

4. Make sure to yield the right of way to others when pushing custodial carts through hallways. Watch out for obstacles when you are working in close quarters. Call out warning before going around corners.

5. Be sure that you've been trained in ladder safety before attempting to use one.

6. Don't operate floor machines until you have received adequate training.

7. When operating floor machines, remember to keep the cord away from the machine by draping it over your shoulder. Learn proper body mechanics so you don't incur a back injury. When you tangle the cord, unplug the machine before untangling the cord.

8. When working with power tools keep in mind a few simple rules.
   A. Always ground three wire plugs to three-wire receptacle.
   B. Wear ear, eye, and respiratory protection.
   C. Watch out for people in the work area and pedestrians walking across floor areas.
   D. Read the owner's manual and NEVER operate these tools without proper training.

9. Facility management, particularly their inspection and maintenance, must be attended to regularly. Keeping these areas safe is one of the most important duties of both custodial and maintenance workers. Report all building maintenance problems to extension 4228 as soon as possible.

It also should be noted that you, the custodial worker are an essential player in providing a safe environment. Like many workers, you're asked often to do a difficult job with little in the way of recognition. We would like to change this by recognizing you for what you are. A vital and
strong link in providing safe and healthy facilities for students, the general public and all of us who use public facilities. Thank you for doing a great job!

13. Automotive Services:

People that work in an automotive repair shop know there are plenty of ways to cause themselves pain. There are greasy floors to slip on; hoses, lines, creepers to trip on; tires, tools and parts to fall on your head; and at least a million ways to skin knuckles, bash fingers and strain backs.

Of course, those are minor problems compared to battery explosions and gasoline fires that can and do occur around the repair shop. When you think about it, an auto repair shop can be a pretty hazardous place to work. That is just it. Many automotive technicians don't think about the hazards or they don't think about them enough. That is why auto repair facilities are high on the list of accidents and injuries to employees. At least 99.9 percent of all shop accidents can be prevented with just a bit of thought and knowledge by YOU.

The purpose of this guide is to remind you of the hazards that do exist and to help you do your job in a safe professional manner.

A. 12 Basic Shop Rules and Procedures

1. Wear proper clothing at all times. Dangling shop coats, loose sleeves and hanging neckties or jewelry have a habit of finding their way into the fan or other moving parts. Safety shoes are always a good idea.

2. Remove all jewelry and metal from your body before beginning work. Rings and watches have been the cause of many painful burns and even lost fingers and hands.

3. Keep your work area clean and keep your tools picked up. You won't be able to find the tool you need until you or someone else slips on it.

4. Don't leave anything lying around when you are working on a vehicle - especially a creeper. Keep the creeper under the vehicle or store it upright in the designated place when you are finished with it.

5. Never get underneath a vehicle that isn't properly supported by safety stands. This is still one of the most common fatal errors that results in many deaths every year.

6. Do not get underneath a vehicle that is running and don't crawl under when someone is working topside. Likewise, don't try to work on a vehicle when someone is underneath. Before crawling under, remove all tools and equipment from the engine and fenders.

7. Disconnect the battery ground cable before doing any engine or electrical work beyond simple diagnosis.
8. Always use the correct tools and equipment for the job. Know the correct procedure for the job before you begin. This will save a lot of time, headaches and embarrassment. Also, follow the manufacturer's recommended procedures when using any shop equipment or installing parts and accessories.

9. Always wear eye protection whenever there is any chance of danger to your eyes.

10. Give the job your full attention don't be distracted by what someone else is doing until you're finished with your job.

11. Do not choke an engine by placing your hand over the carburetor. Also, do not pour gasoline into the carburetor when the engine is being cranked. Instead, to start a car that does not have fuel in the carburetor, pour a small amount of gasoline into the carburetor, replace the air cleaner and then crank the engine. This procedure will prevent a fire or a burned hand.

12. Never run a vehicle inside the shop without hooking up the exhaust elimination system.

B. GASOLINE FIRE PREVENTION

Gasoline can be an ever-present hazard around the auto shop and service station. The problem is that gasoline is so much a part of automobiles and repair shops that most technicians and station attendants forget just how dangerous it really is. Consequently, gasoline is often handled carelessly and there are hundreds of gasoline fires and explosions every year.

The important fact to remember about gasoline is that liquid gasoline itself is not the real danger. The real danger is the gasoline vapors. So to avoid gasoline fires and explosions in the shop you have to prevent gasoline vapors from escaping. The vapors are heavier than air and settle in low spots along the floor - for example, in lubrication and alignment pits. A source of ignition such as a lighted match or cigarette, even an arc from an electric switch or motor, can ignite the gasoline vapors.

The vapors may be carried by air movement a considerable distance and ignited by a source such as a space heater or pilot light on a water heater. Avoid buildup of gasoline vapors in the shop, even if you think there are no sources of ignition.

Think of gasoline as being hazardous if not handled properly. If the energy in one gallon of gasoline could be utilized at one time, it would be powerful enough to lift the Empire State building off of its foundation. The rules for handling gasoline are simple:

1. The first rule is that gasoline should be used ONLY as a source of energy for a gasoline engine. It should never be used for any other purpose.

2. Never use gasoline to clean anything, including your hands. Kerosene, or high flash point
solvents designed for cleaning parts should always be used to clean parts and tools. Vaporized gasoline can ignite and flash back to the container you are using.

3. Clean up gasoline spills immediately. If gasoline is spilled inside the shop, open doors and windows to get plenty of ventilation. Avoid any type of fire or spark, including electric switches, until the vapors are dispersed. Small spills can be wiped up with rags, which then should be disposed of in an approved container. Large spills should be cleaned with absorbent sand, then thoroughly flushed with water. The sand is to be placed in a safety can for disposal.

4. If there is a large gasoline spill, such as at the gasoline pump island, shut off the emergency switch to cut electric power at the pumps. Call the local fire department by dialing 9-911, the University Police at 4239 and OES 4827. Do not flush gasoline into the street unless approved by the fire department.

5. Perform fuel system work only outside or in a well-ventilated area. When draining the carburetor or a fuel line, catch the gasoline in a container.

6. Gasoline soaked clothes should be removed immediately and allowed to dry away from any source of ignition.

7. Store gasoline only when absolutely necessary and only in an approved safety can.

8. Don't pour gasoline from one container to another without bonding of the two cans with a ground wire. This can generate a static charge sufficient to ignite the gasoline.

9. Finally, of course, never smoke around gasoline. Only smoke in approved smoking areas. Remember that gasoline can be dangerous if allowed to vaporize around any source of ignition, including appliance pilot lights and electric switches.

If you had a shop fire, would you know where the fire extinguishers are? Would you know how to use them? There's plenty of water around most shops, and water is fine for what is known as a Class A fire. A Class A fire is burning paper, rags and wood. But for gasoline fire, you'd have to have an extinguisher designed for flammable liquids, which are Class B fires. Your shop probably has an A-B-C or B-C rated extinguisher that can be used for combustible materials, flammable liquid and electrical fires. Take a minute to look at the extinguishers to be sure you know how to use them and what fires they can be used on. If you ever have to fight a gasoline fire, aim low at the base of the fire and stay with the fire until you are positive that it is out. Gasoline vapors can reignite very quickly if you don't get the fire thoroughly snuffed out.

The two most common fires you might encounter are a shop fire and a car fire. You can usually put out a small shop fire without much difficulty. However, always have someone call the fire department while you take an extinguisher to the fire. It's certainly better to have
the fire department arrive and find the fire already out than wait and have the fire get out of control before they can arrive.

The majority of car fires are under-hood electrical fires. The first rule in fighting them: Don't jerk the hood open. This just feeds more oxygen to the fire. Have an extinguisher ready and make sure it works. Slowly open the hood and put out the fire. If you don't have an A-B-C or B-C extinguisher, you may be able to use a blanket or a fender cover to carefully smother the flames. But be careful of burning Ignition wires; never try to rip them out with your hands.

C. LIFTING

Lifting heavy parts and equipment is a regular part of shop activity. Probably the most common and often the most painful injuries around the auto shop result from improper lifting and straining. The best way to avoid them is to use your head instead of your back.

If you're lifting something heavy, get help. If you're straining on a bolt or nut get a longer wrench or breaker bar to give you better leverage. Don't try to muscle a stuck fastener. Penetrating solvent and the right tool save time and your back.

The best method for lifting is to lift with your legs, not your back.

Some common "back breakers" to be avoided:

- Don't bend over to lift a battery. Squat and use a battery carrying strap; this also protects you from the battery acid.
- Don't try to push a car by yourself.
- Don't raise or lower a wheel when the car is on a fully raised hoist. Bring the car down to your level-then use your leg to help lift the wheel to the car.
- When trying to loosen a tight bolt or nut inside the engine compartment, don't lean over the fender so that you are on your tiptoes and straining on the wrench. If the wrench or your feet slip, you've had it stand on a stable work stool to get better leverage.

Rules To Remember Are as Follows:

1. Place one foot alongside the load and the other just behind it.

2. Bend your legs into a squat position with the forward knee up and the other horizontal with the floor. One foot flat on the floor the other bent with toes on floor.
3. Grasp the load with the palmer grip - the whole hand, not just the fingers.

4. Tuck in your chin and keep your spine straight, but that does not mean vertical. Maintain the natural curves when lifting.

5. Draw the load close and lift with your legs, thrusting first with the rear foot. Never jerk the load when lifting, use a good steady lift.

6. Lift load to a standing position. Never carry a load that requires you to stoop.

7. Shift your feet when turning, never twist your body.

D. KEEP YOUR AREA CLEAN

A clean work area is safer, a more pleasant place to work and instills customer confidence. All agency personnel need to be treated as a customer in a private business would be treated. Customer confidence is especially important today when a car owner expects professional automotive care from a technician. When he sees your tools and equipment clean and neatly organized, the customer will think he's getting the care the vehicle deserves.

Keeping a clean area begins with general good housekeeping. Some tips are:

1. Clean up grease and oil spills on the floor immediately. using a cloth or sprinkling and sweeping up an oil-absorbent compound. Always pick up removed and discarded parts and components as soon as you are finished with the job. This alone will eliminate a large majority of shop accidents which are the slip and trip variety.

2. Don't leave tools lying around on the floor and always store creepers when not in use. This is especially important because you are usually the one who trips over your own equipment.

3. Also, keep your workbench neatly arranged and keep tools and parts away from bench edges where they can be knocked-off onto your toes.

4. Always place oily rags and waste materials in the proper covered container.

5. Gasoline spills are especially bad because they are both a fire hazard and a slipping hazard. Do not use sweeping Compounds on gas spills. Compounds work as a wick and speed vaporization into the flammable range.

6. Make a practice of cleaning and arranging your work area every evening.
E. TOOLS OF THE TRADE

The tools of the trade for the automotive technician are, in fact, tools. You can tell a real professional by his tools and his hands. His tools are clean and in top condition, and his hands do not have bashed knuckles and gashed fingers.

To prevent injuries from tools, you should check your tools carefully when cleaning them, and immediately replace or dress tools that have any defects such as:

1. Box ends, open ends and sockets that are cracked or rounded.
2. Slipping socket wrench ratchets.
3. Screwdrivers with broken handles.
4. Worn adjustable wrenches.
5. Hammers with cracked handles or loose heads.
6. Cold chisels with mushroomed heads.
7. Files without handles.

Using the right tool for the job is the key to getting the job done with the least pain. Think about what you need when you start the job. And if it works out that you need a different tool, get it—even if it means crawling back out from underneath a car. The right tool always saves time and trouble in the end. Think about it. How many times has trying to do the job with the wrong tool really saved time?

In addition to using the right tool, there are other rules of tool usage that are sometimes overlooked.

You should make sure the tool is clean. You know what happens when a wrench slips. Clean the tool after each use.

It is sometimes necessary to clean off the bolt or nut being worked on. Pull on the wrench instead of pushing: this gives better control and protects against bashed hands.

Don't try to muscle off a stuck fastener.

Penetrating solvent and the right wrench, breaker bar or swivel will prevent a strained back or a sheared bolt—which could cause even more pain.

Use a box-end or socket whenever possible. They grip all sides of the nut and are less likely to slip.

Adjustable wrenches should be used only when absolutely necessary.
Don't try to use a conventional wrench on a rounded-off fastener. Stick with vise grips that give a good grip on the nut.

Never use standard sockets on in impact tool because they can shatter. Always use impact sockets.

Injuries involving screwdrivers can be avoided by:

1. fitting the screwdriver blade squarely in the center of the slot before applying pressure;
2. guarding against your hand striking an object if the screw-driver slips;
3. keeping your free hand and other parts of your body away from the direction in which pressure is being applied;
4. do not use broken or bent screwdrivers.

One last thing, don't carry tools around in your pockets-especially pointed tools such as punches and screwdrivers. These can go right into your leg or kidney area if you slip and fall.

F. POWER TOOLS

The use of hydraulic, electric and air-operated power tools is becoming more common in auto repair facilities. Power tools such as pneumatic wrenches are vary handy because of their speed. However, they offer a lot of potential for accidents. Here are some common sense rules that will help prevent any problems with power devices:

1. With electrically operated tools, be sure they are properly grounded. Check to be sure the cables are in good condition and the insulation is not cracked. If the tool case is damaged, don't use it. If the grounding prong on the plug is damaged, repair or replace the equipment at once. A proper ground is your protection against possible electrocution.

2. Do not use more extension cords than necessary-use the electric outlet nearest the work area. Don't string electric cords across pathways.

3. Do not use electric tools near water—even a slightly damp floor is dangerous.

4. Know exactly what you are doing when you use a power tool. Concentrate on the job. Also, never surprise anyone who is using a power tool.

5. Eye and face injuries are common in repair shops because many
technicians don't use eye protection. Always protect your eyes from debris when cutting, grinding or polishing.

6. Make sure machine guards are correctly positioned and use them.

G. COMPRESSED AIR

A very common source of injury is the improper use of compressed air. Two of the most common bad practices are the use of an air hose to blow dirt off clothing or parts of the body and to spin-dry bearings.

Using an air gun to blow dirt off clothing or parts of the body is very dangerous because foreign matter may be forced into your eyes or skin.

Using compressed air to spin-dry bearings is extremely hazardous. If you spin a wheel bearing with 30 PSI, you are spinning it 10 times faster than it would ever rotate inside the hub. This can cause the bearing to shatter and fly apart like shrapnel. Bearings should be cleaned in solvent and placed on a clean shop towel to air-dry.

Avoid using compressed air to blow anything clean if you can. If you use air, wear eye protection and a respirator to prevent inhaling small particles. Whenever possible, use a solvent wash or vacuum instead of blowing parts clean.

Do not use compressed air to clean brake parts when performing a brake job. Because of the potential of harmful asbestos or metal dust, always use a washer or vacuum to clean - brake assemblies.

H. JACK SAFETY

When a vehicle is raised off the floor, there is always potential for danger. Jacking up a car and working under a raised car is where many technicians continue to be careless. These basic rules for raising vehicles should be followed:

1. Use the proper jack for the job and follow the jack manufacture's instructions.

2. Never get under a vehicle that is supported only by a jack. Secure the vehicle with safety stands of proper capacity as quickly as possible. Slowly lower the vehicle so it is fully supported on the stands. Leave the jack in place for added support.

3. Use proper lift points when raising a vehicle with a hydraulic jack. Correct lift points are normally shown in the vehicle service manual. Do not lift on the oil pan or any steering system components.
4. With the roll-around type of hydraulic jack, the vehicle must be left out of gear with the parking brake off. Leaving the brake on when lifting With these jacks is a common error that frequently results in a car failing off the jack.

5. When raising a vehicle with any jacks—especially a hydraulic jack—check the stability of the vehicle several times on the way up.

6. If you must use an original equipment bumper jack to raise a vehicle, be sure to use the specified lift point. Also, be sure that the jack is stable. Even when changing a tire with a bumper-jack, it is best to get a jack stand or support under the vehicle.

I. DRIVING VEHICLES

One potential hazard around the shop is simply moving vehicles. Be extremely careful when moving vehicles and never travel faster than 5 m.p.h. Check for tools and other equipment before driving a vehicle. Walk around it to be sure.

When test driving a vehicle or even riding in one, wear the safety belt. Use proper caution when driving all types of vehicles.

J. FUELING STATION

As part of your servicing and maintenance of vehicles will require you to dispense fuel. Here are some things to keep in mind when performing gasoline service:

1. because of the fire hazard, obey the law and do not pump fuel with the engine running. Do not smoke or allow smoking anywhere near gasoline pumps.

2. Do not block open the gasoline nozzle with the gas cap or any other device. This is asking for an overflow., the automatic shut-off has a purpose.

3. Always keep body and face away from filler neck to prevent getting doused by an overflow.

4. Avoid overflows by dispensing gasoline slowly to allow air pressure to escape.

5. Drain all gasoline from nozzle before returning to pump.

6. Hang hose back on pump carefully to avoid loops or twists that could catch car bumper when the car pulls away.
7. Remember that the law prohibits the dispensing of gasoline into any container except a properly labeled gasoline container.

8. Take extra precautions when fueling vehicles with compressed gases due to the high pressure and very cold temperatures. Contact with gaseous fuels can destroy or burn flesh severely.

K. WINDSHIELD SERVICE

When cleaning windshields and lights, check for cracks in the glass and lenses. Report the damage immediately and take care not to cut yourself on slivers of glass that might be present.

When cleaning windows, never place your hand in an open door jamb. The door may slam shut on your hand.

L. UNDER - HOOD CHECKS

The first thing a vehicle service technician should remember in making under the hood checks is to be sure the hood is secured in a raised position.

Never perform and under - hood service, such as checking oil, belts or battery, the engine running.

Be cautious of hot manifolds and other engine parts when working under the hood.

Be sure the hood is properly closed and latched. Double-check the latch to prevent the hood from flying up to blind the driver when they drive off.

M. RADIATOR

Working on the radiator and other components of the cooling system of a vehicle present a hazard to the service mechanic in many ways. The following are some tips to avoid burn and chemical injuries.

1. Never work on a cooling system that is hot. The typical coolant is approximately 180 degrees F. This can cause severe burns.

2. Never open the radiator cap to a system that has overheated. Allow the vehicle to cool and then remove the cap slowly. The contents of the cooling system are under pressure.

3. Never add water or coolant to a system that has been or is running unless the system is cool. If the cold water or coolant encounters extremely hot engine components, this will cause steam to spray out of the system.
4. Always wear goggles and gloves when handling coolants to avoid getting the chemicals into your eyes or on your skin.

5. In the event of contamination of the skin with coolant, wash your skin immediately with soap and water. Contaminated clothing should be removed. Seek immediate medical attention.

**N. Tire Pressure**

To check tire pressure, be sure the engine is off and the parking brake is on. If the valve stems are hidden under the fender or behind the fender skirts, do not search for them - this is a good way to gash your hand.

Have the driver move the vehicle until the valves are accessible.

When inflating a tire, turn your face and body away from the tire to protect yourself in the event the tire explodes.

**Truck Tires**

Precautions are necessary when inflating truck tires. Never inflate a truck tire that is flat, or when the lock ring is unseated. If either condition is present, the tire should be removed and serviced.

**O. Tire Changing**

One of the greatest potentials for serious injury and even death is in mounting and demounting tires. It is essential that you fully realize the potential power of compressed air when working with tires. Always observe all precautions when deflating and inflating tires. Know the correct procedures for the tire changing machine in your shop and follow all operating instructions. The following list of tips for tire changing applies to all tires and should always be observed.

Tips for Tire Changing:

1. Follow the manufacturer's procedures and cautions for the type of tire changer you are using

2. Respect the potential power and explosive force of air under pressure. Serious accidents result from lack of awareness of the danger of compressed air.

3. Make sure all tools are in good condition not damaged, dented or deformed.

4. Always remove the valve core to exhaust all air from the tire (or tires, in the case of a dual assembly), before Remounting. Probe the valve stem with a wire as a final
check to make sure the valve is not plugged.

5. Don't loosen lug nuts on duals until all air is exhausted from both tires. A broken or cracked rim part under pressure could blow apart and seriously injure or kill if lugs are removed before air is exhausted.

6. Never apply heat or do repair work on a rim with a tire mounted on it. Heat can increase air pressure to a level sufficient to burst the tire or rim.

7. Always block vehicle so it cannot roll forward or backward after it is jacked up.

8. Always place safety stands under the vehicle.

9. Don't reinflate a tire that has been run flat or seriously underinflated without demounting the tire and checking it and the tube for damage.

10. Always clean and inspect used rim parts thoroughly. Don't mix rim parts of different manufacturers unless such use is approved by those manufacturers. Don't attempt, under any circumstances, to rework, weld, heat or braze rim parts. Replace damaged parts with the same size, type and make.

11. Always use new tubes and new flaps in new tires.

12. Don't use a tube in a tire larger or smaller than that for which the tube was designed.

13. Inspect the inside of the tire for loose cords, cuts, penetrating objects or other carcass damage. Remove dirt, debris and liquids from inside of the tire before tube is installed.

14. Lubricate with approved rubber lubricant, such as thin vegetable oil soap solution or commercial lubricant. Use a clip-on chuck and extension hose with remote control valve and pressure gauge, long enough to allow you to stand to one side during inflation.

15. Securely lock the wheel down, or place the assembly in a safety cage or portable safety device before attempting to inflate the tire to seat beads.

16. Don't inflate beyond recommended bead seating pressure. Don't stand over tire while inflating.

17. Adjust air pressure to manufacturer's recommended cold operating pressure after beads have been seated.

18. Inspect valve cores for proper air retention. Replace damaged or leaky cores.
P. Tire Lifting Procedure

1. Raise hoist until axle is at belt level.
2. Remove lugs bolts from wheel. Pull tire off lugs with tire supported on leg. Roll it off leg and guide to the floor.
3. Never carry the tire to the changer. Always roll it.
4. Place tire in front of you with outside of the wheel facing the changer.
5. Reach over the tire and grasp the center hole on the outside of the wheel. Lean tire back against leg just above the knee.
6. Pull tire up from center hole against leg support and swing outer rim upward.
7. Rest inside of the wheel on the center post of the tire changer.
8. Place wheel on changer by pushing forward with leg and lifting with hands.
9. Reverse the procedure to remove the tire from the changer. Lift with hands, slide onto leg, roll to the floor.
10. Roll the tire and wheel to the car. Do not carry.
11. Position outside of tire toward car, reach over top center to center hole, using leg as rest.
12. With tire supported on leg, rotate upward and slip on lugs.

Q. Changing Truck Tires

Because of the numerous types of multi-piece truck tire rim assemblies, it is essential to consult the rim manufacturer's manual or a similar source for the correct demounting and mounting procedure for each type of rim. When working on truck tires, all of the standard safety precautions given previously apply. However it is especially critical to follow proper procedures to prevent lock rings from coming loose when Inflating truck tires. Always inflate truck tires in a safety cage to protect yourself from flying lock rings.

R. WHEEL BALANCING

Wheel balancing is a regular part of the tire service performed in most shops. As with all other shop procedures, doing the job correctly insures a safe, properly completed job. There are three general types of balancers in common use in most shops. The general safety procedures for each type are summarized below:
Bubble Balancer

Injuries occurring as a result of using the bubble balancer are generally back injuries caused by improper lifting. A good procedure to follow for placing a tire and wheel on the balancer is as follows:

1. With the tire in a vertical position, squat and grab the tire with both hands. Rise to a standing position and rest the tire on your knee.

2. Use your leg and arm muscles to place the tire on the balancer. After the weight has been marked on the face of the tire, turn the balancer handle to the OFF position. With little exertion the tire can be tilted and the bottom weights tapped into place.

On-Car Type Balancer

Fasten balancing mechanism securely to wheel and try to pull mechanism off by hand before spinning tire. Place jacks firmly in position under the front of the vehicle so the wheels can spin about two inches off the ground. Keep arms, legs, and clothing away from spinning wheels. Do not use balancer on rear of car. Mount rear tires on front of car to balance. Damage may result to some differentials when balancing rear wheels.

Off-Car Spin Balancer

Follow general safe lifting procedures given for bubble balancer when placing wheel on machine. Use correct adapter as specified by balancer manufacturer. Remove old wheel weights and clean all debris from tire tread before spinning wheel. Always lower safety guard and lock into place before spinning wheel.

S. LUBRICATION

The lube bay is the site of numerous minor but painful injuries such as slips, banged fingers and bumps. The following information on lube bay service should help prevent some of the usual problems:

Using the Hoist

Hoists can drop because of inadequate inspection and service. Be sure the hoist is in good operating condition and safety devices are operable.

If the hoist is to be partially lowered to work on a car, lower the hoist past the level you want and then raise it to the stiff leg level. This device will prevent slow creep or dropping of the hoist.

Operate the hoist by holding the control valve in position with your hand. Never block the control valve open or shut or leave it unattended.
Raising the Car

You should always drive the car onto the hoist. If you are guiding any other driver, stand to one side when giving signals-never stand directly in front of the car.

After the car is in position over the hoist:

(1) Stop engine.

(2) Place car in neutral.

(3) Place adapters in position, at the same time checking that wheels are of equal distance from the rails and center of car's weight is directly over hoist's lifting cylinder.

(4) Raise hoist so that wheels are one inch from the floor.

(5) Check to see that adapters are set accurately or that frame contact hoist is making firm contact with care underbody.

(6) Do not permit passengers or pets to remain in the car while it is being raised.

General Rules

The lube bay should always be kept neat. Do not allow the floor to become littered with tools, buckets, grease guns, oil spills, etc. Return items to their proper places and clean up oil spots. Regularly clean the lube floor to eliminate fire hazard. Always be aware of your footing, the floor can be slippery. Tools or equipment should not be left on the hoist. A hammer, socket wrench, grease gun, or oil can falling from a height of five or six feet can easily cause a painful injury. To prevent foreign particles from falling into your eyes, do not stand directly below the part of the car on which you are working. You can never go wrong by wearing goggles or a face shield.

T. BATTERY SERVICE

The battery is potentially one of the most dangerous items around the auto shop. Batteries normally give off explosive hydrogen gas - especially when being charged - that can be ignited by a flame or a spark. Battery electrolyte is an acid solution that can cause damage to eyes and skin, as well as to clothing. The primary rule in handling batteries is to avoid smoking or any chance of ignition from a spark or open flame.

Other important rules for handling batteries are:

(1) Rings, Identification bracelets and watches should never be worn because of the danger of burns. Rings or watches can complete circuits between terminals, or
between positive post and the car frame, causing a heavy flow of current. This current can heat a ring to a high temperature almost instantaneously, causing a severe burn.

(2) Chemical goggles and neoprene gloves should always be worn when performing battery service.

(3) Stand at arm's length when removing battery caps.

(4) If you get acid or battery corrosion on your skin, wash the area thoroughly. If you get acid in your eyes, they should be washed with water for 15 minutes and you should immediately consult a physician.

Battery Charging

(1) Follow charger manufacture's procedures for setting charging rate and time.

(2) Remove battery caps and adjust fluid level. Be sure that vent holes in caps tire open.

(3) To prevent sparks, connect and disconnect charger clips only With charger In OFF position.

(4) Use charger only in a well-ventilated area, or in a room designed for battery charging.

Jumper Cable Use

To minimize battery explosion hazards and prevent damage to the alternator. the following jump start sequence should be used:

(1) Make sure the vehicles are not touching. Set the parking brakes and put the transmission in Park or Neutral. Turn off all electrical loads.

(2) Check to -be sure battery electrolyte is not frozen. Never try to jump a frozen battery.

(3) Connect positive jumper cable to terminal of the discharged battery. Connect other end of positive cable to positive terminal of booster battery.

(4) Connect negative jumper cable to negative terminal of booster battery, then to prevent a spark near the battery, connect the negative cable to a good ground on engine of disabled car. Avoid making connection near the discharged battery.

(5) Start the disabled car's engine.

(6) Remove the Jumper cables in the following sequence:

♦ Negative cable from engine-.
Negative cable from negative terminal of booster battery;
Positive cable from booster battery;
Positive cable from battery of disabled car.

Additional Jump Start Cautions

♦ Do not use a power source exceeding 12 volts for a 12-volt battery, or 6 volts for a 6-volt system.
♦ Always double check the polarity before trying to start the disabled car.
♦ Do not lean over batteries when making connections. Keep head and body away as much as possible in case of a battery explosion.

Filling Dry-Charge Batteries

(1) Never fill a battery with electrolyte in the car.
(2) The battery should be placed on the floor when it is filled with electrolyte to prevent the acid from getting on you or your work area.
(3) An eyewash facility should be in the vicinity of battery filling and charging operations.
(4) Always wear protective chemical goggles or a face shield and gloves when filling the battery.
(5) Properly dispose of left-over electrolyte.

U. WELDING OR CUTTING

Another source of ignition and potential explosion hazard is in welding or cutting. When done incorrectly, or when the tanks are handled carelessly, gas welding is extremely dangerous.

The following precautions should be strictly followed:

(1) Never use valve protection caps for lifting cylinders.
(2) Cylinders must never be used as rollers or support for machinery.
(3) Keep cylinders from being knocked over while in use.
(4) Keep cylinders far enough away from welding or cutting so that sparks cannot reach...
them. Avoid rough handling of cylinders, which may damage the fuse plugs and allow gas to escape.

(5) Always leave the space between the cylinders and the job clear, so the valve can be reached quickly in an emergency. Always have a spanner wrench available for emergency shutoff.

(6) Regulators should always be attached to cylinder tanks to obtain a safe working pressure. Do not interchange regulators.

(7) Open valves slowly. Open acetylene valve a maximum of one and one-half turns.

(8) Never use more than 15 pounds pressure.

(9) Close the cylinder valve when you have finished and open the blow pipe valve to drain the hose and the regulator of excess gas and pressure.

(10) Always close cylinder when work is finished. Do not turn off only torch controls because of the possibility of leaky fittings.

(11) Use soapy water to test for leaks around valves and fittings. Under no circumstances use a lighted match.

(12) Never open an acetylene cylinder near any source of ignition.

(13) Keep your hands and all equipment and fittings free of grease and oil. Oil can ignite violently in the presence of oxygen.

(14) Do not apply too much pressure in hooking up a torch. Always use correct amount of gas for welding tip.

(15) Always wear welding goggles or helmet when welding or watching the operation.

(16) Light a torch only with a friction lighter.

V. PARTS CLEANING

Although an approved solvent is much safer than gasoline for cleaning parts, some caution is required. Solvents can cause skin irritation and vapors may be harmful if breathed excessively. The following cautions should be observed when cleaning parts:

(1) Clean parts only in the solvent dip tank; do not store solvent in your work area.

(2) Wear protective gloves and an apron to keep solvent from getting on exposed skin. Wash hands and arms with soap and water when finished at the dip tank.
(3) Avoid breathing solvent vapors. A respirator and face shield should be used when washing parts with a pressurized spray.

(4) Keep dip tank closed when not in use.

**W. BRAKE JOBS.**

A hazard around the shop is breathing asbestos dust from the brake shoes. Even metal brake shoes can produce respirable dust. Steps need to be taken to prevent respiration of dust from brake assemblies.

When cleaning the wheel area, you should use a HEPA equipped vacuum or a solvent washer rather than compressed air to clean away accumulated brake dust. It is also wise to wear an approved respirator. Contact the Environmental Safety Coordinator for the correct respirator.

A frequently ignored precaution when working on brakes is eye protection. However, safety glasses are essential when removing and installing return springs on drum brakes.

**X. EXHAUST SYSTEM WORK**

Automobiles have always provided many ways to be burned. However, the vehicles equipped with catalytic converters present a greater risk. The converters operate at temperatures above 600 degrees Fahrenheit, which presents a serious hazard to anyone working on exhaust systems.

The rule of letting the vehicle cool completely before working on it should prevent any difficulties—even with the catalytic converter.

Gloves are always a good idea, to avoid cuts as well as bums, while working under a car. Also, because of the high temperature of the converter, care should be used not to park a hot vehicle over flammable material.

**Y. TUNE-UP SERVICE**

Doing tune-ups is one of the most common tasks around the average shop. A good tune-up technician knows the tricks to make the job go easily, such as using the right spark plug wrench and extensions. However, two valuable little tools that are often overlooked by the technician are a spark plug wire puller and plug starting tool.

These items make life easier by preventing the common burns that occur when trying to remove plug wires, and when trying to start plugs in hard to reach locations on engines with recessed plugs.

Another recent aspect of the tune-up service is the wider use of electronic test equipment.
The chief danger to look out for when using a scope is to hook the leads carefully. You don't want to trip over the leads or get them caught in the engine fan.

Also, with today's cars having higher energy ignition systems, it is more important than ever to know what you are doing. Remember that higher energy ignitions pack a bigger wallop than older systems and can really jolt you - which can cause you to jump and bang your head or startle you into a slip and fall or get caught in a moving part.

Z. REPLACING FAN BELTS

Prior to the replacement of the fan belt, remove the ground -cable from the battery. Serious injuries from the fan have occurred when the engine is started unexpectedly. Never try to run a belt onto a pulley by using the engine starter. Instead, be certain you have the correct size belt and loosen the components as much as possible to ease installation. A folded rag looped around a belt is an easy and safe way to pulling a belt over the pulleys.

AA. INSTALLING LAMP BULBS AND FUSES

To prevent injury from broken glass when installing bulbs, lamp bulb pliers should be used for small size lamps. If the bulb is inaccessible for removal with pliers, place a folded shop towel around the bulb and break the bulb inside the rag. Then, remove the base of the bulb with a screwdriver. Always be careful of broken glass when replacing headlamps.

Use a non-conductive fuse puller or disconnect the negative battery cable when removing a fuse. Prying one out of the clip with a screwdriver can bring on a shocking and often painful surprise.

BB. PARTS AND ACCESSORIES

When installing any parts or accessories, follow the manufacturer's procedures and cautions that are printed on the box or instruction sheet. The manufacturer puts the information there for a reason.