

Overview

Spreading a safe culture to everybody in the shop is important to the Highlanders. Everywhere in the shop safety should be enforced to keep an environment of safety. This manual should be used to help create, maintain, and reinforce a safe work environment.

The Importance of Training and Spreading Safety

Training plays a role in developing a strong safety culture in which employees promote safe procedures in the workplace. Another important benefit of regularly-scheduled safety training is the reminder of job-related hazards and how to prevent injuries

Everybody plays an important role in safety training. Therefore everybody should play a role in modeling safety to others rather than appointing one person. Specific responsibilities of anybody working in the shop should include: (note some of these should be done only by someone on the safety team)

1. Encouraging a safe work culture by modeling and enforcing safe work practices
2. Completing periodic (quarterly as best practice, semi-annual at a minimum), inspections of shops under their direction
3. Developing safe work procedures, including standard operating procedures (SOP) and job safety analyses (JSA). (SOP/JSA are essential training tools that communicate hazards and corresponding safe work practices.)
4. Providing appropriate safety training and personal protective equipment to employees under their supervision.
5. Documenting employee training and departmental safety activities.

The resources to training safety and becoming advanced in safety are endless and should be utilized to achieve a safe environment in the Highlanders shop.

Hazards:

Hazards are a real threat to your wellbeing and precautions should be taken to avoid any injury. Below is a list of potential hazards and their sources:

POTENTIAL HAZARDS	HAZARD SOURCES
Physical:	Physical:
Compressed air/gases	Oxygen, acetylene, air
High pressure fluids	Hydraulics
Flying debris	Grinders, saws, power tools
Noise	Any power tool
Pinching, cutting, amputation	Grinders, saws, vises, power tools, hand tools
Slipping, tripping	Spilled oil, electrical cords, oil, etc.

Dust	Sanding, grinding
UV radiation	Welding
Electrical:	Electrical:
Overload	Too many cords per outlet
Fire	Frayed, damaged cords
Shock	Ungrounded tools, equipment
Fire:	Fire:
Flammable chemicals	Gasoline, degreasers, paint thinners, etc.
Sparks	Welders, grinders
Static sparks	Ungrounded tools or solvent containers
Uncontrolled fire	Lack of appropriate fire extinguishers
Chemical:	Chemical:
Toxic liquids	Cleaning solvents, degreasers, etc.
Toxic fumes, gases, dusts	Welding, motor exhaust, etc.

It is not possible to detail all the risks involved with shop work. However, it is possible to foresee many hazards by carefully planning each job. To prevent accidents, utilize your knowledge, training, and common sense. Evaluate potential sources of injury, and attempt to eliminate any hazards.

Ergonomics and Materials Handling

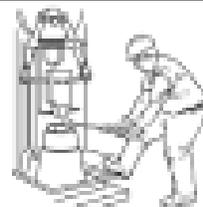
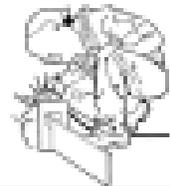
This section goes over designing your work area and completing tasks in a way that makes your job more efficient and comfortable. Ergonomics and proper materials handling techniques make your job safer and help to prevent injuries.

Ergonomics focuses on how your work affects your physical well-being. It is the science of matching the job to the right person to improve efficiency and to reduce the risk of discomfort or injury. Ergonomic changes can include restructuring or changing the work environment or modifying a task by using tools or different procedures. In the area of materials handling, ergonomic interventions can include training in back safety, reducing the weight of objects lifted, using mechanical lifting devices, or changing the height of a pallet or shelf.

The goal of ergonomics is to reduce your exposure to work hazards. A hazard is defined as a physical factor within your work environment that can harm your body. Ergonomic hazards include working in awkward or uncomfortable postures and using excessive force or high repetition.

WORK SMARTER, NOT HARDER

Table 3.1 – High-risk Postures

	<p>Working with hands above the head, or with the elbows above the shoulders for prolonged periods without frequent breaks</p>
	<p>Working with the neck bent more than 45° without support or frequent posture changes for prolonged periods</p>
	<p>Working with the back bent forward without support or frequent posture changes</p>
	<p>Squatting or kneeling to work repetitively or for prolonged periods</p>

Also avoid forceful exertions which include high hand forces, contact pressure, and high forces.

Before lifting an object, assess the situation by asking yourself the following questions:

- Can you lift this load safely, or is it a two-person lift?
- How far will you have to carry the load?
- Is the path clear of clutter, cords, slippery areas, overhangs, stairs, curbs or uneven surfaces?
- Will you encounter closed doors that need to be opened?
- Once the load is lifted, will it block your view?
- Can the load be broken down into smaller parts?
- Would gloves improve your grip or protect your hands?

Size up the load

- Test the weight by lifting one of the corners. Stop lifting if it is too heavy or difficult to handle.
- Consider asking for help from fellow workers.
- Break down the load into smaller parts.
- Use a mechanical lift or a hand truck.

Lifting

Before lifting an object, assess the situation by asking yourself the following questions:

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- Once the load is lifted, will it block your view?
- Can the load be broken down into smaller parts?
- Would gloves improve your grip or protect your hands?

Size up the load

- Test the weight by lifting one of the corners. Stop lifting if it is too heavy or difficult to handle.
- Consider asking for help from fellow workers.
- Break down the load into smaller parts.
- Use a mechanical lift or a hand truck.

Make sure to use proper lifting and use your legs not your back to lift.

Machine and Tool Safety

Safe work practices in shops are critical to preventing work-related injuries. Safety must become second nature to you. Crushed hands and arms, severed fingers, and blindness can occur when shop work is done carelessly. Machine parts, functions, or processes that may cause injury must always be controlled or eliminated whenever possible.

Never use machinery without proper training or appropriate guards. Ask your supervisor for training if you do not know how to use a piece of machinery or a power tool.

Stay alert when working, and keep others at a safe distance when using a machine. If you see a co-worker having difficulty working (e.g., from being over-medicated, ill, or excessively tired), let your supervisor know so they can take care of the situation.

Always use lock out/tag out procedures when inspecting or repairing machines. And make sure you report any equipment that is unsafe or needs repair.

Machinery Safety Guidelines

1. Get trained before using machines.
2. Follow instruction manuals.
3. Select the appropriate machine/tool for the job.
4. Use required PPE and guards.
5. Set up before starting. Change dull blades, clamp work, and secure bits, and remove chuck keys.
6. Make sure operating controls are clearly labeled and easy to reach.
7. Turn off machinery when unattended.

Table Saw Safety Tips

1. Set blade height maximum $\frac{1}{4}$ " (6mm) above stock. This ensures that if your hand slips, you will get a slight cut rather than lose a limb.
2. Position guides.
3. Make sure tabletop is smooth and polished. Dirty, rough tables require extra force to push the stock through the blade. This can increase your chance of slipping or losing your balance.
4. Stand balanced and avoid awkward movements to avoid falling into the blade.
5. Select seasoned, dry, flat wood for cutting.
6. Check stock for nails, knots screw, stones, etc. These items can become projectiles and cause injury.
7. Release work only after it has gone past the blade.
8. Use a push stick to cut stock that less than 6" (150 mm) wide.
9. Make sure that the blade has stopped turning before you adjust the table.
10. Do not leave the saw until the blade has come to a complete stop.

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Band Saw Safety Tips

1. Clear tools, debris, and unnecessary materials off table.
2. Verify location of on/off switch and emergency power disconnect.
3. Check blade for tightness.
4. Adjust the blade guard as close as possible to the table without interfering with movement of the stock.
5. Adjust the travel guard down so that the blade will travel within the angle or channel.
6. Operate at manufacturer's recommended speed.
7. Cut only those materials recommended for use with the machine.
8. Do not force material into the blade.
9. Unplug power cord before changing blade or servicing.
10. Lock power disconnect in "off" position when changing the blade or servicing the saw.
11. Test the saw after disconnecting power and before beginning service.

Drill Press Safety Tips

1. Select round, hex, or triangular shank bits.
2. Secure bits and remove chuck before turning on machine.
3. Work at speed appropriate for bit size and material.
4. Position work to avoid drilling into table.
5. Clamp work to table.
6. Feed bit evenly into work piece.
7. Back out of deep holes.
8. Clear off chips with brush after turning off machine.
9. Never hold work piece by hand.
10. Always clamp sheet metal to table before drilling.

Bench and Pedestal Grinder Safety Tips

1. Stand to the side of the grinder when starting the electric motor.
2. Use the correct wheel for the material you are grinding, polishing, or buffing.
3. Adjust the tool rest as close as possible to the grinding wheel without touching it. It must have a gap of between $\frac{1}{16}$ and $\frac{1}{4}$ inches.
4. Keep the face of the abrasive wheel square. Use a dressing tool to remove some of the abrasive compound to square the wheel.
5. Never grind on the side of the wheel. This can cause the wheel to shatter.
6. Avoid overheating metal when grinding. If the metal becomes too hot and is allowed to cool too slowly, it may become soft. If it is cooled too quickly (quenched), it may become brittle.
7. Dip the metal into the water pot attached to the bottom of the grinder as you shape it to keep it from getting too hot.
8. If your grinder does not have a water pot, place a container of water near the grinder to cool the piece you are grinding.

Milling Machine Safety Tips

1. Keep area around machine clear of debris; wipe up any oil on the floor.
2. Clean and dry the table before setting up.
3. Secure any holding devices (e.g., vise, angle plate, dividing head, or tail stock).
4. Select the right kind of cutter for the job.
5. Check to make sure that the machine is turned off before inserting the cutter.
6. Make sure that the arbor, cutter, and collars are clean before mounting them in the spindle.
7. Handle sharp cutters with a rag.
8. Securely set the work piece in the vise with a rubber hammer or mallet.
9. Be certain that the holding device clears the arbor and the over-arm supports.
10. Select the proper cutting speed, rpm, and rate of feed for the job.
11. Disengage the control handles when using automatic feeds.
12. Keep hands away from the revolving cutter at all times.
13. Never touch the metal chips with your fingers. Clear chips away from the cutter with a brush. After cutting is finished, vacuum or sweep debris rather than blowing with an air hose.
14. Release any automatic feeds after the job is complete.
15. Clean and wipe the machine when finished.

Safety Guidelines for Electrical Tools

1. Inspect cords for defects such as cracks, frays, and other signs of wear or faults in the cord insulation.
2. Use properly grounded tools with three-prong plugs and double insulation.
3. Inspect the plug for cracks and for missing, loose, or faulty prongs.
4. Use manufacturer recommended guards and shields.
5. Switch off tools before connecting them to a power supply.
6. Disconnect the power supply before making adjustments or changing accessories.
7. During use, keep power cords clear of tools and away from the path that the tool will take.
8. Use approved extension cords that have the proper wire size (gauge) for the length of cord and power requirements of the electric tool that you are using.
9. Use appropriate PPE for the work you are doing. This may include items such as safety glasses or goggles, hearing protection, dust mask, gloves, safety boots or shoes, or rubber boots.

Hand Tool Safety Tips

1. Keep knife and saw blades sharpened.
2. Direct blades away from other workers in the work area.
3. Replace wrenches when jaws are worn and begin to slip.
4. Replace tools with splintered handles, cracked blades, or any other defect.
5. Use tools for their intended use only.

Basic Safety Guidelines

1. Keep all tools in good condition with regular maintenance.
2. Use the right tool for the job.
3. Examine each tool for damage before use.
4. Operate tools according to the manufacturer's instructions.
5. Use the appropriate PPE for any existing hazards such as dust, fumes, mists, vapors, or gases.

Safety Guidelines for Pneumatic Tools

1. Review the manufacturer's instructions before using a tool.
2. Wear safety glasses or a face shield and, where necessary, safety shoes or boots and hearing protection.
3. Make sure air hoses do not present a tripping hazard.
4. Never point a compressed air gun at another person.
5. Use the recommended air pressure for the task.
6. Post warning signs where pneumatic tools are used. Set up screens or shields in areas where nearby workers may be exposed to flying fragments, chips, dust, and excessive noise.
7. Ensure that the compressed air supplied to the tool is clean and dry. Dust, moisture, and corrosive fumes can damage a tool. An in-line regulator filter and lubricator increases tool life.
8. Keep tools clean and lubricated, and maintain them according to the manufacturers' instructions.
9. Do not attempt to catch falling machinery or power tools.
10. Support heavy tools with a counter-balance when possible.

Fire Safety

This section contains information about fire prevention, instruction on using fire extinguishers, obtaining emergency response placards, and procedures for what to do in the event of a fire.

Housekeeping

Clean up debris from machines and work areas frequently, as certain shop materials can pose a significant fire hazard. For example, dust explosions can occur from high levels of airborne wood dust or from accumulation inside switchgear. Always make sure there is adequate ventilation when conducting work also.

Fire Safety Equipment

Know the location of fire safety equipment (extinguishers, smoke detectors, fire alarm pull stations, etc.). Fire safety equipment should have a designated location and be visible.

Storage

Avoid excess storage of combustible materials (e.g., cardboard, paper, and rags) in the shop. Do not store items closer than 18 inches from the level of sprinkler heads, in order to allow the free flow of water from fire sprinklers, or 24 inches below the ceiling level if there are not any sprinklers.

No more than 10 gallons of flammable chemicals may be stored outside of a flammable storage cabinet at any time. Keep oily rags in a separate, flash proof metal container.

Always keep flammable and combustible materials away from all sources of ignition (e.g., welding operations, electrical equipment, etc.).

Electrical Equipment

All electrical equipment must be properly grounded and bonded. Grounding ensures that electricity is directed correctly and bonding prevents the building up of static electricity, which can lead to sparks. Also ensure that extension cords and electrical circuits are never overloaded.

Fire Extinguisher Types

Fire extinguishers are classified into four classes depending on the type of fire they extinguish:

- Class A:** Combustible materials
- Class B:** Flammable liquids
- Class C:** Electrical
- Class D:** Combustible metals
(magnesium, sodium, lithium, potassium)



Fire extinguishers may be used for a specific class of fire or a combination thereof. A common combination is the ABC fire extinguisher. Check the shop to ensure that the correct types of extinguishers are available. Extinguishers are inspected annually and are refurbished every six years. Fire extinguishers must be properly mounted, accessible along exit paths, and be labeled with a sign. Never store items on or around them and make sure they are visible and accessible at all times.

Using a Fire Extinguisher

Remember the "PASS" acronym when operating an extinguisher:

- P** – Pull the pin.
- A** – Aim at the base of the fire.
- S** – Squeeze the trigger.
- S** – Sweep the base of the fire.

The EH&S Fire Division provides fire safety awareness training and fire extinguisher training. Contact EH&S for more information or to schedule a training session.



Having a plan for what to do in the event of fire is an essential fire safety measure.

In order to PREPARE for a fire, you must:

- Know the evacuation routes from your office, floor, and building. Study these in advance. It is easy to become disoriented during an actual emergency.
- Know the location of the nearest fire extinguisher. Report missing fire extinguishers immediately to Facilities Management (x62911).
- Always keep fire rated doors closed.
- Post emergency numbers and your own room number on your telephone.
- Report any unsafe conditions to the EH&S Fire Division immediately (x59797).

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DURING a fire, you must:

- Remain calm and get out of the immediate area.
- Activate the fire alarm, exit via the stairs and **DO NOT USE THE ELEVATOR**.
- Close the door behind you as you leave and all other doors as you exit—doors are built to withstand fire for a period of time—it gives you time to escape.
- If you see smoke, find another way out, if possible.
- Feel the door with the back of your hand before you open it. If it is hot, find another way out.
- Drop to the floor to avoid smoke and fumes. Crawl to safety.
- If your clothes catch on fire, **STOP** where you are, **DROP** to the ground and **ROLL** over and over to smother the flames.
- Call 9-1-1 from a safe location.
- If you are trapped in a burning building, stay near a window and close to the floor. If possible, signal for help.
- Meet with the emergency responders upon arrival and report what you saw—**DO NOT LEAVE THE AREA**. The information you have may save lives and valuable time.

Important Fire Safety Reminders

If your clothing catches on fire, you can use the nearest emergency shower. If you are not near a shower, then stop, drop, and roll. A fire extinguisher may also be used to extinguish a fire on someone's person. Report any burn injuries to the supervisor immediately and seek medical treatment.

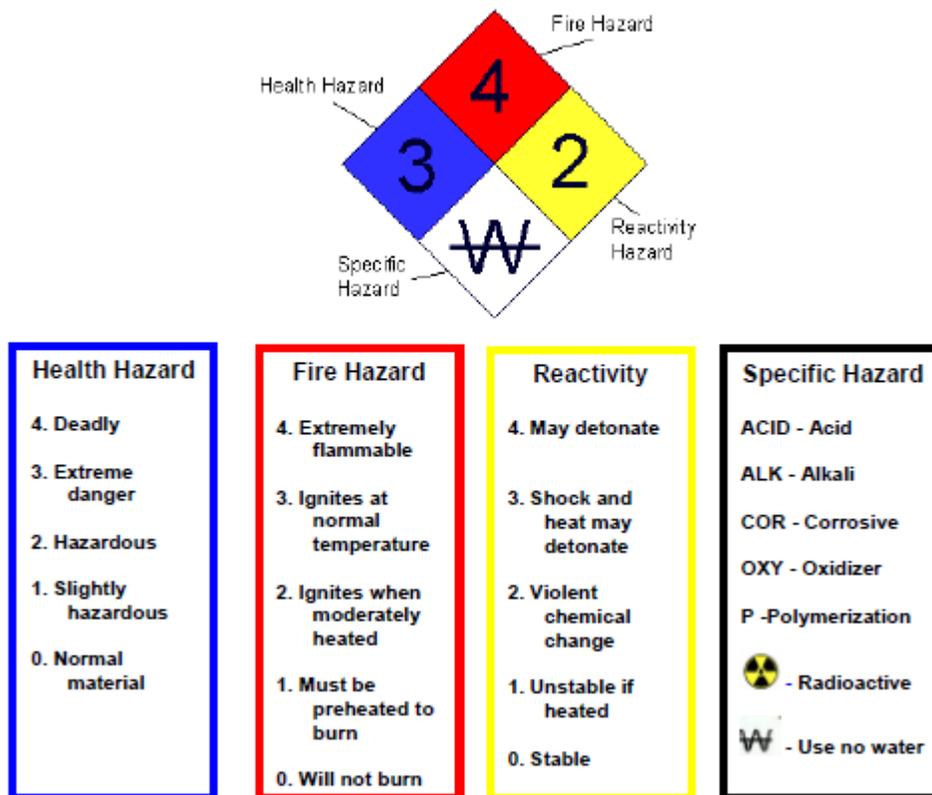
Anytime a fire extinguisher is used or discharged, it must be reported immediately to UCPD Dispatch (310-825-1491).

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All fires, regardless of size, must be reported immediately (911); this is a California State Fire Marshal's requirement.

Reading the Emergency Response Placard:

Figure 5.1 – Emergency Response Placard



Chemical Safety:

Before working with any chemical, you must be aware of the hazards associated with it, how to use and handle it with appropriate safety controls, and the proper storage and disposal of it. Use the MSDS to refer to the chemical before being used and read precautions regarding that chemical.

How do I find information on a MSDS?

You will need to know the following information for the chemicals that you use. Follow the corresponding numbers to see where this information is displayed in Figure 7.1.

1. Name (e.g., bleach)
2. Physical state (solid, liquid, or gas)

3. Hazards and how to control them

4. MSDS

The Clorox Company
1221 Broadway
Oakland, CA 94612
Tel. (510) 271-7000

Material Safety Data Sheet

I Product: CLOROX REGULAR-BLEACH
Description: CLEAR, LIGHT YELLOW LIQUID WITH A CHARACTERISTIC CHLORINE ODOR

Other Designations Clorox Bleach EPA Reg. No. 5813-50	Distributor Clorox Sales Company 1221 Broadway Oakland, CA 94612	Emergency Telephone Nos. For Medical Emergencies call: (800) 448-1014 For Transportation Emergencies Chemtrec (800) 424-9300
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II Health Hazard Data
DANGER: CORROSIVE. May cause severe irritation or damage to eyes and skin. Vapor or mist may irritate. Harmful if swallowed. Keep out of reach of children.
Some clinical reports suggest a low potential for sensitization upon exaggerated exposure to sodium hypochlorite if skin damage (e.g., irritation) occurs during exposure. Under normal consumer use conditions the likelihood of any adverse health effects are low.
Medical conditions that may be aggravated by exposure to high concentrations of vapor or mist: heart conditions or chronic respiratory problems such as asthma, emphysema, chronic bronchitis or obstructive lung disease.
FIRST AID:
Eye Contact: Hold eye open and rinse with water for 15-20 minutes. Remove contact lenses, after first 5 minutes. Continue rinsing eye. Call a physician.
Skin Contact: Wash skin with water for 15-20 minutes. If irritation develops, call a physician.
Ingestion: Do not induce vomiting. Drink a glassful of water. If irritation develops, call a physician. Do not give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. If breathing is affected, call a physician.

III Hazardous Ingredients

Ingredient	Concentration	Exposure Limit
Sodium hypochlorite CAS# 7681-52-9	6.15%	Not established
Sodium hydroxide CAS# 1310-73-2	<1%	2 mg/m ³ , ¹ 2 mg/m ³ ^{1,2}

¹ACGIH Threshold Limit Value (TLV) - Ceiling
²OSHA Permissible Exposure Limit (PEL) - Time Weighted Average (TWA)
None of the ingredients in this product are on the IARC, NTP or OSHA carcinogen lists.

IV Special Protection and Precautions
No special protection or precautions have been identified for using this product under directed consumer use conditions. The following recommendations are given for production facilities and for other conditions and situations where there is increased potential for accidental, large-scale or prolonged exposure.
Hygienic Practices: Avoid contact with eyes, skin and clothing. Wash hands after direct contact. Do not wear product-contaminated clothing for prolonged periods.
Engineering Controls: Use general ventilation to minimize exposure to vapor or mist.
Personal Protective Equipment: Wear safety glasses. Use rubber or nitrile gloves if in contact liquid, especially for prolonged periods.
KEEP OUT OF REACH OF CHILDREN

V Transportation and Regulatory Data
DOT/MDGATA - Not restricted.
EPA - SARA TITLE III/CERCLA: Bottled product is not reportable under Sections 311/312 and contains no chemicals reportable under Section 313. This product does contain chemicals (sodium hydroxide <0.2% and sodium hypochlorite <7.35%) that are regulated under Section 304/CERCLA.
TSCA/DSL STATUS: All components of this product are on the U.S. TSCA Inventory and Canadian DSL.

VI Spill Procedures/Waste Disposal
Spill Procedures: Control spill. Containize liquid and use absorbents on residual liquid, dispose appropriately. Wash area and let dry. For spills of multiple products, responders should evaluate the MSDS's of the products for incompatibility with sodium hypochlorite. Breathing protection should be worn in enclosed, and/or poorly ventilated areas until hazard assessment is complete.
Waste Disposal: Dispose of in accordance with all applicable federal, state, and local regulations.

VII Reactivity Data
Stable under normal use and storage conditions. Strong oxidizing agent. Reacts with other household chemicals such as toilet bowl cleaners, rust removers, vinegar, acids or ammonia containing products to produce hazardous gases, such as chlorine and other chlorinated species. Prolonged contact with metal may cause pitting or discoloration.

VIII Fire and Explosion Data
Flash Point: None
Special Firefighting Procedures: None
Unusual Fire/Explosion Hazards: None. Not flammable or explosive. Product does not ignite when exposed to open flame.

IX Physical Data
Boiling point: approx. 212°F/100°C
Specific Gravity (H₂O=1): ~ 1.1 at 70°F
Solubility in Water: complete
pH: ~11.4

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DATA SUPPLIED IS FOR USE ONLY IN CONNECTION WITH OCCUPATIONAL SAFETY AND HEALTH DATE PREPARED 05/05

UCLA Shop Safety Manual – Section 7 - Chemical Safety Page 2 of 12 September, 2012

General Safe Handling Practices

- If you are using flammable chemicals, make sure any ignition sources have been extinguished.
- If you are using more than one chemical, make sure nothing you are working with could react dangerously with one another.
- If you notice any fumes, vapors, bubbling, or unusual odors, stop what you are doing and request assistance.

Minimize Your Exposure

Proper chemical handling includes selecting the right kind of PPE for the specific chemical hazard. In particular, you must select a glove that provides adequate protection against the individual chemical you are using. When pouring or handling

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liquid chemicals, make sure you don't proper splash protection (including gloves, aprons, and goggles). Refer to section 3 for more information on selecting the proper PPE.

A functional workplace ventilation system can prevent unnecessary inhalation exposures and eliminate the need for respiratory protection. Proper ventilation can also reduce the potential for fire hazards. Examples of workplace ventilation systems include:

- Dust collection systems on woodworking equipment.
- Using spray hoods when painting.
- Snorkel vents over chemical and welding operations.
- Using glove boxes when working with dusty operations.

Contact EH&S for a hazard evaluation if you are unsure if the chemical you are handling requires special PPE, ventilation, or respiratory protection.

KNOW WHAT TO DO IN CASE OF A SPILL

Personal safety is the highest priority when a spill occurs. Depending on the scope of the spill and if you are trained in spill clean-up procedures, you may be able to clean-up a spill yourself or with the help of coworkers who are also trained in spill clean-up.

CHEMICAL STORAGE

Chemicals must be physically segregated according to hazard class to prevent adverse chemical reactions. The same segregation rules apply to all chemicals, regardless of their physical state (solid, liquid, or gas). Proper chemical segregation can be accomplished by designating storage cabinets, tubs, bins, or specific areas for a specific hazard class. Hazardous classes include:

- Flammable: fuel, welding gases, solvents, paint thinner, acetone, spray aerosols
- Combustible: flux, paint, wood dust, stain, cutting fluid, some adhesives, oil, diesel fuel
- Oxidizers: oxygen, hydrogen peroxide, bleach, certain cleaners
- Poisons: mercury, lead, alloys containing cadmium or beryllium, chlorinated solvents or degreasers, solders, pesticides
- Acids: etching solutions, battery acid, drain cleaner
- Bases: caustic or alkaline materials, ammonia based cleaners, drain cleaners, and some chemical strippers
- Reactive chemicals: polymer kits, epoxy resin

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Chemicals must be stored in secondary containment, such as plastic tubs, and cannot be scattered around the shop. Ensure that these materials are properly restrained when they are stored in cabinets or on shelving. Avoid storing chemicals near sources of heat or combustion.

Chemical containers must be compatible with the chemicals they are holding. For example, corrosive chemicals, such as strong acids and bases, will corrode metal containers. (If space is limited, incompatible chemicals can be placed in separate secondary containments in the same cabinet.)

All chemical containers must also be clearly labeled with the manufacturer's original label. If you transfer any chemicals to another container, you are required to provide your own label.

Containers must be clearly labeled with their constituents (including water), and with the product name, any hazardous ingredients, and appropriate hazard warnings.

No more than 10 gallons of flammable chemicals may be stored outside of a flammable storage cabinet at any time. Keep oily rags in a separate, flash proof metal container.

When chemicals are not in use, they must be tightly sealed. If containers are damaged, leaking, or corroded, the contents must be transferred to a new properly labeled container or disposed of as hazardous waste.

HAZARDOUS CHEMICAL WASTE

When a chemical product is discarded or is no longer useable, it typically becomes a hazardous waste, which requires special disposal practices. Old or expired chemicals that cannot or will never be used should be disposed of as hazardous waste. Remember that waste can be decreased by not purchasing large quantities of chemicals when only a small quantity is necessary for a job or by substituting non-hazardous products for hazardous chemicals.

What is hazardous waste?

A waste meets the definition of hazardous waste if it has one or more of the following hazardous characteristic(s): flammable, corrosive, reactive, or toxic. These are referred to as characteristic wastes. Hazardous wastes that could be generated in the shops include oil, oily rags, used solvent, paint, aerosol cans, etc.

Electrical Safety

OVERVIEW

Electricity is such an integral part of today's world that it is easy to forget how dangerous it can be. It can shock you painfully, damage sensitive equipment, and ignite combustible materials. In the worst case scenario, it can kill.

Unsafe equipment, unsafe acts, and working with electricity in hazardous environments can lead to electrical accidents and injuries.

WHY WORRY ABOUT ELECTRICITY?

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Electricity can be deadly. Electrocution is the fourth leading cause of workplace fatalities. Only traffic accidents, violence, and construction rank higher. Almost 8,000 electrical contact injuries occur every year in the United States, with about half resulting in permanent disabilities.

Surprisingly, most of these accidents involve low voltage (600 volts or less).

Assume that all overhead wires are energized at lethal voltages. Never assume that a wire is safe to touch even if it is down or appears to be insulated.

Never touch a fallen overhead power line. Call the electric utility company to report fallen electrical lines.

Stay at least 10 feet (3 meters) away from overhead wires during cleanup and other activities. If working at heights or handling long objects, survey the area before starting work for the presence of overhead wires.

If an overhead wire falls across your vehicle while you are driving, stay inside the vehicle and continue to drive away from the line. If the engine stalls, do not leave your vehicle. Warn people not to touch the vehicle or the wire. Call or ask someone to call the local electric utility company and emergency services.

Never operate electrical equipment while you are standing in water.

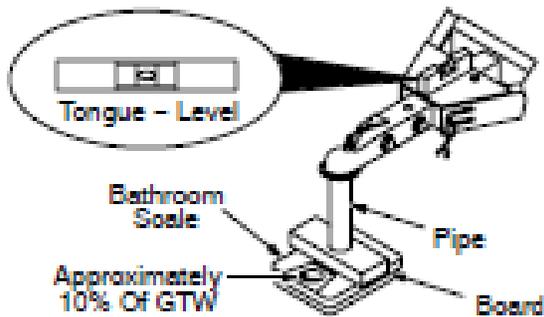
Never repair electrical cords or equipment unless qualified and authorized.

Have a qualified electrician inspect electrical equipment that has gotten wet before energizing it.

If working in damp locations, inspect electric cords and equipment to ensure that they are in good condition and free of defects, and use a ground-fault circuit interrupter (GFCI).

Always use caution when working near electricity.

Incorrect tongue weight can cause fishtailing and loss of control of towing vehicle resulting in serious injury and equipment damage.



Install generator according to Owner's Manual with engine end toward hitch end of trailer.

Ground generator frame to trailer frame — see Owner's Manual.

Distribute weight so that trailer tongue weight is approximately 10% of the gross trailer weight (GTW).

Do not let tongue weight exceed coupler and hitch rating.

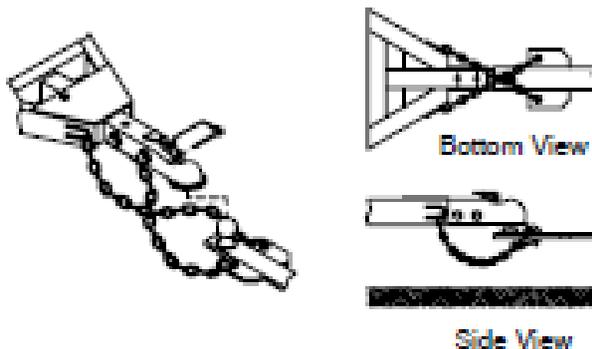
Trailer And Coupler Class ¹	Gross Vehicle Weight Rating (GVWR) ² lb (kg)	Gross Trailer Weight (GTW) ² lb (kg)	Maximum Tongue Weight ³ lb (kg)
1	Up to 2000 (Up to 910)	1000 (455) 2000 (910)	100 (45) 200 (90)
2	2000 to 3500 (910 to 1590)	2000 (910) 3500 (1590)	200 (90) 350 (155)
3	3500 to 5000 (1590 to 2270)	3500 (1590)	350 (155)

¹ Information From SAE J684 May 1987

² Gross Trailer Weight (Actual Loaded Weight)

³ 10% of GTW Recommended

Safety chains can prevent runaway trailer in case hitch/coupler fails.

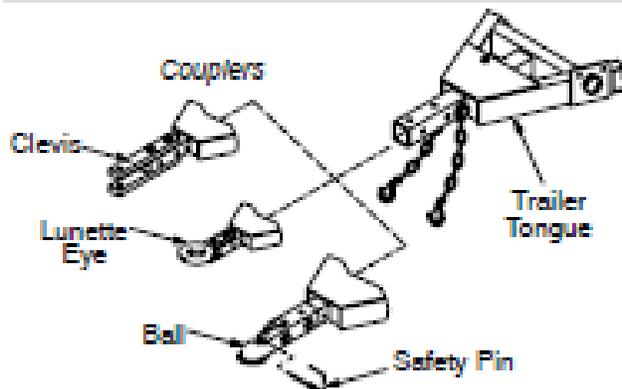


Always use safety chains when towing.

Cross safety chains under coupling to prevent tongue from dropping to ground.

Allow only enough slack for eight turns.

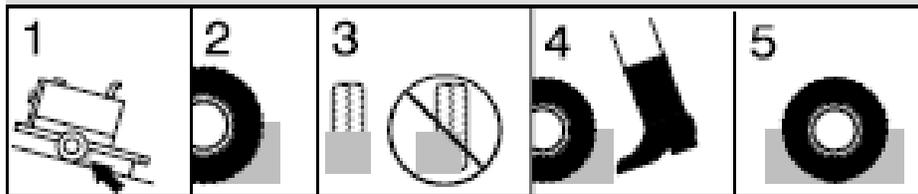
Incorrect size or rating of hitch can cause trailer to break loose from towing vehicle.



Make sure hitch and ball are properly sized, match each other, and are fully engaged.

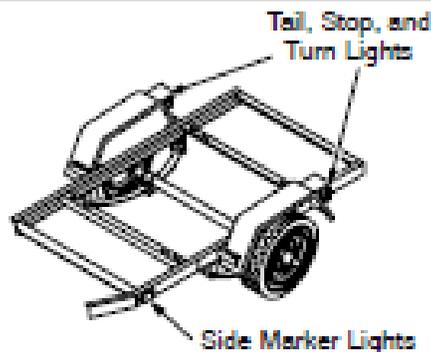
On optional ball couplers, always insert hitch safety pin before towing.

Wheels must be chocked when trailer is uncoupled from vehicle.



1. Chock in direction of grade.
2. Position chock snugly behind tire.
3. Place chock square to the tire.
4. Tap chock into place.
5. For added protection, chock both sides of tire.

Incorrectly working lights can cause accidents.

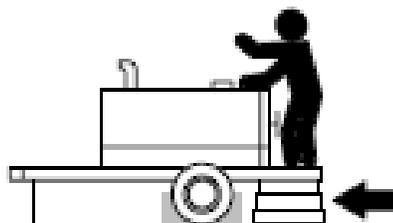


Be sure vehicle and trailer light connectors match and are securely pushed together.

Check all lights for proper operation before using the trailer.

Check condition of wiring harness leads, plugs, bulbs, and connections regularly. Repair or replace damaged bulbs, parts, or wires.

Unexpected tilting of trailer can cause injury and damage.

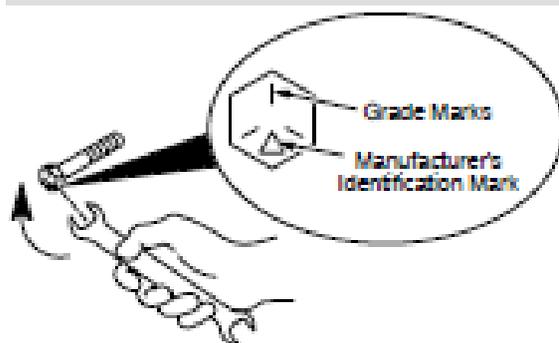


When trailer is uncoupled from towing vehicle, use jack on front and blocks under rear to prevent tilting.

Use proper blocks that are large enough and able to support the necessary weight.

Always chock the wheels when uncoupled.

Loose or incorrect hardware and fasteners can cause injury and damage.

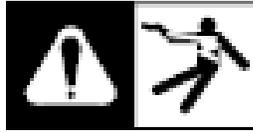


Periodically double-check all nuts and bolts for tightness and condition.

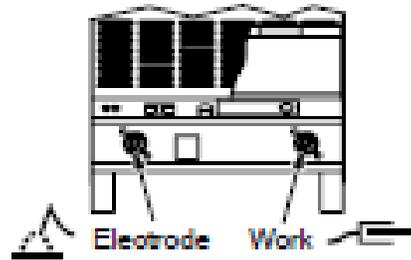
If necessary, always replace any fastener with one of equal size, grade, and type.

Be sure the grade marks on replacement fastener match the original bolt. The manufacturer's identification mark is not critical and does not matter for the replacement fastener.

9. Weld Cable Selector Guide*



-  Turn Off power before connecting to weld output terminals.
-  Do not use worn, damaged, under-sized, or poorly spliced cables.



Welding Amperes	Weld Cable Size** And Total Cable (Copper) Length In Weld Circuit Not Exceeding***			
	100 ft (30 m) Or Less		150 ft (45 m)	200 ft (60 m)
	10 - 60% Duty Cycle	60 - 100% Duty Cycle	10 - 100% Duty Cycle	
100	4	4	4	3
150	3	3	2	1
200	3	2	1	1/0
250	2	1	1/0	2/0
300	1	1/0	2/0	3/0
350	1/0	2/0	3/0	4/0
400	1/0	2/0	3/0	4/0
500	2/0	3/0	4/0	2 ea. 2/0
600	3/0	4/0	2 ea. 2/0	2 ea. 3/0
700	4/0	2 ea. 2/0	2 ea. 3/0	2 ea. 4/0
800	4/0	2 ea. 2/0	2 ea. 3/0	2 ea. 4/0
900	2 ea. 2/0	2 ea. 3/0	2 ea. 4/0	3 ea. 3/0
1000	2 ea. 2/0	2 ea. 3/0	2 ea. 4/0	3 ea. 3/0
1250	2 ea. 3/0	2 ea. 4/0	3 ea. 3/0	4 ea. 3/0

*This chart is a general guideline and may not suit all applications. If cable overheating occurs (normally you can smell it), use next size larger cable.

**Weld cable size (AWG) is based on either a 4 volts or less drop or a current density of at least 300 circular mils per ampere. Contact your distributor for the mm² equivalent weld cable sizes.

***For distances longer than those shown in this Guide, call a factory applications representative at 820-733-4503.

Basics

- NEVER weld without a proper face shield.
- Closed shoes must be worn.
- Long-sleeved, non-flammable shirt must be worn.
- Wear proper welding gloves.
- Never weld on or near anything that's been cleaned with a chlorinated hydrocarbon like brake-cleaner. Combined with UV light it can create phosgene gas. THIS CAN KILL YOU OR PEOPLE NEARBY or hurt you really badly. Ventilation will not prevent poisoning. [Here's what can happen. \(PDF version.\)](#)
- Always wear ear protection (earplugs or muffs) if there's any chance at all a spark could bounce or fall into your ear canal. An eardrum punctured by a spark will instantly cauterize and never heal.
- If you burn yourself, immediately douse with cold water: seconds count!

Fire

Make sure the weld area is free from all flammable materials such as flammable liquids, paper, etc. Do not wear clothing or gloves that have been exposed to flammable liquids.

Electrocution

Before turning on a weld machine, make sure there are no puddles of water on the floor around the weld bench or the machine. Make sure the weld machine is dry, including the main box, the torch, the pedal and the plug.

There is little risk of dangerous electrocution from a properly working TIG weld machine. When the user presses on the pedal to initiate the arc, a high-frequency low amplitude arc will emit from the tip of the weld torch. Once the machine detects the grounded metal piece that is to be welded, the arc will switch over to a high-amplitude DC current. Even if the operator deliberately points it toward their body, the shock will be mild, since the machine will not switch over to the high amplitude current.

Burns

Welded metal will remain hot for several minutes after it is welded. In most cases the heat is localized near the welds itself. In the case of more conductive materials such as copper and aluminum, the heat may more distributed throughout the piece.

In the case of TIG welding, sparks and spatter are non-existent, unless rusty or dirty metal is used. When MIG welding steel, there will be sparks, earplugs and full coverage safety glasses (as always) should be worn to prevent burns to sensitive tissues.

Gloves must be worn when welding and handling recently welded material. White cotton welding gloves may be used for light TIG welding, as long as they are free from holes. For heavier welding, deerskin or heavy duty welding gloves should be used.

Closed shoes are a must: no sandals.

UV Burns

The light emitted from a weld arc is much brighter than that of the sun, since it is much closer. Do not look at the arc without wearing a full-faced welding mask, with a shade 10 or darker filter plate. Always make sure the weld curtains are in place between the welders and other people in the shop. Also be sure to cover any exposed skin while welding or observing inside the weld area, including cuffs and collar areas. The rays from the arc can cause a UV burn much worse than a sunburn. Observers may use a cardboard mask with a shade 10 filter plate.

Compressed Gas Tanks

Argon and CO₂ are gasses normally found in atmosphere and aren't inherently dangerous, however, if left on in an enclosed area could potentially cause suffocation by fully displacing the breathable air. The larger potential danger is the change of the top getting knocked off the tank, causing it to become a rocket powerful enough to cause severe damage to people, equipment, and ever possibly the building itself.

The following guidelines must be followed **at all times**.

Storing

- Tanks must always remain upright, NEVER stored horizontally
- Tanks must be secured -- connected to an immovable object and prevented from falling over with a non-combustible material (metal).

Moving

- Tanks must be securely capped

General Shop Safety Tips

- Think through the entire job before starting.
- Do not rush or take chances, obey all safety rules.
- Use appropriate protective equipment.
- Never leave a machine running unattended.
- Do NOT grind aluminum or magnesium.

Highlanders FRC

- Welders **MUST** take appropriate safety precautions and use appropriate safety equipment.
- No long hair and no long sleeves! Pulled back & tied up. No wearing jewelry or watches while working! Closed toe shoes or boots only!
- Do not operate any item of equipment unless you are familiar with its operation and have been authorized to operate it. If you have any questions regarding the use of equipment ask a coach.
- In case of injury, no matter how slight, you must report it to a Coach and fill out the **FIRST** Injury Report Form and submit it to the safety leader.
- Do not work in the shop if tired, or in a hurry.
- A brush or gentle air blasts should be used for removing chips, shavings, etc. from the work area. Never remove by your hands.
- A hard hammer should not be used to strike a hardened tool or any machine part. Use a soft faced hammer.
- Practice cleanliness and orderliness in the shop areas. Never leave a dirty piece of equipment.
- If you have not worked with a particular material before, check the hazardous materials data sheets book for any specific precautions to be taken while working with the material. Also, ask a coach before cutting any unusual material.
- Follow all appropriate precautions when working with solvents, paints, adhesives or other chemicals. Use appropriate personal protective equipment.