



MRAF Safety Guide

**Procedures, Guidelines, and Best Practices for the
Marine Research Assets Shared Facility (MRAF)**

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**Great Lakes
Research Center**
Michigan Technological University

Table Of Contents

Procedures, Guidelines, and Best Practices for the Marine Research Assets Shared Facility (MRAF)

Introduction	1
Access	2
General Shop/Tool Safety	2
Personal Protective Equipment (PPE)	2
COVID-19 Exposure Reduction (text taken directly from Michigan Tech’s MTU Flex COVID Guidance, 11-16-21)	3
Power Tools	3
Flammables	4
Compressed Air	5
Electrical Safety	5
Lockout/Tagout Procedures	6
Marine Operations	6
Trailer and Towing	6
Ice Operations	7
Overhead Lifts and Cranes	9

Introduction

The hazards associated with shop, marine, and winter field work require special safety considerations. Whether you are working in the shop or in the field, the potential hazards for personal injury are numerous. This section highlights essential safety information for working in the shop, on MRAF research vessels, docks and piers, as well as safety considerations and best practices during on ice field operations. Details not addressed in this manual, can be found in the University Safety Manual, online at <https://www.mtu.edu/ehs/documents/safety-manual/>. All remaining questions and concerns can be addressed by directly contacting MRAF staff.

Access

Only authorized users (as defined by MRAF staff) should have access to shop spaces. Training may be required before shop and/or tool access is granted.

General Shop/Tool Safety

The following general safety practices apply to all work areas of the MRAF. MRAF staff may apply rules and enforce requirements that are more restrictive than the minimums listed below:

- Always wear appropriate personal protective equipment (closed toe/heel shoes and safety glasses).
- Tie back long hair, restrict loose clothing and jewelry.
- Food, drink, tobacco products, gum, medications, and cosmetics are not allowed in work areas.
- Avoid distractions (earbuds, cell phone, etc.).
- Avoid working alone in the shop, but when unavoidable, make arrangements with MRAF staff or a colleague to check on your status periodically.
- Obtain approval from MRAF staff before using any machines or tools.
- Know the hazards associated with the work.
- Ensure you are fully educated on the proper use and operation of any tool before beginning work.
- Ensure adequate ventilation to prevent exposure when working with glues, lacquers, paints, dust, and fumes.
- Ensure equipment guards and shields are in place.
- Return tools to their proper locations.
- Report damaged equipment to MRAF staff.
- Keep all work areas and aisles clean and unobstructed.

- Know emergency procedures.
- Report injuries to MRAF staff.

Personal Protective Equipment (PPE)

Employees and students who use machinery and equipment and who are exposed to the hazards of falling, flying, abrasive and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases will be provided with the appropriate equipment needed, including PPE, to protect them from the hazard. Shop users are expected to use assigned PPE when called for by standard operating procedure, container label or safety data sheet. PPE shall be maintained by MRAF staff in a clean, sanitary and usable condition.

- Safety glasses are to be worn at all times.
- In ear or over ear hearing protection will be worn in loud environments.
- Those who choose to wear either a half-face, air-purifying respirator, APR, or filtering facepiece (dust mask), must do so in accordance with EHS standards detailed online at <https://www.mtu.edu/ehs/workplace-safety/respiratory/>.
- Gloves of the appropriate material will be worn when working with solvents, adhesives, lubricants, and fuels.
- Personal Flotation Devices (PFDs) - see section on Marine Operations
- Hard hats - see section on Lifts and Cranes
- Anti exposure wear - see section on Ice Operations

COVID-19 Exposure Reduction

(text taken directly from Michigan Tech's MTU Flex COVID Guidance, 11-16-21)

Behavior and operations at Michigan Tech are guided by our Health and Safety Levels. These levels provide us with the agility to respond to COVID-19 on campus and in the local community in real time with scientifically informed, practical, and targeted steps.

The COVID-19 Health and Safety Levels provide flexibility, to the extent reasonably possible, for those who are at higher risk for complications from the virus or who have an immediate household member in that category. At the same time, they permit students and employees to be on campus with mitigation efforts tailored to real-time metrics, such as the presence of the virus in the campus community; the presence of the virus in the local community; the health care capacity in the local community; and relevant local, state, and federal guidance and orders.

[Click here to view the current Health and Safety Level, as well as the descriptions and expectations of each level.](#)

Power Tools

Hand tools are non-powered tools such as saws, screw drivers, hammers, chisels and wrenches. Hand tools generally do not require specialized training. Hand tools should be properly maintained after each use.

Portable power tools are powered by an electrical power source (cord or battery) or gasoline. Examples include: drill, circular saw, grinder, router, jigsaw, and sander. Pneumatic tools are powered by compressed air. These include: drill, impact wrench, grinder, ratchet, sander, and a cut-off tool.

Stationary power tools are large, non-portable and powered by sources such as electricity, gravity, pneumatic, or hydraulics.

Follow these guidelines for general tool safety:

- Use a tool for its intended purpose and only if you have been trained on the tool.
- Inspect all tools before use. Repair or replace them when damaged or defective and report problems to MRAF staff.
- Keep tools sharp.
- Direct sharp cutting tools away from yourself and others.
- Keep all guards in place and lockout devices in place.
- Avoid distractions and pay attention when operating power tools.
- Do not rely on strength to perform an operation. The correct tool, blade, and method should not require excessive force.
- Never reach into the point of operation while equipment is running.
- Disconnect or unplug the power source before clearing jams or blockages.
- Never disable or tamper with safety releases or switches.
- Whenever possible use a push stick or pad to move material through a machine.
- Keep a firm grip on portable power tools.
- When possible, secure work pieces with a clamp or vise.
- Keep bystanders away from moving machinery.
- Store tools in a manner that prevents them from being damaged.
- When not in use, power tools are to be unplugged.
- **Milling and machining will be performed by MRAF Staff only.**

Flammables

- When not in use, flammable materials are to be kept in marked containers and placed in a closed flammables cabinet.
- Small amounts of flammable liquids (totalling less than one gallon) may be placed in clearly labeled containers and kept in closed cabinets.

- Waste motor oil and lubricants will not be kept long term; They will be collected into a designated 5-gallon bucket labelled “GLRC Used Oil”, and retrieved on request by EHS for disposal at their convenience.
- Further details, considerations, and best practices are provided by EHS online at <https://www.mtu.edu/ehs/fire-life-emergency/flammable-storage/>.

Compressed Air

The following precautions pertain to the use of compressed air in MRAF facilities:

- All pipes, hoses, and fittings must have a rating of the maximum pressure of the compressor.
- Air supply shutoff valves should be located (as near as possible) at the point-of-operation.
- Air hoses should be kept free of grease and oil to reduce the possibility of deterioration.
- Hoses should not be strung across floors or aisles where they are liable to cause personnel to trip and fall. When possible, air supply hoses should be suspended overhead, or otherwise located to afford efficient access and protection against damage.
- Hose ends must be secured to prevent whipping if an accidental cut or break occurs.
- Pneumatic impact tools, such as riveting guns, should never be pointed at a person.
- Before a pneumatic tool is disconnected (unless it has quick disconnect plugs), the air supply must be turned off at the control valve and the tool bled.
- Compressed air must not be used under any circumstances to clean dirt and dust from clothing or off a person’s skin. Shop air used for cleaning should be regulated to 15 psi unless equipped with diffuser nozzles to provide lessor pressure.
- Goggles, face shields or other eye protection must be worn by personnel using compressed air for cleaning equipment.
- Static electricity can be generated through the use of pneumatic tools. This type of equipment must be grounded or bonded if it is used where fuel, flammable vapors or explosive atmospheres are present.

Electrical Safety

Electrical voltages as low as 12-volts, can be dangerous and cause injury. When working with or around electrically powered equipment follow these general precautions:

- Shop equipment must be powered by an appropriate electrical source matched to the power requirements recommended by the manufacturer.
- All electrical equipment must be UL listed and have either a grounded plug (three prong) or be double insulated.
- Protect electrical power cords from damage. Immediately replace cords that are worn, frayed, or otherwise damaged.
- Extension cords are to be used only for temporary use (less than 72 hours).

- Electrical equipment used within six feet of water or in wet/damp environments must be plugged into a Ground Fault Circuit Interrupter (GFCI).
- Do not connect multiple pieces of equipment to the same power source. Shop equipment should be plugged directly into a wall outlet and not a multi-plug power strip.
- Grasp the plug to remove it from the socket – never pull the cord.
- Always unplug electrical equipment before attempting any repair or maintenance.
- Further details, considerations, and best practices are provided by EHS online, at <https://www.mtu.edu/ehs/workplace-safety/safety-manual/ch8.html>.
- **Direct any further questions regarding electrical systems, batteries, or related power systems to MRAF staff member, Mr. Ron Gnadinger.**

Lockout/Tagout Procedures

- **Preparation:** Before beginning any maintenance or repair work, identify all energy sources associated with the equipment. This includes electrical, mechanical, hydraulic, pneumatic, chemical, and thermal energy sources. Understand the hazards associated with these energy sources and the methods to control them.
- **Notification:** Inform all affected employees that a lockout/tagout procedure is going to be implemented. Ensure that everyone understands that the equipment will be out of service until the maintenance or repair work is completed.
- **Isolation:** Physically isolate the equipment from its energy sources. This may involve turning off power at a breaker or valve, disconnecting the energy source, or blocking or securing a mechanical part.
- **Lockout/Tagout Application:** Apply lockout devices to each energy isolating device. These locks should only have one key, and the key should remain with the person applying the lock. Tagout devices should also be used if the lock cannot be applied directly to the energy isolating device. The tags should clearly indicate that the equipment should not be operated until the tag is removed.
- **Verification:** After the lockout devices are applied, verify that the equipment is properly isolated and de-energized. This may involve attempting to start the equipment with the control panel, checking for the absence of energy with a meter or test light, or physically inspecting the isolation. This step is crucial to ensure that all energy sources are fully disconnected and the equipment is safe to work on.

Marine Operations

The “kill switch” lanyard must be worn by anyone operating S/V Thunderjet, any time the vessel is operating above displacement speed (on plane). Slow speed operations such as launching/recovering, idling while conducting research activities (i.e sidescan), etc, do not require the kill switch lanyard to be worn, but the operator may do so if he/she feels it would greatly reduce the risk of an ejection overboard.

- PFDs will be worn on the docks by individuals working over the side deploying instruments, taking samples, etc. PFDs will also be worn any time an individual is working alone on a GLRC dock. Life rings with throw ropes are located on both GLRC docks.
- PFDs will be worn at all times during operation of MRAF small vessels. When aboard the Agassiz, and all life-lines are up, PFDs are not required.
- Any time a vessel operates beyond the Keweenaw Waterway (Lake Superior or Keweenaw Bay), and the water temperature is 60 degrees or below, a “gumby” suit must be carried onboard for each person. The vessel Captain/operator will notify all persons on board of the location and instructions for use in the event of an emergency.
- All small vessel operators, in cooperation with MRAF staff, must demonstrate competency and/or detail past experience w/ vessels of similar size and type. If necessary, an on water evaluation and remedial training will be scheduled and performed.
- Float plans must be filed (opened and closed) with Public Safety when operating the Agassiz, Osprey, and Polar, regardless of the location and duration of operation.
- The pontoon, RIB, and jetski, may be operated without a float plan when deployed within visual **and** radio contact of a research vessel or the GLRC.
- When working with any overhead equipment or vessel davits and cranes, hard hats are required.
- **Direct any further questions regarding vessels and other marine systems to MRAF Director, Mr. Jamey Anderson.**

Trailing and Towing

Of all the varied and challenging work we do on the Great Lakes, towing trailered boats at highway speeds is one of the most dangerous. The following standards will provide a solid foundation for the safe operation of our trucks and trailers.

Before Towing

1. Drivers will inspect the trailer and hitch in advance of leaving and not depart if any system is not functioning safely. This includes:
 - a. Hitch, pin, ball, receiver
 - b. Brakes, all lights and trailer light connections
 - c. Wheels, tire tread and pressure
 - d. Vessel transom straps and bow safety chain
2. If the driver is not qualified to inspect the trailer, MRAF personnel will inspect it for them.
3. No driver with more than 5 points on his/her drivers license will be permitted to drive MRAF vehicles. Drivers should self-report if they have more than 5 points on their license.

While Towing

1. Drivers with trailers will obey (not to exceed) all posted speed limits, up to, but not exceeding 75 mph.
2. Drivers with trailers will allow for 5 seconds of spacing between the tow vehicle and vehicles in front of them. This equals ~400 feet at 55 mph and ~550 ft at 75 mph.
3. Drivers will be otherwise legal to drive in the US and state of MI, and will obey all local traffic laws.
4. Seat belts will be worn by drivers and all passengers while the vehicle is in motion.
5. All incidents should be promptly reported to the MRAF manager and GLRC Director upon reaching your destination.
6. If a vehicle or trailer is damaged or breaks down while away from Houghton and needs to be left at the side of the road or highway, you will notify the above, as well as MTU public safety, local law enforcement and then arrange a local tow for repairs.

Ice Operations

Ice strength is dependent on thickness, daily temperature, ice history, and snow cover, plus water depth under the ice, the size of the water and water chemistry, currents, and distribution of the load on the ice. Additional points to consider:

- **Ice thickness over a body of water is not constant.** Water currents, particularly around narrow spots, bridges, inlets and outlets, are always suspect for thin ice. Beware of ice around partially submerged objects, such as docks, trees, logs, brush, Embankments, pier/bin walls or dam structures.
- **Snow can act like a blanket insulating the water below.** Snow can insulate ice and keep it strong. It can also insulate it to keep it from freezing. Snow cover also hides the surface and can mask rotten ice and thin spots. You should always be cautious when moving across snow-covered ice.
- **Springs and currents** can create areas of extreme thickness and patches that are just wafer thin.
- **Cracks in the ice.** Dry cracks indicate the ice sheet has not been penetrated and they are usually of no concern. Wet cracks mean penetration has occurred to the water below.
- **Stationary loads.** Under moving loads, ice is elastic (depresses, and then recovers to original position after load passes). In the situation of static loads, the ice surface will continue to sag and, depending on the strength of the ice cover, may even fail. Signs of failure are radiating cracks from the bottom of the ice beneath the stationary object, circular cracks in the upper layers of ice adjacent to the load and worse case, signifying imminent failure, circular ice shears immediately adjacent to the loaded surface.

There is always risk when working on ice. Safety best practices for work on ice include:

- **Never go alone and never go on ice if there is any question of its safety.** Never attempt to rescue a victim of ice failure alone.
- Before you leave, **inform your advisor and/or MRAF staff of your destination and expected time of return.**
- When your team is starting from shore and when changing locations on the ice, always **walk at least 10 feet apart.**
- Visually observe the ice from the water's edge before starting onto the ice. Look for evidence of recent thaws, open water, etc. As you proceed from shore, “spud” out in front of you early and often. **Do not travel on ice less than 4” thick. Don’t guess, drill a hole and check the thickness with a tape measure.**
- When crossing a large body of water, it is always a good idea to **drill test holes as you progress out from shore** to help judge the thickness and character of the ice. Again, Do not travel on ice less than 4” thick.
- Stay away from cracks, seams, pressure ridges, slushy areas and darker areas that signify thinner ice.
- **Dress for immersion.** Wear layers; insulated, waterproof boots; gloves and a windbreaker. Clothing that will restrict the ability to swim or float, such as hip waders, should be avoided.
- **Always wear a life jacket or personal flotation device (PFD)** over layered winter clothing. Life jackets provide excellent flotation and protection from hypothermia (loss of body heat). Float coats, exposure suits, “Gumby” immersion suits, and dry suits are also recommended.
- Carry a basic personal safety kit that includes:
 - Ice rescue picks
 - Rope or rescue throw bag
 - Mobile phone
- **Direct any further questions regarding on ice field operations to MRAF Director, Mr. Jamey Anderson.**

Overhead Lifts and Cranes

- Only authorized students, faculty, and staff are allowed to use any crane or lift.
- Hard hats are required when using a jib crane, davit, or lift.
- Before use, ensure the lift or crane is suitable for the planned hoisting task. Confirm it has appropriate travel, lift height, and capacity.
- Confirm the load weight. Check the capacity of all equipment including the hardware, rope, and slings. Do not exceed these capacities.
- Do not carry a load over people.
- Do not allow anyone to ride on a load carried by the crane or on the crane hook.
- Never try to stop the load with your hands or body.

- Inspect equipment daily before use. Always keep an eye out for changes in the equipment and safety area.
- Never leave the controls unattended while a load is suspended. Lower the load to the floor if it is necessary to leave the controls.
- **When not in use, the pier jib crane is to be electrically shut off (switch located near the Captain's Office).**