

## Machine Shops

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Events are requested to host a machine shop, to help teams with repair and fabrication of their robots. While the machine shops vary, *FIRST* strives to have the available tools that teams need in order to make on-site fixes to their robots at all events. With this goal, we do try to have welding and a variety of high-powered tools available at all events; however, some events may not be able to offer welding or certain equipment due to restrictions (e.g. liability reasons, venue restrictions, availability, etc.)

The machine shop should be available for the sole use of the Competition for all days of the event. The shop must have 2-3 qualified machine shop staff available to operate the machines. Team members are **NOT** allowed to operate shop equipment that is owned by the host site. Teams are encouraged to provide the materials needed as they may not be available in the machine shop.

At a minimum, the machine shop **should** have the following equipment:

- Drill Press (any is helpful, but prefer one with 14" swing (7" throat) or larger)
- Drill Bits (Metric & SAE up to 3/4", hole saws (1. 1.5 & 2") and taps (Metric & English to 3/4")
- Hand Drills, 110V and/or cordless with chargers
- Clamps, 1 1/2" up to 6"
- Band Saw, upright, for materials softer than steel with extra blades
- Bench grinder with abrasive and wire wheels
- Work Bench with 6" Vice
- Arbor Press, 1/2 ton minimum (3 ton preferred)
- Bench Disc and/or Belt Sander" with Sandpaper, various grits
- Miscellaneous Tools such as: Sledgehammer, ball peen hammer, claw hammer, screw drivers, torx drivers, Allen wrenches, adjustable wrenches, center punches, hacksaws, files, and fasteners

The following equipment is a nice to have but not required:

- Vertical Milling Machine – 4" Z axis, 12" x & 6" Y - (X/Y Digital read out is useful)
  - With End Mills (1/16-1/2, two and four flute)
- Engine Lathes – 6" swing, 13" bed with associated collets, carbide & HS Tools, tool holders and 3 & 4 jaw chuck
- TIG Welding, with shielding and table
- Finger brake, free standing
- Portable Band Saw to cut steel or tubing
- Jigsaw/Sabre saw
- Router or Roto-zip
- Circular saw
- Rotary tool (e.g. Dremel) with variety of accessories (cutoff discs, sanding wheels, etc.)
- Air compressor

## NASA Mobile Machine Shops

NASA has a limited number of mobile machine shops that are allocated for use at selected Domestic U.S. *FIRST* Robotics Competition events through a generous grant provided to *FIRST* by NASA. The scheduling of these mobile machine shops is coordinated through *FIRST* HQ. HQ will send an application via the PDP email annually in the fall that must be filled out if your domestic regional event or District Championship would like to request NASA Machine Shop support. All requests will be considered, however, the final decision on approving requests is made by NASA; and their decision is final.

## Hosting NASA Mobile Machine Shop Requirements

If assigned a NASA Machine Shop, your event will be responsible for the travel and hotel costs for the NASA staff. In addition, you will need to provide certain materials (gasses for welding, access to power, etc.) *FIRST* will arrange for welding gases to be shipped directly to the venues for Regional and District Championship events. Show Ready will work with *FIRST* to coordinate power access and the delivery/pickup of the gas tanks. District events are responsible for ordering their own welding gases. *FIRST* requests District events that are hosting a NASA Mobile Machine Shop to order from the following vendor:

Airgas East

Address: PO Box 827049

Philadelphia, PA 19182-7049

Phone: 800-562-3815

Before filling out a NASA Machine Shop request, please be sure that your Regional/ District Championship has a minimum of \$4,500 available in the budget to cover the expenses associated with hosting a NASA Machine Shop. The total cost will vary, depending on the location of your event, the number of NASA staff attending, cost of hotels, etc.

The PDP will need to work to coordinate hotel rooms for each NASA staff member. *FIRST* will work with NASA to ensure that all travel arrangements have been made and provide you with arrival and departure dates to book the hotel rooms. Once you have the rooms booked, please provide that information to NASA staff directly and CC FRC Program Coordinator, Sarah McIntyre.

## Non-NASA Mobile Machine Shops

*FIRST* welcomes team-provided mobile machine shop facilities/trailers at events, but the proposed facility must comply with *FIRST* and venue requirements. The mobile machine shop/trailer owner must adhere to the following sections.

## Approval and Liability and Security Coverage (Regionals Only)

- Include an appropriate experienced operator to perform the requested work. Each must be covered under the provided liability coverage.
- Provide for any security requirements. Neither *FIRST* nor the venue will provide these services.
- Work with your Show Ready Event Planner (as applicable) to verify that your venue allows welding and if there are any requirements in doing so. It's possible the local venue will be required to have a safety check walk through with the local Fire Marshall/Authority. On occasion, a NASA machine shop (if the NASA center is local) will require a safety walk through by the local NASA Safety Officer with their Machine shop onsite.

## Off-Site Machine Shops

In most cases, the machine shop is on-site and readily accessible to all teams. If a team attends an event where the Machine Shop is off-site, volunteers are in place to transport the robot or parts to and from the machine shop. In this case, a team fills out a Machine Shop Request Form that travels with the robot or parts, so the machine shop staff and volunteers can follow their directions.

As much of the above equipment as possible should be on site to cover "first aid" with larger jobs transported to the remote facility. The Event Manager will advise the PDP and Regional Planning Committee on the transportation requirements at the initial site inspection. If the machine shop is on

campus, a golf cart type maintenance vehicle is appropriate. A quick rule of thumb is a walk of over three minutes, and/or terrain is too difficult to navigate with a simple dolly will require transportation.

## Local Restrictions

Although *FIRST* may approve a local machine shop use at any Regional, there are local restrictions such as fire codes, and venue approval that you must consider as part of the process. For US Regionals, *FIRST* will do its best to convey any relevant needs, and work on your behalf to gain venue approval through a professional and legal process. *FIRST* will need to understand and adhere to all health and safety rules and plans of the venue and/or municipality.

## Other Requirements

In addition to the above, if a team is sponsoring the Machine Shop, the sponsoring team(s) must:

- Include an electrical source for the mobile machine shop facility;
- Provide Fire Extinguishers as required by local Fire Marshall;
- Provide “Hot Work Permits” required for welding and torch work.
- Provide **inside** area to set up welding booth, if applicable;
- Ensure that every team has equal access to use the tools and machines. Access cannot be restricted to certain teams. The sponsoring team(s) should:
  - Handle job requests through the same counter/process as *FIRST* / NASA; - provided shop services; i.e.; provide a volunteer to take in and give back the jobs to the teams. This person should be knowledgeable and familiar with machine shop procedures. This procedure should include the sponsoring team’s requests.
- Operate **ONLY** during event hours when the Pits are open, and
- Provide a contact list with cell phone numbers to be available on the table.
- Provide a list of qualified names to operate the team machine shop, to the Event Manager.