FRC 2008

Inspector Training Manual

Document Purpose

•This document is intended to supplement the Inspection Checklist. Photographs and drawings are included to explain, clarify and illustrate the Checklist items.

•If there are any discrepancies between this document, the Inspection Checklist and the Robotics Competition manual (Sections 7 and 8), the manual rules.

Summary

- Role of Inspector
- Checklist Items
- Definitions
- Approved!
- Conclusion

Standards used in this document

•Reference numbers (✓X) in the slide titles refer to item numbers on the inspection checklist.

Team Responsibilities

Teams are strongly urged to have representatives available to present various areas of the Robot to the inspectors. Teams that have a clear understanding of how their machine works, and can express it, will have an easier time at inspection..

The Inspector

Preparation Resources

- Inspection Documents
  - Required Reading
    - Inspection Checklist
    - Robot Inspectors' Checklist Manual (this document)
    - Section 8 "The ROBOT" in the competition manual
    - Welcome to Inspection
    - Kit of Parts Checklist with Photos
  - Extra Credit
    - Q & A Bulletin Board
- Robot inspector job description
- Other experienced robot inspectors

You know you have had a good day as a robot inspector when:

- No issue is left unresolved
- The teams view you as someone who will do anything *within the rules* to help their machine compete
- Your observations are understood and acted upon
- You deal with the students, instead of coaches or mentors, letting the students field your questions
- You and your inspection team are eager to do it again

How to be a successful Robot Inspector

•Be prepared: Study the manual carefully. Try to understand the intent behind each rule. Know the inspection principles, logistics, and process.

•Be organized: Have your tools ready.

•Be a leader: Know the rules and follow them using gracious professionalism.

•Use good judgment and be flexible

Understanding *FIRST* Culture

- *FIRST* is a competitive event, but…
  - A core value of *FIRST* is that all teams have succeeded just by participating.
  - The competitions are a vehicle for celebrating that success.
  - Our role is to be a part of that celebration.
  - We are supporters, mentors, and helpers, not policemen.

Robot Inspector Duties

- Your job is to assess the team's work, and point out any things you see that are not in compliance with the rules.
- It is the team's responsibility to follow all of the rules. They own it, not you personally!
- You will not see everything that could be incorrect. You are looking for the major issues, particularly safety.
- You are also the feedback link to *FIRST* about the inspection process. How can we improve it?

Robot Inspector Teams

•Each regional event has a team of robot inspectors.

•The inspectors each have a role or roles.

1.Team sign-in & inspection master record.

2. Weigh-in

3. Machine-sizing

4. Cost accounting

5. General/mechanical inspector

6. Electrical inspector

7. Pneumatics inspector

•One inspector will be Lead Inspector who is responsible for the entire inspection process.

•Some inspectors may have the ability to inspect multiple inspection categories. *FIRST* leaves it to the Lead Inspector to assess the abilities of the inspectors and to assign tasks as required.

Qualities of a Good Robot Inspector

- Decisive and fair
- Firm, but not a nitpicker
- Diplomatic
- A team player
- Friendly and helpful

Inspector as Facilitator

•Nobody understands a particular Robot better than the Team.
•Actively encourage the team members to explain various sections of the Robot.
•Inspector helps the team be successful.
•If a team is struggling with a particular device, the inspector may help them find someone else in the pit that could help them.
•Inspector is in unique position to help facilitate cross team cooperation and information sharing.

Day by Day

Robot Inspectors Day: Wednesday and before

Wednesday & Before

•Know your inspection team assignment

•Lead Inspector meets with Event Manager to decide on inspection area.

•Set aside an area within the inspection area for teams to make quick violation repairs.

•Have inspector tools ready: clipboard, pen, paper towels or rag, flashlight, and access to the first aid station

•Lead Inspector trains the inspection team

•Review inspection checklist, this manual and related documents

Robot Inspector Day: Thursday

- Arrive early, prepare for the day. It will be a busy one.
- Set up inspection tables in agreed upon space.
- Walk around the pit area and look at robots – get familiar with the kit parts on them, don't be afraid to ask the kids to point parts out to you.
- Calibrate the Scale prior to team arrival.
- Conduct inspections.

  Teams inform the sign-in inspector when they are ready for inspection.

  Sign-in inspector assigns an inspector OR informs the team representative when an inspector will be available.

  Once the Robot passes the inspection, the inspector places a **PASSED INSPECTION 2008** sticker and colored dot on the machine and finishes the inspection with initials and date. Sticker instructions will be included in the envelope with the stickers.

Robot Inspector Day: Friday

•Calibrate the Scale

•Late inspections and re-inspections will also be done today – must be completed before a robot can compete.

•Remind teams making changes after the inspection process that they must request a re-inspection.

•The Lead Inspector or Head Referee may request a re-inspection at any point for due cause.

Robot Inspector Day: Saturday

•Same as Friday

EXCEPT…

Please make sure that ALL items are returned to the inspector's crate for shipping to the next event. Please replace any dead batteries and report any missing items or consumables.

-Scale

-Sizing System

-Demo Kit-of-Parts

-Tools for assembling above

-Calibration Weights

Inspection Process

•Pit announcer announces when the inspection area is ready to begin inspections.

•Pit announcer continually encourages teams to begin inspection process as soon as possible.

•As teams arrive, the sign-in inspector issues an inspection sheet with appropriate team number.

•Sign-in inspector instructs teams to: have cost information ready, to expect a weigh-in, a size check, and a technical inspection.

•All of the above may be done in any order, but all aspects need to be complete before the inspector signs and dates the completed checklist and initials and dates the PASS box on the inspection sticker.

•Tell teams: any segment of inspection can be done during the day OR teams can choose to have entire inspection done at one time.

•Inspectors will use their initials to indicate approval for each item.

•For violations, inspectors shall describe the violation(s) in the comment box.

•Make it clear to teams what your expectation is for correcting each violation you find.

CHECKLIST ITEMS

GENERAL

✓10 Robot Size Inspection

Sizing operation (refer to documentation within the inspection kit for details of the sizing mechanisms):

•Have team put robot in largest starting size

•Remove bumpers (per Rule R08)

•Determine whether the robot is within the required volume (refer to sizing system documentation for utilization details)

✓20 ✓30 Weight Inspection Guidelines

Although weighing the robot seems like a straight forward task, several things need to be understood.

•Team members should know what robot parts need to be with the Robot when weighing. Teams should present these parts with the robot.
•Team should be able to quickly remove the battery and compliant bumpers. No delays at inspection.
•The weight of the robot cannot exceed 120 lbs (excluding standard bumpers and bicycle flag). Standard bumpers (per R08) cannot weigh more than 15 lbs. In addition, standard bumpers should have a density of 3 oz per inch of perimeter length or less (ie no short heavy bumpers).

✓20 Things to include when weighing the robot

Include:

•Robot weight must include everything that could be on the machine during competition.

•Decorations

Don't Include:

•Spare and Replacement parts (see DEFINITIONS)
•Bumpers (per R08)
•12V battery and Anderson cable half

✓20 ✓30 Weighing Procedure

•If the scale drifts off of zero when empty, Press the 

button to zero.

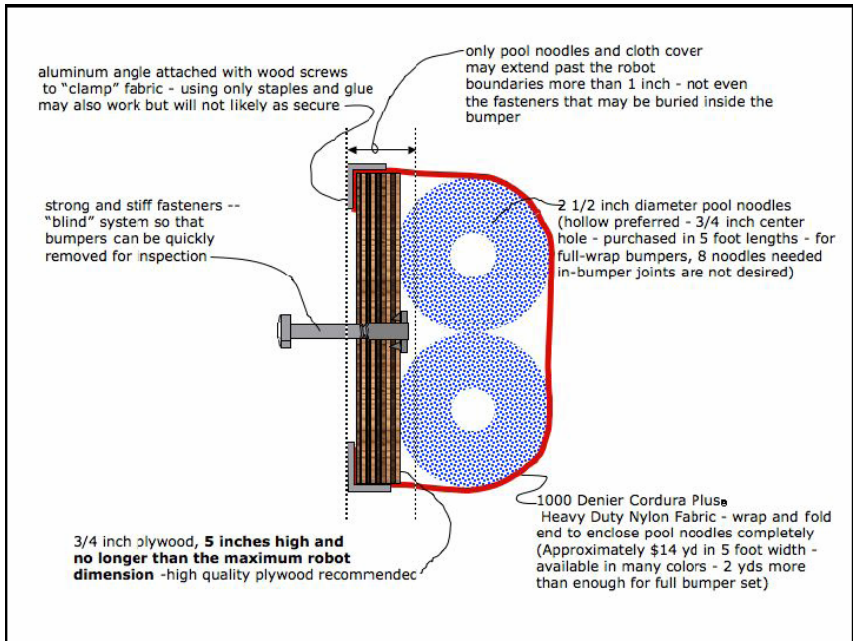
•Position the system to measure (robot or bumper) on the scale.

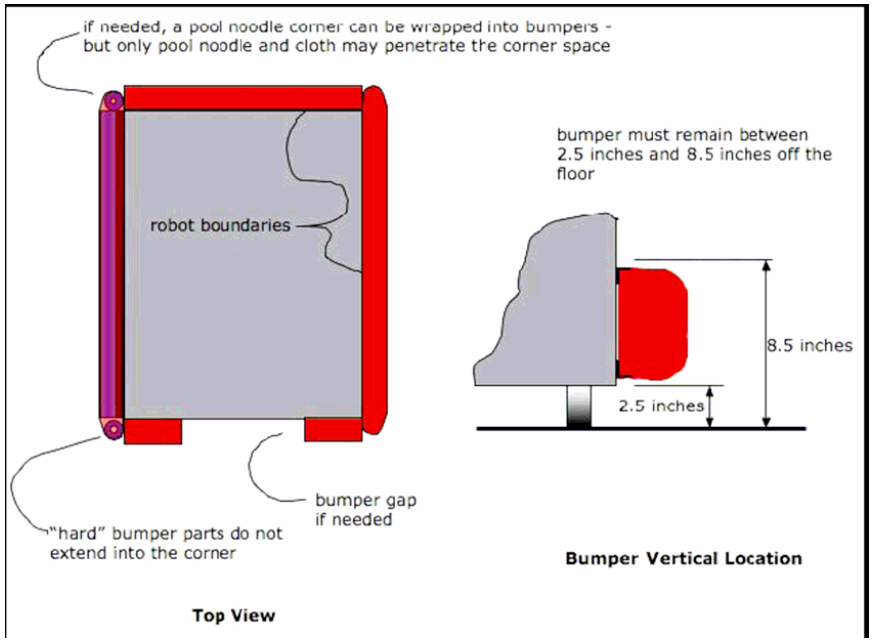
•Allow scale to stabilize for 10s

•Take reading

✓30 Bumpers…

Bumpers must be used to cover at least 2/3 of the perimeter of the robot and must use the design shown below. When mounted, bumpers may stick out past the maximum (28x38”) size by the amounts shown. They must be securely fastened (no Velcro) yet easily removable for size measurement.

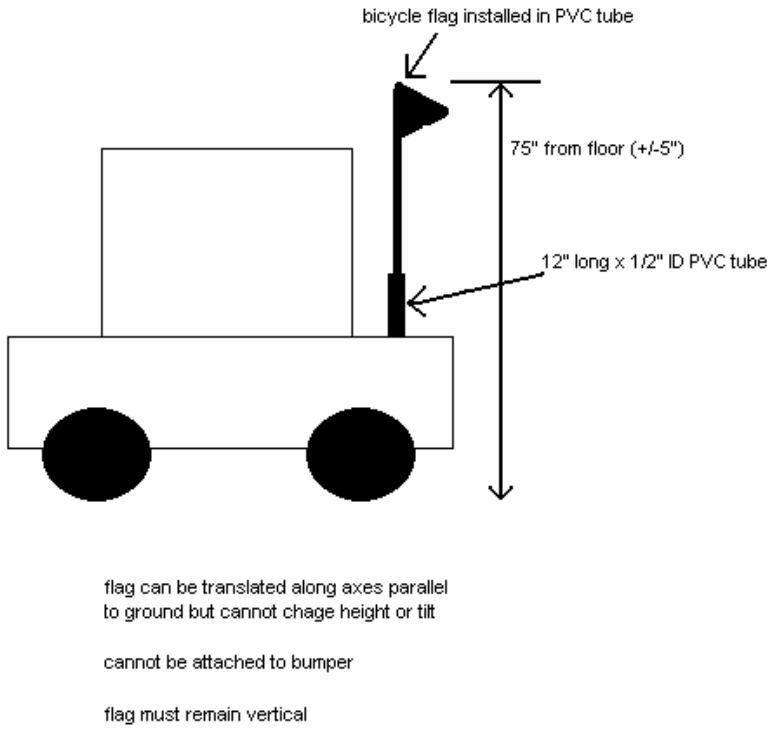




✓20 Robots should be reweighed if..

Replacement part or Upgrade part will increase Robot weight to above maximum. (inspector's judgment on whether to reweigh)

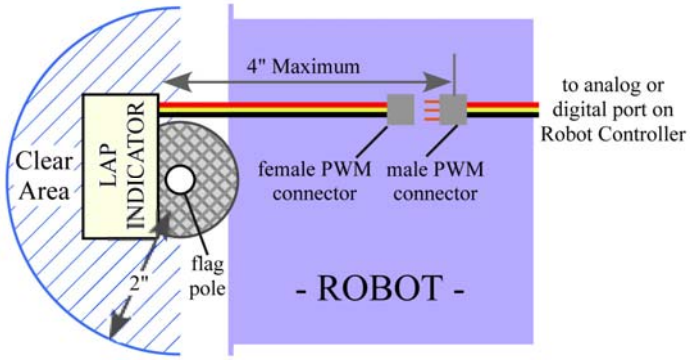
✓40 Bicycle Flag



- the robot must include a contiguous 12” long x ½” (nominal) ID Schedule 40 PVC tube to accept the flag (with no attempts at weight reduction)
- the robot’s PVC tube must be capped at its “bottom” with a cemented PVC cap
- the flag must remain approximately vertical while the robot is in its PLAYING CONFIGURATION (the orientation of the robot beginning sometime soon after the start of the match and continuing to the end of the match)
- the top of the flag must be 75” from the floor (+/-1”)
- the robot’s PVC tube cannot be attached to a bumper
- the robot’s PVC tube cannot be longer than 12”
- the robot’s PVC tube must be hard-mounted to the robot (eg no tape or hook-and-loop fasteners)

✓50 Lap Indicator

The robot must include an unobstructed area around the top of the flag holder for mounting the Lap Indicator. There must also be a powered PWM connector for supplying the module as shown below.



✓60 Cost Guidelines

Teams are required to have their additional costs presented in a detailed Bill of Material (BOM). The teams are required to provide a hardcopy printout.

Teams - The quality of the team's organization here goes a long way toward convincing the inspector of the accuracy of your numbers A sloppy listing may make the inspector think that the accounting is equally sloppy. Make a professional presentation.

✓60 Sample Spreadsheet

Team Number		Date		Event:		
2B2		dd/mm/yy		Manchester		
	Description	**Number Purchased**	**Cost per unit**	**Total Cost**	**Vendor**	**Vendor Part Number**
Electrical Costs						
	100 ft roll 18AWG PVC inslulated Red wire	1	$21.26	$21.26	Newark	123xyz
	Box of Terminal Lugs	1	$5.50	$5.50	Radio Shack	8924t
Mechanical Costs						
	12" x 12" steel sheet 1/8" thick	1	$15.00	$15.00	MSC	FSLKR269
	90deg 1/4 Elbow	2	$1.00	$2.00	MSC	Plumb678
Miscellaneous						
	4" high stick on letters for team Number	12	$2.00	$24.00	Joe's label shop	Various
			Total =	**$67.76**		

Maximum unit cost for Electrical Item $400 USD →

Maximum unit cost for Non-Electrical Item $400 USD →

Maximum total cost $3500 USD

✓60 Total Costs & Max. Individual Costs

$3500 USD maximum Total Cost of Non-Kit items

$400 USD maximum for an individual COTS Electronic part

$400 USD maximum for an individual COTS Non- Electronic part.

COTS = Consumer Off the Shelf Parts

✓60 Items Excluded from Total Cost

Lubricants

Adhesives

Non-Functional Decorations

Also:
- Spare Parts: Parts that are duplicates of parts already on Robot.
- Anything used on the Alliance Station
- Replacement parts for items missing from kit

Fasteners: if no individual part costs more than $1.00 USD

✓60 Cost Comparison: Sponsor Provides Labor

Raw Material + Machining = Finished Part

Material Cost = $10.00

Recognized Sponsor provides 1 hour Labor (typical labor rate is $30/hour)

Total Cost = Material Cost = $10.00

Teams are encouraged to get as many sponsors as possible. Since the sponsor is considered a Team member, their labor isn't included in the cost accounting.

✓60 Cost Comparison: Non-Sponsor Provides Labor

Raw Material + Machining = Finished Part

Material Cost = $10.00

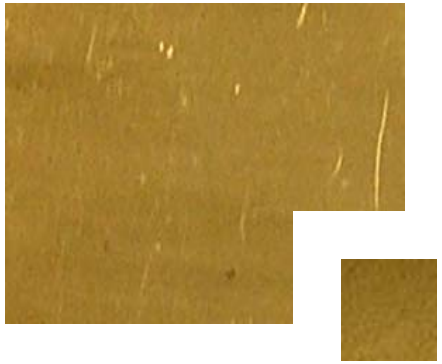
Non-Sponsor donates or charges team for 1 hour of Labor (typical labor rate is $30/hour)

Total Cost = Material Cost + Labor Cost = $40.00

Since the labor is provided by a non-sponsor, team must account for the labor cost even if the labor was donated.

✓60 Cost Determination of Bulk Purchased Items: Stock

Bulk Purchased 4’ x 4’ steel sheet for $160 USD to be sure they had enough material. ($10/ft^2)



Team used only 10” x 10”

Example 1: Team looks in catalog and determines that 12” x 12” pre-cut pieces are available for $15.
Team should put $15 on their cost accounting sheet.

Example 2: Team looks in catalog and determines that 4’ x 4’ is the smallest size available.
Team should put $160 on their cost accounting sheet.

There’s no advantage to buying more than you need. You should plan ahead. Price is based on the smallest commonly available unit.

✓60 Cost Determination of Bulk Purchased Items: Wire

100 foot Roll of 18 AWG PVC insulated Hook-up wire costs $21.26

100 foot roll is the smallest available size

1000 foot Roll of 18 AWG PVC insulated Hook-up wire costs $113.25

Example 1: If the team uses 80 ft. they must use the 100 foot roll price.
$21.26 should appear on the Cost accounting sheet.

Example 2: If the team uses 101 ft. they must use two 100' rolls.
$42.52 should appear on the Cost accounting sheet.

Price is based on the smallest commonly available unit that satisfies the teams needs.

✓60 Cost Determination – Parts of Modular Assemblies

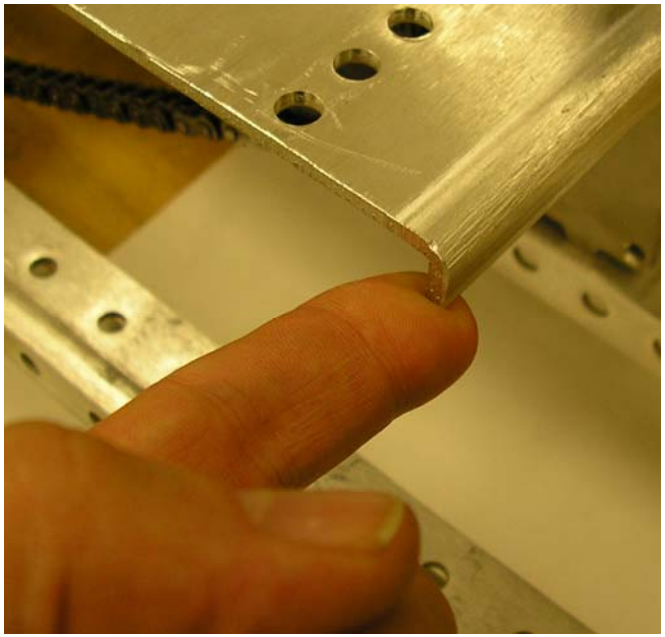
Be on the lookout for "cost-splitting" – dividing an expensive assembly into a group of components that are individually below the $400 threshold.

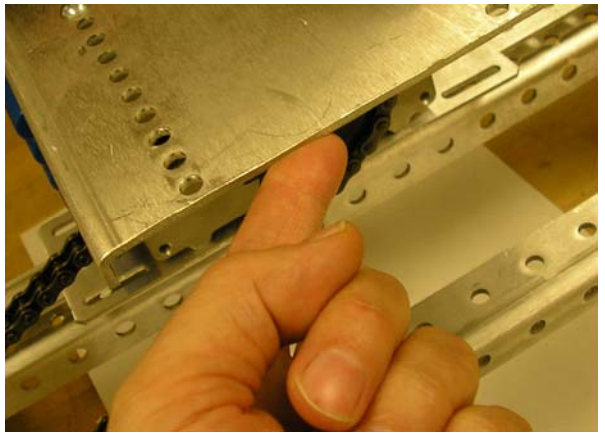
Teams are NOT allowed to sneak an expensive assembly into their robot using "cost-splitting".

The only exception to the "cost-splitting" ban is for designs that do not use all of the components in at least one variation of the robot's starting configuration. In other words, the expensive assembly is truly modular and the team intends to exploit that modularity.

✓80 Sharp Edges

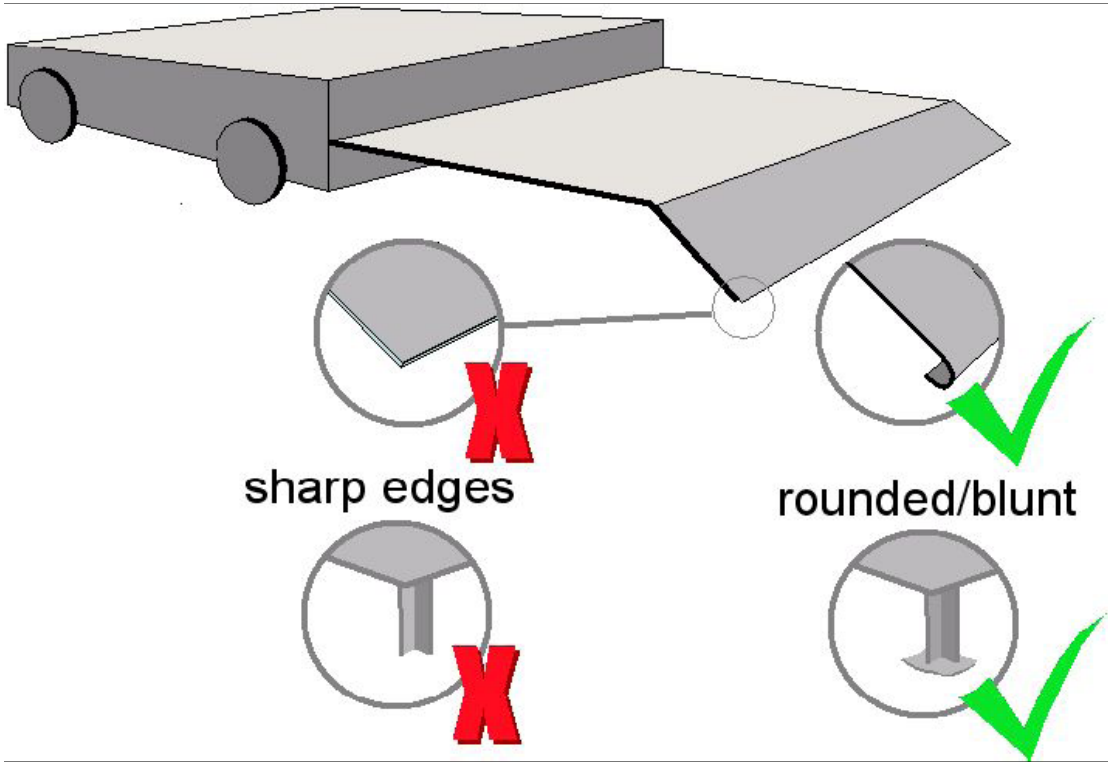
You should be able to run your finger along any surface on the Robot and not get cut. Pay special attention to materials that were sawed or machined.





✓80 Sharp Edges – Carpet Contact

With the exception of wheels, robots must slide freely on the carpet. It is nearly impossible for FIRST to repair the field during a regional in the event that a robot tears the carpet.

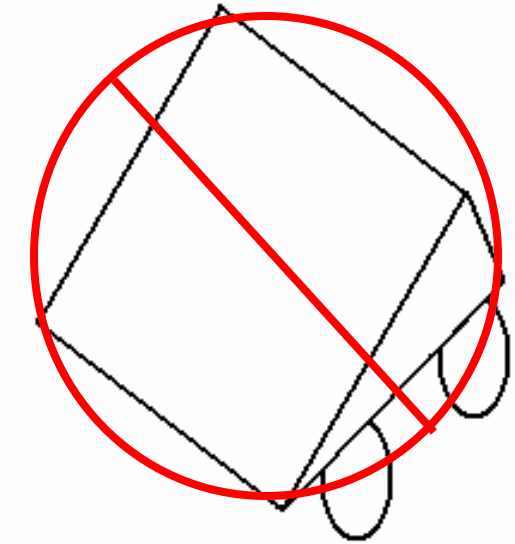


✓80 Puncture Hazards

Inspector will check machine for any protrusions that may present a puncture or impalement hazard. Leading edges not less than 1 in ^{2}.

Ask yourself: If this robot ran into me, would something sharp on it draw blood? Could this robot puncture a tube on the field?

✓80 Wedge Robots



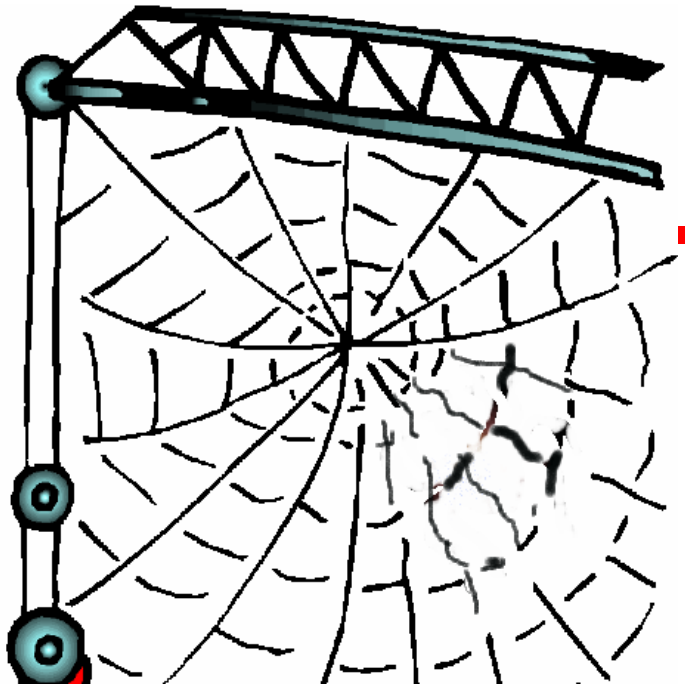
WEDGES ARE NOT ALLOWED!!

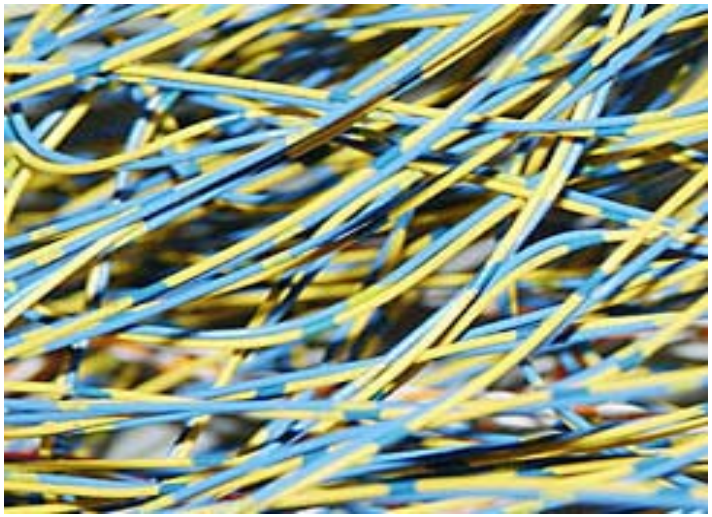
Carefully examine the robot for design elements that could potentially lift another robot.

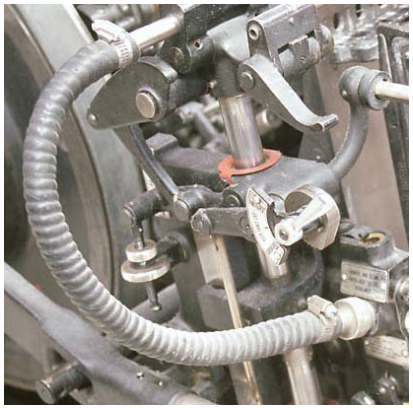
All parts of the robot base between 0” and 8.5” from the ground that are expected to contact other robots during the competition must be within 10 degrees of vertical.

✓80 Entanglement

Entanglement with another robot could disable your robot. You could get hoses or wires pulled off. Look for anything that could get caught on another Robot's arm or other part. loose cables, hoses, cordage,

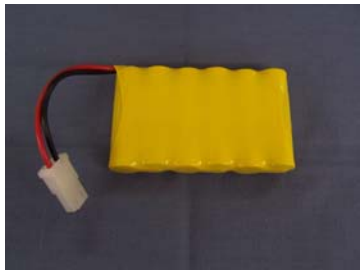






✓90 Allowed Energy Sources

12 Volt battery



7.2 Volt backup battery

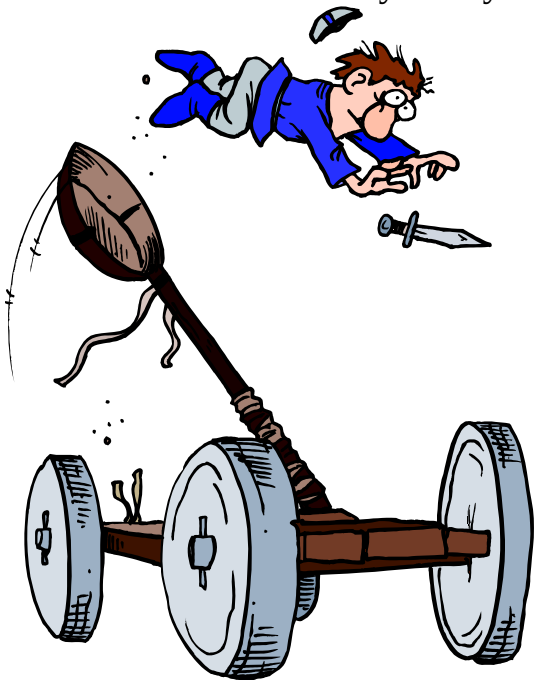
Gravity

Compressed air stored in
up to 4 Clippard tanks.

Stored Energy devices if safe.
See Stored Energy Hazards Slide.

✓90 Stored Energy Hazards

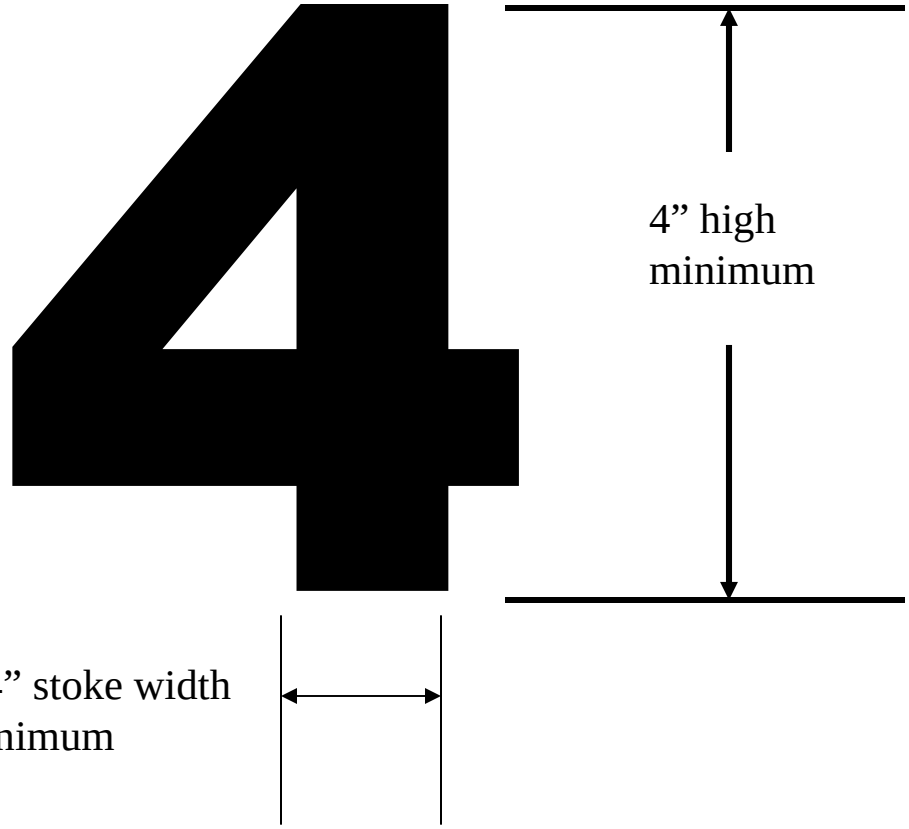
Stored energy devices are allowed but cannot pose a hazard. Inspector will look for any stored energy hazards. Devices such as compressed springs, dropping masses, and mechanically deformed parts can present a serious hazard if the energy is suddenly released. Teams should be expected to demonstrate the function and safety of any stored energy devices.



✓100✓110 Marking Visibility and Logos

Robot is marked on four sides with team numbers. If you were a judge, you should be able to see the number from 100' Not obscured by arms…….

ALSO –
School Name and Primary Sponsor Name/Logo must be displayed.



✓120 LED Flasher

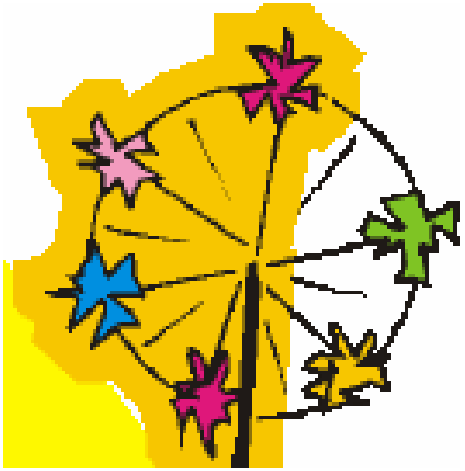
The LED should be clearly visible when standing in front of the robot in its starting position.

Inspector should ask: Would a Judge or Referee be able to see the LED from the sidelines?

✓130 No interference with another Robot's Vision System.

No devices or decorations intended to jam or interfere with operation of vision system are allowed.

No color changing features on Robot



✓150 No interference with other teams' visibility

No devices or decorations (such as shields or curtains) that may interfere with the ability of teams to remotely control their robots.

✓160✓170 Adhesive Tapes

OK

Sticky labels
•Electrical tape (for electrical insulation only)
•Velcro Tape, Hook-and-Loop Tape and double-sided foam for attaching components
•Reflective tape used with optical sensors in small amounts
•Textured or coated tapes to provide alternate surface finishes

Not OK

•Duct Tape
•Using tape to cap or attach bicycle flag holder

✓170 Check Traction Devices

OK

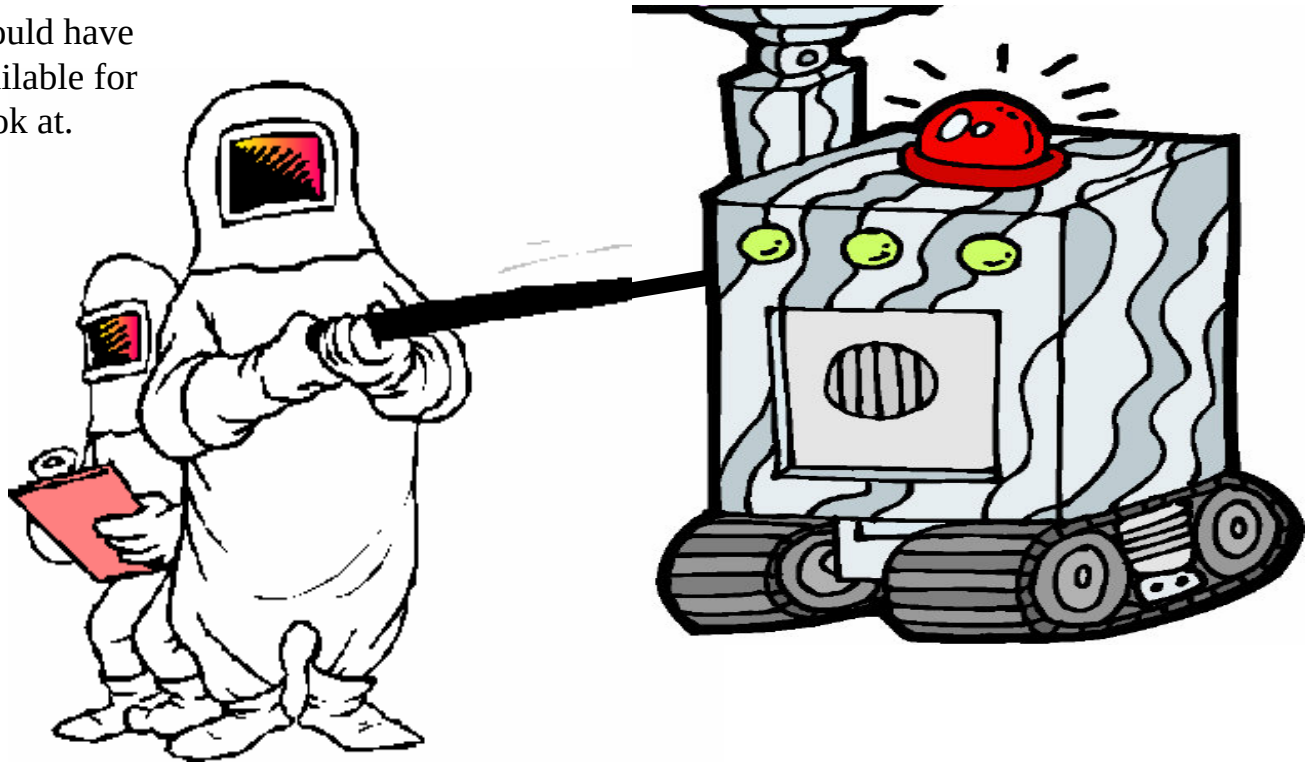
•Stabilizing arms with rubber or equivalent against field surface

Not OK

•Anything that could damage the playing field.
•Metal cleats
•Studs
•Velcro
•Sandpaper
•Wire Brushes

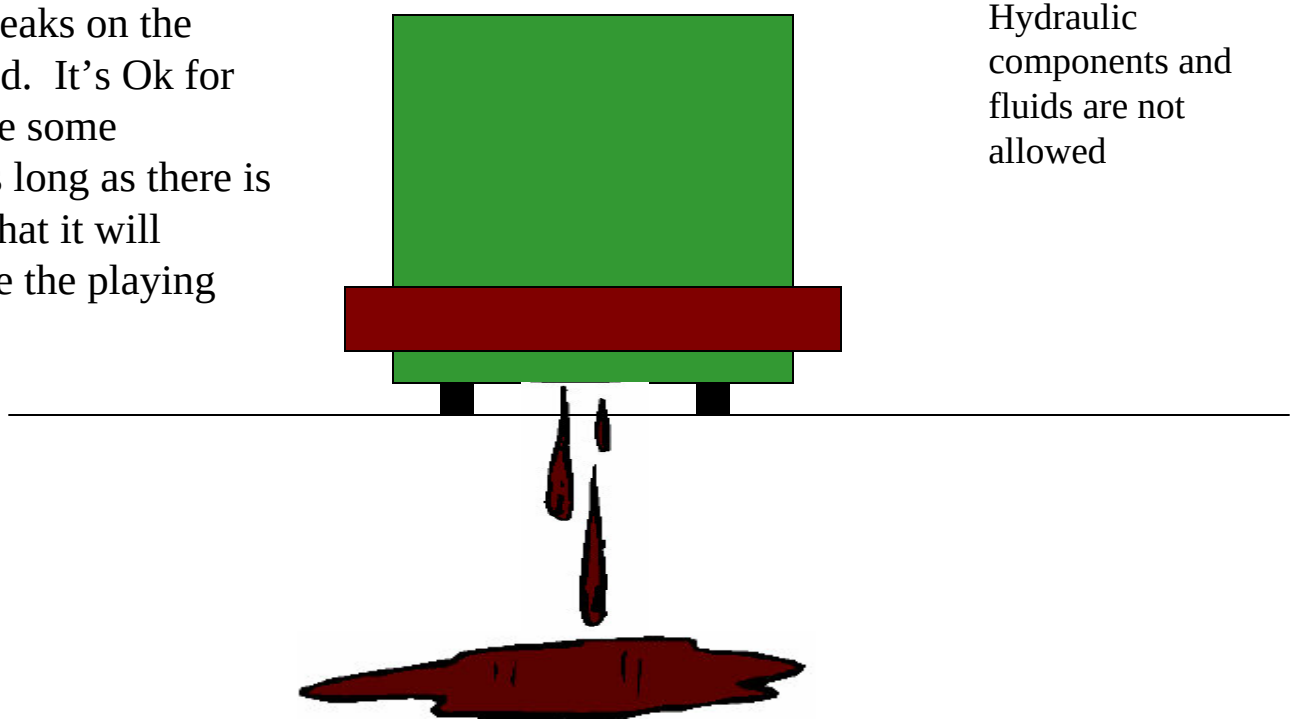
✓170 No Hazardous Materials

No Hazardous Materials:
Any questionable materials that a team uses should have an MSDS sheet available for the inspectors to look at.



✓170 Check for Leaking Lubricants

The intention of this rule is to prevent leaks on the playing field. It's Ok for teams to use some lubricant as long as there is no danger that it will contaminate the playing field



Hydraulic components and fluids are not allowed

✓180 Motor Modifications

The purpose of this rule is ensure that every Robot has the same maximum power output and to avoid destructive motor failure resulting from aggressive modifications.

OK

Shorten leads (external to motor, any added wire must conform to wire size rules).

Modify Mounting brackets.

NOT OK

Modify motor internal electrical system.

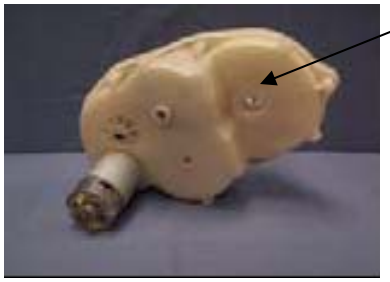
Modify integral mechanical parts.

Replacing leads (from inside motor).

Removing mass for any purpose other than mounting mods and discarding gearbox and output shaft mechanisms.

OK to remove gearboxes from these motors (also from Banebots motor)

Globe Motor



Fisher Price

ELECTRICAL & CONTROLS

✓190✓200 Only one MK Battery ES17-12 on Robot

Make sure that the battery is securely fastened within the robot (eg in a "pocket" with a velcro strap)!

MUST be –
MK Battery ES17-12

the following line (12V-18AH/20HR) may be different and the battery color may vary

✓190✓200 Check Speed Controllers

Only VICTOR 884 Controllers are allowed.
Not 883 or 885's

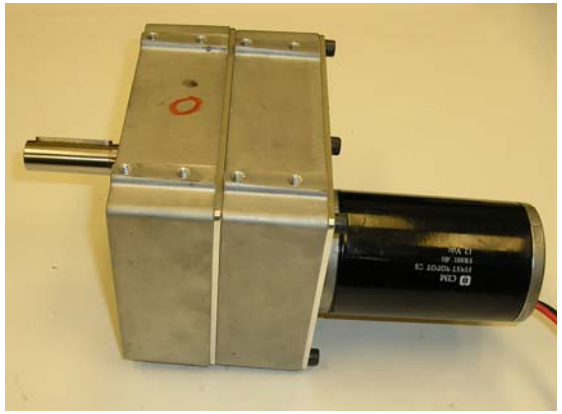
(the 884 Controllers may have different colors)

884's only

✓190✓200 Small CIM Motors: 4 Allowed

The 2008 KOP includes 2 of the smaller CIMs (FR801-001 or M4-R0062-12). Teams may additionally purchase and include 2 of the smaller CIMs on their robot.

6”scale shown for sizing..



These motors will typically be mounted to a gearbox.

✓190✓200 Motors other than CIMs

The 2008 KOP includes a number of various motors. Teams are not permitted to use any motors that are different than those provided in the kit. Furthermore, teams may only use the quantity of motors provided in the kit (with the exception of using up to 2 additional CIMs for a total of 4 CIMs).

Please refer to the Kit of Parts checklist for quantities, part numbers and pictures for the various motors that have been included in the kit.

There is one set of exceptions to the above rule – teams are permitted to use any number of FTC servos and motors (IFI P/Ns 276-2162 and 276-2163).

✓190✓200 Allowed Circuit Breakers

Find many of these on the ATC Fuse Panels and Maxi Style Fuse Block

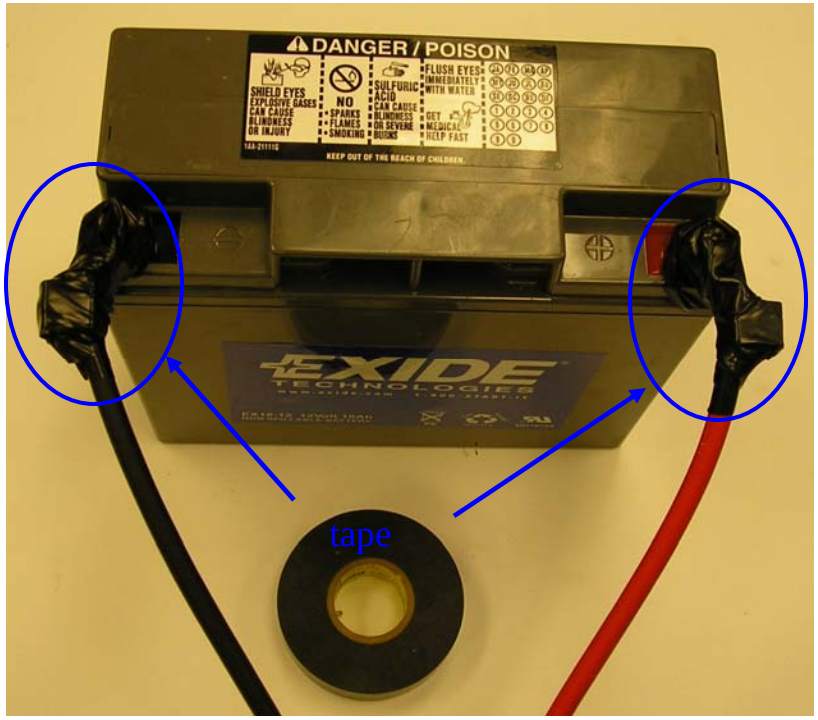
Main shutoff breaker attached directly to battery (via Anderson quick-disconnect connectors) and feeds the Rockwell Power Distribution Blocks

✓210 Connections to Battery – Insulated Crimp Lugs

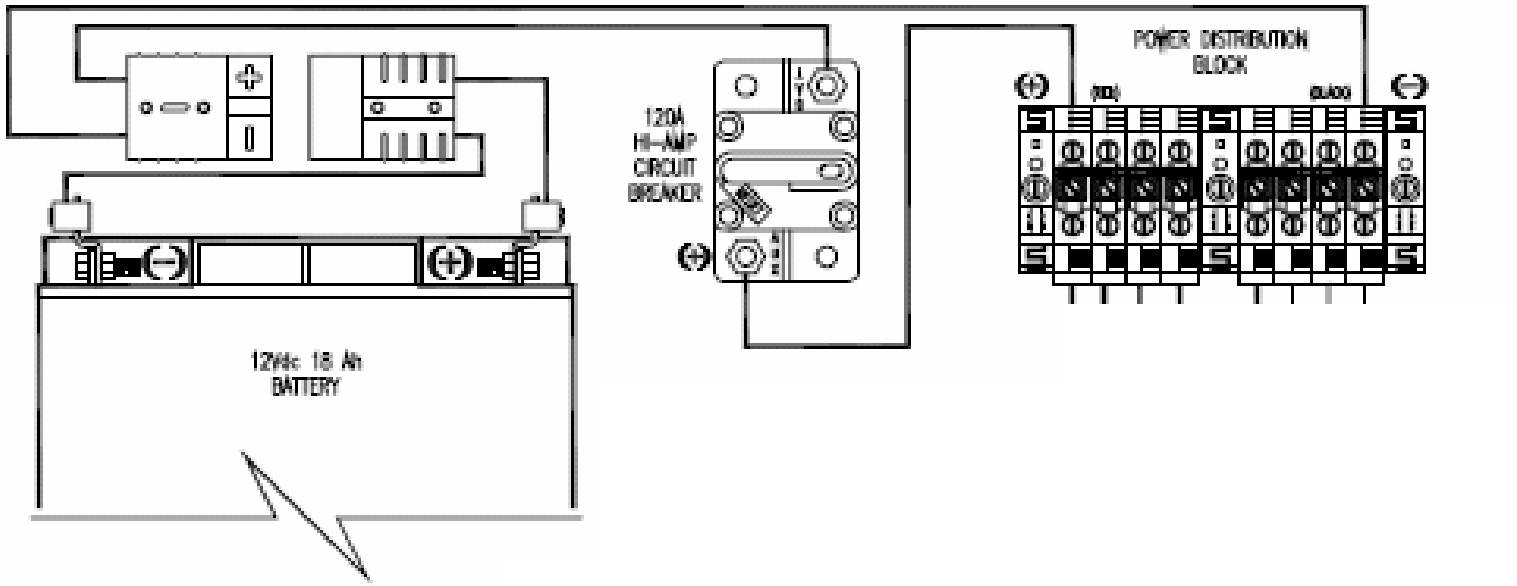
Before insulation shown for reference only.

*** The pictures on this page show lugs and battery from prior years' KOP. Teams must use the MK Battery ES17-12 from the 2008 KOP. Teams may use the FCI Burndy lugs from the 2008 KOP but are permitted to use any comparable crimp lug.**

Terminals must be insulated with electrical tape, shrink tubing or similar material. Inspectors can feel though the insulation for the crimp lug connectors.



✓220 Battery, Anderson Connector, Main Breaker, Power Distribution Block

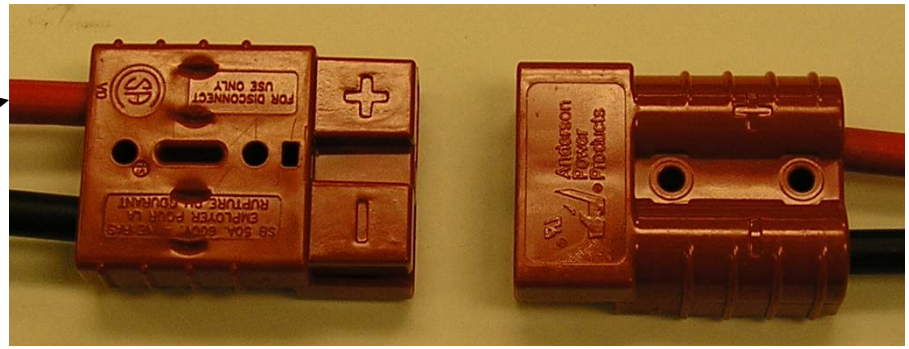


- The above diagram is from the 2008 FRC Power Distribution Wiring Diagram. Teams MUST wire the components as shown but may use as many of the positions in the Power Distribution Block as they wish.

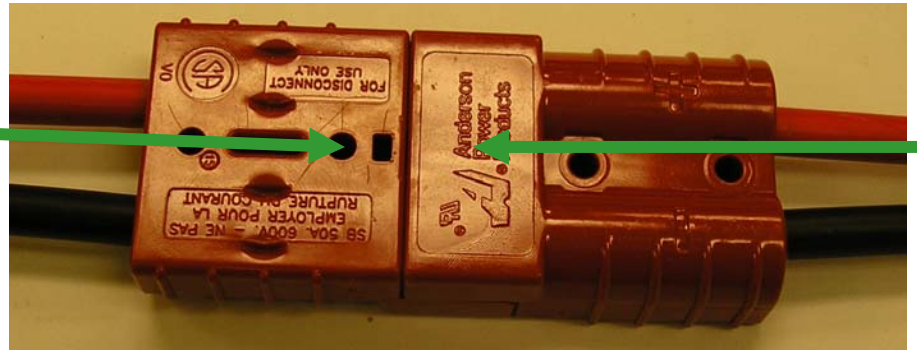
✓220 Anderson Quick Disconnect Connector Demonstration

Uncoupled

RED wire is connected to + Terminal



Coupled



✓230 Main Circuit Breaker is Accessible

This is typically used as the ON/OFF button for the robot.

In an emergency, a team member or Referee would want to be able to find and press the RED button quickly.

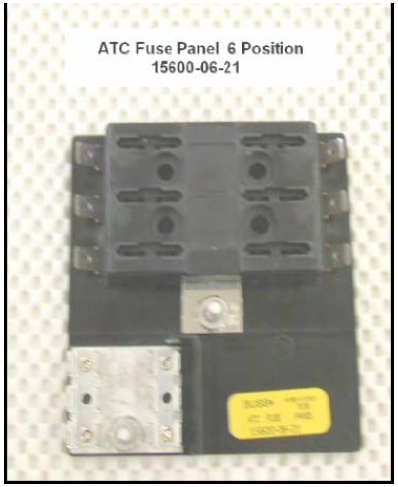
Would you feel comfortable enough to reach in and throw the switch in an emergency?

✓230 Circuit Breakers Accessible for Inspection

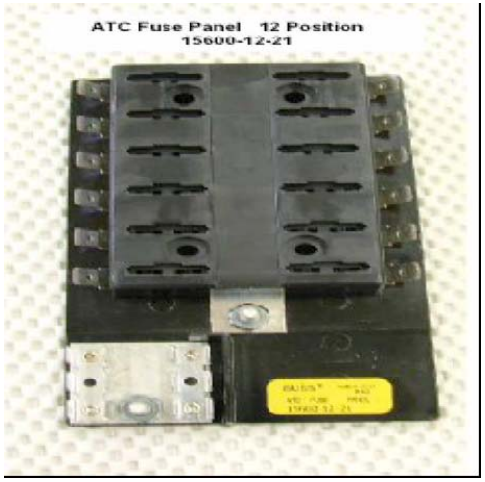
20, 30 and 40A Circuit Breakers (these are plugged into the modules below)

Maxi Style Fuse Block (should only contain 40A breakers (not a specific rule), each team can use 2 of these on their robot)

6-position ATC Fuse Panel (only 1 per robot)

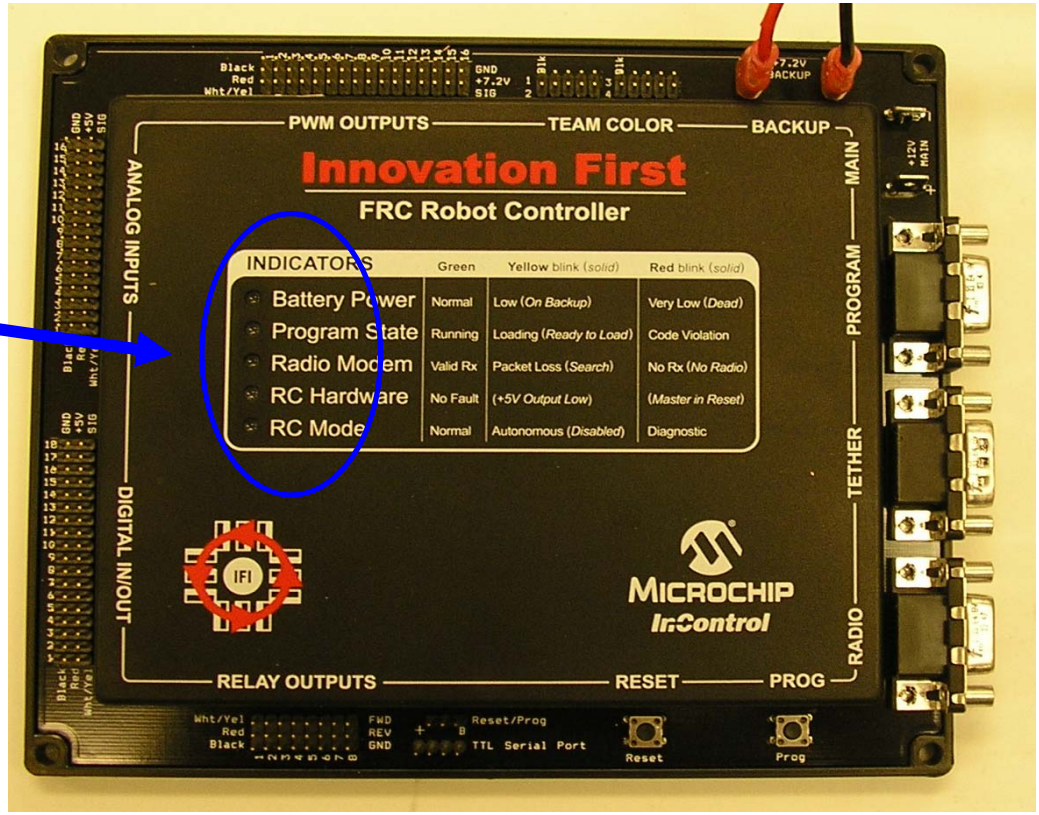


12-position ATC Fuse Panel (only 1 per robot)



✓230 Robot Controller

Indicator Lights must be readily visible

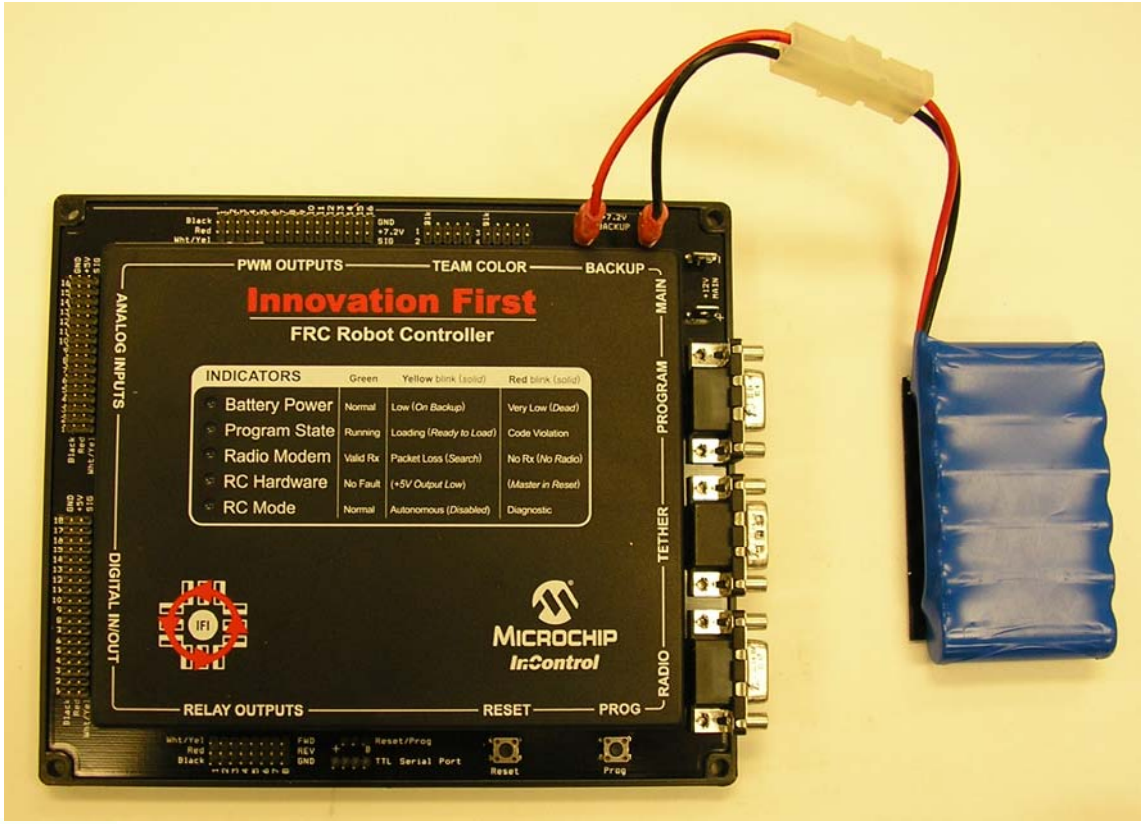


Inspector must be able to easily see all connections made to the controller

✓240 No Modifications to the Robot Controller

DON'T MODIFY THIS!! (except its software)

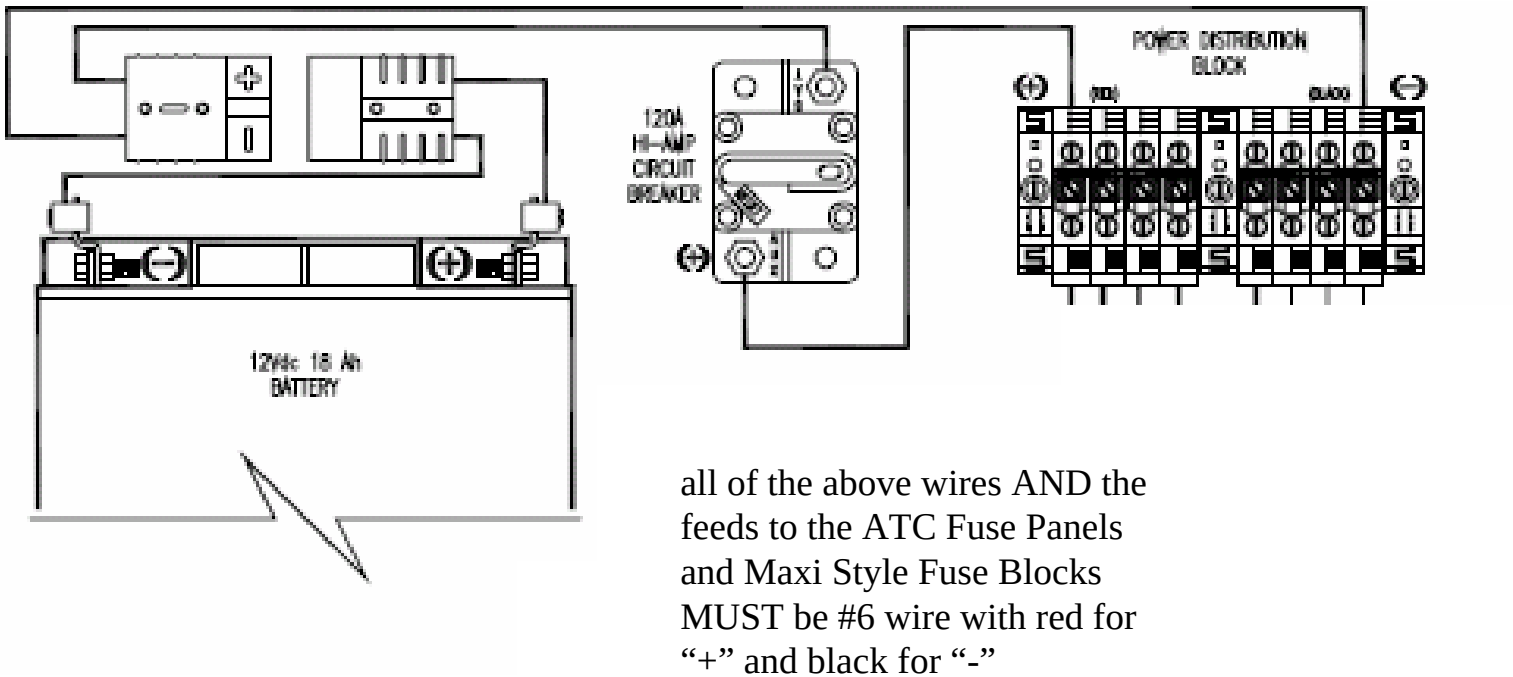
✓260 7.2V NiCad Battery Pack



Teams are allowed (encouraged) to include an on-robot charger for the 7.2V battery to continuously maintain charge using the robot's 12V battery. The on-robot battery charger consists of a circuit board between the 7.2V battery and the RC with an additional connection to 12V power to the RC (must be supplied from the same 20A breaker as the RC).

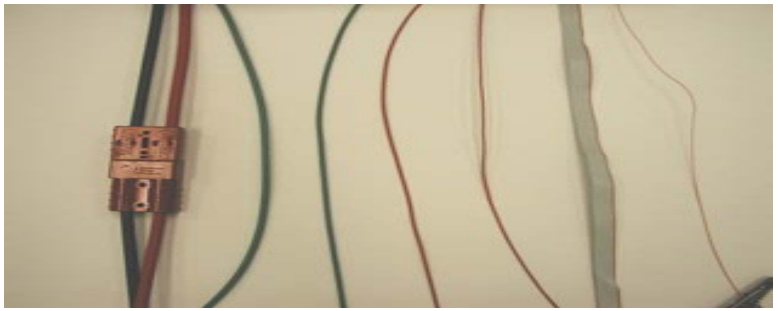
IF the teams use an on-robot charger, they may either use the IFI-designed circuit that is available online or a similar custom circuit.

✓270 #6 Wire for Main Power



all of the above wires AND the feeds to the ATC Fuse Panels and Maxi Style Fuse Blocks MUST be #6 wire with red for "+" and black for "-"

✓270 Wire Sizes



Wire Gauges (AWG) = 6 12 14 18 24 ribbon 32

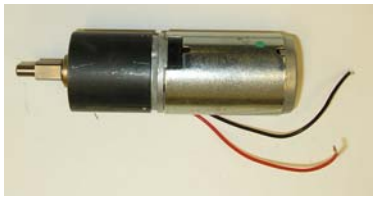
- 6 AWG (or larger diameter) must be used in battery-to-Maxi/ATC Panel path
- 12 AWG (or larger diameter) must be used in circuits connected to 40A breaker
- 14 AWG (or larger diameter) must be used in circuits connected to 30A breaker
- 18 AWG (or larger diameter) must be used in circuits connected to 20A breaker
- 24 AWG (or larger diameter) must be used for wiring pneumatic valves
- 24 AWG or larger may be used for sensors, vision system, muffin fans, LEDs and PWM signals
- Ribbon cables with individual conductors smaller than 24AWG may be used to connect to the 9 pin ports on the Robot Controller

**EXCEPTIONS – Cables that are included in the kit and intended to power kit parts (eg solenoid valves and cameras) and cables attached to motors do NOT have to obey the above rules. The exempt cables may be shortened (motor cables cannot be disconnected directly at the motor windings) but extensions/replacements MUST obey the rules.

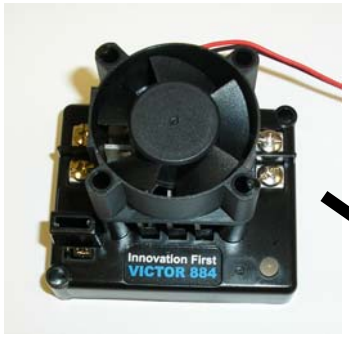
✓270 Wiring Conventions

+ POSITIVE +	- NEGATIVE -
RED	BLACK
WHITE	BLUE
BROWN	

✓280-✓290 Wiring Paths – Need a Breaker



Motors, compressor and solenoid valves **must** be wired to a Speed Controller or Spike Relay which, in turn, **must** be wired to an ATC Fuse Panel or Maxi Style Fuse Block



or

OR ATC Fuse Panel

✓290 20A Circuit Breaker Must Be Used For…

- **SPIKE Relay Modules**
- **Air Compressor**
- **Custom Circuits**
- **Robot Controller**

ALSO…

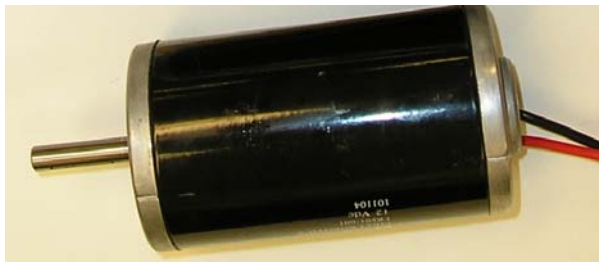
Only 1 motor can be driven by each SPIKE Relay.

Circuit Breakers driving the Robot Controller and the Air Compressor cannot be used to drive any additional load.

✓290 One Motor per SPIKE

only one motor (any of the kit motors (air compressor included), excluding the CIM and FP) is allowed to be connected to each SPIKE's M+ and M- outputs

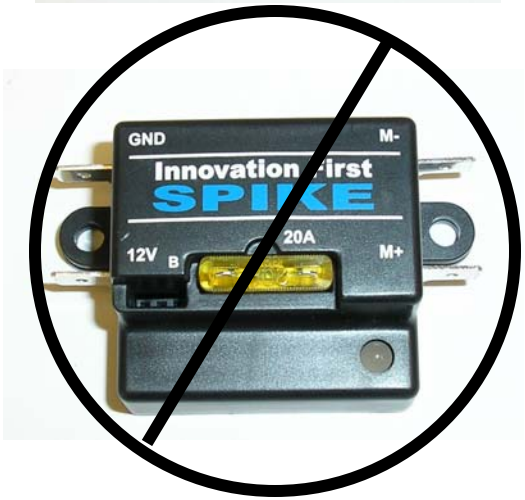
✓300 Motor Wiring Requirements



CIM

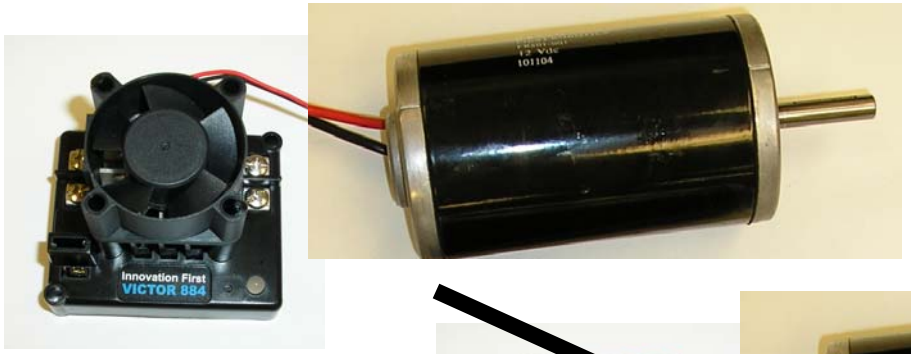
Fisher-Price

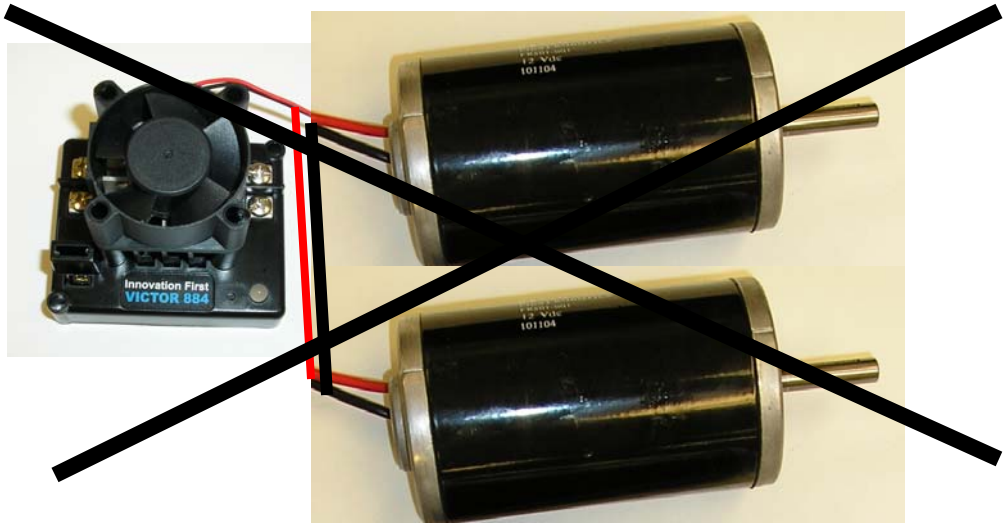
These motors, if used, must be wired to an 884 not a SPIKE Relay



✓305 Motor Wiring Requirements

Only one motor may be attached to each Victor and Spike





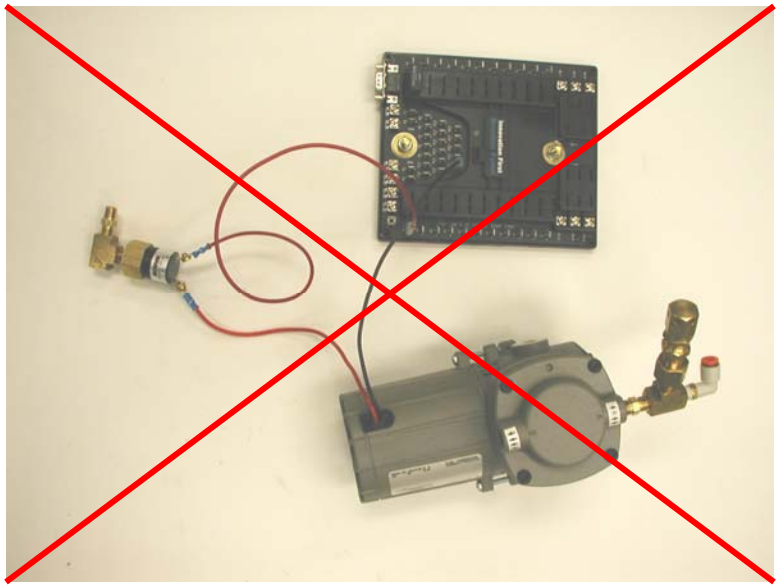
✓310 Motor Wiring Requirements

air compressor (the 20A fuse on the SPIKE can be replaced with a 20A Snap Action breaker)

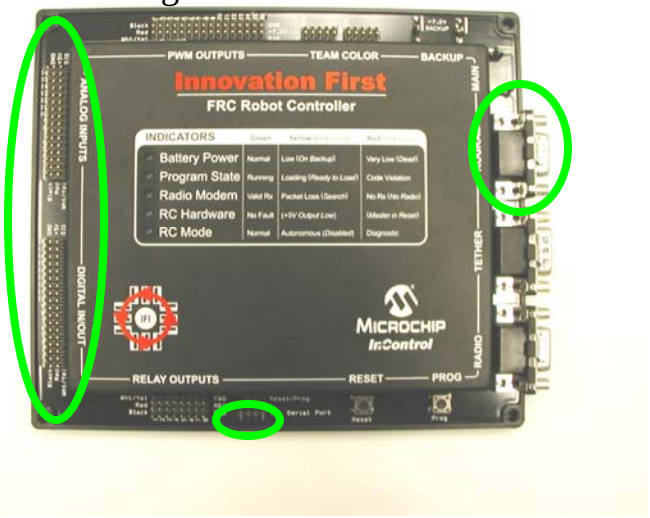
These devices, if used, must be wired to a SPIKE Relay and not an 884

pneumatic valves

✓330 Sensor Outputs ONLY Connected to Robot Controller or Custom Circuit

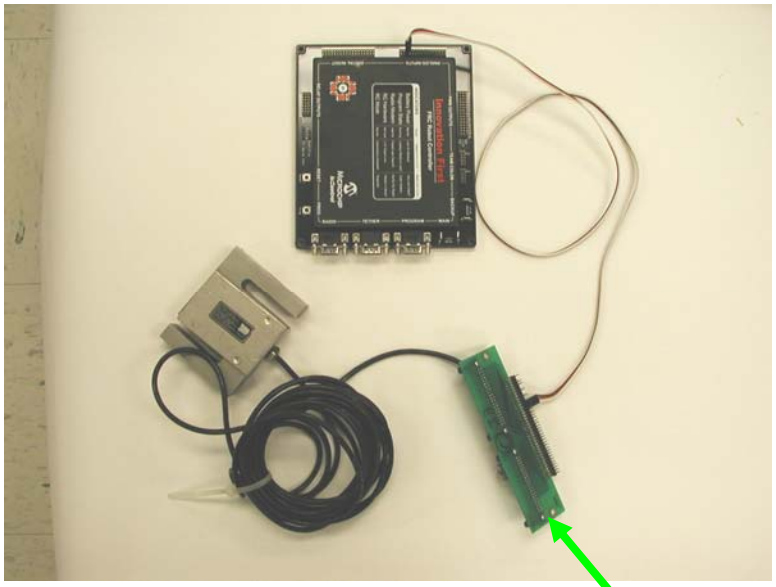


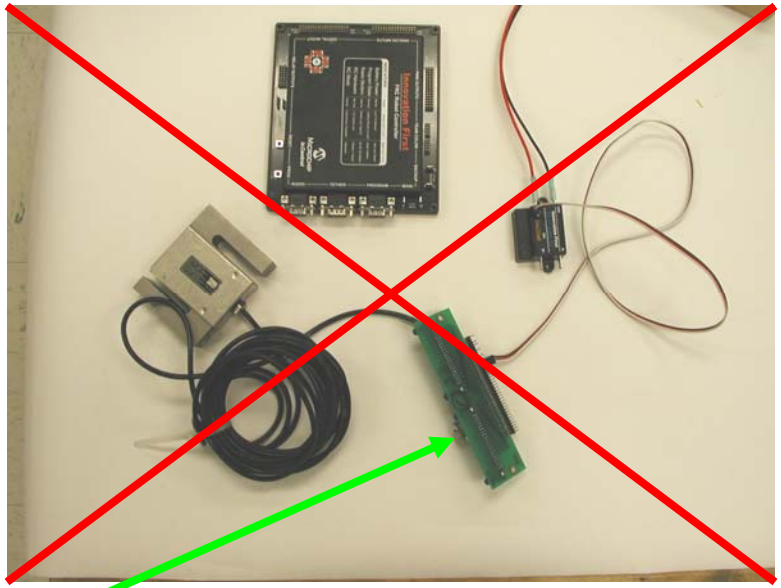
Sensor outputs can be connected to ports circled in green or to Custom Circuits



ALL sensor outputs (including the pressure switch shown above), MUST be connected to inputs on the Robot Controller or Custom Circuit. Sensor outputs CANNOT directly apply power (eg using a pressure switch to turn the air compressor on/off as above) or provide inputs to Speed Controllers or Spike Relays.

✓340 Custom Circuits



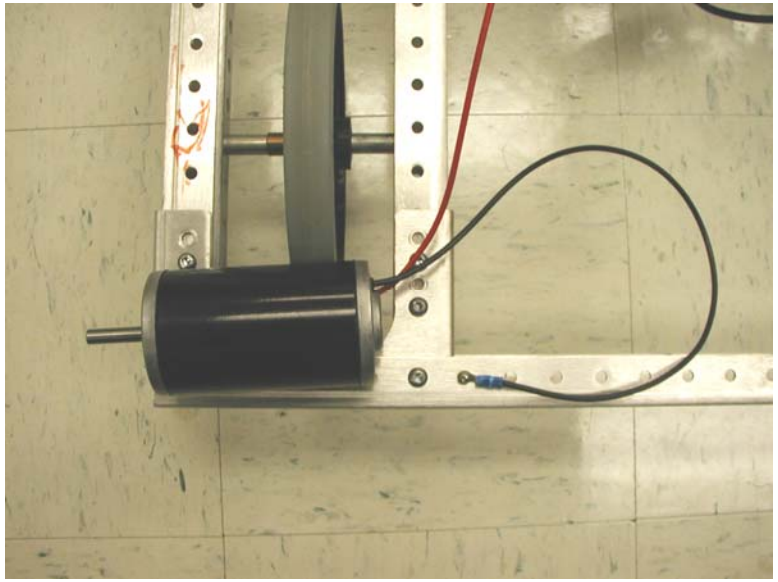


Example of Custom Circuit

MAY be connected to any port on the Robot Controller (except Radio or Tether Port), Speed Controller and Spike Relay outputs, to any kit or COTS sensors

CANNOT directly affect an output device (or be used for wireless communication or connect to the Radio or Tether Ports on the Robot Controller)

✓350 No Exposed Electrical Conductors



Teams are NOT allowed to use their chassis to carry electrical currents. The picture at left shows a ground connection for a CIM motor attached to the chassis – NOT ACCEPTABLE! Although it's tempting to use the metal chassis to carry currents and thereby minimize wiring, FIRST robots MUST use dedicated wiring for ALL electrical currents.

If possible, a preferred inspection technique involves measuring the resistance between the robot's chassis and each terminal of the battery. Neither battery terminal should be connected to the chassis with a resistance less than 1MegaOhm.

✓370 Decorations

Any decorations on the robot that use electrical power must be powered from the on-board MK Battery ES17-12 and must be protected with either a 20A or 30A circuit breaker on an ATC Fuse Panel. Decorations CANNOT interfere with other control system components.

PNEUMATICS

✓370-450 Pneumatic Inspection Guidelines

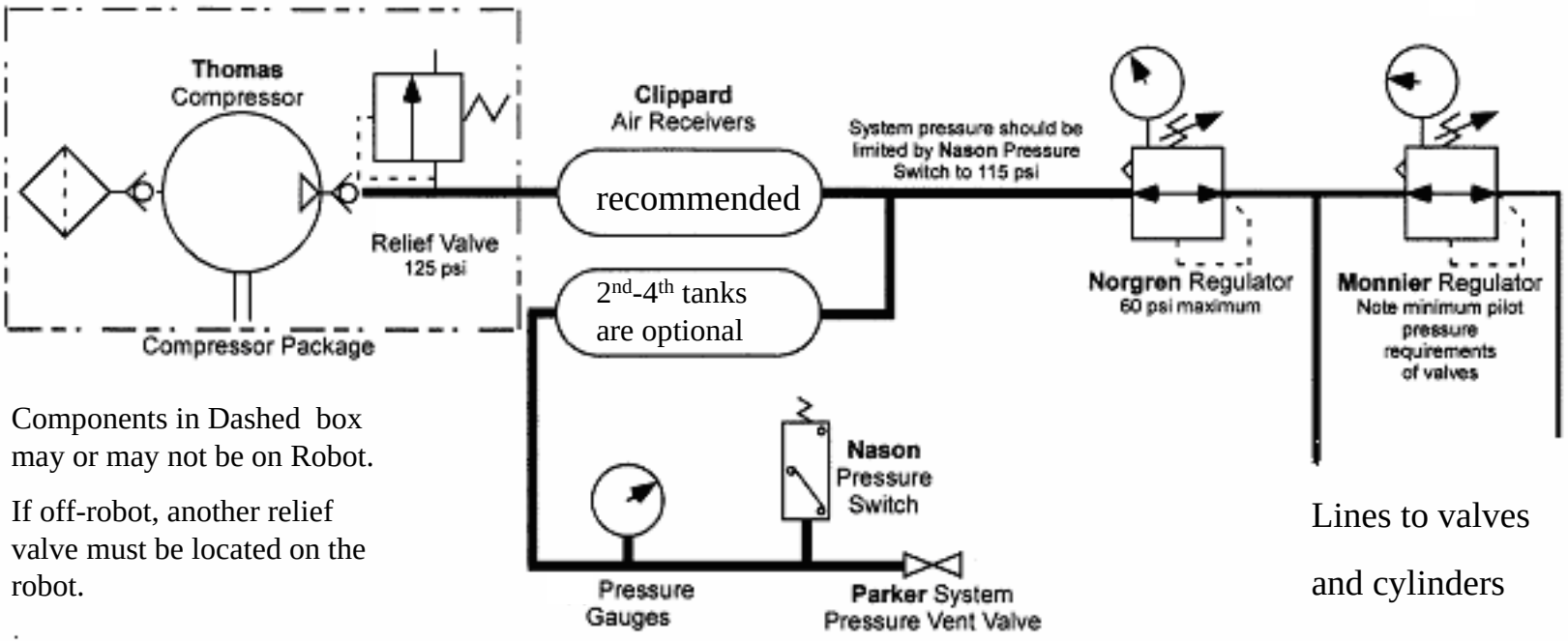
Inspection of the pneumatics starts with charging the system. While the compressor is running, check how the compressor is wired (refer to 2008 Pneumatics Manual). Watch the high pressure gauge to make sure that the compressor shuts off at 120 - 125 psi.

Ask the students to describe how the system works, while they are doing that, look for the parts of the system that need to be inspected. If the inspector pays attention, they will not have to ask the questions on the check list. The students will tell them the answers as they describe their robot.

If they do not touch on one of the points that you are interested in, ask them "What is the max allowed PSI of the working side of your system?, How do I know that is true on your robot?" I then have them point it out to me.

Always try and ask questions that may not be on the check list, that will lead to the answer you are looking for. Try to make the inspection educational for the student as well as fun.

✓370✓400-420 Typical Pneumatic System



Components in Dashed box may or may not be on Robot.

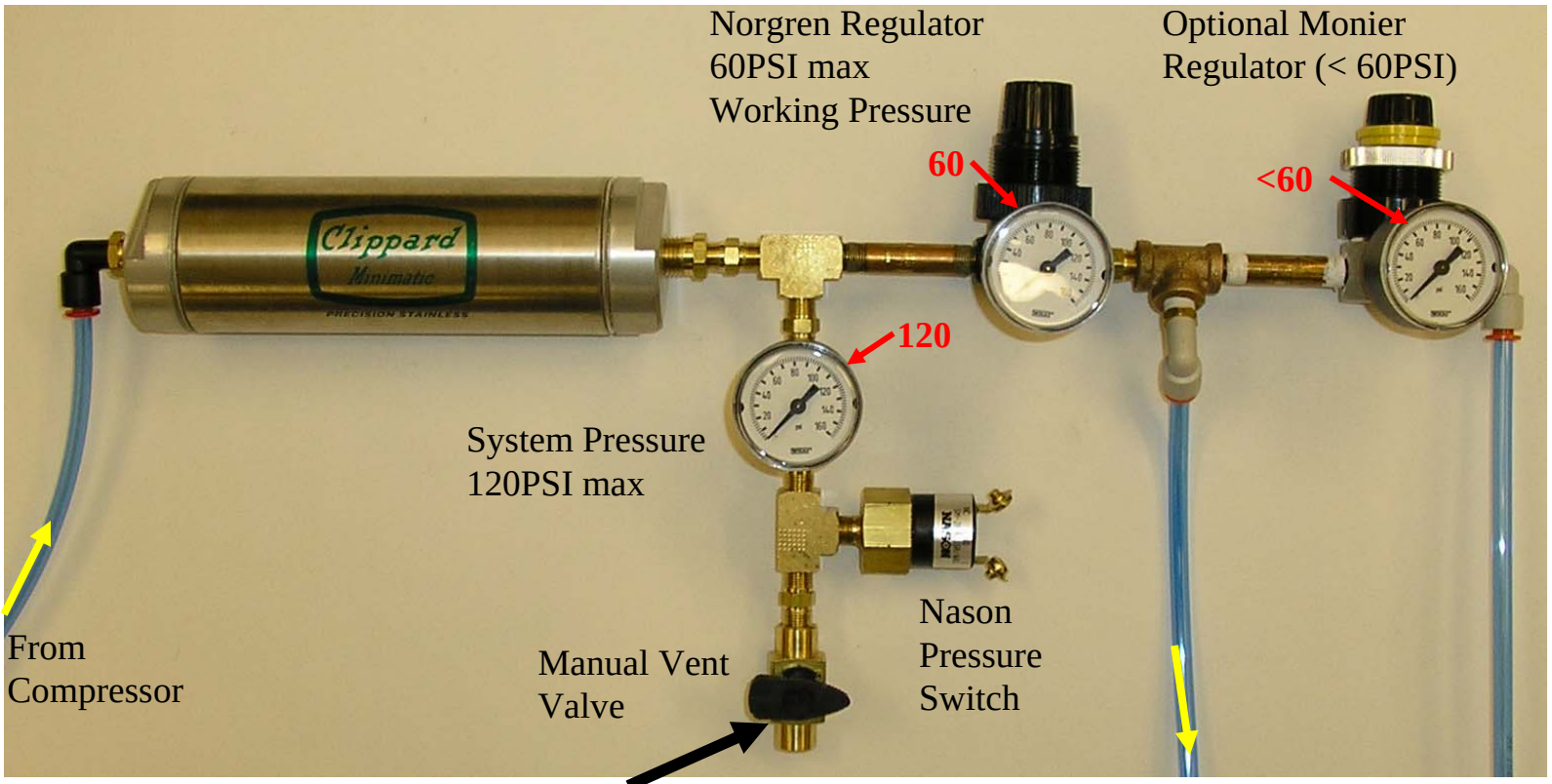
If off-robot, another relief valve must be located on the robot.

.

Lines to valves

and cylinders

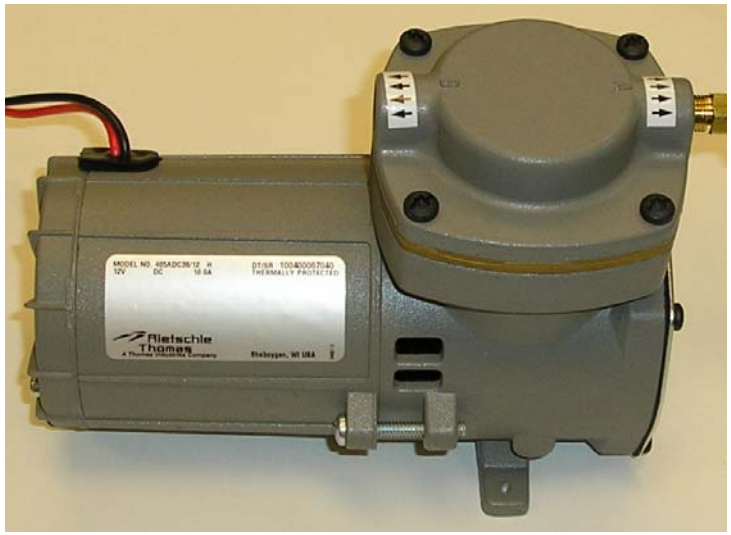
✓370✓400-420 Typical Pneumatic System Layout



This valve must be visible & accessible.
Inspector will check function of this valve.

60PSI max to solenoids,
valves and cylinders

✓370 Only Allowed Compressor



The Thomas compressor must be the only source of compressed air.

Vacuum generators can be used if desired but, if the device requires a motor, the motor must be from the KOP.

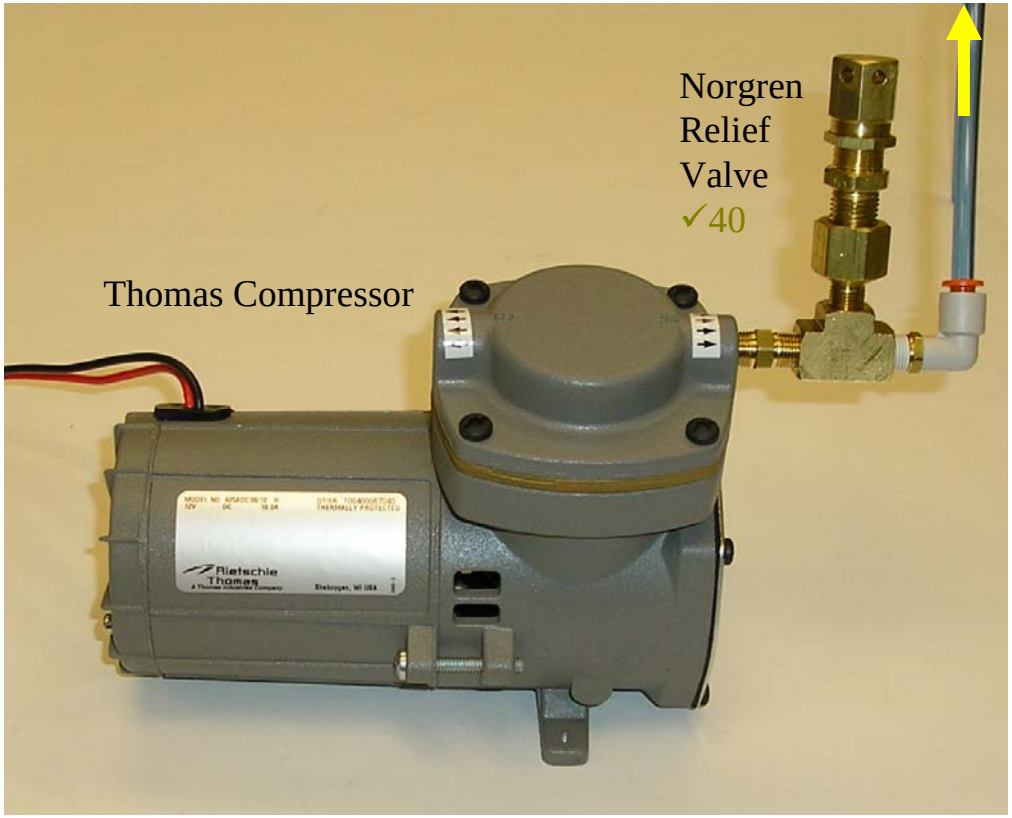
If the robot does not use the compressor “on-robot”, the Thomas compressor is the only acceptable means for “pre-pressurizing” the robot prior to competition.

Regardless of whether the compressor is on or off the robot, the Spike, battery and Nason pressure switch must be located on the robot and driven/sensed by the robot’s RC.

✓370-390 Compressor & Relief Valve

If the robot uses pneumatics, this compressor must be used to charge the pneumatic system. It can be mounted on the Robot or be used in the pits to charge the Clippard Volume tank(s).

The relief valve (Norgren from 2007 shown but may be different in 2008) must be mounted on the compressor in either case. If the compressor is not stored on the robot, a duplicate relief valve must be present on the robot.



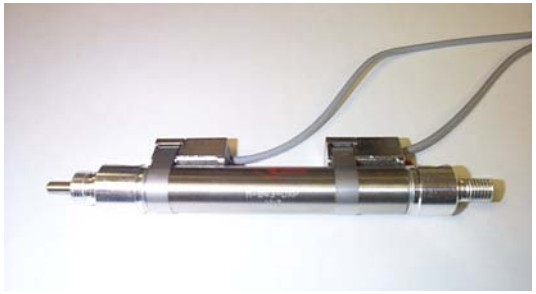
✓370✓380 Allowed Air Storage Tanks

If using pneumatics, teams are allowed to use between 1 and 4 of the tanks shown at left.

✓370 Additional Pneumatic Components

•All components must be “off-the-shelf”
•All components must be rated to handle at least 125PSI
•All cylinders and rotary actuators must be identical to those found on the FIRST Free Pneumatics Components Order Form in the 2008 Pneumatics Manual (see pictures below and following page) and available from either Bimba or Parker
•Metric cylinders may be used but require a letter from FIRST
•Teams are allowed to obtain, at no cost (ie does not need to be listed on the team’s accounting sheets), up to 3 cylinders or up to 2 cylinders and 1 rotary actuator.
•Teams may use as many solenoid valves, air cylinders, rotary actuators, pressure regulators and connecting fittings as desired.

Examples of additional pneumatics components.



Cylinders: various sizes

Rotary Actuator: one size

✓370 Additional Pneumatic Components – Allowed Actuators

The following table lists the only valid air cylinder configurations. Air cylinder part numbers must be M-XXYY-ZZ.

-"M" is optional (specifies whether magnetic position sensors are included)

- XX represents bore, must be either 04 (for ¾" bore), 17 (for 1.5" bore) or 31 (for 2" bore)
- ZZ represents mounting option, must be DP (for ¾" and 1.5" bores) or DXP (for 2" bore)
- YY represents stroke length, must be a value from the table below

Bore (XX)	Valid Stroke Lengths (YY, in inches)
-04 (3/4" bore)	0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 10
-17 (1.5" bore)	0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 11
-31 (2" bore)	0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 12, 24

-Rotary actuators must also be from Bimba. There are only 2 acceptable part numbers.

- PT-017090
- PT-017090-M

Teams may use dimensionally similar cylinders from any vendor as long as the cylinders have not been modified in any way, are rated for at least 125PSIG.

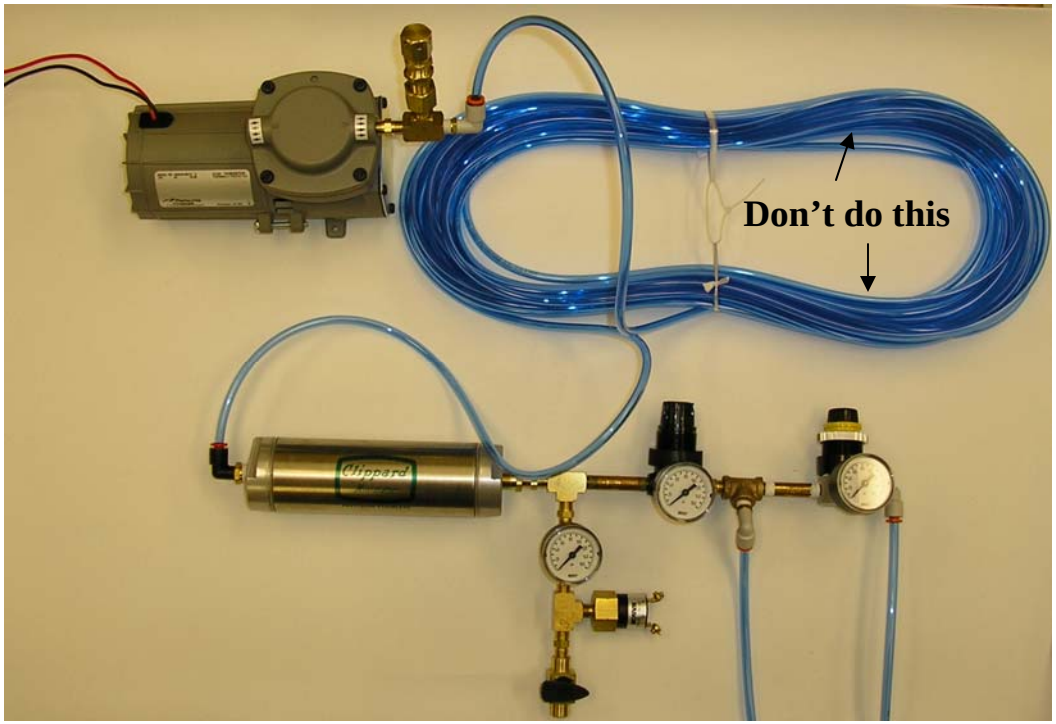
✓430 Check physical condition of actuators and tanks

Cylinders and Volume Tanks are pressure vessels. Any damage to these parts could result in a sudden and dangerous release of energy.

Inspectors will check that there has been no filing, machining, or abrasive removal of any part of an actuator (including rotary actuators and linear cylinders) or volume tank.

Ok to remove this pin but don't damage cylinder

✓440 Extra tubing used as accumulator is not allowed.

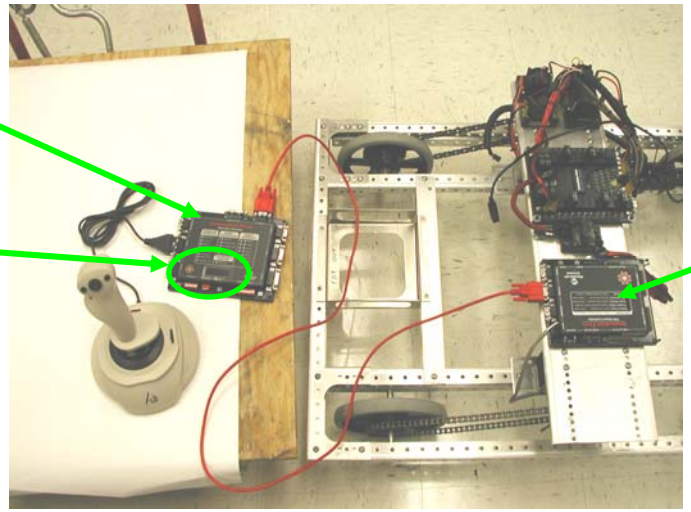


Hose runs should be as short as reasonable.

Using long lengths of hose to 'store' pressurized air is not allowed.

DRIVER CONSOLE AND POWER-UP

✓500 Confirm Team Number and SW Version



Tether the Operator Interface to the Robot Controller as shown above (red serial cable). Pressing SELECT on the OI cycles through the 4 digit team number (eg “0001”), radio channel number (eg “c40”), battery voltage (eg “12.0”) and “user byte” info (eg “u010” for version 10). When the OI is displaying the “user byte”, press the “Robot Reset” button on the OI to temporarily force the “user byte” field to display the version number. After the reset period, the “user byte” display may change to a new value since the field is programmable (typically useful to teams as a means of debugging).

Confirm that the team number is correct and the SW version matches the expected value.

✓510 Pneumatics Test

If the robot design includes pneumatics, confirm that (while running)
• the pressure in the air storage tanks (i.e. at compressor output) does not exceed 125PSIG
• the “working” pressure does not exceed 60PSIG (output of the Norgren adjustable regulator and any additional downstream regulators)
• the manually operated vent valve (must always be present) and the Nason pressure switch function as required

After the pneumatics system has reached a steady-state condition, operating the vent valve must release the air in the tanks and cause tank pressure to drop. Also, the compressor should turn on to attempt re-pressurization.

✓520 Electrical Test

While running, confirm that the LED Flasher is visible and operating properly.

Turn off the robot's power by throwing the 120A main circuit breaker. The robot should be disabled and the RC lights and LED Flasher should all turn off.

If the robot uses pneumatics, operate the manual vent valve to ensure that system air pressure drops to 0PSIG.

Hopefully you've already checked the accessibility of the main breaker and feel comfortable enough with the robot's safety. Even though this is the last inspection item, it may be the most difficult – power-up and power-down sequences are not a good time for any surprises.

DEFINITIONS

Guidelines to Essential Definitions

The following definitions are for terms used in this document. A complete list of definitions can be found in "*THE ROBOT*" document.

Inspectors and teams should have a clear understanding of these terms to insure clear communication in the pits.

Example: Installation of a "spare" part would not require a re-inspection. Inspector should always be informed when a replacement or upgrade part is installed. The inspector will determine what level of re-inspection,if any, is required in these circumstances.

Spare Part

Spare part: Component or Mechanism that is physically and functionally identical to part already on Robot. Teams can freely swap out spare parts.

Original part was damaged during competition

=

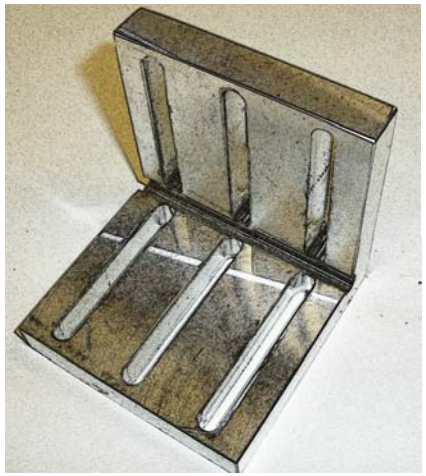
Identical spare installed in place of removed damaged part

Replacement Part

Replacement part: Component or Mechanism that is functionally identical to broken or defective part on Robot but may have design enhancements to improve performance.

"This is a replacement part that we're putting on our robot." Inspector may want to weigh the individual parts if he/she thinks it may have an impact on overall weight.

Mechanical Replacement Part Example



Original plastic part

Material is different but size and shape are equivalent

Aluminum Replacement part

If part is substantially different in weight than the replaced parts, inform inspector.

"This is a replacement part that we're putting on our robot." Inspector may want to weigh the individual parts if he/she thinks it may have an impact on overall weight.

Upgrade Part

Upgrade Part: Component or Mechanism that provides additional functionality or adds capabilities to the Robot. Shown are three examples of types of upgrades. They should be considered universal and apply equally to all subsystems. (electrical, pneumatic, software, electronic, vision…….)

Pneumatic Upgrade Example

Upgrade Part: Component or Mechanism that provides additional functionality or adds capabilities to the Robot.

Original cylinder

Upgrade

Upgrade cylinder provides greater force and longer stroke.

Electrical Upgrade Example

Motor was controlled by a SPIKE relay.

Upgrade

VICTOR 884 adds functionality. Speed control improves functionality of Robot

Example: Upgrade by adding stuff

Upgrade

Original Robot had four wheels

Upgraded Robot has six Wheels. Note: Even though new wheels are identical to the existing wheels, the additional wheels add functionality and are therefore considered to be upgrades.

Approved

Place the “PASSED INSPECTION” sticker on the robot (select an easily noticed location). Place a colored dot (color varies with regional) on the sticker and sign/initial the dot.

PASSED INSPECTION 2008

FRC REGIONAL XYZ

TEAM ABC

Sign here

(approximation of inspection “done” sticker)

Conclusion

- Inspectors are responsible for making sure that the robots are *SAFE* - to surrounding people and the field.
- Inspectors are responsible for making sure that the robots are competitive - no unfair advantages by virtue of expensive, proprietary technologies or components.
- Know the rules
- Read and understand the reference materials
- When in doubt, ask the Lead Inspector for assistance. Consistency in the inspection process is absolutely critical.
- Deal directly with the students. Ask a lot of questions and have them describe their robot.