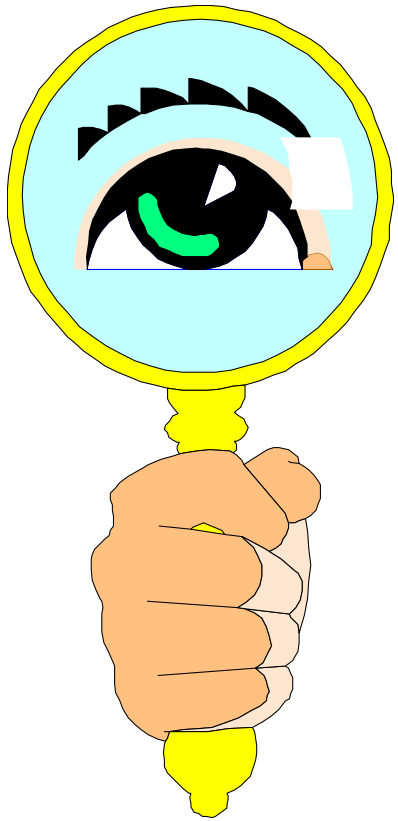
Inspectors' Checklist Manual 2006



FIRST

Created by:

Dan Jacques
Manufacturing Engineer
DEKA Research and Development Corp.

Russ Beavis
Research Engineer
DEKA Research and Development Corp.

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 4 and 5), the manual rules.

Standards used in this document

- Page titles with "***XXXX***" before and after capital text are title pages. They are place keepers in the document and contain no detailed information. Use them to quickly navigate between sections.
- Reference numbers (✓X) in the slide titles refer to item numbers on the inspection checklist.
- Slide footers include rule numbers in parentheses (refer to Section 5 Robot Rules and other sections)

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 5 "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

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.

  If the Robot passes the inspection, the inspector places a **PASSED INSPECTION 2006** sticker and colored dot (on the sticker, color corresponds to week of event) on the machine, initials and dates it. 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.

-Scale

-Sizing Box and Wand

-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 initials and dates the PASS box.
- 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
########

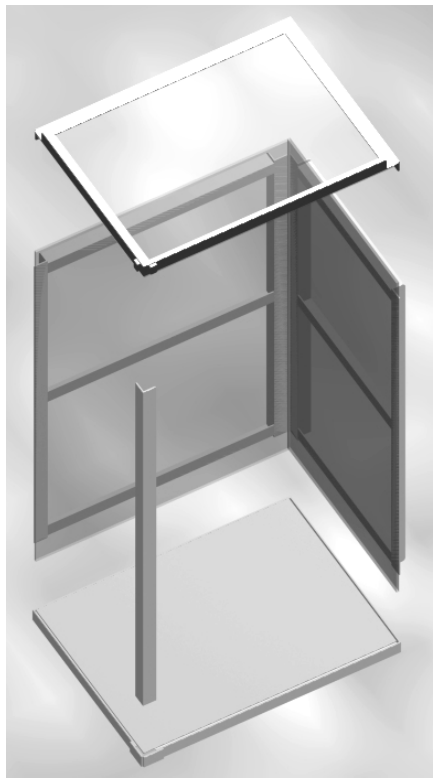
*******GENERAL ********

Sizing

✓1 The Sizing Box

The Sizing Box is supplied in six pieces;

1. One Side Panel
2. One Back Panel
3. One Base
4. One Top Panel
5. One Support
6. One Wand



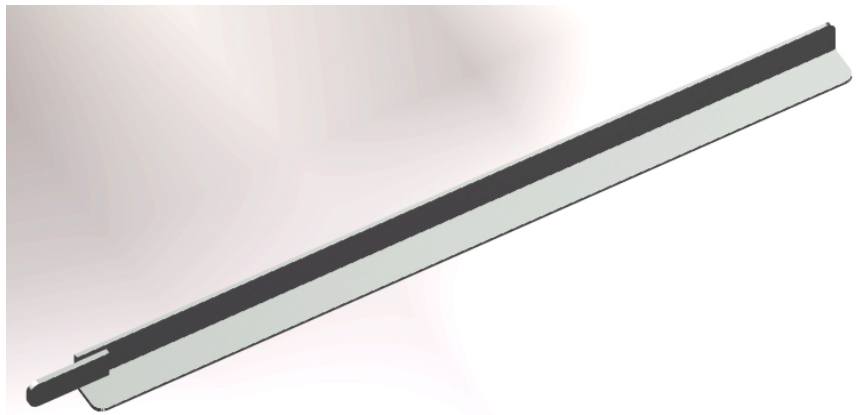
The Side and Back panels are assembled to the Base by inserting the ends of the plastic sheets into the channels along the side and end of the base.

The Support is assembled to the Base by inserting the sharp-cornered end of the Support into the corner slot provided on one corner of the base.

The Top Panel is assembled to the structure by placing the Top panel on the structure with the corner tabs fitting onto the support. The Side and Back panels assemble to the Top Panel in the channels created between the plastic sheet and

✓1 The Wand

The Wand is used to determine if any part of the robot protrudes beyond the limits of the open sides of the sizing box.



✓1 Robot Size Inspection

Sizing Box operation:

•Have team put robot in largest starting size.

•Remove bumpers (if included and designed as per Rule R35)

•Load the robot (if necessary, temporarily raise the Top Panel and remove the Support). Ensure that all panels are squarely in place.

•Position the robot within the box .

•Sweep the Wand up and down, flush across each open side of the box. Orientation is such that the underside of the Wand's tab slides along the outside of the Support, and the other end of the Wand slides along the edge of Side or Back Panel. (ref maximum size is 28" x38" x 60"

•If no part of the Robot interferes with the Wand, the Robot passes sizing.

Weight

✓2 ✓3 Weight Inspection Guidelines

•Although weighing the robot seems like a straight forward task, several things need to be understood.
•Team member should know what robot parts need to be with the Robot when weighing. Team should present these parts with the robot.
•Team should be able to quickly remove the battery and compliant bumpers. No delays at inspection.
•Of course, the weight of the robot cannot exceed 120lb and the bumpers cannot weigh more than 15lb. In addition, bumpers should have a density of 3 oz per inch of perimeter length or less (ie no short heavy bumpers).

✓2 Things to include when weighing the robot

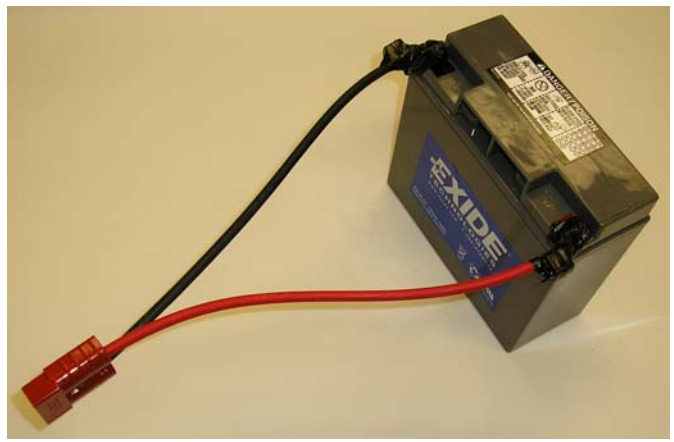
Include:

•Robot weight must include everything that <u>could be on</u> the machine during competition.

•Decorations

Don't Include:

•Spare and Replacement parts (see ***DEFINITIONS***)
•Compliant bumpers
•12V battery and Anderson cable half



(R09, R101)

✓2 ✓3 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

✓2 Robots should be reweighed if..

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

Extended Size and Shooter Mechanisms

✓4 Robots cannot extend beyond a 60” cube

Have the team energize the robot and extend all mechanisms to full displacement. Confirm that no part of the robot extends outside an imaginary 60” cube around the robot (cube faces parallel to edges of rectangular robots).

For non-rectangular robots, the team must define a forward direction for the robot. The imaginary 60” cube must have a surface perpendicular to the forward direction.

✓4 Shooter Mechanisms cannot extend beyond robot base

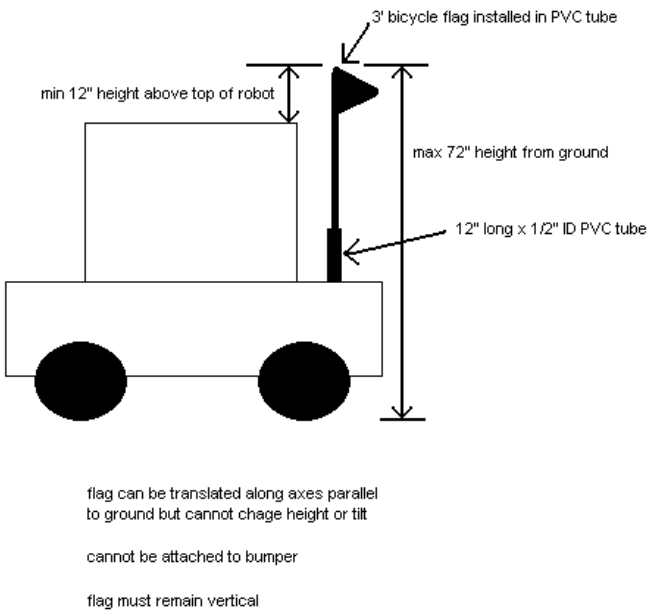
If the robot design includes a mechanism(s) for delivering a dynamic impulse to a ball, confirm that no part of the mechanism(s) that contact the ball either during or after the impulse extends beyond the base of the robot (without bumpers).

Components of the robot that maneuver a shooting mechanism (a turret, for example) can extend beyond the robot base.

You should also take this chance to confirm that all shooter mechanisms are shielded in order to minimize the likelihood of shrapnel and inadvertent ingress (fingers and other robots' mechanisms).

Bicycle Flag

✓5 Bicycle Flag



• the robot must include a contiguous 12” long x ½” ID PVC tube to accept the flag (with no attempts at weight reduction)
• the robot’s PVC tube must be capped at its “bottom” (tape is not allowed)
• the robot’s PVC tube must remain approximately vertical at all times and cannot be articulated or actuated
• when the 3’ bicycle flag is installed in the tube, the height of the top of the flag cannot exceed 72”
• the top of the flag must ALWAYS be at least 12” higher than any other component on the robot (even given any extension of the robot)
• the robot’s PVC tube cannot be attached to a bumper
• the robot’s PVC tube cannot be longer than 12”

(R13)

Cost

✓6 Cost Guidelines

Teams are required to have their additional costs presented in a detailed Bill of Material.

A hardcopy printout is preferred but not a requirement. (The purpose of this is to provide feedback to FIRST regarding what parts the teams are using. Perhaps, commonly used parts could be a part of the kit next year.)

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.

(R24, R41, R42, R46-R50)

✓6 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 $200 USD

Maximum unit cost for Non-Electrical Item $400 USD

Maximum total cost $3500 USD

✓6 Total Costs & Max. Individual Costs

$3500 USD maximum Total Cost of Non-Kit items

$200 USD maximum for an individual COTS Electronic part

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

COTS = Consumer Off the Shelf Parts

(R24, R41, R42, R46-R50)

✓6 Items Excluded from Total Cost

Lubricants

Adhesives

Non-Functional Decorations

Spike Relays

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

Speed Controllers

(R24, R41, R42, R46-R50)

✓6 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.

(R24, R41, R42, R46-R50)

✓6 Cost Comparison: Non-Sponsor Provides Labor

Raw Material + Machining = Finished Part

Material Cost = $10.00

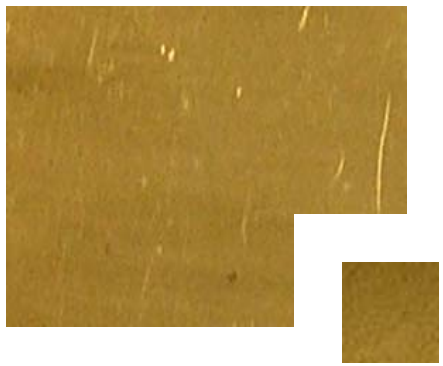
Non-Sponsor donates or charges team for 1 hour of Labor (typical labor rate is $30/hour)

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.

✓6 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 48” x 48” 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.

✓6 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.

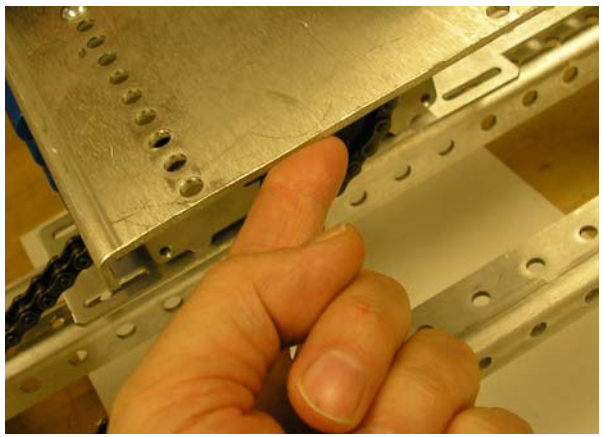
Example 2: If the team uses 101 ft. they must use two 100' rolls.
$42.52 should appear on the Cost accounting sheet.

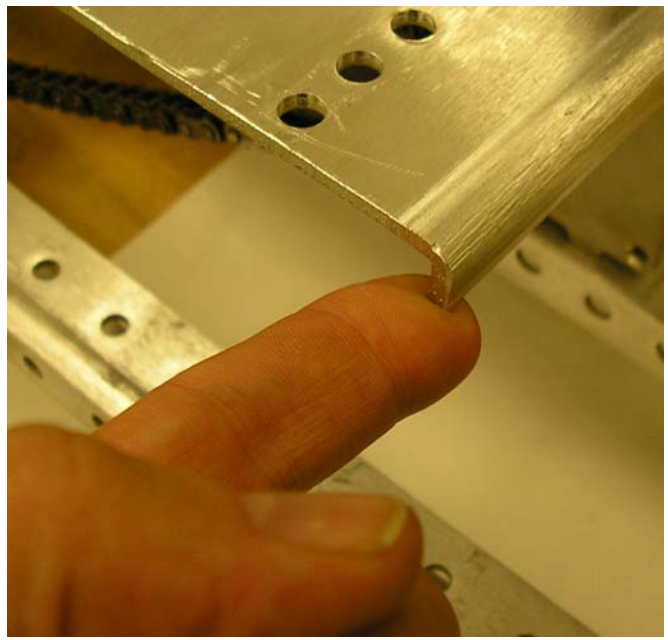
Price is based on the smallest commonly available unit that satisfies the teams needs.

General Continued

✓8 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.



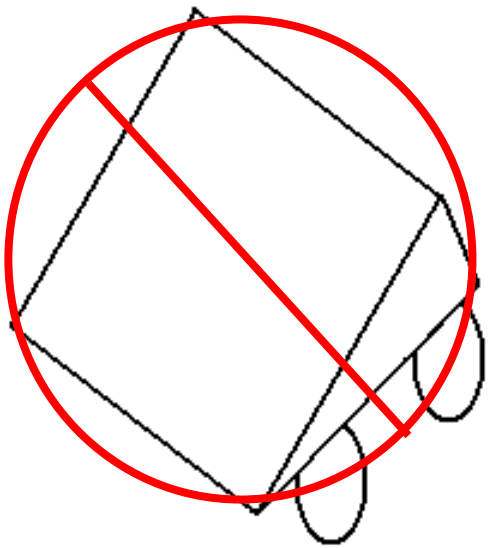


✓8 Puncture Hazards

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?

✓8 Wedge Robots



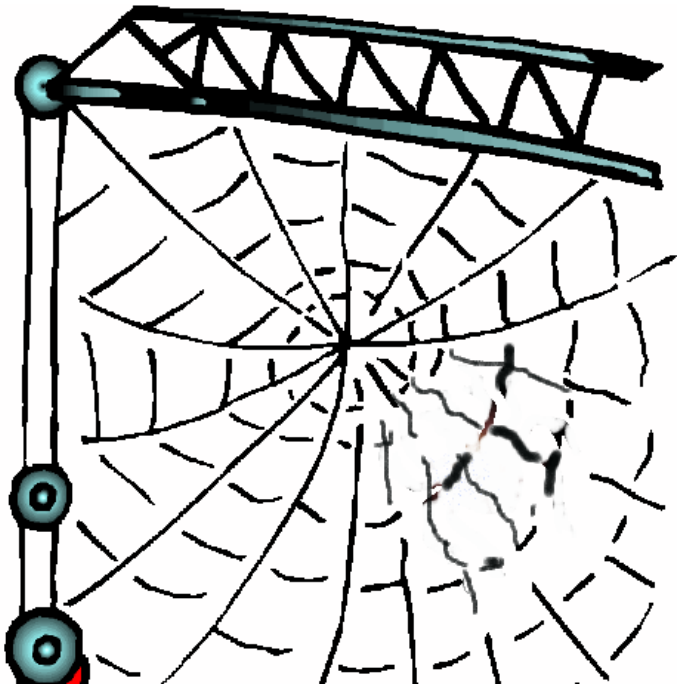
WEDGES ARE NOT ALLOWED!!

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

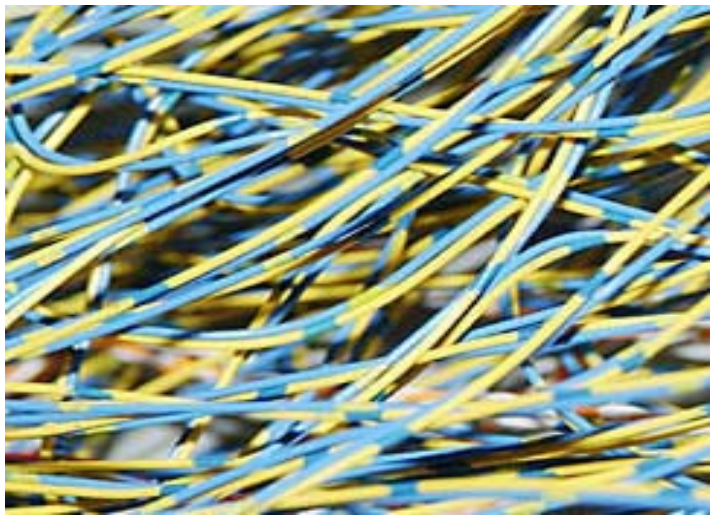
Many robot designs will use a wedge (aka ramp) for ball handling. That's OK – just make sure that the wedge is sufficiently protected from interactions with robots to avoid lifting. For example, the wedge could be just wide enough for a single ball, the wedge could be covered or the wedge could be "inside" the robot.

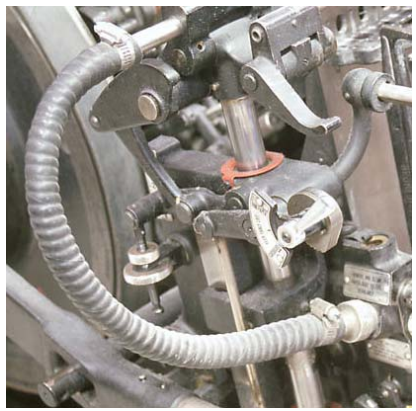
(R03, R04, R30)

✓8 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,





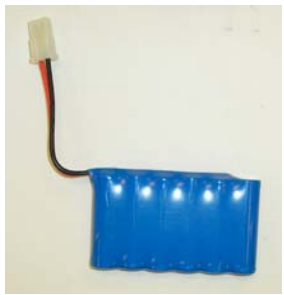
✓8 Shooter Mechanisms Need Shields

Confirm that, if the robot uses a shooter mechanism, the design includes a shield to cover the apparatus. The shield must be present to prevent the egress of shrapnel and the ingress of foreign objects (fingers and other robots' mechanisms).

An easy metric to employ – using a ¾" dowel, you should not be able to touch any moving component within the shooter (except when entering the mechanism from the shooter "outlet").

✓9 Allowed Energy Sources

12 Volt battery



7.2 Volt backup battery

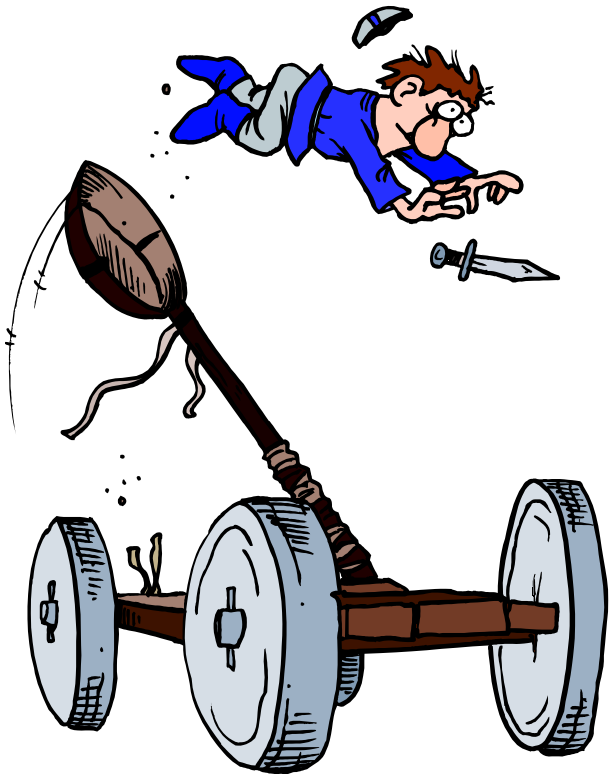
Gravity

Compressed air stored in Clippard tanks.

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

✓9 Stored Energy Hazards

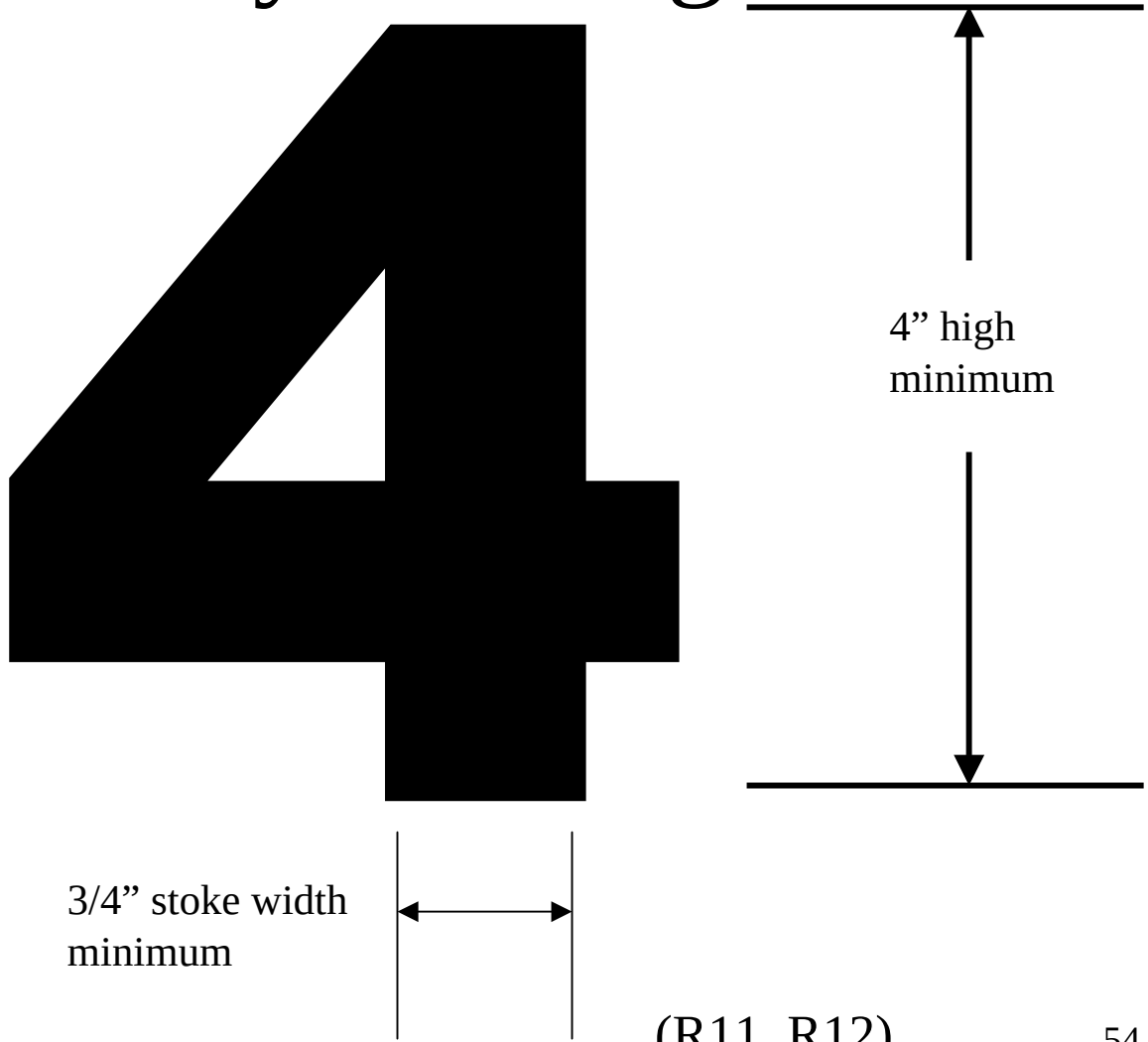
Stored energy devices are allowed but cannot pose a hazard. Inspector will look for any stored energy hazards. Devices such as compressed springs, dropping masses, and mechanically deformed parts can present a serious hazard if the energy is suddenly released. Teams will be expected to demonstrate the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



✓10✓11 Check 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.



(R11, R12)

✓12 Team LEDs

For this year's competition, the Alliance Color LEDs (aka Team LEDs) are not required but are strongly recommended.

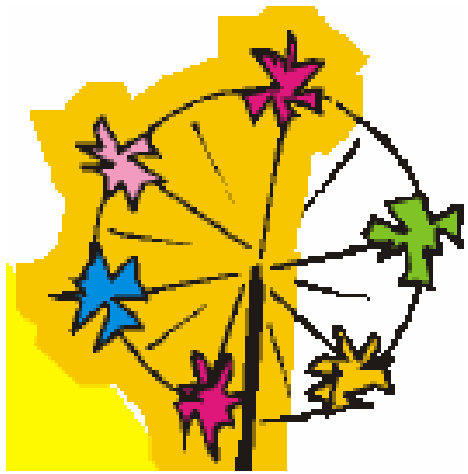
If the LED is used, it should be clearly visible when standing in front of the robot in its starting position.

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

✓13 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



✓15✓16 Adhesive Tapes

OK

•Sticky Labels
•Electrical tape as electrical insulator only
•Velcro Tape or Hook-and-Loop Tape for attaching components
•Reflective tape used with optical sensors in small amounts

Not OK

•Duct Tape

✓16 Check Traction Devices

OK

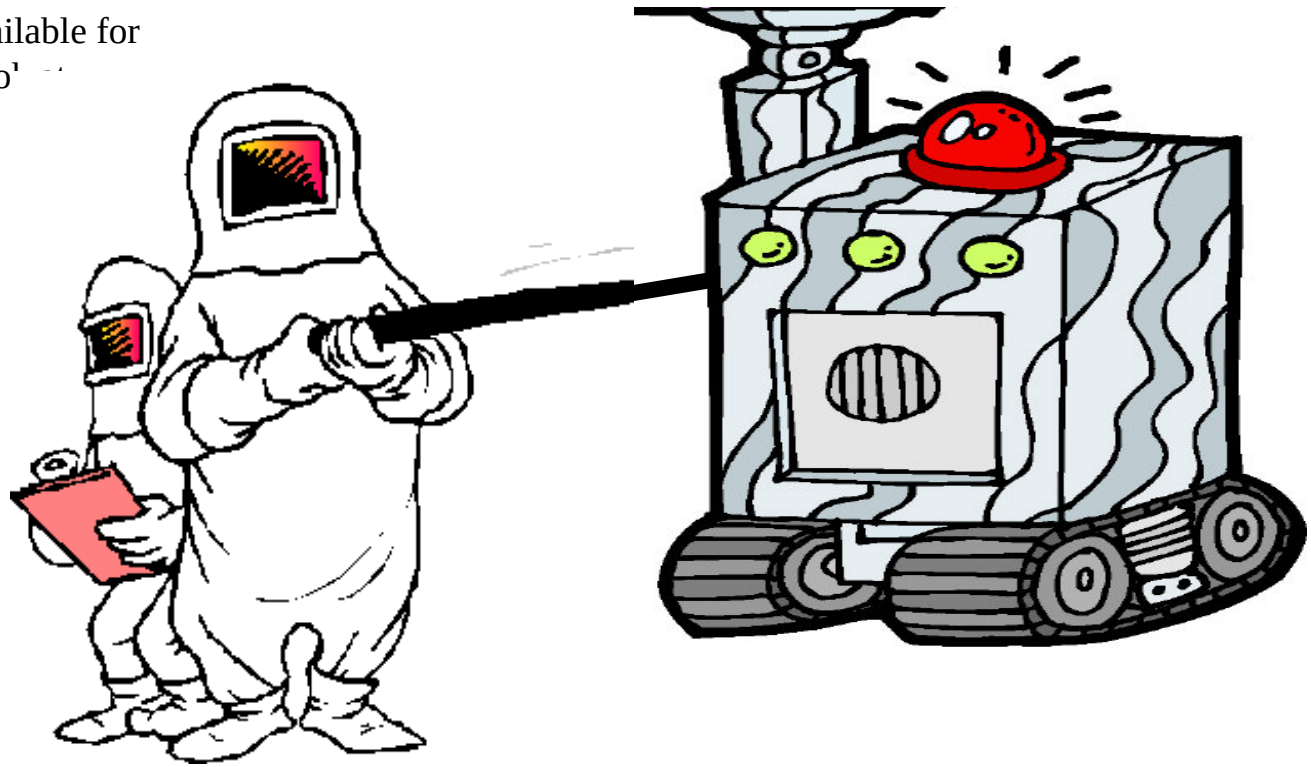
•Stabilizing arms with rubber or equivalent against field surface
•Van der Waals forces

Not OK

•<u>Anything that could damage the playing field.</u>
•Metal cleats
•Studs
•Velcro
•Sandpaper

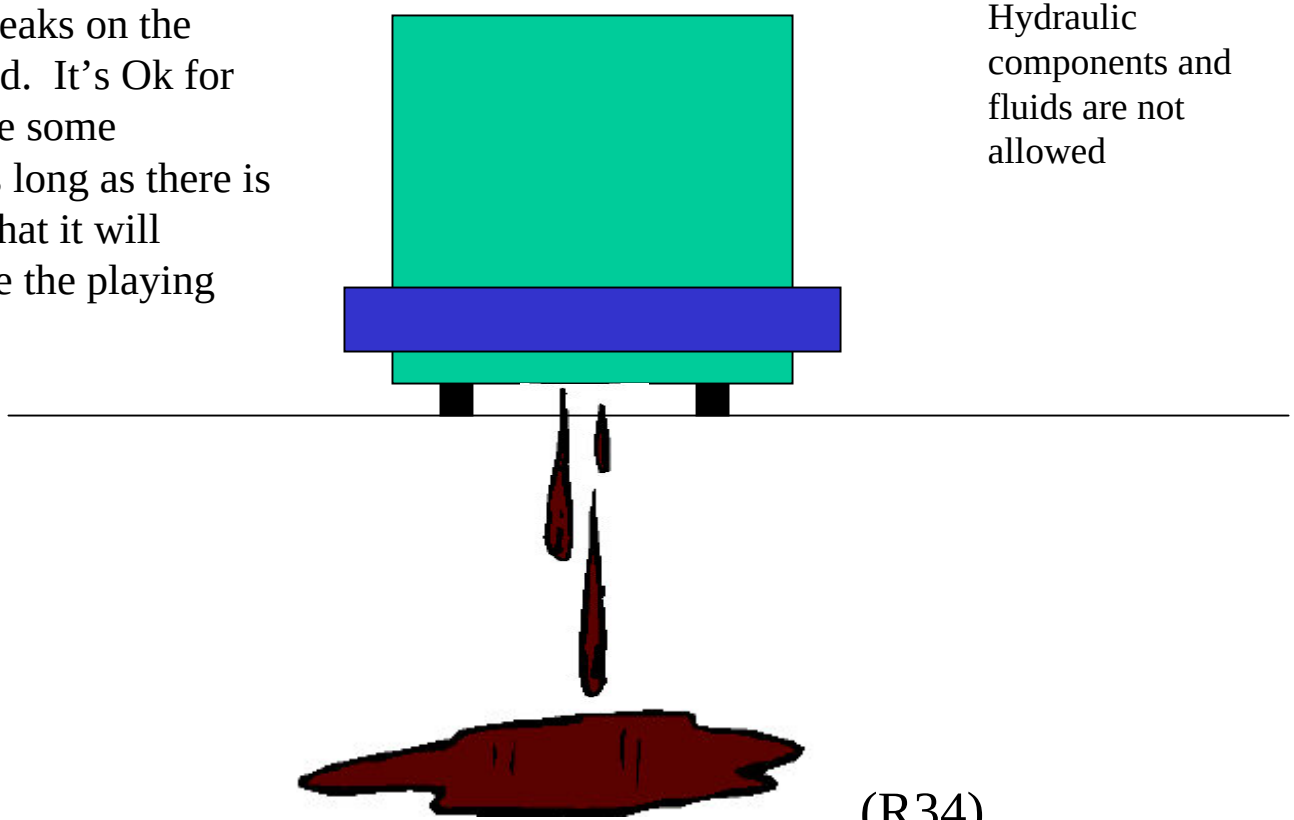
✓16 No Hazardous Materials

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



✓16 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

✓18 Motor Modifications

The purpose of this rule is ensure that every Robot has the same maximum power output (just like NASCAR) 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 housings.
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 modifications or discarding gearboxes of Globe and FP motors.

OK to remove gearboxes from these motors

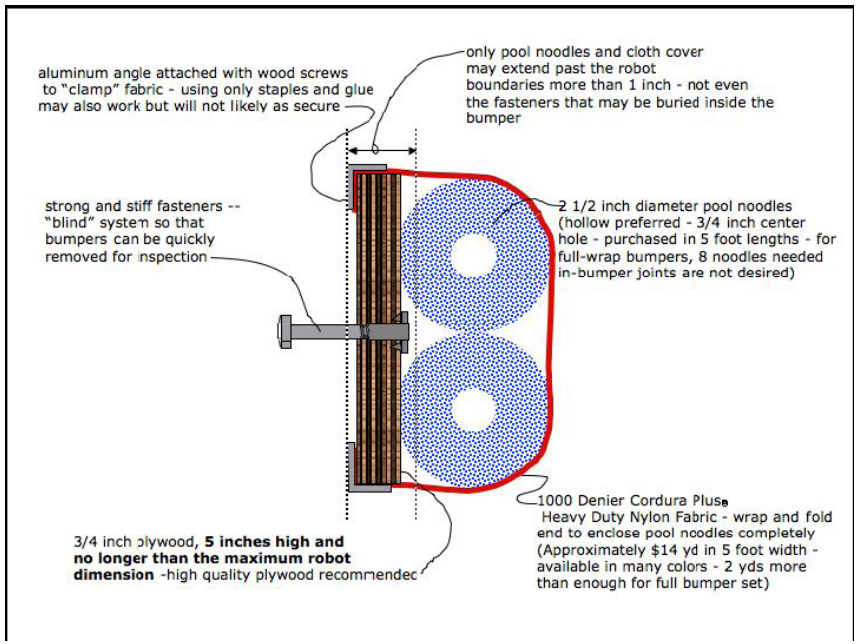
Globe Motor

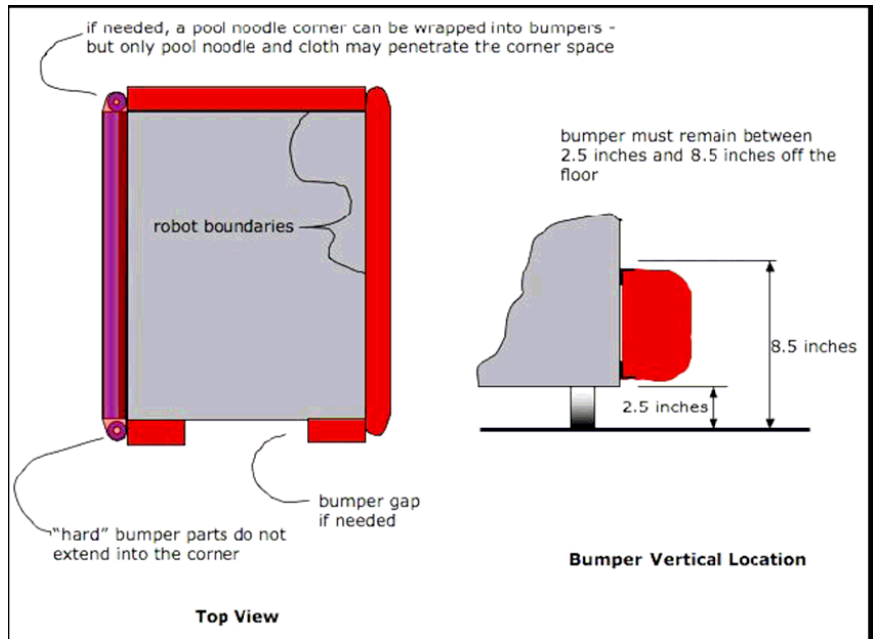
Gearbox

Fisher Price

✓19 Bumpers…

Bumpers, if used, 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) but must be easily removable for size measurement.





✓20 Ball Visibility and Access

If the team plans on pre-loading their robot with balls before the beginning of a match, it is required that the pre-loaded balls be visible for counting. Confirm that all mechanisms for pre-match storage provide adequate visibility of the balls.

Opaque shooter mechanisms are acceptable as long as the team does not plan on beginning a match with balls in the opaque region.

Balls remaining in the robot at the end of match must be removable without powering-up the robot. In particular, confirm that balls remaining in shooter mechanisms can be safely removed from a disabled robot.

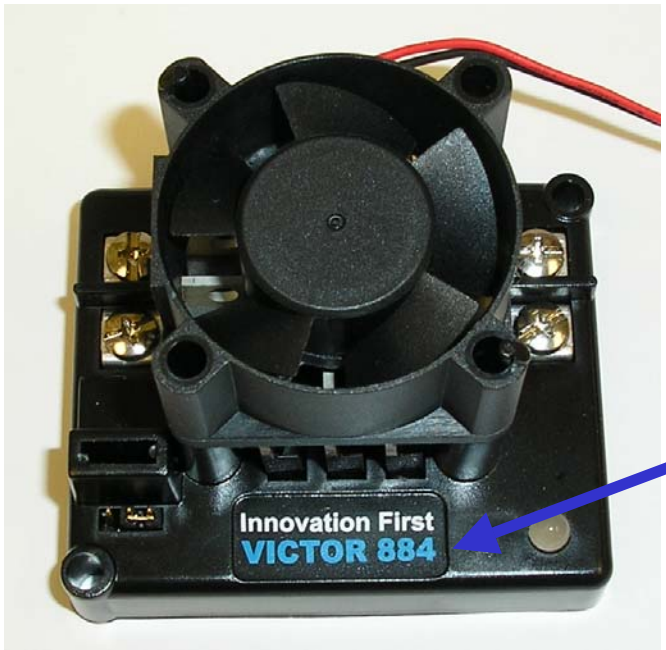
*******ELECTRICAL & CONTROLS*******

✓21✓22 Only one Exide Battery on Robot

EX18-12 (ES18-12 is also allowed)

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

✓21✓22 Check Speed Controllers



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

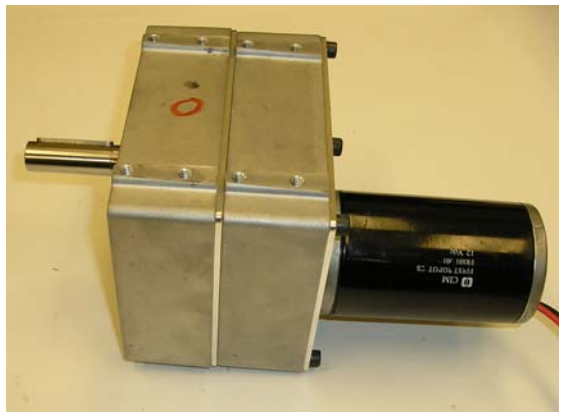
(the 884 Controllers may have different colors)

884's only

✓21✓22 Small CIM Motors: 4 Allowed

The 2006 KOP includes 2 of the smaller CIMs (FR801-001) and 2 of the larger CIMs (aka mini-bike motors, FR801-005). Teams may additionally purchase and include 2 of the smaller CIMs on their robot.

6”scale shown for sizing..

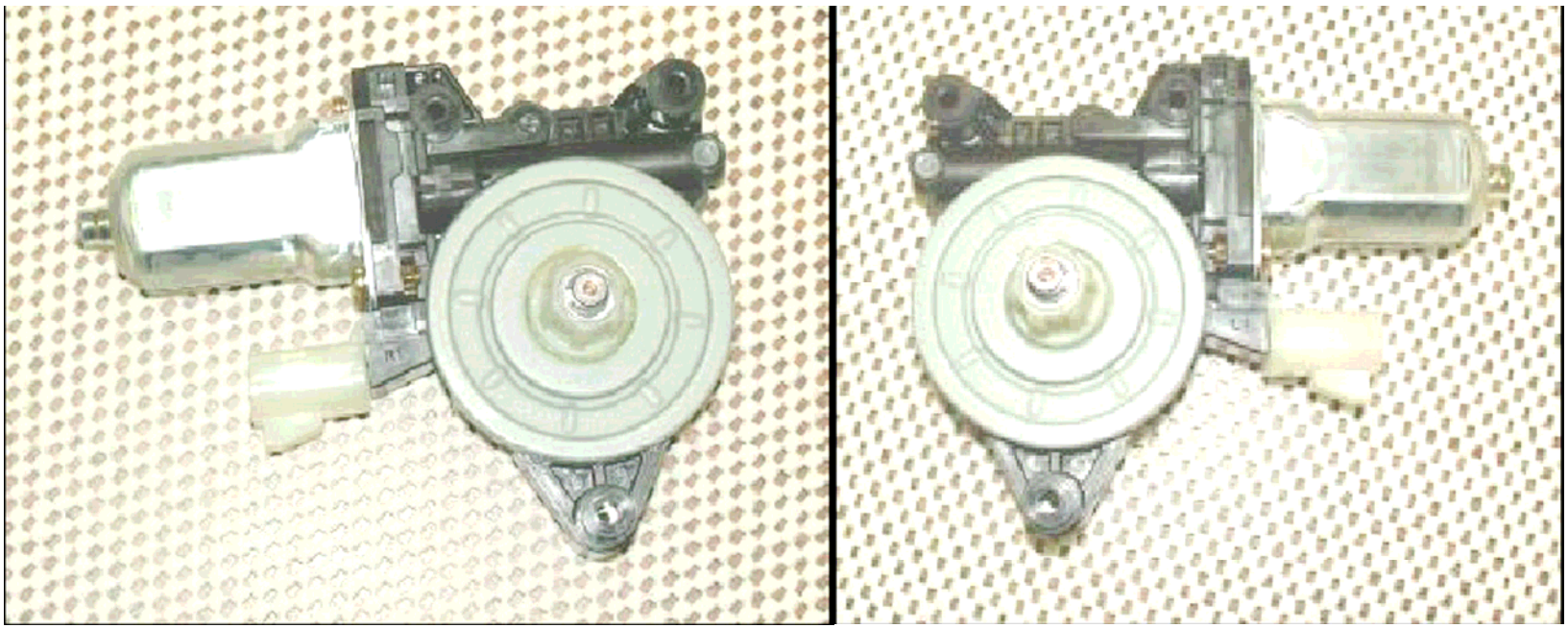


These motors will typically be mounted to a gearbox.

✓21✓22 Large CIM Motors (aka mini-bike): 2 Allowed

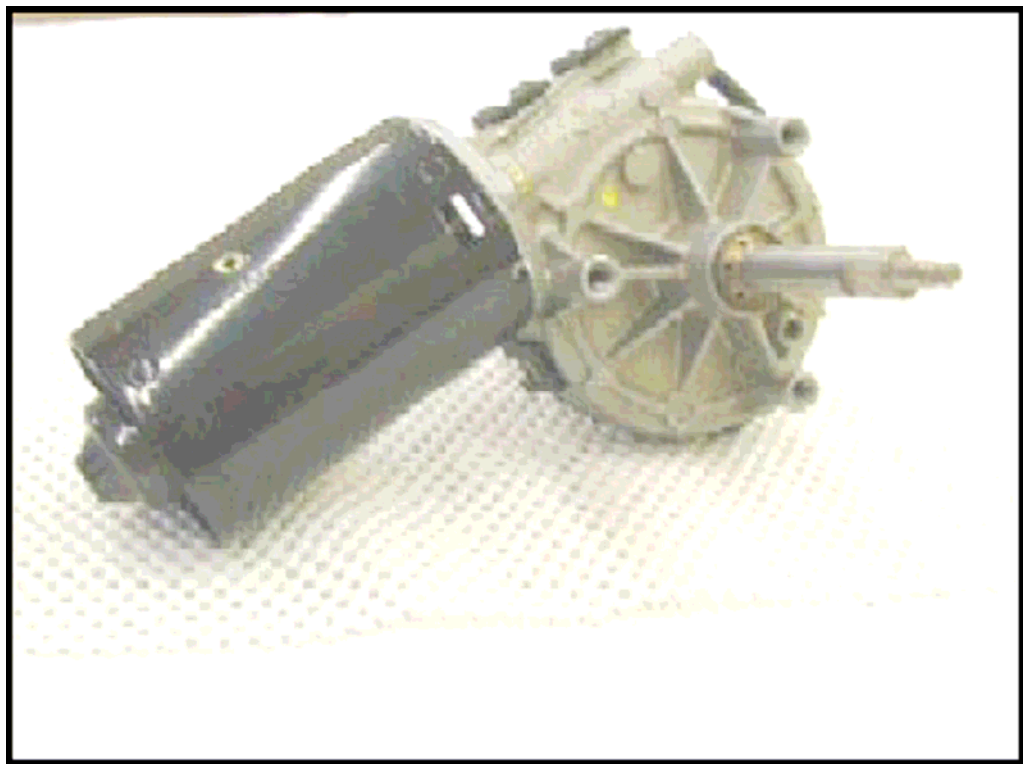
The 2006 KOP includes 2 of the larger CIMs (aka mini-bike motors, FR801-005). The output shaft mechanisms are allowed to be removed from the large CIM.

✓21✓22 Nippon Denso RH and LH Window Motors: 1 Each Allowed

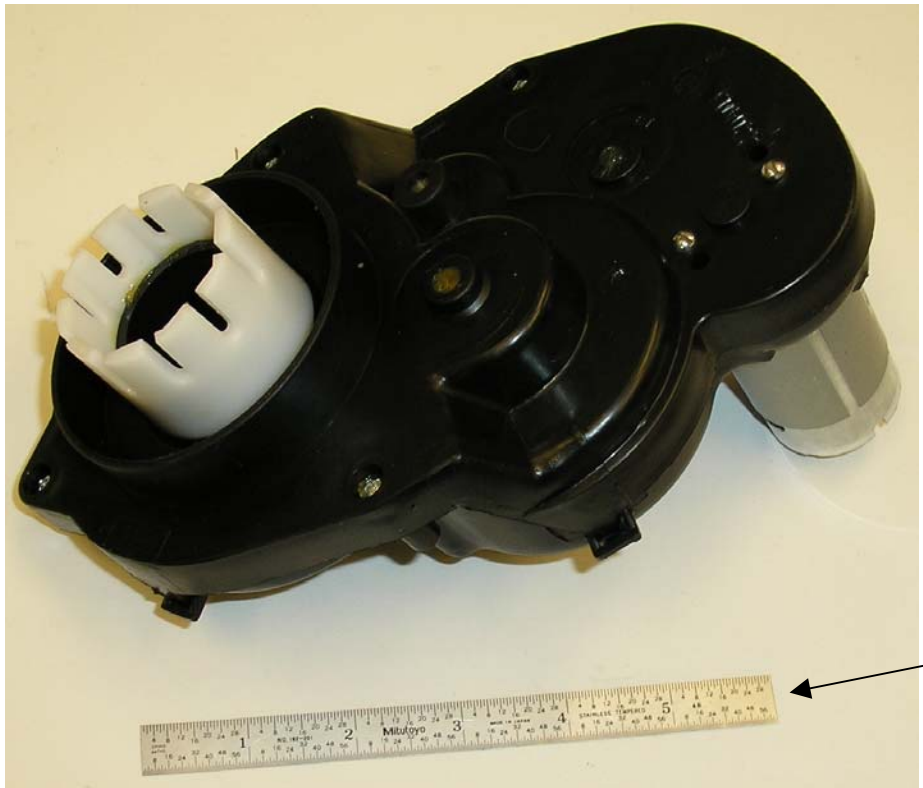


✓21✓22 Mabuchi Motor: 1 Allowed

✓21✓22 Bosch Motor (aka van door): 1 Allowed



✓21✓22 Fisher Price Motor: 2 Allowed



Model Numbers 9003 and 9012 are both allowed.

6”scale shown for sizing..

✓21✓22 Globe Motor: 2 Allowed

6”scale shown for sizing..

✓21✓22 Allowed Circuit Breakers

Find many of these on Breaker Panel

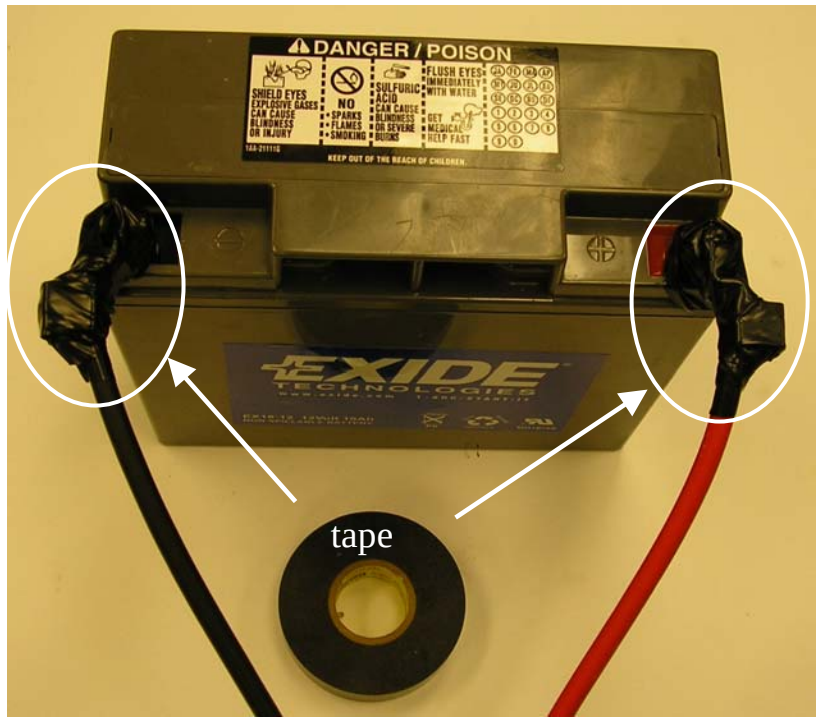
Main shutoff breaker attached directly to battery

✓23 Connections to Battery - Insulated SLU-35 (or similarly secure connector)

Before insulation shown for reference only.

SLU-35 Connectors

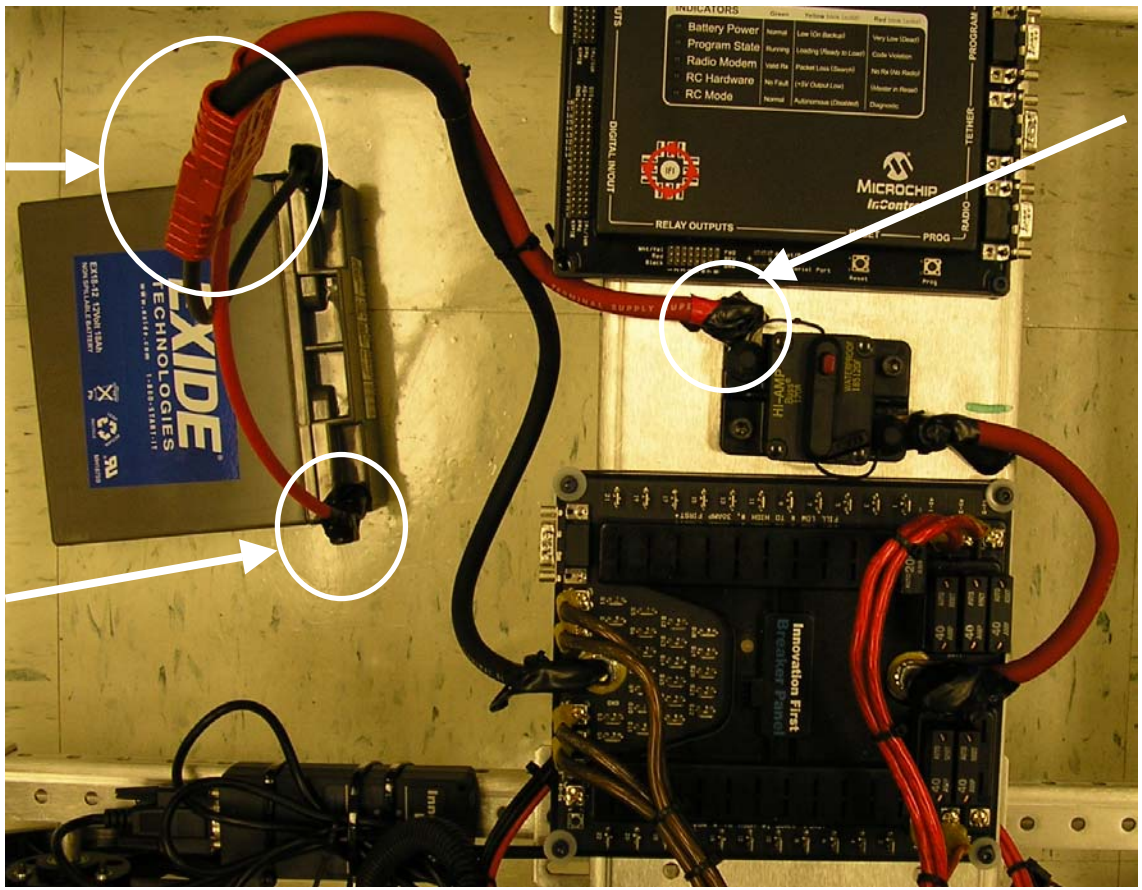
Terminals must be insulated with electrical tape or shrink tubing. Inspectors can feel though the insulation for the SLU-35 Connectors



***** Teams are not required to use the SLU-35 lugs. They are permitted to use any secure connector system.**

✓24 Battery, Anderson Connector, Main Breaker

Black and Red wire go through Anderson Quick Disconnect connector



Red +12 Volt connected to main circuit breaker

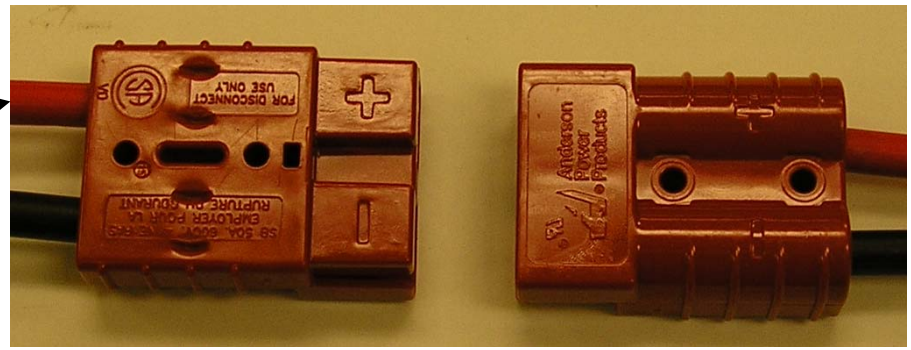
Red Wire connected to +12Volt

The 2005 CB/Distribution Panel shown (at left) may be used in place of or in addition to the Maxi-Blocks and ATC Breaker Panels in the 2006 Kit of Parts

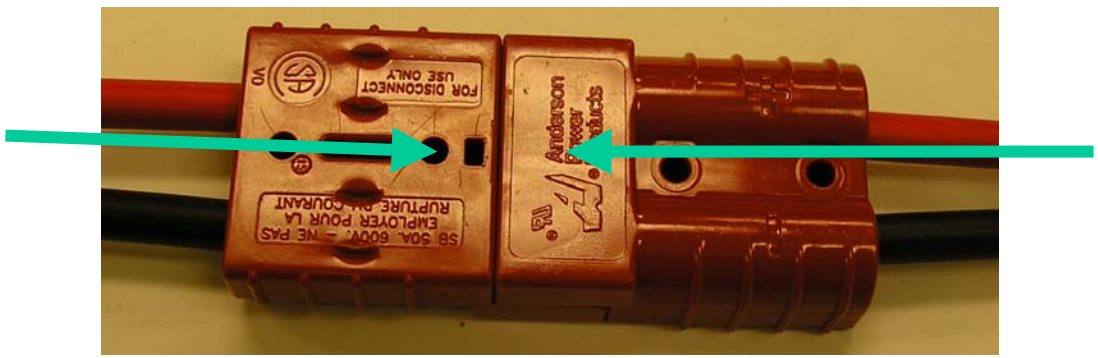
✓24 Anderson Quick Disconnect Connector Demonstration

Uncoupled

RED wire is connected to + Terminal



Coupled



✓25 Main Circuit Breaker is Accessible

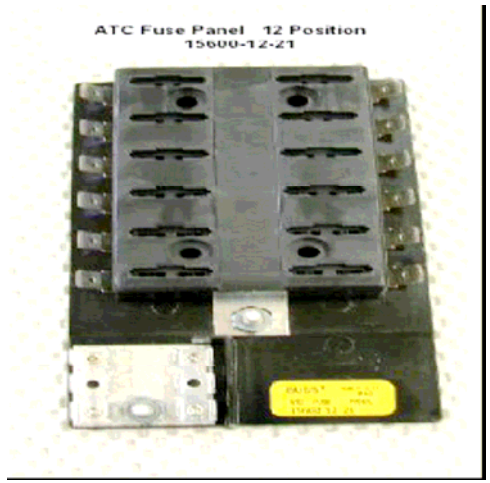
This is typically used as the ON/OFF button for the robot.

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?

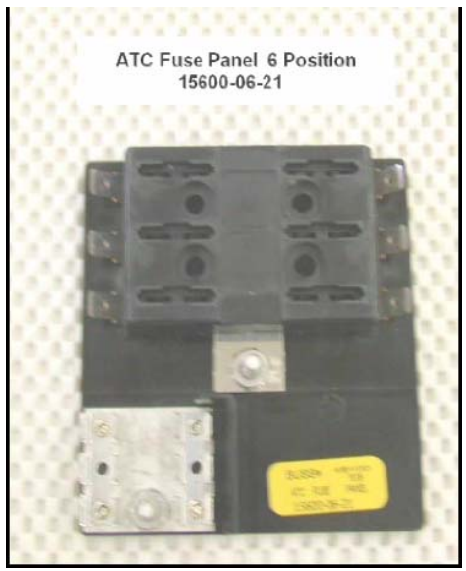
✓25 Circuit Breakers Accessible for Inspection

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



12-position ATC Fuse Panel (should only contain 20A and 30A breakers, each team can only have 1 of these on their robot)

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

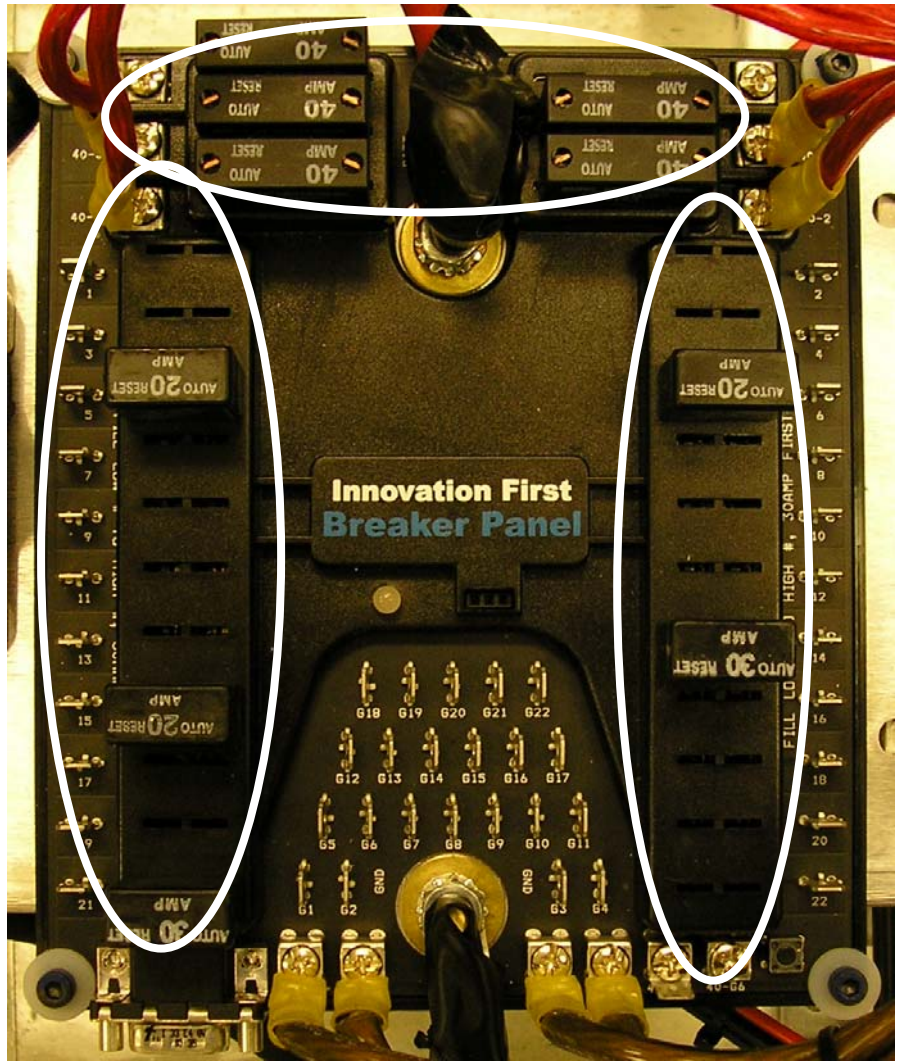


6-position ATC Fuse Panel (can only contain 40A breakers, each team can only have 1 of these on their robot)

(R64)

✓25 Circuit Breakers Accessible for Inspection

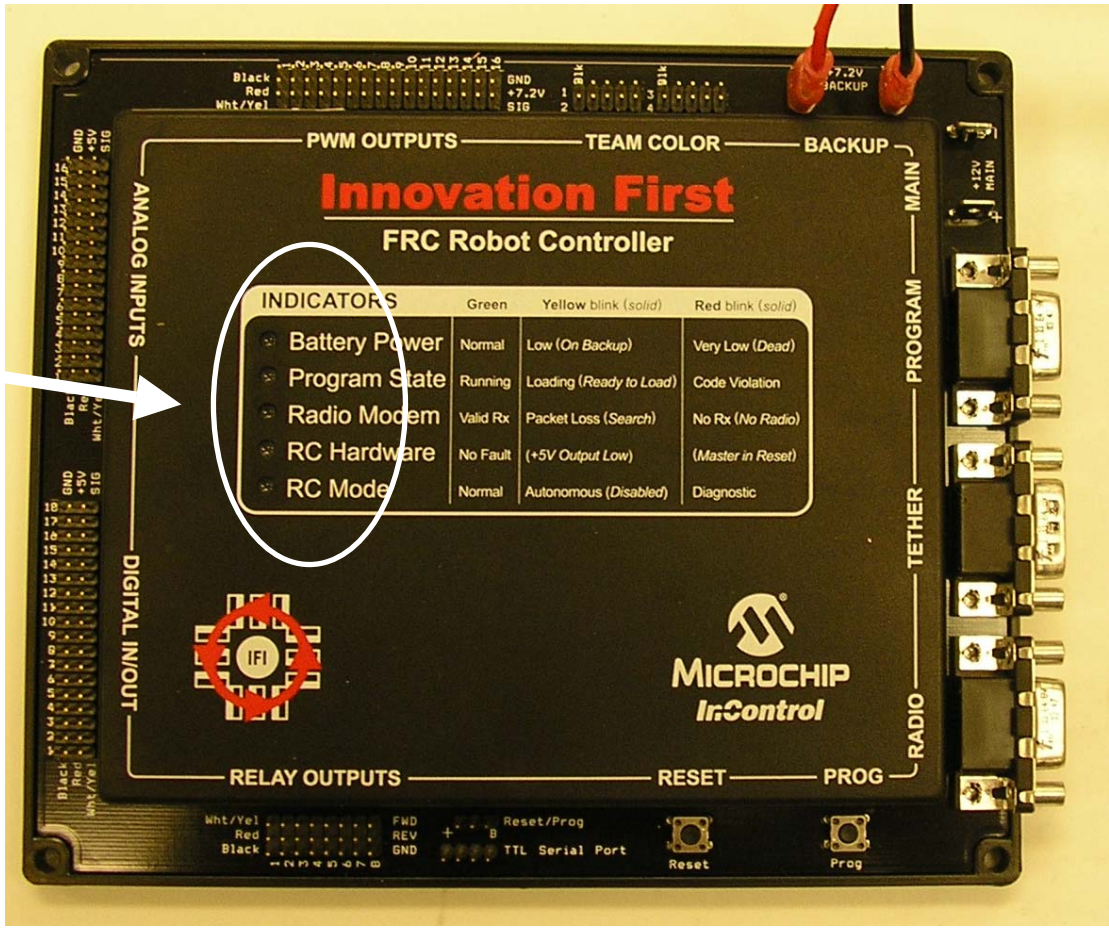
This will help the team identify problems. It will also allow the inspector to verify that the correct circuit breakers are on each circuit.



2005 CB/Distribution Panel – each team can use 1 per robot with any combination of 20, 30 and 40A breakers

✓25 Robot Controller

Indicator Lights Must be readily Visible

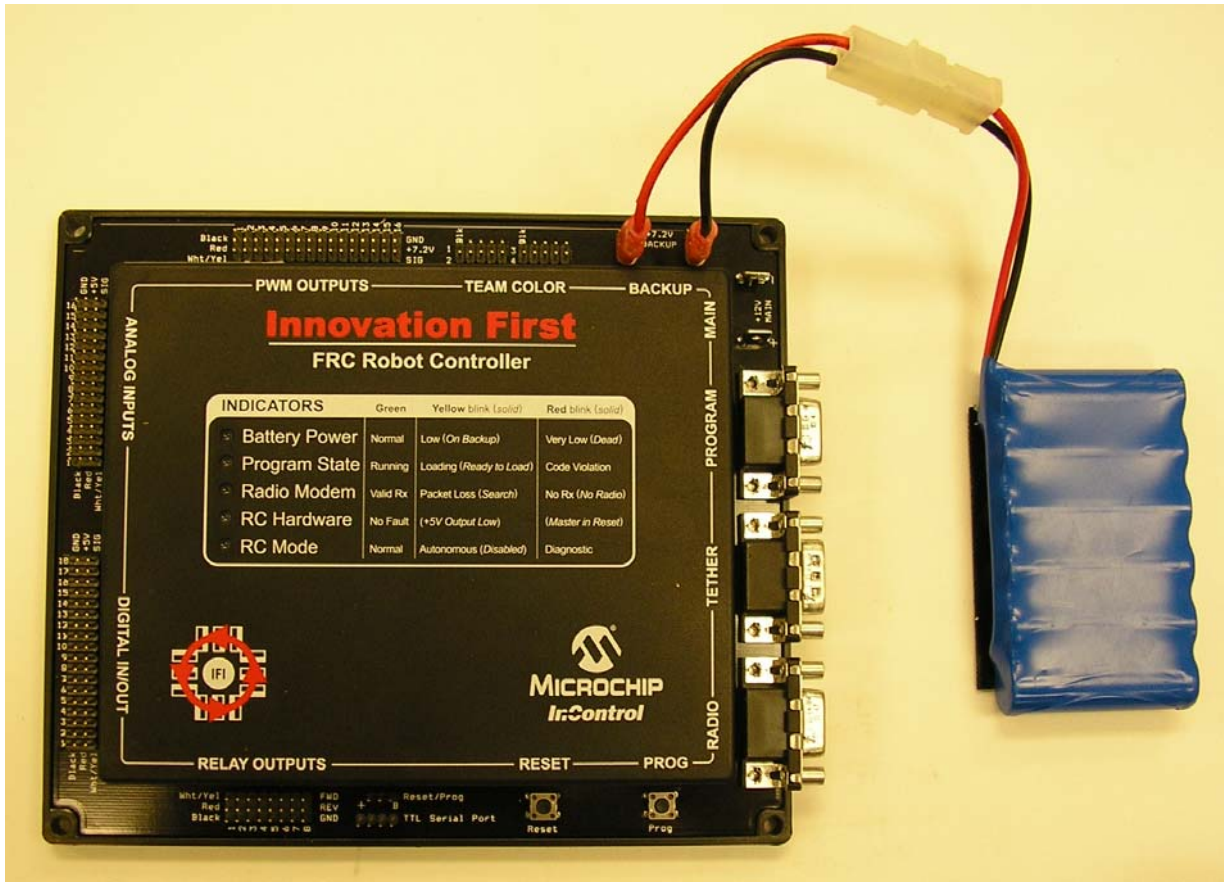


Inspector must be able to easily see all connections made to the controller

✓26 No Modifications to the Robot Controller

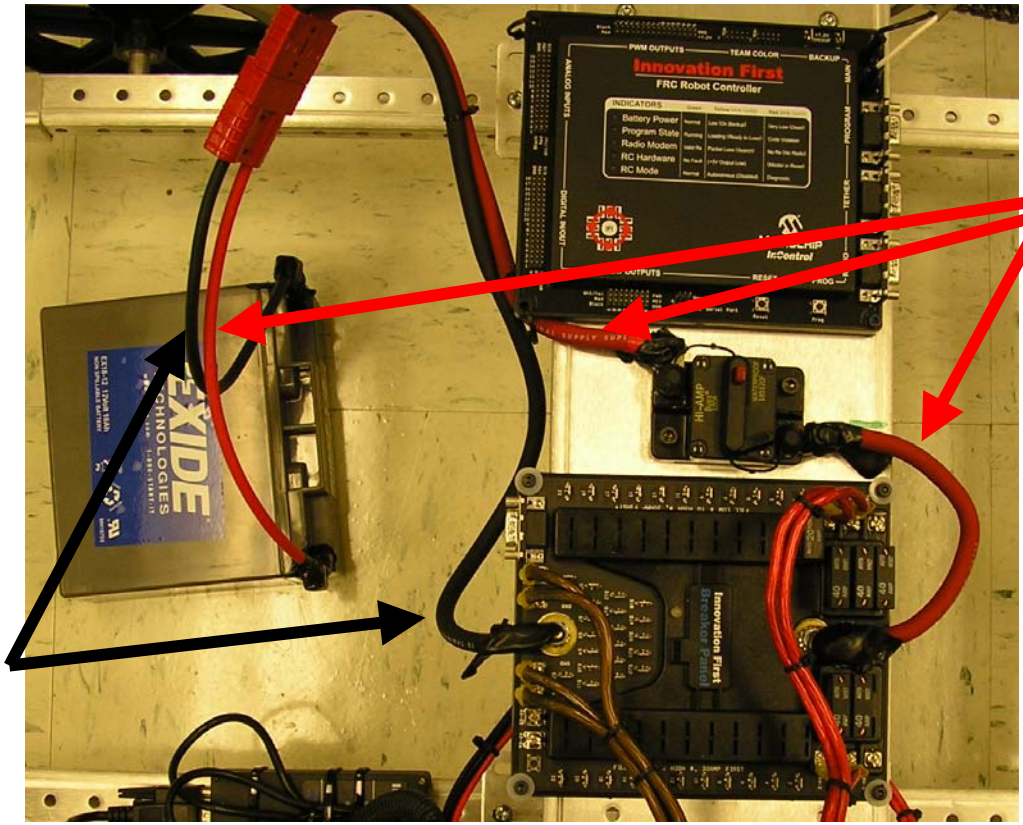
DON’T MODIFY THIS!! (except its software)

✓28 7.2V NiCad Battery Pack



✓29 #6 Wire for Main Power

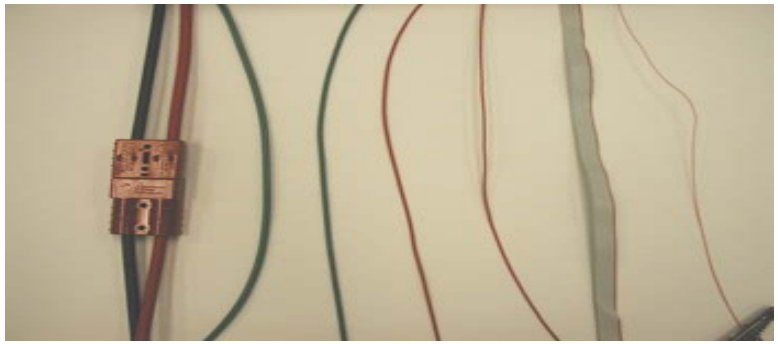
Note the Anderson Connectors come prewired with #6 wire. There is more of this wire in the kit.



These three wires should be the same size (#6) and color (RED)

These two wires should be the same size (#6) and color (BLACK)

✓29 Wire Sizes



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

- 6 AWG (or larger diameter) must be used in battery-to-CB/Distribution/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 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.

✓29 Wiring Conventions

+ POSITIVE +	- NEGATIVE -
RED	BLACK
WHITE	BLUE
BROWN	

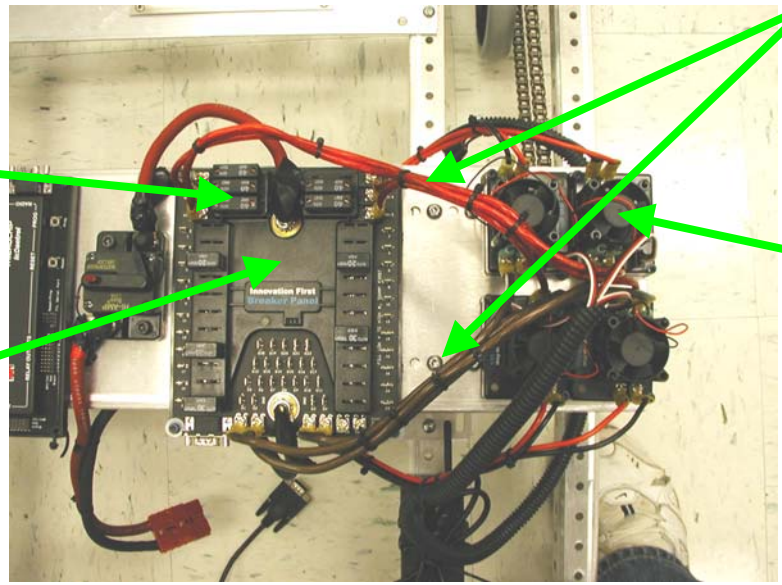
✓30 One Motor per Speed Controller

CIM

Only one motor (any of the kit motors) connected to each Victor 884 speed controller

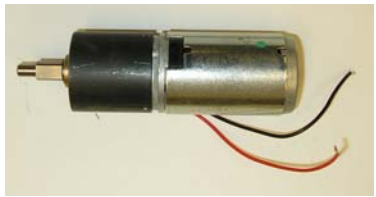
Fisher-Price

✓30 Either 20A, 30A or 40A Circuit Breaker For Speed Controller

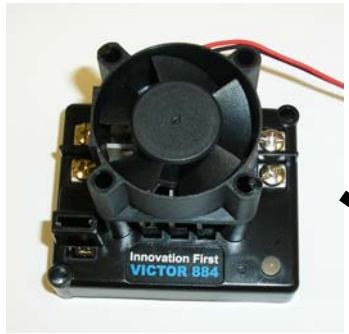


Speed Controllers must be powered from the CB/Distribution Panel (shown) or Maxi-Block or ATC Panel via either 20A, 30A or 40A Snap-Action or Bussman circuit breakers (40A breakers shown above).

✓30-31 Wiring Paths – Need a Breaker



Motors, compressor and solenoid valves **must** be wired to a Speed Controller or Spike Relay than to Breaker Panel



or

✓31 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.

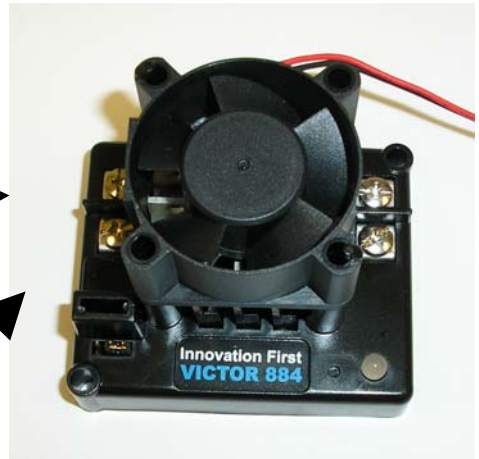
✓31 One Motor per SPIKE

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

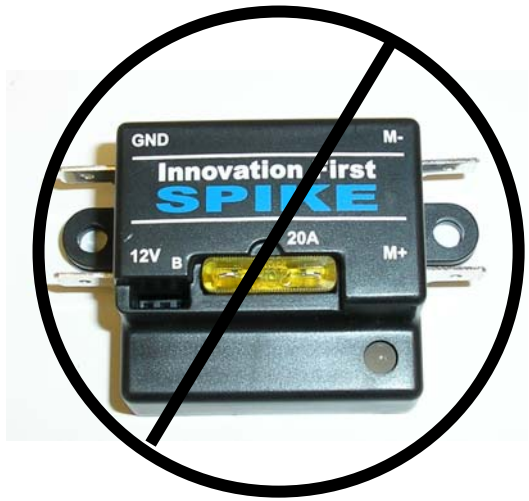
✓32 Motor Wiring Requirements

CIM (both small and large (mini-bike))

These Motors must be wired to an 884 not a SPIKE Relay



Fisher-Price

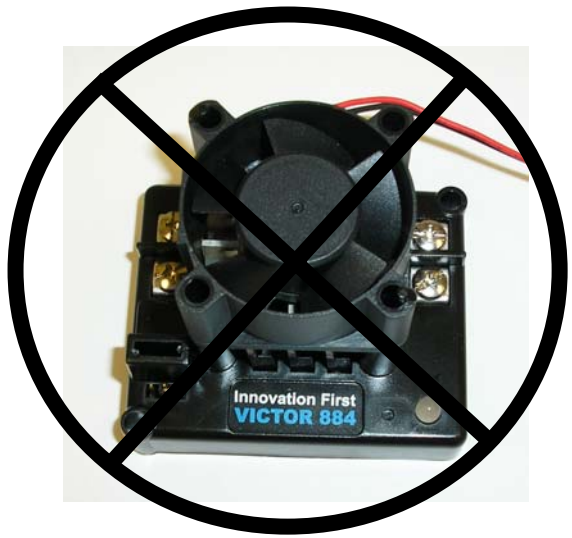


✓33 Motor Wiring Requirements

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

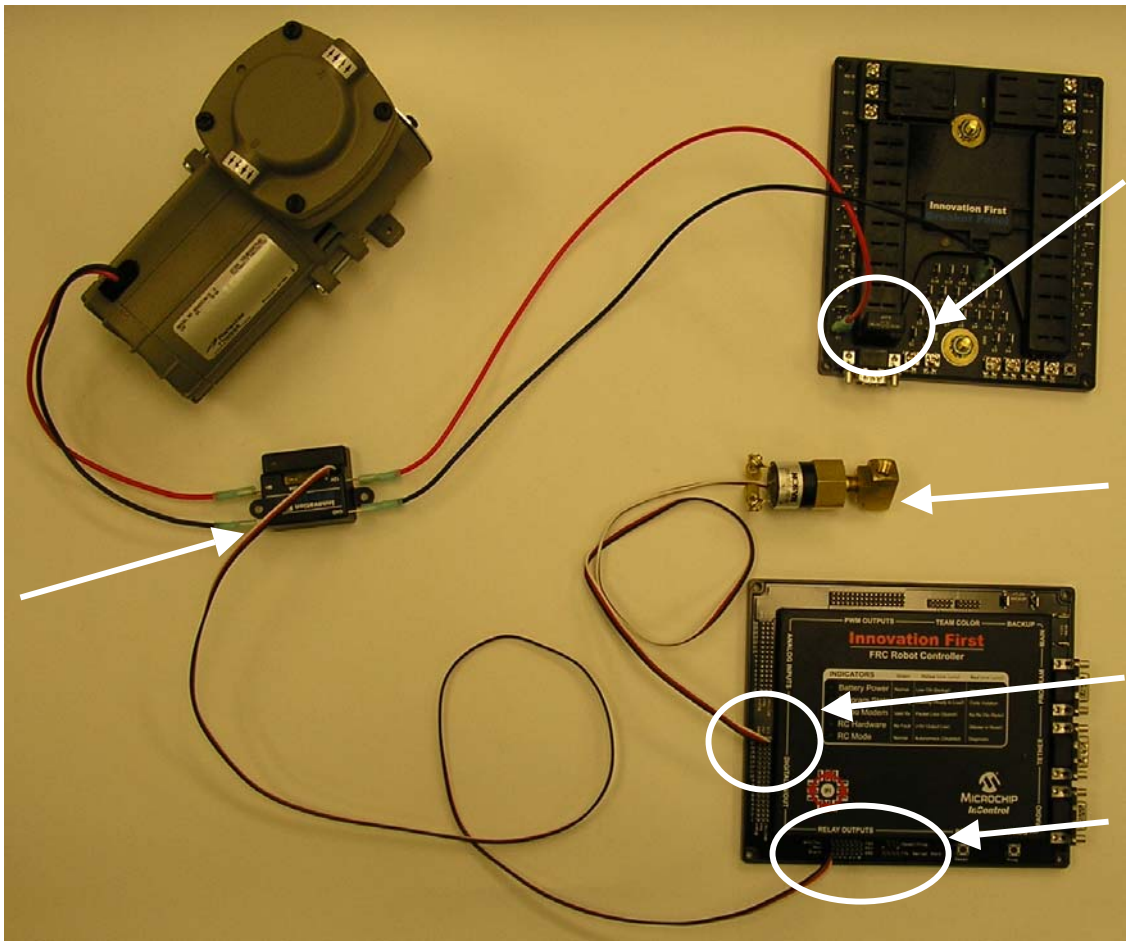
These devices (if used) must be wired to a SPIKE Relay and not an 884

pneumatic valves



✓33 Compressor Wiring

(identical schematic regardless of whether the compressor is on or off the robot)



20A Breaker, compressor alone on this circuit
R81 (2005 CB/Distribution Panel shown, one of the ATC Breaker Panels could also be used)

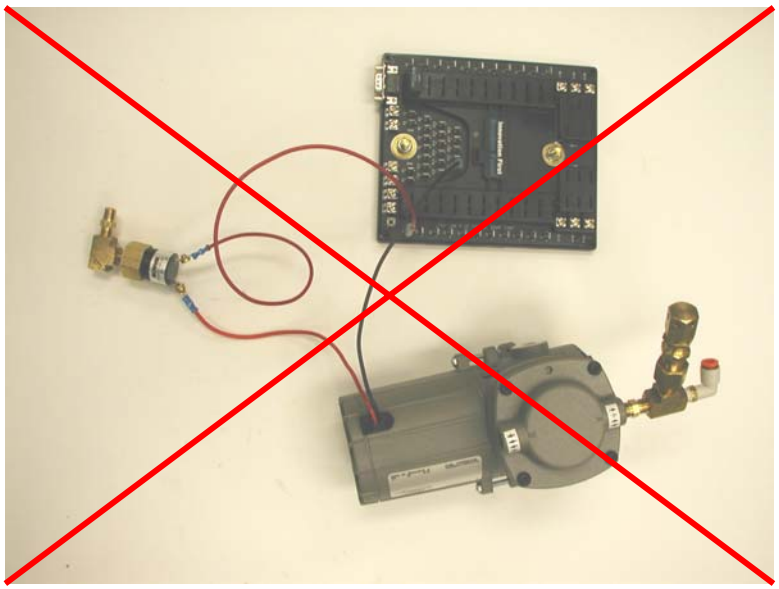
✓44 Nason Pressure switch

Any digital I/O

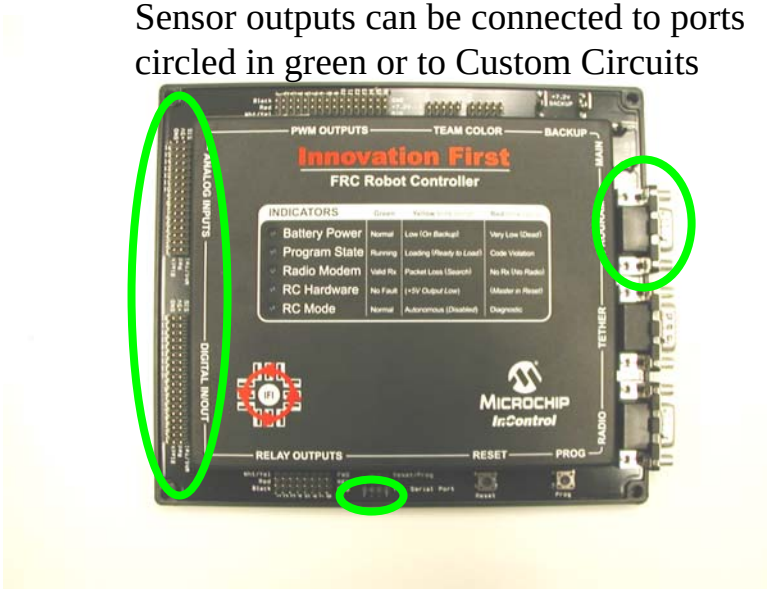
Any Relay output

Spike Relay, the fuse can be replaced with a 20A Snap Action breaker (this is the only Spike for which that mod is permitted)

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

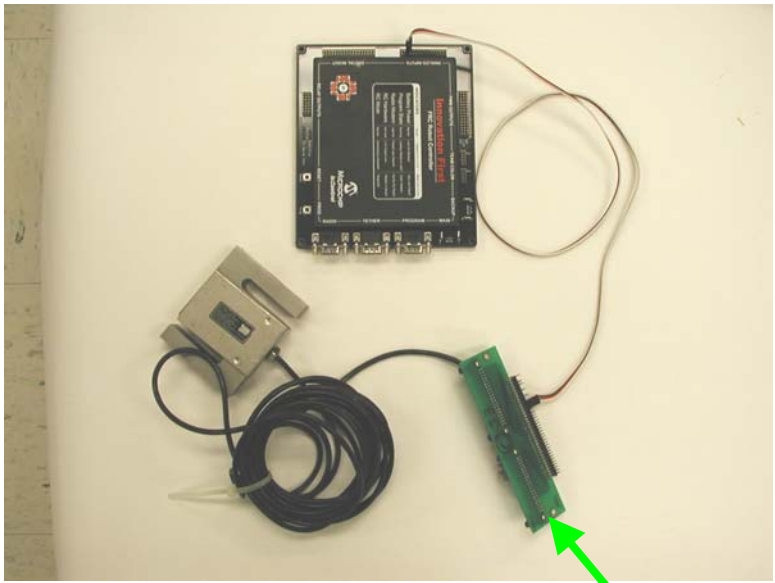


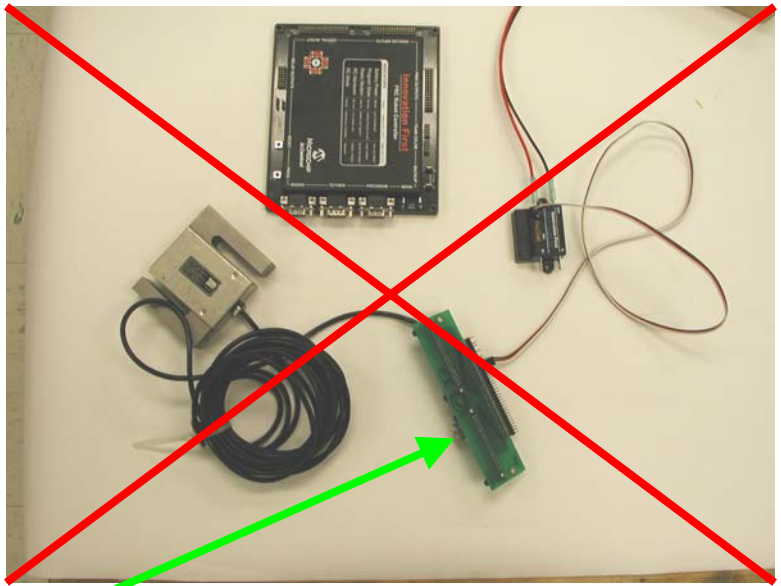
Sensor outputs can be connected to ports circled in green or to Custom Circuits



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.

✓36 Custom Circuits



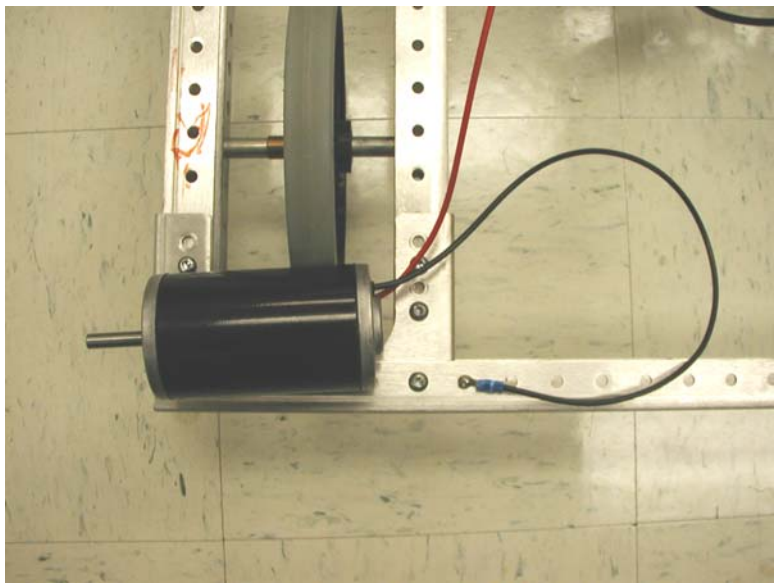


Example of Custom Circuit

MAY be connected to any port on the Robot Controller (except Radio or Tether Port), to CB/Distribution Panel, 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)

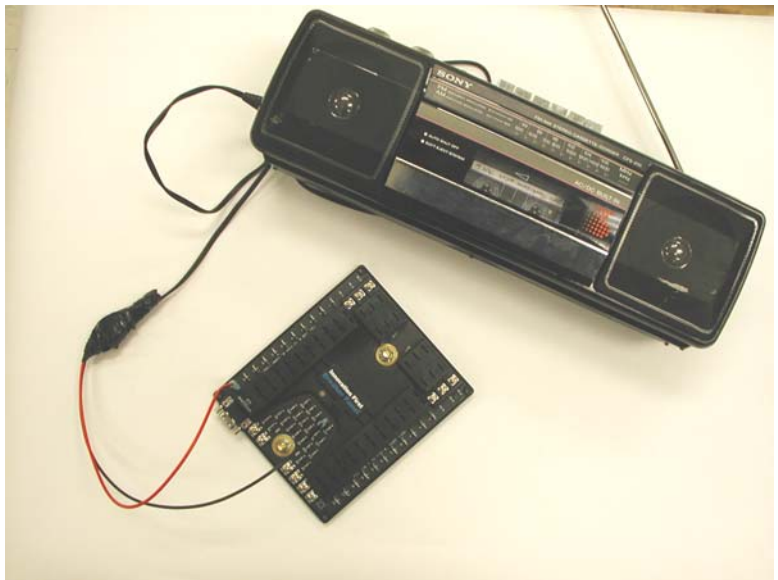
✓37 No Exposed Electrical Conductors



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.

✓38 Decorations



Any decorations on the robot that use electrical power must be powered from the on-board Exide battery and must be protected with either a 20A or 30A circuit breaker on a CB/Distribution Panel or ATC Fuse Panel. Decorations CANNOT interfere with other control system components.

********PNEUMATICS*******

✓39-47 Pneumatic Inspection Guidelines

Inspection of the pneumatics, starts with charging the system. While the compressor is running, check how the compressor is wired. (See ✓24 Compressor wiring slide.) Then watch the high pressure gauge to make sure that the compressor shuts off at 120 - 125 psi.

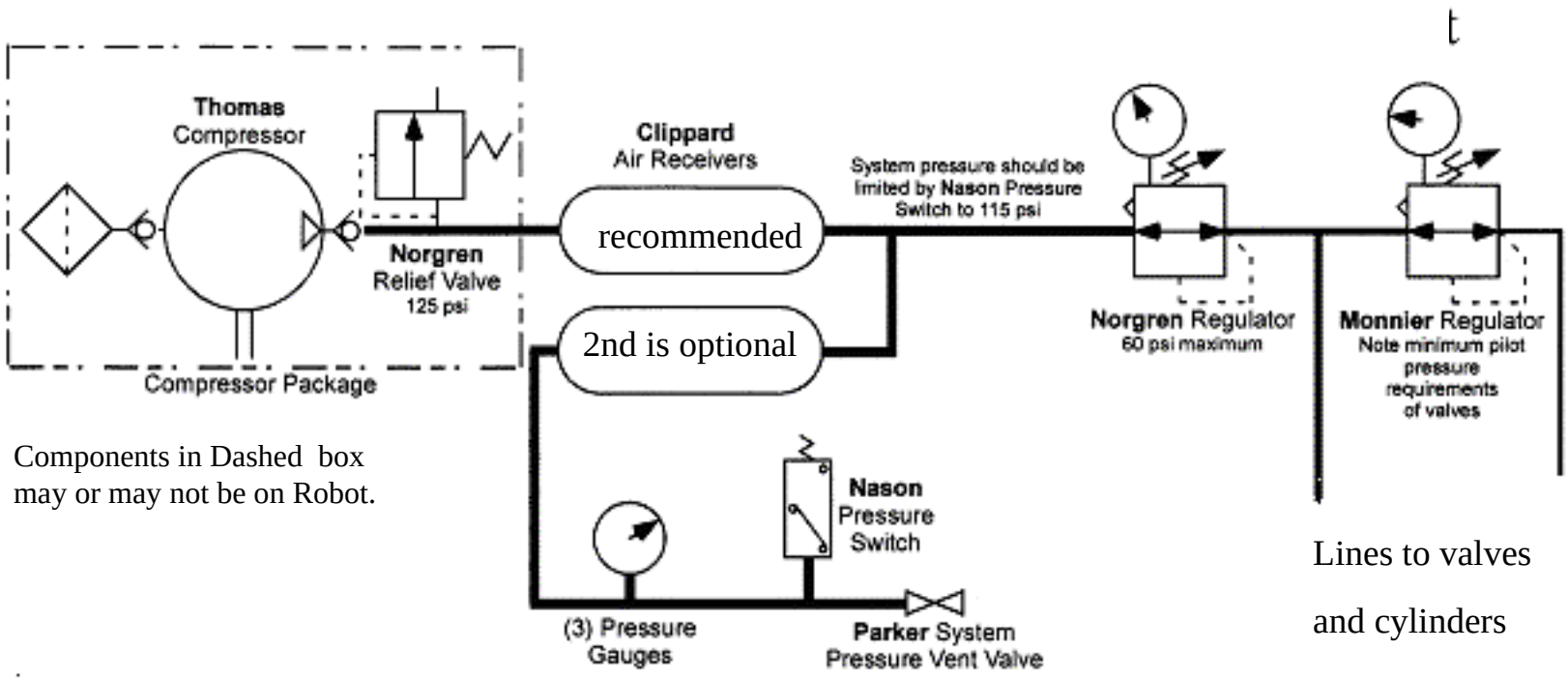
Ask the students to describe how the system works, while they are doing that, look for the parts of the system that need to be inspected. If the inspector pays attention, they will not have to ask the questions on the check list. The students will tell them the answers as they describe their robot.

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.

TEAMS ARE ONLY ALLOWED TO USE SMC TIUB07 SERIES OR EQUIVALENT TUBING (1/4" ID, polyurethane, any color) WITH A TOTAL LENGTH NOT TO EXCEED 20 METERS.

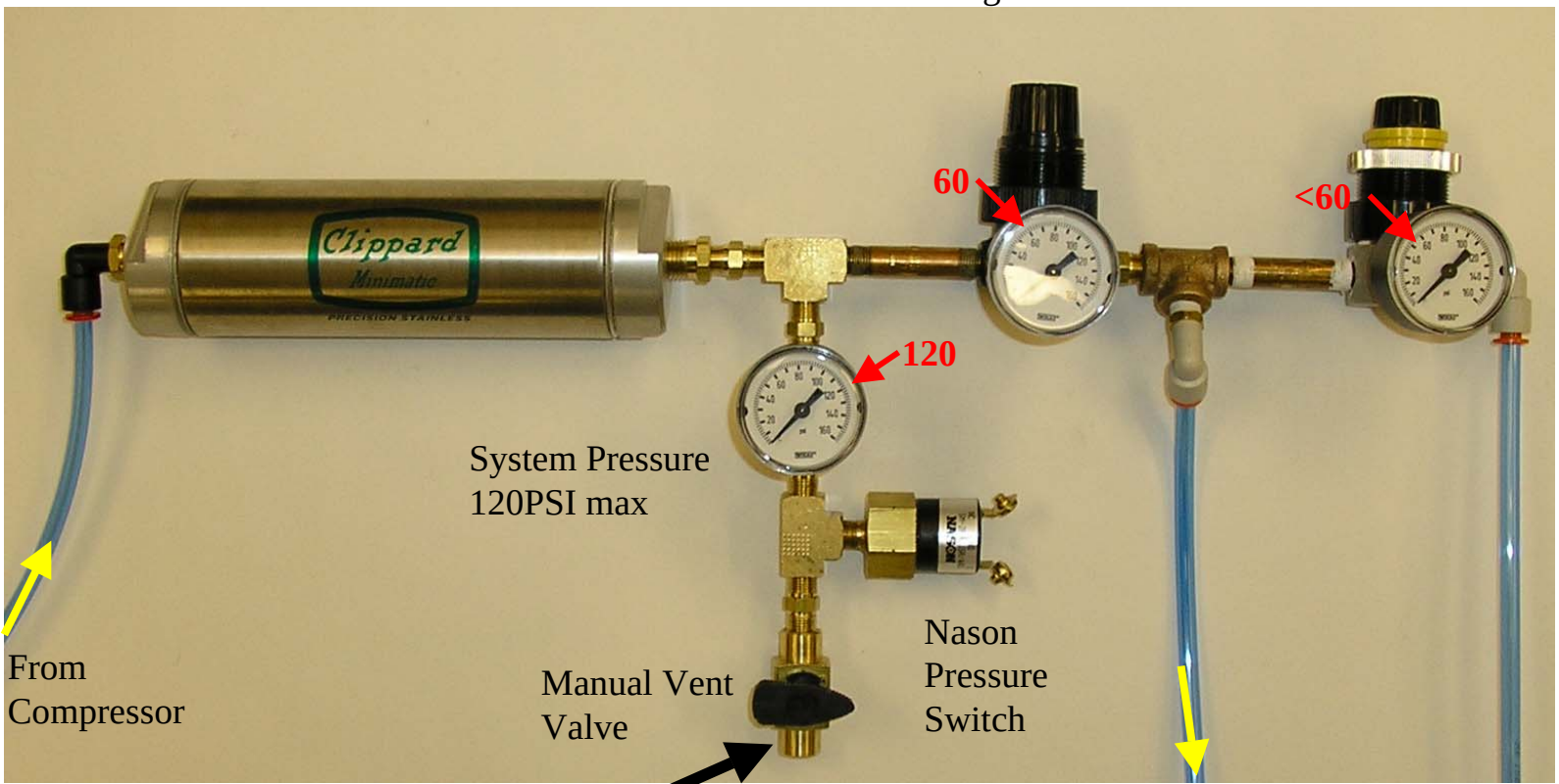
✓39✓42-44 Typical Pneumatic System



✓39✓42-44 Typical Pneumatic System Layout

Norgren Regulator
60PSI max
Working Pressure

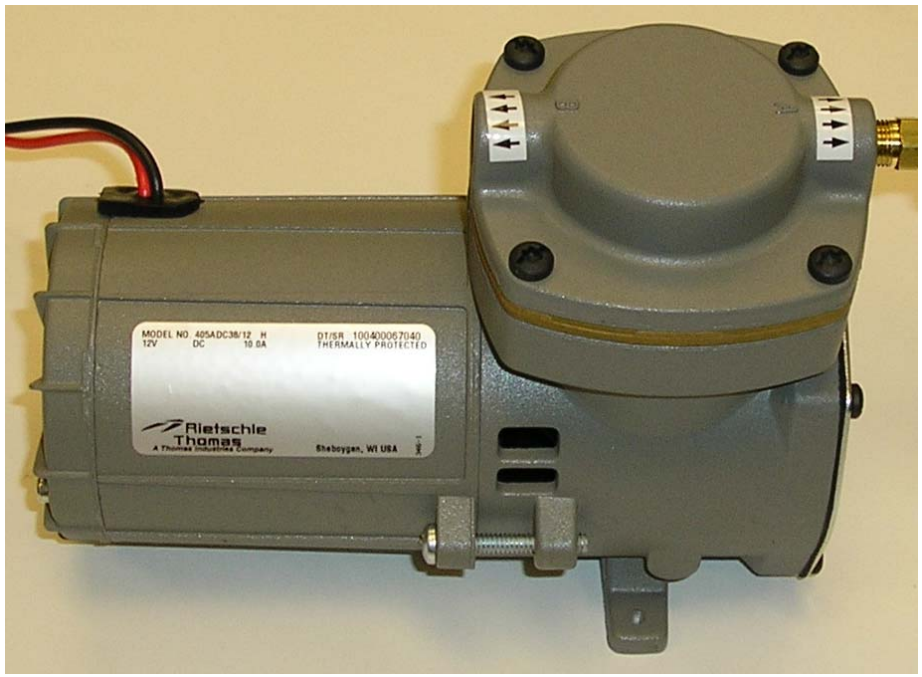
Optional Monier
Regulator (< 60PSI)



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

(R21, R40, R44, R46, R94-R100)

✓39 Only Allowed Compressor



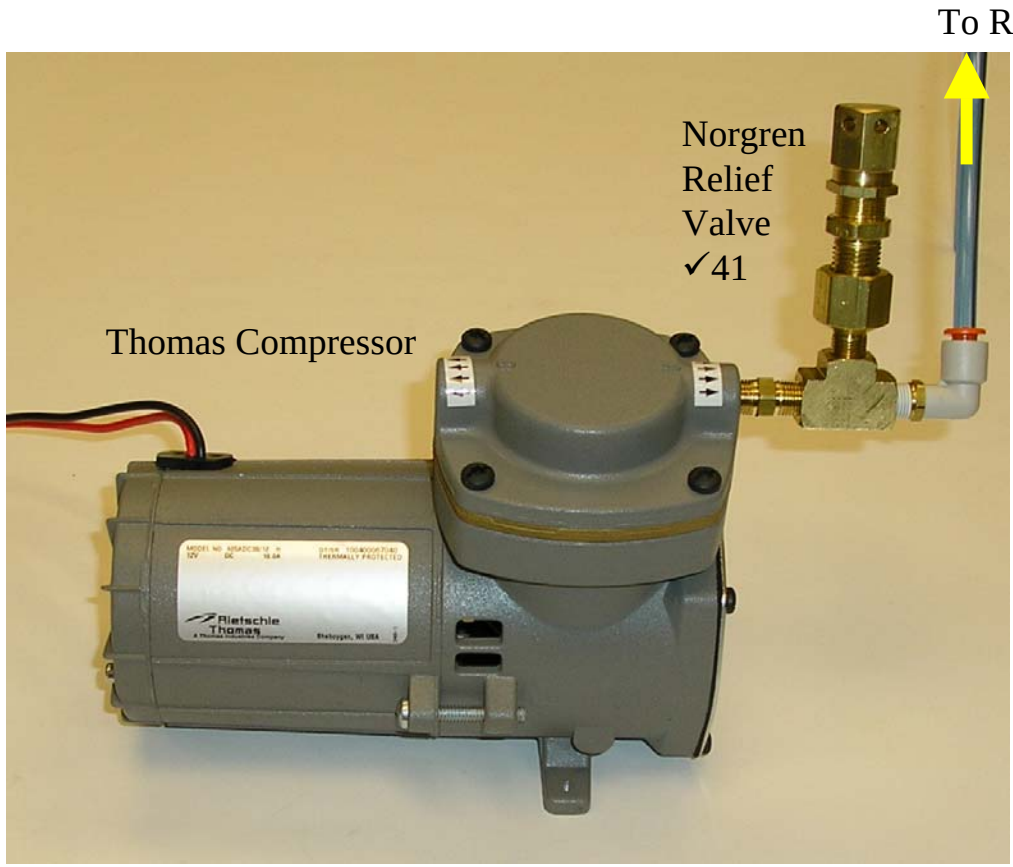
The Thomas compressor must be the only compressed air source.
Vacuum generators can be used if desired but must be powered by motors from the kit.

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.

✓39-41 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 Norgren relief valve should be mounted on the compressor in either case.



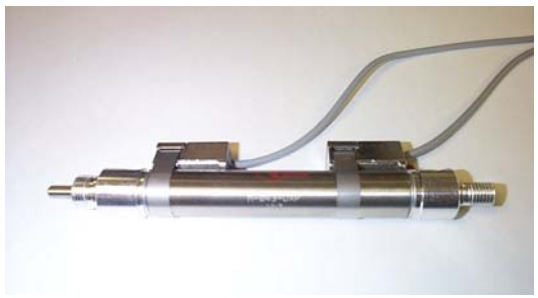
✓39✓40 Allowed Air Storage Tanks

If using pneumatics, teams can use either 1 or 2 tanks.

✓39 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 Bimba’s website (the portion dedicated to FIRST) (see pictures below and following page)
•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

✓39 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, 12, 24
-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

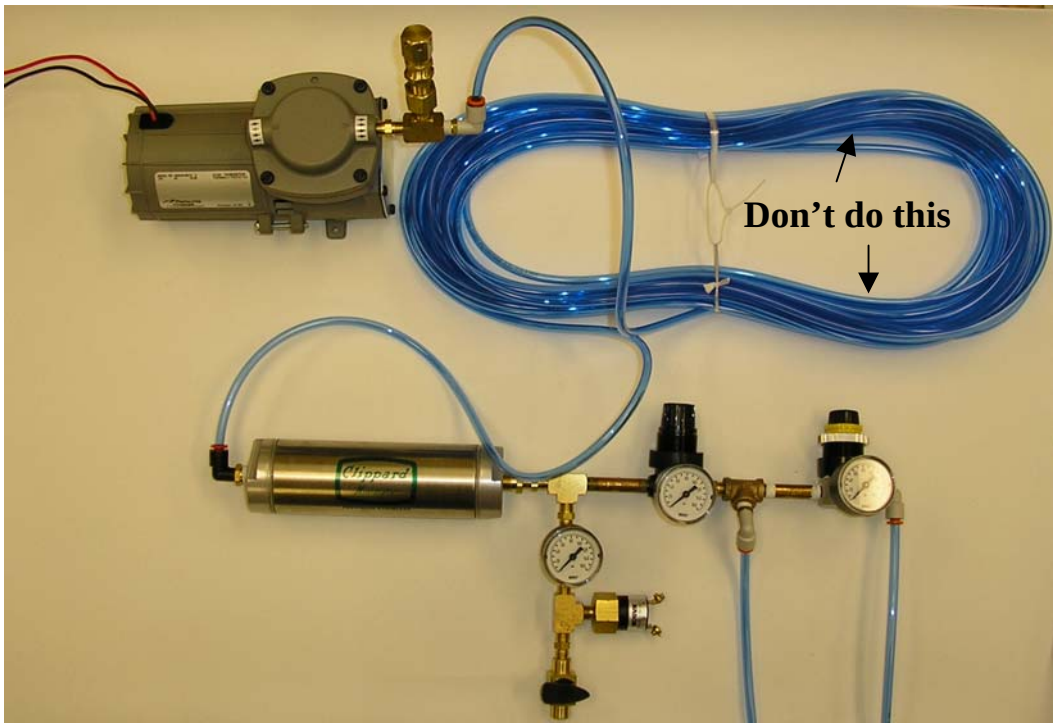
✓45 Check physical condition of actuators and tanks

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

✓46 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.

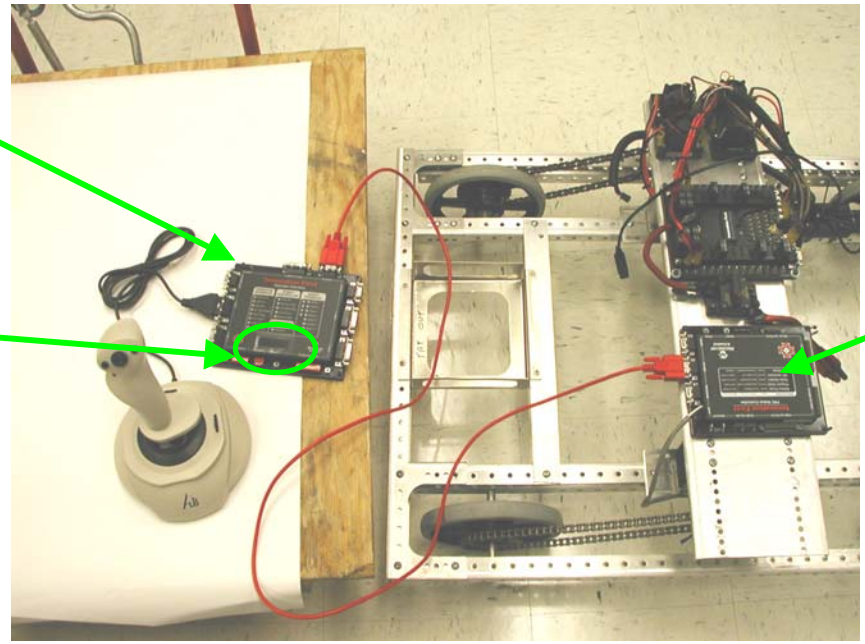
✓47 Off-Robot Compressor

(only applicable for robots using pneumatics with an off-robot compressor)

Refer to checklist item 33 regarding wiring for off-robot compressor.

DRIVER CONSOLE AND POWER-UP

✓52 Confirm Team Color LED (if used), Team Number and SW Version



Tether the Operator Interface to the Robot Controller as shown above (red serial cable). Upon power-up, the Team Color LED (if used) must blink and, by cycling the SELECT button on the OI, the team number and software version must be displayed on the Operator Interface. 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).

The Team Color LED is not shown – if present (it's not required) it should be mounted on the front side of the robot and be easily visible.

✓53 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 120PSIG
• 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.

✓54 Electrical Test

While running, turn off the robot's power by throwing the 120A main circuit breaker. The robot should be disabled and the RC lights should all turn off.

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

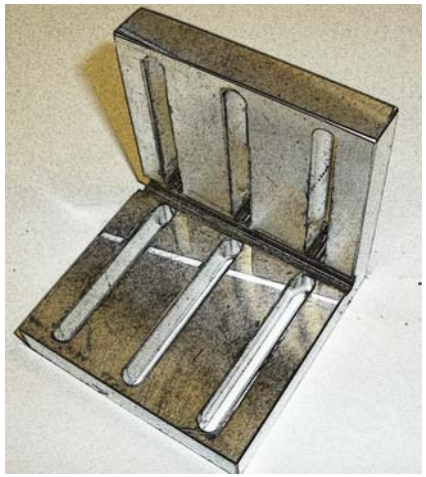
Identical spare installed in place of removed damaged part

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

Upgrade

Motor was controlled by a SPIKE relay.

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 week) on the sticker and sign/initial the dot.

PASSED INSPECTION 2006

FRC REGIONAL XYZ

TEAM ABC

Sign here

(approximation of inspection “done” sticker)