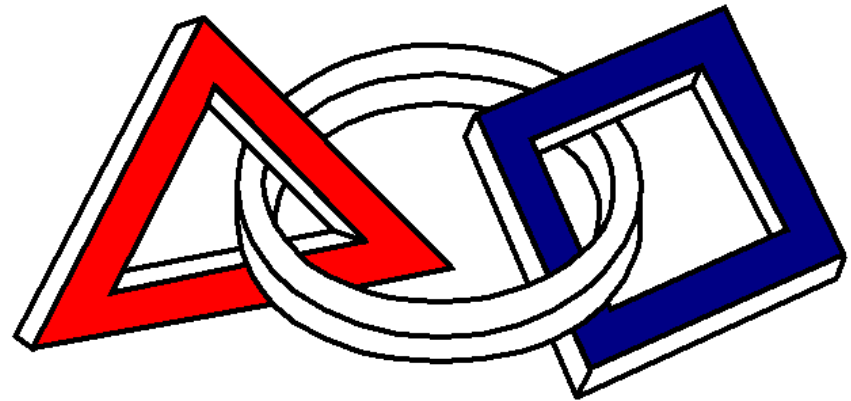
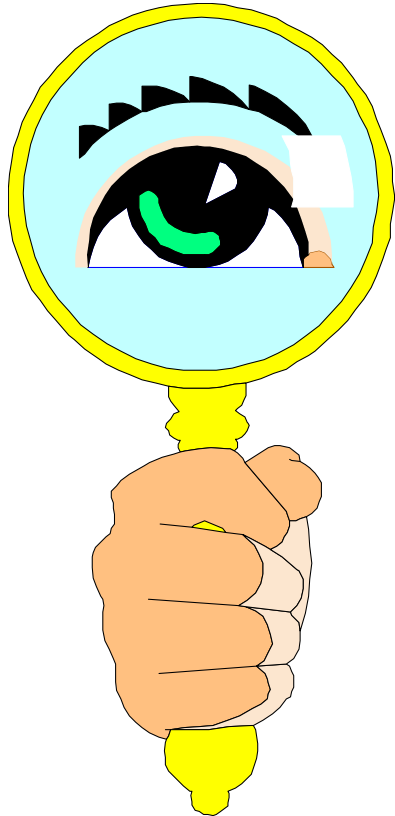


Inspectors' Checklist Manual 2005



FIRST

Created by:

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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 is any discrepancy between this document and the Robotics Competition manual, 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.

Viewing this Document

Using ADOBE, activate the Bookmark and Pages tabs to quickly navigate between sections of this document.

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 Check List
 - Robot Inspectors' Checklist Manual (this document)
 - Section 5 "The ROBOT" in the competition manual

 - Extra Credit

 - Q & A Bulletin Board (Lead inspector must read these to keep ahead of updates and clarifications to rules)

- 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 access 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.
- Lead inspector should make every effort to complete inspections prior to first match.
- 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** sticker in 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.
- 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.

*** Scale Setup and Calibration***

Inspector will Set up and calibrate scale

Put scale on hard surface.

Minimize vibration

Calibrate scale using calibrated weights

Locate scale near 120Vac outlet

The scale must sit on a firm surface, not carpet.

The scale must be level from front to back.

Everyone at the competition uses the same scale.

Inspectors will weigh the robots with the official scale provided by FIRST.

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

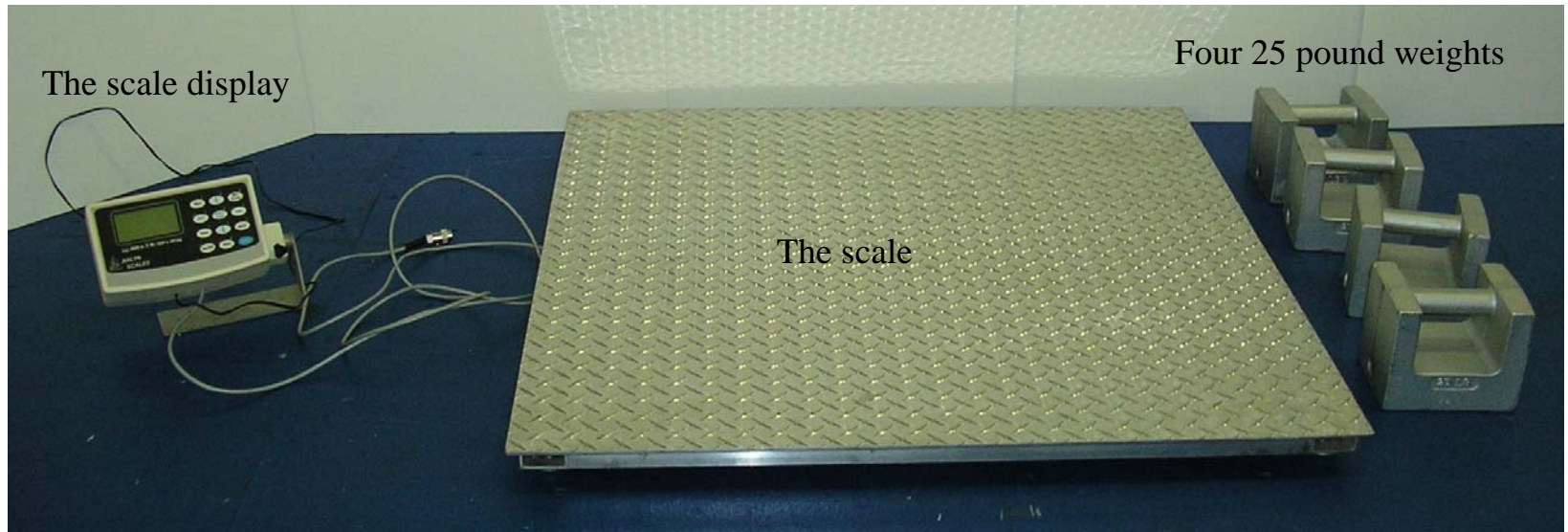
Maximum allowed **displayed** weight is 120.1 lb.

This includes the robot, controller, bumpers, decorations, etc. It does NOT include any Operator Interface items.

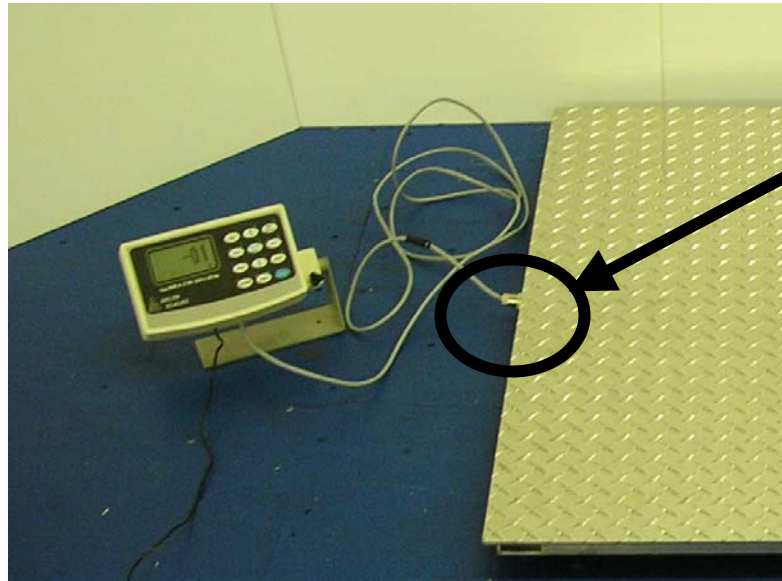
Periodically check the scale for “0” empty weight and re-tare as necessary. (There are four, 25 lb. Calibrated weights provided to check the scale with. If necessary, follow the scale’s Instruction Manual for “Span Calibration”.)

Calibration will not be done to satisfy those who think the scale is defective.

What you'll need is in the travel crate.



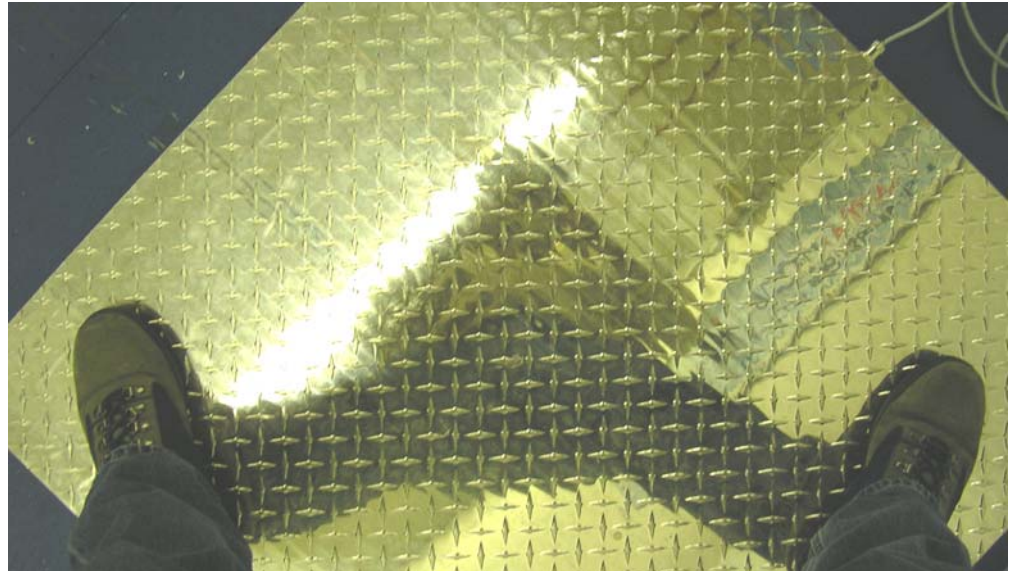
Connect power and scale plugs



Position platform on a clean hard surface and adjust leveling feet.



Press down on corners of scale to make sure that they are firmly on floor. Adjust leveling feet as required



Stand on scale (500 lb max) and shift your weight around. Scale should not rock. Adjust leveling feet as required

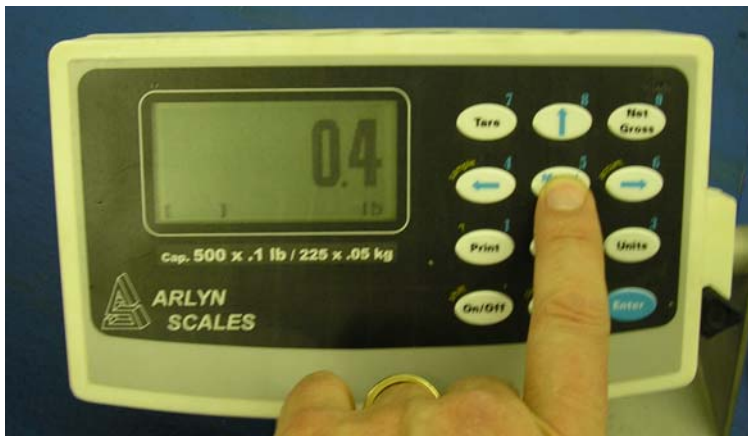
Start up Conditions / Warm up



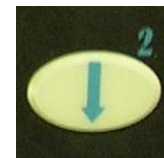
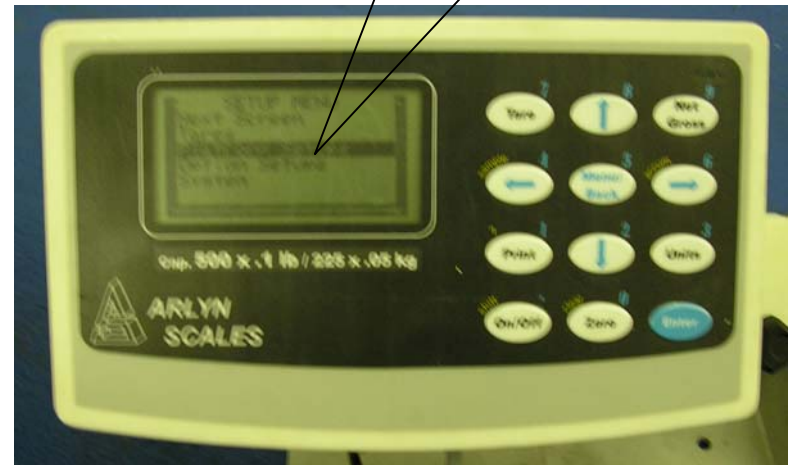
At startup, scale will show “ready”. Press On/Off button once to enter weighing screen. Scale may or may not read zero.

WARM UP: After powering on, let scale warm up for a minimum of 15 minutes. If it's been sitting on a cold loading dock all night you should let it warm up longer.

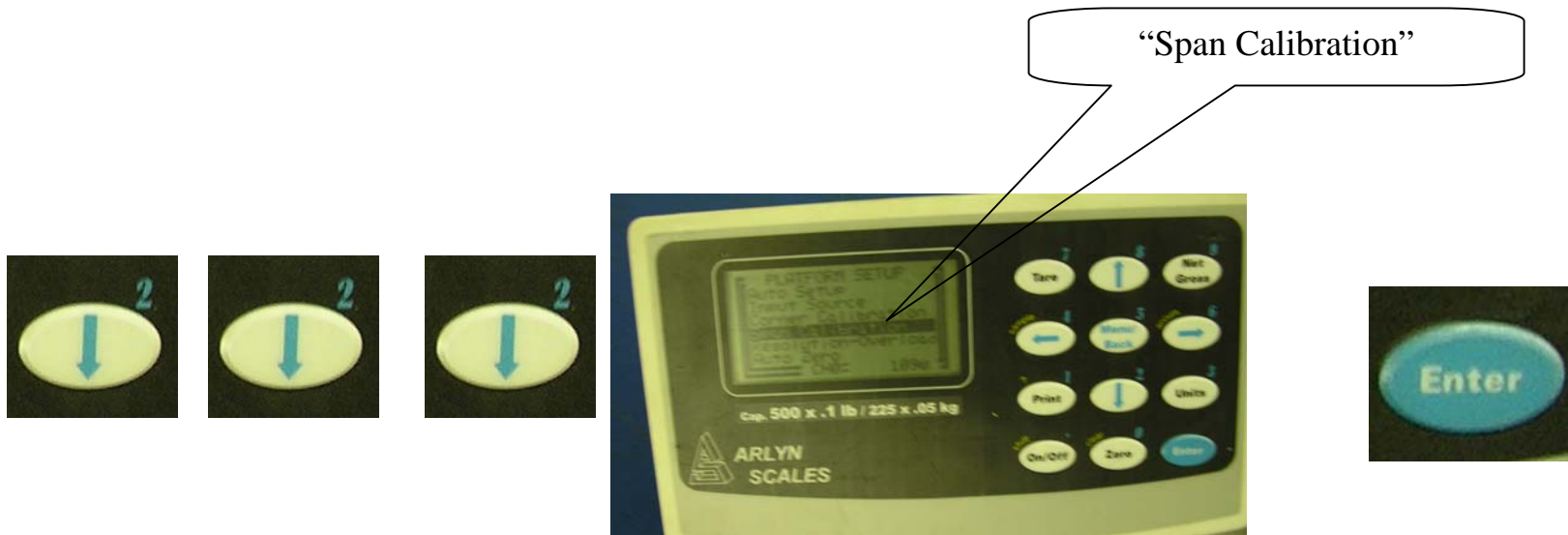
Perform Calibration Daily



Press Menu/Back to get to Setup Menu



Perform Calibration continued

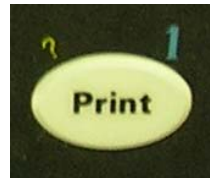


Follow screen prompts

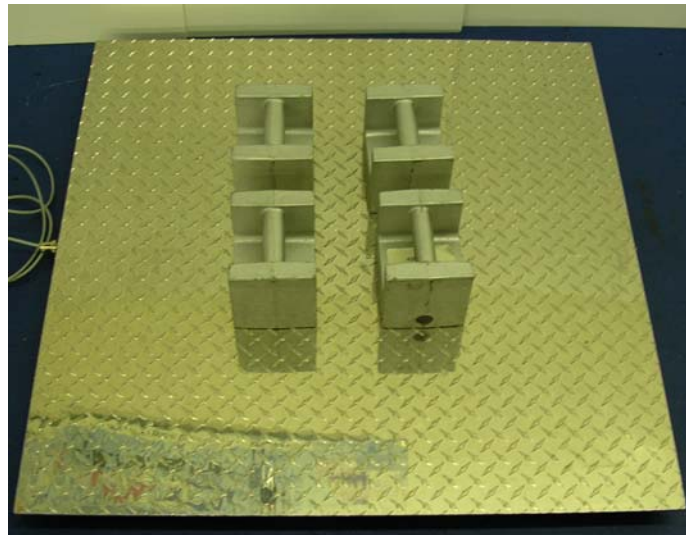
Remove all weight (if any) from platform than press “enter”.



Enter Calibration
Weight “100 Enter”



Put calibration
Weights on
scale.



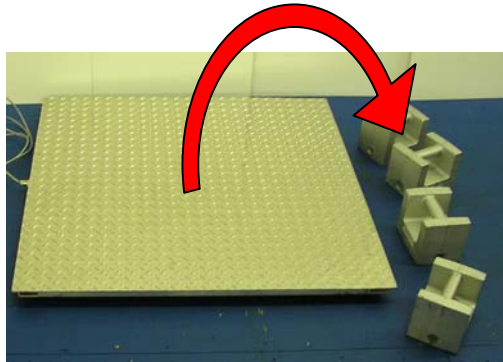
Wait 15
seconds for
scale to
stabilize and
press “enter”



Remove Calibration Weights

When calibration is done; the screen will return to the earlier menu.

Remove
the
Weights



It is important to do this now.

Press menu
back to return
to main “ready”
screen.



Press on/off to return to
weighing screen. Scale
should read 0.0 lb



Return Calibration weights to crate.

Once a day calibration is sufficient. Inspectors will not re-calibrate scales during the day to satisfy team requests.

If the scale drifts off of zero when empty,
Press the  button to zero.

#####

CHECKLIST ITEMS

#####

*****GENERAL*****

****Cost****

✓ 1 Cost Guidelines.

Teams are encourage to have their costs presented on a spreadsheet.

Teams will need to have a copy to turn in at each regional they attend. (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.

✓ 1 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 insulated 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

Team must give the inspector a copy of their cost accounting. A spreadsheet is preferred but not a requirement.

Maximum total cost \$3500 USD

✓ 1 Total Costs & Maximum 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

✓ 1 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

✓ 1 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.

✓ 1 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)



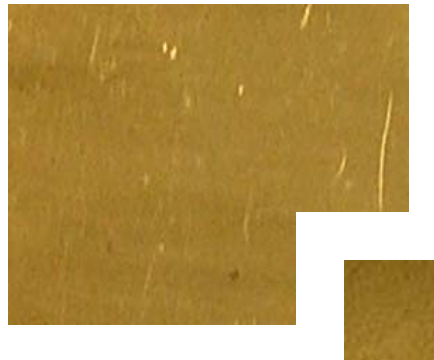
Total Cost =
Material Cost + Labor Cost
= \$40.00

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

✓ 1 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/ft²)



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.

✓ 1 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.

****Sizing****

✓ 2 The Sizing Box

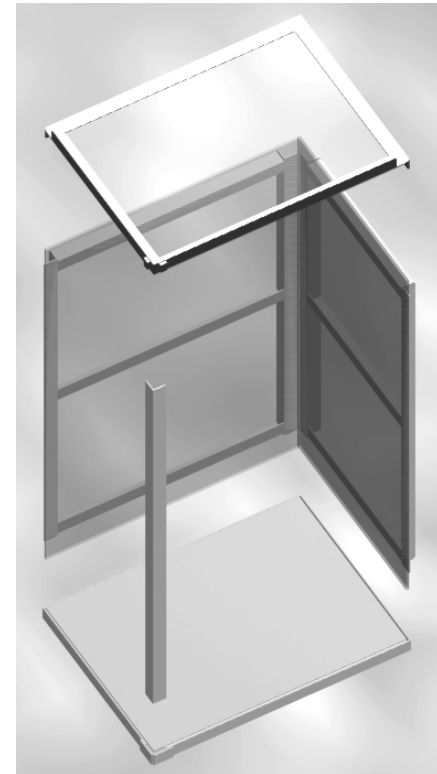
The Sizing Box is supplied in six pieces;

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.

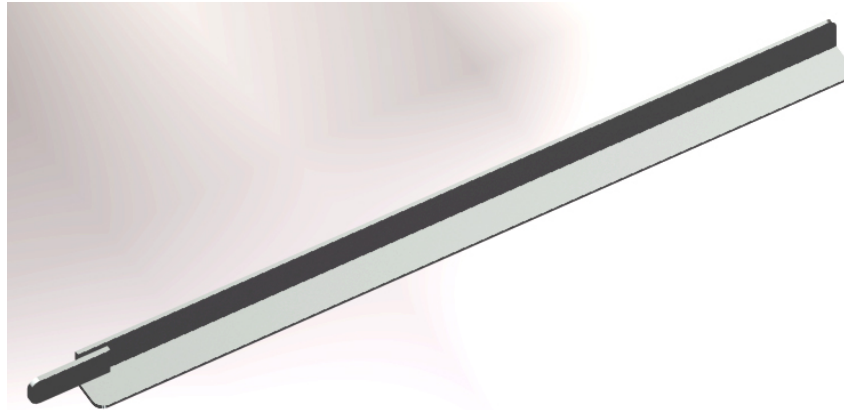
The Support is assembled to the Base by inserting the sharp-cornered end of the Support into the corner slot provided on one corner of the base.

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



✓ 2 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.



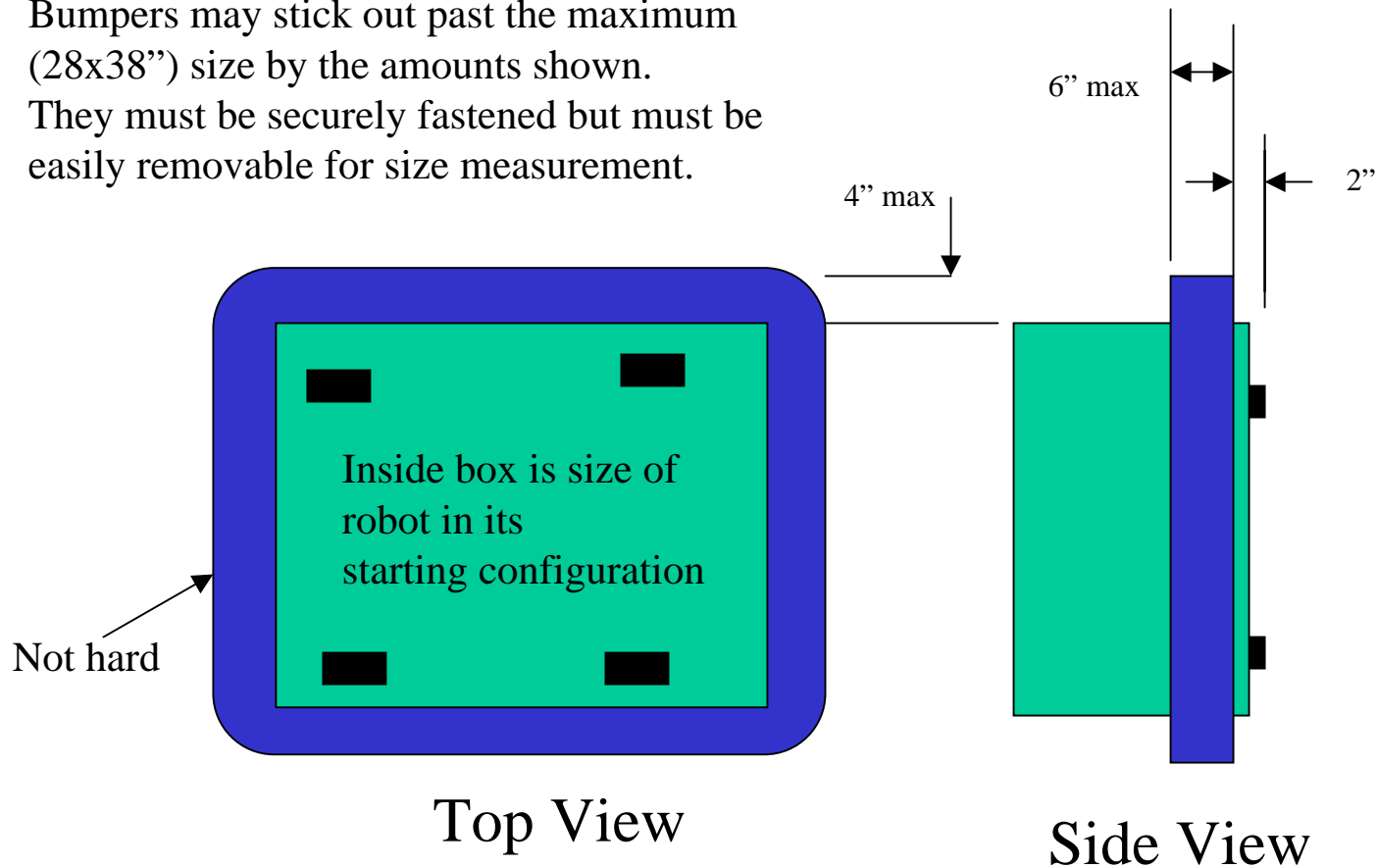
✓ 2 Robot Size Inspection

Sizing Box operation:

- Have team put robot in largest starting size.
- Remove bumpers if any.
- 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.

✓ 2; ✓ 17 Bumpers may stick out.

Bumpers may stick out past the maximum (28x38") size by the amounts shown. They must be securely fastened but must be easily removable for size measurement.



****Weight****

✓ 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. No delays at inspection.
- Of course, the Weight must be less than 120lb.

✓3✓4 Things to include when weighing

Include:

- Bumpers
- Robot weight must include everything that could be on the machine during competition.
- Decorations

Don't Include:

- Spare and Replacement parts (see ***DEFINITIONS***)
- 12V battery and Anderson cable half



✓ 3 Weighing Procedure

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



button to zero.

- Position the Robot on the scale.
- Allow scale to Stabilize for 10s
- Take reading

✓ 3 Robots should be reweighed if..

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

General Continued

✓ 5 Allowed energy sources



12 Volt battery



7.2 Volt backup battery



Gravity



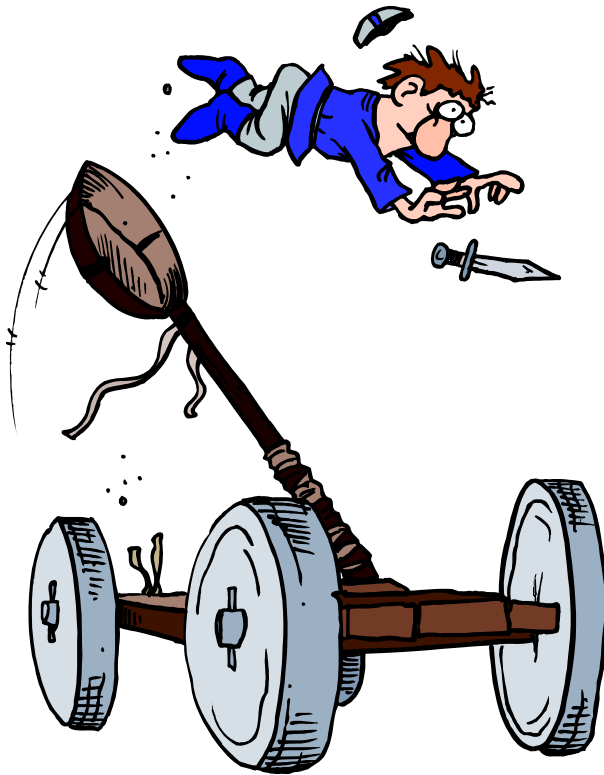
Compressed air stored in Clippard tanks.



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

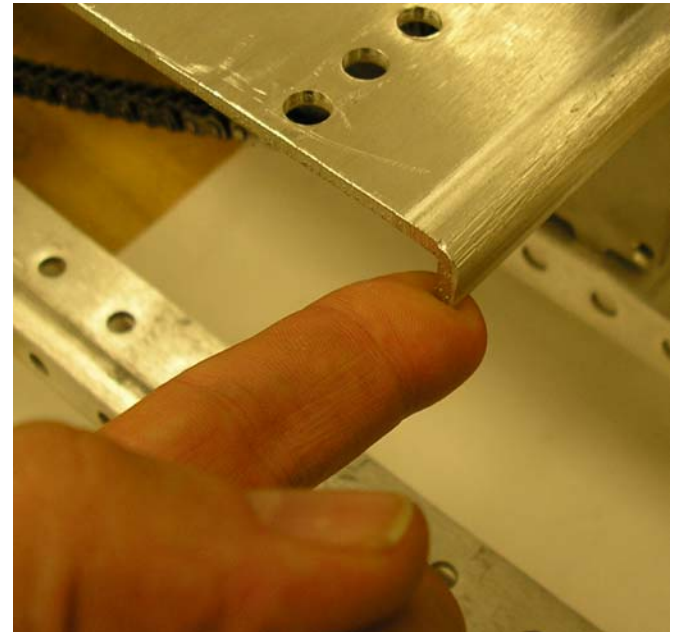
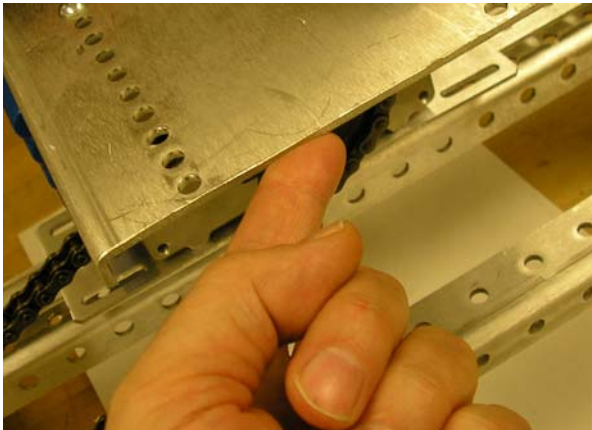
✓ 5 Stored Energy Hazards

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.



✓ 6 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.



✓ 6 Puncture Hazards

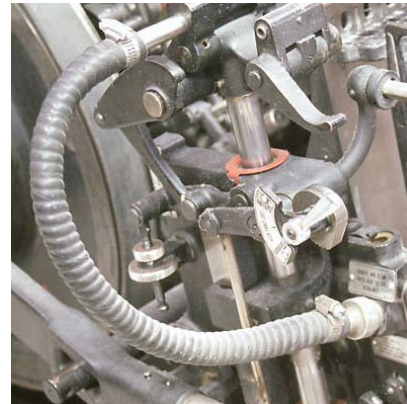
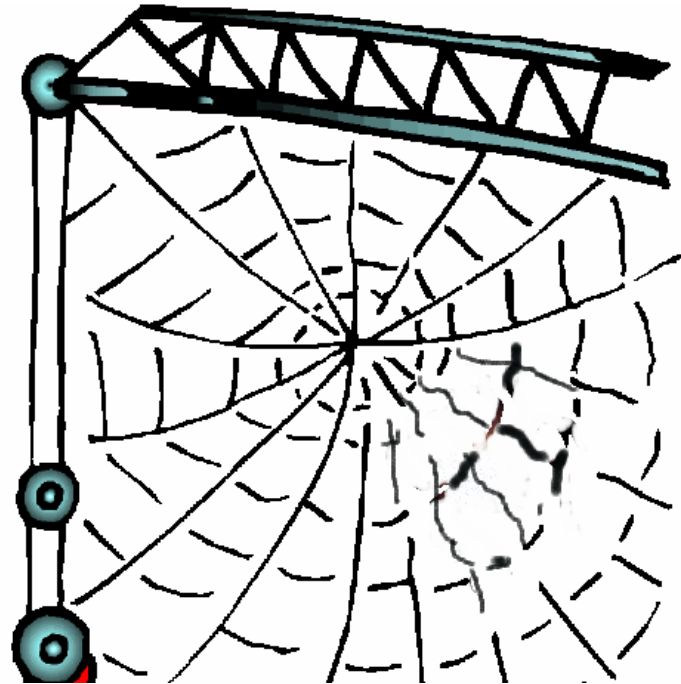


Inspector will check machine for any protrusions that may present a puncture or impalement hazard. Leading edges not less than 1 in ².

Ask yourself: If this Robot ran into me, would something sharp on it draw blood?

✓7 Entanglement

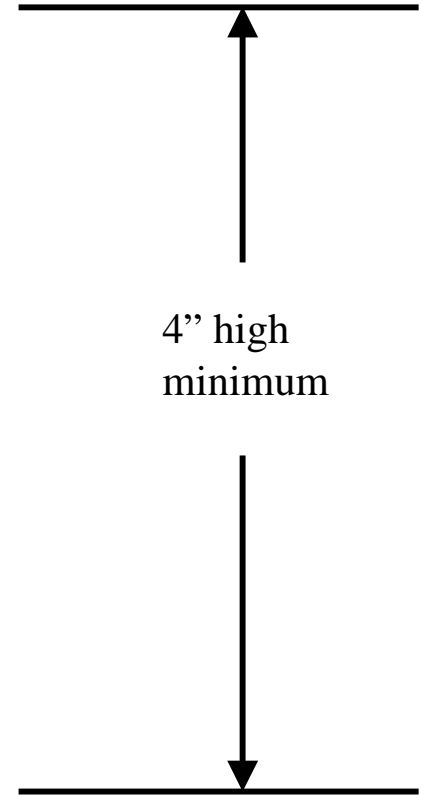
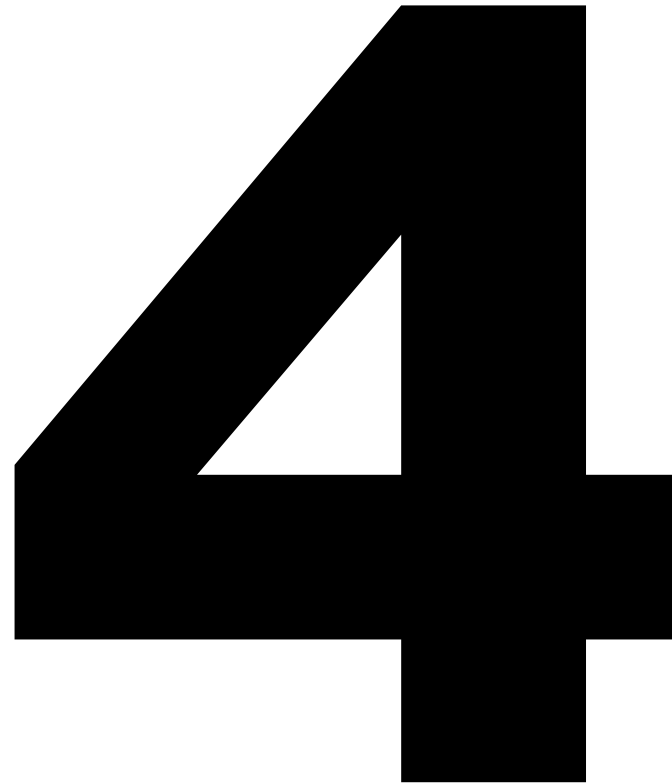
Entanglement with another robot could disable your robot. You could get hoses or wires pulled off. Look for anything that could get caught on another Robot's arm or other part. loose cables, hoses, cordage,



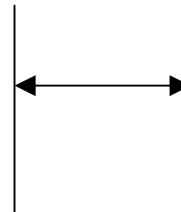
✓9 Check Marking Visibility

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 Sponsor Name/Logo must be displayed.



3/4" stroke width minimum

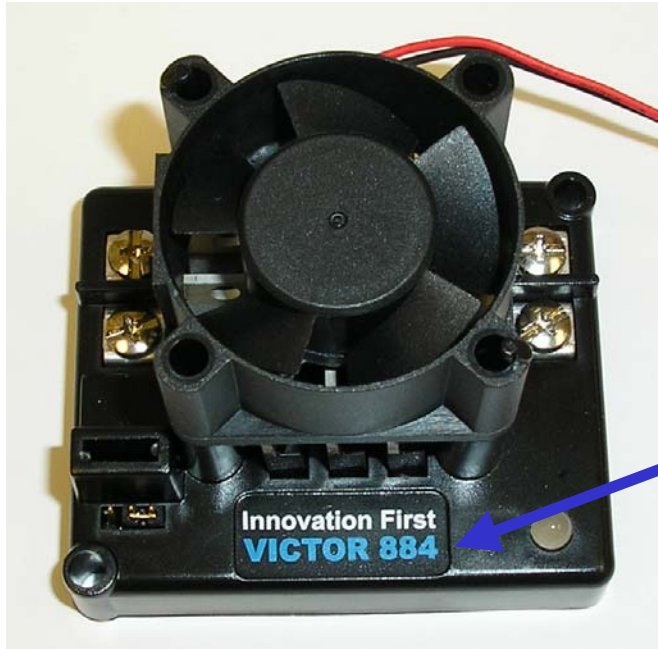


✓ 10 Team LED's

Two team color LED's mounted on opposite sides of Robot.

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

✓ 11 Check speed controllers



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

(the 884 Controllers may have different colors)

884's
only

✓ 11 Allowed Air storage tanks

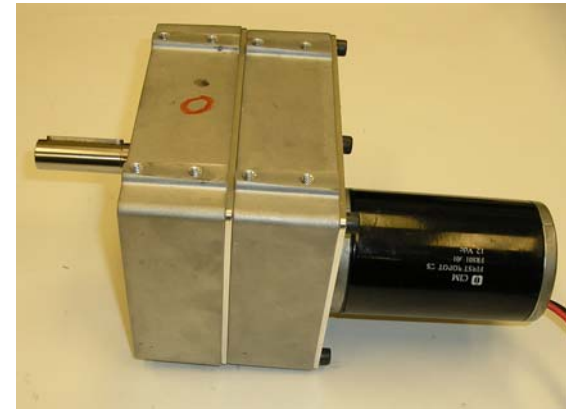


Kit comes with one
and team is allowed
to add one more

✓ 11 CIM Motors: 4 Allowed

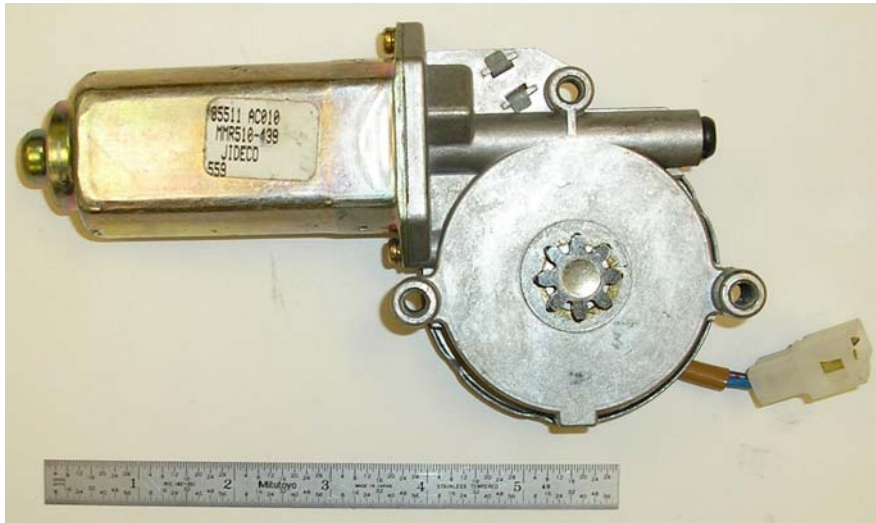


6" scale shown for sizing..



These motors will typically be mounted to a gearbox.

✓ 11 Jideco Motor: 1 Allowed



Front View



Back View

6" scale shown for sizing. This motor may be either left hand or right hand.

✓ 11 Nippon RH Window Motor: 1 Allowed



Front View



Back View

6" scale shown for sizing..

✓ 11 Mabuchi Motors: 1 Allowed

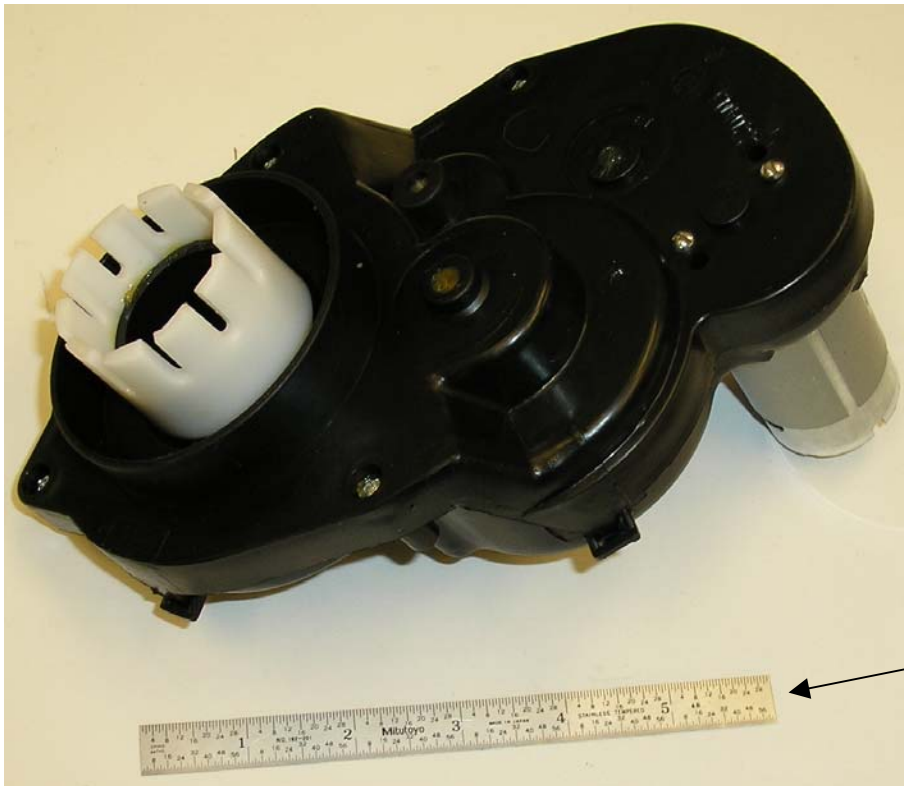


✓ 11 Taigene (aka van door)
Motor: 1 Allowed



6" scale shown for sizing..

✓ 11 : Fisher Price Motors 2 Allowed



Because of a part number mixup, teams are allowed to use Fisher Price motors and gearboxes from previous years' kits. If their motor doesn't look like the one in the picture, just ask them how they obtained the motor.

6" scale shown for sizing..

✓ 11 Globe Motor: 1 Allowed



6" scale shown for sizing..

✓ 11 Allowed Circuit Breakers

Find many of these on Breaker Panel



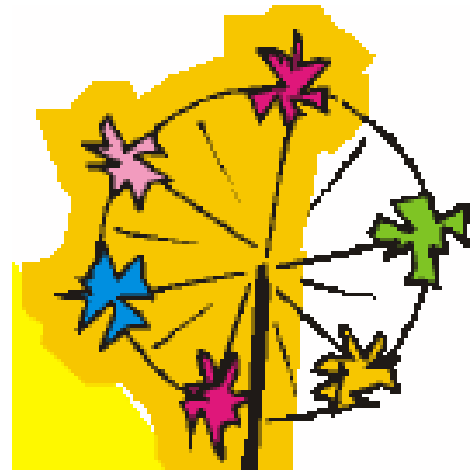
Main shutoff breaker attached directly to battery

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

Decorations should not jam or interfere with operation of vision system.



No color changing features on Robot



✓ 13 Check Traction Devices

OK

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

Not OK

- Anything that could damage the playing field.
- Metal cleats
- Studs
- Velcro
- Sandpaper

✓ 14 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

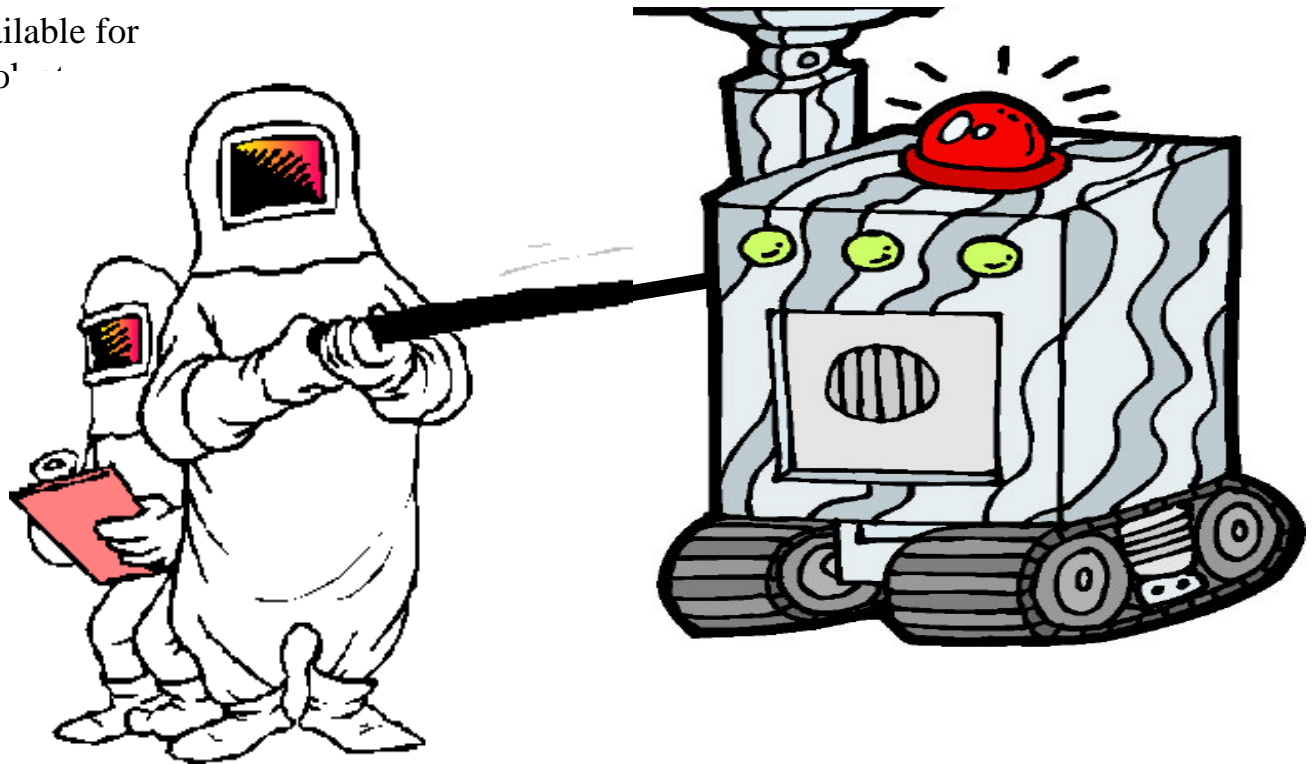
Not OK

- Duct Tape



✓ 15 No Hazardous Materials

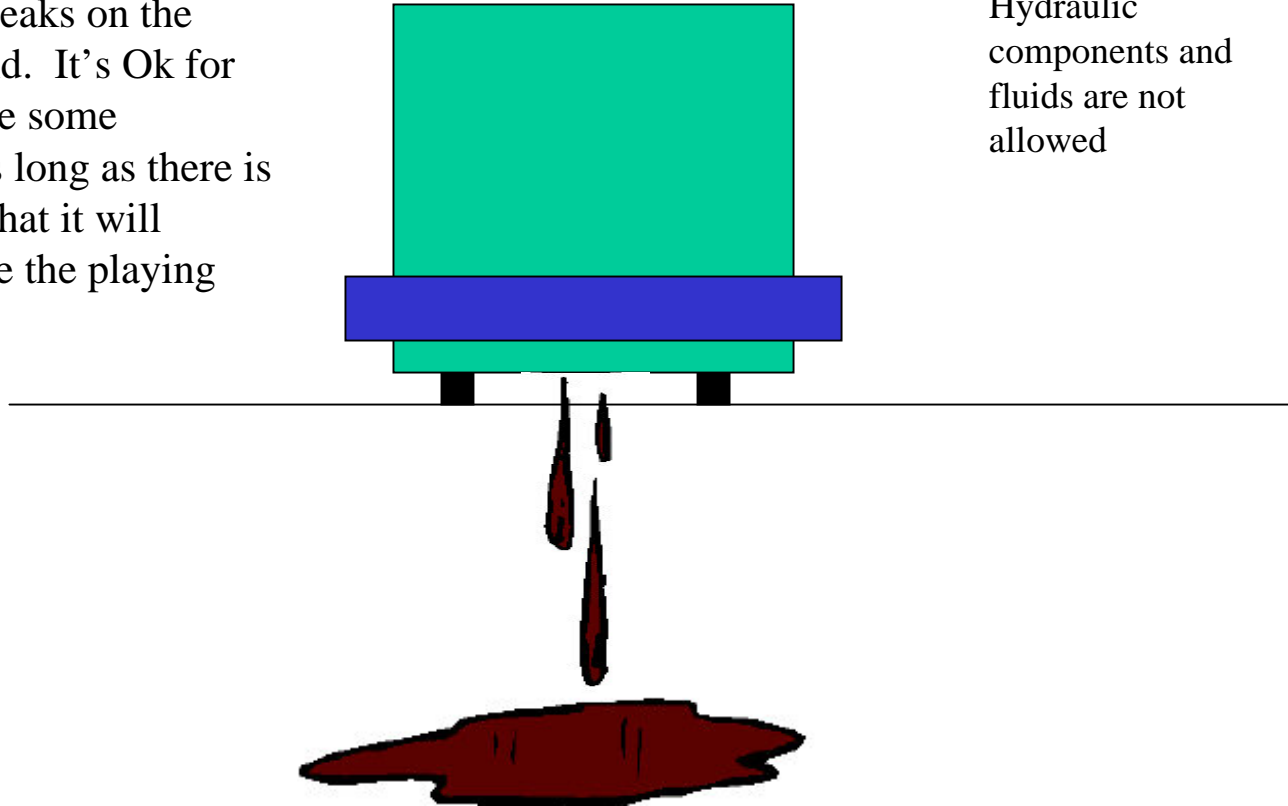
No Hazardous Materials:
Any questionable materials
that a team uses should have
an MSDS sheet available for
the inspectors to look at.



✓ 11 ✓ 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 insure that every Robot has the same maximum power output. (Just like NASCAR)

OK

Shorten leads (external to motor).

Modify housings.

Modify Mounting brackets.

NOT OK

Modify motor internal electrical system.

Modify integral mechanical parts.

Replacing leads (from inside motor).

OK to remove gearboxes from these motors



Globe Motor



Fisher Price

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

✓19-✓26 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 TUBING (1/4" ID, polyurethane, any color) WITH A TOTAL LENGTH NOT TO EXCEED 20 METERS. Teams are allowed to coil the tubing (forming with heat is OK) when used in applications where the tube must be extended/retracted.

✓ 19 Check physical condition of cylinders and Volume tanks



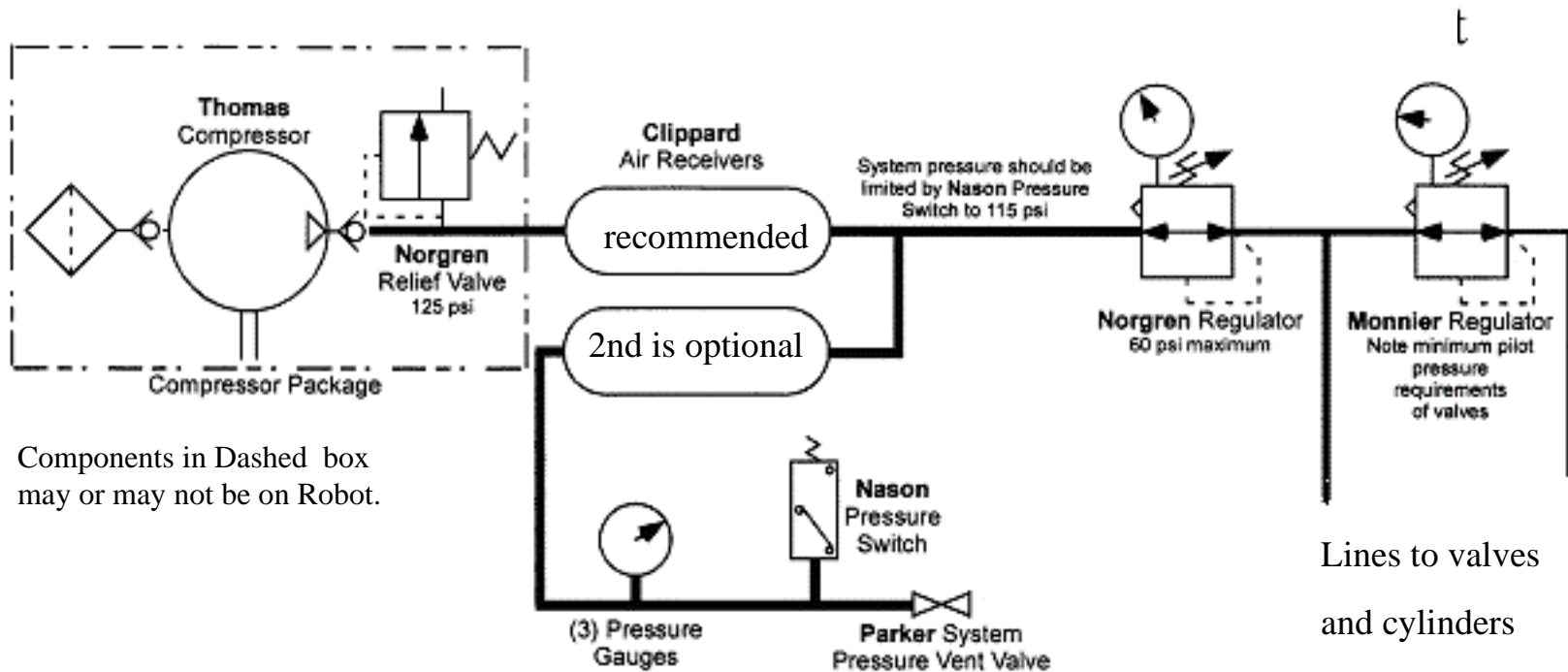
Cylinders and Volume Tanks are pressure vessels. Any damage to these parts could result in a sudden and dangerous release of energy.

Inspectors will check that there has been no filing, machining, or abrasive removal of any part of a Cylinder or Volume tank.



Ok to remove this pin but don't damage cylinder

✓ 20 Typical Pneumatic system



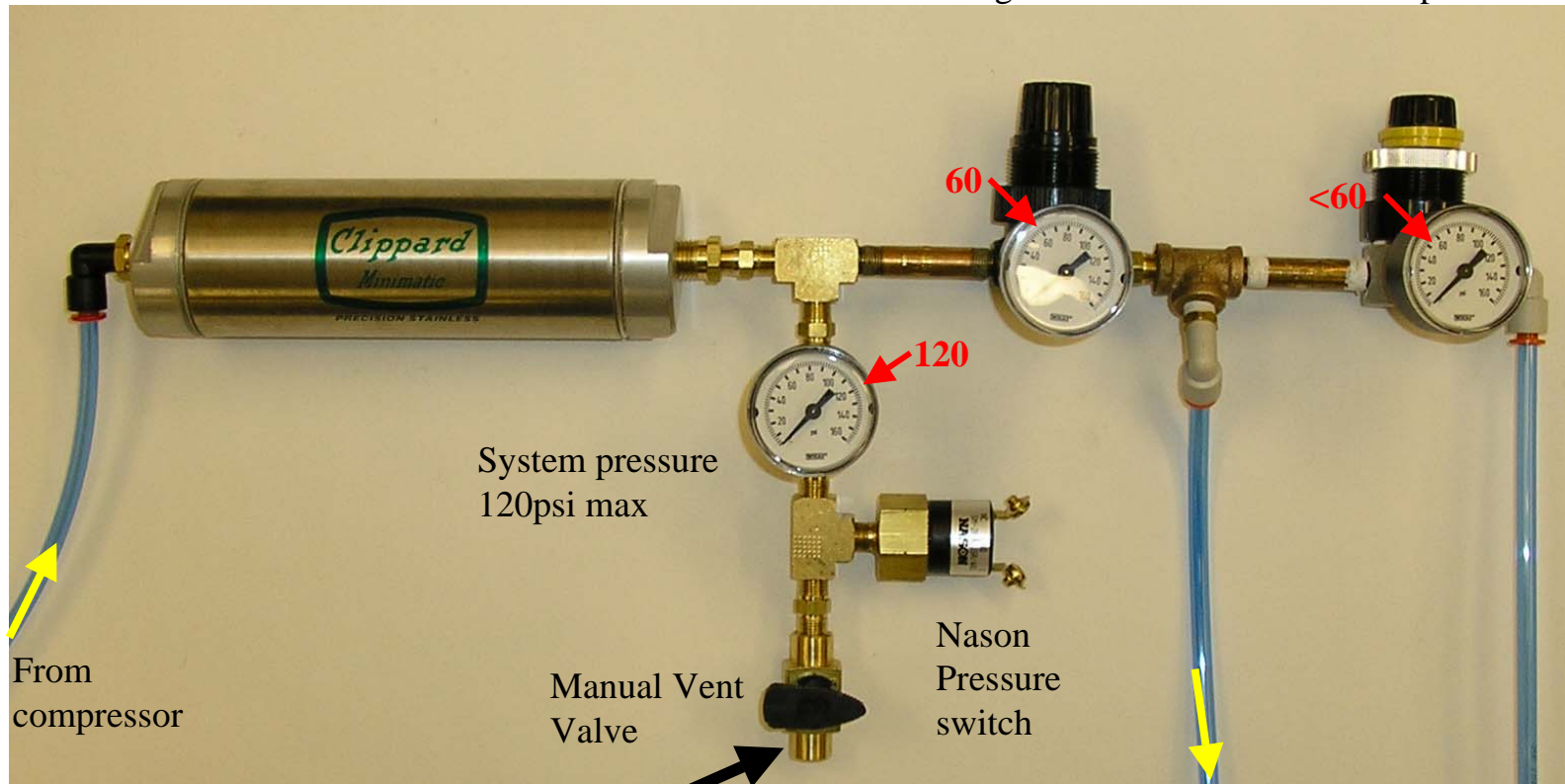
Components in Dashed box may or may not be on Robot.

Lines to valves and cylinders

✓20 ✓21 ✓22 Typical Pneumatic System Layout

Norgren Regulator
60psi max
Working Pressure

Optional Monier
secondary Regulator
less than 60psi



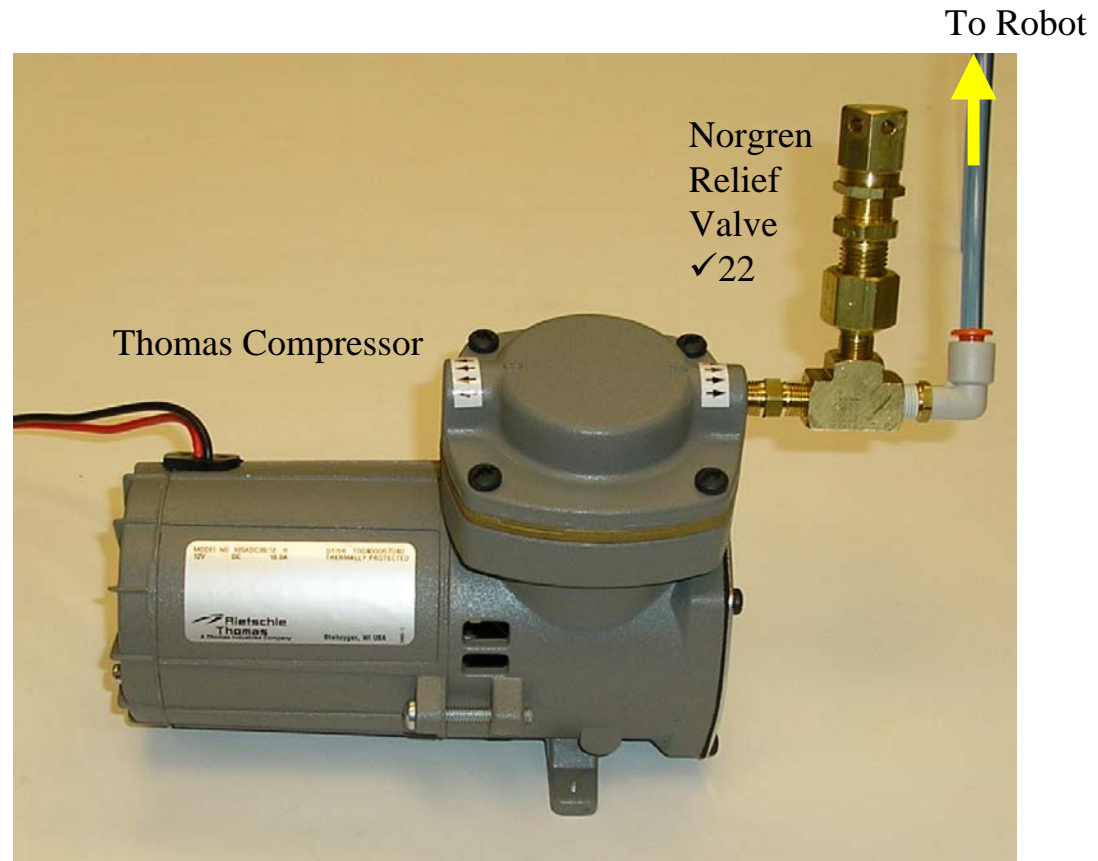
**This valve must be visible & accessible.
Inspector will check function of this valve.**

60psi max to
solenoid valves /
cylinders

✓22 Compressor & Relief Valve

This compressor should 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.



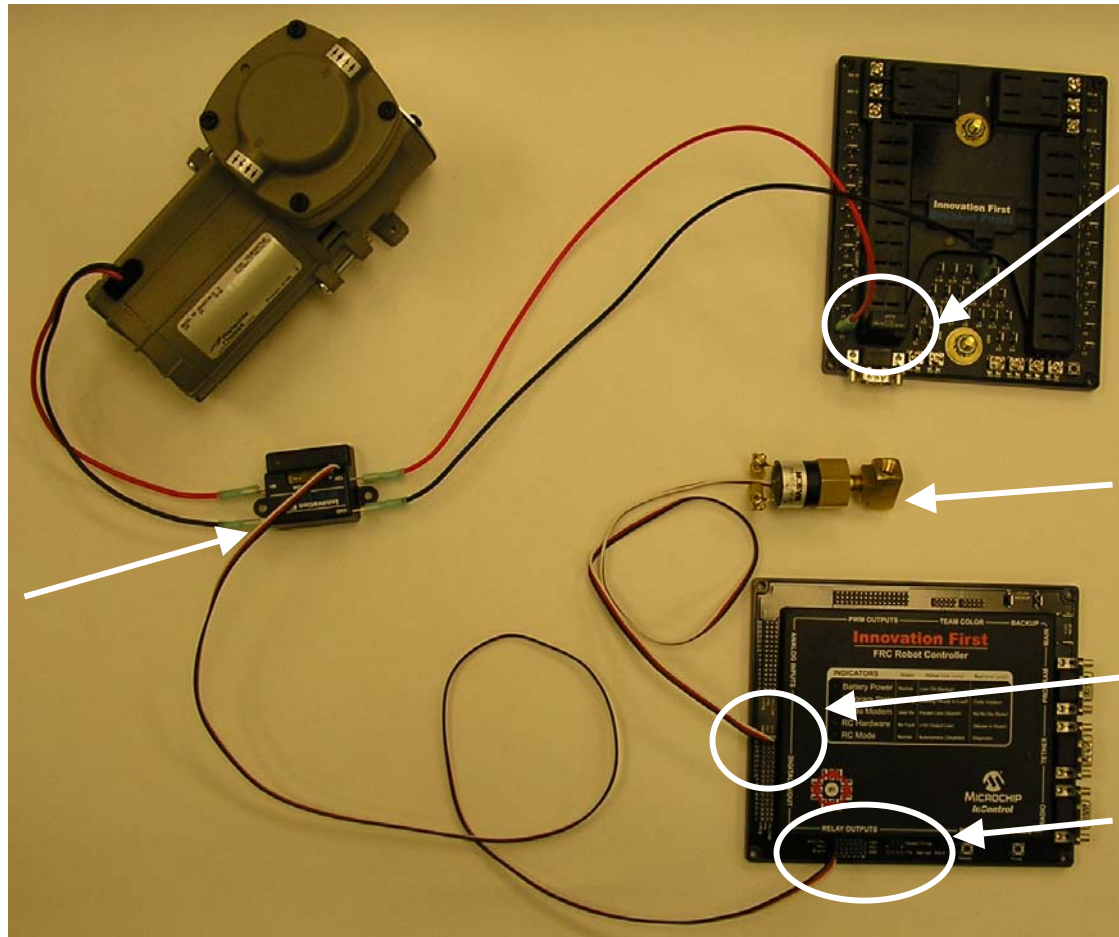
✓ 23 Extra tubing used as accumulator is not allowed.



Hose runs should be as short as reasonable.

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

✓ 24 Compressor Wiring



20A Breaker,
compressor
alone on this
circuit
R81

✓22 Nason
Pressure switch

Spike Relay

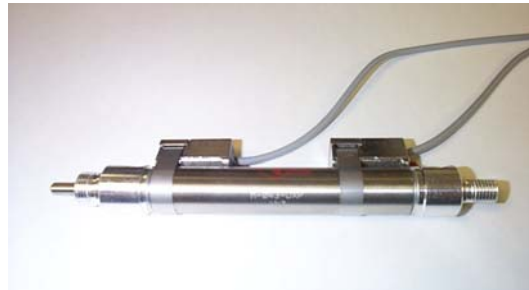
Any digital I/O

Any Relay output

✓25 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

✓25 Additional pneumatic components – allowed actuators

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

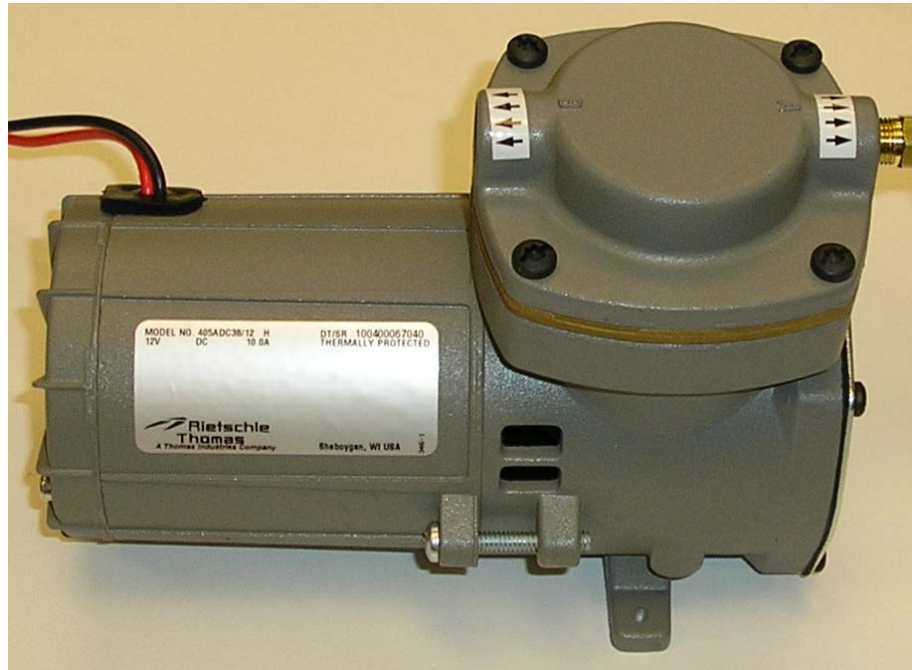
- “M” is optional (specifies whether magnetic position sensors are included)
- XX represents bore, must be either 04 (for 3/4” bore), 17 (for 1.5” bore) or 31 (for 2” bore)
- ZZ represents mounting option, must be DP (for 3/4” and 1.5” bores) or DXP (for 2” bore)
- YY represents stroke length, must be 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

✓26 Only Allowed Compressor



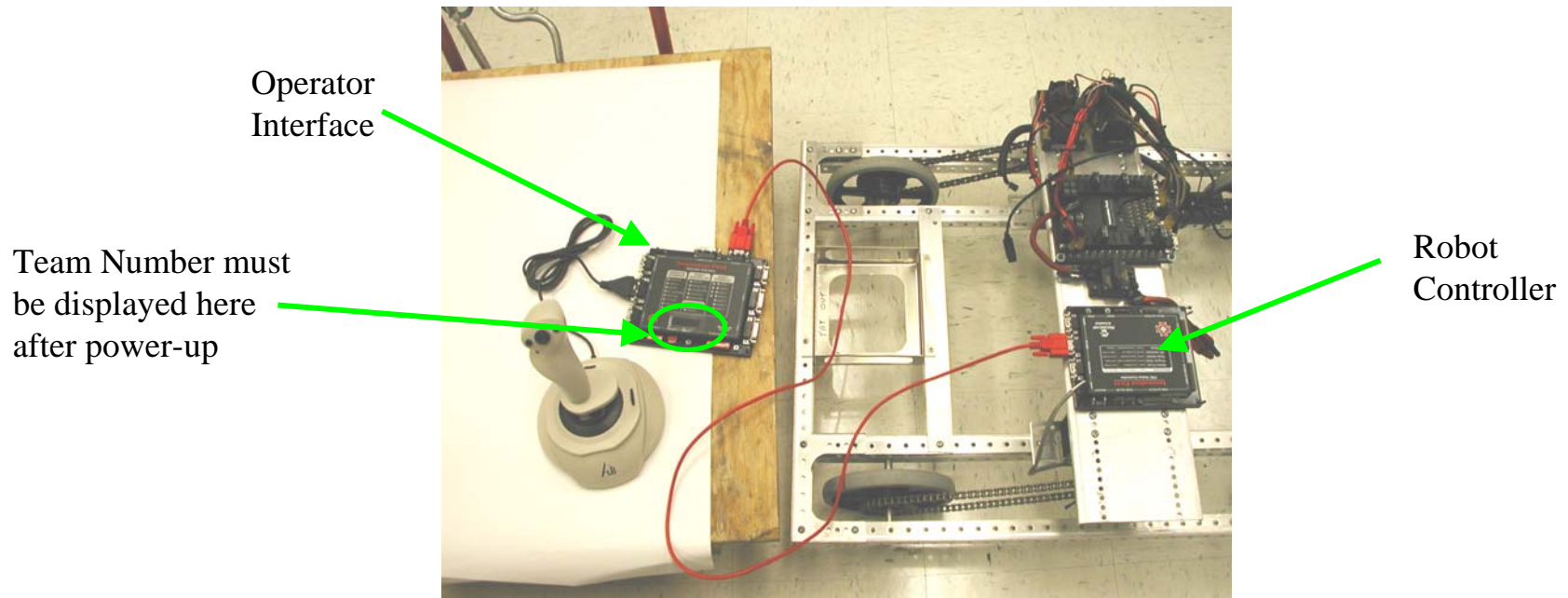
The Thomas compressor must be the only compressed air source.

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.

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

✓ 27 Confirm Team Color LEDs and Team Number



Tether the Operator Interface to the Robot Controller as shown above (red serial cable). Upon power-up, the Team Color LEDs must blink and the team number must be displayed on the Operator Interface. The Team Color LEDs are not shown - they must be present on opposite sides of the robot and easily visible.

✓ 28 Only one Exide Battery on Robot

EX18-12
Or
ES18-12



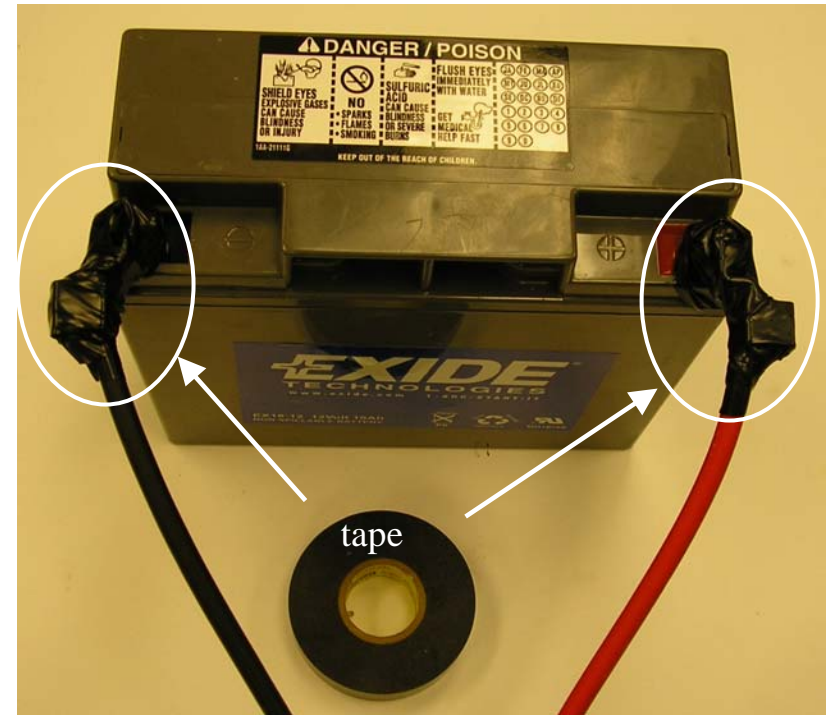
✓ 29 Insulated SLU-70 Connections to Battery

Before insulation shown for reference only.



SLU-70
Connectors

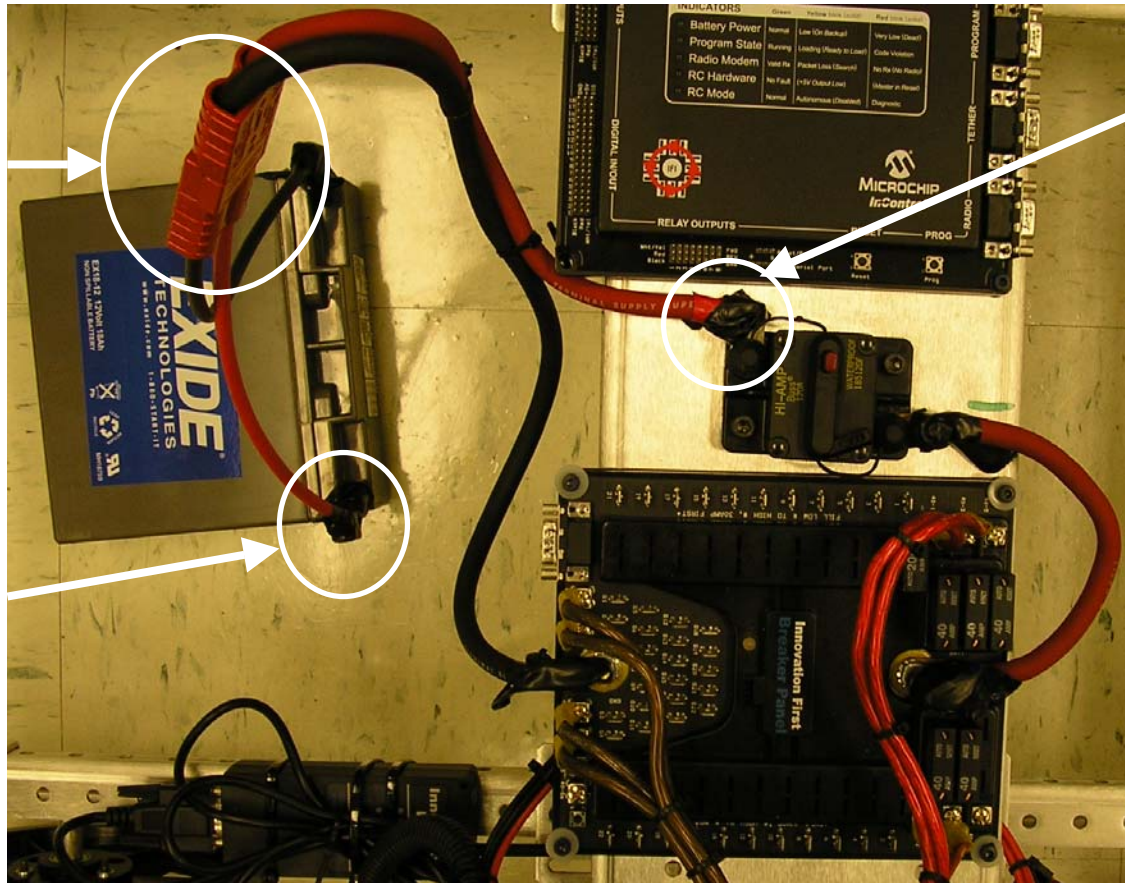
Terminals must be insulated with electrical tape or shrink tubing. Inspectors can feel though the insulation for the SLU-70 Connectors



✓ 30 Battery, Anderson Connector, Main Breaker

Black and Red wire go through Anderson Quick Disconnect connector

Red Wire connected to +12Volt

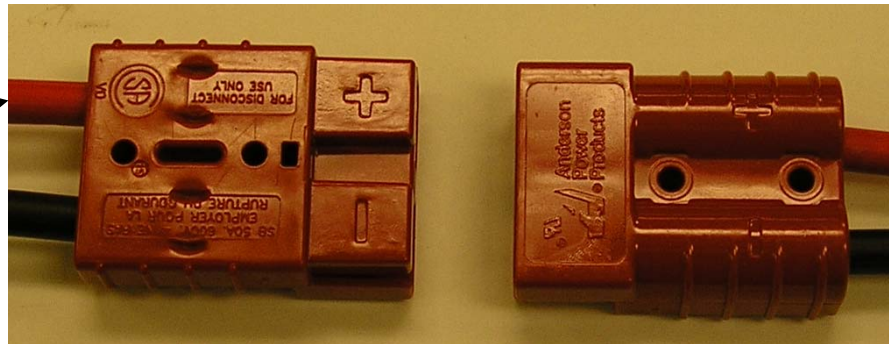


Red +12 Volt connected to main circuit breaker

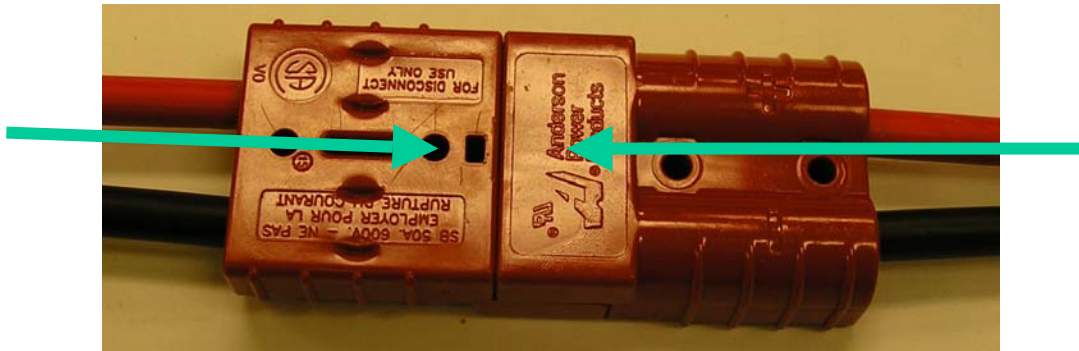
✓ 30 Anderson Quick Disconnect Connector Demonstration

Uncoupled

RED wire is
connected to
+ Terminal



Coupled



✓ 31 Main Circuit Breaker is Accessible

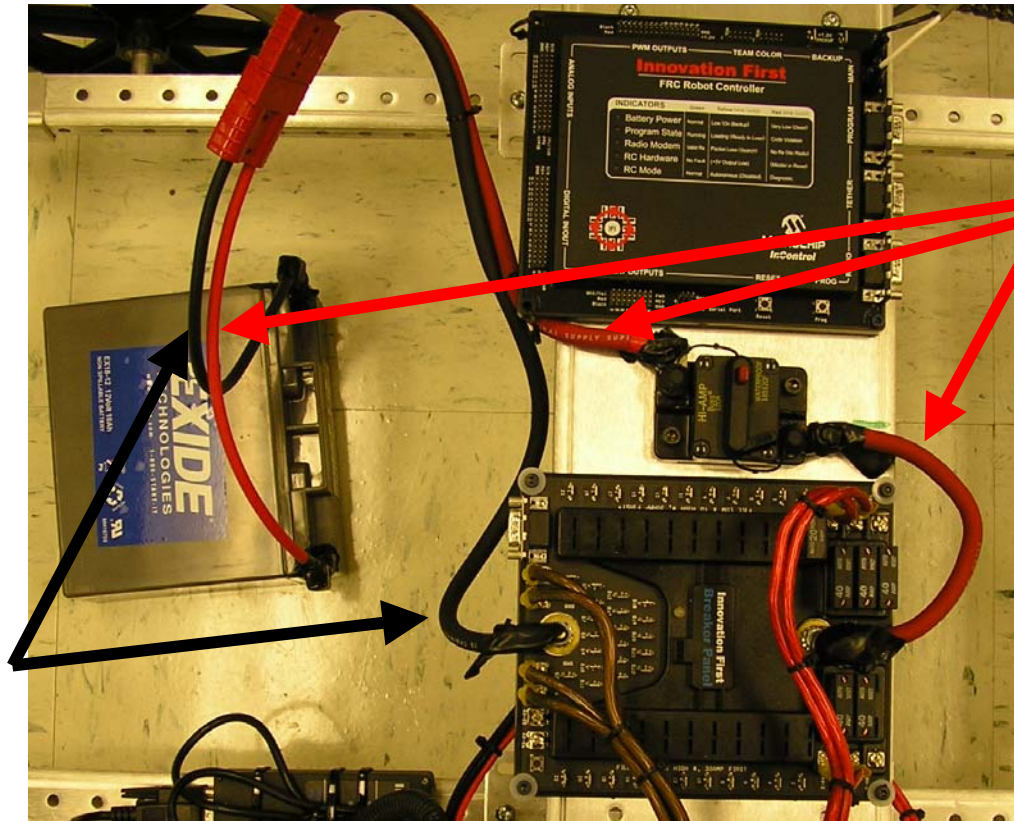


In an emergency, a Team member, or Referee would want to be able to find and press the RED button quickly

✓32 #6 Wire for Main Power

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

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



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

✓ 33 Wiring Conventions

+ POSITIVE +

- NEGATIVE -

RED

WHITE

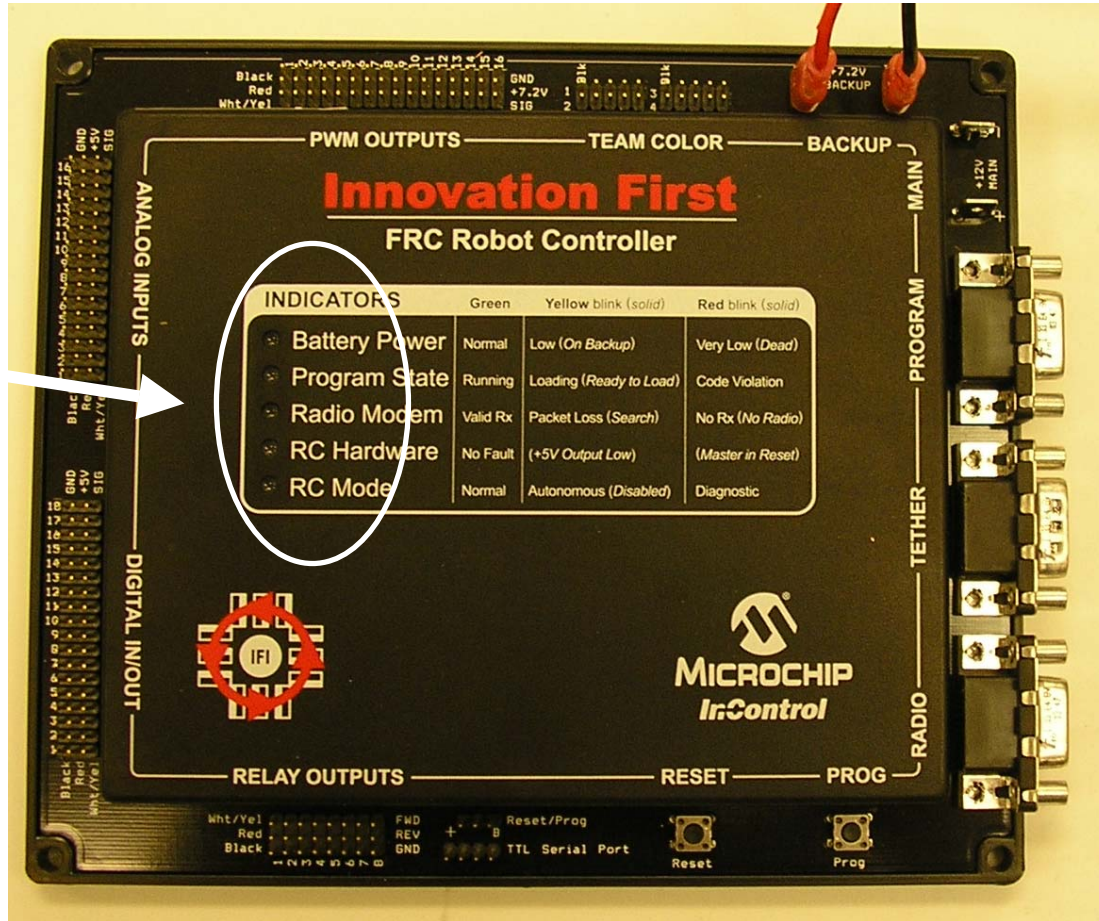
BROWN

BLACK

BLUE

✓ 34 Robot Controller

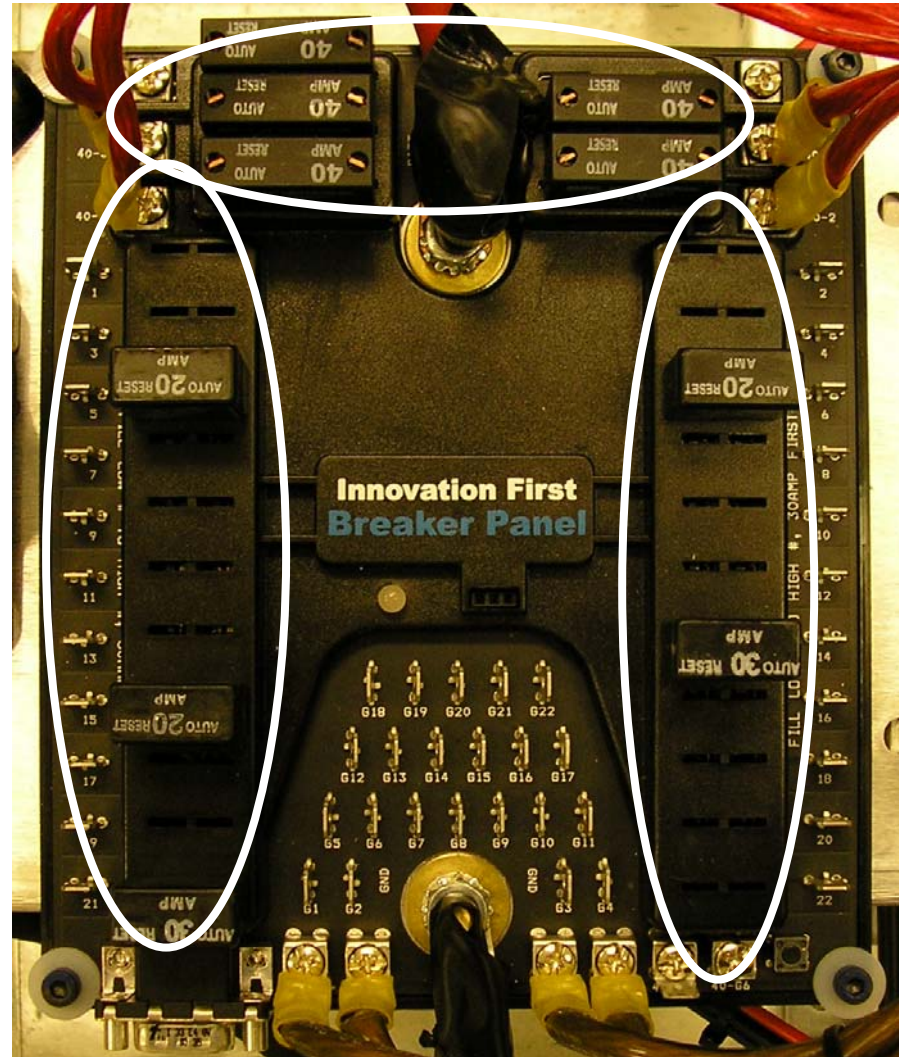
Indicator
Lights
Must be
readily
Visible



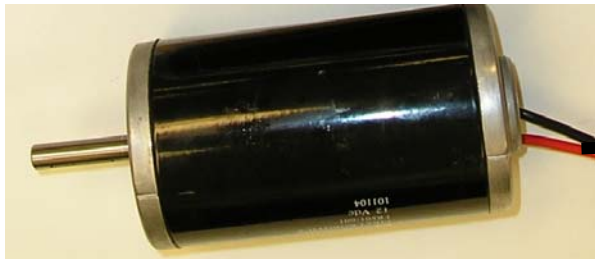
Inspector
must be able
to easily see
all
connections
made to the
controller

✓ 35 Circuit Breakers Accessible for Inspection

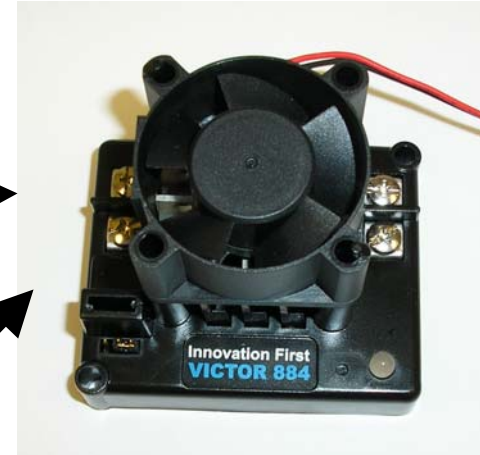
This will help the team identify problems. It will also allow the inspector to verify that the correct circuit breakers are on each circuit.



✓ 36 Motor Wiring Requirements



CIM



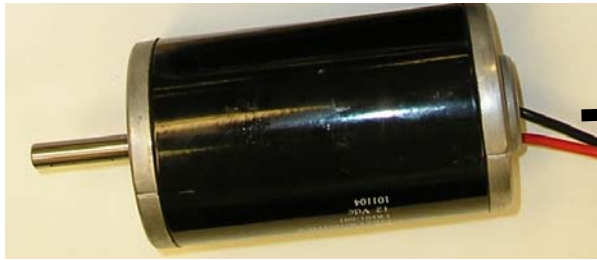
These Motors must be wired to an 884 not a SPIKE Relay



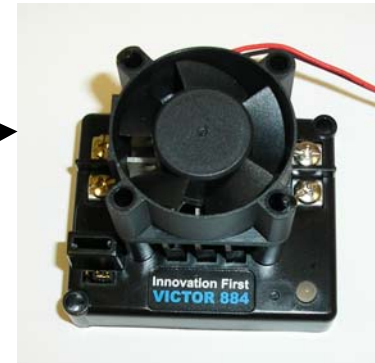
Fisher-Price



✓ 37 One Motor per Speed Controller



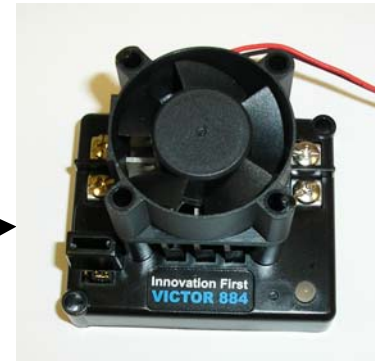
CIM



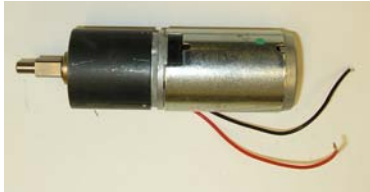
Only one motor
(any of the kit
motors) connected
to each Victor
884 speed
controller



Fisher-Price



✓ 38 Wiring Paths



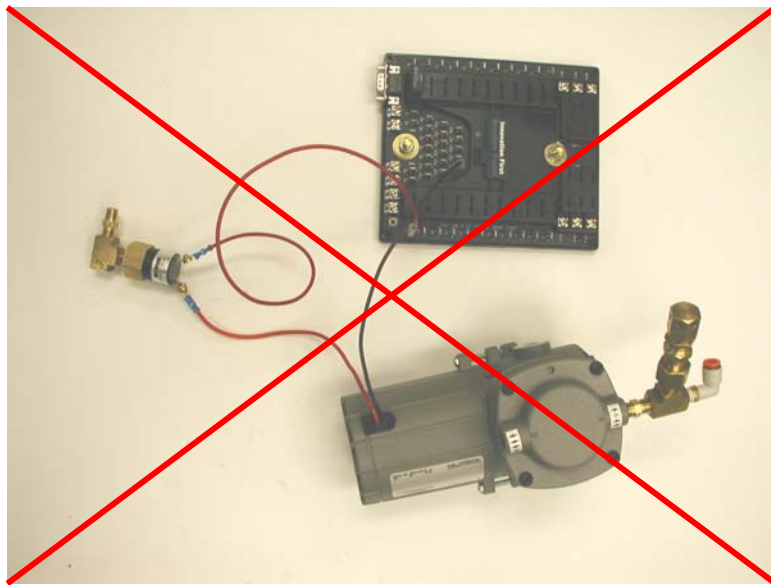
Motors, compressor, solenoid valves **must** be wired to a Speed Controller or Spike Relay than to Breaker Panel



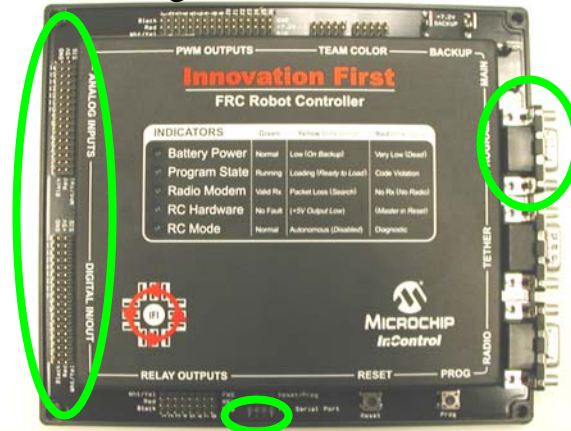
or



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

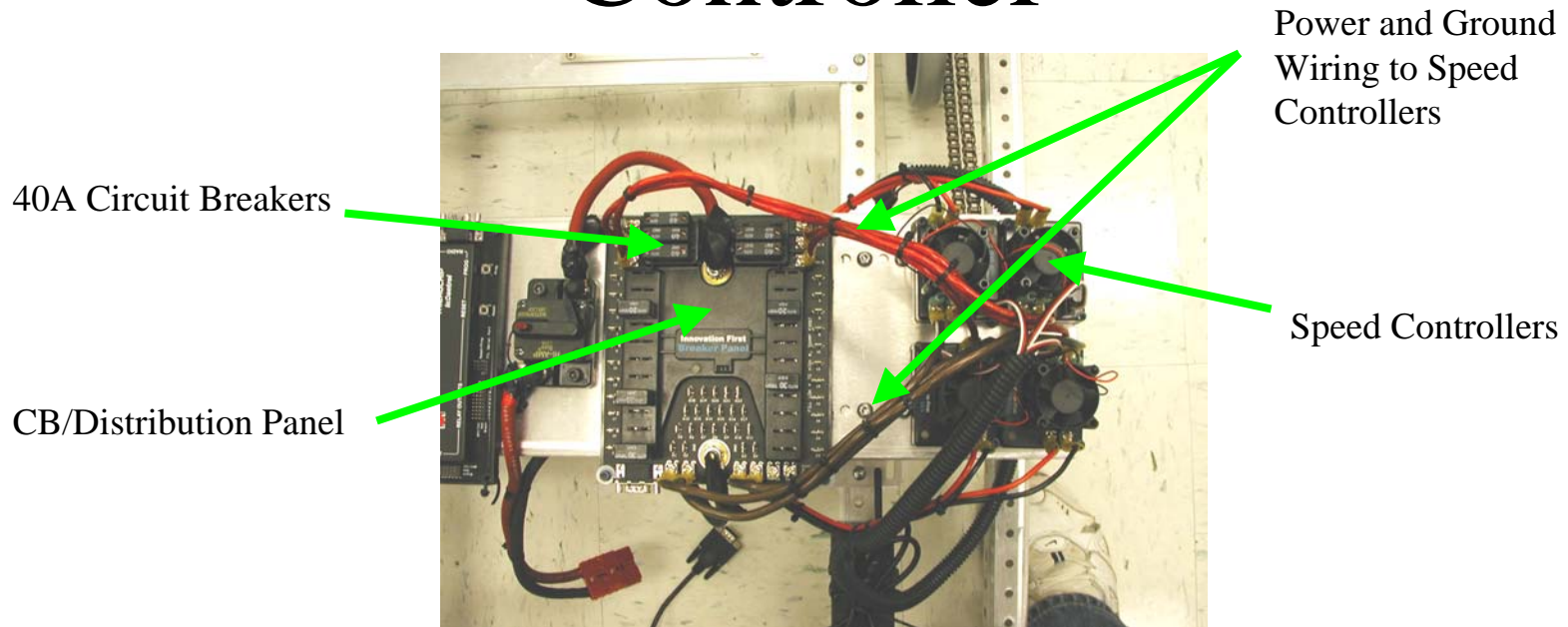


Sensor outputs can be connected to ports circled in green or to Custom Circuits



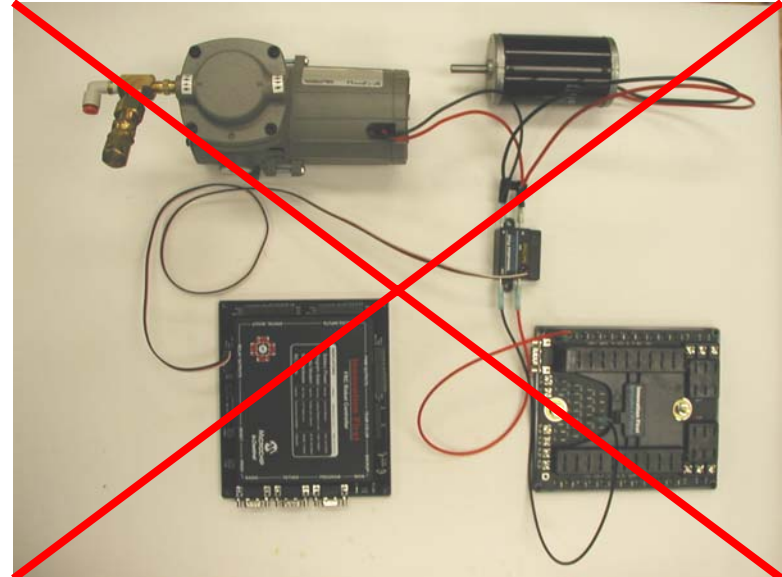
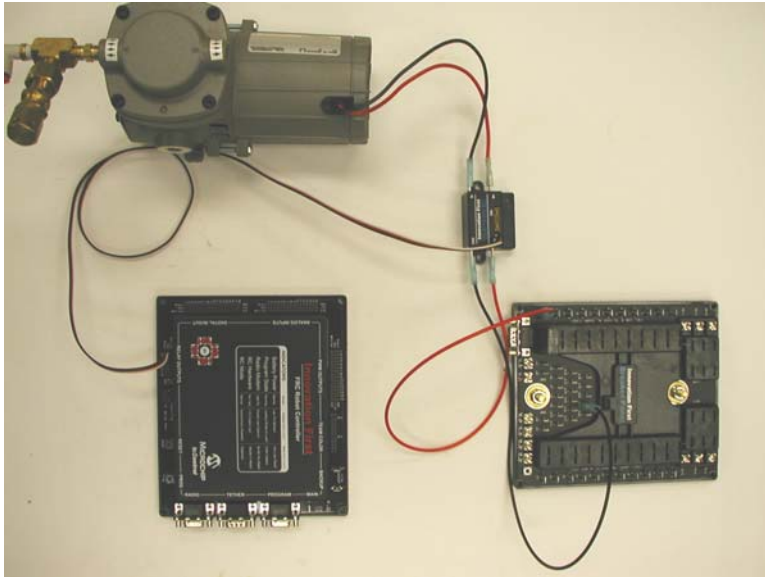
ALL sensor outputs (including the pressure switch shown above), MUST be connected to inputs on the Robot Controller or Custom Circuit. Sensor outputs CANNOT directly apply power (eg using a pressure switch to turn the air compressor on/off as above) or provide inputs to Speed Controllers or Spike Relays.

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



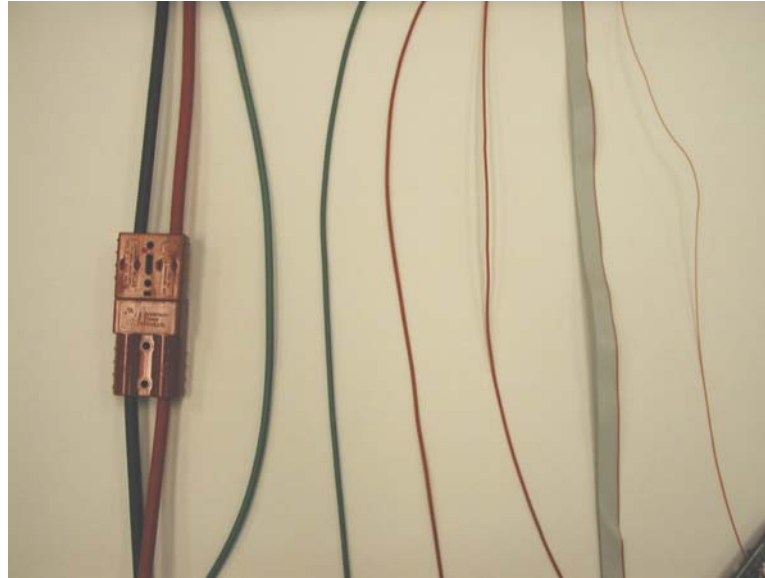
Speed Controllers must be powered from the CB/Distribution Panel via either 20A, 30A or 40A Snap-Action or Bussman circuit breakers (40A breakers shown above).

✓ 41 20A Circuit Breaker Must Be Used For...



Spike Relay Modules, Air Compressor (shown), Custom Circuits and the Robot Controller must all be protected with 20A circuit breaker on the CB/Distribution Panel. Only 1 motor can be driven by each Spike Relay (2 are being driven in the “don’t do this” picture at right above). Circuit Breakers driving the Robot Controller and the Air Compressor cannot be used to drive any additional load.

✓ 42 and 43 Wire Sizes



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

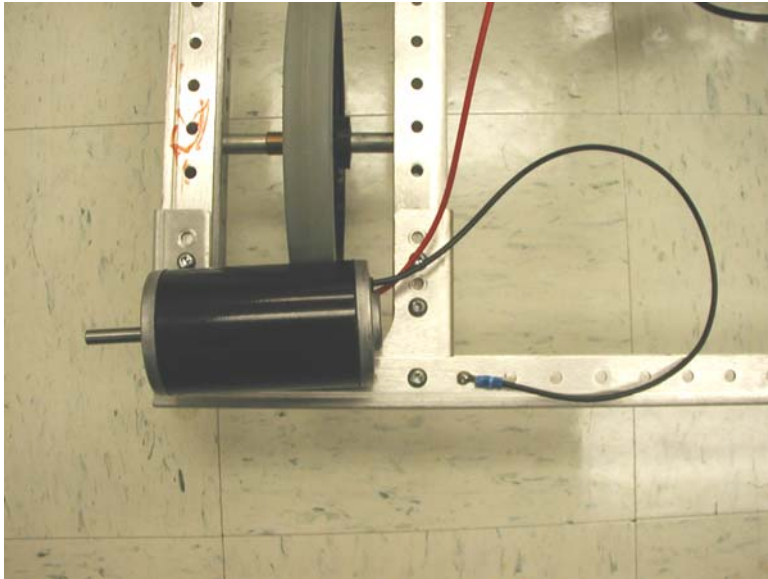
6 AWG must be used in battery-to-CB/Distribution Panel path

12 AWG (or larger diameter) must be used in circuits connected to 40A breaker, 14 (or larger) with 30A circuits and 18 (or larger) with 20A circuits

24 AWG or larger may be used for sensors, vision system, muffin fans, LEDs and PWM control signals

Ribbon cables with individual conductors smaller than 24AWG may be used to connect to the 9 pin ports on the Robot Controller

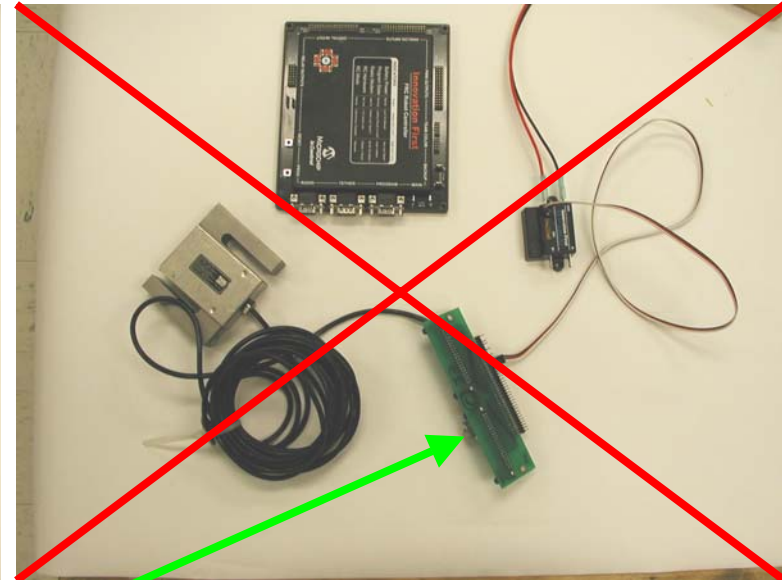
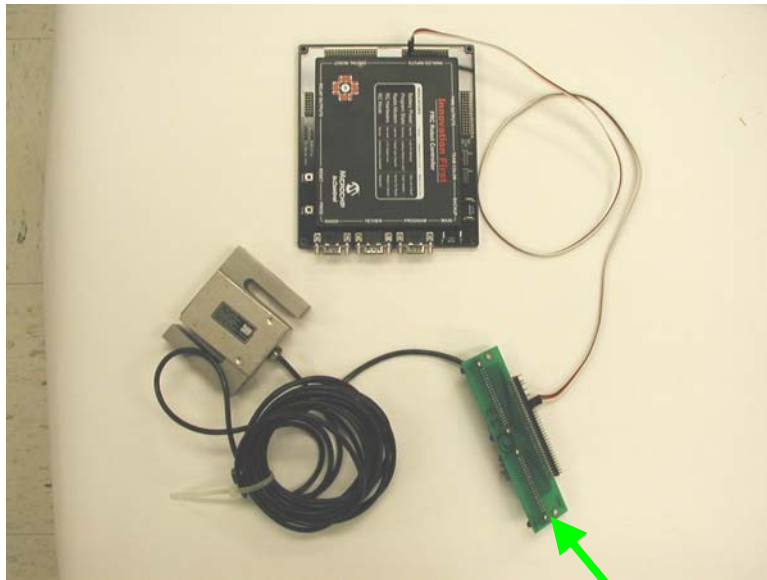
✓ 44 No Exposed Electrical Conductors



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.

✓ 45 and 46 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)

✓ 47 No Modifications to the Robot Controller



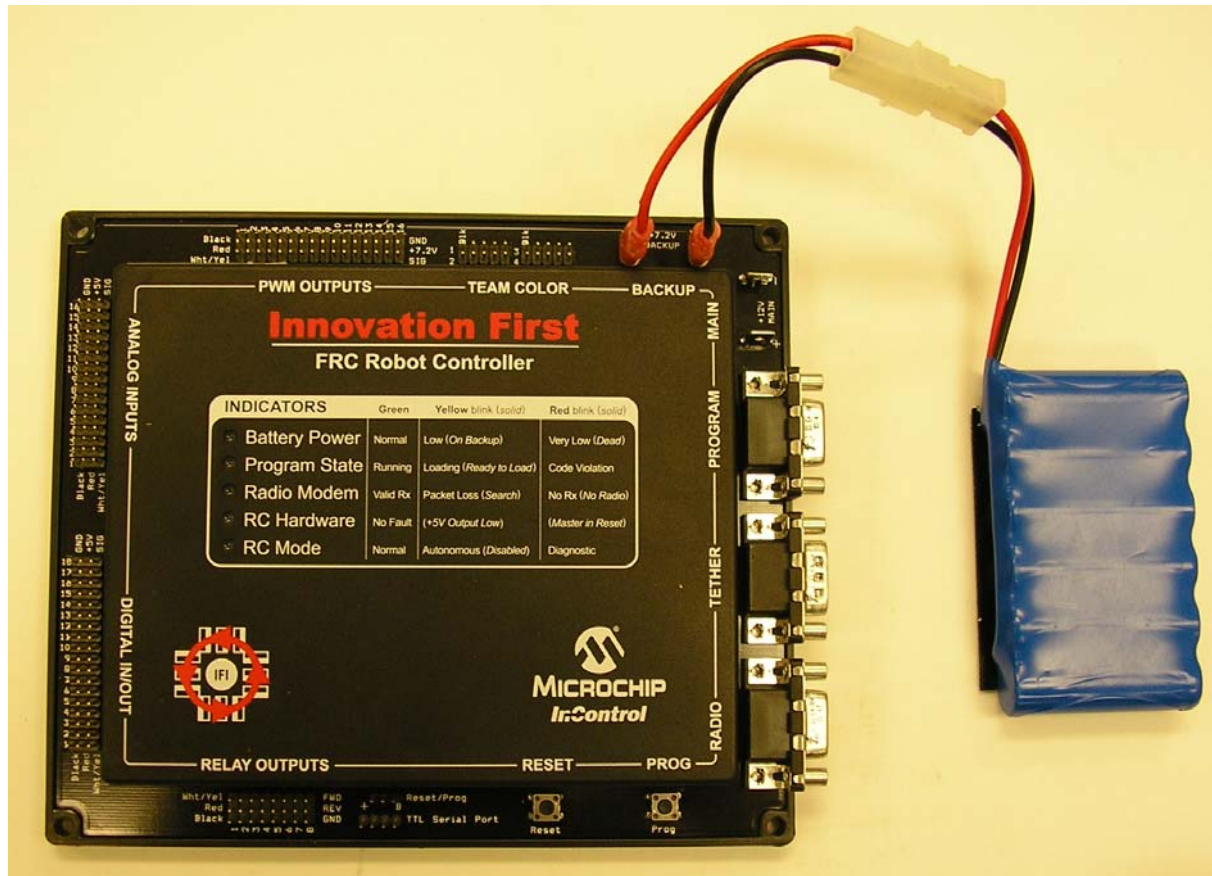
DON'T MODIFY THIS!! (except its software)

✓ 48 Buttons must be accessible or remotely wired

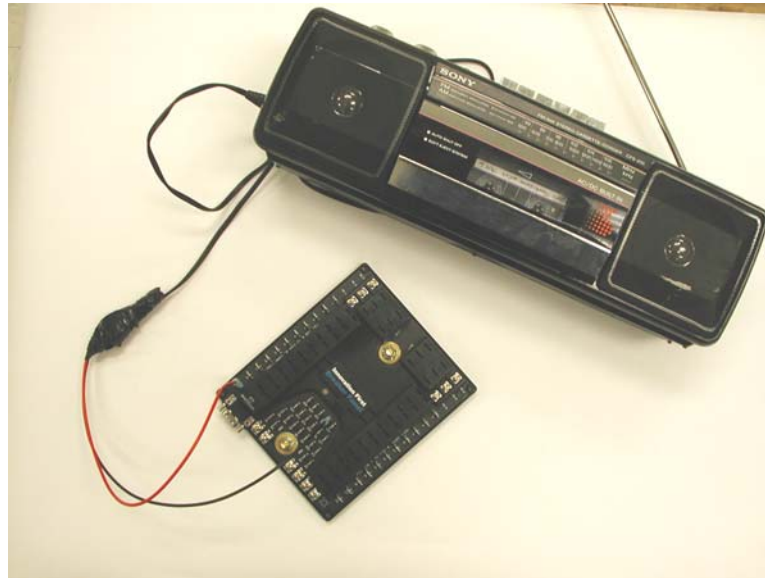


Reset and Prog buttons must be easily accessible or remote switches must be wired in here.

✓ 49 Ni-Cad Battery Pack



✓ 50 Decorations



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

Decorations may optionally be powered using a separate battery but must be completely isolated from the rest of the robot's electronics.

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

=



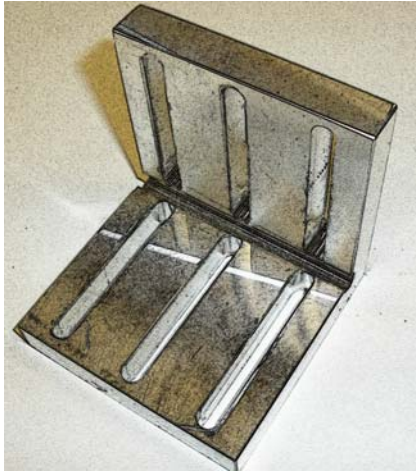
Identical spare installed in
place of removed
damaged part

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

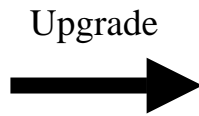
Upgrade Part: Component or Mechanism that provides additional functionality or adds capabilities to the Robot. Shown are three examples of types of upgrades. They should be considered universal and apply equally to all subsystems. (electrical, pneumatic, software, electronic, vision.....)

Pneumatic Upgrade Example

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



Original cylinder

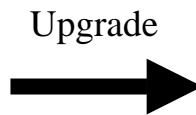


Upgrade cylinder provides greater force and longer stroke.

Electrical Upgrade Example



Motor was controlled by a SPIKE relay.



VICTOR 884 adds functionality. Speed control improves functionality of Robot

Example: Upgrade by adding stuff



Original Robot had four wheels

Upgrade
→



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

