Dear 2008 FRC Inspector,
Welcome to the 2008 *FIRST* Robotics Competition and

THANK YOU VERY MUCH!!!

Your contribution to our program is greatly appreciated. We hope that you'll really enjoy being involved in the inspection process and interacting with the many spectacular student/mentor teams.

In addition to offering a sincere "thank you", this document provides a brief overview of the inspection process and schedule. Also, there are a couple of reference attachments included that you will probably want to keep with you while performing inspections.

Typical Schedule

Wednesday PM – volunteer kick-off and initial training, assist with inspection area setup (scale(s), equipment, sizing box). Take the opportunity to get to know your Lead Inspector and familiarize yourself with the inspection area, equipment, checklist, training documents, pit area and sample kit of parts (KOP). Ask plenty of questions.

Thursday AM – calibrate the scale(s), last-minute and "on-the-job" training. If you've never inspected before, the Lead Inspector may have you train with a veteran inspector – this is an excellent way to get some experience. If you're lucky, a few teams may be ready for inspection by noon. Most teams won't be ready until 2PM or even later.

Thursday PM – inspections. Most inspections will occur between about 2PM and close-of-pits and take about ½ hour each. Expect a bit of chaos but a lot of great interactions with the teams. Most teams will try to have their inspection performed between practice rounds. Your Lead Inspector may not allow teams to practice without either a full inspection or a preliminary screening for safety issues.

Friday AM – calibrate the scale(s), last-minute inspections before competitions. There are almost always a few stragglers. Every robot needs to be inspected before they can compete.

Friday PM and Saturday – competitions and teardown of the inspection area (after finals on Saturday). Not much for inspectors to do. An occasional re-inspection may occur. Your Lead Inspector may want you to perform random re-inspections.

Inspections

In a nutshell – the inspection process involves filling out a checklist for every robot (provided by *FIRST* to the Lead Inspectors) and placing a label ("Inspected by…") on the robot after passing inspection. That's about it.

In reality (and your Lead Inspector may have a slightly different procedure), the process is typically –

1) A team brings their robot to the dedicated inspection area for weight and size checks. The inspectors will "start" the checklist for the team and begin the process.
2) At the inspection station, the robot must be weighed (with all possible mechanisms but without battery and bumpers (as long as the bumpers are "standard")), bumpers must be separately weighed (as long as the bumpers are

"standard") and the robot must be sized (in "starting configuration"). Your Lead Inspector may also want you to quickly scan the robot for any issues (sharp edges, components that can damage the field or tubes) in order to allow the robot to begin practices. At this time, you should put the inspection "base" label on the robot (no colored dot or signing yet).

3) When the team is ready to finish the inspection, they will approach the inspection area and request that an inspector follow them to their pit. Bring their checklist with you along with any additional reference material that you may need.
4) INSPECTION – Introduce yourself to the team and try to engage a student as your primary contact. Have her/him give you a quick summary of their robot's design. Ask plenty of questions – she/he will be very happy to tell you everything about their robot. Go through the checklist (sequentially should be fine). If their robot passes every check (some will not be applicable for all robots (e.g. pneumatics)), sign the checklist, place a colored dot on the inspection sticker and sign/initial the sticker (pre-numbered stickers (with team #) and colored dots (color varies by week) have been provided by *FIRST*). You may find a few issues with the robot, in which case you may have to return later after the team has a chance to correct the issue. Always return the completed checklist (with a copy of the team's bill of material if a hardcopy printout or softcopy memory storage device is supplied) to the Lead Inspector or inspection area.

Questions?

If you have any questions, please don't hesitate to consult the Lead Inspector for the regional or a *FIRST* representative.

Remember –

1) Gracious Professionalism
2) SAFETY and EQUALITY - Although we continue to strive for perfectly objective inspection metrics, many checklist items will always be somewhat subjective. As long as the robot is SAFE (for humans, field, balls, other robots) and there are no components that give the team an unfair advantage, you should consider accepting marginal items (unless the team can easily correct the issue).
3) HAVE FUN!

Thanks again and GOOD LUCK!
Russ Beavis, Chief Inspector for *FIRST*

PS - Your Lead Inspector may have additional information for you. He/she may wish to use a process that is slightly different from the process described above. For example, many Lead Inspectors will require that the entire inspection process be performed at the inspection station instead of in the team's pit.

Attachments –

PLEASE READ – Inspection Checklist Details (to keep the checklist brief)

PLEASE READ (for last-minute rules interpretations) - Summary of GDC (Game Design Committee) Responses that Impact Inspection (from *FIRST*'s Q&A site)

What's New in 2008 – for veteran inspectors who want a summary of the key changes

Custom Cylinder Form – list of acceptable pneumatic actuators that may be used

Pneumatics Diagram – schematic for the required components and plumbing

Pneumatics Picture – picture of the components assembled as per diagram

Main DC Power Components - pictures

Wire Gauge Picture – picture comparing wiring of different sizes

Bumper Diagram – drawing showing bumper requirements

Parts Use Flowchart

Bicycle Flag Diagram

Additional Reference Info –

Another excellent set of documents to include with the above reference material are the following documents found on the *FIRST* website. You may want to keep a set of printouts handy.

http://www.usfirst.org/community/frc/content.aspx?id=452.

1) Kit of Parts Checklist (photos and part numbers for every part)
2) Robot Power Distribution Diagram (how to wire all power components)
3) Battery Power Terminal Strip (datasheet for the Rockwell Power Distribution Blocks)
4) Pneumatics Manual

Inspection Checklist Details

Size: The robot must fit freely in sizing box - 28" x 38" base with height of 5'. The bumpers (per rule R08) may be removed. The robot must be in its largest start-of-match configuration. The bicycle flag does not need to be installed. Any decorations that may be used on the robot must be present.

Weight: All potentially utilized mechanisms must be included with the robot while on the scale - including decorations and the 7.2V backup battery but excluding the bicycle flag and the MK Battery ES17-12 battery & its Anderson Connector w/leads. The robot must weigh 120.0 lbs or less (no exceptions).

Bumper Weight: Bumpers must be 15.0 lbs or less and the bumper mass must be approximately distributed uniformly. No abnormally "heavy spots" and no 15 lb "short" bumpers (i.e. battering rams).

Bicycle Flag:

1) the robot must include a contiguous 12" long x ½" (nominal) ID Schedule 40 PVC tube to accept the flag
2) the robot's PVC tube must be capped at its "bottom" with a cemented PVC cap
3) the flag must remain approximately vertical while the robot is in its PLAYING CONFIGURATION (the orientation of the robot beginning sometime soon after the start-of-match and for the remainder of the match)
4) when installed, the top of the flag must be between 70" and 80" from the floor
5) the robot's PVC tube cannot be attached to a bumper
6) the robot's PVC tube cannot be longer than 12"
7) the tube cannot be machined in order to reduce mass
8) the tube must be hard-mounted to the robot (eg no tape or Velcro)

Bill of Material: All teams must provide a detailed cost estimate for their robot that describes the costs associated with every non-KOP component (except for the following excluded items - non-functional decorations, fasteners, adhesives, lubricants, spare parts, Victors and Spikes, parts at driver station).

1) Hardcopy printout is preferred but a softcopy may be provided. Regardless, some version of the BOM must be provided for the Inspectors to keep.
2) The total cost of non-kit parts cannot exceed $3500 with no individual component over $400.
3) All components must be readily available such that ALL teams could, theoretically, acquire the identical part at the quoted cost and within a reasonable delivery time if so desired.
4) Costs for components that have been salvaged from previous years' robots must not include depreciation.
5) All parts purchased from IFI (i.e. not in the kit) must be included in the bill of material INCLUDING additional Victor 884 Speed Controllers and Spike Relay Modules (more than the 4 of each supplied in the kit).

6) "Parts of modular systems" described in Chapter 8.3.4.4 with respect to cost accounting rules. No "cost-splitting" allowed – ie dividing an expensive assembly into a group of components that are individually below the $400 threshold. Teams are NOT allowed to sneak an expensive assembly into their robot using "cost-splitting". The only exception to the "cost-splitting" ban is for designs that do not use all of the components in at least one variation of the robot's starting configuration. In other words, the expensive assembly is truly modular and the team intends to exploit that modularity.

Teams from outside North America: Teams from outside the U.S. may request exemptions for some parts due to availability (e.g. metric vs. English). If the team is foreign and has successfully petitioned *FIRST* for an exemption, attach a confirmation letter (typically email response from *FIRST*) to this worksheet.

Safety and Wedges: No sharp protrusions (approximately 1 square inch minimum), no sharp edges, no entanglement risks, no wedge-shaped robot bases. All surfaces on the robot base that may contact other robots should be within 10 deg of vertical between the ground and 8.5" from ground.

Energy Sources: No energy sources are permitted other than a single MK Battery ES17-12 battery, 7.2V backup battery, compressed air supplied by the Thomas compressor (either on or off the robot) and stored within the pneumatics (all components from the kit), dropping of robot's center of gravity and "safe" deformation of robot components (e.g. springs). No flywheels. In addition, the MK and 7.2V batteries must be securely attached within the robot.

Logos: Must prominently display school name and either primary sponsor logo or name.

Team Number: Must be displayed on all 4 sides at approximately 90 degree angles, numbers must be at least 4" high and have minimum stroke width of ¾", must be clearly visible (i.e. sharp contrast to attached surface).

LED Flasher: The LED Flasher must be clearly visible while standing in front of the robot while in starting configuration. Teams must use at least one LED flasher but are permitted to use up to four.

Interference Mechanisms: Robot cannot include devices or decorations that may interfere with the vision systems of other robots

Decorations: Cannot affect outcome of match, cannot broadcast using wireless communication without clearance from *FIRST* Engineering, cannot employ 900MHz cameras, cannot use electrical power unless drawn from MK ES17-12 12V battery via either 20A or 30A circuit breaker

Lap Indicator: The robot must include an unobstructed region around the top of the flag holder for mounting the Lap Indicator (attached to the bicycle flag). The robot must also include a powered PWM port for supplying the module within 4" of the tube top.

Acceptable Mechanical Parts: All parts that are used on the robot must be either from the kit of parts (or identical to a part in the kit) and/or be acceptable as per Parts Use Flowchart (rule R48).

Specifically Prohibited Mechanical Parts:

1) mechanisms from previous years' robots (this is essentially impossible to inspect but it is a rule that we need to try to enforce)
2) traction devices that may damage the field - no metal, adhesive or velco acting as an anchor or providing traction
3) adhesive-backed tape except Velcro and double-sided foam for attaching components
4) reflective tape except in small quantities for optical sensing and labels
5) electrical tape used for any objective other than insulation
6) lubricants that may drip onto the field or contact the balls
7) hydraulic components
8) components considered "hazardous" as per MSDS
9) unsafe additional parts
10) expensive COTS assemblies that cost more than $400 unless the assembly will be split into less expensive subassemblies depending on robot starting configuration

Motor Modifications: Modifications to mounting brackets, output shafts, electrical leads and modifications to/removal of Fisher-Price, Globe and Banebots motor gearboxes are the only permissible alterations to the kit motors. Motors CANNOT be modified in order to reduce mass or improve airflow or in any way that could reduce the mechanical integrity of the device. It's OK to add material such as heat exchangers and fins, drill a couple of new mounting holes and alter the output shaft (and pre-attached mechanisms such as the above-mentioned gearboxes) – nothing else.

Bumpers: The robot must include bumpers with the following features –

1) must utilize a pair of stacked "pool noodles" (2.5" OD) on a ¾" thick x 5" tall plywood mounting surface and covered with a tough, smooth cloth (1000 denier Cordura Plus is recommended)
2) must be removable for inspection
3) cannot add more than 3.5" to each side of the robot with only "pool noodles" and cloth extending beyond 1" from the bumper mounting surface
4) when mounted on the robot, must be between 2.5" and 8.5" from the floor
5) cannot include any sections with abnormally large linear mass density (i.e. no short, heavy bumper segments), bumpers should be no heavier than 3 oz per inch of length
6) bumpers cannot be held in place using Velcro-style fasteners

Acceptable Electrical Parts: All parts that are used on the robot must be either from the kit of parts (or identical to a part in the kit) and/or be acceptable as per Parts Use Flowchart (rule R48). The following is a sample list of acceptable additional parts that may be used.

1) additional Hitec HS-322HD servos (no limit except cost)
2) any number of FTC servos and motors (IFI P/Ns 276-2162 and 276-2163)
3) Victor 884 Speed Controllers (any year, no limit except cost)
4) Spike Relay Modules (any year, no limit except cost)
5) 1 additional 4-slot Maxi-style Fuse Block
6) up to 2 additional small CIMs (FR801-001 or M4-R0062-12) any 7.2V backup battery pack similar to the kit component
7) previous years' kit parts as long as they follow all other rules and are acceptable as per Parts Use Flowchart
8) only 2008 versions of the OI, RC and radio modems

Specifically Prohibited Electrical Parts:

1) Victor 883 or 885 Speed Controllers
2) Batteries and Motors different from/in addition to kit of parts components (except for additional servos and CIMs mentioned above).
3) Electric solenoid actuators (solenoids for pneumatic control are allowed and are treated separately, refer to following items in the checklist).
4) 2007 and older IFI RC, OI and radio modems
5) Lasers
6) Speakers, sirens, air horns or other audio devices that generate sound at a level sufficient to be a distraction or hindrance affecting the outcome of a match
7) electrical tape used for any objective other than insulation
8) components considered "hazardous" as per MSDS
9) unsafe additional parts
10) Fuse Panels other than 1 six position ATC panel, 1 twelve position ATC panel and 2 four position Maxi-style Fuse Blocks
11) circuit breakers other than 20A, 30A and 40A auto-resetting Snap Action brand circuit breakers (as in the kit of parts)
12) Any component that is not COTS or assembled from COTS (custom circuit boards and wiring assemblies for attaching the COTS items are acceptable)

Wire Size and Color Rules:

1) must use appropriate colors for power distribution (red/white/brown for positive; black/blue for negative)
2) #6 AWG wire minimum from battery (+ and -) to Anderson Disconnect and to main circuit breaker and to the Rockwell Power Distribution Blocks and to distribute power to all circuit breaker and fuse panels attached to the main circuit breaker (ATC Fuse Panels and Maxi-style Fuse Blocks from KOP)
3) #12 AWG wire min for all circuits protected by 40A Circuit Breaker
4) #14 AWG wire min for all circuits protected by 30A Circuit Breaker
5) #18 AWG wire min for all circuits protected by 20A Circuit Breaker

6) #24 AWG wire minimum for connecting sensors, Vision System, small muffin fans, LEDs or PWM signals to the Robot Controller
7) #24 AWG wire (or larger diameter) for wiring pneumatics valves
8) Ribbon cable smaller than #24 AWG may be used to connect to the 9 pin ports on the RC
9) wire pre-installed on motors and cables supplied for the pneumatics valves and the camera module are exempt from the above rules - these cables can be shortened but replacement or extension wires must obey the above minimums

Sensor Outputs: Sensor outputs can only be wired to Robot Controller Analog Inputs, Digital I/O, TTL Serial, Program Port, or Custom Circuit boards. No series connections between Spike/Victor outputs and their attached loads are permitted **except** low-impedance current sensors connected in series with load being monitored.

Custom Circuits: Custom Circuits may connect to the Robot Controller's Analog Input, Digital I/O, TTL Serial, PWM, Relay or Program Ports. In addition, custom circuits may connect to Branch Circuit breaker outputs, Speed Controller or Relay Module outputs or any kit or COTS sensors. Custom Circuits may NOT interfere with other robots, directly affect any output devices (e.g. generate PWM inputs for the Victor 884), be used for wireless communication or connect to the Radio or Tether Ports on the RC. Teams may place a 1uF capacitor across the leads of motors. Teams may place a 10kOhm (or lower value) resistor in line with any servo's PWM control signal.

Acceptable Pneumatic Parts: All parts that are used on the robot must be either from the kit of parts (or identical to a part in the kit) and/or be acceptable as per Parts Use Flowchart (rule R48). The following is a sample list of acceptable additional parts that may be used.

1) previous years' kit parts as long as they follow all other rules and are acceptable as per Parts Use Flowchart
2) solenoid pneumatics valves, cylinders, regulators and fittings (no limit except cost, must be rated for 125PSI and unmodified, all pneumatics actuators must be identical in dimensions to those listed on the Pneumatics Components Order form and from either Parker or Bimba) (metric cylinders may be used but require a letter from FIRST)
3) pressure sensors (no limit except cost, must be rated for pressure at mounting point)
4) "vacuum generators" (no limit except cost, if electrical power is required - must be driven by motor from the kit of parts)
5) pneumatic shocks as long as the gas is in an enclosed system (no limit except cost)
6) pneumatic pressure relief valve in any quantity (Parker P/N PV609-2)

Specifically Prohibited Pneumatic Parts:

1) components considered "hazardous" as per MSDS
2) unsafe additional parts
3) hydraulic components

4) air tanks different from KOP or more than 4 total
5) air compressor or pressure relief valve different from or in addition to the quantities supplied in the kit
6) pressure relief valve different from the part supplied in the kit (Parker P/N PV609-2)

Pneumatics Operational Test: If the robot design includes pneumatics, confirm that the pressure in the air storage tanks (i.e. at compressor output) does not exceed 125PSIG and that the "working" pressure does not exceed 60PSIG (output of the Norgren adjustable regulator and any additional downstream regulators). Also confirm that the manually operated vent valve 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.

Summary of Game Design Committee Responses to Rules Questions from Teams (responses which may impact the inspection, considering all GDC responses as of 10PM EST Feb 21, 2008)

1) "Wedges and Rule <R19>" – wedges can be included in the robot design but cannot be used as wedges to upset another robot
2) "<R67> Victor fans" – fans may be removed (but not recommended), alternative fans cannot be used (per <R60>)
3) "IR interference" – per <R02> and <R65>, teams cannot intentionally interfere with other team's IR devices (eg by generating so much IR that all devices are defeated)
4) "Pneumatics Question" – teams do not need to connect both ports of a pneumatic cylinder to valves, one of the 2 ports may be directly vented to atmosphere
5) "Pneumatics regulators and cylinders" and "Pneumatics R88 Question" – only one regulator may be used to convert the 120PSIG output of the compressor to 60PSIG working pressure for any single pneumatic circuit (other regulators can be used downstream of the 120-to-60PSIG regulator and other parallel circuits can be fed via their own regulator but a given circuit cannot be fed via 2 or more regulators in parallel)
6) "Pneumatics regulators and cylinders" – Clippard tanks can be attached to the 60PSIG working pressure
7) "Pneumatics regulators and cylinders" – any Bimba or Parker cylinders can be used as long as the specifications are the same as those listed on the "Free Pneumatic Components Order Form" (bore and stroke as well as minimum 125PSIG rating)
8) "Rule <R101> and Driver Pedals" – Pedals can be used and are not required to fit within the OI console's dimensions, however the pedals must be held or worn during the Hybrid Period
9) "<R16> Interpretation" – maximum permissible horizontal distance between any points on the robot cannot exceed 80" while the robot is on the field (note that this is different than fitting within an 80" diameter tube)
10) "80" – standard bumpers are included in the 80" maximum horizontal dimension requirement <R16>
11) "CIM Speed Controller" – the negative return wire does not have to go to the Power Distribution Block as shown in the wiring diagram, the return wire may go to another post or gathering point (eg on a fuse panel) but is not recommended
12) "<R08> Bumpers" – bumpers must be attached to the robot using a "robust bolt-and-fastener system". The question asked whether the attachment could be spring-loaded but the answer was not explicitly "no". We should inspect for "robust bolt-and-fastener system".
13) "2007 Banebots and other transmissions" – 2006 Banebots transmissions cannot be used since they are no longer commercially available
14) "Slip Rings" – slip rings may be used provided that they comply with all applicable rules (eg cost and availability)
15) "<R59> Clarification" – teams may use the motors in the kit plus up to 2 additional CIMs and an unlimited number of Hitec servos, FTC servos and FTC motors

16) "CIM Motor Mods for Encoders" – teams cannot drill holes in the back plate of the CIM for mounting an encoder
17) "Improvement" – plywood must be used as the backing for bumpers
18) "Additional Clarification R16" – robots may be designed such that there is a possibility for unintentionally violating the sizing rule <R16>, teams furthermore are not required to implement a hardware or software limit to eliminate the potential (eg a robot has 2 long arms that, if simultaneously extended, would violate the rule however the team is only intending to extend one at a time)
19) "R61, does the bumper get included in the 80" cylinder ?" – yes (this is actually referring to rule <R16>)
20) "Materials for Robot" – liquid electrical tape can be used as an electrical insulator
21) "Use of automobile airbag components" – fabric may be used, inflator/squib/gas charge may NOT be used anywhere near the FIRST competitions
22) "Auxiliary lighting on the Robot" – teams may use lights on their robot (eg for vision systems) as long as they conform to <R02>, <R03>, <R65> and <S01>
23) "Robocoach device" – teams may use a device other than the KOP IR board (eg an ultrasonic device) unless disallowed by other rules (eg <R02> and <R64>)
24) "Piping for pneumatics" – ¼" ID black iron pipe cannot be used (<R87>)
25) "Electrical Wiring Inspection" – insulation is not required on connections to devices other than the battery unless there are other explicit rules that may be violated (eg <R51> regarding isolation of the chassis)
26) "Sensors" – the IFI CMUcam II module from the 2006 kit may not be used since it was designed specifically for FIRST (refer to rule <R36>), other versions of the CMUcam module may be used as long as they're commercially available from a valid vendor
27) "<R08> Bumper geometry" – corners must be protected with pool noodles and fabric
28) "Air Spring?" – pneumatic pistons may not be used as a shock absorber since the pressures could exceed that piston's ratings, only commercially available closed-loop devices designed to be used as a shock absorber may be used in this application
29) "Re: <R08> Bumper geometry" – non-mounting holes in the bumper's plywood are not permitted (eg for weight reduction)
30) "bumpers in corners" – not required in every corner but strongly encouraged
31) "Standard Bumpers" – segments must be at least 6" long (per <R08>), the measurement shall be taken across the "soft" front surface which therefore allows plywood lengths < 6".
32) "Bumper Question – curved bumpers" – curved plywood (and therefore bumpers) is allowed
33) "R17 Flag Holder" – the flag holder may be mounted on an arm that pivots away from the robot as long as the flag remains approximately vertical and the robot size requirement <R16> isn't violated
34) "R17 Flag Holder" – the flag holder may not be spring-loaded since the flag cannot be expected to remain vertical

35) "Cold Cathodes – Use as Robot Decorations" – lights are permitted (eg the past kits' green cathode tubes) however teams using vision systems are permitted to ask to have the lights disabled during any match
36) "2007 Gear Tooth Sensor" – the 2007 sensor (uses a green PCB) is not allowed to be used (per <R36>) (for reference – the 2008 Gear Tooth Sensor uses a red PCB)
37) "gear tooth sensor wire gauge" – may use 24AWG wire or larger, it's not a custom circuit and therefore doesn't need to comply with the 18AWG 20A rule per <R47>, teams may decide to develop their own fuse panel to adapt a 20A breaker to a number of smaller current (and therefore smaller wire) circuits using lower current fuses
38) "<R67> RC Cabling" – teams are not permitted to replace or modify the 9-pin M-F cable for attaching the radio modem to the RC
39) "Bumper Corners" – cannot use miters in the corners, if pool numbers and cloth extend into the corners the design must use a wrap-around noodle as shown in the "specification"
40) "Bumpers – Rule R08 Robot Perimeter" – perimeter shall be measured as the external perimeter that "flows" around the robot and not simply a perfect contour that follows the perimeter, for example a U-shaped robot's perimeter is simply the perimeter of the rectangle that defines the general shape.
41) "Can bumpers be left on if robot makes size and weight with bumpers?" – sure but they are still required to be removable
42) "Flag Holder Pipe Size" – the PVC tube must have a nominal ½" ID which is actually closer to 0.62"
43) "SKyway wheels from 2006 KOP" – yes they can be used (they're COTS items) however the wheel hubs from the 2006 KOP and the sprockets from the 2007 KOP cannot be used since they were designed specifically for FIRST
44) "Linear Actuators pt. 2" – pre-made (COTS) linear actuators can be used but must utilize a KOP motor
45) "Usage of "Custom" springs" – teams can purchase "custom" components from an established vendor as long as those some parts are capable of being purchased and delivered to any and all FIRST teams, in the particular example the team was wondering whether springs from a manufacturer that really only makes springs per specification was legal (the GDC referred to such a "custom" part as a "fabricated item")
46) "Ground Stud for 40A Circuits" – the ground return wire does not have to go directly to the Power Distribution but instead can go to the ground terminals on other breaker panels
47) "CIM motor" – pool noodles must be 2.5" diameter (not, for example, 2.25" diameter)
48) "CIM motor" – motors from previous robots and kits may be used (<R58>) provided that they also satisfy total number rule <R59> and cost accounting <R26>
49) "Bumper Corners" – if they've got any material, must be a vertical section of pool noodle as shown in the drawing
50) "Bumper Mounting" – cannot use a door hinge with removable pin, must use a bolt and fastener

51) "gear tooth sensor" – the 2007 gear tooth sensor board may not be used since it was custom designed for FIRST and is not a COTS item
52) "Question on connecting motors to the victors" – intermediate connectors may be used as long as they are fully insulated
53) "Special notes on motors???" – the FP801-005 3" "mini-bike" motors are not allowed
54) "PWM Fan Connection" – fans for the Victors may either be powered via the Victors' power input terminals or a separate 20A breaker
55) "Rule <R50>" – insulation is required on battery terminals and attached lugs but is not required on other terminals (although is strongly recommended to minimize the likelihood of short circuits)
56) "Modifying the IR Board" and "IR receiver board" – all modifications are allowed
57) "Vacuum System" – vacuum systems are not to be classified as "pneumatic systems", they are not required to include vent valves or regulators and may use custom storage tanks
58) "Warning Alarm" – a sound generator may be used (eg to indicate launching a trackball) but may be rejected if the sound level is determined to violate <R02>
59) "Yet another bumper question" – custom bumpers may be used in addition to standard bumpers that cover at least 2/3 of the robot's perimeter, the custom bumpers must be included with the robot for testing size and weight
60) "Bumper Mounts" – additional bolts-and-fasteners and off-center bolts-and-fasteners may be used to secure the bumpers to the robot
61) "Painting Bumper Plywood" – it's OK to paint the plywood
62) "Non-Cylindrical Bumpers?" – the pool noodles must be round and have an OD of 2.5"
63) "<R92> Question and orientation of ports on Thomas compressor" – the ports on the compressor are intended to be oriented along the length of the compressor's body, teams are not permitted to disassemble the compressor in order to rotate the ports
64) "vex camera use in competition" – cannot be used unless the transmitter is completely disconnected and disabled
65) "multiple solenoids & victors, 1 circuit breaker: Update 8" – each circuit breaker can protect one, and only one, Victor or Spike, multiple pneumatic valves can be controlled with a single Spike
66) "<R87> and Printed Ratings on Tubing" – Teams may use pneumatics tubing from Freelin-Wade that does not have any markings per <R87>, however the teams must provide documentation to confirm that the tubing is in fact from Freelin-Wade
67) "Is coiled tubing legal?" – yes as long as it's clearly marked as rated for 125PSI or greater and has an ID of 0.16"
68) "Using 5V power from RC" – sensors may be powered directly from the 5V available from the RC
69) "Removing Unused Portions of the Rockwell Block" – unused red and black sections may be removed, in addition the jumpers and DIN rail may be reduced in length as needed

70) "Bumpers and holes in noodles" – any 2.5" diameter pool noodle with round cross-section may be used regardless of whether the noodle is hollow or, if hollow, has an inner diameter other than ¾"
71) "Bumper Frame" – bumpers must be removable and must use a bolt-and-fastener system (ie not permanently fastened via nails or similar)
72) "Can we use electro magnets?" – yes as long as they don't interfere with other robots or other parts rules (wouldn't this conflict with <R60>?)
73) "Are RC's 7.2v pins not to be used for custom circuits?" – nothing should be connected to the backup battery terminals other than a backup battery and, if used, an on-robot backup battery charging circuit (however, the 7.2V power output from the servo terminals may be used to power custom circuits)
74) "small fuses for sensors" – the breaker panels can only use 20A, 30A and 40A breakers, if teams wish to use smaller value fuses and/or breakers then the devices must be used within a custom circuit that's connected to a 20A breaker in a panel
75) "R53 – Lowering Power to motor" – a resistor cannot be placed in series with motors
76) "Operator Console Depth" – the teams' consoles may be more than 12" deep but must be fully supported by the shelf on the field
77) "Standard bumpers and bumper length" – the 6" min length measurement for bumpers can be taken across the "soft" front surface of the bumper instead of the hard plywood backing's length
78) "Use of 2.75 inch pool noodles" – 2.75" diameter noodles are allowed, noodles do not need to have a hollow center but that is preferred
79) "Bumper Mounting" – L-brackets or other mounting systems cannot be considered part of the bumpers and must reside permanently on the robot, only plywood and bolts-and-fasteners can stay with the bumper for sizing and weighing
80) "Robot guarding" - Rule <R05> requires that reasonable efforts be made to mitigate and/or protect pinch points. Shielding particularaly dangerous pinch points is critical. For less hazardous pinch points, shielding is the preferred option. If this is physically not possible for less hazardous pinch points, then brightly colored warning stripes or other visual warning indicators would be an acceptable alternative
81) "Gyro Rules" – the sensor strip (gyro, accelerometer and gear tooth sensor) from the 2007 KOP cannot be used in the 2008 competition
82) "Hybrid Receiver Disconnect Rule" – instead of physically disconnecting any hybrid receivers while the robot is in the pits, a set of switches in the connecting cable can be used with clear labels for OFF
83) "Bumper/robot body covering" – using the same color as a gamepiece (eg the blue of the trackballs) to decorate the robot is acceptable
84) "Bumpers question" – using an aluminum plate/channel to adapt the bumpers to the robot is acceptable as long as the plate remains attached to the robot when removing the bumpers.
85) "Servo Power" – servos must be connected to the RC's PWM ports (per R62, R53 and R03) and cannot derive power from another port (eg a 5V output from the RC)

86) "Keyang Motor Spur Gear" – teams may replace the gears within the motor because the transmission and gears are not considered to be an integral part of the motor (per R61)
87) "RC Busted – Can we Use 2007?" – if a team's 2008 RC becomes inoperable, the 2007 RC may be used as a replacement (also per Team Update #11)
88) "Compressed air management" – per R93, robots cannot intentionally generate compressed air through any means other any the supplied KOP compressor, eg a cylinder cannot be intentionally compressed to generate pressure
89) "Pneumatic Hose Rating" and "Heat-treating tubing?" – teams are not permitted to attempt heat-forming of tubing but are allowed to use commercially-available coiled tubing that is functionally equivalent to the KOP tubing and rated for at least 125PSIG
90) "R18 – Lap Counter Face Backward ? Wiring" – the lap counter does not have to face forward, all 3 wires must be present in the cable that powers the lap couter
91) "<R67> Clarification on backup batteries" – alternate backup batteries may be used but the connectors on the battery must be unmodified, custom adapter cables can be fabricated to attach the backup battery to the control system
92) "Is a manifold a legal fitting" – no, the robot may only use KOP components and items specifically permitted per R86 and R87
93) "legal pneumatic part question" – commercially available pipe nipples are permitted per R88 as long as they are rated for at least 125PSI and are not used to stored excess amounts of air

What's New in 2008

1) Lap Indicator
2) Bumpers are now required and must extend over at least 2/3 of the robots' perimeter
3) FTC servos and motors may be used
4) The use of robot classes (various height/weight classifications) has been abandoned
5) Servos must be driven by RC
6) The diagnostic signal light (aka LED Flasher) has returned and is required
7) Flag height is set to 75" nominal from the floor
8) Be VERY wary of sharp edges – the game pieces are susceptible to punctures.
9) The on-robot 7.2V backup battery charger can either use the IFI design or anything similar
10) Textured/coated tapes are acceptable for altering surface finishes
11) Teams must be allowed to practice prior to inspection but the Lead Inspector and Head Ref are permitted to withdraw that privilege for any team with a potentially unsafe robot
12) Teams may use 24AWG wire (or larger) to wire pneumatics valves (vs. the 18AWG min wire that's typically required for 20A circuits)
13) Any Parker or Bimba pneumatics actuators may be used as long as the part is unmodified, rated to at least 125PSIG and is identical in dimensions to the parts listed on the free order form
14) Pneumatics tubing is 0.16" ID instead of 1/8" ID

Custom Cylinder Form

(from www.bimba.com, this is from the *FIRST*-specific "free cylinder" section)

Teams are allowed to procure up to 3 cylinders and 1 rotary actuator for free. Additional cylinders and actuators are allowed (unlimited quantity) but the costs must be included in the team's bill of material.

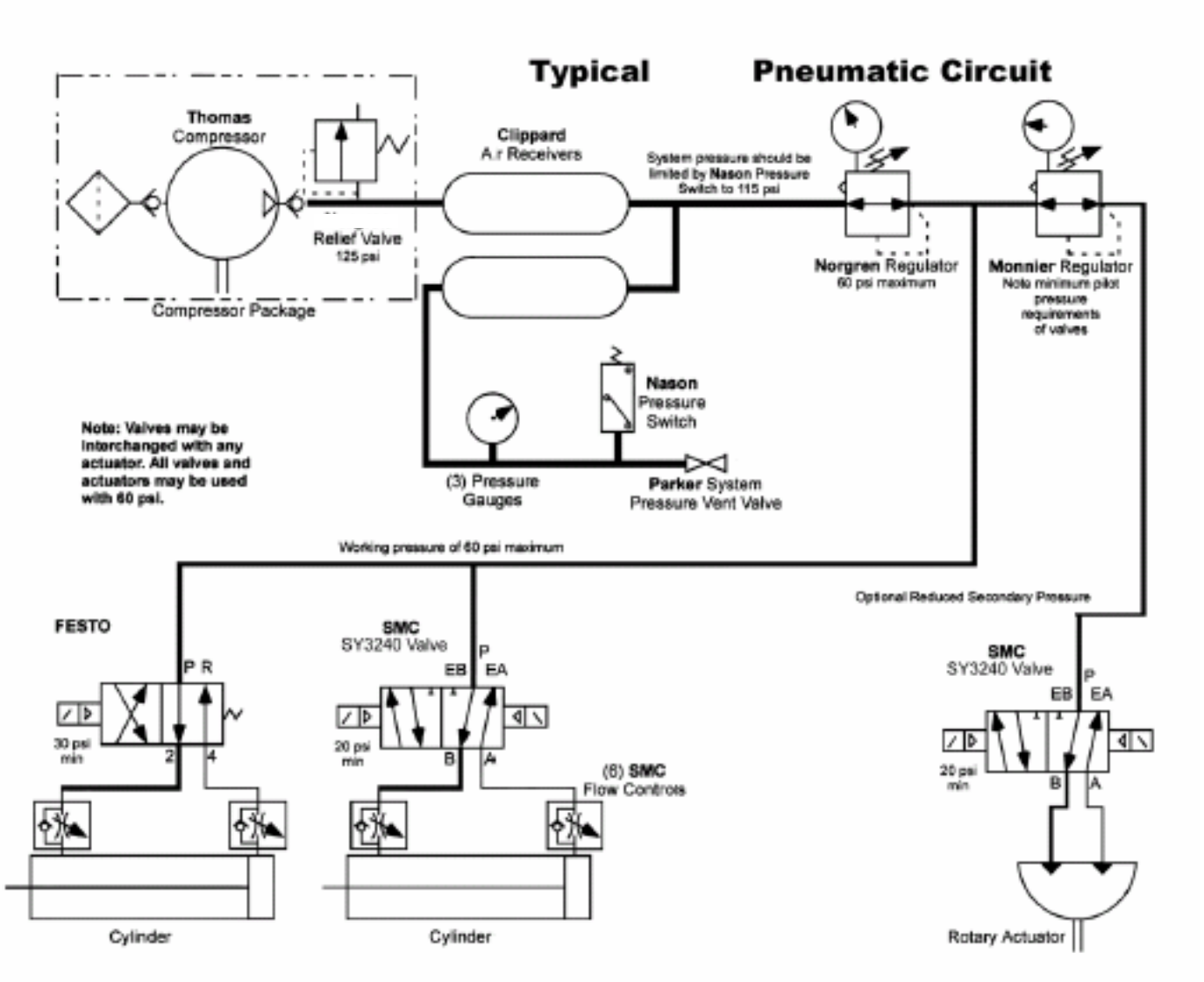
The following table lists the only valid air cylinder configurations. Air cylinder part numbers must be M-XXYY-ZZ.
-"M" is optional (specifies whether magnetic position sensors are included)
- XX represents bore, must be either 04 (for ¾" bore), 17 (for 1.5" bore) or 31 (for 2" bore)
- ZZ represents mounting option, must be DP (for ¾" and 1.5" bores) or DXP (for 2" bore)
- YY represents stroke length, must be a value from the table below

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

Rotary actuators must also be from Bimba. There are only 2 acceptable part numbers.
- PT-017090
- PT-017090-M

Teams may use dimensionally identical cylinders from either Bimba or Parker as long as the cylinders have not been modified in any way and are rated for at least 125PSIG. Metric cylinders may be used but require a letter from FIRST.

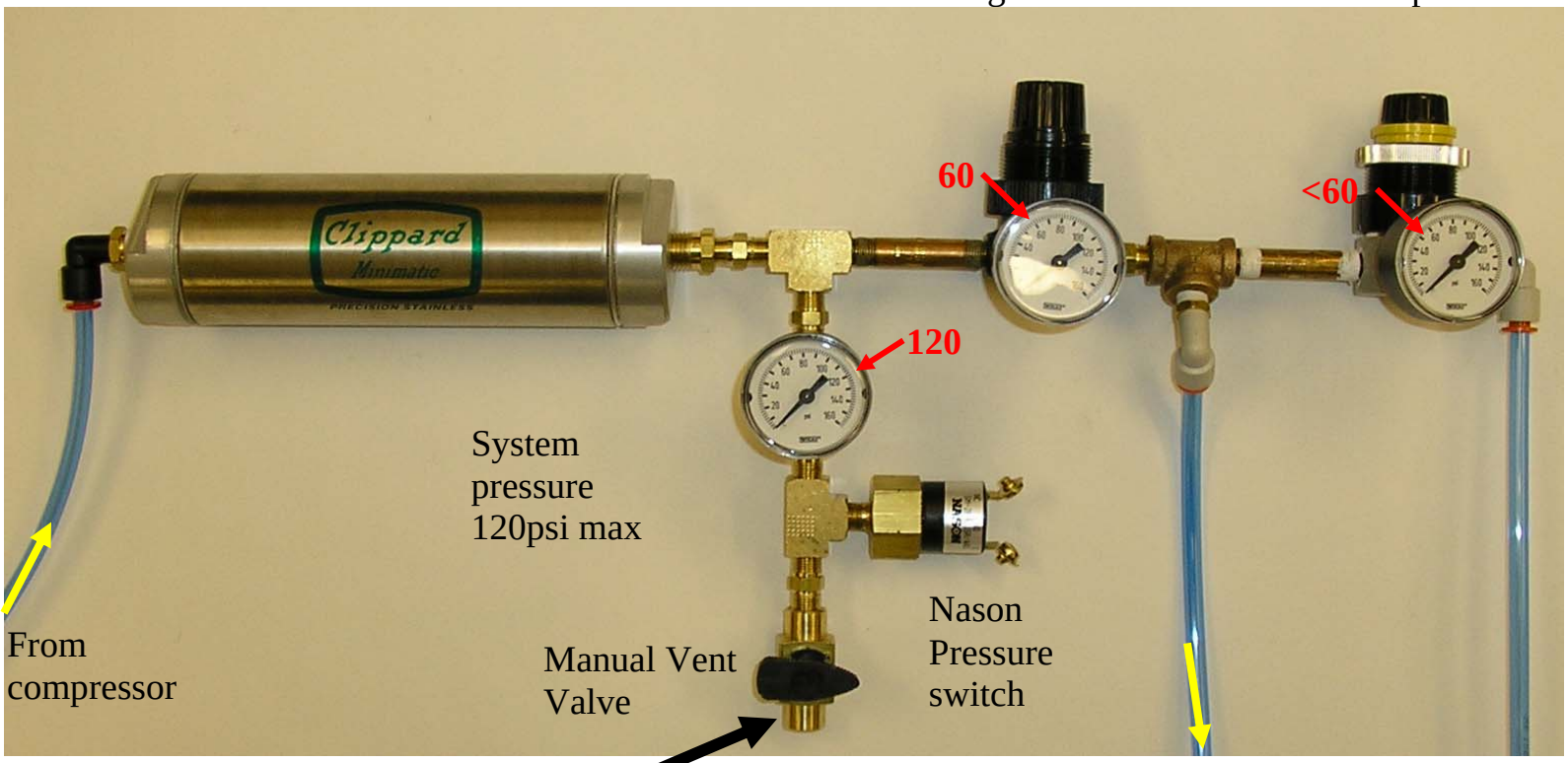
Pneumatics Diagram – If the robot uses pneumatics, the setup must be similar to the following.



Pneumatics Picture – picture of the components assembled as per diagram (only 1 tank shown, 2 may be used)

Norgren Regulator
60psi max
Working Pressure

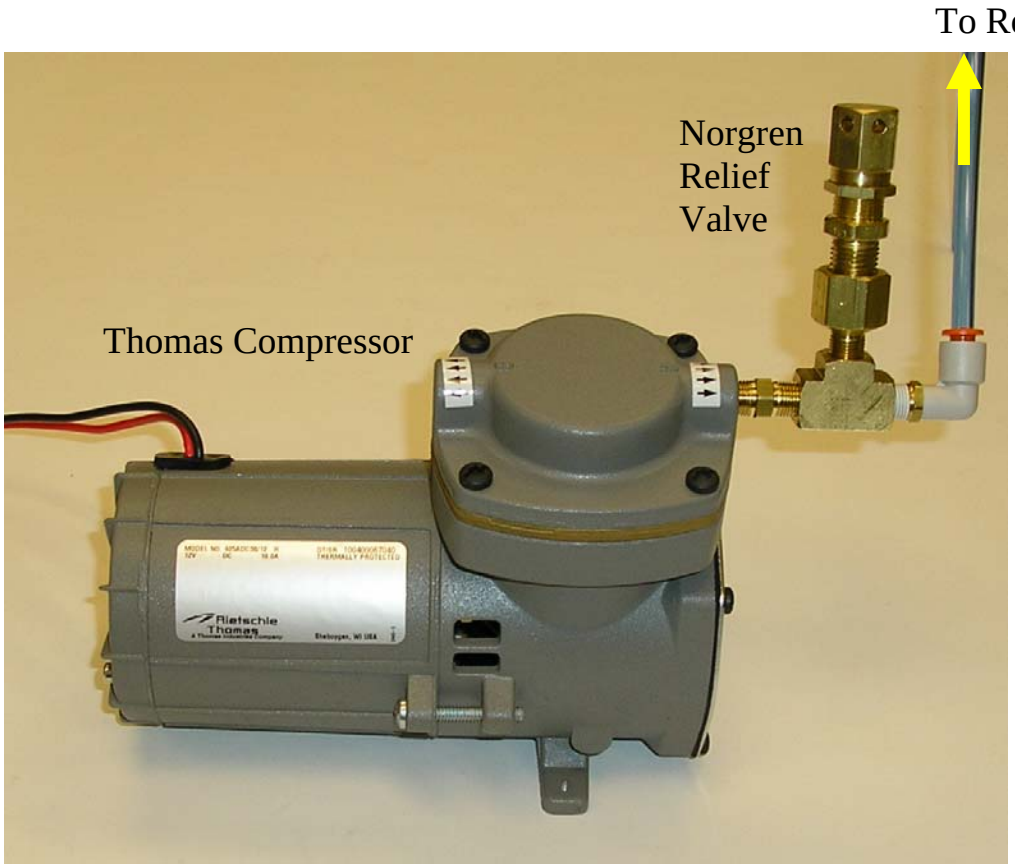
Optional Monier
secondary Regulator
less than 60psi



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

60psi max to
solenoid valves /
cylinders

Pneumatics Picture – picture of the compressor assembled as per diagram (may be on or off the robot)



This compressor must be used to charge the pneumatic system. It can be mounted on the Robot or be used in the pits to charge the Clippard Volume tank(s).

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

Main DC Power Components

MK Battery ES17-12
(may be a different color)

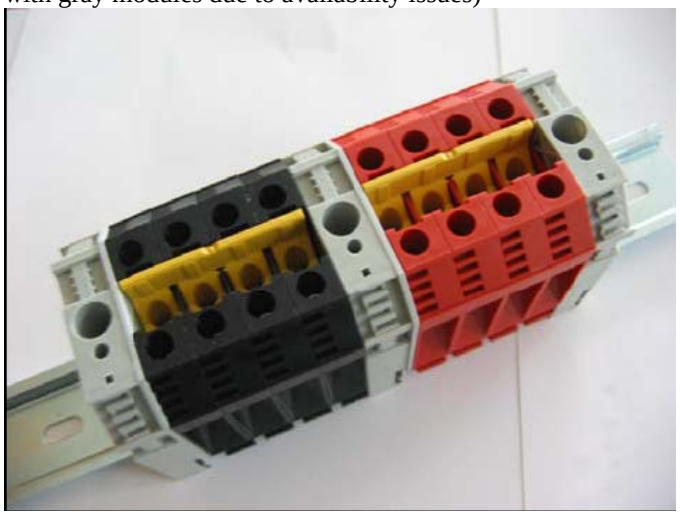
12-position ATC Fuse Panel

4-position Maxi-Style Fuse Block

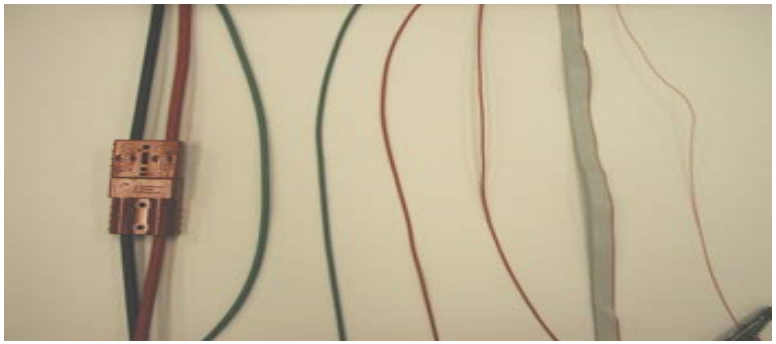
120A Main Breaker

6-position ATC Fuse Panel

Rockwell Automation Power Distribution Block (assembled with all positions, teams do not need to use all 4 channels for both power and ground, teams may use as many positions as they wish, teams may replace the red/black modules with gray modules due to availability issues)



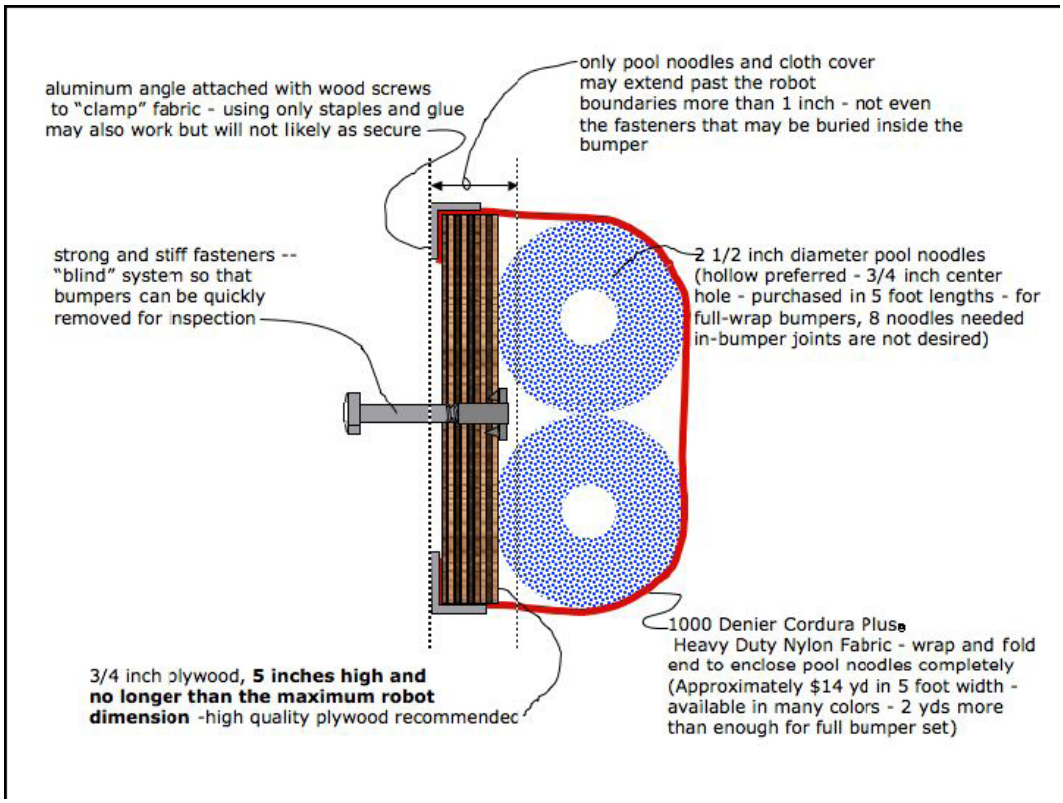
Wire Gauge Picture –comparing wiring of different sizes

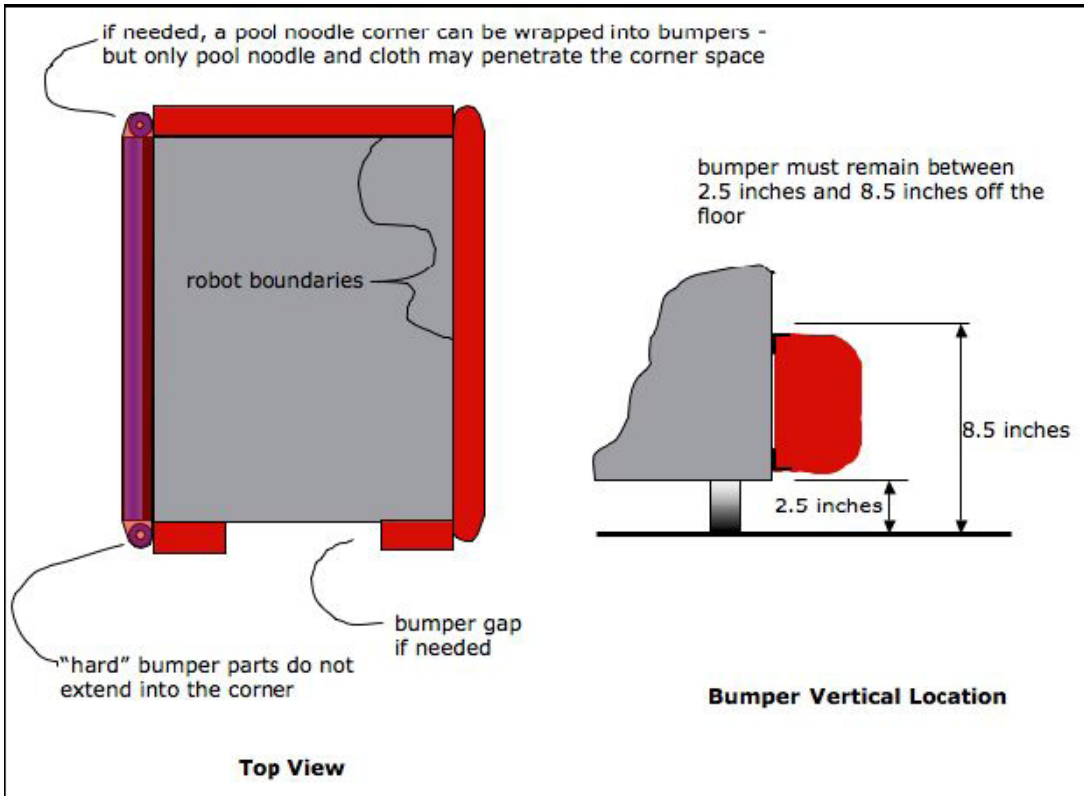


Wire Gauges (AWG) = 6 12 14 18 24 ribbon 32

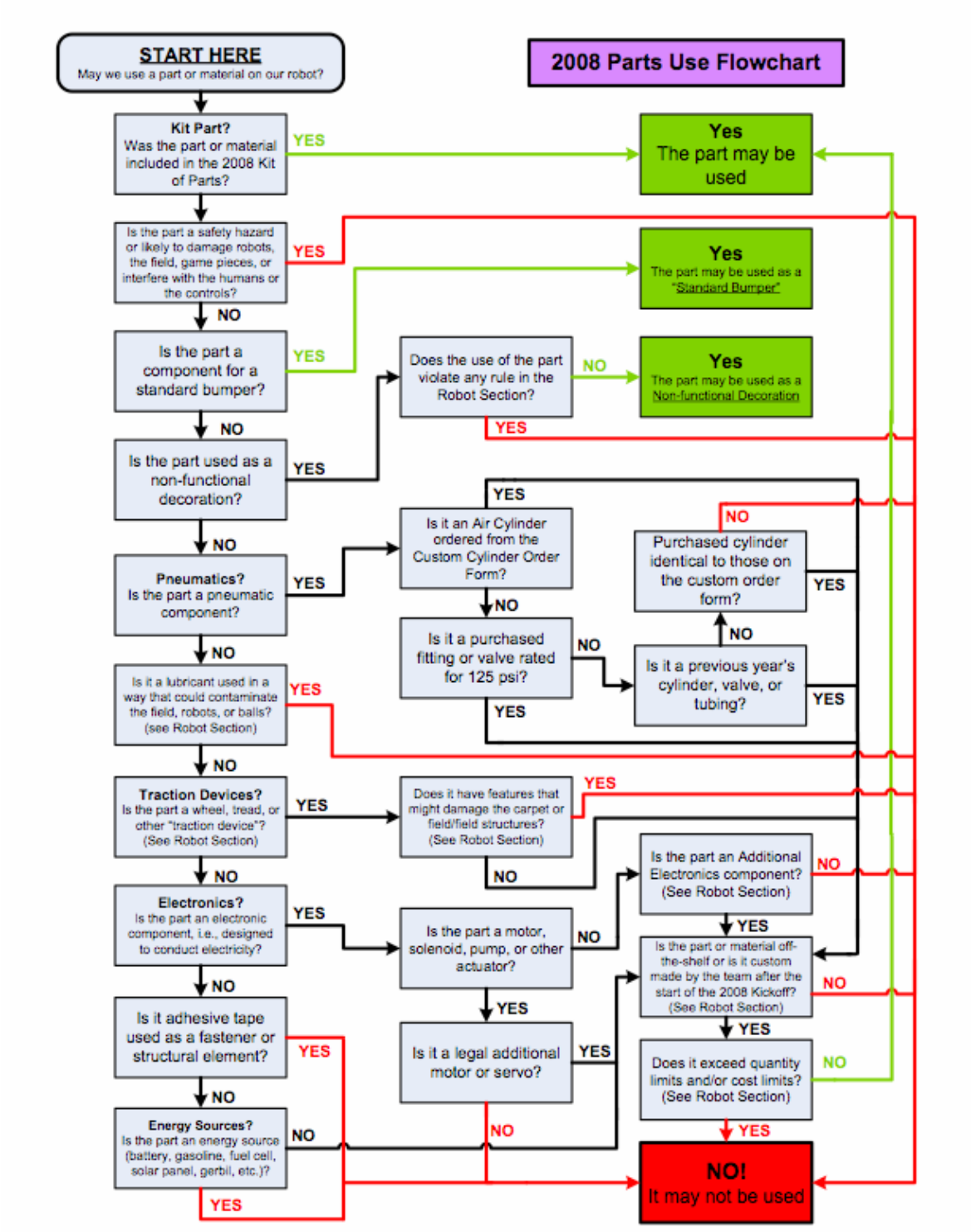
6 AWG (or larger diameter) must be used in battery-to-circuit breaker path
12 AWG (or larger diameter) must be used in circuits connected to 40A breaker, 14 (or larger) with 30A circuits and 18 (or larger) with 20A circuits
24 AWG or larger may be used for sensors, vision system, muffin fans, LEDs and PWM control signals
24 AWG or larger must be used for wiring pneumatics valves
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.

Bumper Diagram – drawing showing bumper requirements



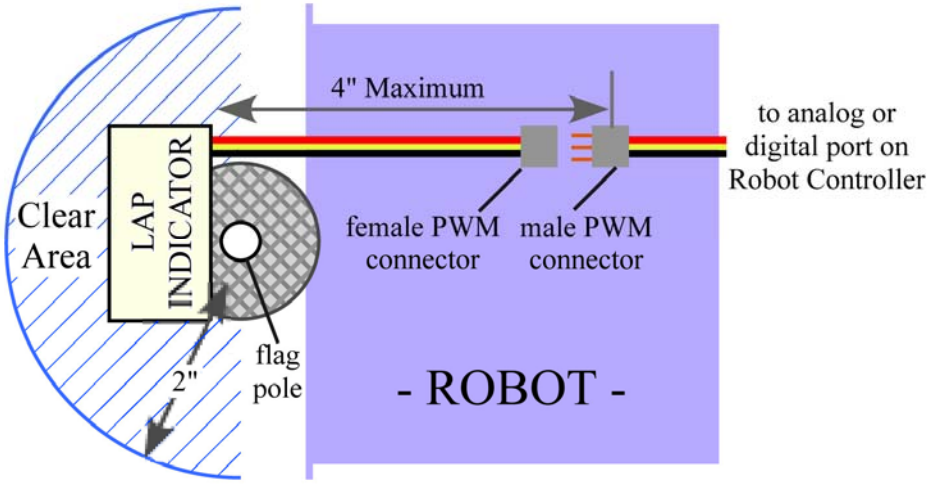


Parts Use Flowchart



Lap Indicator

The robot must include a clear area around the top of the flag holder with unobstructed view from above and powered PWM connector within 4” of the mounting location.



Bicycle Flag

1) the robot must include a contiguous 12” long x ½” (nominal) ID Schedule 40 PVC tube to accept the flag
2) the robot’s PVC tube must be capped at its “bottom” with a cemented PVC cap
3) the flag must remain approximately vertical while the robot is in its PLAYING CONFIGURATION (the orientation of the robot beginning sometime soon after the start-of-match and for the remainder of the match)
4) the top of the flag must be between 74” and 76” from the floor
5) the robot’s PVC tube cannot be attached to a bumper
6) the robot’s PVC tube cannot be longer than 12”
7) the tube cannot be machined in order to reduce mass
8) the tube must be hard-mounted to the robot (eg no tape or Velcro)