

3. ROBOT DESIGN, CONSTRUCTION & OPERATION

3.1 Rules

At the kick off, teams will be furnished with 2 containers which comprise a complete Kit of Parts, and this manual which initiates the beginning of the design/build process. Rules for the following categories relating to the design, construction and operation are contained in Appendix A. Paragraphs are classified by the following letters and the individual rules are numbered within each category.

- Game Violations V
- Game Rules of Play P
- SCoring SC
- Safety Rules S
- Machine Design & Operation Rules M
- Control System Rules C
- Kit Materials Usage & Limitations K
- Notes on Playing Field Construction F

Before you begin the design and build stage, it is very important to become very familiar with the above rules. By taking the time to read through the rules carefully, you will save time in the long run. Major blocks of time can be wasted rebuilding, due to the lack of knowledge about a certain rule at the onset of the design process.

Plan your overall schedule to include simulated competition test runs and give your drivers as much practice as possible. If you have not built some sort of prototype (motors and wheels mounted on a board running around the floor, picking up mechanisms, etc.) by the end of the 3rd week, you are way behind schedule. If in doubt, consult this manual and team updates. If these can not answer the questions, call FIRST. It is far better to find out 2 weeks or even 2 days before you ship that something you wanted to do is against the rules instead of finding out at the event and having to scramble to re-engineer your robot.

As you progress into the design and build stage, be sure to carefully read all team updates which will be periodically issued. By being attentive to this, each team receives the benefit of getting answers to all questions asked, and additional clarification of requirements.

3.2 Kit of Parts

The following pages are a detailed packing list for all Components which make up the official Kit. A checklist has been included in your registration packet which you should use as you go through the Kit to be sure you have received all parts. This checklist should be signed by a team member and returned to a FIRST staff member as you leave the Kick-off. Any materials you did not receive will be shipped to you as soon as possible.

List of Components

Bearings

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
2 Bolt Self Aligning Flange	Fits 1/2" Bearing	Gray Container - Bearing Bag	8	The Torrington Company
Radial Ball Bearing With Sphencal O.D.	1/2" I.D., Self Locking Collar	Gray Container - Bearing Bag	4	The Torrington Company
Single Row Radial Flanged Ball Bearing	1/4" I.D.	Gray Container - Bearing Bag	4	The Torrington Company
Single Row Radial Flanged Ball Bearing	3/8" I.D.	Gray Container - Bearing Bag	4	The Torrington Company
Window Motor Bushing	5/16" I.D. x 1/2" Long	Green Container - Miscellaneous Bag	1	Stock Drive Products

Control System

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
2 Conductor Jacketed Wire	30', #24 AWG	Gray Container - Loose	1	General Cable Company Inc.
2 Conductor Jacketed Wire	35', #16 AWG	Gray Container - Loose	1	General Cable Company Inc.
2 Pin Logic Power Connector	Black, European Style Header	Green Container - Electronics Bag	1	Thomas & Betts Corp.
25 Pin Cable	DB25 Male to Female, 6', Shielded	Green Container - Loose	1	Brevan Electronics
25 Pin Male D-Sub Solder Cup Connector	25 Pin Male D-Sub Sloder Cup	Green Container - Electronics Bag	2	AMP Incorporated
3 Conductor Shielded Wire	30', #24 AWG	Gray Container - Loose	1	General Cable Company Inc.
8 Pin Relay Output Connector	Black, 8 Position European Style Header	Green Container - Electronics Bag	2	Thomas & Betts Corp.
9 - 15 Pin Cable	3' Long, DB9 Female to HDB 15 Male	Green Container - Miscellaneous Bag	2	Brevan Electronics
9 Pin Cable	DB9 Male to Female, 6', Shielded	Green Container - Loose	3	Brevan Electronics
Antenna, Helical UHF	3' Long	Kick Off Check Out	2	Motorola
Battery Box	Fits Sealed Lead Acid Battery	Green Container - Loose	1	Associated Power Products
Battery Charger	For Sealed Lead Acid Battery	Green Container - Loose	1	Associated Power Products
Battery Fuse		Green Container - Miscellaneous Bag	1	FIRST
Battery Fuse Holder	For Battery Fuse	Green Container - Miscellaneous Bag	1	FIRST

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List of Components

Battery, Sealed Lead Acid	12 Vdc. 18 Amp Hours	Green Container - Loose	2	Associated Power Products
Battery Terminal Mounting Bolt	3/16" Ø x 1/2" Long	Green Container - Miscellaneous Bag	2	Aubin Hardware
Battery Terminal Mounting Nut	3/16" Ø. Self Locking	Green Container - Miscellaneous Bag	2	Aubin Hardware
BNC Bulkhead Connector	BNC Male to Male	Green Container - Miscellaneous Bag	1	FIRST
BNC Coax Cable	BNC Female to Female	Green Container - Miscellaneous Bag	2	FIRST
Circuit Breaker For Motors	30 amp, 12 volt, Auto-Resetting	Green Container - Electronics Bag	4	Snap-Action, Inc.
Diode	1 Amp, Maximum	Green Container - Electronics Bag	2	Digi-Key
Flightstick Joystick	7" Cable with Male DB15	Green Container - Loose	2	CH Products
Ground Plane Assembly	12" x 12" with BNC Connector	Gray Container - Loose	1	FIRST
Heat Shrink Tubing	1/4"Ø x 15", Black, 2:1 Shrink Ratio RNF100	Green Container - Electronics Bag	1	Raychem Corporation
Heat Shrink Tubing	1/8"Ø x 24", Black, 2:1 Shrink Ratio RNF100	Green Container - Electronics Bag	1	Raychem Corporation
Heat Shrink Tubing	3/8"Ø x 15", Black, 2:1 Shrink Ratio RNF100.	Green Container - Electronics Bag	1	Raychem Corporation
Knob for Potentiometer	1" Hexagon, Fits 1/4" Shaft	Green Container - Miscellaneous Bag	2	Radio Shack
LED	Yellow	Green Container - Miscellaneous Bag	1	Brevan Electronics
Limit Switch		Green Container - Electronics Bag	10	Honeywell - Microswitch Division
Lug for Battery	10 AWG, 3/16" I.D. Bolt Hole	Green Container - Miscellaneous Bag	4	Newark Electronics
Muffin Fan	12 Vdc	Green Container - Loose	1	EBM Industries
Optical Sensor	Miniature DC Sensor	Green Container - Miscellaneous Bag	2	Honeywell - Microswitch Division
Potentiometer	100KΩ, Linear	Green Container - Electronics Bag	4	Bourns, Inc.
Power Supply	9 Vdc. 1.0 Amp max	Green Container - Loose	1	Golden Pacific Electronics, Inc.
Project Box	Black	Green Container - Loose	1	Serpac

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Receiver	2.25" x 5.75" x 8.75"	Green Container - Loose	1	FIRST
Reed Switch	Normally Open. Magnet Activated	Green Container - Electronics Bag	4	CP Clare
RNet 9600sslm. Programmable	High Density DB15 Female	Kick Off Check Out	2	Motorola
Rocker Switch	Black	Green Container - Electronics Bag	8	Honeywell - Microswitch Division
Rocker Switch Cover	Black	Green Container - Electronics Bag	1	Honeywell - Microswitch Division
Rocker Switch Cover	Blue	Green Container - Electronics Bag	2	Honeywell - Microswitch Division
Rocker Switch Cover	Green	Green Container - Electronics Bag	1	Honeywell - Microswitch Division
Rocker Switch Cover	Red	Green Container - Electronics Bag	2	Honeywell - Microswitch Division
Rocker Switch Cover	White	Green Container - Electronics Bag	1	Honeywell - Microswitch Division
Rocker Switch Cover	Yellow	Green Container - Electronics Bag	1	Honeywell - Microswitch Division
Servo	Hitec/JR-style Connector, 42 oz. in.	Green Container - Electronics Bag	2	Hitec RCD, Inc.
Servo Extension Cable	Hitec/JR-style, 36" Long	Green Container - Electronics Bag	4	Hitec RCD, Inc.
Servo Y Cable	Hitec/JR-style, 24" Long	Green Container - Electronics Bag	2	Hitec RCD, Inc.
Spade Connector	Female, 12-10 AWG, Yellow	Green Container - Electronics Bag	20	Thomas & Betts Corp.
Spade Connector	Female, 16-14 AWG, Blue	Green Container - Electronics Bag	20	Thomas & Betts Corp.
Spade Connector	Female, 22-18 AWG, Red	Green Container - Electronics Bag	20	Thomas & Betts Corp.
Spade Connector	Male, 12-10 AWG, Yellow	Green Container - Electronics Bag	20	Thomas & Betts Corp.
Spade Connector	Male, 16-14 AWG, Blue	Green Container - Electronics Bag	20	Thomas & Betts Corp.
Spade Connector	Male, 22-18 AWG, Red	Green Container - Electronics Bag	20	Thomas & Betts Corp.
Speed Controller	7.2 - 12 Vdc. Reversing	Green Container - Loose	4	Tekin Electronics, Inc.
Terminal Strip	Tubular, Double Screw Terminal Strip (7 slots)	Green Container - Electronics Bag	4	Thomas & Betts Corp.

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Tether Adaptor	Black DB9 Female-Female Connector	Green Container - Miscellaneous Bag	1	Brevar Electronics
Thermo-Plastic Shield for 25 Pin Connector	25 Pin Connector	Green Container - Electronics Bag	1	AMP Incorporated
Transmitter	1.75" x 5.50" 7.50"	Green Container - Loose	1	FIRST
Window Lift Mechanism Washer	Fits over Flanged Bushing	Green Container - Miscellaneous Bag	2	Aubin Hardware
Wire	35', #10 AWG, Black	Gray Container - Loose	1	General Cable Company Inc.
Wire	35', #10 AWG, Red	Gray Container - Loose	1	General Cable Company Inc.
Wire Nut	Wire Nut for Wire Sizes #18-10 AWG	Green Container - Electronics Bag	10	Thomas & Betts Corp.
Wiring Harness For Receiver Relay Power Connector	1', #10 AWG, Red and Black	Gray Container - Loose	1	Nova Biomedical/Amp Inc.
Wiring Harness For Seat Motor	5', #16 AWG	Gray Container - Loose	2	Nova Biomedical/Pioneer
Wiring Harness For Window Motor	5', #16 AWG	Gray Container - Loose	2	Nova Biomedical/Pioneer

Documentation

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
BASIC Stamp Programming Disk	3.5" HD Floppy	Green Container - Electronics Bag	1	Parallax, Inc.
BASIC Stamp Programming Manual	Version 1.8	Green Container - Loose	1	Parallax, Inc.
Battery Technical Handbook		Gray Container - Loose	1	Associated Power Products
Control Program Source Code - 1998	3.5" HD Floppy	Green Container - Electronics Bag	1	FIRST
Kee Klamp Pipe Fitting Catalog		Gray Container - Loose	2	Kee Industrial Products
Operation & Maintenance Manual for the Pneumatic Pump	For the Pneumatic Pump	Green Container - Loose	1	Gast Manufacturing Corp.
Pneumatic Training Manual		Green Container - Loose	1	SMC Pneumatics, Inc.
Small Parts Catalog	Catalog No. 18W	Gray Container - Loose	4	Small Parts, Inc.

Fasteners

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
5 Minute Epoxy Gel	Resealable 1 oz. Dual Syringe	Gray Container - Hardware Bag	1	McMaster-Carr Supply Company

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Cable Tie	11" x 0.14"	Gray Container - Hardware Bag	20	Thomas & Betts Corp.
Cable Tie	8" x 0.09"	Gray Container - Hardware Bag	20	Thomas & Betts Corp.
Cable Tie Mounting Base	Self-Adhesive. Holes For #8 Screws	Gray Container - Hardware Bag	25	Thomas & Betts Corp.
Helical Plastic Wire Wrap	1/4" Ø x 24"	Gray Container - Hardware Bag	1	McMaster-Carr Supply Company
Velcro 1" Hook & Loop Tape (No Adhesive Backing)	18" Lengths	Green Container - Velcro Bag	1	Velcro USA, Inc.
Velcro 1" Hook & Loop Tape (W/ Adhesive backing)	18" Lengths	Green Container - Velcro Bag	1	Velcro USA, Inc.
Velcro 1" One WrapTape	18" Lengths. Red	Green Container - Velcro Bag	1	Velcro USA, Inc.
Velcro 5/8" One WrapTape	60" Lengths. Black	Green Container - Velcro Bag	1	Velcro USA, Inc.
Velcro Sticky Back Coins	5/8" Ø, 15 Sets Per Pack	Green Container - Velcro Bag	15	Velcro USA, Inc.

Field Components

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Ball	24", Blue	Green Container - Loose	1	Sports Fun

Motors & Pumps

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Capacitor, Drive Motor Noise Suppression	0.1 µF, 50 V Ceramic Molded Radial	Green Container - Electronics Bag	6	KEMET Electronics Corporation
Drill Gearbox	225 in. lbs Maximum Torque	Green Container - Drill Bag	2	S-B Power Tool
Drill Housing, Left and Right with Shift Lever	T-Handle Style Grip	Green Container - Drill Bag	2	S-B Power Tool
Drill Housing Screws	Pan Head	Green Container - Drill Bag	16	Fastenal Company
Drill Motor	12 Vdc	Green Container - Drill Bag	2	S-B Power Tool
Gear	Use with Window Tape. Window Lift Mechanism	Gray Container - Window Lift Mechanism Bag	2	Delphi Interior and Lighting Systems
Guide Drive	Use with Guide. Channel, Window Tape	Gray Container - Window Lift Mechanism Bag	8	Delphi Interior and Lighting Systems
Guide, Left Hand	Attach to Triangular Mount. Window Lift	Gray Container - Window Lift Mechanism Bag	1	Delphi Interior and Lighting Systems
Guide, Right Hand	Attach to Triangular Mount. Window Lift	Gray Container - Window Lift Mechanism Bag	1	Delphi Interior and Lighting Systems

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Seat Motor	12 Vdc	Gray Container - Loose	2	ITT Automotive
Triangular Mount	White, Window Lift Mechanism	Gray Container - Window Lift Mechanism Bag	2	Delphi Interior and Lighting Systems
Van Door Motor	12 Vdc, 265 in. lbs at 50 Amps	Gray Container - Seat Positioning Unit Bag	2	Delphi Interior and Lighting Systems

Other

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Carpet Sample	12" x 12", 20 oz., Closed Loop	Gray Container - Loose	1	FIRST
Co-Polymer Gutter Guard	6" x 24"	Gray Container - Loose	1	Home Depot
Folding Table Leg Brace, Left Hand	Heavy Duty Leg Brace	Gray Container - Loose	1	Stanley Hardware
Folding Table Leg Brace, Right Hand	Heavy Duty Leg Brace	Gray Container - Loose	1	Stanley Hardware

Pneumatics

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Adaptor Fitting For Pressure Switch	1/4" NPT Female to 1/8" Barb, Assembly	Green Container - Pneumatics Bag	1	Numatics, Inc.
Air Cylinder	1-1/16" dia. Bore, Rear Pivot, 4" Stroke	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Air Cylinder	3/8" dia. Bore, Double Clevis, 6" Stroke	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Air Filter for the Pneumatic Pump	For the Pneumatic Pump	Green Container - Pneumatics Bag	1	Gast Manufacturing Corp.
Barbed T-Connector	1/8" Ø Barbs	Green Container - Pneumatics Bag	2	Value Plastics, Inc.
Check Valve	1/8" Ø Barbs 75 max. psi	Green Container - Pneumatics Bag	2	Air Logic
Double Solenoid Valve	12 Vdc, 2 Position, 5 Port Base	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Kent™ Connect Fitting, Barbed Female Adaptor	1/4" Ø	Green Container - Pneumatics Bag	1	Value Plastics, Inc.
Kent™ Connect Fitting, Barbed Female Adaptor	1/8" Barb	Green Container - Pneumatics Bag	6	Value Plastics, Inc.
Kent™ Connect Fitting, Barbed Male Adaptor	1/4" Ø	Green Container - Pneumatics Bag	2	Value Plastics, Inc.
Kent™ Connect Fitting, Flanged Male Plug	For Fittings	Green Container - Pneumatics Bag	1	Value Plastics, Inc.
Kent™ Connect Fitting, Manifold	1 Port	Green Container - Pneumatics Bag	1	Value Plastics, Inc.

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Kent™ Connect Fitting, Open Flow	Female Side to 1/4" Ø PTF	Green Container - Pneumatics Bag	2	Value Plastics, Inc.
Kent™ Connect Fitting, Recessed Male Plug	Use with Manifold	Green Container - Pneumatics Bag	1	Value Plastics, Inc.
Kent™ Connect Fitting, Rotating Barbed Male Adaptor	1/8" Ø	Green Container - Pneumatics Bag	1	Value Plastics, Inc.
Kent™ Connector Fitting, Barbed Male Adaptor	1/8" Ø	Green Container - Pneumatics Bag	7	Value Plastics, Inc.
One Touch Fitting	Bulkhead Union, 1/2-20	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
One Touch Fitting	Male Elbow, 1/8" NPT	Green Container - Pneumatics Bag	3	SMC Pneumatics, Inc.
One Touch Fitting	Male Elbow, 10-32 UNF	Green Container - Pneumatics Bag	8	SMC Pneumatics, Inc.
One Touch Fitting	Straight Union Fitting, 1/8 NPT	Green Container - Pneumatics Bag	3	SMC Pneumatics, Inc.
One Touch Fitting	Straight Union Fitting, 10-32 UNF	Green Container - Pneumatics Bag	8	SMC Pneumatics, Inc.
One Touch Fitting	Union Tee	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Plug For Valves	M5 X 0.8 Pitch	Green Container - Pneumatics Bag	2	SMC Pneumatics, Inc.
Polyurethane Tubing	3/16" I.D., 5/16" O.D. x 4', Clear	Green Container - Pneumatics Bag	1	Value Plastics, Inc.
Polyurethane Tubing	4mm OD, Blue, 10m Bundle	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Pressure Switch	1/4" NPT Male Thread	Green Container - Pneumatics Bag	2	Numatics, Inc.
Pump	Diaphragm Pump, 1/8HP, 12VDC, 30psi, 1.3 CFM	Green Container - Loose	1	Gast Manufacturing Corp.
Single Solenoid Valve	12 Vdc, 2 Position, 5 Port Base	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Vacuum Injector	Light Weight, High Density, Resin Body	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Vacuum Pad	Suction Cup	Green Container - Pneumatics Bag	1	SMC Pneumatics, Inc.
Volume Chamber	Approximately 1 liter, 1/4" NPTF Ports	Green Container - Loose	1	Numatics, Inc.

Rods & Shafts

Part Name/Description	Dimensions	Location	Qty/Kit	Product Supplier
Aluminum Rod	1/2" O x 24"	Gray Container - Tube	2	Cohen Steel Supply Inc.

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Brazing Rod	1/16" Ø x 18"	Gray Container - Tube	6	McMaster-Carr Supply Company
Brazing Rod	1/8" Ø x 18"	Gray Container - Tube	2	McMaster-Carr Supply Company
Delrin (Acetal) Rod	1/4" Ø x 20"	Gray Container - Tube	1	McMaster-Carr Supply Company
Drill Rod	1/2" Ø x 18"	Gray Container - Tube	2	Cohen Steel Supply Inc.
Drill Rod	1/4" Ø x 18"	Gray Container - Tube	2	Cohen Steel Supply Inc.
Drill Rod	3/8" Ø x 18"	Gray Container - Tube	2	Cohen Steel Supply Inc.
Drill Rod	5/16" Ø x 18"	Gray Container - Tube	2	Cohen Steel Supply Inc.
Flexible Motor Shaft	13.5" Long, Fits Seat Motor	Gray Container - Loose	4	Grand Rapids Controls
LDPE Rod	1" Ø x 24"	Gray Container - Tube	1	Plastic Supply Inc.
Lead Screw	18.75" Long	Gray Container - Loose	1	Kerk Motion Products, Inc.
Threaded Rod	1/4" Ø x 24", 20 Pitch Coarse Thread, Alloy	Gray Container - Tube	1	McMaster-Carr Supply Company

Sheets & Boards

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Aluminum Plate	1/4" x 3" x 12"	Gray Container - Loose	1	Cohen Steel Supply Inc.
HDPE Block	1" x 2" x 6"	Gray Container - Loose	1	McMaster-Carr Supply Company
Polycarbonate Sheet	1/16" x 12" x 12"	Gray Container - Loose	1	Plastic Supply Inc.
Rubber Sheet, Black	3/32" x 6" x 9"	Gray Container - Loose	1	McMaster-Carr Supply Company
Rubber Sheet, Red	1/16" x 6" x 18"	Gray Container - Loose	1	McMaster-Carr Supply Company

Small Parts

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Channel For Tape Drive	30" Long	Gray Container - Loose	4	Delphi Interior and Lighting Systems
Double Magnet Cabinet Catch		Gray Container - Hardware Bag	1	Stanley Hardware
Flange Nut for Seat Positioning Unit	1/16 x 1.0 Pitch	Gray Container - Seat Positioning Unit Bag	8	Delphi Interior and Lighting Systems

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Flat Washers	1/4" I.D., 7/8" O.D.	Gray Container - Hardware Bag	4	Fastenal Company
Flexible Shaft Coupling	Black	Gray Container - Hardware Bag	2	DEKA
Folding Table Brace	9-1/2" Brass plated	Gray Container - Hardware Bag	1	Stanley Hardware
Gate Latch	Steel/Zinc Plated	Gray Container - Hardware Bag	1	Stanley Hardware
Hex Head Bolt for Seat Positioning Unit	M6 x 1.0 Pitch x 30mm	Gray Container - Seat Positioning Unit Bag	4	Delphi Interior and Lighting Systems
Hex Nuts	1/4" I.D., 20 Pitch Coarse Thread	Gray Container - Hardware Bag	8	Fastenal Company
Horiz. Act. for Seat Positioning Unit, Left Hand	Natural Color	Gray Container - Seat Positioning Unit Bag	1	Delphi Interior and Lighting Systems
Horiz. Act. for Seat Positioning Unit, Right Hand	Black and Natural Color	Gray Container - Seat Positioning Unit Bag	1	Delphi Interior and Lighting Systems
Lower Channel for Seat Positioning Unit	2.25" x 17" Channel	Gray Container - Loose	2	Delphi Interior and Lighting Systems
Magnet	1/4-20 Plastic Thread	Gray Container - Hardware Bag	4	Honeywell - Microswitch Division
Pivot	5/16" Ø	Gray Container - Hardware Bag	2	Stanley Hardware
Roller Guide	7/8" Ø x 1/4" Wheel	Gray Container - Hardware Bag	2	Stanley Hardware
Screen Door Catch	Zinc-Plated	Gray Container - Hardware Bag	1	Stanley Hardware
Seat Recliner Actuator Assembly, Left Hand	9" Tube with Actuator	Gray Container - Loose	1	Excellence Manufacturing, Inc.
Seat Recliner Actuator Assembly, Right Hand	9" Tube with Actuator	Gray Container - Loose	1	Excellence Manufacturing, Inc.
Trantorque Coupling	3/8" I.D., 3/4" O.D.	Gray Container - Hardware Bag	2	Small Parts, Inc.
Upper Channel for Seat Positioning Unit	1.3125" x 9.875" Channel with Gear Rack	Gray Container - Seat Positioning Unit Bag	2	Delphi Interior and Lighting Systems
Wheelchair Wheel	6" Ø, 5/16" I.D. Bearings, 1-1/2" Wide Flange	Gray Container - Loose	2	Skyway Recreation Products
Wheelchair Wheel	8" Ø, 5/16" I.D. Bearings, 1-1/2" Wide Flange	Gray Container - Loose	2	Skyway Recreation Products
Window Lift Bracket, Left Hand	Color Natural	Gray Container - Window Lift Mechanism Bag	1	Delphi Interior and Lighting Systems
Window Lift Bracket, Right Hand	Color Natural	Gray Container - Window Lift Mechanism Bag	1	Delphi Interior and Lighting Systems

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Window Lift Mechanism Tape	16' Length	Gray Container - Window Lift Mechanism Bag	1	Dymetrol Company, Inc.
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Springs

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Compression Spring	0.600" O.D. x 3" Long x 0.059" Wire Diameter	Gray Container - Hardware Bag	2	Associated Spring Raymond
Constant Force Spring, Medium	0.85" I.D.	Gray Container - Hardware Bag	2	Associated Spring Raymond
Constant Force Spring, Small	0.56" I.D.	Gray Container - Hardware Bag	2	Associated Spring Raymond
Latex Tubing	1/4" I.D., 3/8" O.D., 5'	Green Container - Loose	1	Gulf South Medical Supply
Small Extension Spring	0.500" O.D. x 2.875-3.000" Long x	Gray Container - Hardware Bag	2	Associated Spring Raymond
Snugger	Spring With Plastic Guide	Gray Container - Hardware Bag	2	Stanley Hardware
Spring Loaded Hinge	4" x 4", 30 in/lb Maximum	Gray Container - Hardware Bag	2	Stanley Hardware
Torsion Spring, Left Hand	180 Degrees. 500" Dia. 0.063" Wire Diameter	Gray Container - Hardware Bag	1	Associated Spring Raymond
Torsion Spring, Right Hand	180 Degrees. 500" Dia. 0.063" Wire Diameter	Gray Container - Hardware Bag	1	Associated Spring Raymond

Sprockets & Pulleys

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Pulley With Fixed Eye	1" Ø. For 5/16" Rope	Gray Container - Hardware Bag	3	Stanley Hardware

Tool

<u>Part Name/Description</u>	<u>Dimensions</u>	<u>Location</u>	<u>Qty/Kit</u>	<u>Product Supplier</u>
Crimping Tool for Spade Connectors	Orange Color	Green Container - Electronics Bag	1	Thomas & Betts Corp.

3.3 Additional Hardware List

The parts listed on this page may be purchased from Small Parts, Inc. or other sources, and are subject to the limitations mentioned in Appendix A paragraphs K1 through K19.

Control System

Heat Shrink Tubing	Any Amount, Any Ø
Speed Controller	Tekin Rebel (up to 4)

Fasteners

Hose Clamp	Up to 10 of Any Size
Rubber Band, Large	3-1/2" x 1/4" Wide, Up to 5
Rubber Band, Small	3-1/2" x 1/8" Wide, Up to 5

Other

Fiberglass Matting	1 Sheet 4' x 8' Up to 1/8"
Resin + Hardner	As Needed for Fiberglass

Rods & Shafts

Closet Rod	1 Rod 1 1/4" Ø x 6'
Copper Water Pipe	1 Length 1/2" Ø x 10'
Electrical Conduit Pipe (EMT)	1 Length 1" Ø x 10'
Electrical Conduit Pipe (EMT)	1 Length 1/2" Ø x 10'
Electrical Conduit Pipe (EMT)	1 Length 3/4" Ø x 10'
Flexible Conduit (ENT)	1 Length 1/2" Ø x 10', PVC
PVC Pipe	1 Length 1" ID x 10',
PVC Pipe	1 Length 1-1/2" ID x 10',
PVC Pipe	1 Length 1/2" ID x 10',
PVC Pipe	1 Length 3/4" ID x 10',

Rope, Belts, & Chain

Chain/Belt	Up to 12' Total, Any Combo
Nylon Braided Rope	1 Length 5/16"Ø x 20'

Sheets & Boards

1/2" Plywood OR 7/16" Chipboard	1 Sheet 4' x 4'
1/4" Plywood OR 1/2" Plywood OR 7/16"	1 Sheet 4' x 4'
Aluminum Plate	1 Piece 1/4" x 1' x 2'
Aluminum Plate	1 Plate 1/32" x 4' x 4'
Pine Board	1 Board 3/4" x 3-1/2" x 10'
Polycarbonate Sheet	1 Sheet 1/16" x 4' x 4'
Polycarbonate Sheet	1 Sheet 1/4" x 4' x 4'
Polycarbonate Sheet	1 Sheet 3/8" x 2' x 4'

Sprockets & Pulleys

Sprockets and Pulleys	Up to 4 Total, Any
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3.4 FIRST Policy on Repair and Replacement of Kit Parts

FIRST has developed the following policies on the repair and replacement of various kit parts.

If you experience a failure in any of the items mentioned below, please call FIRST to insure that all components are correctly configured. If this does not resolve the problem, you will be instructed to follow the steps outlined below. Please note the differences in procedure based on the component that is determined to be inoperative.

- If, during examination of components, a failure is determined to be due to misuse or miswiring, in general only one additional unit will be supplied, or the original unit will be repaired only once.

3.4.1 Transmitter or Receiver

- 1) Ship the unit to FIRST. Teams are responsible for this shipping cost.
- 2) Upon receipt of the unit, it will be examined to determine whether it can be repaired or must be replaced.
- 3) FIRST will ship the repaired or replacement unit to the team via 2nd day UPS shipment within 1 business day of receipt.

3.4.2 Speed Controllers

The speed controllers have a 90 day warranty. Teams have the option of contacting Tekin for repair/replacement of defective units. Tekin estimates an approximate 3 day turnaround time from receipt of units to shipment of repaired/replacement units.

FIRST is able to provide these replacement speed controllers through a special arrangement with Tekin, and has only a limited number of speed controllers available. This policy is intended to provide teams with failed units a timely method of obtaining replacements. Teams wishing to obtain spare speed controllers must go through regular retail channels.

If you do experience a failure, you should seriously consider the fact that if one speed controller failed with the current robot design, a replacement may also fail during The Competition. Carefully evaluate the abrupt startup and reversing loads on the motor, the interim and overall gear ratios, and the driving techniques used.

- 1) Ship the non-functional unit to FIRST. Teams are responsible for this shipping cost.
- 2) FIRST will ship a replacement speed controller to the team via 2nd day UPS shipment within 1 business day of receipt.

3.4.3 R Nets

- 1) Ship both R Nets to FIRST.
- 2) FIRST will ship a pair of replacement R Nets via 2nd day UPS shipment within 1 business day of receipt.

3.4.4 Servos & Servo Cables

These units will be shipped via 2nd day UPS air. As with speed controllers, FIRST has a limited number of servos available. Teams wishing to purchase spare servos may purchase equivalent models through regular retail channels.

- 1) Ship the non-functional unit to FIRST. Teams are responsible for this shipping cost.
- 2) FIRST will ship a replacement to the team via 2nd day UPS shipment within 1 business day of receipt.

3.4.5 Joysticks

Flightstick joysticks are available in most computer stores.

Replacement Flightstick joysticks can be supplied by FIRST, but limited quantities are available.

- 1) Ship the non-functional unit to FIRST. Teams are responsible for this shipping cost.
- 2) FIRST will ship a replacement to the team via 2nd day UPS shipment within 1 business day of receipt.

3.4.6 Drill Motors and Gearboxes

There are a limited number of replacement motors and gearboxes available.

If you have a burned out motor:

- 1) Ship the non-functional motor to FIRST.
- 2) FIRST will ship a replacement motor to the team via 2nd day UPS shipment within 1 business day of receipt.

If you have a non-functional gearbox:

- 1) Ship the gearbox to FIRST.
- 2) Seriously consider the fact that if a brand new gearbox failed with the current robot design, a replacement may also fail during The Competition. Carefully evaluate the shock loading of the gearbox, the interim and overall gear ratios, and the driving techniques used.
- 3) FIRST will ship a replacement gearbox to the team via 2nd day UPS shipment within 1 business day of receipt.

Note: If you modify the gearbox, and a failure occurs, FIRST will not provide a replacement.

Alternately, teams may purchase a new Bosch 12 volt cordless drill from S-B Power Tool Company. The drill parts supplied in the Kits are from Bosch model 3310K-10 12V cordless drill.

3.4.7 Seat, Window, and Van Door Motors

- 1) Ship the non-functional motor to FIRST.
- 2) FIRST will ship a replacement motor to the team via 2nd day UPS shipment within 1 business day of receipt.

As with other components, FIRST has a limited number of replacement motors available. Teams wishing to purchase spare motors may purchase equivalent models through General Motors parts distributors.

3.4.8 Batteries and Battery Chargers

- 1) Ship the non-functional battery or charger to FIRST.
- 2) FIRST will ship a replacement battery or charger to the team via 2nd day UPS shipment within 1 business day of receipt.

As with other components, FIRST has a limited number of replacement batteries and chargers available. Teams wishing to purchase these Power Sonic items may purchase equivalent models through Associated Power Products.

3.4.9 Contact Information for Suppliers

Teams wishing to obtain additional parts direct from FIRST suppliers consult contact information in Appendix C.