

Product Catalogs

Mechanical

McMaster 106

Grainger 395

Brodhead Garrett 2003

IGUS energy chain Systems

Iglide plastic bearings

Frame work - aluminum framing components

Small Parts 22

Misumi 2004

Martin sprocket & gear 2001

Bosch 3.0

IKO bearings

MSC 2003

Electronics

2006 Allied Electronics

Mouser 623

Newark in one 123

Jameco

Acroname



For Inspiration and Recognition of Science and Technology



Hauppauge Robotic Eagles

Team358.org

Handbook Appendices

Updated Summer-2006

Forward

This is a collection of some common topics that were just making the regular handbooks a little longer than we wanted. They are collected here instead where people could check them out if they were interested, but where they wouldn't get in the way of more critical messages.

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- 2002 CNN
- 2002 National Geographic
- Dean Kamen on 60 Minutes
- 2003 Championship Wrap-up
- 2003 Discovery Channel
- 2003 Headline News
- 2004 FIRST Kickoff
- 2004 Championship Wrap-up
- 2004 CNN
- 2005 FIRST Promo
- 2005 Championship Wrap-up
- 2006 FIRST Promo (BE FIRST)
- 2006 News 12
- 2006 PBS

Videos

Some of these are available on our website and others in DVD or VHS formats in the robotics room.

DVDs

Team 2006
 Team 2005
 Team 2004
 Team 2003
 Team 2002
 2003 team highlights (loop DVD)
 2005 FIRST Promo and News videos

VHS

2004 Philly Regional
 2003 LI regional
 02, 03, 04 clips + game animation 13 minutes (loop tape)
 02, 03, 04 clips 10 minutes (loop tape)
 2002 CNN on FIRST
 2002 FIRST Promo and News videos

CDs

2004 animation entries
 2002 animation entries
 2001 game manual

Digital Files

1993 ABC News
 2001 FIRST Promo
 2001 FIRST Kickoff (After Ten Years)
 2002 FIRST Corp.
 2002 FIRST Chairman's Concept
 2002 Will Smith FIRST Promo
 2002 ABC News

Competition Events

What to Expect at Events

- ❖ Our Team uniform is a team shirt, that we provide, worn with khaki pants or shorts. The only alternative is to wear the eagle mascot outfit! Further, safety conscious attire is a necessity. If you are working around the robot then no loose jewelry, or open footwear, and of course safety glasses/goggles become an integral part of the uniform. Goggles are required anywhere in the Pits and on the field. Our Safety Captain has spares for parents wishing to visit the pit.
- ❖ We cheer for our team during the qualifying rounds, but cheer for our alliance during the Finals. Cheer for small teams who don't have much support, cheer for teams you admire and those who just do a good job. Cheering encourages all those students and gives them pride in the work they've done.
- ❖ Teams compete in random alliance pairings, so your opponent in one match may be your partner in the next. The objective is to play the game hard, but without malice or rancor. We make friends with all teams so they might pick us and we might pick the best of them to partner with for finals.
- ❖ Avoid damaging other robots during a game. If you do break another team's robot then visit their pit after the game to apologize and offer assistance in fixing it.
- ❖ Official events take 3 days:
 - Thursday – Setup and Practice. We spend the day ironing out mechanical issues and running practice matches. Only the Pit Crew and drive team are essential. The pits are open until 8pm and we stay until the last minute working on our robot and helping with others. This will require excused absences from classes. The robot must pass

inspection by the close of the day in order to compete. Early crate opening for three team members (one adult, 2 students) and registration.

- Friday – Qualifying matches begin after opening ceremonies and run all day. Technical awards are presented at closing. Sometimes there is a team social dinner after awards. Pits close earlier at 6. This will require excused absences from classes. A team scouting meeting is held late in the evening. Sometimes FIRST distributes mentor veteran pins.
- Saturday – Opening ceremonies are followed by Qualifying matches until noon. Our scouting team meets to finalize partner recommendations. The top 8 teams pick alliance partners to play with them in the finals during the afternoon, followed by closing ceremonies and award presentations. Pick up participation medals if the team did not win medals (chairman’s, champion, finalist).
- ❖ We never play alone, but in alliances with other teams. During the qualifying matches alliances are random pairings with different teams each match and final rankings are largely due to how well the robots and drive teams work together and cooperate.
- ❖ Off-season events hosted by teams are general one day with qualifying matches in the morning, alliance picking at noon, and finals in the afternoon.
- ❖ No one in the field and surrounding area except for badged drive team. Special pit crew are sometimes also allowed during finals.
- ❖ No communication (cell phones, hand waving, Morse code) with the drive team while our match is in progress (Disqualification will result). They operate alone. What you see happening on the field will sometimes make no sense to the spectators, but there is always a reason – the robot may be malfunctioning, the referees may be giving

Team Library

Reference Books

Robot Builders Bonanza - 99 Robot Projects
Gordon McComb

Robot DNA series
Building Robot Drive Trains
Dennis Clarke & Michael Owings

The Personal Robot Navigator
Merl Miller, Nelson Winkless, Joe Bosworth

Robot Mechanisms and Mechanical Devices
Paul Sandin

Robot DNA series
Programming Robot Controllers
Myke Predko

The C Programming Language(1st edition)
Kernighan and Ritche

The C Programming Language(ANSI version)
Kernighan and Ritche

The C Answer Book
Tondo and Gimpel

FIRST Hauppauge Robotic Eagles Team 358

aluminum brackets	McMaster			\$20.00
Pneumatics				
All KOP				\$0.00
Electrical				
Grayhill 63K128 encoders	Digikey	2	\$52.	\$104.00
Potentiometer	Digikey	2	\$1.19	\$2.38
ADX300 gyro	Analog Devices	1	\$50.	\$50.00
Breaker Panel	Innovation First	1	\$84.95	\$84.95
Limit switch	Digikey	2	\$5.00	\$10.00
Project box	Radio Shack	2	\$2.69	\$5.38
BCD switch	Digikey	1	\$16.99	\$16.99
Rocker switch	Radio Shack	1	\$3.49	\$3.49
Momentary switches	Radio Shack	3	\$1.65	\$4.95
SubD connector	Radio Shack	2	\$1.59	\$3.18
Wire #10, #12, #18, #22				\$45.00
Miscellaneous				
Flag pvc	Home Depot	1		\$2.00
Bumper fabric	Donated			\$15.00
Pool Noodles	Donated	6	3.5	\$21.00
Luan	Home Depot	60	0	\$2.75

Total \$2,755.28

FIRST Hauppauge Robotic Eagles Team 358

them cautions or overriding instructions, or the alliance strategy may call for unusual actions.

- ❖ FIRST awards fall into three groups:
 - Organization: Chairman’s Award, Engineering Inspiration
 - Competition: Champion, Finalist
 - Technical & Individual Awards: Woodie Flowers, Quality, Sportsmanship

Student Jobs for Competition

Here we discuss the particular tasks that have to get done by students for the FIRST Robotics Competition, both before and during events.

- ❖ Analyze and track game rules and interpretations/clarifications
 - FIRST rules and updates have to be known by heart.
 - FIRST Q&A system – game rules are clarified and explained here. Our questions may only be submitted by our lead advisor, but we can see questions from all teams.
 - chiefdelphi.com – team community forums. Please join and participate.
- ❖ Online awards

Generally submitted by officers or award group leaders. Awards and criteria are described in the FIRST rules released with the game each year.

 - TIMS Judges info essay
 - Team history
 - Team's FIRST impact
 - Team strengths
 - Robot and game strategy
 - Funding sources
 - Team goals
 - Community description
 - Most significant challenge overcome
 - Most competitive for Which Awards
 - Public Awareness
 - Chairman's Award - due end of February
 - Woodie Flowers Award - due end of February
 - Autodesk Visualization - due end of February
 - Animation – Safety animation due in December, regular animation due end of February.

Gears	SDP			\$42.74
Pulleys	SDP	4	\$8.14	\$32.56
Timing belt	SDP	2	\$3.56	\$7.12
Drum grip tape	Sports Authority	1	\$5.99	\$5.99
Turret				
#25 Chain	Beardslee	2	\$2.40	\$4.80
Pan Sprocket	Beardslee	1	\$5.20	\$5.20
Track Roller	McMaster	12	17.31	\$207.72
12"x12"x3/4" Delrin Sheet, Black	McMaster	1	57.67	\$57.67
Alum 12"x24"x.190"	McMaster	1	47.04	\$47.04
1.5 SQ. Tube x 36"	McMaster	1	22.18	\$22.18
3/4" Dia Alum Round	McMaster	1	13	\$13.00
12" x 12" x .19	McMaster	2	31.29	\$62.58
1/2" OD x .25ID Alum	McMaster	1	26.56	\$26.56
1/2" Hex Alum	McMaster	1	11.76	\$11.76
20 tooth spur gear, brass, 1/4" ID	Stock Drive Products	2	11.18	\$22.36
40 tooth spur gear, brass, 1/4" ID	Stock Drive Products	2	17.79	\$35.58
3/4" ID x 1" OD flange bushing	Stock Drive Products	4	5	\$20.00
1/4" ID x 1/2"OD flange bearing	Stock Drive Products	10	6.2	\$62.00
1/4" Thrust Busing	Stock Drive Products	10	0.82	\$8.20
Delrin Spur Gear, 24Pitch, 20 Teeth	Stock Drive Products	2	1.94	\$3.88
Delrin Spur Gear, 24Pitch, 40 Teeth	Stock Drive Products	2	1.94	\$3.88
Conveyor				
		12		
Belting	McMaster	12	\$0.06	\$68.68
Shaft	McMaster	2	\$16.06	\$32.12
Rollers	McMaster	27	\$7.04	\$190.08
Sprockets	McMaster	4	\$6.17	\$24.68
#25 Chain	Beardslee	3	\$2.40	\$7.20
Plastic (guide)	Home Depot			\$10.00

Inspection Bill-of-Materials

This is required to pass inspection at each FIRST event. FIRST uses it to track how expensive it's getting to build the robots. Each year's game rules specify the individual item \$ limit (e.g., \$200) and the total cost limit (usually \$3,500).

Team 358 Materiel Cost Accounting

Material	Supplier	Qty in in2 ea	Cost/ unit	Total
Frame & ball tracks				
1" x 1" x .062 wall alum. tube	McMaster	22	\$1.52	\$33.44
Aluminum sheet	McMaster	1	\$7.50	\$7.50
Miscellaneous Parts	Sears			\$15.00
3/4" Aluminum 90 deg. angle	McMaster	15	\$1.53	\$22.95
1/4" dia. Aluminum rod	McMaster	15	\$0.92	\$13.80
Luan	Home Depot	10	\$0.72	\$7.20
Drive train				
Pillow block	McMaster	8	\$5.50	\$44.00
1/2" shaft, steel	McMaster	4	\$7.60	\$30.40
shaft sprockets	Andy-Mark	2	\$20.00	\$40.00
2-speed Transmissions	Andy-Mark	2	\$330.00	\$660.00
#35 sprockets 18 tooth	AndyMark	4	\$14.00	\$56.00
#35 chain & master link		8	\$2.68	\$23.00
Traction 6" wheel/hub	AndyMark	2	\$89.00	\$178.00
Wheelchair 6" wheels	Skyway	2	\$5.80	\$11.60
Encoder gears	Small Parts	4	\$2.60	\$10.40
Miscellaneous Parts	McMaster			\$50.00
Shooter				
Bosch 20x20 Ext		98	\$0.20	\$19.60
Bearings	SDP	11	\$6.20	\$68.20
3/16 Al plate	McMaster	95	\$0.20	\$19.00
3/16 Al 90 degree angle	McMaster	22	\$0.50	\$11.00
1/4 dia steel shaft	SDP	29	\$0.26	\$7.54

❖ Events

- Scouting – The Scout Master will organize every student attending competitions into scouting teams with specific assignments. When your assigned turn for duty comes, report to the Scout Master. Primary tasks are to watch and fill out scouting reports on all competing robots in all matches, enter the scouting reports into our computer-based scouting analysis system, visiting pits for robot photos and visual confirmation of objective robot design criteria (# and type of motors used, drive train type, manipulator solution, wheel/tread type, etc.). Experienced scouters/mentors will judge robustness and suitability of the overall robot designs, as well as, compatibility with our strategy and drive team.
- Robot inspection (weight, size, rules, safety) on Thursday with re-inspection at noon on Saturday for Finals (Pit Crew and Drive Team).
- Judge interviews in the pits – students knowledgeable about our Team, our outreach, our robot technology represent our team and talk to roaming judges making random visits to the pits. These are for technical awards presented Friday and Saturday. An important component of getting recognized for awards is effective and energetic communication. Show your excitement!
- Pit Chief – manages all tools, parts, and materials. Rotates and charges the batteries and is responsible for choosing the batteries for each match. In the pit at all times during working hours to locate needed tools, suggest materials, and to make sure tools/parts/materials get properly stored after use so they can easily be found.
- Pit Crew – Pit technical set-up and organization, redesigns/improvements, repairs, maintenance (check bolt tightness between matches),

programming fine tuning and autonomous strategy, etc.

- Safety Captain – insures a safe working environment in the pits and on the field. Reminds those who forget personal safety goggles, has spares for visitors. Handles special FIRST safety promotions, such as the safety tokens last year.
- Pit display team – designs, prepares and sets up our team pit display of banners, art work, etc.
- Chairman’s interviews
 - 3 students – at least one underclass member dedicated to doing the award next year to provide continuity.
- Animation interviews – the judges want to understand the difficulties you faced, what the challenging parts were.
- Drive team - requires special badges to be on the field. The field is off-limits to all others. Responsible for strategy and tactics working with the field competition mentors (Mr. Tiu & Mr. Schuler). Autonomous strategy is the responsibility of the programmers and programming mentor (Mr. McLeod), but will complement the chosen drive team strategy.
- Socialize with other teams – organize a Frisbee game.
- ❖ Off-season events
 - Both more laid back and can be rougher play since no one is saving their robot.
 - Drivers are rotated through matches to get freshmen exposure and a chance as a member of the drive team. Usually one experienced paired with one inexperienced driver.
 - We help other teams whenever and wherever possible. If someone comes looking for parts or expertise please drop unimportant tasks and help

- c. Called FedEx to request pickup on Monday at Atlanta drayage address
- d. Filled out paperwork at UTC drayage desk
- 6) Tool pallet
 - a. Shipped by JP Express from Hauppauge to pickup location in Atlanta
 - b. Return shipping has to be via Yellow or FedEx from the Georgia Convention Center (cost \$1100).
 - i. Filled out paperwork at Atlanta drayage desk
 - ii. Provided a credit card
 - iii. Put Hauppauge shipping address on all four sides of pallet
 - iv. Put “Battery-inside” signs on all four sides of pallet

- b. Used special FIRST FedEx website to print one shipping label
 - i. Use for home-to-Regional and Regional-to-Atlanta (not for Atlanta-to-home)
 - ii. The website is a little odd to navigate. Pickup location can be straightened out by calling FedEx (see “f” below).
 - c. FedEx shipping label on front
 - d. Labeled all four sides with Festo drayage address
 - e. Filled out paperwork at UTC drayage desk
 - f. Called FedEx special FIRST shipping desk to request pickup on Monday at UTC drayage address. Provide them:
 - i. Drayage address
 - ii. Estimated weight of crate ~400 lbs is good enough
 - iii. Crate size - 48" x 48" x 70" tall
 - g. Added bumpers to crate
- 4) Shipped from SBPLI to Atlanta
- a. Registered on FedEx website and printed one shipping label
 - b. FedEx shipping label on front
 - c. Labeled all four sides with Atlanta drayage address
 - d. Did not call FedEx for pickup (it only confused them)
 - e. Let drayage folks know the crate was ready to pickup
 - f. Added one battery to crate weight came up to 390 lbs
 - g. Added “battery-inside” labels to all four sides
- 5) Ship from Atlanta to Hauppauge
- a. Used FedEx air bill supplied in Atlanta registration packet
 - b. Labeled all four sides with Hauppauge H.S. address (500 Lincoln)

them. They need to get their robot working so we can play with them. See the Pit Chief, Pit Crew member, an officer, or a mentor if you need assistance.

Travel

- ❖ Peer-to-peer mentoring visits to other teams.
- ❖ Long Island Regional at the Hofstra University Arena
 - We meet in the Teacher's parking lot at 7:00 to board the school bus. Completed Field Trip Permission Slips must be in-hand to board the bus. Without it you will be remaining at the school. Returns are at different times the three days of competition. Families can meet the buses at the arena, or come and go later in the day.
- ❖ High School Field Trip Permission Slips
 - Signed by all teachers whose class will be missed due to travel on school days. Make arrangements to make up missed classwork.
 - Signed by parent or guardian.
- ❖ FIRST release
 - They don't want to be held at fault if you run over yourself with your own robot
 - Right to use photos or videos you may appear in
- ❖ Transportation Release form
 - If you wish to pickup your child from an event this release from school transportation is required. Mostly so the count comes out right and we aren't searching for students who decided to go home without telling us.
- ❖ Away Trips
 - If trip attendance must be limited, then priority is given to essential personnel, e.g., drive team, followed by work hours logged.
 - Luggage – tag all pieces, early drop-off at school office, luggage will not be accessible after drop-off until we reach the hotel, so do NOT put your photo ID, books or CD's to read or listen to on the bus or plane, or anything else you will need before we reach our destination.

Shipping Details for 2006

These are specific details of the chain of events for shipping the robot, and in the case of Atlanta, our tools to and from the official FIRST events we attended. Off-season we just threw it in a mini-van.

- 1) Preliminary
 - a. Team Shipping Contact received an email from FedEx with a special invitation and link to register for the special FedEx PassKey shipping online site.
- 2) Shipped via JP Express from Hauppauge H.S. to UTC
 - a. Made arrangements ahead of time with JP Express
 - b. Pickup at H.S. was not a fixed time
 - c. Had students lift crate onto the higher deck of the 18-wheeler from the loading dock.
 - d. Crate had FIRST labels for UTC drayage on all four sides
 - e. No batteries, just robot, no bumpers
 - f. Obtain a Bill of Lading from the carrier (evidence of shipment)
 - i. Showing date and time the crate left your possession.
 - ii. Write your Team number on the Bill
 - iii. Make a copy for your records
 - iv. Send it to FIRST immediately via USPS with a simple signed confirmation of receipt.

TEAM SUPPORT
FIRST ROBOTICS
200 BEDFORD STREET
MANCHESTER, NH 03101
- 3) Shipped from UTC to SBPLI via FedEx
 - a. Side note: if not using FedEx then contract with Midwest Conference services, Yellow Transportation, or whoever has the Regional site contract.

7. Do not walk beyond the barrier near the playing field during competitions.
8. A curfew may be put in place by the advisors.
9. Members may not leave the hotel without an advisor.
10. Respect all FIRST volunteers, employees and officials.

- Photo ID – required for airline travel
- Hotel
 - Rooms – students room four to a room
 - Noise – Please be considerate of other hotel or restaurant guests. Remain as quiet as possible in the hallways and rooms. The hotel is not a playground (other than any play room or the pool) and there are other guests around us.
 - Curfew – A time, generally 10:30, will be set for the students to be back in their own rooms and a room check is done by the advisors/chaperones. No student may leave their room after the room check. Not even for the ice machine. In case of emergency, immediately contact the advisors or chaperones.
 - Traveling as a Team means you must be up, showered and ready on time to leave the school, hotel, competition as a group. You will be up early! Please don't keep us all waiting. Take everything you need when you leave the hotel, you won't return except as a group in the evening.
 - Dating issues – Keep contact modest and romance low-key while traveling with the team.
- Off-Island trips can be canceled under certain circumstances. For example, in 2003 the Federal terrorist alert went high and District policy caused all off-island field trips, including our Championship trip, to be cancel.
- ❖ General travel notes
 - The team travels together since it is a school sponsored field trip.

- The Advisors are responsible at all times for students. Students may not leave the team at any time without approval from an Advisor (not a mentor), even with parents or guardians, especially not to return to the hotel. If a parent or guardian wishes to take a student home with them from an event a special student release form must be submitted to the advisors. The Advisors must know where students are at all times.
- The advisors should be made aware of any special physical or medical issues, well in advance of any travel. Medications will be administered by the trip advisors or chaperones only with doctor/parent written instructions.
- Advisor and chaperone contact phone numbers will be distributed. The advisors must also have all student cell phone numbers.
- The Advisors are there to help you work out any problems that may arise.
- Serious disregard of the rules or conduct that endangers others will result in dismissal from the team and an immediate trip home at your expense.

Rules for Competitions

1. All members must wear a Team 358 t-shirt and khaki pants/shorts.
 - a. FESTO hats are to be worn if we are given them.
2. Be respectful of other teams.
 - a. Do not make fun of other teams and/or robots.
 - b. Do not say negative things online.
 - i. Chief Delphi Forums
 - ii. Team 358 Forums
 - c. Remember you represent not only yourself, but our team, school and sponsors.
3. Help out other teams whenever possible.
 - a. If you cannot help yourself, find someone on our team who can.
4. Members are expected to watch matches.
 - a. All matches we are in are to be watched.
 - i. Cheer for our team.
 - ii. Cheer for other teams.
 - b. Do not boo under any circumstances.
 - c. All members will help scout.
 - i. A rotating schedule will be made
5. You may not leave a competition without a release form signed by a parent/guardian.
 - a. School website:
<http://www.hauppauge.k12.ny.us/new%20web/web2/High%20School/hs.htm>
 - b. Team 358 website:
<http://www.team358.org/rules>
 - c. Before you leave you must tell an advisor (not an adult) that you are leaving.
 - d. You may not go back to a hotel before the group goes back.
6. Safety glasses or goggles are to be worn at all times while in the pit.
 - a. If the robot needs work done and you are not helping then clear the pit area.

- a. Never reach into the robot when it is on.
- b. Always “Kill” the robot when not in use.
- c. Never run the robot without the Kill Switch attached.

Team Rules

Robotics Club Rules & Expectations

In order to be in the robotics club you must read and abide by the following rules, or rules created throughout the year by the advisors, as well as the standard District Code of Conduct. The newest copy of these rules as well as the standard District rules are available on our website at <http://www.team358.org/rules>. Rules not explicitly stated within this document may be put into effect by either advisors or officers if necessary.

General Rules

1. There must always be an advisor in the room you are in at all times.
2. You are not allowed to be in the halls.
 - a. If you need to leave the room you *must* sign out and sign back in.
3. Computers will be used for robotics use only.
 - a. You may not play games.
 - b. Do not download anything or install programs on the computers.
4. There will be no horseplay or inappropriate behavior while at robotics.
 - a. If you are not sure if you should be doing it – don’t do it!
5. Do not order food.
 - a. If food is to be ordered (if that is what we are having for dinner/lunch) you must have an advisors permission.
6. If you do not have work to do then ask an advisor or a senior member for a job.
 - a. If you cannot find a job to do, watch others and learn from what they are doing.
 - b. You may not just “hang out” at robotics. You must be doing work.
 - c. If you are not content with that, go home.

7. Put away tools and clean your area after you are done working.
8. Do not touch parts on the “New Parts” shelf unless specifically instructed to.
9. Members are expected to respect one another.
 - a. If you have a problem with another team member talk to an advisor or officer.
10. You must be dropped off and picked up from robotics from the back of the school.
 - a. You may not be dropped off in the North parking lot and walk through the school.
11. Hours will be kept starting from Kickoff.
 - a. Members must sign in and out each day.
 - i. Members must sign out and back in if they are leaving and coming back.
 - ii. Members receive zero hours if they do not sign out.
 - b. Members can lose hours for misbehavior.
 - c. Hours will be used if there is a limited number of spots available for a trip.
 - d. Hours will be rounded to every five minutes.
 - e. Total hours will be kept by an officer.
 - i. Unproductive hours will not be counted.
 - ii. Total hours will be released at the discretion of the advisors/officers.
12. Robotics club members must know the rules to the year's game.
 - a. Club members can be tested to see how much of the game rules they know.
 - b. Drivers and Human Players will be tested.
13. All applicable sections of the “Hauppauge School District Code of Conduct” must be followed. Available at:
 - a. The School website:
<http://www.hauppauge.k12.ny.us/new%20web/web2/High%20School/hs.htm>
 - b. The Team 358 website: <http://www.team358.org/rules>

Safety Rules

1. Safety glasses or goggles must be worn at all times while working.
 - a. Sun glasses do not count.
 - b. Prescription glasses do not count.
2. Power Tools:
 - a. May not be used unless you have permission.
 - b. May not be used unless you have been instructed on how to use them.
 - c. May not be used unless a advisor or mentor is in the room.
 - d. Make sure the tool is running the correct way.
 - i. The lathes, drill press, grinder and band saw do not all run on the same polarity outlet.
3. Do not run in the shop.
4. Do not tighten vices all the way.
 - a. Tighten them almost all the way, then loosen so they hang down.
5. Drill press:
 - a. Clamp the part down you are drilling.
 - b. If necessary surround the part with wood, especially underneath, to avoid damage.
6. Lathe:
 - a. Never leave the chuck key in the chuck.
 - b. Check that the chuck clears all parts of the lathe before turning it on.
7. Welding:
 - a. Do not stare at the welder while someone is welding.
 - b. Use caution when handling pieces that were recently welded.
 - i. Check for temperature.
8. Band Saw
 - a. Allow the blade to cut the metal, do not force it through.
 - b. Do not cut steel on the band saw.
 - c. When cutting small pieces use a guide/jig.
9. Robot Operation