



How to Design and Construct a 15 lb Battling Robot ?

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I. Assemble a Team

- Assign/Select Positions
(based on skill and/or desire)

Team Responsibilities:

Designers (How will you decide on type?)

Builders (assign parts for each? Group work?
Some do all? Who decides?)

Record Keeping / Accounting / Set time schedule

Know the Rules

How Do You Win A Bout

Know the Scoring System.

6.2.3 Judging Criteria Definitions

The following describe the criteria that can be used by judges to determine a match winner.

1. *Aggression*
2. *Control*
3. *Damage*
4. *Strategy*

Aggression

- The frequency, severity, boldness and effectiveness of attacks deliberately initiated by the robot against any opponent. If a robot appears to have accidentally attacked an opponent, that act will not be considered aggression.

Control

- The ability of the robot's operators to move the robot in a specific and deliberate manner. Control means a robot is able to attack an opponent at its weakest point, use its weapons in the most effective way, and avoid being struck by the opponent or its weapons.

Damage

- Through deliberate action, a robot either directly or indirectly using the arena hazards, reduces the functionality, effectiveness or defensibility of an opponent. Damage is not considered relevant if a robot inadvertently harms itself. Also, if a pressure vessel or a rapidly spinning device on a robot fragments, any damage to the opponents robot will not be considered “deliberate”.

Strategy

- The robot exhibits a combat plan that exploits the robot's strengths against the weaknesses of its opponent. Strategy is also defined as a robot exhibiting a deliberate defense plan that guards its weaknesses against the strengths of the opponent. Strategy can also involve using the Arena hazards to gain a relative advantage.

Prepare for a Bout lasting.....

6.4.2 BotBout Time Limits

Unless a Bout is terminated early, the Match will end after a maximum of **Three Minutes** of actual fighting.

How to Select a BattleBot Type?

- Research types and make a few top choices.
(you have to start somewhere, just go with something that is interesting but not too complicated for first time builders)

- Add video [HERE](#)

Documentation

Keep: records / notes / receipts from the start.

Follow the checklist from the BotsIQ manual.

*Review the checklist.

Set and Keep a Time Schedule

You Must Start ASAP or you may have a hard time getting done early

Decide Team Positions.

Select Bot Type.

Design / Drawing.

Order Parts and Components.

Schedule with your Business partner.

(you will have to work with their schedule)

Building the Bot.

*** Plan on getting done a few weeks early in order to practice controlling the Robot during competition.**

Sketches/Drawings to start

- Once you have decided on what type to build, you will begin a process of **Robotic Design, Research and Purchase of Components, and Making and/or have parts made.**
 - *** keep all receipts and documents with all Bot related purchases*****
- You will need to know the **SIZE and WEIGHT** of the following components to begin your design drawings. (you can get some of the information from web sites, but you may have to purchase some things to know the exact sizes and/or weight.)
 - **Drive Motors**
 - **Weapon Motors**
 - **Wheels**
 - **Speed Controllers**
 - **Batteries**
 - **Power Switch**
 - **Weapon Parts**
 - **Anything else you want to use.**

Consider Damage Repair Time.

- There is a **20 minute** time allowance between bouts. (you are disqualified if you cannot get operational in your allotted time)
- Can you disassemble and reassemble accurately and quickly?
- Is there room for tools to move?
- *Can hands and fingers fit safely?*
- Will Air flow to dissipate heat?

Build a Prototype

Work out all of your problems with cheap and easy to work materials. This should help eliminate problems later during construction and assembly.

- 3/16" Foam Board Sheets
- Masking Tape
- Utility type Knife
- Ruler
- Graph Paper

Primary Considerations

1. Weight Limit (15 pounds maximum)
you will need access to an accurate scale

The Tournament Rules and Weight limit makes it difficult to make a **destructive** battling Robot.

A. Movement considerations

(objective = Must be able to maneuver with control.)

Drive Motors (weight)

Attached how? Directly bolted or Brackets(weight)

Direct Drive vs Belt Drive or Chain Drive (weight)

Wheels (weight)

Diameter (do you want to drive if flipped over?)

Grip (you need good traction)

Durable enough for competition

B. Protection considerations

(objective = protect components and structural integrity)

Shell or Shields (weight)

How attached? Brackets or welded?

Strong enough for Battles?

Can you replace or repair quickly?

Is there space for components to be safe from impacts?

Can the exterior help with scoring / help with weapon(s)?

C. Weapon System considerations (weight) (objective= damage or disable opponent)

Ram or wedge?

Spinning? (Blade, Barrel, helicopter, entire shell, etc.)

Flipper?

Hammer?

Weapon Motors (weight)

Direct Drive, belt drive, or chain drive(weight)

Air Tanks(weight)

rule: all compressed air tanks must have safety test certification documentation. See rule for specifics.

2.0 General Requirements

- 2.1 **Mini Class Weight Limits (Non-walking)**
Minimum Wt.: 10.0 pounds
Maximum Wt.: 15.0 pounds
- 2.2.2 **Size and Mobility Requirements**
Speed/Mobility – Minimum Speed 6 in/sec
- 2.3.1 **Construction**
Construction Materials – Expanding Liquid Foam cannot be used if it hides any wiring or parts.

2.0 General Requirements Cont.

- 2.4.1 **Power System Types**

The Types of Power Systems that can be used

a. Electric Motors see “5.5 electric motors”

b. Low-Pressure Pneumatics see “ 6.0 Pneumatic Systems”

c. Springs see “7.5 Large Spring Weapons”

* No Hydraulically-activated systems or Fuel Powered engines

- 2.5 **Safety Covers and Restraints**

All Sharp points/corners must be covered.

All movable parts must be immobilized.

All pinch points/chains etc must be restrained.

- 2.8 **External Design and Decoration**

2.8.2 **Robot Name** – Must be ¼” high minimum and able to read with all Safety Covers and Restraints installed.

4.0 Activation and Deactivation

- **4.2 Activation Requirements**

- 4.2.1 Activation Time**

- Activation Cannot take more than 30 seconds.

- 4.2.2 Deactivation Time**

- Deactivation cannot take more than 45 seconds.

- 4.2.4 Activation/Deactivation Tools**

- Maximum of Two tools needed to Activate/Deactivate.

- 4.3.2 Spin Down Time**

- Spinning Parts must come to a complete Stop within 30 Sec. after power is shut off.

5.0 Electrical Power

- 5.2 **Voltage Limits**

24 Volts DC Maximum Nominal

- may measure up to 28 Volts

- 5.3 **Electrical Power Sources**

- 5.3.1 **Allowed Battery Types**

- a. Sealed Lead-Acid (must be leak proof)
 - b. Nickel-Cadmium (Ni-Cad)
 - c. Nickel-Metal Hydride (Ni-MH)
 - d. Lithium-Ion (Li-Ion)

5.0 Electrical Power Cont.

- 5.4.2 **Primary Power Master Switch**
 - a. Switch must Directly Shut off Power from the primary Battery.
 - b. Be Completely Mechanical.
 - c. Be a Two Position Switch that is stable in both the On and OFF positions.
- 5.5 **Electric Motors**
 - 5.5.1 Electric Motor Types

Any DC or AC motor is allowed.

6.0 Pneumatic Systems

- 6.2 **Pneumatic System Gas Storage**

 - 6.2.3 **Pneumatic Pressure and Volume**

 - Maximum Pressure at any time is **150 PSI**.

 - Maximum Volume is **8 cubic feet**.

 - 6.2.4 **Tank Standards**

 - Pressure Relief Valve set to no more than 130% of Tank Rating.

- 6.3 **Pneumatic Components**

 - 6.3.2 Component ratings

 - Each pneumatic component must be clearly marked or have certified documentation of the rating or equivalent testing documentation.

- 6.5 **Pressure Tank Filling**

 - Should fill with a hand pump, or an external or internal pump that has a maximum output no greater than 150 PSI.

7.0 Weapons

- 7.1

Weapon Design

- 7.1.2 **Damage to Arena**

- Do Not Damage the Arena with your Weapon(s).

- 7.2

Weapon Types Not Allowed

- 7.2.1 Electromagnetic Weapons.

- 7.2.2 Arena Fouling Weapons.

- Cannot release Water, Glues, Powders, Sand, Grease, oil, etc.

- 7.2.4 Explosive/Flammable Weapons.

- 7.3

Restricted Weapon Types

- 7.3.1 Projectile Weapons may be used if....

- a. Restrained by a tether.

- b. Tether reaches less than 4 feet.

7.0 Weapons Cont.

- 7.4 **Flywheel Weapons**

- 7.4.1 **Flywheel Power**

- Cannot start spinning prior to start of Bout.

- 7.4.2 **Flywheel Safety and Spin-down**

- Must stop spinning within 30 seconds of shut-down.

- 7.5 **Large Spring Weapons**

- 7.5.1 **Definition**

- Any Spring that requires 20 lbs to Extend or Compress.

- 7.5.3 **Remote Arming Mechanism**

- All Arming is required to be done by remote control.

How are your parts getting made?

Business Partner

Purchased Parts

Make your own parts

Business Partner

Utilizing your business partner.

1. Make contact early and often.
2. Inquire about the business (show an interest)
3. Invite them to visit your school facility and meet the students Bot team.
4. Ask about a tour of their facility for your group.
5. Get organized and determine needs early to allow necessary time for partner not to be rushed.

Purchased Parts

Some Popular Robotic Web Sites

- The Robot Marketplace

<http://www.robotmarketplace.com/store.htm>
|

- Bane Bots

<http://banebots.com/>

- BattleBot Parts information

<http://battlebotparts.com/>

http://www.loganbot.com/bot_tips.html

Make your own parts

Do you have access to a material processing lab?

- Can you Cut Materials?
- Can you Drill Materials?
- Can you Bend and/or Shape Materials?

Are you certified to have students use tools and/or machines under your supervision?

Safety and Liability must be considered.

- CTC and Technology Education Teachers are covered.
- What about Physics, Math, or others? Know your school policy.

Driving and Control

Driving competency and control in general are key components to scoring in a Battle.

- * Make a simple drive only Bot for practicing driving if you will not complete your Bot early enough to be a skillful Driver.

Drive Methods

Tank vs Joystick Control

Joystick – Works well with 2 drive motors and 1 weapon motor.

- You will use the Right side to control the movement and the Left side for the weapon.
- This keeps the two systems controlled from separate sides.
- Eliminates confusion in the heat of the Battles.

Tank – Mostly for Wedge type Bots.

- When only using 2 drive motors.

Commonly Used Material Types

- Aluminum
 - Good weight to strength ratio
 - Easy material to cut/bend/drill
- Titanium
 - Very strong / Great weight to strength ratio
 - tough material to cut/bend/drill
- Carbon Fiber Laminates
- Lexan

When you arrive at the Competition

- This is what to expect.

Pit and Testing Area Rules

3.2.1 Eye/Face Protection

All Team members must wear **Safety Glasses** in the Pits at all times.

3.2.2 Runaway Protection

All motion systems must be suspended in the air a minimum clearance of $\frac{1}{4}$ " , such that it will not move even if the motion system is activated.

3.2.4 Protective Covers/Restraints

All sharp objects and edges must have Safety Covers installed, all pinch hazards blocked, and any Safety restraints installed.

Pit and Testing Area Rules

3.2.6 No Robot Activation

Under NO circumstances can a robot be activated in the pit.

3.2.9 Robot Pressure Tanks

Pressurized tanks are allowed in the pits if...

- a. Is completely undamaged. See 5.7.5
- b. Has an attached pressure relief valve or burst disk.
- c. Is either in the Bot or in a container.

3.2.10 Charging Supply tanks

Supply tanks are PROHIBITED in the pit area.

Safety/Tech Inspection

Internal Inspection

- 1. Set up your Pit Table area**
Set robot so that the wheels are at least $\frac{1}{4}$ " off the table.
- 2. Pre-Weigh your Robot**
Check Weight before Inspection.
- 3. Open Bot for Internal Inspection**
Remove any panels that may hide any Bot parts/ Everything must be checked.
- 4. Depressurize any Pneumatics**
- 5. Notify Safety Tech that your Bot is ready.**
Do Not take Bot to inspector, they will come to your table.

Functional Test

Prepare the Robot to Display all Necessary Functions

- 1. Charge all Batteries**
- 2. Pressurize Nuematics**
- 3. Add any Fluids**
- 4. Re-Assemble the Robot**
- 5. Weigh the Robot**
- 6. Notify Safety that your Robot is ready**

You must bring your Robot and Adult Supervisor to the Safety/Tech Area

Required Documentation

- Photo Release Form.
- Liability Release Form.

***Must have these Two signed in order
to participate.***

Travel with Students

Prepare/Schedule for Transportation Early.

- March 13th and /or 14th
- April 13th

Have Parent/Guardian Permission forms that are school approved for liability reasons.

Plan for Food and Drink (it can be a long day)

Tools / Equipment

Multimeter (check battery charge level)

Electrical Pliers/Crimper

Electrical Tape

Solder/Solder Iron/Flux

Scale (accurate to the ounce)

* Plan on bringing everything and anything you might need to repair/replace/maintain your robot for the battles.

Be a Team

Have Team T-Shirts (and hats?) made for all Team members and possibly Financial contributors, Business partners, and helpers.

Document the Experience

Have a person (team member?) be in charge of taping the event for a DVD.

1. Provide a copy for each team member.
2. Provide a copy for your Business Partner(s).
3. Provide a copy for your Administration and/or Public Relations person.
4. Provide a copy for any sponsors.
5. Anyone else who helped.

(We had teachers show our video during free time in their class periods)

Contact Info.

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