A Guide to Successful Baja SAE Technical Inspection

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SAE INTERNATIONAL

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Introduction

This document is a revision and update from the original guide posted in 2012. The authors hope this information is useful to new and existing teams to reduce time spent in technical inspection and improve the quality of student built vehicles.

The technical inspectors present at all Baja SAE events are:

- Baja SAE Alumni
- Unpaid Volunteers

The technical inspectors want you to:

- Learn from the Baja SAE experience
- Compete with other schools and show off your work

Technical inspectors may also be corporate recruiters, so have a good attitude at technical inspection. You never know when you are being interviewed!

Introduction

Facts:

- Your team ***can*** pass technical inspection on the first try. Several schools have passed tech on the first try, and even a first-year team passed on the first try in 2016.
- Technical Inspectors are not out to get you. The technical inspectors take their job of ensuring safe and fair competition seriously.
- Prepared, punctual, and organized teams who have read and are familiar with ***all of the rules*** have the ***shortest*** inspection times.

Introduction

- Teams with questions regarding rule interpretation or design have many resources at their disposal.
  - BajaSAE.net Forums
  - BajaSAE.net Rules Inquiry
  - Faculty Advisors
- Ask an experienced engineer or mechanic to inspect your vehicle against the tech inspection sheets.
- When performing a pre-competition inspection, be sure to put a team member's initials on the tech sheet. A check mark or an "X" is not sufficient.
- No matter what, ***perform your own inspection!***

Paperwork

- Keep an organized binder of any and all paperwork you will need at technical inspection.
  - Receipts
  - Equivalency Calculations
  - Team Roster and Information
  - Technical Inspection Sheets

Paperwork

Specifically for technical inspection sheets:

- Do not fold, bend, or destroy.
- Present clean, crisp, legible copies without stains or tears.
- Write legibly in blue or black ink.
- Do not print double sided.
- Do not print in portrait or vertical format.
- Do not staple. Technical inspectors need to be able to readily split up sheets between other inspectors.
- Ensure you have the latest revision. Previous versions will not be accepted.
- Ensure the information on your tech sheets is accurate and reflects the configuration of your vehicle. If it is found to be different than what is on your sheets, you are subject to a 75 point penalty.

Tech Quiz

- A Tech quiz will determine the order for the first 40 spots into engine check.
- Quiz will be available 2 weeks before the first competition
- More details are available on the SAE website, but this new process will reduce wait times and long lines to receive tech numbers

- Even if your team is not worried about being one of the first through tech, it is still important to show up as early as possible on day 1. This allows your team the maximum amount of time, and feedback, therefor significantly improving your odds of passing tech.

Frame

- The frame is the most critical vehicle system, protecting the driver in the event of a collision or rollover.
- Understand the frame rules completely. Each year, technical inspectors disqualify some cars due to failure to meet basic specifications. Help avoid this by:
  - Building a CAD model of the Baja SAE frame template.
  - Building a CAD model of a driver.
- Vehicles are also turned away for not having proper sized structural tubing.
  - Perform your own calculations each year regarding material equivalency.
  - Have your teammates and advisors check your calculations.
- Show alternative material equivalency
  - Use correct units
  - Use typed calculations presented in a logical and consise form.
- Have all required signatures, especially if your faculty advisor will not accompany you to competition.

Driver Safety

- Helmet Rating
  - A SNELL rating is required.
  - Other certifications may be accepted. Check the current year's rules.
  - ***DO NOT rely on salespeople to determine if a helmet is SNELL rated.*** Check for the SNELL sticker yourself, located underneath the soft foam liner of the helmet.
- Roll Offs / Tear Offs
  - Tear offs are imperative to driver safety when track conditions get muddy.
  - Know how to install them, and keep several on each set of goggles when you arrive at technical inspection.
  - Teams that are not wearing goggles or run out of tear offs will be black flagged.

Driver Safety

- Harness
  - Shoulder harnesses must be protected from fuel and fire. Ensure the harness is completely sealed from the engine compartment with material meeting firewall requirements.
  - The shoulder harness webbing may not be redirected by any part of the seat or firewall.
  - Understand the function of the anti-submarine belt (5th point) and how to properly install. Many teams fail to properly mount the anti-submarine belt.
  - Install the harness such that the largest and smallest drivers still have adjustment available in the webbing.
- Fire Extinguishers
  - Have an identical, UL-rated, spare fire extinguisher with a dial gauge.
  - Make sure the proper fire extinguisher mount is used, and all hardware is properly routed and mounted.

Driver Safety

Know how to wear your harness. Many teams are sent out of technical inspection due to harnesses not having sufficient adjustment for all drivers.

Know how to egress the vehicle. Each year technical inspectors must revoke driving privileges for some drivers who are unable to egress the car.

Practice often, and in full gear.

1) Unlock – Positively unlatch the lap belt.
2) Separate – Use both hands to separate the lap belt.
3) Exit – Exit the vehicle once all belts are separated.

Brakes

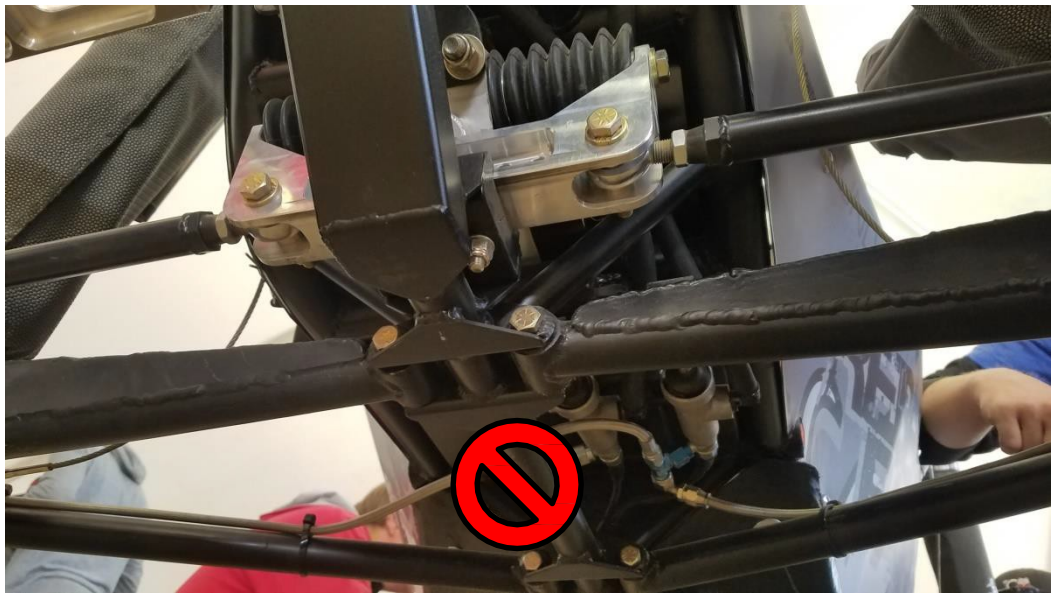
- Design
  - Many teams struggle with passing brake check each year.
  - Braking is achieved with the proper normal force on the brake pad and a proper coefficient of friction.
- Use fresh, non-fouled brake pads that are of appropriate design for the brake rotors.
- Make sure the brake rotors are clean, dry, and not fouled with brake fluid, grease, or other lubricant.
- Use properly sized master cylinders, and ensure that free motion of the push rod is possible.
- Use a properly designed motion ratio between the brake pedal and master cylinder piston travel.
- Check for any line obstructions or leaks.
- Check for proper brake alignment and free movement of the brake caliper and piston.
- Make sure your braking system is easily serviceable.

Brakes

- Design
  - Design and construct brake systems that minimize locations where air can become trapped.
  - Ensure that bleeder valves on brake calipers are properly oriented to bleed trapped air.
  - Construct brake systems that can supply enough brake fluid to the braking system.
  - ***Design for two truly independent systems.*** Avoid using single master cylinders that have two internal circuits.
  - Ensure the brake light is lit with any actuation of standard brakes or cutting brakes.
- Brake Check
  - Teams should perform their own brake check before arriving at competition.
  - Removing trapped air:
    - Bench bleed master cylinders.
    - Make sure bleeder valves are located where trapped air will collect.

Brakes

- Brake master cylinders must be protected by the skid plate and within the roll envelope.
- Brake lines must be free from damage.
- Both photos show problems teams had to fix before they passed tech inspection.



Guards

- All rotating parts must be guarded.
- Any and all rotating components rotating faster than the final drive shall be protected.
- A “searching finger” should be protected from rotating components.
- Many times teams forget backing plates or to guard the part from the bottom of the car.
- CVT’s, chains, and other components that may fly apart during a failure must be able to be contained by the guard.
- Required banding must cover the entire width of the component in question. In the case of a CVT, the flyweights, sheaves, springs, and belt must be protected.
- New for 2019, ensure all 4wd power transmission components are guarded per requirements.

Fuel

- The entire fuel system must be contained within the envelope of the roll cage.
- This includes:
  - Spill Prevention
  - Splash Guards
  - Drain Lines
  - Fuel Lines
- The roll envelope will be checked by a straight-edge between any two points on the roll cage itself.

Fuel

- When constructing drip pans and splash shields, consider how fuel can get spilled.
  - From a broken fuel line
  - From a hasty refueling
  - From a missing fuel cap
- Splash shielding rules apply for all fuel tanks. Removable fuel tanks are not exempt from any splash, drip, or spill prevention rules.
- When routing fuel lines, consider the path with respect to hot engine components. Also make sure fuel lines are not stretched or under tension.

Body

- Avoid large gaps in the firewall and body panels, especially along the LFS tube.
- Use many body panel fasteners in order to reduce locations for a gap to form.
- Cable ties, hook-and-loop, adhesive tape, or other similar mounting method will not be allowed.
- Consider the use of easily removable fasteners to help facilitate quicker technical inspection.

Body

- Gaps in the side panels for steering linkages must be protected. Generally, this is accomplished with a steering rack cover made from rigid material.
- The steering rack cover also protects the drivers heel, ankle, and calf from a puncture if a steering link fails.
- Any universal joints on the steering shaft in close proximity to the drivers feet must be booted or otherwise protected to prevent the entanglement of shoelaces. This negatively affects the driver's ability to egress if needed.
- Sharp edges are dangerous to technical inspectors, track workers, and design judges.
- Sharp edges will give a poor first impression to technical inspectors and design judges. Pay special attention to: sheet metal cuts, cable ties, or flashing from saw cuts.

Body

Cable ties are one of the top laceration hazards on a Baja SAE vehicle. Any and all cable tie tails are expected to be cut perfectly flush with the head of the cable tie.

The use of dykes, side cutters, or other similar tool will not result in a flush cut.

Baja SAE technical inspectors encourage teams to make use of dedicated cable tie tools such as the inexpensive Panduit STS-2.

Electrical

- Brake Light
  - Ensure the brake light shines bright and the battery voltage matches the required voltage of the light.
- Wiring
  - Avoid “rats nests”. These give a bad first impression.
  - Utilize proper wire crimps, connections, insulation and termination.

Fasteners

Critical fastening systems, such as those found in the driver restraint, fuel system, fire extinguisher, and kill switch systems, must meet the minimum fastener requirements of being:

- Captive
- Grade 5 or better

Avoid the use of threaded rod, home-made, or exotic fasteners requiring equivalency or proof of equivalency. Your technical inspection time will be longer if you are required to show equivalency.

What Slows Down Inspection?

- Teams who didn’t fill out their tech inspection forms.
- Teams who didn’t have proper frame documentation.
- Teams who do not have easily removable body panels and guards.
- Teams who do not have all drivers present at tech inspection
- Teams who have not practiced egress.
- Teams who do not have their safety gear ready to be inspected.
- Teams without proper fastener equivalency documentation (if required).
- Teams who did not do their own static brake check.

Conclusion

- Know the current year's rules. No excuses.
- Own the details
  - Distribute responsibility of the details of car preparation to team members.
- Stay Organized
- Be Prepared
- Have a good attitude.
- Suggested Reading
  - "Prepare to Win" – Carroll Smith
  - "Engineer to Win" – Carroll Smith
  - "Fastener Handbook" – Carroll Smith
  - FAA Maintenance Circulars
  - Mechanical Engineers Handbook.