

A graphic of a globe with a grid of latitude and longitude lines. The globe is rendered in shades of yellow and orange, with a blue background behind it. The globe is positioned on the left side of the page, partially overlapping the red header bar.

**A Guide to Successful  
Baja SAE  
Technical Inspection**

## Outline

- Introduction
- Paperwork
- Frame
- Driver Safety
- Braking
- Guards
- Body
- Fuel
- Electrical
- Fasteners
- Miscellaneous



# Introduction

- Technical Inspectors:
  - are unpaid volunteers.
  - are Baja SAE alumni.
  - they want you to:
    - LEARN from the BSAE experience
    - COMPETE among other schools and show off your work
  - *may also be corporate recruiters.*
    - Have a good attitude at tech inspection!



# Introduction

- Facts:
  - You can pass tech on the first try. Several schools have passed tech on the first try.
  - No one is “out to get you.”
  - Teams that are prepared, punctual, organized and **know all of the rules** have shorter tech inspection times.



# Introduction

- Utilize the online message boards and ask questions to other teams.
- Send rules questions to [bajarules@sae.org](mailto:bajarules@sae.org)
- Make use of your advisor or other faculty members.
- Ask an engineer or mechanic to inspect your vehicle against the tech inspection sheets.
- ***Do your own inspection!***



# Paperwork

- Keep an organized binder – receipts, tech sheets, equivalency calculations, team information, etc.
- Tech Sheets
  - Do not fold, bend, or destroy
  - Keep them away from water and/or fire
  - *Write legibly in ink (not red ink)*
  - *Do not print dual sided*
  - *Do not staple – techs need to split up inspection duties*
  - **Make sure your inspection sheet 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.**



## Frame

- The frame is the most critical vehicle system.
- Understand the frame rules completely. Each year, several vehicle frames are found to not meet rules by design.
  - Build a CAD model of the frame template
  - Build a CAD model of a driver
- Vehicles are also turned away for not having proper sized structural tubing.
  - Perform your own calculations for material equivalency.
  - Get your teammates or advisor to check your calculations.
  - Check your calculations again and again.
- Show alternative material equivalency
  - Use correct units
  - Use typed calculations presented in logical and concise form.
- Have all required signatures, especially if your faculty advisor will not accompany you to competition.



# Driver Safety

- **Helmet Rating**
  - SNELL rating is required (other certifications accepted; see rules)
  - Do not rely on salespeople – check for the SNELL sticker yourself, located underneath the soft foam liner.
- **Roll Offs / Tear Aways**
  - Know how to install them, and keep several on each set of goggles when you arrive at tech.
  - Teams that are not wearing goggles or run out of tear aways will be black flagged.





# Driver Safety

- **Harness**
  - Shoulder harnesses need to be protected from fuel and fire. Ensure that the harness is **completely** protected.
  - Shoulder harness webbing may not be redirected by any part of the seat.
  - Understand the function of the anti-submarine belt (5<sup>th</sup> point) and how to properly install.
  - Install the harness such that the shoulder harnesses for the smallest driver still have adjustment but do not bottom out on the stitching.
- **Fire Extinguishers**
  - Have an identical spare fire extinguisher with a dial gauge.
  - Have two, identical, OEM, metal mounts. Ensure that the fire extinguisher mount is attached to the car using all mounting holes.



## Braking

- Design
  - Several teams struggle with passing the brake test each year. Braking force is quite simply, normal force times friction coefficient.
  - Approaching from the friction coefficient:
    - 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.
  - Approaching from the normal force:
    - Use properly sized master cylinders, and ensure that free movement is possible
    - Use a properly designed motion ratio.
    - Check to see that any mechanical linkages, such as bias bars, do not bind.
    - Check for any line obstructions or leaks.
    - Check for proper brake alignment and free movement of the brake caliper and piston.
    - Make sure that your braking system is easily serviceable.



## Braking

- Design
  - Construct brake systems that minimize locations where air can become entrapped.
  - Ensure that bleeder valves on brake calipers are properly oriented to bleed entrapped 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.
  - Brake light switches
    - Mechanical switches are not allowed.
    - Two brake light switches are required. One for each circuit.
- Brake Check
  - Teams should perform their own brake check before arriving at competition.
  - Removing entrapped air
    - Bench bleed master cylinders
    - Make sure bleeder valves are located at areas where entrapped air will collect.



# Guards

- Peripheral Coverage
  - Two piece covers
    - Two piece covers must have some means of overlap or a connection between both halves of the metal band to ensure complete peripheral coverage.
- Finger Guarding
  - Check cover and cover mounting interface for any gaps
  - Use the “Pen Test” – if a standard ball-point pen can be inserted in the questionable gap, it must be fixed.



# Guards

- All guards must have a steel band (AISI 1010 1.5 mm thick), or aluminum (6061-T6 3.0 mm thick) surrounding the entire periphery of any belt or chain they protect.
- Previous years allowed equivalency for alternative materials. *This is no longer in effect.*
- Even if a guard is made from kevlar or some other engineered material, it must have a steel or aluminum band of appropriate thickness.



# Guards

- Polaris Clutch Cover
  - Do not cut into two pieces. A modified Polaris clutch cover is not exempt from guarding rules.
  - Finger guarding rules apply to the vent tube. Tape is not acceptable. Use plastic or metal to construct a finger guard for the vent tube.
  - Have a good CVT cover backing plate if you do not use the OEM backing plate.



# Fuel

- ALL of fuel system must be inside the **roll cage**.
- This includes:
  - Spill prevention
  - Splash guards
  - Fuel lines



# Fuel

- Splash shielding
  - Consider how fuel can get spilled:
    - From a broken fuel line
    - From hasty refuelling
    - From a missing fuel cap
  - Splash shielding rules apply even to removable fuel tanks
- Fuel line routing
  - Is it safely routed?
    - Away from hot engine parts
    - Not stretched or under tension





# Fuel

- Drainage

- All fuel systems must have a spill guard with a drain, even if using a removable tank set-up.
- Ensure that the drain line is secured from the tank to the bottom plane of the vehicle.
- Ensure the drain is the proper inside diameter – including the fitting inside diameter.



# Body

- Avoid large gaps in firewall and body panels, especially along the LFS members.
- Properly fasten body panels, especially belly pans.
  - NO cable ties, adhesive tape, or hook-and-loop fasteners will be accepted.
- Consider allowing easy removal of all body panels for access by inspectors.



# Body

- Sharp edges
  - Sharp edges are dangerous to tech inspectors, track workers, and design judges.
  - Sharp edges give a poor first impression to inspectors
  - Pay attention to:
    - Sheet metal cuts
    - Cable ties
    - Metal flashing from saw cuts



# Electrical

- Brake light
  - Avoid adhesives and rubber grommets for brake light mounting.
  - Match bulb and battery voltages.
- Wiring
  - Avoid “rats nests” – these give a bad first impression
  - Utilize proper wire crimps, connections, insulation, and termination.
- Battery
  - Utilize secure, mechanical fastening/mounting, avoiding hook-and-loop fasteners, elastic bands,
  - Insulate both terminals – prevent short circuits.
  - Use proper connections



## Fasteners

- The fastener rules have been opened up for the 2012 season. Only the driver restraint fasteners must meet the existing fastener requirements.
- However, if there is a poorly implemented fastener that raises a safety concern, tech inspectors will require you to make modifications.
- It is highly recommended that you do the following:
  - All fasteners should be captive
    - Wire tie or Nylon locking for nuts / bolts
    - Retaining rings or wire tie for unthreaded fasteners
  - All fasteners should meet or exceed Grade 5
  - Own wire-tie pliers and know how to use them
    - 13 twists per inch is the standard for safety wire use.
  - Avoid exotic fasteners
  - Avoid manufacturing fasteners
  - Avoid threaded rod



# Miscellaneous

- Driver compliance
  - Know how to wear your harness
  - Egress
    - Practice, practice, practice in full gear
    - 1) Unlock – unlatch the lap belt all the way.
    - 2) Separate – use both hands to separate the lap belt.
    - 3) Exit – exit the vehicle once all belts are separated.



# Conclusion

- Know this 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