This presentation has been placed under the “FH, FSAE, FS Training” tab on Mrs. Royce’s web site for scrutineers, at:

   http://www.scrutineering.net
Outline

• General
• Before the Competition
• Preparations at the Competition
• In Tech Inspection
• After Tech Inspection
Tech Inspection - General

- Tech Inspection is:
  - A “no points” activity, but
  - Stressful
Tech Inspection - General

• The tech inspector’s/scrutineer’s job is to:
  — Get the car out onto the track in a not unsafe condition, as quickly as possible

• He/she does this by:
  — Checking that the car meets the FSAE/FS/FH Rules
Instructions to the Tech Inspectors

- FSAE, FS and FH are educational programs
- Students have put many hours into their cars
- Our job is to get the cars out onto the track in a safe condition
- Know the Rules
- 95% of Rules are safety rules
- When in doubt, discuss with your partner
- Still in doubt, consult the Rules, read the rule exactly
- Still in doubt, go to the intent of the Rule
- Still in doubt, talk to the Chief Tech Inspector
Instructions to the Tech Inspectors - Cont’d

• Teach but don’t preach

• Keep moving, don’t gossip, there are many cars

• Don’t loose your “cool”

• Don’t get into an argument with the Faculty Advisor – call the Chief Tech Inspector over

• Be gentle with the Restrictor Gauge – don’t ram it down hard!

• Be courteous
Before the Competition

- Tech Inspection preparation starts NOW!!
- Ask questions well in advance
  - For USA, Kathleen McDonald at katklauz@aol.com
  - F Hybrid, Formula Student and FS Germany have own sites
- Get your SES in early
- Stay on schedule!
- Have the car inspected by a qualified non-team member
  - An SCCA tech inspector (or ASN equivalent)
  - A team alum
  - Use a Tech Form
- Run Noise Tests
  - Aim for a maximum of 100 dBC at idle and 107 dBC at the test speed
- Do Brake Tests
Driver’s Equipment VE.3

• Check all your driver’s safety gear BEFORE leaving for the competition
  - Remove ALL non-compliant gear from your bag/box
  - Wash all socks, balaclavas and underwear
  - Wash or dry clean all driver’s suits
  - Make sure ALL the suits have the SFI or FIA labels
  - Repair any torn suits with Nomex thread
  - Make sure all shoes have the FIA or SFI labels
  - Do NOT bring DOT helmets to Tech

• Check that BOTH fire extinguishers show a full charge

• If going to an overseas competition, check their web site for different rules, e.g.
  - FS UK does not accept M or K helmets without prior permission
  - All FS competitions require Nomex underwear.
At the Competition

• Timetable for Tech Inspection
  - On the 1st “statics” day, and often the day or 1/2 day preceding that

• Tech Inspection order:
  - Different depending on the competition
    - FSAE US - based on the order of SES approval
    - FSG – quiz, then order assigned
    - FS - send in completed Tech Form with photos, then assigned
  - So read the competition’s “Supplementary Regulations”

• The Tech Inspection Process
  - Officially Tech Inspection has 3 parts (5 pages of Tech Form)
    - Scrutineering (Pages 1-4)
    - Tilt Test (Page 5)
    - Noise, Master Switch and Brake Test (Page 5)

• FH & FSAE Electric exceptions, extra Elec. Pre-inspection before Mechanical Inspection

• FS UK exception, MSA Safety Scrutineers
At the Competition – Cont’d

Going into Tech Inspection

• You will need:
  - Your (blank) Tech Form (normally in the Registration packet)
  - The actual IA that was tested (unless using the Standard FSAE Impact Attenuator)(by Rule)

• You should also have:
  - Your Structural Equivalency Spreadsheet (SES) (On laptop)
  - Copy of your Impact Attenuator Report
  - Copies of any rules questions sent in and the answers

• Don’t leave these back in the pit box or the trailer
At the Competition – Cont’d

- Going into Tech Inspection you will also need:
  - The car (mounted on its “dry” tires)
  - Rain tires (if you have them)
  - ALL the drivers’ equipment
    - Helmets
    - Suits
    - Shoes, socks
    - Gloves
    - Balaclavas
    - Arm restraints
  - Fire extinguishers (both)
  - Push bar
  - All the drivers (at some point)
  - Tools to remove the bodywork and the throttle body
At the Competition – Cont’d

• Fill out the top portion of the Tech Form on page 1 & 5 with
  – Engine information, (for Noise Test volunteer)
  – Tire information, Dry and Rain tires
  – Transponder number (if applicable)

• Bodywork on
At the Competition – Cont’d

• First impressions
• Going into Tech Inspection you will need:
  - A polite attitude
  - A neat and clean car
    - Wiring
  - Keep the Faculty Advisor away!
  - Don’t argue with the inspector(s)
    - Move argumentative team members out of the area
    - If you disagree intensely, get Team Captain to ask to speak to the Chief Tech Inspector
The Tech Inspection Process

- Usually 2 person teams of inspectors
- Pages 1 through page 4 of Tech Form
  - Although FS UK a little different
    - Separate sheets for Chassis, Safety, Technical, Electrical
    - Structural, Percy and template checks done first
    - And a separate MSA “safety” scrutineering check
  - Formula Hybrid & FSAE Electric add an Electrical Tech pre-inspection and then a full Electrical Inspection, and a Rain Test
- Bodywork off after the page 1 checks
Some Things to Trip You Up

• Some things, but not all! (There are plenty of others!)
• Going through in the order they show on the Tech Form

• In general, the numbering on the following slides is that used in the 2019 FSAE Rules.
Rear Jacking Point / Quickjack
VE.1.1 Car Numbers

Car numbers must appear on the vehicle as follows:

a. Locations: In three (3) locations: the front and both sides;
b. Height: At least 150 mm minimum
c. Font: Block numbers (i.e. sans-serif characters). *Italic*, *outline*, *serif*, *shadow*, or *cursive numbers are prohibited.*
d. Stroke width and Spacing between Numbers: 18 mm minimum.
e. Color: Either white numbers on a black background OR black numbers on a white background. (Except electrics)
f. Background shape: *round*, *oval*, *square* or *rectangular*.
g. 25 mm minimum between the edge of the numbers and the edge of the background.
h. Clear: The numbers must not be obscured by parts of the car, e.g. wheels, side pods, exhaust system, etc.
VE.1.1 Car Numbers - OK
VE.1.1 Car Numbers - Not OK
VE.1.3 & VE.1.4 Sticker Spaces & Locations

- Technical inspection stickers will be placed on the upper nose of the vehicle. Cars must have a clear and unobstructed area at least 25 cm wide x 20 cm high (10” x 8”) on the upper front surface of the nose along the vehicle centerline.

- The SAE logo must be displayed on the front and/or both sides of the vehicle in a prominent location.

- SAE logo stickers will be provided to the teams on site.
T9.1.3 Edge Radii of Aerodynamic Devices

All forward facing wing edges including wings, end plates, Gurney flaps, wicker bills, splitters and undertrays that could contact a pedestrian must have minimum edge radii of at least 5 mm (0.2 inch) for all horizontal edges and 3mm (0.12 inches) for vertical edges (end plates).

If the edges themselves do not meet this requirement, additional permanently attached pieces designed to meet this requirement must be used.

For example, pushed-on pieces of split tube relying on friction for retention are not a satisfactory engineering method of achieving the radii.

Note: This means at least a 10 mm (3/8 inch) or 6 mm (1/4 inch) thick edges respectively.
T.9.1.2 Front Bodywork

Sharp edges on the forward facing bodywork or other protruding components are prohibited.

All forward facing edges on the bodywork that could impact people, including the nose, must have forward facing radii of at least 38 mm (1.5 inches).

This minimum radius must extend to at least 45 degrees relative to the forward direction, along the top, sides and bottom of all affected edges.
All forward facing edges on the bodywork that could impact people, including the nose, must have forward facing radii of at least 38 mm (1.5 inches).

This minimum radius must extend to at least 45 degrees relative to the forward direction, along the top, sides and bottom of all affected edges.
VE.1.5 Transponder Location

- VE.1.5.1 Each vehicle must have a functional, properly mounted transponder of the specified type.

- VE.1.5.2 Vehicles without a transponder may not be allowed to compete in any event for which a transponder is used.

- VE.1.5.3 The approved transponder type(s) and mounting details will be provided on the FSAE Online Website or by the organizer.

Presenter’s note: The transponder location is usually given as “On the right hand side of the car, forward of the Front Roll Hoop with a clear view of the ground.”

For the US competitions, SAE is using RFID tags that are mounted on the left hand upright of the Main Roll Hoop. These are for identification and do NOT replace the MYLAPS transponder.
VE.2.5 Cameras

- VE.2.5.1 The mounts for video/photographic cameras must be of a safe and secure design.

- VE.2.5.2 All camera installations must be approved at Technical Inspection.

- VE.2.5.3 Helmet mounted cameras and helmet camera mounts are prohibited.

- VE.2.5.4 The body of a camera or recording unit that weighs more than 0.25 kg must be secured at a minimum of two points on different sides of the camera body. (Typical Go-Pro cameras are less than 0.25 kg (9 oz.))

- VE.2.5.5 If a tether is used to restrain the camera, the tether length must be limited so that the camera cannot contact the driver.
T.2.27 - Inspection Holes

T.2.27 Inspection Holes

- The Technical Inspectors may check the compliance of all tubes. This may be done by the use of ultra sonic testing or by the drilling of inspection holes at the inspector’s request.

Presenter’s comment:
Teams are recommended that they drill inspection holes in the Main and Front Hoops in case the ultra sonic equipment is not available or is malfunctioning.
The shoulder harness must be mounted behind the driver to a single piece of uncut, continuous, closed section steel tubing that meets the requirements of T.2.5 or T.2.6.

This Shoulder Harness Mounting Bar must attach to the Main Hoop on both sides of the chassis. T.4.5.2

Bends in the Shoulder Harness Mounting Bar, if present, must be smooth and continuous with no evidence of crimping or wall failure. (T.2.8.2)

Bent Shoulder Harness Mounting Bars are required to have bracing members attached at the bends and to the Main Hoop.

Material for this bracing must meet the requirements of T.2.5, T.2.6 or T.2.7, “Shoulder Harness Mounting Bar Bracing.” The included angle in side view between the Shoulder Harness Bar and the braces must be no less than 30 degrees.
2017 Rules Changes, FSAE IC & EV

T2.24 Non-Crushable Objects

Was expanded to separate the requirements *inside* and *outside* the primary structure.

- **T.2.24.1 Now reads:**
  “All non-crushable objects (such as batteries, master cylinders, hydraulic reservoirs) *inside the primary structure* must have 25 mm (1”) clearance to the rear face of the Impact Attenuator Anti-Intrusion Plate.”

This 25mm minimum clearance inside the primary structure is to account for the allowable anti-intrusion plate deflection.

- **T.2.24.2 cover how a front wing must be accounted for in the IA test and IAD Report.**
T.3.3.1 Seat - Not OK

T.3.3.1 Seat

In side view, the lowest point of the driver’s seat must be no lower than the bottom surface of the lower frame rails or by having a longitudinal tube (or tubes) that meets the requirements for Side Impact tubing, passing underneath the lowest point of the seat.

Note: The smallest tube would be 1.00” OD X 0.065” wall
T1.6.7 Steering Wheels

Not OK

OK
T.1.6.10 Steering

Joints between all components attaching the steering wheel to the steering rack must be mechanical and be visible at Tech Inspection. Bonded joints without a mechanical backup are not permitted.
Things to Trip You Up
T.10.2.2 Fasteners - FSAE

T.10.2.2 All Critical Fasteners must be one of the following:
- Hex head
- Hexagonal recessed drive (Socket Head Cap Screws or Allen screws/bolts)

“Critical Fasteners” include those used in:

a) Primary Structure attachments
b) Impact attenuator attachment
c) Driver’s harness attachment
d) Steering system
e) Brake system
f) Suspension system
g) Intake manifold attachment
h) Fuel rail attachment
Things to Trip You Up
T11.1.2 Fasteners - FH

T11.1.2 The use of button head cap, countersunk head, pan head, flat head or round head screws or bolts is prohibited in ANY location in the following systems. Hexagonal recessed drive screws or bolts (sometimes called Socket head cap screws or Allen screws/bolts) are permitted:

a) Driver’s cell structure
b) Impact attenuator attachment
c) Driver’s harness attachment
d) Steering system
e) Brake system
f) Suspension system
Things to Trip You Up  
T.10.3 Securing Fasteners

- Loose jam nuts
- Positive locking  
  - Since the 2015 Rules, the securing system must be:
    1. Be visible to team members AND tech inspectors
    2. Does not rely on clamping force
T.10.2 & T.10.3 Securing Fasteners

All critical bolt, nuts, and other fasteners on the steering, braking, driver’s harness, and suspension must be secured from unintentional loosening by the use of positive locking mechanisms. Positive locking mechanisms are defined as those that:

a. The Tech Inspectors (and the team members) are able to see that the device/system is in place, i.e. it is visible.

b. The “positive locking mechanism” does not rely on the clamping force to apply the “locking” or anti-vibration feature. In other words, if it loosens a bit, it still prevents the nut or bolt coming completely loose.

Positive locking mechanisms include:

a. Correctly installed safety wiring.

b. Cotter pins.

c. Nylon lock nuts (Except in high temperature locations where nylon could fail, approximately 80 degrees Celsius or above).

d. Prevailing torque nuts.

NOTE: Lock washers, bolts with nylon patches and thread locking compounds, e.g. Loctite, DO NOT meet the positive locking requirements.
T.10.3 Securing Fasteners - Safety Wire

- Double twist method - correct
- Double twist method - incorrect
- Double twist method - multiple fastener
- Double twist - single fastener
- Single strand method used with small screws, closely spaced in closed pattern
T.10.3 Securing Fasteners - Safety Wire

Good examples
Securing Fasteners – T.1.5.5 Spherical Rod Ends
T.10.4.2 Adjustable Tie-rod Ends

All spherical rod ends on the steering or suspension must be in double shear or captured by having a screw/bolt head or washer with an O.D. that is larger than spherical bearing housing I.D.

Adjustable tie-rod ends must be constrained with a jam nut to prevent loosening.
Positive Locking - Examples
T.1.7 - Wheel Mounting

- T.1.7.2 Any wheel mounting system that uses a single retaining nut must incorporate a device to retain the nut and the wheel in the event that the nut loosens. A second nut (“jam nut”) does not meet these requirements.

- T.1.7.3 Standard wheel lug bolts are considered engineered fasteners and any modification will be subject to extra scrutiny during technical inspection. Teams using modified lug bolts or custom designs will be required to provide proof that good engineering practices have been followed in their design.

- T.1.7.4 If used, aluminum wheel nuts must be hard anodized and in pristine condition.
Visible Access

All items on the Inspection Form must be clearly visible to the technical inspectors \textit{without using instruments such as endoscopes or mirrors}. Visible access can be provided by removing body panels or by providing removable access panels.

Note: This example is the reason for the Rule! Bad visibility.
T.4.2 Belts - General

T.4.2 Harness Requirements

The vehicle must use a 5, 6 or 7 point restraint harness meeting the at least one of the following specifications:

- The belts must have the original manufacturer's labels showing the specification and expiration date.
- The harness must be within the year of expiration shown on the labels. Harnesses expiring on or before Dec 31 of the competition year are permitted.
- The harness must be in new or like new condition, with no signs of wear, cuts, chaffing or other issues.
- To accommodate drivers of differing builds, all lap belts must have a “quick adjuster” feature.

*Lap belts with “pull-up” adjusters are recommended over “pull-down” adjusters.*

- All harness hardware must be threaded in accordance with manufacturer's instructions.
- All harness hardware must be used as received from the manufacturer. No modification (including drilling, cutting, grinding, etc) is permitted.
T.4.2 Belts - General

T.4.2.1. Harness Requirements
All drivers must use a 5, 6 or 7 point restraint harness
Belts - “Quick Adjusters”, Tilt-Lock Adjusters or “Zip Adjusters”

Tilt-lock on Lap or Shoulder Belt

Tilt locks on Sub-belts
Belts-3-Bar Adjuster

A tilt-lock adjuster must not to be confused with a 3-bar adjuster.
Driver’s Harness & Mounting

- SFI belts now have “good through” dates showing 2 years after the date of manufacture (or Dec. 31st of the 2nd year).

- T.4.3.4.b. Where a single shear tab is welded to the chassis, the tab to tube welding must be on both sides of the base of the tab.

- T.4.3.3.c. The bracket or tab must be aligned such that it is not put in bending when that portion of the harness is put under load.

- Note: Double shear attachments are preferred. (Where possible) the tabs and brackets for double shear mounts should also be welded on both sides.

- T.4.4.2 The lap belts must not be routed over the sides of the seat. The belts must come through the seat at the bottom of the sides of the seat to maximize the wrap of the pelvic surface and continue in a straight line to the anchorage point. (Was “should” in both cases).
Harness Mounting Bolts

- T.4.4.8 Any bolt used to attach a lap belt, either directly to the chassis or to an intermediate bracket, is a Critical Fastener, …, with a minimum diameter that is the smaller of:
  - The bolt diameter specified by the manufacturer
  - 10mm or 3/8 inch

- T.4.5.6 Any bolt used to attach a shoulder harness belt, either directly to the chassis or to an intermediate bracket is a Critical Fastener, …, with a minimum diameter that is the smaller of:
  - The bolt diameter specified by the manufacturer
  - 10mm or 3/8 inch

- T.4.6.4 Any bolt used to attach an anti-submarine belt, either directly to the chassis or to an intermediate bracket, is a Critical Fastener, …, with a minimum diameter that is the smaller of:
  - The bolt diameter specified by the manufacturer
  - 8mm or 5/16 inch
To fit drivers of differing statures correctly, “in side view, the lap belt must be capable of pivoting freely by using either a shouldered bolt or an eye bolt attachment”, i.e. mounting lap belts by wrapping them around a frame tube is not acceptable.”
T.4.6 Sub-Belt Mounting

T.4.6.1 The anti-submarine belt of a 5-point harness must be mounted in line with, or angled slightly forward (up to twenty degrees (20°)) of, the driver’s chest-groin line.

T.4.6.2 The anti-submarine belts of a 6-point harness must be mounted either:
   a. With the belts going vertically down from the groin, or angled up to twenty degrees (20°) rearwards. The anchorage points should be approximately 100 mm (4 inches) apart. Or
   b. With the anchorage points on the Primary Structure at or near the lap belt anchorages, the driver sitting on the anti-submarine belts, and the belts coming up around the groin to the release buckle.

"Must” was “should”.
T.4.6.1 Sub-Belt Mounting, 5 Point

T.4.6.1 The anti-submarine belt of a 5-point harness must be mounted in line with, or angled slightly forward (up to twenty degrees (20°)) of, the driver’s chest-groin line.
T.4.6.2 Sub-Belt Mounting, 6 Point

T.4.6.2 The anti-submarine belts of a 6-point harness *must* be mounted either:

a. With the belts going vertically down from the groin, or angled up to twenty degrees (20°) rearwards. The anchorage points should be approximately 100 mm (4 inches) apart. Or
T.4.6.2 Sub-Belt Mounting, 6 point

Or

b. With the anchorage points on the Primary Structure at or near the lap belt anchorages, the driver sitting on the anti-submarine belts, and the belts coming up around the groin to the release buckle.
T.4.6.3 Sub-Belt Mounting
2018 Rules Change

All anti-submarine belts must be installed so that they go in a straight line from the anchorage point(s) without touching any hole in the seat or any other intermediate structure until they reach:

- Either the harness release buckle for the 5-point mounting per T.4.6.1,
- Or the first point where the belts touch the driver’s body for the 6-point mounting per T.4.6.2(a) or T.4.6.2(b).
T.3.5 Firewall

- A firewall must separate the driver compartment from all components of the fuel supply, the engine oil, the liquid cooling systems, any lithium batteries and any high voltage system.
- It must extend sufficiently far upwards and/or rearwards such that any point less than 100 mm (4 ins.) above the bottom of the helmet of the tallest driver shall not be in direct line of sight with any part of the fuel system, the cooling system or the engine oil system.
- The firewall must be a non-permeable surface made from a fire resistant material.
T3.5 Firewall – Cont’d

- Any firewall must seal completely against the passage of fluids, especially at the sides and the floor of the cockpit.

- Pass-throughs for wiring, cables, etc. are allowable if grommets are used to seal the pass-throughs.

- Multiple panels may be used to form the firewall but must be sealed at the joints.

- Seat belts must not pass through the firewall.

Not OK
T.4.7 Head Restraint

The head restraint must:

• Be vertical or near vertical in side view.

• Be padded with an energy absorbing material that meets either SFI Standard 45.2, or is listed in the FIA Technical List No. 17 as a “Type B Material for single seater cars”, i.e. CONFOR foam CF-42 (pink) or CF-42M (pink). CF-42AC (pink) is acceptable.

• Have a minimum thickness of 38 mm (1.5 inches)

• Have a minimum width of 15 cms (6 inches)

• Have a minimum area of 235 sq. cms (36 sq, ins) AND have a minimum height adjustment of 17.5 cms (7 ins) OR have a minimum height of 28 cms (11 ins).
T.4.7 Head Restraint – Cont’d

T.4.7.4 The restraint must:
• Be located so that:
  - It is no more than 25 mm (1 inch) away from the back of the driver’s helmet in the uncompressed state, with the driver in his/her normal driving position.
  - The contact point of the back of the driver’s helmet on the head restraint is no less than 50 mm (2 inch) from any edge of the head restraint.

Notes:
(1) The head restraint must meet the above requirements for all drivers.
(2) Head restraints may be changed to accommodate different drivers (See T.1.2.2)

Note: Head restraint on the right is NOT OK.
T.3.7 Vehicle Controls

All vehicle controls, including the shifter, must be operated from inside the cockpit without any part of the driver, e.g. hands, arms or elbows, being outside the planes of the Side Impact Structure defined in T.2.26 and T.2.34.

OK

“Fixed”
All vehicle controls, including the shifter, must be operated from inside the cockpit without any part of the driver, e.g. hands, arms or elbows, being outside the planes of the Side Impact Structure defined in T.2.26 and T2.34.
T.2.14.3 Foot & Toe Protection

The driver’s feet and legs must be completely contained within the Major Structure of the Frame.

2018 wording also said:

While the driver’s feet are touching the pedals, in side and front views no part of the driver’s feet can extend above or outside of the Major Structure of the Frame.
T.4.9 Driver’s Leg Protection

• To keep the driver’s legs away from moving or sharp components, “All moving suspension and steering components, and other sharp edges inside the cockpit between the front roll hoop and a vertical plane 100 mm (4 inches) rearward of the pedals, must be shielded with a shield made of a solid material.

• Moving components include, but are not limited to springs, shock absorbers, rocker arms, anti-roll/sway bars, steering racks and steering column CV joints.

• Covers over suspension and steering components must be removable to allow inspection of the mounting points.”
Driver Checks

FORMULA SAE - DRIVER COCKPIT CHECKS

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<th>Car #</th>
<th>University:</th>
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<th>Driver's Name</th>
<th>Helmet Line.</th>
<th>Head Rest Fore &amp; Aft</th>
<th>Head Rest-To Edges</th>
<th>Lap Belt</th>
<th>Shoulder Belts</th>
<th>Sub Belts</th>
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Helmet 50 mm (2 ins) min. below lines between Main & Front Hoops and between Main Hoop & rear attachment point of Main Hoop Bracing

Head Restraint - Fore & aft, 25.4 mm (1 inch) max. to back of helmet.

Head Restraint - Helmet contact point 50 mm minimum from any edge.

Lap Belt - Over hip bones and tight.

Shoulder Belts - 10 deg. up & 20 deg. down to horizontal and tight.

Sub Belts - Tight.

Less than 5 secs. "go" to BOTH feet on ground.
IC.1.2 Air Intake and Fuel System Rollover Protection

All parts of the engine air and fuel control systems (including the throttle or carburetor, and the complete air intake system, including the air cleaner and any air boxes) must lie within the surface defined by the top of the roll bar and the outside edge of the four tires.
IC.1.2 Air Intake & Fuel System Rollover Protection - cont’d

All parts of the fuel storage and supply system, and all parts of the engine air and fuel control systems (including the throttle or carburetor, and the complete air intake system, including the air cleaner and any air boxes) must lie within the surface defined by the top of the roll bar and the outside edge of the four tires.
IC.3.3.2 Throttle Return Springs

- The throttle actuation system must use at least two return springs located at the throttle body, so that the failure of any component of the throttle system will not prevent the throttle returning to the closed position.

- Throttle Position Sensors (TPS) are NOT acceptable as return springs.
IC.2.3.1 Intake Manifold Attachment

Intake Manifold – The intake manifold must be securely attached to the engine block or cylinder head with brackets and mechanical fasteners. Hose clamps, plastic ties, or safety wires do not meet this requirement. The use of rubber bushings or hose is acceptable for creating and sealing air passages, but is not considered a structural attachment.

NOTE: These fasteners are considered “critical fasteners”, and must have “positive locking” per T.10.
Fuel Rail – The fuel rail must be securely attached to the engine cylinder block, cylinder head, or intake manifold with brackets and mechanical fasteners. Hose clamps, plastic ties, or safety wires do not meet these requirements.

Note: These fasteners are considered “critical fasteners”, and require “positive locking” per Article 10.
IC.7.2.4 Header Wrap

- Use of any fibrous/absorbent material, (such as header wrap), on the outside of an exhaust manifold or exhaust system is prohibited.
T.7.2 - Drivetrain Shields & Guards

• T.7.2.1 Exposed high-speed final drivetrain equipment such as Continuously Variable Transmissions (CVTs), sprockets, gears, pulleys, torque converters, clutches, belt drives and clutch drives, must be fitted with scatter shields in case of failure.

• The final drivetrain shield must:
  • a. Be made with solid material (not perforated)
  • b. Cover the chain or belt from the drive sprocket to the driven sprocket/chain wheel/belt or pulley.
  • c. Start and end parallel to the lowest point of the chain wheel/belt/pulley. (See figure).

• T.7.2.3 Body panels or other existing covers are not acceptable unless constructed per T.7.2.5/T.7.2.6.

• T.7.2.4 If equipped, the engine drive sprocket cover may be used as part of the scatter shield system.
T.7.4 and IC1.10 System Sealing

T.7.4 System Sealing

- T.7.4.1 Any cooling or lubrication system must be sealed to prevent leakage.

- T.7.5.1 Separate catch cans must be employed to retain fluids from any vents for the coolant system or the crankcase or engine lubrication system. Each catch-can must have a minimum volume of ten (10) percent of the fluid being contained or 0.9 liter (one U.S. quart) whichever is greater.

- T.5.3 Catch cans must be capable of containing boiling water without deformation, and be located rearwards of the firewall below driver’s shoulder level, and be positively retained, i.e. no tie-wraps or tape.

- T.8.2.5 Any catch can on the cooling system must vent through a hose with a minimum internal diameter of 3 mm (1/8 inch) down to the bottom levels of the Frame.

- IC1.10.1 Any crankcase or engine lubrication vent lines routed to the intake system must be connected upstream of the intake system restrictor.

- IC1.10.2 Crankcase breathers that pass through the oil catch tank(s) to exhaust systems, or vacuum devices that connect directly to the exhaust system, are prohibited.
T.8.1 Gas Cylinders

T.8.1 Compressed Gas Cylinders and Lines
Any system on the vehicle that uses a compressed gas as an actuating medium must meet the following:

T.8.1.3 Pressure Regulation - The pressure regulator must be mounted directly onto the gas cylinder/tank.

T.8.1.4 Protection – The gas cylinder/tank and lines must be protected from rollover, collision from any direction, or damage resulting from the failure of rotating equipment.

T.8.1.5 Cylinder Location - The gas cylinder/tank and the pressure regulator must be:
   a. Located either rearward of the Main Hoop and within the Primary Structure Envelope aft of the Main Hoop, or in a structural side-pod
   b. Located outside the cockpit.
   c. Protected by structure that meets T.2.26 / T.2.34

T.8.1.6 Cylinder Mounting - The gas cylinder/tank must be securely mounted to the Frame, engine or transmission.

T.8.1.7 Cylinder Axis - The axis of the gas cylinder/tank must not point at the driver.

T.8.1.8 Insulation - The gas cylinder/tank must be insulated from any heat sources, such as the exhaust system.
IC.5.8.4 & IC.6.1.1 Fuel Lines for LPI Systems

**Fuel Lines** – Any **Low Pressure** flexible fuel lines must be either:

- Metal braided hose with either crimped-on or reusable, threaded fittings, or
- Reinforced rubber hose with some form of abrasion resistant protection.

Presenter’s Note: With fuel line clamps per IC.5.8.4.b. And hose clamps over metal braided hose will not be accepted.
IC.5.8.4 Fuel Lines - Non-Aeroquip Type

If rubber fuel line or hose is used, the components over which the hose is clamped must have annular bulb or barbed fittings to retain the hose.

Also, clamps specifically designed for fuel lines must be used. These clamps have three (3) important features,

(i) a full 360 deg. wrap,
(ii) a nut and bolt system for tightening, and
(iii) rolled edges to prevent the clamp cutting into the hose. Worm-gear type hose clamps are NOT approved for use on any fuel line.
Things to Trip You Up - Fuel Lines

- Plastic Fuel Fittings
  - Plastic fuel lines between the tank and the engine ARE prohibited per IC.5.8.3
  - Plastic fuel FITTINGS are not specifically prohibited
  - **But don’t!!**

- Plastic Fuel Rails, IC.6.1.2
  - Student designed & built plastic or carbon fiber fuel rails are prohibited
  - Plastic OEM fuel rails ARE allowed if unmodified

- “Quick Connect” Fuel Line Connectors
  - Not specifically prohibited by rule,
  - Except possibly by IC.5.8.3 and IC.6.1.1
  - But are NOT suitable for FSAE usage
  - **So, don’t use!**
IC.5.5 Fuel Tank Filler Neck & Sight Tube

All fuel tanks must have a filler neck:

(a) at least **35 mm (1.375 inches)** inner diameter at any point between the tank and the fuel filler cap,

(b) at least 125 mm (4.9 inches) vertical height above the top level of the tank and

c) angled at no more than 30 degrees from the vertical.

The 125 mm of vertical height of the fuel filler neck must be above the top level of the fuel tank, and must be accompanied by a clear, fuel resistant sight tube for reading the fuel level (Figure 14).

The sight tube must have at least **125 mm (4.9 inches)** of vertical height and a minimum inside diameter of **6 mm (0.25 inches)**. The sight tube must not run below the top surface of the fuel tank.

A clear filler tube may be used, subject to approval by the Rules Committee or technical inspectors at the event.
IC.5.5 Fuel Tank Filler Neck & Sight Tube - OK
IC.5.5 Fuel Tank Filler Neck & Sight Tube - cont’d

Not OK
IC.5.5 Fuel Tank Filler Neck & Sight Tube - cont’d

Not OK

Not OK
IC.5.5 Fuel Tank Sight Tube & Filler Cap

- IC.5.5.4 Fuel Level Line - A permanent, non movable fuel level line must be located between 12 mm and 25 mm below the top of the visible portion of the sight tube.

- This line will be used as the fill line for the Tilt Test, and before and after the Endurance Test to measure the amount of fuel used during the Endurance Event.

- IC.5.5.5 The sight tube and fuel level line must be clearly visible to two individuals (one to fill the tank, the other to visually verify fill) without the need of assistance (artificial lighting, magnifiers, etc) or the need to remove any parts (body panels, etc).

- IC.5.5.6 The individual filling the tank must have complete direct access to the filler neck opening with a standard two gallon gas can assembly.

- IC.5.5.7 The filler neck must have a fuel cap that can withstand severe vibrations or high pressures such as could occur during a vehicle rollover event.
T.7.4.4 Bellypan, Etc.

- T.7.4.3 Flammable liquid leaks must not be allowed to accumulate.

- T.7.4.4 At least 2 holes, each of a minimum diameter of 25 mm, must be provided in the lowest part of the structure or belly pan in such a way as to prevent accumulation of volatile liquids and/or vapours.

- T.7.4.5 Absorbent material and open collection devices (regardless of material) are prohibited in compartments containing engine, drivetrain, exhaust and fuel systems below the highest point on the exhaust system.
Things to Trip You Up
- Electrical
Low Voltage Batteries

• Battery Attachment
  – Per T.11.1, “Must be attached securely to the frame.”
  – Normal interpretation – metal hold down, no bungees!

• T.11.1.2 All low voltage batteries must have overcurrent protection that trips at or below the maximum specified discharge current of the cells.

• “Hot” terminal insulated, T.11.1.3
  – FS UK also requires “ground wire” to be tagged with yellow tape.

• T.11.1.4 Any wet cell battery located in the driver compartment must be enclosed in a nonconductive marine type container or equivalent.
Things to Trip You Up
T.11.1 Low Voltage Batteries

T.11.1.5 Battery packs based on Lithium Chemistry:
   a. Must have a rigid, sturdy and fire retardant casing.
   b. Must be separated from the driver by a firewall as specified in T.3.5

T.11.1.6 All batteries using chemistries other than lead acid must be presented at technical inspection with markings identifying it for comparison to a datasheet or other documentation proving the pack and supporting electronics meet all rules requirements.
T.5.2 Brake Overtravel Switch

T.5.2.2 Must be a mechanical, single pole, single throw switch (push-pull or flip type).
T.5.3 Brake Lights

- LED “tape” is becoming very common. It is sold in flexible strips as shown to the right.

- When LED lights are used without a diffuser, they may not be more than 20mm apart. If a single line of LEDs is used, the minimum length is 150mm. (This was enforced in 2014)

- It must be a single, “rectangular, triangular or near round shape,” on the centerline of the vehicle.
Percy’s Placement

The bottom 200 mm circle will be placed on the seat bottom with the center of the circle ("Percy’s” hips and buttocks) no less than 915 mms (36 inches) from the rear face of the pedals in their most forward position.
2017 Rules Changes, FSAE IC & EV
T.3.1 & 3.2 Cockpit Templates

T.3.1.2 Cockpit Opening
The template will be held horizontally, parallel to the ground, and inserted vertically from a height above any Primary Structure or bodywork that is between the Front Hoop and the Main Hoop until it has passed below the top bar of the Side Impact Structure (or until it is 350 mm (13.8 inches) above the ground for monocoque cars).

T.3.1.3 Fore and aft translation of the template is permitted during insertion.

T4.2.1 Cockpit Internal Cross-Section
A free vertical cross section, which allows the template shown in Figure 9 to be passed horizontally through the cockpit to a point 100 mm (4 inches) rearwards of the face of the rearmost pedal when in the inoperative position, must be maintained over its entire length. If the pedals are adjustable, they will be put in their most forward position.

T4.2.2 The template, with maximum thickness of 7mm (0.275 inch), will be held vertically and inserted into the cockpit opening rearward of the rear-most portion of the steering column.
T.3.1, T3.2 & IN.7 Cockpit Templates

- New starting locations for the templates from 2017 –
  - Above any Primary Structure or bodywork between the Front Hoop and the Main Hoop for the Cockpit Opening template, and
  - Rearwards of the steering column for the Cockpit Internal Cross Section

Failing the templates OR Percy means no Tech Sticker and no competing in the dynamic events!

Do NOT design line-to-line to the templates. Frames twist during welding, and there are things like wires, cables and brake lines that have to be routed past the Front Hoop.
# Driver Checks

**FORMULA SAE - DRIVER COCKPIT CHECKS**

<table>
<thead>
<tr>
<th>Car #</th>
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<tr>
<th>Driver’s Name</th>
<th>Helmet Line.</th>
<th>Head Rest Fore &amp; Aft</th>
<th>Head Rest To Edges</th>
<th>Lap Belt</th>
<th>Shoulder Belts</th>
<th>Sub Belts</th>
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- Helmet 50 mm (2 ins) min. below lines between Main & Front Hoops and between Main Hoop & rear attachment point of Main Hoop Bracing.
- Head Restraint - Fore & aft, 25.4 mm (1 inch) max. to back of helmet.
- Head Restraint - Helmet contact point 50 mm minimum from any edge.
- Lap Belt - Over hip bones and tight.
- Shoulder Belts - 10 deg. up & 20 deg. down to horizontal and tight.
- Sub Belts - Tight.
- Less than 5 secs. "go" to BOTH feet on ground.

89
After Scrutineering - Tilt Test

45 degrees for Fluid Leaks

60 degrees for Stability
After Scrutineering – Noise Test

• Noise Test
  - Simple test
  - Test speeds at:
    o https://www.sae.org/binaries/content/assets/cm/content/attend/2018/student-events/fsae/michigan/noise-test-speeds-2015.pdf
    o Properly tuned exhaust does not rob power
  - Get inexpensive meter and have it calibrated
  - No ambient corrections
  - Aim for max. of 100 dBC at idle and 107 dBC at the test speed.

• IC3.2.3 Noise Test – Restrictions on active or adjustable tuning devices.
After Scrutineering

- Check the Master Switch, at a higher engine speed, not just at idle. Done during Noise Test. (IN.10.7)

- IC.8.4.2 – Alternator field wire *must* be cut by master switch.

- Brake Test
  - Very high stresses on car.
  - Known to break suspensions!
  - Must test before going to Competition!!
Summary, Do’s and Don’ts

• Do start NOW!
• Do have all team members look at our web site at:
  - www.scrutineering.net
• Do have your car inspected by a qualified outside party well before the Competition
• Do test, test, test!
• Do including brake, noise and master switch tests!
• Do think safety ALL the time!
• Don’t miss your dates
Questions?
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