FORMULA STUDENT SCRUTINEERING
TECH INSPECTION

PART 3
INTERIOR

by Michael and Suzanne Royce
Albion Associates, LLC
with material from
Jeff Lovell
T5.1 Belts - General

• Harness Requirements
  All drivers must use a 5, 6 or 7 point restraint harness meeting the following specifications:
  a. All driver restraint systems must meet either SFI Specification 16.1, SFI Specification 16.5, or FIA specification 8853/98.
  b. The belts must bear the appropriate dated labels.
  c. The material of all straps must be in perfect condition.
  d. There must be a single release common to the lap belt and shoulder harness using a metal-to-metal quick release type latch.
  e. To accommodate drivers of differing builds, all lap belts must have a tilt-lock adjuster ("quick adjuster") feature.
     A tilt-lock adjuster in each portion of the lap belt is highly recommended. Lap belts with “pull-up” adjusters are recommended over “pull-down” adjusters.

Note: The official name of the “quick adjusters” is “tilt-lock adjusters”.

T5.1 Belts – General – Cont’d

5-Point
Happens to be Link & Latch

6-Point
Happens to be Cam Lock
T5.1.1 Belts - Upright vs Reclined Driver

T5.1.1 Definitions

d. An upright driving position is defined as one with a seat back angled at 30 degrees or less from the vertical as measured along the line joining the two 200 mm circles of the template of the 95th percentile male as defined in Rule T3.10.3 and positioned per T3.10.4.

e. A reclined driving position is defined as one with a seat back angled at more than 30 degrees from the vertical as measured along the line joining the two 200 mm circles of the template of the 95th percentile male as defined in Rule T3.10.3 and positioned per T3.10.4.
Cars with a Reclined driving position must have:
- either a **6 point or 7-point** harness, AND
- have either **anti-submarine belts with “tilt lock adjusters”** or
- have **two (2) sets of anti-submarine belts installed.**

With a reclined driving position, in side view the lap belt must be between an angle of 60 degrees and 80 degrees to the horizontal.
Belts - “Quick Adjusters”, Tilt-Lock Adjusters or “Zip Adjusters”
T5.2 Harness Installation - General

• The lap belt, shoulder harness and anti-submarine strap(s) must be securely mounted to the Primary Structure. Such structure and any guide or support for the belts must meet the minimum requirements of T3.4.1.

• The tab to which any harness is attached must have:
  a. A minimum cross sectional area of 60 sq. mms (0.093 sq. ins) of steel to be sheared or failed in tension at any point of the tab, and
  b. A minimum thickness of 1.6 mm (0.63 inches).
  c. Where lap belts and anti-submarine belts use the same attachment point, a minimum cross sectional area of 90 sq. mm (0.140 sq in) of steel to be sheared if failed in tension at any point of the tab.
  d. Where brackets are fastened to the chassis, two fasteners of 6mm Metric Grade 8.8 (1/4 inch SAE Grade 5) fasteners or stronger must be used.
  e. 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.

NOTE: Double shear attachments are preferred. Where possible, the tabs and brackets for double shear mounts should also be welded on both sides.

Presenter's comment: Any bracket or tab should be aligned such that it is not put in bending when that portion of the harness is put under load.
T4.5.3 & T5.2.3 Firewall & Seat Belt Mounting

- T4.5.3 Any firewall must seal completely against the passage of fluids, especially at the sides and the floor of the cockpit, i.e. there can be no holes in a firewall through which seat belts pass.

- T5.2.3 Harnesses, belts and straps must not pass through a firewall, i.e. all harness attachment points must be on the driver’s side of any firewall.

This basically means that the seat cannot be used as a “firewall”!!
T5.3 Lap Belt Mounting

- The lap belt must pass around the pelvic area below the Anterior Iliac Spines (the hip bones).

- The lap belts MUST not be routed over the sides of the seat. The lap 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.

- Where the belts or harness pass through a hole in the seat, the seat must be rolled or grommeted to prevent chafing of the belts.

- 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 no longer acceptable.

- Any bolt used to attach a lap belt, either directly to the chassis or to an intermediate bracket, must be a minimum of 10mm Metric Grade 8.8 (3/8 inch SAE Grade 5)
Lap Belt Mounting - cont’d

“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 no longer acceptable.”
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 no longer acceptable.”
Lap Belt Mounting - Angles

• Per T4.3.5 With an “upright driving position”, in side view, the lap belt must be at an angle of between 45 degrees and 65 degrees to the horizontal. This means that the centerline of the lap belt at the seat bottom should be approximately 0-76 mm (0-3 inch) forward of the seat back to seat bottom junction (see Figure 6a).

• Note: Per T5.3.6, With a “reclined driving position”, in side view the lap belt must be between an angle of sixty degrees (60°) and eighty degrees (80°) to the horizontal.
T5.4 Driver Restraint System - Shoulder Harness Mounting

- 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 T3.4.1.

- This Shoulder Harness Mounting Bar must attach to the Main Hoop on both sides of the chassis. Bends in the Shoulder Harness Mounting Bar, if present, must be smooth and continuous with no evidence of crimping or wall failure.

- 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 T3.4.1 “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.
The shoulder harness mounting points must be between 178 mm (7 inches) and 229 mm (9 inches) apart.

From the driver’s shoulders rearwards to the mounting point or structural guide, the shoulder harness must be between 10 degrees above the horizontal and 20 degrees below the horizontal.

Any bolt used to attach a shoulder harness belt, either directly to the chassis or to an intermediate bracket, must be a minimum of 10mm Metric Grade 8.8 (3/8 inch SAE Grade 5).
T5.5.1 Anti-Submarine Belt Mounting
5 Point System

• The anti-submarine belt of a 5 point harness must be mounted in line with, or angled slightly forward of (up to 20 deg), the driver’s chest-groin line.

• The chest-groin line is the straight line that in side view follows the line of the shoulder belts from the chest to the release buckle.

• Any bolt used to attach an anti-submarine belt, either directly to the chassis or to an intermediate bracket, must be a minimum of 8mm Metric Grade 8.8 (5/16 inch SAE Grade 5)
T5.5.2 Anti-Submarine Belt Mounting
6 Point System

• 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 20 deg. 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.

• **Any bolt** used to attach an anti-submarine belt, either directly to the chassis or to an intermediate bracket, **must be a minimum of 8mm Metric Grade 8.8 (5/16 inch SAE Grade 5)**
T5.5 Sub-Belt Mounting

- All anti-submarine belts should be installed so that they go in a straight line from the anchorage point(s) to:
  - Either the harness release buckle for the 5-point mounting per T5.5.1,
  - Or the first point where the belts touch the driver’s body for the 6-point mounting per T5.5.2.a or T5.5.2.b, without touching any hole in the seat or any other intermediate structure.

Presenter’s note: This is not a 2017 rule, but is a “good engineering practice” and has been proposed to the Rules Committee for 2018.
Harnesses are a System

Acceptable*
- If tab cross-section area is met
- If using manufacturer’s hardware and instructions

(Don’t forget the cotter pin!)
Seatbelt Installation

"3-bar adjuster"

**STEP 1:** Insert strap through tightening buckle.

**STEP 2:** Pull strap to 8”–10” beyond buckle, fold edges and insert into mounting bracket.

**STEP 3:** Fold back strap and reinsert through buckle as shown.

at least 100 mm (4")
Seatbelt Installation

**Step 4** is very frequently overlooked, but simple to identify, and easy to fix.

**STEP 1:** Insert strap through tightening buckle.

**STEP 2:** Pull strap to 8”–10” beyond buckle, fold edges and insert into mounting bracket.

**STEP 3:** Fold back strap and reinsert through buckle as shown.

**STEP 4:** Fold back strap again and insert through bottom portion of buckle.

Belt passes through rearward slot **3 times**

Good
Seatbelt Installation- advanced

Acceptable alternative for 3-bar adjuster used to wrap around frame tubes.
→ More compact, but more difficult to install.

Wrapping Instructions:

Belt passes through forward slot 3 times
Seatbelt Installation - Other Types

“Light Weight Wrap” - common for anti-sub belts.

Belt passes through slot 4 times
Monocoque - Driver’s Harness Attachment Points

Monocoque Driver’s harness Attachment Points

• The monocoque attachment points for the shoulder and lap belts must support a load of 13 kN (approx. 3000 pounds) before failure.

• The monocoque attachment points for the ant-submarine belts must support a load of 6.5 kN (approx. 1500 pounds) before failure.

• If the lap belts and anti-submarine belts are attached to the same attachment point, then this point must support a load of 19.5 kN (approx. 4500 pounds) before failure.

• The strength of lap belt attachment and shoulder belt attachment must be proven by physical test where the required load is applied to a representative attachment point where the proposed layup and attachment bracket is used.
T4.5 Firewall

- A firewall must separate the driver compartment from all components of the fuel supply, the engine oil and the liquid cooling systems.
- It must protect the neck of the tallest driver. 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.
- Pass-throughs for wiring, cables, etc. are allowable if grommets are used to seal the pass-throughs. Also, multiple panels may be used to form the firewall but must be sealed at the joints.
Radiator Ducts behind Driver

When the radiator duct is positioned behind the driver, ensure there is not line-of-sight between any part of the radiator and the driver (below midpoint on helmet).

**T4.5.1** …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.

Inspect line-of-sight to radiator, even inside duct.
Presenter’s notes:

- Using the seat as a firewall is not specifically prohibited, but is extremely difficult to achieve while meeting the rules, especially T4.5.3 ("there must be no holes in a firewall through which seat belts pass.” And is discouraged.

- Watch carefully for sealing “completely against the passage of fluids, especially at the sides and the floor of the cockpit.”

- Any radiators and cooling hoses in side pods need to meet the “spraying rule” covered in the previous slide. The “firewall can be a side pod or a duct, just as long as it would stop the spray of coolant.

- Behind the driver, a “firewall” can go upwards or rearwards to improve coverage.
T4.4 Floor Close-out Panel

Floor Close-out

- All vehicles must have a floor closeout made of one or more panels, which separate the driver from the pavement. If multiple panels are used, gaps between panels are not to exceed 3 mm (1/8 inch). The closeout must extend from the foot area to the firewall and prevent track debris from entering the car.

- The panels must be made of a solid, non-brittle material.

Presenter’s notes:

- Aluminium, steel, fibreglass and CRP are “solid, non-brittle materials”. Metal mesh or “aircraft fabric” are not for the floor. Aircraft fabric is OK for other body panels.
- Have teams minimize the openings required around any steering and suspension components.
T3.10 Main & Front Hoops - General Requirements

T3.10.3 Helmet Line

When seated normally and restrained by the Driver’s Restraint System, the helmet of a 95th percentile male (anthropometrical data) and all of the team’s drivers must:

a. Be a minimum of 50.8 mm (2 inches) from the straight line drawn from the top of the main hoop to the top of the front hoop. (Figure 1a)

b. Be a minimum of 50.8 mm (2 inches) from the straight line drawn from the top of the main hoop to the lower end of the main hoop bracing if the bracing extends rearwards. (Figure 1b)

c. Be no further rearwards than the rear surface of the main hoop if the main hoop bracing extends forwards. (Figure 1c)
T3.10.3 Main & Front Hoop Heights

• When seated normally and restrained by the Driver’s Restraint System, the helmet of all of the team’s drivers must:
  
  a. Be a minimum of 50.8 mm (2 inches) from the straight line drawn from the top of the main hoop to the top of the front hoop. (Figure 1a)
  
  b. Be a minimum of 50.8 mm (2 inches) from the straight line drawn from the top of the main hoop to the lower end of the main hoop bracing if the bracing extends rearwards. (Figure 1b)
  
  c. Be no further rearwards than the rear surface of the main hoop if the main hoop bracing extends forwards. (Figure 1c)
Main & Front Hoop - General Requirements

Drivers who do not meet the helmet clearance requirements of T3.10.3 will not be allowed to drive in the competition.
T5.6 Head Restraint

• The restraint must:
  a. Be vertical or near vertical in side view.
  b. Be padded with an energy absorbing material such as Ethafoam® or Ensolite® with a minimum thickness of 38 mm (1.5 inches).
  c. Have a minimum width of 15 cms (6 inches).
  d. Have a minimum area of 235 sq. cms (36 sq. inches) AND have a minimum height adjustment of 17.5 cms (7 inches), OR have a minimum height of 28 cms (11 inches).

Note: Padding to SFI 45.2 or pink Confor® Foam is recommended.
The restraint must also:

- 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.
T5.7 Roll Bar Padding

Roll Bar Padding
Any portion of the roll bar, roll bar bracing or frame which might be contacted by the driver’s helmet must be covered with a minimum thickness of 12 mm (0.5 inch) of padding which meets SFI spec 45.1 or FIA 8857-2001.

Note: Pipe insulation or foam is OK on other parts of the frame to protect the legs, knees and arms.
T4.6 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 <>.
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 T3.3.
T3.14.6 Foot & Toe Protection

Front Impact Structure
The driver’s feet must be completely contained within the Major Structure of the Frame. 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.
**T5.8 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.

Presenter’s note: Watch out for overly long bolts and sharp zip/cable ties.
T3.14.6 Front Hoop Bracing - Leg Protection

- Per T3.14.3 says “The Front Hoop braces must be constructed such that they protect the driver’s legs and **should** extend to the structure in front of the driver’s feet”, but T3.14.6 then says “The driver’s feet and legs **MUST** be completely contained within the Major Structure of the Frame, …in side and front views.”