FORMULA SAE/FORMULA STUDENT TECHNICAL INSPECTION/SCRUTINEERING

PART 3
STEERING, SUSPENSION & BRAKES

by
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T6.2 Ground Clearance

There is no longer a minimum ground clearance requirement. However, ..

Ground Clearance

Ground clearance must be sufficient to prevent any portion of the car, other than the tires, from touching the ground during track events. Intentional or excessive ground contact of any portion of the car other than the tires will forfeit a run or an entire dynamic event.

Comment: The intention of this rule is that sliding skirts or other devices that by design, fabrication or as a consequence of moving, contact the track surface are prohibited and any unintended contact with the ground which either causes damage, or in the opinion of the ‘dynamic event organizers’ could result in damage to the track, will result in forfeit of a run or an entire dynamic event
Ground Clearance - cont’d

Clarification of "Ground Clearance"  WARRENDALE, Pa., Sept. 22, 2010

Based on some questions submitted by teams and in accordance with FSAE Rule 3.1.1, the Rules Committee is issuing the following clarification of Rule B6.2 Ground Clearance.

The intent of eliminating the ground clearance requirement was to remove the specific 1 inch dimension and its accompanying verification checks.

The Design Judges believe that eliminating this requirement allows more design freedom and presented the argument that 1 inch clearance is not necessary to limit ground contact at many locations under the car, nor does it necessarily guarantee non-contact. As the note to Rule B6.2 makes clear, under Rule D1.1.2 contact with the track is a valid reason for disqualification from a dynamic event.

This statement is being issued to make it clear that the Rule Committee and Organizers will interpret those rules collectively as requiring that all vehicles be designed so the only contact between the vehicle and the ground occurs at the tire contact patches. The tech inspectors will be examining the vehicle to confirm there is clearance between all parts of the vehicle (except tires) and the ground.

Sliding skirts and other devices that by design, fabrication or as a consequence of moving, contact the track surface are not allowed. Wings also need to be designed to have clearance to the ground.

Simply stated, if it is not a tire it cannot touch the ground.
T6.1 Suspension

- T6.1.1 The car must be equipped with a fully operational suspension system with shock absorbers, front and rear, with usable wheel travel of at least 50.8 mm (2 inches), 25.4 mm (1 inch) jounce and 25.4 mm (1 inch) rebound, with driver seated. The judges reserve the right to disqualify cars which do not represent a serious attempt at an operational suspension system or which demonstrate handling inappropriate for an autocross circuit.

- The objective of this rule goes back to the start of Formula SAE, and its intent is to prohibit the use of “go kart suspensions”, i.e. using a flexing frame as the suspension, and to require the teams to design suspensions with springs and dampers.

- It is NOT required that you measure the suspension movement to make sure the teams comply with the 50 mm travel requirement!
T7.1 Brakes

- It must have two (2) independent hydraulic circuits acting on all 4 wheels.
- A single brake acting on a limited-slip differential is acceptable.
- Each hydraulic circuit must have its own fluid reserve, either by the use of separate reservoirs or by the use of a dammed, OEM-style reservoir.
- "Brake-by-wire" systems are prohibited.
- Unarmored plastic brake lines are prohibited.
- The braking systems must be protected with scatter shields from failure of the drive train (see T8.4) or from minor collisions.
- In side view no portion of the brake system that is mounted on the sprung part of the car can project below the lower surface of the frame or the monocoque, whichever is applicable.
T7.1 Brake Pedal

- T7.1.8 The brake pedal shall be designed to withstand a force of 2000 N (450 lbs.F) without any failure of the brake system or pedal box.

- This may be tested by pressing the pedal with the maximum force that can be exerted by any official when seated normally.

Presenter’s comment: This means that if a tech inspector or a design judge gets in the car, and presses as hard as they can on the brake pedal, it must not break!

- T7.1.9 The brake pedal must be fabricated from steel or aluminum or machined from steel, aluminum or titanium.

Presenter’s comment: This means no carbon fiber or bonded brake pedals.
T6.5.6 Steering Wheel

The steering wheel must have a continuous perimeter that is near circular or near oval, i.e. the outer perimeter profile can have some straight sections, but no concave sections. “H”, “Figure 8”, or cutout wheels are not allowed.
Steering Wheel - cont’d

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Steering Wheel - cont’d

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T3.12.5 Front Hoop to Steering Wheel

**Front Hoop**

The Front Roll Hoop must be no more than 250 mms (9.8 inches) forward of the steering wheel.

This distance shall be measured horizontally, on the vehicle centerline, from the rear surface of the Front Roll Hoop to the front surface of the steering wheel rim with the steering in the straight-ahead position.
T6.5: Rear Wheel Steering

Is allowed; limited to 6° travel. Travel limits must be demonstrated at Tech.
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.
T11.1 Fasteners

Fastener Grade Requirements

• All threaded fasteners utilized in the driver’s cell structure, and the steering, braking, driver’s harness and suspension systems must meet or exceed, SAE Grade 5, Metric Grade 8.8 and/or AN/MS specifications when a minimum size is specified elsewhere in these rules.

• The use of button head cap, pan head, flat head, round head or countersunk screws or bolts in critical locations is prohibited. These locations include:
  – Primary structure attachments,
  – Impact attenuator attachment
  – Driver’s harness attachment
  – Steering system
  – Brake system
  – Suspension system

Note: Hexagonal recessed drive screws or bolts (sometimes called socket head cap screws or Allen screws/bolts) are permitted.

Presenter's note: Watch for button head, countersunk, etc. screws around the brakes and the steering wheel mounting.
T11.1.3: Fasteners

Bolted joints in frame must have > 1.5 dia. from edge of hole to edge of material. (But not suspension pickups; frame only.)
AKA “edge distance ratio “e/D” of 2 or greater”

Bolted joint in primary structure

This tab is too small
T11.2 Securing Fasteners

All critical bolt, nuts, and other fasteners on the steering, braking, safety harness, and suspension must be secured from unintentional loosening by the use of positive locking mechanisms. Positive locking mechanisms include:

- Correctly installed safety wiring
- Cotter pins
- Nylon lock nuts (Except in high temperature locations where nylon could fail, approximately 80 degrees Celsius or above)
- Prevailing torque lock nuts

Note: Lock washers, bolts with nylon patches and thread locking compounds, e.g. Loctite®, DO NOT meet the positive locking requirement.

There must be a minimum of two (2) full threads projecting from any lock nut.
T11.2 Securing Fasteners - cont’d

Securing Fasteners
“Positive locking mechanism” are defined as those that:

a. The Tech Inspectors (and the team members) must be 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.

Also, “prevailing torque lock nuts” fabricated by a team will not be acceptable. We have no certainty that they will have the quality control to work all the time.
Nylon lock nuts ("Nylock" nuts) only acceptable in locations not exposed to heat (not above 80° C, such as very close to exhaust system.)
T11.2.1 Positive Locking - Examples
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
Securing Fasteners - Safety Wire

Good examples
T11.2 Safety Wire - sometimes

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- Cotter pins
- Nylon lock nuts
- Prevailing torque lock nuts

Note: Lock washers, bolts with nylon patches and thread locking compounds, e.g. Loctite®, DO NOT meet the positive locking requirement.

There must be a minimum of two (2) full threads projecting from any lock nut.
Safety Wire - sometimes

“Through bolt”
- Correctly installed safety wiring
- Cotter pins
- Nylon lock nuts
- Prevailing torque lock nuts

“Blind screw”
- Correctly installed safety wiring
- Cotter pins
- Nylon lock nuts
- Prevailing torque lock nuts
Safety Wire - sometimes

“Through bolt”

- Correctly installed safety wiring
- Cotter pins
- Nylon lock nuts
- Prevailing torque lock nuts
Safety Wire - sometimes

“Blind screw”

- Correctly installed safety wiring
- Cotter pins
- Nylon lock nuts
- Prevailing torque lock nuts
Safety Wire - sometimes

Blind screws

- Correctly installed safety wiring
- Cotter pins
- Nylon lock nuts
- Prevailing torque lock nuts
- Locking tabs (uncommon but OK)
Safety Wire - sometimes

All fasteners in this picture are acceptable **without** positive locking mechanisms!
(None are steering, suspension, harness, or brakes)

(Chain scattershield missing...)
T11.2.3 Securing Fasteners - Spherical 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.
T6.3 Wheel Mounting

• 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.

• 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.

• Aluminum wheel nuts may be used, but they must be hard anodized and in pristine condition.
T2.5 & S2.2.1 Visible Access

Visible Access

All items on the Inspection Form must be clearly visible to the technical inspectors 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 same wording is repeated in S2.2.1 Technical Inspection
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