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TARHEEL SPORTS CAR CLUB

High Performance Driving School

Technical Specifications Guide

TARHEEL SPORTS CAR CLUB

Technical Specifications Guide

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P.O. Box 3122 Wilson, NC 27895-3122

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Credits

The editor would like to thank the following for assistance in compiling this document and/or permission to re-print their materials:

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Introduction

The purpose of Annual Technical Inspection is to ensure each and every vehicle entered in a Tarheel Sports Car Club event is thoroughly inspected on a lift, once each season, by someone other than the owner and/or driver. Annual Tech will help insure that the vehicle is track-worthy enough to last a typical track event weekend. Breakdowns are both dangerous and disruptive to the event and can be minimized by performing normal preventative maintenance. Critical systems, such as suspension, brakes, steering and cooling, should be well maintained and in serviceable condition when the vehicle is presented for annual tech. Fully serviceable condition is defined as a component that is expected to perform its intended function for the current track season or calendar year. It is recommended the owner/driver have a shop manual on hand to verify service wear limits. The Annual Inspection sticker will only be issued to vehicles inspected in the manner described in this document.

Any non-OEM modifications or components must be secure and not interfere with safe operation of the vehicle. It is the sole responsibility of the owner and driver to ensure, at all times, the safety and suitability of their vehicle for high-speed track events. Persons performing the inspection are not responsible for the condition of the vehicle or the actions of its driver. The Driver must sign the statement at the bottom of the Tech form acknowledging the above statement before the inspector stamps or signs the tech form. This guide and requirement are NOT a guarantee against serious injury or death to those involved in an HPDE event in any capacity.

Items are listed in the order they appear on the Annual Technical Inspection Form. Where applicable, the SCCA General Competition Rules (GCR), SCCA Time Trial and Hill Climb Rules, or Department of Transportation requirements are referenced. Detailed drawings and safety equipment installation documentation have been included to aid in the proper installation and verification of non-factory supplied equipment.

1.0 Vehicle Interior



1.1 Throttle Pedal

Check for smooth travel and positive return

1.2 Rear View Mirror

Required. Must be securely mounted and consistent with the ability to pass State Inspection. Conditional waivers may be given, pending correction by the owner.

1.3 Windshield Wipers

Required. Check and verify operation consistent to pass State Inspection. Conditional waivers may be given; pending correction by the owner.

1.4 Glass

Pitting, chips, and small cracks are acceptable provided the structural integrity of the windscreen is not compromised.

Verify door windows roll down completely.

Verify DOT Safety Glass, Lexan, or Polycarbonate

1.5 Brake Pedal

Verify firm brake pedal. Soft and/or excessive pedal travel is not permitted or acceptable.

1.6 Steering

Verify smooth operation without excessive free play or leaks. More than two inches of total free play at the outer radius of the steering wheel rim is unacceptable. Verify against factory service manual for actual specifications.

2.0 Underbody/Suspension



2.1 Brake Pads

Verify the pads on the vehicle will be the same as used on track. If the driver plans to change pads upon arrival at the track, they are required to have those pads available for inspection when the vehicle is presented for annual tech. Pads and/or shoes used on track must not be less than the manufacturer's minimum thickness or .250" of friction material.

2.2 Steering linkage/Rack/Tie Rods

Securely mounted, dust boots in place. No excessive play in rack assembly. Tie rod assembly, idler arms and/or steering arm components must be in fully serviceable condition suitable for high speed track use.

2.3 Shock Absorbers/Struts

Oil seepage on struts is acceptable. Verify that mounts and bushings are in good condition. Each corner of the vehicle should settle after one bounce to insure high-speed stability during track use.

2.4 Ball Joints

Wear indicators must not exceed the factory specification and be in fully serviceable condition for high speed track use.

2.5 Tires

It is not required to present track tires at the Annual Tech Inspection.

Tires used on track must meet or exceed the speed rating specified by the vehicle's manufacturer. H speed rating is the required minimum, unless the OEM specifications are greater. Tires must be in good condition. Tires must not show cords at any time during the event. In order to facilitate wet weather use, the minimum tread depth should be 3/32" or .0937". Drivers using slick tires will not be permitted to run during wet conditions. We do not recommend the use of a repaired, plugged, or patched tire for high speed operation. Verify driver/owner is aware of the tire manufacturer's minimum and maximum recommended values of inflation pressure. Drivers are reminded that tires should be constantly monitored during the event for wear and inflation pressures.

2.6 Wheel Rims and fasteners

Inspect carefully for cracks or signs of impact damage. Wheel fasteners should be torqued to manufacturer specification or 90 ft lbs. Drivers are reminded to re-torque wheel fasteners before each track session. Threads of wheel studs must be at a minimum flush with the top surface of the wheel nuts. Threads of wheel bolts must fully engage the hub to original OEM depth.

2.7 Brake calipers

Securely mounted without any signs of fluid leakage.

2.8 Brake lines

Securely mounted, rust free, without any signs of fluid leakage, and consistent to pass State Inspection. Insure sufficient clearance from moving parts or heat sources. Use heat shields where necessary. DOT rated braided steel brake lines are highly recommended.

2.9 Fuel, Fuel lines & Containers

Securely mounted, rust free, without any signs of fluid leakage, lack of fuel odor, and consistent to pass State Inspection. Verify the condition of filter, pumps and/or accumulator where possible for integrity. Ensure sufficient clearance from moving parts or heat sources. Use heat shields where necessary. Gasoline or DOT approved Propane or GNG conversions are the only allowed fuel's permitted for HPDE. Fuel can only be carried in the stock factory specification fuel tank/tanks or an SCCA/FIA rated Safety Fuel Cell installed per SCCA GCR Section 19. NOX equipped vehicles must either remove the NOX bottle or verify 0 pressure in the system.

2.10 Suspension Location Points

Bushings and mounts in fully serviceable condition. Make certain any surface rust has not compromised the structural integrity of the vehicle.

2.11 Wheel Bearings

Tapered bearings should not have any play. Slight endplay in sealed units is acceptable. Endplay should not exceed manufacturer's maximum. Vehicles presented for Annual Tech must not have marginal wheel bearings.

2.12 CV Joints

Boots in good condition and not ripped or torn. CV joints and mounting hardware should be tight with shafts in good condition.

2.13 Motor Mounts

Check for cracks, separation, or other signs of failure where rubber meets metal. This is a common cause of breakdowns during track events.

2.14 Exhaust

Must be secure, leak free, and exit behind the driver. Drivers are reminded the venues we attend enforce a 93dB sound limit. Sound measurements are taken by track management to ensure compliance. Annual tech inspection cannot check for sound limits. The driver should be aware that an excessively loud car may be excluded from the event by the venue. For the purpose of Annual Tech, rotary engines require a muffler to meet the 93dB limit.

3.0 Vehicle Exterior



3.1 Brake Lights

Two functional brake lights are required. A conditional waiver may be given pending driver/owner correction.

3.2 Fluid Leaks

Slight oil seepage is common and acceptable. If the vehicle drips oil to the extent that it puddles on the floor, leakage is unacceptable. Any evidence of coolant system leaking is not acceptable. Pressure checking the coolant system is highly recommended. This is a common cause of breakdowns, is disruptive to the event, and poses safety issues.

3.3 Exterior Mirror

Left side mirror is required. It must be secure and functional.

3.4 Panels & Trim

Doors must latch and secure properly. Hood and deck lids must latch properly or be secured with retention devices such as hood pins. Bumper covers and spoilers must be secure.

3.5 Gas caps are required.

4.0 Engine Bay & Trunk



4.1 Battery

It must be firmly secured by OEM or a metal clamp and/or strap to a metal base. There should be no visible leaks or acid corrosion. Cables must be secured and in good condition

4.2 Relays & Electrical Harnesses

Secured, taped, and/or tie wrapped to protect from moving parts and protect from damage where passing through bulkheads. Conditional waivers may be issued pending correction by owner/driver.

4.3 Throttle Linkage

Where applicable, operate by hand to ensure smooth operation. Visually inspect for potential interference, and verify that cables are free from fouling.

4.4 Fuel lines

Secure with no evidence of leakage and protected from heat sources.

4.5 Fan Belts & Hoses

Fan belts and hoses must not show evidence of dry rot, swelling, softness, cracks or abrasion. Failure of these components is a common cause of on-track breakdowns and is disruptive to the event. Pressure checking the cooling system is highly recommended.

4.6 Brake Fluid

Cars must have clear fresh fluid when presented at annual tech and must be flushed within 3 months of an event. DOT 3 or DOT 4 high temperature rated fluid is recommended. However, the “freshness” of the fluid is more important than its temperature rating when new. This is of critical importance.

4.7 Exhaust Headers

Inspect and listen for leaks. This is a safety issue if exhaust fumes accumulate in the cockpit.

4.8 Tow Hooks

Factory tow/transportation hooks are to be installed where available. All vehicles are strongly encouraged to provide a means of attaching a tow strap to facilitate the timely recovery of the vehicle in the event of a mechanical issue or off track excursion.

5.0 Personal Safety (Driving School)



An example of forces involved in a roll over exiting a low speed corner.

Modern passenger cars are capable of providing a high level of protection. It is strongly recommended that vehicles used for both daily transportation and track use not compromise existing safety equipment. Vehicles used for the HPDE must, at minimum, meet State Inspection Standards.

No additional safety equipment is required to participate in the HPDE other than the use of a SNELL SA2005 minimum helmet.

Many drivers attempt to install competition harnesses in passenger cars to cope with the higher g-forces encountered during track driving. For the vast majority of vehicles, it is not possible to safely mount competition harnesses because there is no proper place to mount and position the shoulder harness, or ensuring that the anti-sub strap passes through the center of the seat bottom cushion. In many cases, “harness bars” that are used for shoulder harness mounting are too small, untested, and of unknown strength.

Harness bars should only be used to guide or position a harness. They must never be used for the anchorage of shoulder harnesses. Harnesses must be anchored to a structural member or bulkhead with proper reinforcement. Keep in mind that “peak loads of any lap or shoulder mounting point in a 35mph impact to a solid barrier is approximately 3,000 lbs for 60 to 70ms for a person of 175 lbs.”

Shoulder straps should never run downwards from the backrest (or backrest slots) more than 10 degrees from a horizontal plane without a harness guide bar that can take the load applied during a crash. The backrest of any seat, including race seats, is not designed to take this load and will collapse.

The recommended solutions for dual-purpose vehicles are:

- 1) 3 point OEM seat belt system or,
- 2) Schroth street legal ASM 4 pt harnesses systems that meet German TÜV, ECE-R 16.04, and US-DOT FMVSS 209. As these systems have been crashed tested and certified for use on public roads, they are acceptable for the HPDE as an alternative to stock 3 point belts or competition harnesses. However, the stock system must be retained for use at the discretion of the instructor. Note, the ASM system is not compatible with a HANS device.

If a driver so chooses, competition harnesses can be used for the HPDE but they must, without exception, be installed in compliance to the current SCCA GCR.

The appendix lists detailed drawings and descriptions to guide harness installation to ensure compliance. OEM replacement harnesses having the DOT label will have been tested to FMVSS209 Federal Certification. They will be specific to a make and model or be included on the list of make, models, and possibly seat type for which they are certified. It is mandatory for the driver/owner to produce this documentation to allow inspection of the vehicle. These documents can be obtained from the manufacturer and should be included with the harnesses. If this documentation is not present, it must be assumed the harnesses do not meet FMVSS 209 and will not be acceptable.

Examples of DOT spec harnesses are given in the Appendix of this document.

5.1 Driver & Passenger Restraints

5.1.1 Must be one of the following:

- Factory Stock 3 point system DOT (FMVSS209)
- Schroth Profi II ASM, Quick Fit Pro (limited BMW Mini, VW/Audi, and Subaru applications only), AutoControl II, Auto Control III, tested and certified to FMVSS209.
- SFI 16.1,116.5 or FIA 8853/89, 8854/98 certified 5 or 6 point Harness installed per SCCA GCR Section 9.3.19. The SFI or FIA certification label will indicate the date harnesses expire. The club policy is belts must not be older than 5 years.

See Appendix Figures 1, 2 and/or 3 for some examples of installation and threading but always use what the manufacture specifies.

- 5.1.2 All harnesses, hardware, retractors, and mounts must be in good condition, free of cuts, tears, excessive chafing, or signs of excessive UV damage that can reduce effectiveness, regardless of age and type.
- 5.1.3 Stretch indicators must not be visible.
- 5.1.4 THSCC enforces an “Equal Protection Policy”. This requires both driver and passenger have available the same level of protection. This applies to Seats, Harnesses, Padding and all installed safety equipment.
- 5.1.5 Harnesses must be inspected with the driver of the car seated in their normal driving position.
- 5.1.6 The driver’s (and passenger’s) head with helmet must fit inside the vehicle when seated in the normal driving position. The top of the helmet must not exceed beyond the height of the roof or T-Top along a plane starting from the top of the windscreen frame to the top of the rear C pillar (or Roll Bar, if equipped). There are no exceptions to this minimum requirement. 2 inches of clearance is highly recommended.

5.2 Helmets

Helmets used for the HPDE must be SNELL Foundation rated SA 2005, SFI 31.1a, 31.2a or higher. Such helmets will have a SNELL or SFI sticker designation either under the padding or embossed on the outer rear of the shell.

- SNELL designates the SNELL Memorial Foundation.
- SA designates Special Applications for Motorsports.
- SHA designates helmets with tether mounts factory installed.
- M (Motorcycle) rated helmets are no longer acceptable.
- SNELL SA2005 or SA2010/SAH2010 rated helmets are required.
- The number designates the year the helmet was rated. Designations older than 10 years are not acceptable.
- Example: SA 2005 will expire Dec 31, 2015.
- SFI designates the SEMA Foundation Inc. safety rating.

5.3 Convertibles

Convertibles must have a roll bar to participate in the HPDE. This is a requirement of all venues where we currently hold events. Hard top vehicles do not require roll bars to participate in the HPDE.

- 5.3.1 Targa or T-Top models are not classified as convertibles and thus do not require a roll bar.
- 5.3.2 Convertibles with removable roofs installed are still convertibles and require a roll bar.
- 5.3.3 Roll Bars must meet SCCA Time Trial Rules spec as defined in the current SCCA Time Trial and Hill Climb rules.
- 5.3.4 Factory installed “head rest braces”, “roll hoops”, or aftermarket “style bars” do not meet this requirement.
- 5.3.5 Roll bars must be installed per the requirements in the SCCA Time Trial and Hill Climb rules.
- 5.3.6 The roll bar must be padded with high density padding in areas where a helmet may contact. Assume 6 inches minimum for seat and/or harness displacement.
- 5.3.7 Both the driver and passenger must use arm restraints. Miatas using SPEC Miata approved bolted-in roof top brackets are exempt from using arm restraints.

5.4 Driver Clothing

Drivers and passengers, when on track, must wear long sleeve shirts and long pants of natural fibers with closed toe leather top shoes. Driving suits are recommended but not required.

6.0 Documentation

6.1 Annual Tech Sticker

Punch out the year.

Place at the **lower left corner** of the windscreen.



7.1.2 Approved Annual Tech facilities.

All vehicles participating in the HPDE must have an annual tech performed. Track Inspections can be performed at any shop of the participant's choice. Inspections performed at recommended shops will qualify to receive an annual tech sticker. Alternatively, the club may reserve the right to issue a single-event or weekend tech sticker. The club may perform a safety audit to any vehicle, at any time, during the event. Substandard vehicles may be rejected by club officials at any time prior to or during an event. It is the owner/driver's responsibility to ensure their vehicle is track ready before arrival at the event.

Please see the current list of recommended shops to have an annual tech performed, as well as any scheduled annual tech days, and the tech form to use on our web site.

6.2 Helmet Sticker

Place at lower left side of helmet.

Orange sticker designates SA rated helmets valid until 12/31/15

6.3 Annual Tech Form

Must be signed and dated by the driver/owner.

Must be signed or stamped by the person or shop that performed the inspection. One copy should remain with the car. The signed original should be turned in at your first event registration for the season and kept on file by the HPDE Tech Director.

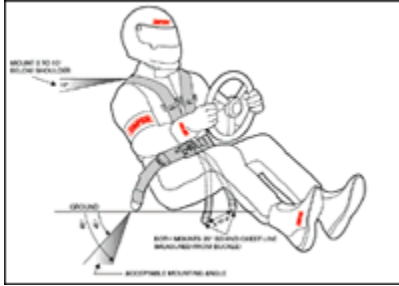
6.4 DOT Aftermarket Restraints

- Must have a DOT Label and documentation, by the Manufacturer, of FMVSS209 certification and intended make and model of application.
- Must have installation sheet provided by Manufacturer to verify the restraint system was installed in the same configuration it was certified.
- Must be installed in the vehicle application following the methods documented to achieve FMVSS209 certification.
- DOT/FMVSS209 certified restraint systems can include 4 point harnesses.
- 4 –point harnesses not meeting DOT/FMVSS209 (“competition models”) are not permitted in the Driving School.

Appendix I

- Figure 1. Simpson Race Products 5 and 6-point Harness Product Guide
- Figure 2. Simpson Race Products Harness Mounting Product Guide
- Figure 3. Simpson Race Products Harness Webbing Product Guide
- Figure 4. GFORCE Harness Installation Guide
- Figure 5. SFI Article on SFI rated competition seat belt systems
- Figure 6. Typical SCCA TTR Spec Roll bar by Autopower
- Figure 7. SCCA TTR Spec Roll Bar “Hard Dog” Miata Single Diagonal
- Figure 8. Alternative TTR Spec “Hard Dog” Miata Double Diagonal
- Figure 9. SCCA TTR Spec Roll Bar “Hard Dog” BMW Z3
- Figure 10. Brey-Krause Roll Bar Extension for the Porsche Boxster
- Figure 11. SCCA TTR Spec. Roll Bar Honda Sports 2000 “Hard Dog” manufactured by Bethania Garage.
- Figure 12. SCCA TTR Spec. Roll Bar Toyota MR2 (Bethania Garage)
- Figure 13. Approved Roll Bar for Viper #220-601 and seat lowering kit
- Figure 14. SCCA Spec. Drawing for Slip Joint for Removable Diagonal
- Figure 15. FMVSS 209 Rated OEM replacement Harness acceptable for HPDE only.
- Figure 16. Example of an acceptable Harness Bar.

UPRIGHT SEATING POSITIONS

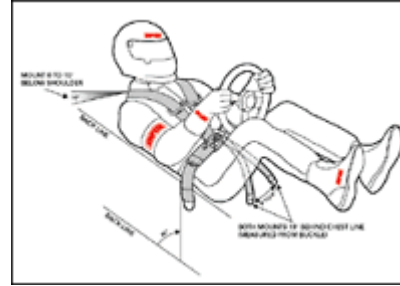


Lap Belt must be anchored to the frame rail or roll cage as close to the hip as possible at an angle of 45 degrees, but no greater than 60 degrees to the ground.

5-Point Anti-Submarine Belt should be anchored on or slightly behind the Chest Line¹.

6-Point Anti-Submarine Belt should be anchored at an angle of 20 degrees behind the Chest Line as measured from the intersection of the Chest Line and the lap belt buckle. Mounts should be approximately 8 to 12 inches apart (approximately located under each hip and as close to the body as possible). Two routing holes in the seat or a special seat mount may be required. Using the 5-Point hole detracts from the effectiveness of this system.

RECLINED SEATING POSITIONS



Center Shoulder to Center Hip angles between 30 to 50 degrees to the ground.

Lap Belt anchors must be positioned at an angle of 60 degrees in relation to the Back Line² and mounted to the frame rail or roll cage as close to the hip as possible.

5-Point Anti-Submarine Belt should be anchored approximately 10 degrees behind the Chest Line as measured from the intersection of the Chest Line and the lap belt buckle.

6-Point Anti-Submarine Belt should be anchored at an angle of 10 degrees behind the Chest Line as measured from the intersection of the Chest Line and the lap belt buckle. Mounts should be approximately 8 to 12 inches apart (approximately located under each leg, even with the pelvis).

ALL SEATING POSITIONS

Anchor shoulder straps at point zero to 10 degrees below the top of the shoulder. Note: Preferred mount is as close to shoulder as possible.

Shoulder Harness Adjusters should be located in line with the bottom of the sternum (lower chest area).

During adjustment of the belts, make sure that webbing enters and exits straight and in-line with all adjusters and mounting hardware.

Figure 1. Simpson Race Products 5 and 6 point Harness Product Guide

MOUNTING BRACKETS

Mounting brackets should be installed at an angle that is compatible with the direction of pull on the webbing under full load. Preferred mount is in a double shear with allowance for the bolt-in bracket to pivot and align toward the direction of the load as shown in Figure 1.

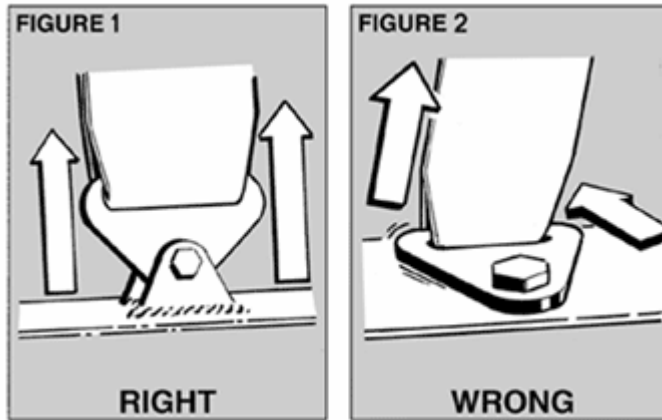


Figure 1 and Figure 2

All mounting brackets should be attached directly to the frame or chassis of the car and installed to limit the driver's body travel both upward and forward. Do not weld around or near belts or belt hardware.

Minimum specification for bolts and washers to attach the seat belts, harnesses and anti-submarine belt hardware are Grade 8.

Wrap Around style mounts should have a provision to prevent lateral or side-to-side movement.

DO NOT MOUNT TO THE SHEET METAL FLOORBOARD. ALL MOUNTS SHOULD HOLD A MINIMUM OF 3,000 LBS. FORCE.

Figure 2. Simpson Race Products Harness Mounting Product Guide

WEB INSTALLATION

Belt webbing must have an unobstructed travel path. Allow a minimum 1-inch space around the belts in the seat opening for anticipated travel. Your belts will move in the direction of the impact. Make sure this area is clear of obstruction. All edges including any seat holes must have an edge guard to protect the webbing against abrasion and cuts.

Keep belts away or protected from sources of heat (i.e., exhaust headers and welding).



UNDER NO CIRCUMSTANCES ARE BOLTS INSERTED THROUGH BELT WEBBING ACCEPTABLE FOR MOUNTING.

"LOCKING" the 3-Bar Slide Adjuster shown in Steps 1 through 4 is VERY IMPORTANT. The 3-Bar Slide Adjuster must be located as close as possible to the Bolt-in bracket or Roll Bar (in Wrap Around design).

Figure 3. Simpson Race Products Harness Webbing Product Guide



Extremely Important Harness System Information

Most or all of our seat belts meet or exceed SFI-16 specifications. Useful life of webbing in the best conditions should not exceed two years and it is highly recommended that it be replaced at or before that time. If involved in an accident or fire, or if webbing shows wear or abuse, the it should be replaced or returned to the manufacturer for inspection. All metal hardware should not be welded on, bent or straightened or modified in any way. Seat belts should not be exposed to excessive heat, gasoline, solvents, or anything that could degrade or damage them. It is very important that the user should inspect seat belts before each and every use. Seat belts are manufactured for off-road use only. Seat belts should always be used as a complete set (lap belt, shoulder harness and crotch strap).

Important Notice

Seat belt webbing is designed to stretch up to 20% of its total length to help absorb impact. Your body also stretches in an impact. Be sure to have adequate clearance for the driver from the steering wheel, rollbars and other impact areas in the vehicle. Pad those areas where the driver may experience unavoidable contact as a result of an accident. (WARNING: Seat belts are not D.O.T. approved and should not be used for street use).

Warning

Motor racing is extremely dangerous. Death or injury will occur. The products we sell have no warranty or representations made with the ability to protect against injury or death. The user assumes that risk. Most or all of the items are for off road use only and are not approved or recommended for street use.

Installation Instructions

Harness sets are designed for use with a sub-strap. Use of harness set without sub-strap can cause serious injuries!

The sub-strap holds the harness buckle in place over the pelvis area and helps prevent the driver from sliding down in the seat. The pelvis area can withstand 5000lbs. of load before serious injury where the abdominal area can withstand only 800 lbs. of load so it is very important that the harness remains in the proper location.

Seat belt installation instructions are general guidelines only. Please refer to the installation requirements of the sanctioning body you are racing under or consult a professional engineer for your particular application.

Floor mount hardware on the ends of the lap belt that attaches your belt assembly to the floor must be mounted in a vertical position. When using this type of hardware for any reason, shoulder harnesses or belts must be mounted vertically. Seat belts are not to be mounted to sheetmetal, but to frame, rollcage or factory seatbelt mounting points.

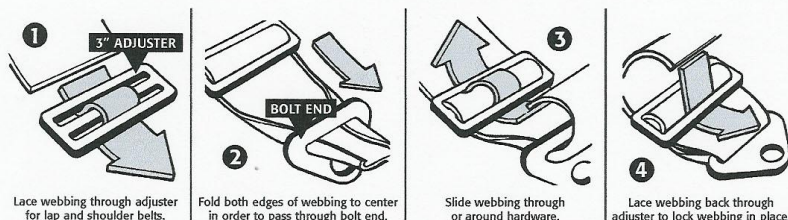
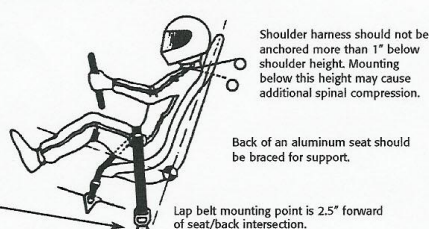


Figure 4. GFORCE Harness Installation Guide

Figure 5. SFI Article on SFI rated competition seat belt systems (two pages).

Participation in the program is purely voluntary, so this does not mean that all manufacturers not in the program produce inferior belts. Their restraint assemblies may be just as good as one that is certified, but they merely choose not to participate in the SFI program. However, to ensure quality belts, it would be a good idea to look for the SFI label.

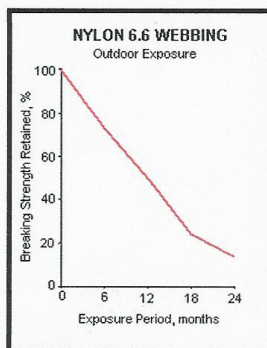
The standard that applies to safety belts is SFI Specification 16.1. The spec defines a driver restraint assembly and outlines basic design dimensions and requirements. It also explains the testing procedures in detail and how to interpret the test results to determine if the product meets the required criteria and thus passes the test.

Once a product is passed, the manufacturer installs SFI certification tags on the belts which display the date of manufacture. The purpose of the dated certification tags is to enable drivers and race officials to easily determine when the belts reach their 2-year life span. One of the most important requirements of the specification states that the useful life of the webbing in the straps of the restraint assembly shall not exceed two years and they must be replaced at or before that time. Only the original manufacturer can reweb an assembly prior to recertifying.

Seat Belts Should be Inspected and Recertified Every Two Years

Restraints must be maintained, inspected, and replaced or rewbed **every two years** because they degenerate from exposure to the elements and over time. Prolonged exposure of seat belt webbing and thread to sunlight can cause degradation of the fibers and loss of restraint integrity.

The rate at which the breaking strength of the webbing decreases with outdoor exposure is illustrated in the graph below. The webbing used in motorsports restraints is typically made with DuPont Nylon 6-6 or a similar product. According to the data, the webbing loses about half of its strength in one year.



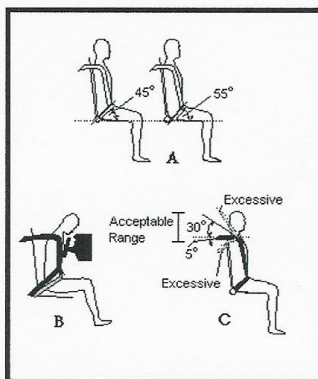
With this kind of rapid deterioration, it is obvious why replacing the webbing every two years is essential to driver safety. Old and weakened belts could easily snap under the loads imposed upon them in an accident situation. Failure to properly restrain the driver in a crash would have devastating consequences.

Proper Installation is Important

The effectiveness of a restraint assembly is also influenced by attachment techniques. The principal precaution for installing the mounting hardware to the vehicle is to minimize bending stress in the fitting. This is achieved by making sure the belts pull from a straight angle against the hardware. The assembly should be installed so that the straps do not rub against any surface that can cause the webbing to fray. The anchoring mechanisms should also periodically be checked so that they don't become loose or weakened.

Proper installation of the restraint assembly also means achieving the correct fit to the driver. Belts should be as short as possible to reduce stretching for better control of occupant movement.

The attachment points must provide the optimum geometry to minimize movement of the belts. Lap belts perform best when they act at an angle between 45° and 55° relative to the longitudinal axis of the vehicle as illustrated in part A of the Figure. This angle permits the lap belt to react to the upward pull of the shoulder harness. A system installed with a shallow belt angle, as shown in part B of the Figure, permits the shoulder harness to pull the lap belt up off the pelvic area and into the abdominal region with the likelihood of injury to internal organs.



The end attachments of the shoulder harness must also be installed at appropriate angles. The ideal position is anywhere between 5° below and 30° above the driver's shoulder, as seen in part C of the Figure.

If the upper attachment point falls significantly below the driver's shoulder, then a spinal compression injury is likely to occur. In an accident situation, the shoulder belts pull down and back on the torso as they resist the forward motion of the driver. The resultant restraint force compresses the spinal column and will add to the stresses in the spine already caused by the force of the crash impact.

On the other hand, if the trailing ends of the harness are too far above the shoulder (greater than 30°), then two problems can occur. First, tension in the shoulder harness is increased and undue stress is

applied to the harness and its structural attachments. Second, excessive angle will cause excessive motion. If the harness belts are too far above the shoulder, they will provide little resistance to forward motion of the driver's upper torso. The result is impact with the steering wheel and the possibility of neck injury. The shoulder straps should also be 3-6" apart behind the driver's neck to prevent slippage off the shoulders.

The reliability of a restraint system is greatly affected by the way it is installed. It is imperative to follow the installation instructions provided by the seat belt manufacturer. Also, the necessity of replacing or rewebbing seat belts every two years cannot be more important.

As cars become more advanced and consequently go faster, everything possible must be done to make the racing experience safe as well as fun. Failure to do so can cause serious injury, or worse. If there is anything that can be learned from the sport of racing, it's that anything is possible, and taking the attitude that "it won't happen to me" is risky, because it does happen.

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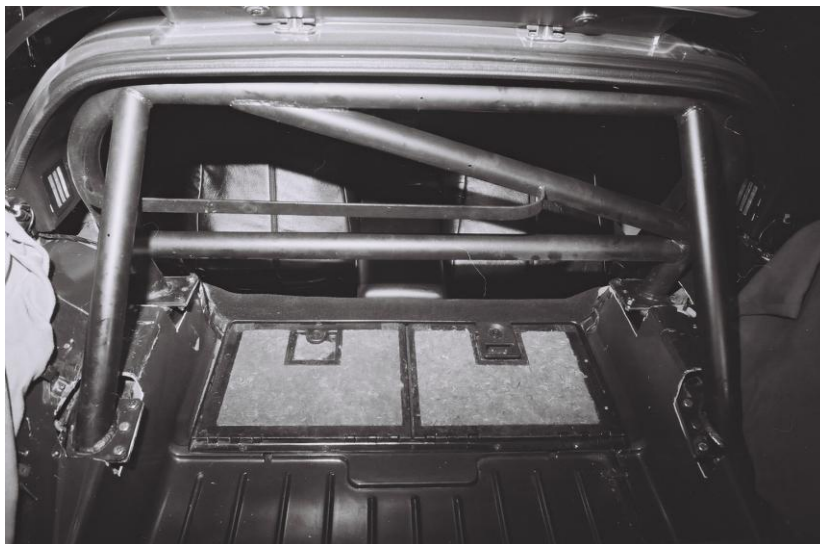


Figure 6. Typical SCCA TT Spec Roll bar by Autopower



**Figure 7. SCCA TTR Single Diagonal Spec. Roll Bar: “Hard Dog”
manufactured by Bethania Garage**



Figure 8. Alternative TT Spec. “Hard Dog” Double Diagonal



Figure 9. SCCA TTR Spec Roll Bar BMW Z3 Bethania Garage



Figure 10. Brey-Krause Roll bar extension for the Porsche Boxster



Figure 11. SCCA TTR Spec. Roll Bar Honda Sports 2000 manufactured by Bethania Garage.



Figure 12. SCCA-TT Spec. Roll Bar Toyota MR2 manufactured by Bethania Garage



Figure 13. SCCA/NHRA Dodge Viper Roll Bar
#220-601 snakeoilproducts.com; Seat lowering Kit #222-532-100-00 required

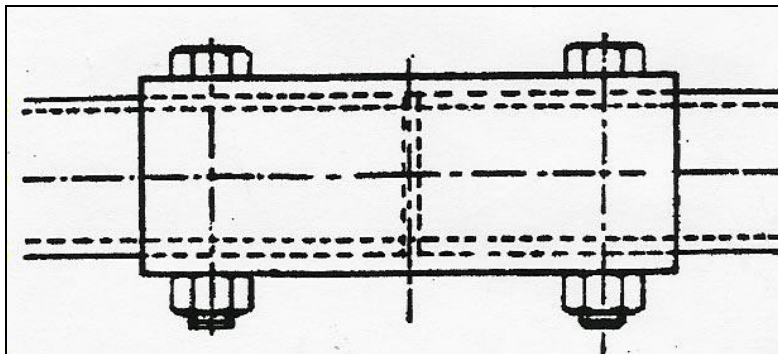
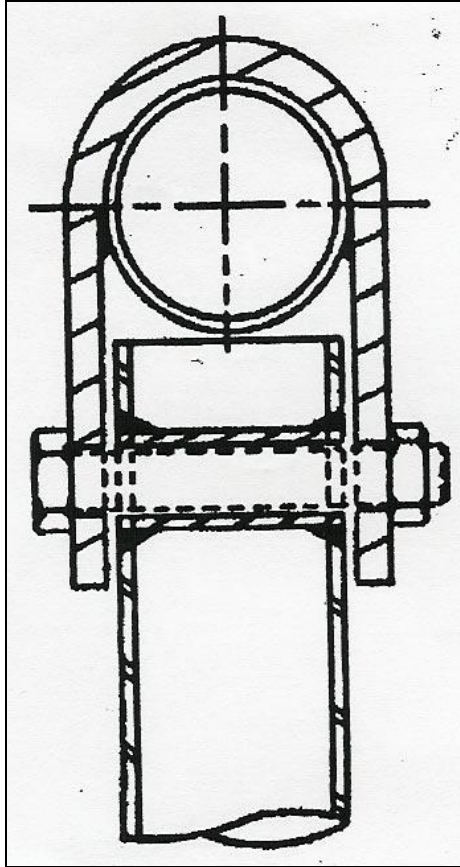


Figure 14. SCCA Spec. Drawing for Slip Joint and Removable Diagonal



Refer to Schroth web site for installation information and documentation:
<http://www.schrothracing.com/main/Documents>

Figure 15. Schroth DOT-FMVSS 209, TUV, and ECE-R 16.04, 3 point Street Legal Vehicle Specific Harness. Make and model of the applicable car is printed on the tail strap label. ASM Autocontrol II, PROFI II ASM, and Quick Fit PRO



Figure 16. Acceptable Harness Bar and Seat Back Brace Mount.

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