Building A Race Car: Part 6

Safety is the first priority

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PAUL MELHADO PHOTO

"Gentlemen, please think safety. Build these cars to absorb energy, make the cockpit areas strong and padded, think fire, watch oil lines, fuel lines, anything containing hot or flammable liquids around exhaust. You men know this; don't jeopardize your existence," said Dick Beatty at a drivers' meeting in Atlanta in early 1985. While Beatty was director of competition for NASCAR, he repeated these words hundreds of times at drivers' meetings.

To those growing up in motorsports, safety issues and actual danger become second nature. The reality hits home, however, when they lose a friend in a tragic accident on the track or in the pits.

Driver and crew safety begins with careful preparation of safety systems and chassis design. As we learned in our discussion of chassis construction (May 1999), roll cages not only stiffen a chassis to enhance handling, but also protect drivers when violent rollovers occur. The front and rear clips, which attach to the driver's cockpit area, not only hold suspension parts, but also absorb energy on impact.

The absorption of energy is important in any collision. In a car running 100 mph, the driver's internal organs are traveling at the same speed. When a car hits an object, the car and driver stop abruptly, but the organs are still traveling and collide inside body cavities. When the brain impacts the inside of the skull, the bruising that occurs is called a concussion. Better helmets, seats and seat restraints increase the safety of the vessel (the driver's body), but do not insure the contents.

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Richard Petty's spin down the front stretch at Daytona and Michael Waltrip's

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Bristol crash in the Busch Grand National race are good examples of energy displacement. The King's car spun on end with the body disintegrating piece by piece, using all the energy until no inertia was left. Although bruised by seat belts and dizzy from spinning, Petty walked away unhurt.

Waltrip's crash was one of massive impact. The car hit in an opening coming off Turn 2 and was destroyed from end to end. The silence that followed that wreck in Bristol was deafening as spectators waited. They feared the worst until Waltrip's motionless legs began to move, the roof and dash lifted, and he stepped out.

The impact had stripped the drivetrain from the car. The front sub-frame was severed from the main cage and chassis section. The Grand Prix body was stripped from the chassis. The seat and belts were still secured in the driver's compartment, but the dash and floor board were separated on impact. Each bolt that stretched, tube that bent, and panel that collapsed used up the energy and saved Waltrip's life.

At one time, Indy cars had no safeguards to expend these dangerous forces. Many drivers who made light impact sustained internal injuries. It took many years for the Indy car industry to install energy-absorbing devices such as impact boxes on rear gear boxes, side pods and extended wings on the front.

With these thoughts in mind, let's cover safety measures that we can install in construction.

Seat Yourself

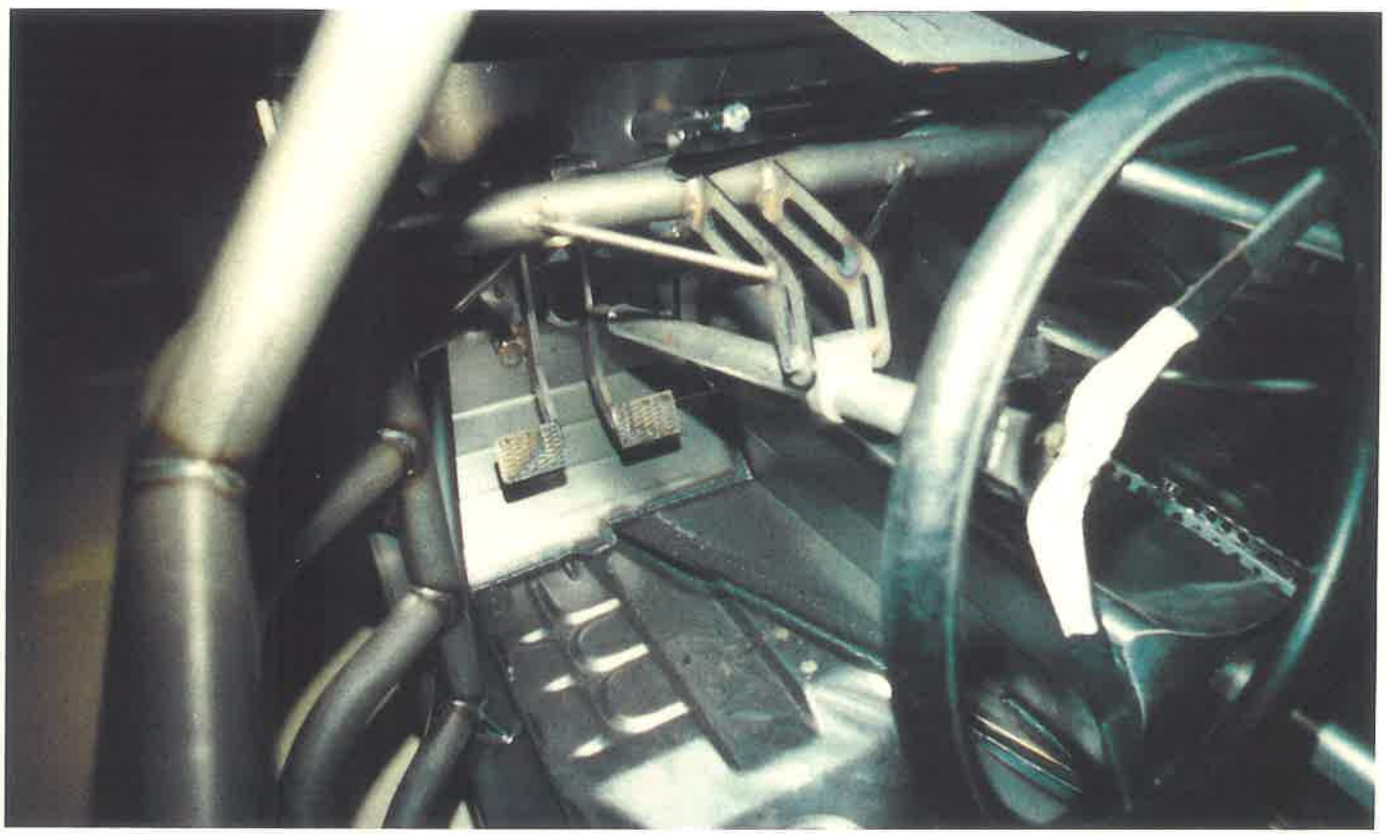
Driver environment is very important. Seats are the pivotal point of the driver compartment. Years ago the common seats used were van seats. Low-back bucket seats with fabricated rib braces and very little support or padding sat in each cockpit. These seats were not only unsafe, but uncomfortable. Drivers sat up straight and would fall out of their seats with fatigue. The 1980s saw the introduction of custom-fitted seats that protected drivers with rib supports, head supports and shoulder supports. Seat manufacturers sprung up using common designs to enhance driver comfort. Today 20-degree lay banks, lower rib protectors, shoulder supports and leg supports are fitted to each driver.

The seat belts in use now evolved from the four-point fighter pilot belts designed in the early 1940s. Belt manufacturers took common designs in the buckles, added Nomex webbing and threads — along with many colors — to meet the demand. Many manufacturers are working to develop safer belt material to make fireproof, longer lasting belts. Belts are dated for inspection purposes.

Flame Retardant

Years ago, fire systems consisted of household, hand-held fire extinguishers. In case of an interior fire, drivers had to unlatch extinguishers and pull the pin. This process took minutes and in fires, drivers don't have minutes.

In the late 1950s, NASA, working closely with the U.S. Navy, started charging fire extinguishers with Halon. This odorless chemical absorbs oxygen, and suffocates the fire. The use of Halon in the interior of race cars was heaven sent. Easily discharged with a push-pull button from a five-pound bottle, the Halon easily absorbs



The small tubing gussets that hold the steering column stiffen the total package, but in a collision, the brackets bend left or right. The pedals are similarly constructed. They are super strong, but bend right or left if a driver's legs are caught between them.

Safety is important in car construction. Notice that the seat bracket assembly fastens to the roll bars, not to the frame. In a collision, the seat will travel with the roll cage.

all the oxygen created by a fire in a cockpit area. In 1998, Halon production was halted because of ozone depletion. Halon banks say at present consumption, all Halon will be gone in 10 years.

However, the U.S. Navy has already developed a replacement for Halon, and some motorsports fire extinguishers contain the new chemical.

Padded Protection

Roll bars protect drivers, but this maze of restraints also opens up the driver to many injuries. Roll bars have to be padded for protection. For many years, they were padded with insulation, but the density of foam did little to absorb the force of a swinging arm or head. BSCI, a company experienced in energy-impact systems for seats, stepped up and designed high-density, fireproof roll bar padding in the late 1980s. Although many companies boast fireproof padding, only BSCI has padding that doesn't melt in a fire. (Ninety percent of driver burns are caused by melting plastics.)

Necessary Hazards

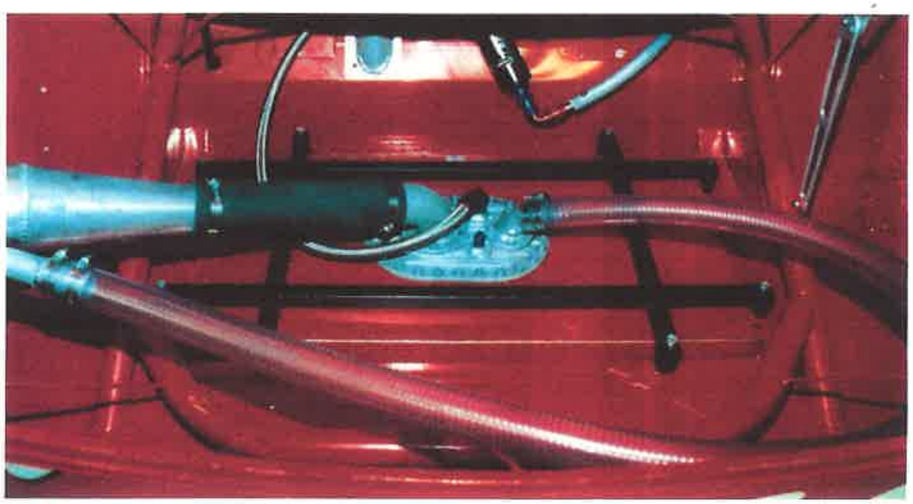
The driver environment also includes many objects that are necessary, but may cause injuries. Brake and clutch pedals can easily break legs in a violent crash. To eliminate this, pedal manufacturers build strong pedals that have a swinging motion that bend easily, side to side. Collapsible steering shafts allow drivers to move them as crashes happen. Mounting brackets of lightweight material for pedal and steering units also absorb energy exerted as the driver applies force during collisions.

Racing fuel is the most volatile fire hazard in a race car. In the early years, rear collisions that destroyed gas tanks meant explosions, which often splashed gas on the drivers, fans, and crew members. Firestone was one of the first companies to develop aviation-type fuel cells filled with foam. These tanks eliminated the splash on impact and slowed leakage considerably when wrecks introduced holes in tanks.

The air-pocket foam holds fuel in a cell enclosed in rubber, tear-resistant bladders. The fuel cell top is equipped with a rollover value that uses stainless steel balls to seal filler and breather holes the minute the car is on its side.

The quick-fill system used by crews during a race was developed by Kaiser for aviation use. The cell can only be filled by a probe designed to push open the fill pathway. Another probe built in the catch can opens a breather tube so air may exit from a cell as fuel is forced in. This check valve stops excess fuel from splashing in the pit area or on the track when the car accelerates as it leaves pit road.

Next month, the tricks begin as we learn about both chassis and drivetrain assembly.



A steel firewall protects the driver from the fuel cell area in the trunk. The fuel quick fill tube (left) follows designs used in the aviation industry. The breather tube (right) vents fumes and excess fuel during refueling. A #10 stainless line connects the fuel cell to a fuel filter that is routed through the driver's compartment in a seamless tube.