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Building A Race Car: Part 3

Chassis Construction

As we begin construction on our Winston Cup car, we have to make many decisions. Before the first tube is put in place, we have to make choices on spindles, roll centers, anti-dive and snout location. For our purposes, a standard straight up car using standard spindles with dropped steering arms will establish the geometry needed to compete successfully on flat, short tracks. Geometry and alignment will be covered in later months.

The first issue to cover in construction is material, so let's review. When looking at a Winston Cup car, the most visible part is the roll cage, a rigid super structure, a 150-foot maze of interlocked, fitted and welded tube. NASCAR rules require many mandatory bars using .090 seamless tube for the main safety structure. The upper halo, back loop, post bar, all cross bars, dash behind the driver, and rollover bars have special locations and measurements.

Interwoven with these are many bars placed in position to add strength under race conditions. These straight truss bars can be made with smaller- diameter and lighter-wall bars. Not all are mandatory. In fact, the total roll cage package, which is often designed by the crew, can save many pounds of weight by using strategically placed bars.

Understanding material puts some manufacturers ahead of others. When ordering .095-wall seamless tube, price and knowledge are critical. Mill runs are random and can vary on the low side at .090 to the high side at .100. Tubing that measures at low sides can save 10 percent per foot. Each Winston Cup car contains 150 feet of round tubing. Normal tubing specs, in thousandths of inches, include .090 13/4 seamless tube 1018 carbon steel. The remainder of the tubing is DOM tubing, that is, welded tubing which is drawn over a mandrel. These are: .090 13/4 tube; .083 11/4 tube; .083 13/4 tube; .065 13/4 tube; .065 11/2 tube.

The actual chassis is a rectangular tubing frame, side rails, front clip and rear clip, made following the strict guidelines NASCAR has established. The side rails are 3x4 rectangular tubing, .120-wall thickness. The front clip and rear clip are cut and mitered from 2x3 rectangular tube .083 thick. Many brackets and suspension points are laser cut from materials as thick as 3/8-inch plate. Bushings are made from special DOM tubes and machined to fit.

With material identified and cut to fit the chassis, the construction process begins. Complex clip fixtures are used to assemble mitered tubing, laser cut brackets and custom-machine bushings. Patterns and fixtures used are the result of an evolution that began in the 1970s. Twenty years of component development incorporated new technology and engineering. These simple fixtures have been updated, duplicated and totally redesigned over the years. The need to duplicate components identically and affordably has turned these customized tools into assembly lines, meeting team needs.

Front clips are fitted and welded completely on jigs. Rear clips follow the same path. Roll cages are also built on jigs. These fixtures insure that bar length and exact

Above: Construction of the front clips includes using a table-mounted jig. These are commonly built by the same individual to insure quality. Right: This wall is covered with patterns that are used for battery boxes to lower A-arm mounts. Some of these patterns have been used for 20 years.

placements exist for each car. Roll cages are welded completely on a jig and in sequence. Trailing arm cross members are also fixture developed.

Brackets and tubing are joined into an exact unit that can be duplicated again and again. The patterns for each bracket and the layout measurements for each roll bar are followed perfectly for each car. Just as a baseline, these records and patterns have been saved through the years for a point of return. Some have been eclipsed, never to be used again. The rest are a constant as technology changes.

Once the small sub frames are constructed, the frame construction starts by placing each sub frame in the master fixture. Again, these are welded together in sequence to insure complete duplication. As the chassis becomes a complete unit, the main roll cage is set in place. At this point, interior sheet metal development begins.

All Winston Cup cars share a common floorboard. This floor stamping came into Winston Cup during the Holman-Moody days as a production-common floorboard. The stamping process produced a strong component utilizing very little material. As the years passed, this Ford Motor Company part continued to meet racing's needs. However, in the early 1980s, Ford discontinued this floor part number, which put the racing world in an extreme shortage for this part. Hutcherson-Pagan and Banjo Matthews explained the racing industry's needs to Ford Motor Company and a new part number was established to continue production.

Using patterns already developed, holes for roll bars, the master cylinder and the transmission tunnel are laid out in the front firewall. Placement of the firewall in conjunction with the floorboard allows roll bars connecting the main cage to the front clip to be installed. The rear firewall is then put in place. Rear roll bars tying the main cage to the rear clip are installed, allowing shock mounts and track bar mounts to be incorporated. A complete finished chassis is often referred to as a surface plate car. Surface plate cars include all component mounts, seat mounts, belt mounts, brake pedal mounts and interior sheet metal.

Above: Roll cages are custom bent following patterns and measurements that insure the consistency of each cage. This tubing bender is table-mounted and the fabricator is reading a scale for duplicating bends. Notice the ever-present NASCAR rule book on the bender table.

At this point, component construction starts and follows the same basic path. Upper control arm jigs are built on adjustable fixtures that allow caster and camber changes to be made as construction takes place. DOM tube of .083, a machined ball joint ring, a control arm shaft and bushings placed properly into the fixture are welded into a well-engineered component.

Lower A-arms are a takeoff on the late GM lowers. The wide-stance lowers were commonly found in Camaros, Novas, etc. and, although stock geometry was followed, the lowers had to be narrowed to reach rules. Fabricating lowers gives control in construction and incorporates many machined parts, such as ball joint rings, mono-ball housings and spring buckets.

Truck arms, too, are jig built. For years, stock components were modified to fit guidelines. But as stock part suppliers diminished, constructing fabricated components meant developing jigs and the machined parts needed. Following the same evolution of lowers and truck arms,

steering components started as factory components. Re-engineering steering geometry meant major component modification and as these geometries were documented, the need to change became necessary for different applications. Components with removable slugs again introduced custom fabrication with additional fixtures to construct.

Fixtures for roll cages, clips, crossmembers and components have been developed for two purposes — duplicating perfectly and duplicating efficiently. Winston Cup chassis builders produce a chassis every two days. This production rate is very deceiving when each chassis' components and pre-built parts use $1,000 dollars' worth of material, and take 175 manhours to build. Chassis manufacturers utilize manpower and material more efficiently than anybody in the Winston Cup construction chain.

Next month: Body construction begins.

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Above: The jigs are used in the placement of the roll cage on the chassis fixture. Notice that interior metal installation has started. Left: This fixture is for seat rails and seat belt brackets, later placed as a complete component in the car and welded. Left below: This lower A-arm fixture incorporates many machined parts, which, like a jig-saw, are cut and fitted to be welded as an assembly.