



So You're Thinking Of Building An Off-Road Race Car...

Labour Of Love

You might be thinking, "I might have a go at building one of these. How hard can it be?" Well, my advice is to go for it, but be warned. By the time it's finished, it'll take 5 times as long and be twice as expensive as you first thought.

It's hard to appreciate how much work goes into building an off-road race car. It truly is a labour of love.

The Essentials

Deciding on what to build depends mainly on your budget. However, even the most basic vehicle needs a few essentials:

Roll cage:

- Fundamental and absolutely crucial. The difference between a good and bad roll cage can literally be the difference between life and death – or at least life in a wheelchair.
- Roll cages need to comply with Australian Standards. It's quite complicated - a quick Google search will give you an idea of just how much is involved.

Certified racing seats:

- These stop you from being thrown around inside the car and protect you in an accident.
- Again, they need to be approved and compliant with Australian Standards.

Racing harness:

- A quality harness is your best friend. You can't race without them.
- You guessed it – Australian Standards apply.

Sealed and ventilated fuel cell:

- Not mandatory in some classes of racing. However anything that minimises the chances of a fire or explosion has to be a good thing!

Fire extinguishers:

- A cheap (and compulsory) form of insurance.

Safety gear:

- Quality helmet, neck restraint, racing (frameproof) suit.



THIS IS A GREAT EXAMPLE OF HOW A WELL-BUILT ROLL CAGE - AND ALL OF THE ITEMS MENTIONED IN THIS SECTION - CAN SAVE YOUR LIFE. THIS VEHICLE HAD A STEERING FAILURE AT HIGH SPEED, ROLLED END-FOR-END SEVERAL TIMES THEN BARREL-ROLLED. BOTH OCCUPANTS SURVIVED WITH NON-LIFE THREATENING INJURIES.



NOTICE HOW THE CABIN IS STILL INTACT, FORMING A SAFETY POD AROUND THE OCCUPANTS. WHILST THE DOOR SKINS WERE RIPPED OFF, THE ACTUAL DOORS STILL OPENED AND CLOSED! A WELL-BUILT ROLL CAGE IS ABSOLUTELY ESSENTIAL.

In contrast, go [here](#) to see a spectacular rollover. Note the fuel pouring into the cabin after the crash. This is what you *don't* want to happen. Also note the bent roll cage after the accident. Two very lucky people...

Decision Time

An enormous amount of work goes into these vehicles. Most of it is hidden. To give you an idea, here's a quick list:

Donor vehicle:

- Think carefully about what you are going to start with. Is it a common vehicle?
- Can you easily get spares – body panels, suspension components and so on? This applies especially to the motor.
- Are spares cheap? Toyotas are rare in off-road racing. Their spare parts are expensive.
- What are the known weak points? For example, Nissan Patrols crack chassis rails and old model Pajeros (pre-monocoque) bend upper front control arms.

Internal fittings and trim:

- A massive job. Stripping the internals down to bare metal involves removing seats, dashboard, internal linings, soundproofing, seat belts, wiring, a myriad of plastic lugs and so on. Soundproofing alone can take days – removing sticky goo on uneven surfaces is not easy!
- Then you have to figure out where the racing seats go, how the roll cage will fit, where to anchor the roll cage to the body, where to anchor the body to the roll cage, how to anchor racing harnesses, what instruments are needed and where to fit them.

Electrics:

- This is the most delicate step. The hardest part is figuring out what can go and what has to stay. For example, indicators, lights, ignition, brake circuit, wipers are obvious ones... or are they? It depends on the vehicle and the extent of modifications.
- If the engine is being changed, it may be easier to strip it all out completely and start again.
- One tip: When you pull out the wiring harnesses, carefully unplug them, identify what each plug is for and keep everything. Even if you're sure you won't be re-using something, keep it until the car is finished.

Battery:

- Where will it go? It won't last long under the bonnet – temperatures are simply too high. Where will the battery isolator be mounted and how will it mount?
- What size battery do you need? If you're adding a winch, you'll need a bigger battery than standard.

Instruments:

- What do you need? Fuel gauge, engine oil temperature, diff temperatures, gearbox temperature? Same deal for oil pressures.
- Should you use a standard instrument cluster or build your own?

Safety systems:

- Strip out all ABS, ESC sensors, air bags, wiring and control modules.
- Will this affect other ECUs?

Heater and air conditioner:

- The air conditioner can go, but what about the heater? You'll need a windscreen demister. The choices are to retain the existing unit, use a smaller one from a small car or remove it and use heating strips in the windscreen.

Window glass:

- Remove or keep? Some prefer to keep all glass intact. Others prefer to replace all (except windscreen) with clear polycarbonate panels – reduces weight and eliminates breakages.
- Another choice is a combination of polycarbonate for the front doors and lightweight aluminium sheet for the rest.
- Some elect to keep window glass in the front doors and use polycarbonate or aluminium sheet for the rest.

Doors:

- Strip out door trim, speakers, mirrors, wiring, plastic lugs and window winders. Cut out the inner door skins to reduce weight.

Navigation aid:

- All types display road speed, cumulative distance covered and distance travelled since last zeroed.
- Broadly, there two types. The most common are gear driven off the transmission. However, newer units use GPS co-ordinates to calculate road speed. The latter are more accurate because they're not affected by wheelspin.
- Either way, it needs to be mounted within reach of the navigator.

Bonnet:

- Cut holes for ventilation panels, remove all soundproofing, fit ventilation panels, remove bonnet catch and replace with bonnet pins.
- Raise rear of bonnet for ventilation.

Engine bay:

- You have a thousand and one decisions here. Are you reusing ECU, brake system, clutch system, power steering system, vacuum assist system, washer bottle, radiator, transmission oil cooler, engine, air filter?
- How does it all fit back together? Where will the piping run?
- You'll be adding a shock on each side, so how do they impact the engine bay?

Engine:

- Standard motor? V6 or V8? Turbo-charged? Will it fit in the engine bay?
- Does the firewall need to be modified?

Cooling System:

- Will the radiator still fit? How big does it need to be?
- Some utes mount the radiator behind the cab. Where can you run the hoses? How do you get cooling air to the radiator?

Exhaust:

- Where will it run? It's going to get super-hot, so it has to be away from anything flammable or likely to melt.
- Will the exhaust manifold/s fit in the engine bay?
- How does the exhaust get from the engine bay to under the car?
- Is it protected under the car?
- Is it away from the fuel tank?

Transmission:

- Standard manual or auto? Sequential box? Where will the oil cooler mount and how do you run the lines?
- If the transmission is non-standard, how will it mate to the engine? Does the firewall or engine tunnel need to be modified?

Clutch:

- For a manual: clutch or torque converter?
- Is the bell housing suitable or does it need an adaptor plate?

Air filter:

- One or two? Where to mount – in the engine bay or elsewhere?
- Where can the piping run and will it fit? What type of element should you use?
- Whatever you decide, don't use flexible hose. It restricts airflow to the engine.

Brakes:

- Standard brakes or modified? It's unlikely standard brakes will work effectively. They simply can't handle the rigours of off-road racing. So what size and type is suitable?
- Standard rotors and after-market calipers can work if properly matched.
- Find a reputable brake workshop and talk it over with them.

Suspension:

- At a minimum, you'll need two shocks at each corner. So mounts need to be fabricated once a suitable location is determined.
- At the other extreme, specialised racing shocks with remote canisters are favoured by the front-runners. And with good reason – they don't fade.
- Hydraulic bump stops are a good investment. Where will they mount?
- Spring rates, longer control arms, reinforcement of components... these all have to be considered.
- Should you add wheel spacers and widen the wheel track?
- Sounds obvious, but make sure any new components – shocks and bump stops – don't foul the wheels.

Underbody protection:

- What to use? Has to be strong, but not too heavy. Has to let in cool air and let out hot air, but not be too open.
- Has to be easily removable, but firmly attached.

Wheels and tyres:

- Are the factory rims strong enough? Should you widen the wheel track for stability? What tyres are suitable?
- Where to mount the spares and jack? How many spares?

Body panels:

- Standard or modified? Steel or fibreglass?
- Do some panels need to be easily removed for access?

Fuel:

- Fuel cell or factory fuel tank? Where will it mount? What capacity do you need? Is it protected in case of an accident?
- If you're building a wagon, the fuel cell will be likely mounted inside the body. It must be ventilated otherwise you'll be swimming in petrol fumes. Where to run the ventilation tubes? Do they fit? Do they get enough airflow?

As you can see, quite a few decisions need to be made! And this list is by no means complete.

It looks daunting when listed like this. But if you take it one step at a time, it can be done.