



# TECHNICAL REPORT

## LET'S LOOK AT THE TOYOTA HILUX



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I-CAR New Zealand is currently developing the Toyota Collision Repair Course for 23 vehicles of the current Toyota fleet. This course will be delivered in two packages, the first covering commercial and recreational vehicles and the second delivery will cover passenger vehicles.

There are a large number of Hilux vehicles around the country and as a result collision damage is common place, unlike the city driven SUVs, many are often used in the rugged or off road conditions they are designed for. Many accidents in these conditions often result in more extensive and sometimes a different type of damage than that commonly seen with city driven vehicles. Roll-over repairs are common place for the Hilux and other similar type vehicles in rural regions around NZ, however detailed repair methods for this type of repair will not always be covered in the body repair manuals.

Before safety features and construction methods for utility type vehicles became the same as any regular type passenger vehicle, the repairer could carry out repairs as he had always done but this is not the case anymore, it is equally as important that these safety features are reinstated like any other passenger vehicle.

We will look at some repair methods for the Hilux that are not always easy to find in the standard repair manual, but first we will look at the body structure of the cab. All three cab configurations have a four star ANCAP safety rating and use High-Strength Sheet Steel (HSSS) for the A, B and C Pillar reinforcements plus the floor cross beams; they do have sectioning methods for the side reinforcements, however make sure you always follow the correct repair specifications if doing this type of repair.

Fig 1: shows the upper staggered joint for sectioning the double cab B Pillar. The repair manual also states that Toyota prohibits the use of the heat repair method when repairing collision damage and that parts that are kinked should be replaced.

*Fig 1. B Pillar reinforcement upper joint*

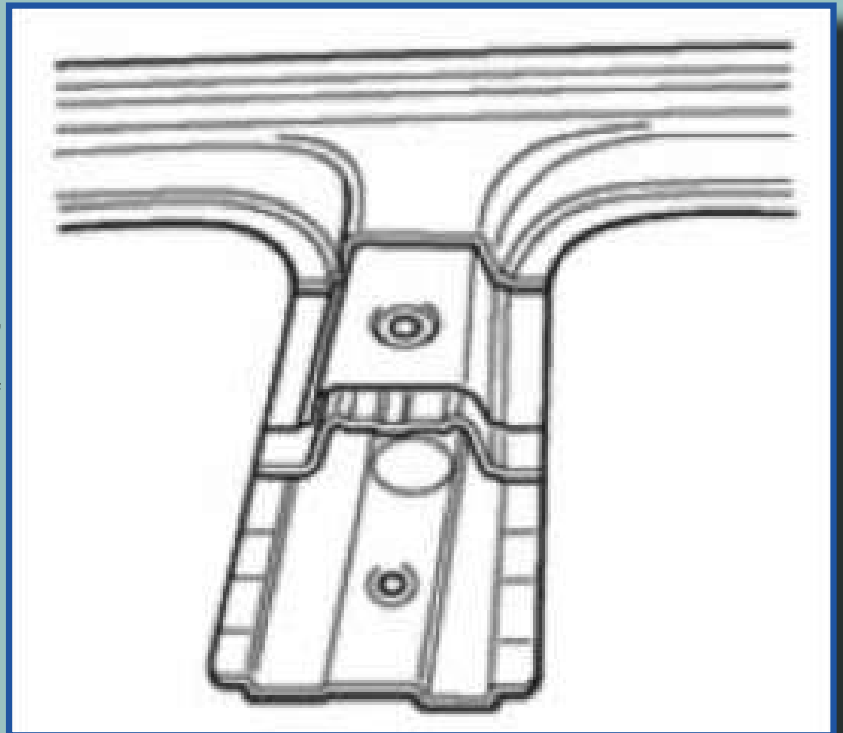
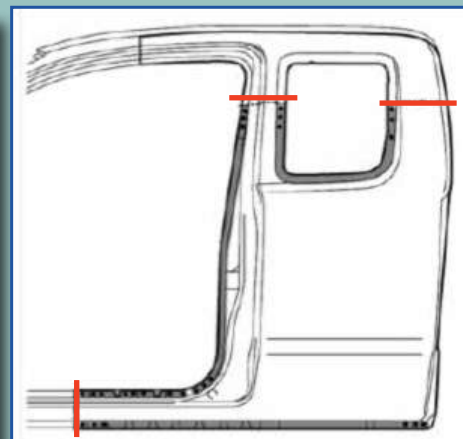
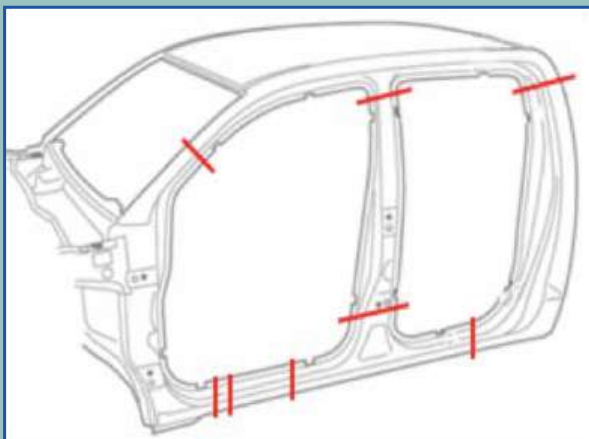


Fig 2 and 3: show the cut options available for the double and extended cab outer side panels; these cut locations are similar for all three models of cab. Note!! This illustration is only an example; you will need the full specifications for accurate cut measurements.

*Fig 2 and 3. Outer panel cut options*



# Let's look at the Toyota Hilux

Because the side panel replacement parts are cut from the full side aperture not all parts required for specific repair situations are covered in the repair specifications. An example of this is if the vehicle has rolled over and just the upper cant rail requires replacing. For these types of repair you will need to purchase the A Pillar and the Rear Quarter Pillar, these parts have the portion of cant rail panel you require. You need to weld these panels together and then use the sectioning joint location shown for the upper A Pillar and Rear Quarter Panel.

## RESPONSE FROM TOYOTA MOTOR CORPORATION, JAPAN

The following is a letter I-CAR New Zealand received from Toyota Motor Corporation (TMC) Japan, as a result of our enquiry to them, that clarifies this as an acceptable repair method.

*We have received some feedback from Toyota Motor Corporation (TMC) with regards to your enquiry about replacing the cant rail.*

*TMC refer to the cant rail as Roof Side Rail Outer. TMC does not supply the Roof Rail Side Outer as a separate part because these are rarely repaired.*

*Therefore you must purchase a Panel, Quarter, LH and Pillar, Front Body, Upper Outer LH to repair the Roof Rail Side Outer. These parts must then be welded together:*

- *Cut location: You decide the cut line depending on the damaged condition of the vehicle.*
- *Weld point: Please refer to Repair Manual (BP-16, BP-47, BP-67) and actual vehicle.*

### WELDING:

Toyota welding recommendations state; the number of welding spots when spot welding should be increased 1.3 times the number of welds used at OEM and spot welds should be close to, but not on the same OEM weld point. When using MIG plug welds they should be the same number as those used at OEM. They also state that when welding panels with a combined thickness of over 3mm the Mig plug welding method should be used.

### HILUX CHASSIS:

Industry is always asking for chassis repair information for the Hilux. Toyota do have some good information for the front section of the Hilux chassis and mounting brackets, however there are no repair methods given for any other part of the chassis, perhaps because a higher strength steel is used for the remainder of the rail. Remember, Toyota don't want heat used for straightening. The front chassis section shown in Fig 3 is available as a part and comes with 18 pages of detailed cutting and welding specifications of how this should be done. The rails can be sectioned in three different locations depending on the extent of damage, see Fig 4 (Reference to this information can be found in Toyota Technical Bulletin 08/03)

Fig. 3; Front chassis rail replacement parts

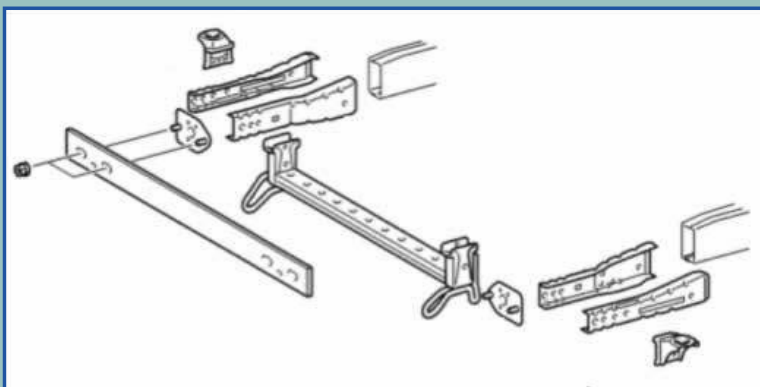
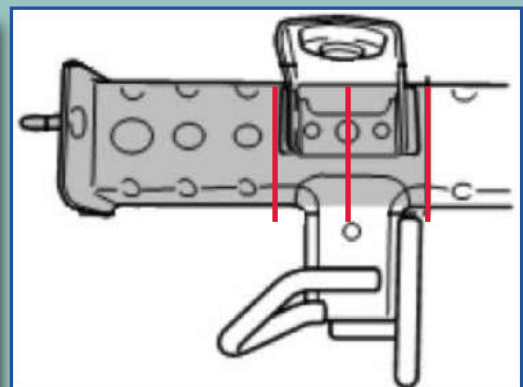


Fig 4; Cut locations shown in red



Full repair details with cautions or special repair requirements for the current model Hilux, will be included in the Toyota Collision Repair programme that is due for completion later this year. This same programme will also include another eight commercial and recreational vehicles from the Toyota fleet.



# Revised Steel GMA (MIG) Welding Qualification Test

The challenges for vehicle makers to make vehicles safe and strong as well as lightweight have resulted in material variations. Many of today's steel-structured vehicles use steel in the range of 0.70 mm thickness for the outer panels, and a thicker, and in many cases higher strength, steel for the structure. This has resulted in I-CAR revising its Steel GMA (MIG) Welding Qualification Test to more accurately reflect the thicknesses of steels being used.

The revised test was released for introduction in early 2013. It features ten welds made on steel coupons in two thicknesses aimed at representing steel thicknesses on today's vehicles (see image below).



Based on a survey of some of the top-selling vehicles, the two thicknesses selected are 22 gauge and 16 gauge zinc-coated steel. 22 gauge coated steel varies in thickness between 0.68 – 0.81 mm. 16 gauge zinc-coated steel varies in thickness between 1.4 – 1.6 mm. The original test coupons were a single thickness, 18 gauge steel. The two thicknesses selected not only represent the steel thicknesses found on current vehicles, but we feel the revised test requires a broader range of technician welding ability and verifies that the technician has the skills required to weld advanced structures.

We were especially motivated to include thin welding coupons in the test, based on several comments from test participants that they would like to test on the steel that is representative of the thin, exterior panels found on many vehicles.

## Mild Steel vs. High-Strength Steel (HSS)

With the multitude of different steels used in vehicles today, material selection and sourcing presented interesting challenges. Which steels do we use? If we select specific steel strengths that represent one vehicle or OEM, how does this compare to other steels on other vehicle makes and models? To maintain a focus on weld quality and a consistent

student experience, both of the coupons used in the revised test are mild steel. We found little or no difference in welder settings when making GMA (MIG) welds on mild steel compared to welding on HSS, or even steel graded as UHSS.

There's another reason we went with mild steel only, and that's because of the experiences we were having with destructive testing. A successful plug weld twist test on two mild steel coupons will invariably twist a nugget out of the base metal, or bottom coupon that does not have the punched hole. Any flaw in the plug weld, such as a skip or one spot around the hole where there's no fusion, results in a nugget twisting out of the top coupon instead.

On a plug weld where the base metal is a grade of HSS and the top coupon is mild steel, there's the opposite result. A successful plug weld twist test pulls a nugget from the top mild steel coupon instead of the bottom coupon. It may be difficult to determine, then, whether the nugget twisted out of the top coupon because it's weaker steel or because the weld is flawed in some way.

## I-CAR Plug Weld Tests

For the I-CAR Steel GMA (MIG) Welding Qualification Test, four of the ten required welds are plug welds. These include a "thin-to-thin" plug weld (22 gauge to 22 gauge) in the vertical position. The plug weld is made in a 6 mm hole punched out of the top coupon. This represents, for example, plug welds on a pinchweld flange joining two exterior panels, such as along a wheelhouse opening. It could also represent plug welds made into a butt joint backing piece, such as along a rocker panel.

There's also a "thick-to-thick" plug weld (16 gauge to 16 gauge) in the vertical position. The plug weld is made in an 8 mm hole punched out of the top coupon. This represents, for example, plug welds made into a butt joint with backing insert when sectioning a rail (see image below).





# Revised Steel GMA (MIG) Welding Qualification Test

For the destructive test on these two welds, I-CAR requires a tearout hole in the bottom, base metal coupon at least 5 mm, but no greater than 10 mm. The I-CAR Steel GMA (MIG) Welding Qualification Test gauge can be used to measure the tearout hole. A tearout hole close to the size of the plug weld itself signifies a strong plug weld, but too large of a tearout indicates too much heat.

There's also a 22 gauge to 16 gauge, or "thin-to-thick" plug weld in both the vertical and overhead positions. These represent, for example, plug welds along a vertical pinchweld joining an outer B-pillar to a thicker reinforcement.

With this example, on a vehicle the thicker steel may be HSS or stronger, as is common on B-pillar reinforcements. Again, in the I-CAR test, we wanted a nugget to twist out of the bottom coupon, so both coupons are mild steel.

We found in our research that the more heat applied when making the plug weld, the larger the tearout hole. Since excessive heat is something to avoid when welding grades of HSS, we require a tearout hole from the bottom, thicker coupon, but that hole should be a maximum 5 mm, rather than a minimum 5 mm like the rest of the plug welds.

## Other Test Welds

In addition to plug welds, there are open butt joints, butt joints with backing, and fillet, or lap welds required in the qualification test. All of these welds are done on the same thickness materials (see image below).



There's a vertical open butt joint using two thin coupons, which represents a common joint required on pillars and rocker panels on Toyota vehicles, for example. There's an overhead butt joint with backing using three thick coupons. This represents, for example, a common joint when sectioning a front lower rail on a Chrysler vehicle. There are two thin-to-thin fillet welds required, both a vertical and overhead. These represent the joints where an exterior panel is lapped over another exterior panel.

## The Test Site is Your Workshop

As has been the case for several years, an I-CAR test administrator will administer the test at your repair facility using your own welding equipment. This helps ensure you are familiar with the equipment and surroundings. Also, you will receive tips on maintenance and tuning the welder for a successful weld. The test administrator provides the test coupons and a weld clamp stand for making the welds in the vertical and overhead positions. A check-off form, given to the repair facility prior to the test day, ensures that the facility has the right equipment, materials and destruction testing of welds has been carried out for the test. (See image below of destruction testing a weld).



The Steel GMA (MIG) Welding Qualification Test is administered in a supportive and friendly learning environment. The test administrator allows a brief practice session, and offers guidance throughout to help ensure all of the technicians making the welds are successful.

## Conclusion

The I-CAR Steel GMA (MIG) Welding Qualification Test has been revised to better represent the steel thicknesses being used by the vehicle manufacturers today. Ten welds are required to be made on 22 gauge and 16 gauge coupons, in a combination of vertical and overhead positions.

Major collision damage requires a greater level of expertise to repair, and welding is one of the most critical skills necessary in completing that repair safely. Poor welds can lead to part failure and reduced protection for the occupants in the vehicle. How well a technician performs welds, even the condition of the welding equipment, impacts not only the structural integrity of the vehicle, but safety, as well.

**To learn more about the Steel GMA (MIG) Welding Qualification Test (WCS03), or to request a welding assessment, visit: [www.i-car.co.nz](http://www.i-car.co.nz)**