SUBARU
ALL-WHEEL DRIVE

SUBARU (AUST) PTY LIMITED

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IMPREZA

TECHNICAL DESCRIPTION

SUBARU
ALL-WHEEL DRIVE

IMPREZA

CONTENTS

INTRODUCTION

The second generation Impreza continues the philosophy of evolution building on the strength's of the current model which have been fine tuned from experience gained in the World rally championship (WRC) since 1994.

The significant mechanical improvements introduced in model year 1999 such as the phase 2 engine and completely redesigned automatic and manual transmissions have continued, this time matched to a completely redesigned body which provides a much stronger and more rigid platform. The benefit is that handling, noise vibration and harshness have been improved and passive safety levels are now world class while the performance levels of the phase 2 engine have been retained despite improved emissions and fuel consumption performance.

There is also now a clear differentiation between the sports orientated sedan and the recreational wagon, not just in appearance but also extending in the sedan to a wider track and optimised suspension design for optimal sports performance handling.

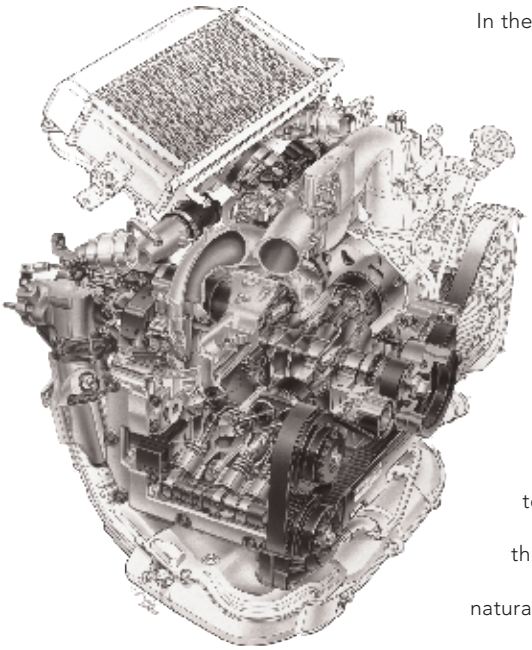
Key mechanical changes in the New Impreza are: -

- Stronger and more rigid body structure with improved world class leading levels of crash performance and structural rigidity.
- Improved handling performance and driveablity
- Reduced levels of NVH (noise vibration & harshness)
- Increased interior passenger room and comfort.
- Increased braking capacity
- Improved exhaust gas emissions and fuel consumption.

ENGINE

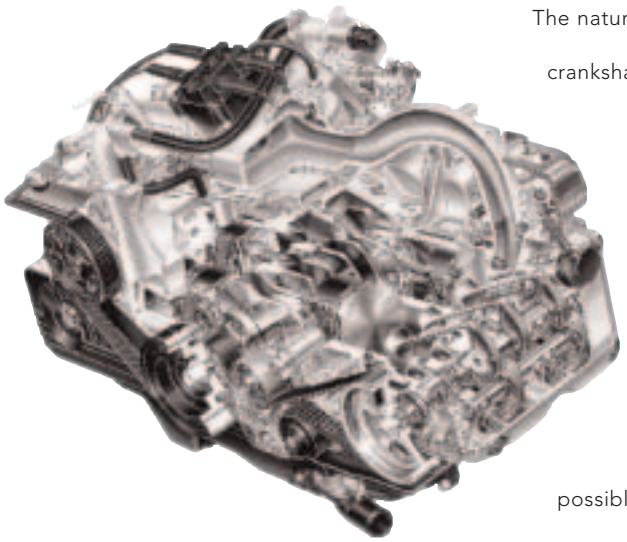
Construction

The phase II engine used in the New Impreza range is the traditional Subaru horizontally opposed boxer engine with newly designed fuel efficient, low emission cylinder heads featuring 'tumble swirl' intake ports.



In the unique configuration of the boxer engine, the pistons move in the horizontal plane from left to right with low levels of noise, vibration and lower power loss. This is due in part to the cancellation of the inertia forces created by the downward force of the pistons that act in opposite directions. With an in-line engine all four pistons are moving in the same direction and therefore a larger and heavier crankshaft is required to counteract this inherent imbalance.

Structurally the horizontal design also yields a more rigid cylinder block because the crankshaft is sandwiched between the left and right hand crankcases and supported by five main bearings. This provides for long life with little wear and tear. An additional improvement on the Phase II engine is the relocation of the crankshaft thrust bearing to the rear of the crankshaft. This provides for a reduction in the transfer of natural engine frequencies to the transmission and driveline thereby improving N.V.H. levels in the passenger compartment.



The natural balance of the horizontally opposed engine along with the lightweight crankshaft provides for excellent rotational balance, rotating smoothly all the way up to high engine speeds without the use of balancer shafts that are necessary with in-line engines. This feature along with the aluminium construction achieves a lightweight compact engine that allows for a great deal of freedom in positioning the engine in the vehicle. Its low height also makes a low centre of gravity possible with a more balanced left/right and front/rear weight distribution for improved vehicle handling.

ENGINE

PERFORMANCE

The Phase II engines used in the New Impreza comes in two variants, the SOHC 2.0 litre non-turbo or the DOHC 2.0 litre turbo used exclusively in the WRX. Both of these engines while based on the original phase II engine first introduced with the 1999 model year have been further refined for improved, low to mid speed torque, fuel consumption, noise reduction and exhaust gas emissions. These engines including the turbo now fully comply with the most stringent world emission standards.

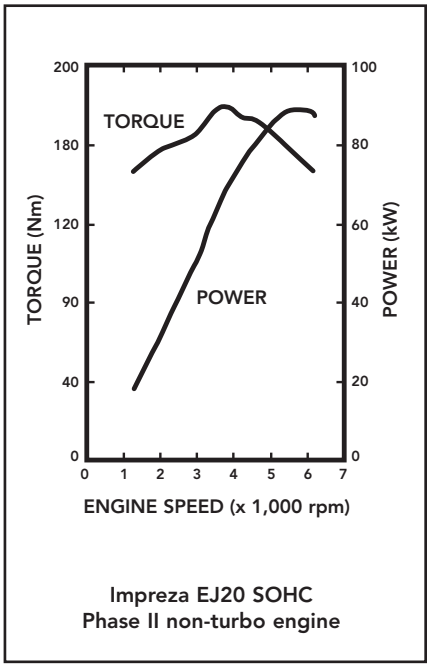
ENGINE SPECIFICATIONS

CAPACITY	BORE	STROKE	kW@RPM	Nm@RPM	COMPRESSION RATIO
1994 cm^3	92 mm	75 mm	92@5600	184@3600	10.1:1
1994 cm^3	92 mm	75 mm	160@5600	292@3600	8.0:1

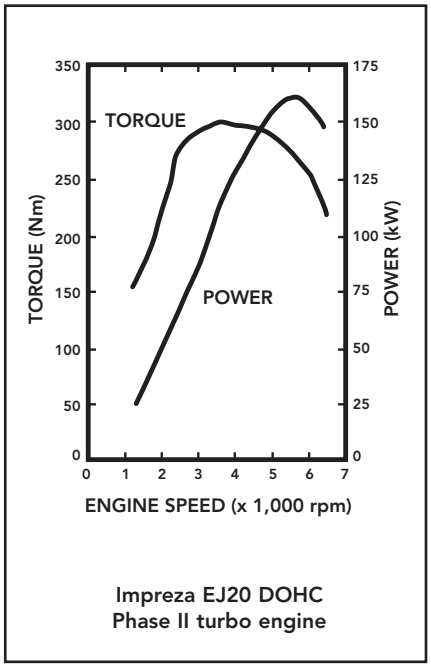
Peak power and torque outputs of the 2.0 Non Turbo and 2.0 litre Turbo engines occur at relatively low engine speed of 5600 rpm and 3600 rpm respectively.

The emphasis of the ongoing development however has centred on further improving mid-range operating conditions to maximise responsiveness and part throttle torque delivery.

These improvements can not be quantified in power curves or quoted power outputs but will be immediately apparent when driving the vehicle in the low to middle engine speed ranges on part throttle.



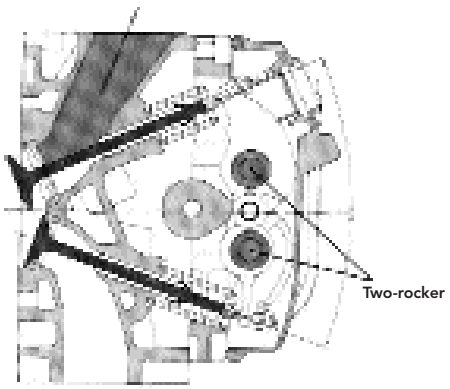
Impreza EJ20 SOHC
Phase II non-turbo engine



Impreza EJ20 DOHC
Phase II turbo engine

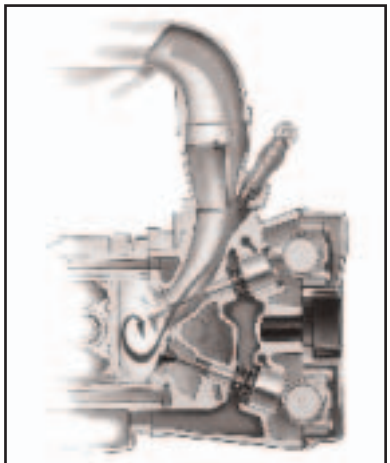
ENGINE

Cylinder Heads



By far the most significant improvement in design for the phase II engine is in the cylinder head and intake manifold design. The major advance is in the design of the Tumble intake port that has been optimised to create a 'Tumble Swirl' air motion as the air and fuel enters the cylinder. This action ensures uniform mixing of the air with the fuel and for uniform flame travel resulting in increased speed of combustion.

This allows for the maximum gas pressure (downward force) to be applied to the piston 10-15 deg. ATDC when the maximum turning moment on the crankshaft occurs resulting in a greater power output.


Conceptual illustration of TGV function

The cylinder heads also continue to feature four valves per cylinder arranged in a cross flow format for good engine breathing. This means that as a result of more air being inducted, more fuel can be injected and when combined with the 'Tumble Swirl' action a higher specific power output is obtained with improved fuel economy. The turbo engine also now employs a Tumble Generator Valve (TGV) for improved exhaust gas emissions at low speed cold engine conditions (right). This valve causes the intake airflow to be redirected by closing a butterfly valve in the intake manifold. In doing so a tumble air motion is created at low intake air speeds thereby ensuring good air/fuel mixing for improved combustion efficiency and emissions along with improved starting.

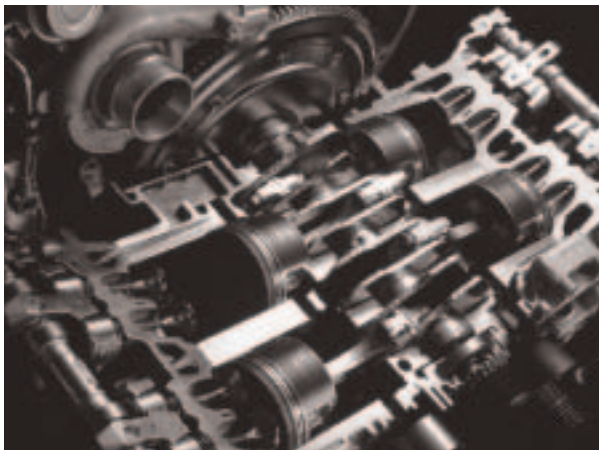
Valve Operation

Valve operation on the non turbo engine is achieved by the use of a single camshaft for each cylinder head and roller rocker arms. On the turbo engine direct acting twin camshafts per cylinder head are used. In order to maximise the 'tumble air' motion, the valve angle and valve lift has been increased. A single timing belt with specially designed round profile teeth for quiet operation drives the camshaft. The belt is made from a strong flexible core wire, wear resistant canvas and heat resistant rubber. The recommended replacement interval for the cambelt is 100,000 kms. or four years, whichever should first occur. The belt tension is self-adjusting and valve clearance checking/adjustment is only necessary every 150,000 kms.

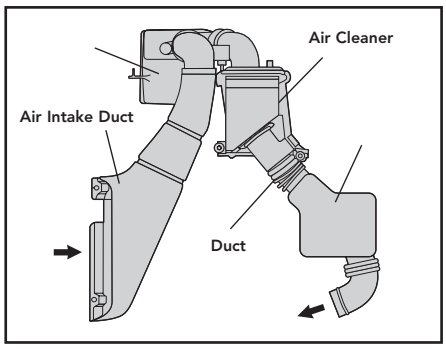
ENGINE

Pistons

Close attention has also been given to the piston design to reduce weight and friction and improve combustion performance. This has been achieved by reducing piston pin offset, use of solid type skirt design, with molybdenum coating, reduced top land to cylinder clearance and a flat top combustion surface. The compression ratio on the non turbo has also been increased from 9.7 to 10 : 1 for greater thermal efficiency on the turbo the ratio remains at 8.0 : 1. The increase in compression ratio has been made possible due to the 'Tumble Swirl' action that provides better atomisation and mixing of the fuel with the air and hence is less susceptible to detonation or pinging.



Air Intake System



The air intake systems have been specially tuned to help achieve high torque in the low to mid engine speed range to produce flexible and responsive engine performance along with improved fuel economy.

The optimised air intake system consists of an air inlet duct that draws air from outside the under bonnet area thus reducing intake air temperature. Two resonators are incorporated in the air duct to smooth the air flow and a large still air box (non turbo only), mounted on the throttle chamber improves engine response and quietness along with a tuned length inlet manifold. These features contribute to an overall improvement in volumetric efficiency that the driver feels as increased pulling power and quicker engine response.

On the WRX the intake manifold has been retuned to provide for smoother power delivery and more mid range torque at part throttle conditions.

Intercooler

The intercooler size has been increased by 12 % and the angle of the intercooler relative to the bonnet has been changed. These changes along with aerodynamic shape of the bonnet have increased the mass of outside airflow through the intercooler.

This has resulted in the cooling capacity being increased from 6.9Kw to 13.2Kw. The engine intake air is therefore cooler and denser meaning a higher power output as a result of greater mass of fuel and air being inducted into the cylinders.

ENGINE

Turbo charger

The turbocharger is a Mitsubishi TD04L unit with approximately a 10% bigger turbine than the previous model with an A/R ratio of 13 for quick turbo response at low rpm. Maximum turbine speed is 190,000 rpm.

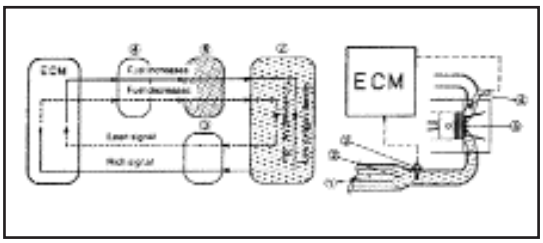
Maximum sustained turbo boost pressure is 700 mm Hg (93.3kPa, 13.5 lb/in2) @ 4800 Rev/Min at full engine load and ideal ambient intake air temperature under factory dynamometer test conditions.

Engine Management System

The engine management system used on the Impreza is a computer controlled multi-point sequential fuel injection system with full direct ignition control. The non turbo model ignition system has two ignition coils; one for each pair of cylinders, 1,2 and 3,4 which fire the spark plugs directly twice per cycle. There are no moving parts such as a distributor to wear and therefore maintenance is limited to the replacement of the spark plugs every 25,000 kms.

On the turbo model each cylinder has its own ignition coil positioned in the cylinder head, directly above the platinum tipped spark plug. This again means no moving parts or high-tension leads to wear and the spark plugs only require replacement every 100,000Km.

Both systems also have an ignition knock control facility with fuzzy logic that enables the maximum ignition advance angle to be used without detonation. This means the computerised ignition programme constantly adapts itself to changes in environmental conditions and fuel quality. The turbo engine however requires minimum 95 RON fuel or higher.



The injectors inject the precise amount of fuel required at any given time and are constantly monitored and corrected to ensure the air fuel ratio is ideal.

The system on the non turbo models is called the feedback control system and is accomplished by means of the computer (ECM) ability to learn from information provided by the exhaust oxygen sensor.

The Turbo model is equipped with the latest OBD (On board diagnosis) system that constantly monitors the exhaust gas emissions and signals to the driver via a warning light when it is performing at less than its optimum.

Constant idle speed is also maintained by a feedback control system via an idle stabilisation control valve, which provides a regulated by-pass air passage around the throttle butterfly.

The ECMs ability to learn and memorise enables it to constantly monitor and evaluate the operating conditions. It then makes any necessary correction so that the engine runs at its optimum for the prevailing conditions. Put simply, the engine constantly tunes itself as you drive. In fact it is no longer possible for the workshop to 'tune' a new generation Subaru.

ENGINE

Engine Management System (cont.)

From a maintenance point of view it is now only a question of replacing spark plugs, filters, belts and changing the engine oil.

In the unlikely event of a fault occurring, the computer has the ability to diagnose the defect and then store the fault in its memory. Depending on the fault, it can also generate a pseudo input to compensate for the defect and therefore provide a failsafe mode to enable the vehicle to be driven to a dealer for rectification. When this occurs the 'Check Engine' light illuminates on the dash advising the driver that attention is required. When the vehicle arrives at the Subaru dealer, a special device called a Subaru Select Monitor is connected to the vehicle which then interrogates the computer to assist the technician in locating the actual fault.

All of this means from the owners point of view that the vehicle always performs with good performance and fuel economy and if attention is required, it is obtained with a minimum of inconvenience and expense.

Immobiliser

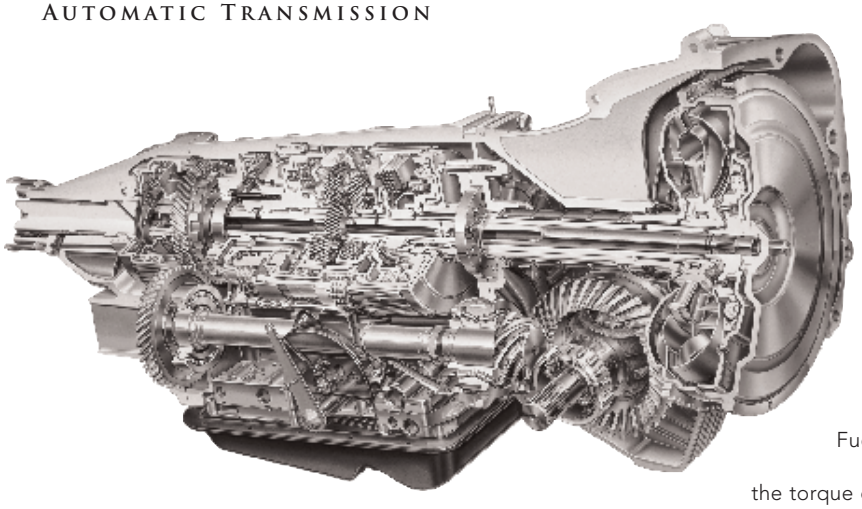
The immobiliser system interfaces directly with the engine management computer (ECU). This system is a transponder type that utilises a rolling code for additional security. Once the key is inserted in the ignition lock and the ignition turned on an antenna amplifier positioned around the ignition lock reads the transponder code and transmits it to the engine management and the immobiliser computer (ECU). The ECU then compares the transmitted code for the correct sequence and, if correct, allows the engine to start. The ECU will allow two attempts at starting and if on both occasions an incorrect code is obtained then the engine will refuse to start.

Remote central locking transmitter is now incorporated as one unit into the key along with the immobiliser transponder.

If a duplicate key is required, the transponder code needs to be registered with the ECU. This teaching operation can only be performed with special equipment and the software is only available to authorised personnel.

TRANSMISSION

Automatic Transmission



The New Impreza automatic transmission is the newly designed E4AT that is 7 kg. lighter and 33mm shorter than the previous model. First introduced in 1999 model year, this unit has now been reprogrammed to provide for even smoother shift feel and improved shift control. Fuel consumption has also been improved by engaging the torque converter lockup clutch at a lower speed.

This transmission is not a revised version of the old transmission but a completely new design incorporating;

* Lower weight-moving components for reduced inertia and shift shock.
* Increased capacity hydraulic control system for more precise control of clutch and brake application thereby providing smoother torque transmission.
* Lower level of engine power loss for improved fuel economy.
* More powerful electronic control system using a computer to monitor 14 separate operating parameter inputs and to generate 8 separate outputs to precisely control shift timing and quality.
* The transmission computer also interfaces with the engine computer to regulate engine torque delivery during gear shift.

Electronic control not only provides for precise full automatic operation but allows the driver to select normal or power modes or to chose 'manual' operation with 'hold' mode which provides for greater driver control when necessary in more severe conditions.

Normal: mode is pre-selected and is a shift pattern map with gear shifting points (load -vs- vehicle speed) programmed into the computer, designed to suit a combination of performance with economy.

Power: mode is selected by depressing a switch on the gear shift lever console. This causes gear shift to occur at a higher vehicle speed than normal mode and allows a lower gear to be held longer thereby improving acceleration.

Manual: selection is engaged by turning on the 'Hold' switch and by moving the shift lever through the four range positions.

TRANSMISSION

Automatic Transmission

'1' Range: first gear is held and upshift will not occur. Engine braking is also provided by a high pressure application of the relevant drive clutch components to prevent slippage under extreme loads, i.e. steep downhill descents.

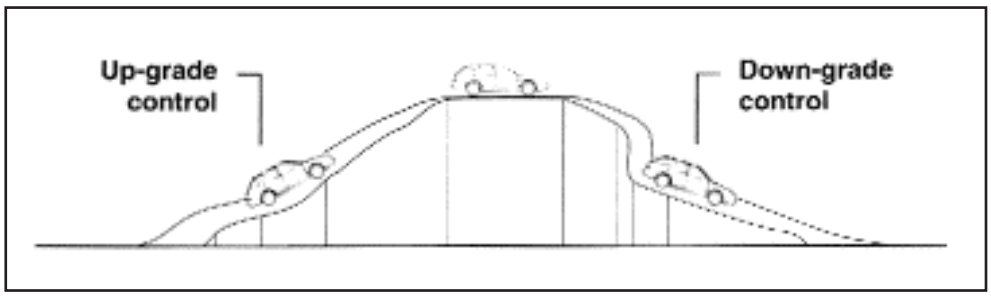
'2' Range: The vehicle will take off in 2nd gear with the 'Hold' switch on and will not up-shift. With the 'Hold' switch off, the vehicle will take off in 1st and then up-shift to 2nd according to the shift map. Engine brake is also provided as in '1' range.

'3' Range: With the 'Hold' switch on, the transmission will take off in 2nd gear but will quickly shift to 3rd gear as vehicle speed increases and then hold 3rd gear. Engine braking occurs with reduced pressure application only at throttle angles less than 20 degrees. With the 'Hold' switch off, normal 1-3 shift occurs.

'D' Range: Provides for fully automatic shift control according to the selected shift pattern map. With the 'Hold' switch turned on however, the transmission will take off in 2nd gear, which provides for better traction in extremely slippery conditions (ice and snow).

Smart Control

The fuzzy logic system has a what is known as up and down grade control which automatically selects a lower gear and holds that gear whilst going up or down a hill with a slope greater than 6.5%.



When going downhill it also requires the speed of the vehicle to be less than 70 km/hr and the brake to be applied by the driver which signals a requirement to slow the car. As a result a lower gear is automatically selected and greater engine braking is therefore applied.

When going up hill when the transmission down shifts it will hold this gear until the vehicle crests the hill then depending on the vehicle speed and throttle opening it will allow up-shift after a learnt distance. This system is designed to smooth the transmission operation and prevent hunting up and down of the gears during hill climbing caused by coming on and off the throttle, for example when negotiating corners etc

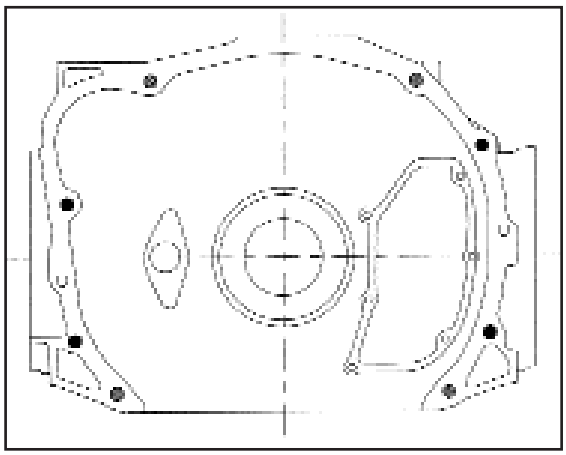
Selector Lever

A new style of shift gate has been provided which allows for smooth quick shifting between the different range positions without the need for pressing a release button.

TRANSMISSION

Manual Transmission

The compact five speed manual All Wheel Drive AWD transmission is the culmination of more than twenty years experience in AWD technology during which time continuous development has occurred. The New Impreza transmission is the same unit first introduced in Model year 1999 which saw the largest number of changes since Liberty introduction in 1990, too numerous to mention individually but in summary are as follows;



* Increased rigidity of the transmission case design and double the number of mounting bolts from 4 to 8 attaching the transmission to the engine. This provides for a more rigid power plant unit and as a result reduces transmission noise vibration and harshness (NVH).
* All synchromesh baulk ring and gear docking teeth angles along with the double cone synchro on 2nd gear and 3rd gear have been tuned to provide a precise but smooth gear shift action.
* Adoption of cold forging and a shot peen hardening process of gears for improved durability.
* Change of shift rail and detent design for improved gearshift operations feel.
* Adoption of a new flexible flywheel design to minimise transfer of natural engine frequency vibration to the transmission and drive-line.

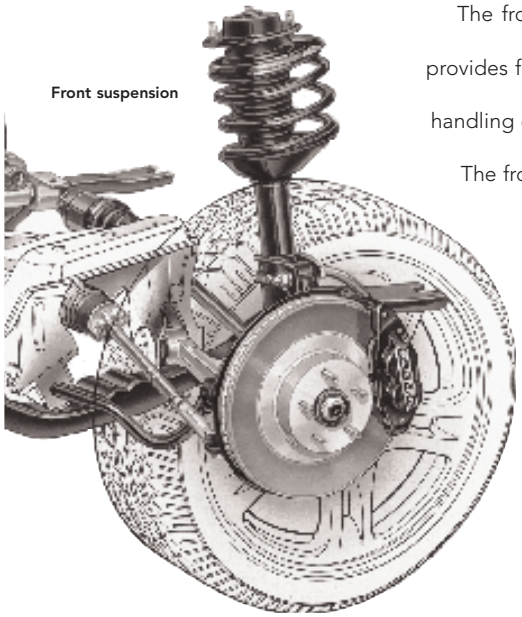
The RX & GX station wagons are also equipped with a dual range transmission with a 45% low range reduction which can be selected on the move and features full synchromesh action. This means when extra pulling power is required quickly without loss of momentum, simply depress the clutch and flip the low range lever.

The transmission case is of single unit construction housing all five forward and the reverse gears along with the reduction and AWD transfer gears in the one housing. This provides for a compact low cost transmission with a symmetrical drive line without any complex gear arrangements or countershafts.

The clutch is an increased capacity single plate diaphragm with hydraulic operation.

SUSPENSION

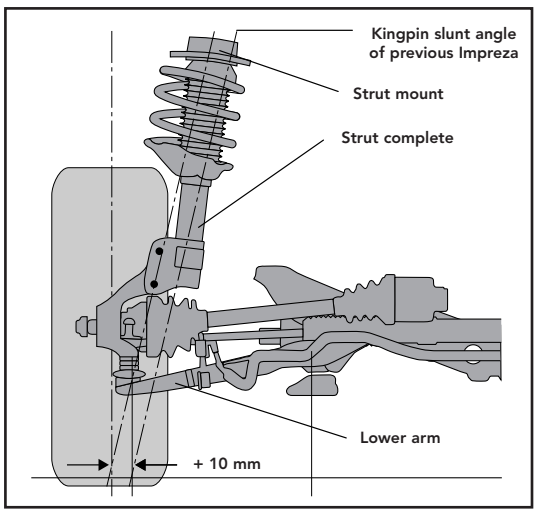
SUSPENSION


Front suspension

The front suspension for the New Impreza is an evolution of the current system that already provides for a high level of lateral rigidity, which significantly contributes, to the vehicle's superior handling characteristics.

The front suspension is a lightweight MacPherson strut independent system that has proven its durability during the world rally Championship (WRC). It features a 'L' shaped transverse link and coil springs that are offset, so that the centre line of the spring coincides with the pivot axis, thereby minimising the friction generated by the up and down movement of the strut. The effect is to lessen vibration and reduce the feeling of thrust transmitted from the road thereby providing good ride comfort with good road tracking. On the Impreza WRX sedan the lower transverse link suspension arm, is made of cast aluminium to reduce the unsprung weight and is a direct input from the World Rally and STI development program.

Suspension geometry has been revised to further improve vehicle stability and handling. On the sedan the front track has been increased by 15mm on the WRX and by 20 mm on the RX & GX models. This has been achieved by moving each strut 10mm toward the outside with the same kingpin angle as the previous model. This means that the geometry retains negative scrub steering roll radius which provides for improved braking stability when braking forces on left and right wheels are uneven due to varying road surface coefficients of friction.



On the station wagon the track is 20 mm narrower than the sedan being the same width as the current model but the mass offset has been reduced. This means that bump steer has been reduced and straight-line stability has been improved.

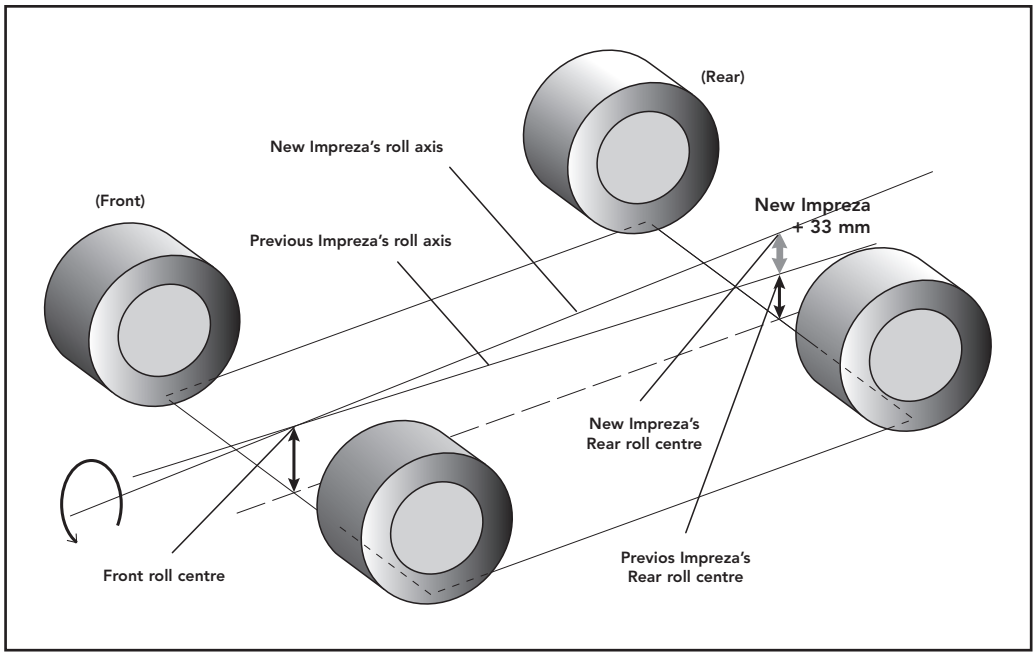
The rear suspension retains the same dual link strut configuration as the previous model, unlike the Liberty multi-link suspension has not been employed. This is because the objective was to produce sports handling performance and the strut suspension was more suitable due to its lighter unsprung weight, smaller number of moving parts and adaptability for WRC competition.

SUSPENSION

SUSPENSION (CONT.)

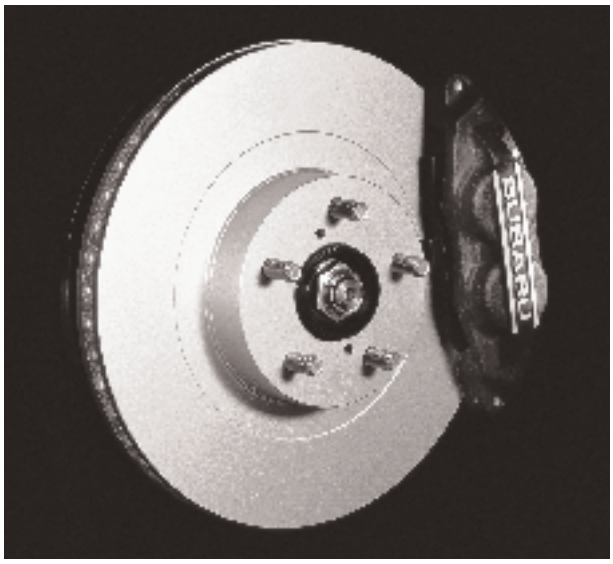
To further improve vehicle stability and cornering performance the rear roll centre has been lifted by 33mm (approx. same as the WRC car). This has the effect of reducing body roll when cornering by effectively reducing the mass that pivots around this axis.

Lastly but not least the dramatic improvements in body strength has meant that the rubber suspension bushing was able to be re-tuned for improved NVH and comfort levels without compromising vehicle stability and handling due to the extremely rigid platform.



BRAKES

BRAKES



The New Impreza braking system features high capacity four wheel discs and the traditional diagonally linked interior piping system with pressure control valve for greater braking power, safety and reliability.

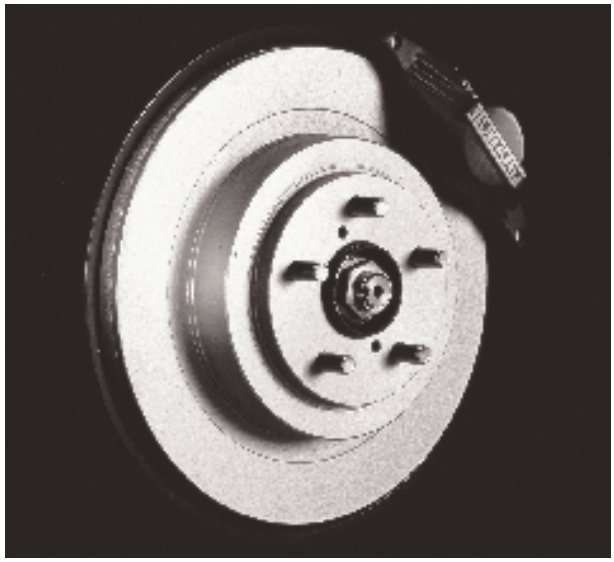
The diagonally linked split system means that if one circuit of the brake hydraulic system should fail then braking is retained in the remaining circuit on opposite corners of the vehicle. This results in the vehicle pulling up under control without any violent lurching to one side, which can occur on vehicles that are split on a front and rear basis. The interior routing of the brake pipes also means that there is less likelihood of damage or fracture of a pipe when driving in rough terrain whilst corrosion of the brake pipes is virtually impossible.

A front and rear pressure control valve is also used to balance the braking force to the weight distribution of the vehicle.

The Impreza WRX also features much improved braking performance with four pot callipers matched to 294mm diameter ventilated discs on the front and two pot callipers on 290mm diameter, ventilated discs on the rear.

The GX and RX models front brakes have 277mm diameter, ventilated discs with heavy-duty twin piston floating callipers. While on the rear 262mm discs with single piston floating callipers are used.

A vacuum suspended tandem booster provides power assistance with an effective diameter that has been increased from 180 + 205mm to 205 + 230mm for reduced pedal effort but retaining a firm braking feel.



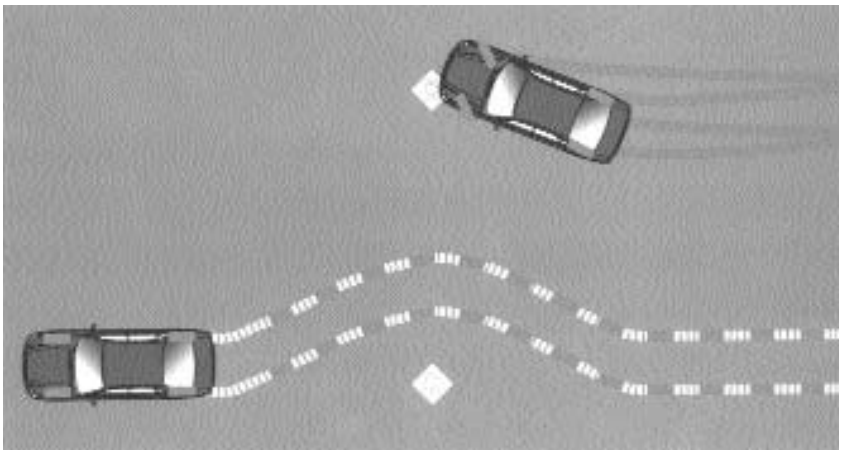
ACTIVE SAFETY

A.B.S.

ABS braking is standard on all models and features the very latest state of the art Bosch 5.3i system made under licence by Nippon ABS.

It is a full four channel, three phase four sensor system with the front wheels being controlled individually and the rear wheels controlled jointly through the select low method. This new system features a much higher level of wheel speed control and is capable of operating the three-phase control cycle 30 times per second.

The select low method uses the rear wheel with the lower co-efficient of adhesion to determine the brake pressure applied to both rear wheels. This select low control, along with electronic delayed build up of braking force at the front wheel with a high adhesion co-efficient and negative steering roll radius, minimises the tendency for the vehicle to turn about its vertical axis (spin) when braking on uneven road surfaces.



To further improve ABS operation Subaru engineers have carried out extensive testing under Australia's unique conditions to enhance the performance of ABS on gravel surfaces, the result was a revised computer logic that is more suitable for Australian conditions. This achieved a reduction in stopping distances on flat gravel roads of 9% and a further improvement of 37% on downhill slopes (≥ 30%) when the vehicle speed is less than 20 kms/hr.

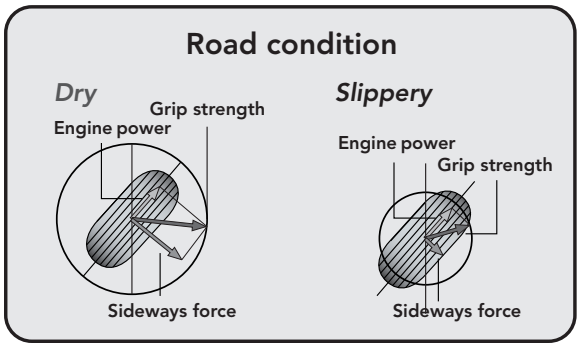
It should be remembered however that whilst it is still true that non ABS vehicles have shorter stopping distances on gravel roads, all direction control is lost when the wheels lock.

ACTIVE SAFETY

ALL-WHEEL DRIVE

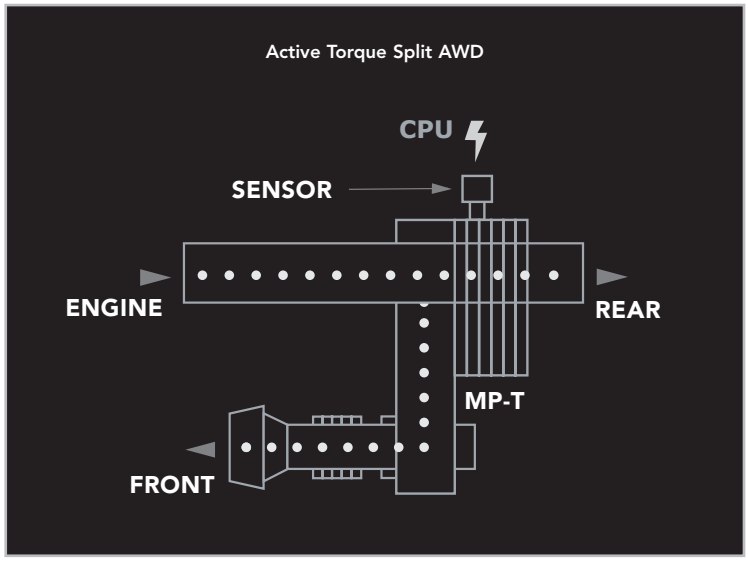
AUTOMATIC TRANSMISSION AWD

The All-Wheel Drive AWD automatic transmission distributes the motive power constantly to all four wheels. It is known as the active torque split system and uses a computer to constantly monitor the driving conditions and distribute torque accordingly. This system can infinitely vary the distribution between 95% front and 5% rear wheel drive to a 60/40 ratio with static weight distribution. The result is that when combined with dynamic weight distribution and selected gear range, the transmission can distribute the drive to provide the best possible traction and fuel efficiency for the conditions at that time.



The computer uses sensors to provide information on vehicle speed, engine load, gear range and rotational differences between front and rear wheels to ascertain road and running conditions.

For highway driving at constant speed the system becomes predominantly front wheel drive for improved fuel efficiency, however on the application of engine load or when cornering the system instantly, without driver involvement, switches to AWD for improved stability and handling.



Unlike part time 4WD systems which require the driver to recognise the necessity for four wheel drive, the active torque split system automatically reacts when road and driving conditions suddenly change. A genuine safety feature even on the bitumen when the road surface changes halfway around a corner or is sharper than anticipated.

In first gear range position the system also increases four wheel drive pressure applied to the transfer clutch for increased drive distribution to the rear wheels for closed throttle operation (steep descent). This provides for better control in difficult slow speed conditions.

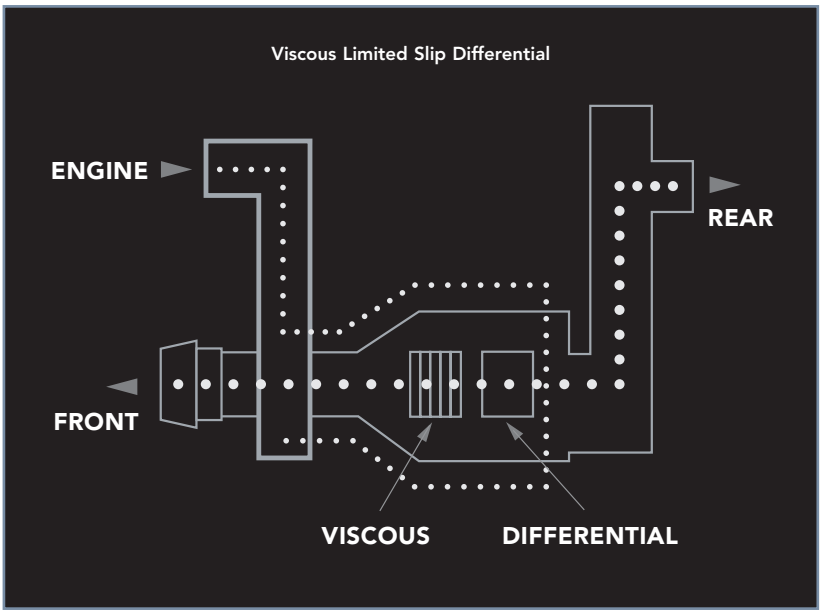
ACTIVE SAFETY

ALL-WHEEL DRIVE

MANUAL TRANSMISSION AWD

In the manual transmission a viscous coupling limited slip centre differential is used to constantly transmit the engine power to all four wheels.

During straight line driving the torque split by the differential is 50/50 to front and rear wheels. Torque distribution at the road however is also dependent on load distribution and tyre grip and as a result the static ratio is 60/40. During actual driving conditions load movement when cornering, accelerating or braking etc. causes the torque distribution to also move in the same proportions.



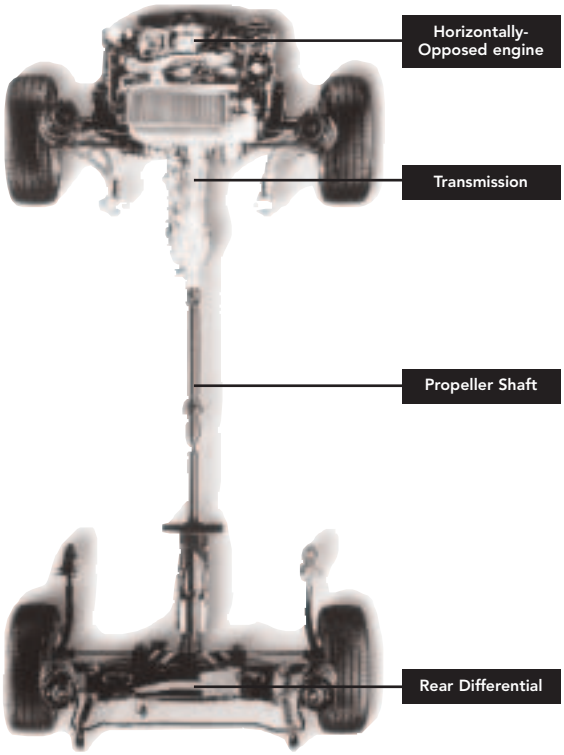
When wheel slip occurs a rotational speed difference between the front and rear axles is created and the viscous coupling automatically matches the torque to grip in order to restore maximum traction.

The nerve centre of the limited slip differential is the viscous coupling which is a housing containing a number of inner plates connected to the rear wheels and outer plates connected to the front wheels. The housing is also filled with silicone fluid and its viscosity increases with temperature. When wheel spin occurs, there is a rotational speed difference between front and rear axles and as a result the inner and outer plates also turn at a different speed.

This causes an increase in the temperature and viscosity of the silicone fluid due to the shearing of the fluid between the plates. The increase in viscosity makes the silicone fluid more difficult to shear and hence torque is transferred from the slipping axle to the axle which still has traction.

ACTIVE SAFETY

Symmetrical Layout



The horizontally opposed engine used in the Subaru has a symmetrical horizontal layout which provides for excellent weight distribution not possible with other engine configurations.

From engine to transmission, propeller shaft and finally rear differential, the entire All-Wheel Drive AWD power train is in a perfect straight line; again with a symmetrical horizontal layout.

If other engine configurations are used such as a east west four cylinder with a transfer case transmission, the rear wheels and driveshaft must be positioned slightly removed from the engine's centre. Seen in plan view the entire drive train is not even close to enjoying a left/right symmetry or weight distribution.

When an in-line 'north south' engine configuration is used, the longer less compact engine creates an imbalance of front/rear weight distribution due to the increased weight overhang past the front wheels. Also with some in-line configurations slant engines are used to reduce the bonnet height and therefore the left/right weight distribution is not symmetrical.

Weight Distribution

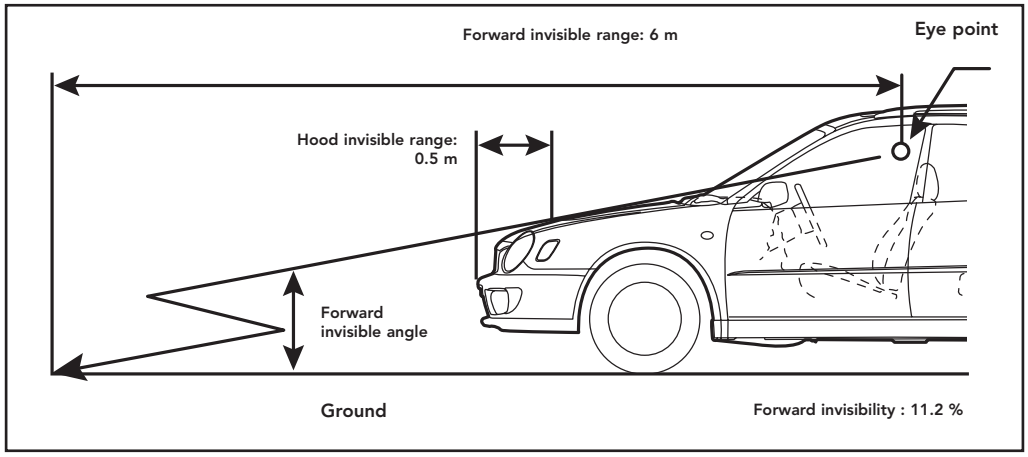
Weight distribution is one of the major factors in determining the available level of traction between tyre and road and is of paramount importance in the level of vehicle stability.

Therefore to provide as close as possible to neutral balance handling characteristics, symmetrical weight distribution is of prime importance. However, in reality because the engine and transmission are two of the heaviest components in a motor vehicle, this is not entirely possible. In a Subaru All-Wheel Drive AWD vehicle with the horizontally opposed engine, the static weight distribution is approximately 60% front, 40% rear.

To further complicate the matter however, weight distribution is not static. When the vehicle is in motion it is dynamic and shifts constantly when accelerating, braking, climbing hills and cornering. A well balanced vehicle in the first instance however, is considerably easier to control than a vehicle which has excessive left/right or front/rear imbalance.

The low centre of gravity created by the low height of the boxer engine also provides not only for improved and safer performance on the highway but also for greater stability in more difficult terrain.

ACTIVE SAFETY



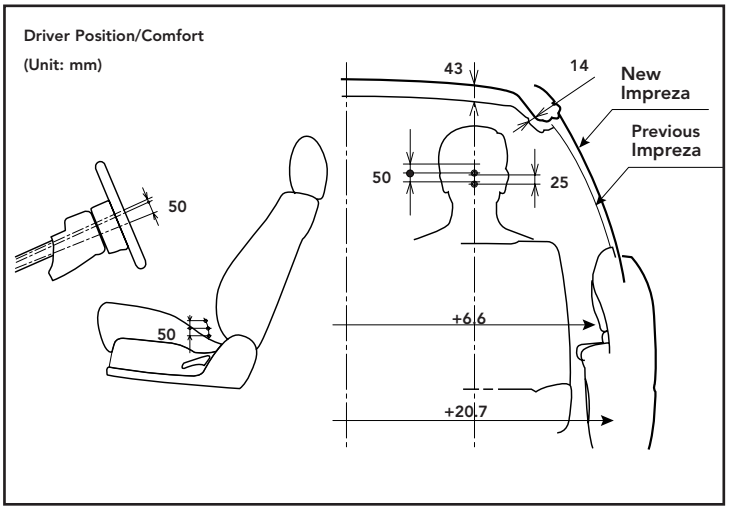
VISIBILITY & COMFORT

Occupant comfort and optimum visibility are important considerations not only from the point of view of creature comfort but also with regard to active safety.

Active safety in the first instance is all about improving the drivers ability to control the vehicle. In this context it is important that the driver is not distracted due to poor visibility or having to move awkwardly to operate the controls.

The choice of the correct eye point not only creates a feeling of freedom and roominess inside the vehicle, it also reduces the number of blind spots and allows the driver to easily judge the exterior dimensions of the vehicle.

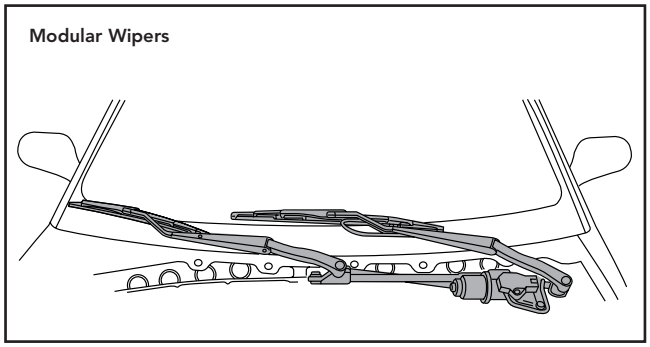
The drivers seat position and forward visibility have been set so that the leading edge of the bonnet can always be seen. This is possible because the horizontal opposed engine is low in the chassis frame and therefore the bonnet can also be positioned low. This along with the fender and headlight design means that Impreza leads its class in terms of forward road visibility.



ACTIVE SAFETY

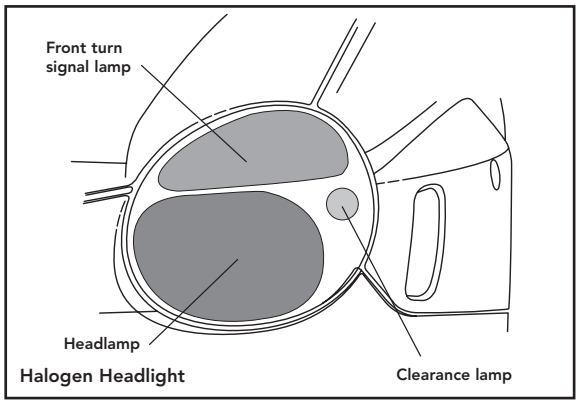
Visibility & Comfort (cont.)

The drivers seating position also plays a big part in providing optimum visibility and comfort and on the New Impreza the driver's hip point has been raised 30mm with head clearance increased by 43mm. When combined with the new ratchet seat lifter, which provides a range of 50mm, any driver of virtually of any size can attain the optimum driving position.


Modular Wipers

It is also important to minimise the amount of eye movement and refocussing which is necessary to take in essential information from the instrument panel. Switches and controls have therefore been designed to facilitate operation using sense of touch rather than having to take ones eyes from the road to verify its operation.

In order to ensure good visibility in poor weather conditions, the performance of the wipers have also been significantly improved. This has been achieved through the use of a modular system that has reduced operating noise and prevents floating of the wiper blades at high speed.



Halogen Headlight

Headlight performance has been improved through the using 2 bulb halogen headlights (55 watt low beam, 60 watt highbeam) using a clear lens and multi-reflector for optimum light distribution.

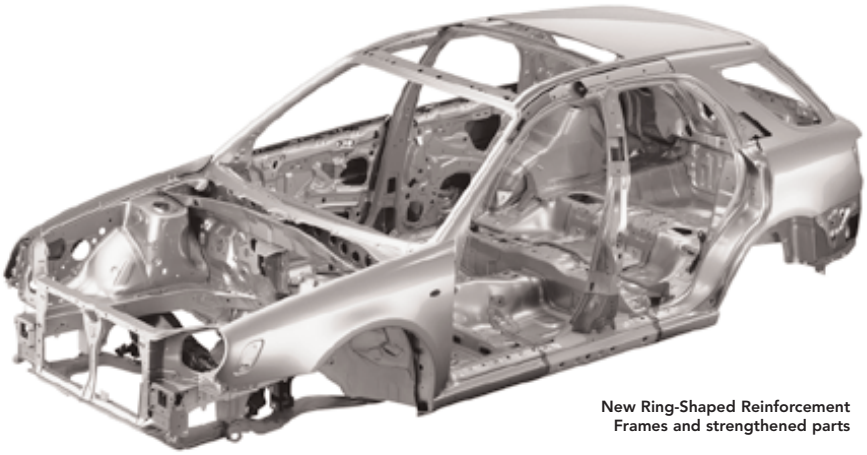
A low level of interior noise also makes a significant contribution to the level of comfort and safety of the vehicle and therefore one of the prime objectives of the designers was comfort and quietness of operation.

PASSIVE SAFETY

BODY

Body construction is the most important aspect of passive safety and this new design has significant improvements, which provides for crash performance equal to the Liberty. It is anticipated that Impreza will receive four star ratings in the independent NCAP (offset) & SINCAP (side impact) tests.

Newly developed ring shaped reinforce performance by improving collision protectio this structure, the centre pillars, roof an connected to form a ring shape for increas rigidity and effective dispersal of the impact energy in a side collision. The structure of the centre pillar also uses a new high strength lightweight construction method called "Tailored blanked welding". This method uses steel plates (2.6mm & 1.2mm) that are laser welded together prior to stamping. The double thickness plate is only used in the specific area where additional strength is required and therefore this method retains the high strength of a single one piece stamping at a much-reduced weight.



New Ring-Shaped Reinforcement Frames and strengthened parts

In a full frontal or an offset collision a newly developed hydro-formed sub-frame and side frames protect the occupants by absorbing and dispersing the impact energy. This two stage structure splits the impact energy into two streams one of which is dispersed by the floor and side sill frame and the other by the 'A" pillar and roof frame.

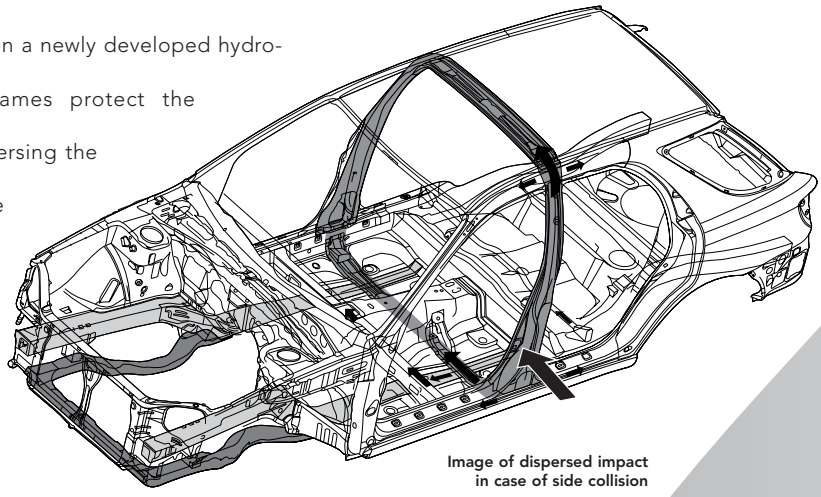
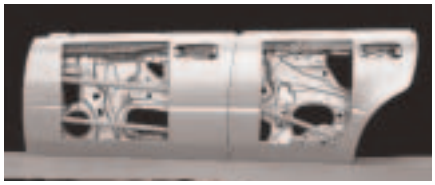


Image of dispersed impact in case of side collision

PASSIVE SAFETY

Body (cont.)



Strategic placement of two side door reinforced beams in the front door and one in the rear provide additional strength against side collision. Further strengthening of the rear door wheel arch and floor prevent the rear door being forced into the cabin in a side impact.

A high strength rigid body also provides a solid frame structure as a base for the suspension and ensures that body flex does not impact upon the precision and superior stability which are fundamental to Subaru's Active Safety System.

To achieve this, lightweight yet rigid double skinned box sections were used for both pillar and roof rails whilst heavy duty reinforced parts are used for the attachment of suspension and steering components. This feature is essential to the Subaru design philosophy as it effectively lowers the centre of gravity and at the same time keeps the body weight to a minimum.

These improvements have resulted in very significant increases in the body strength as shown in the accompanying table.

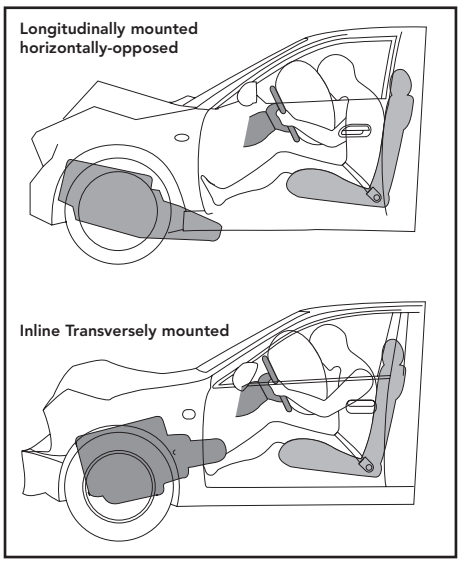
IMPREZA BODY STRENGTH

Improvements	NEW IMPREZA	PREVIOUS IMPREZA	% IMPROVEMENT
Torsional rigidity Nm2	5.48×10^6	2.21×10^6	147%
Flexural rigidity Nm/rad2	3.91×10^6	2.14×10^6	82%

Power Train Layout Advantage

The compact longitudinally mounted horizontally opposed engine and transmission allows for installation in the vehicle with room to spare on all sides, especially to the front and rear. This means that the side frame which acts to absorb the energy of a frontal collision can be designed to the optimum shape and size for its purpose.

Another superior aspect of the design is that in the event of a frontal collision the power train will move downwards and backwards underneath the floor without intrusion into the passenger compartment. The engine bay then becomes a high efficiency crush zone to absorb the shock and energy of the impact. Conversely with an inline transversely mounted engine and transmission layout due to its greater dimension and greater overall height, it cannot move underneath the vehicle and it is forced into the passenger compartment.



PASSIVE SAFETY

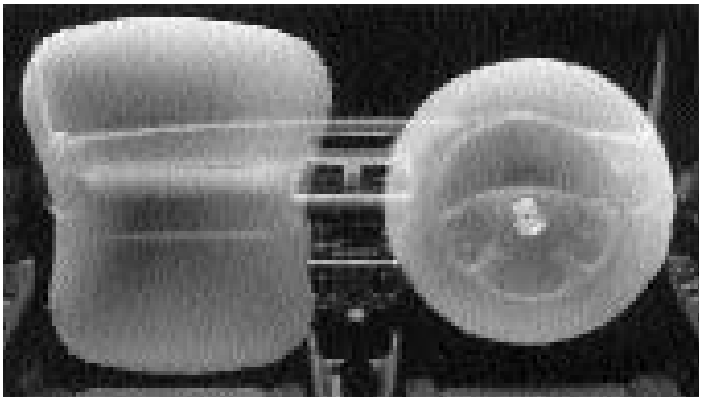
Occupant Restraint

Dual SRS airbags are standard equipment on all vehicles along with electric pre-tensioner seatbelts with load limiters as a total occupant restraint system.

The SRS (supplemental restraint system) airbag is an auxiliary device which is designed to operate in conjunction with the seatbelt and therefore the matching of the deployment of both units is critical in ensuring maximum protection to the occupant.

During a collision which results in a decelerating force approximately equivalent to driving into a brickwall at >23 kms/hr. The SDS (satellite discrimination sensor) system signals the computer to rapidly inflate airbags in front of the driver and passenger. This system which uses two satellite sensors positioned on the chassis rail to determine if it is a side or frontal impact. The main sensor in the control unit determines if the impact exceeds the preset deployment threshold which has been set for Australian conditions and regulations and is less aggressive that those systems previously used in the American market. This is because the inflation rate is tuned to the operation of the seatbelt and the deflation rate is quicker. This system is also less susceptible to unnecessary low speed deployment but the most important consideration remains the protection of the occupants from severe injury and the system is calibrated with this as the primary objective.

The airbags, which are 60 litres for the driver and 100 litres for the passenger, inflate within approximately 30 ms to cushion and absorb the forward momentum of the occupants. Vents in the side of the airbag then allow the bag to deflate as the body strikes the bag thereby decelerating the body at a more favourable rate. This prevents the occupants head from striking the vehicles dash or steering wheel for in spite of the action of the pre-tensioner seatbelts, some forward movement is allowed to occur as the load limiter activates to minimise chest injury.



PASSIVE SAFETY

Pre-tensioner Load Limiter Seatbelts

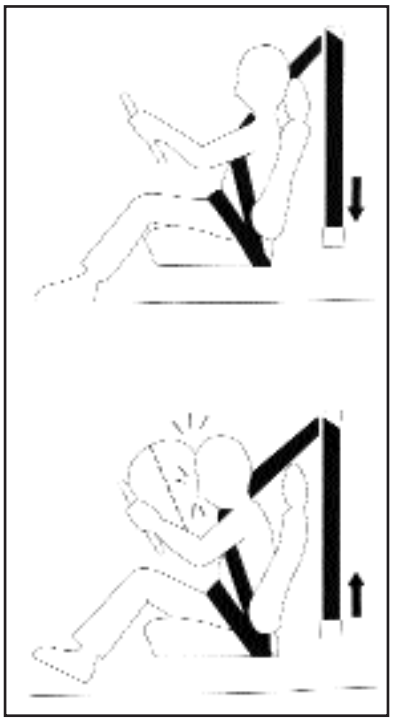
An important measure in ensuring a high level of passive safety even when SRS airbags are used is the efficacy of the seatbelts.

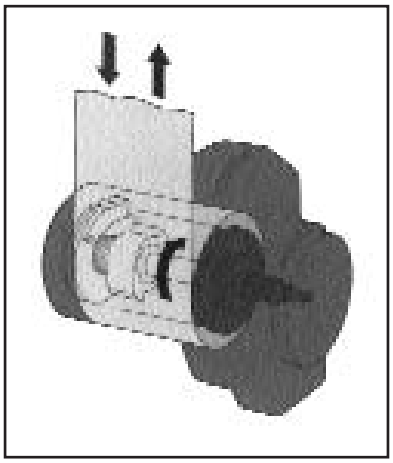
The effectiveness of the seatbelt in minimising injury is increased when the occupant is restrained quickly. If restraint is delayed, the difference in speed of the vehicle and the occupants body increases and it is therefore subjected to extreme force when it stops suddenly. This speed difference will increase if there is any slack between the belt and the body, particularly if the belt is incorrectly positioned or the occupant is wearing bulky clothes.

The pre-tensioner load limiter seatbelt is designed to quickly upon impact tighten the seat belt to take up the slack but then to also limit the load placed on the occupant's chest by feeding out the belt to absorb the shock of the impact. This mechanism is located in the retractor unit bolted to the lower 'B' pillar and it is controlled by the same computer which triggers the airbag deployment.

The front seatbelt top anchor point is also fully adjustable and the buckle is integrated into the seat to ensure the optimum belt position which is most effective in restraining the occupant is possible irrespective of the size of the occupant.

Three point ELR seatbelts have also now been installed in all three rear-seating positions. On the station wagon when not required the centre lap sash seatbelt can be disengaged from the lower anchor point and allowed to retract into the ELR which is positioned in the rear corner of the roof.





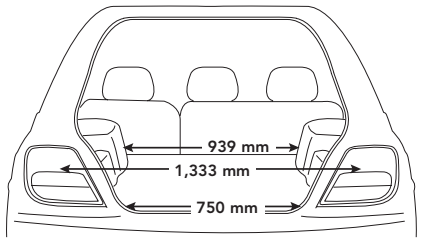
INTERIOR DIMENSIONS

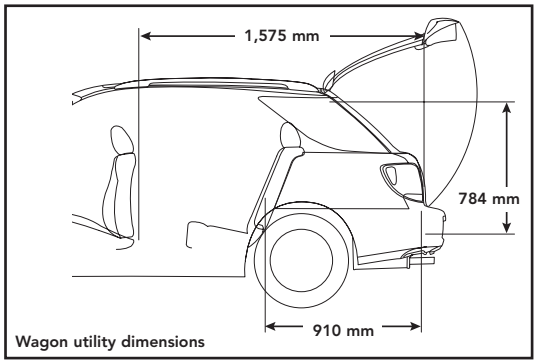
IMPREZA INTERIOR DIMENSIONS

Cargo Volume*			Litres	
	With back seat up (V11) To lower end of rear quarter window		356	
	With back seat folded down (V14)		1266	
	Boot Volume		401	
Interior Size**		FHI	SAE No.	mm
	Front shoulder room		W3	1344
	Rear shoulder room		W4	1340
	Effective leg room (front)		L34	1090
	Effective head room (front)		H61	1010
	Effective head room (rear)		H63	960
	Rear opening lower width	3		750
	Cargo space height	4	H505	784
	Cargo floor width (rear quarter)	2		1333
	Cargo floor width (wheel house)	1	W201	939
	Cargo floor length (back seat up)	6	L203	910
	Cargo floor length (back seat down)	5	L202	1396
	Boot height	7		498
	Boot length	8		936

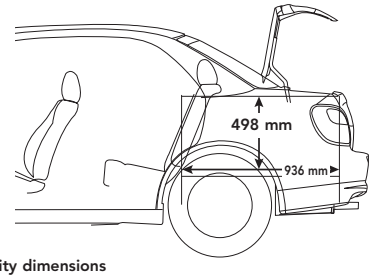
*Cargo volume measured by VDA **Interior Size measured by SAE/FHI

Sportswagon utility dimensions

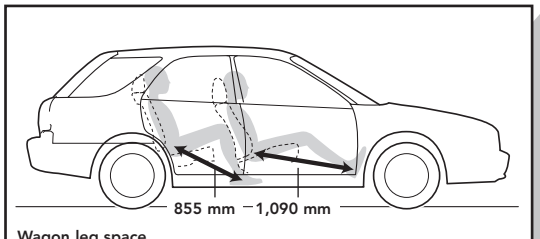




Wagon utility dimensions

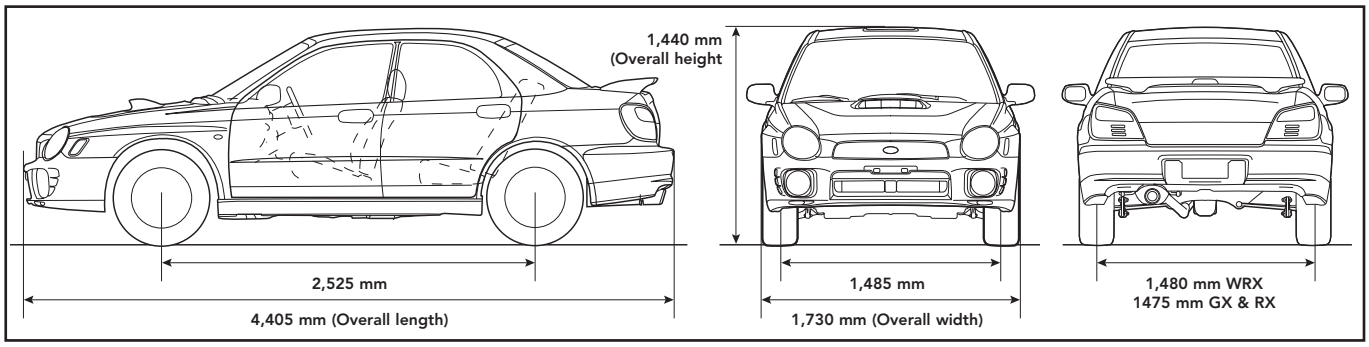


Sedan utility dimensions

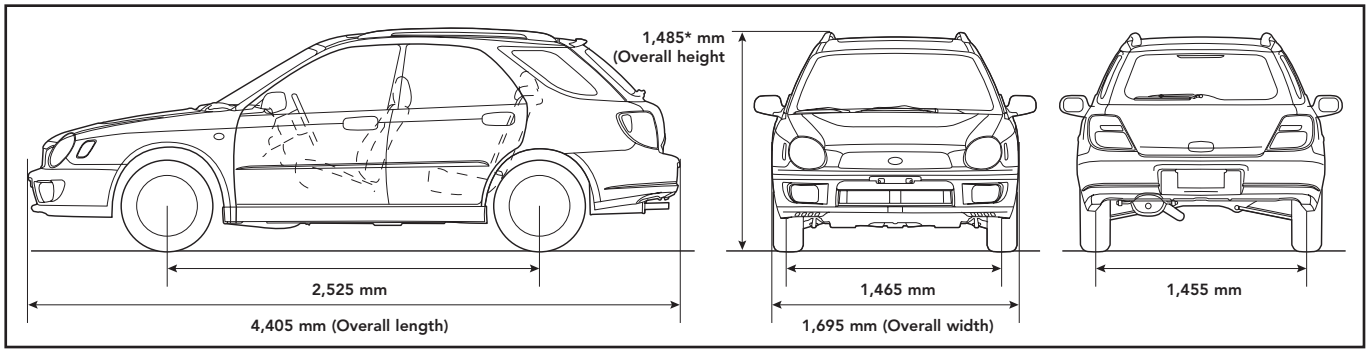


Wagon leg space

EXTERIOR DIMENSIONS



Sedan dimensions



Sportswagon dimensions
*with roof bars

IMPREZA SPECIFICATIONS

Model		SEDAN			HATCH		
		2.0 GX	2.0 RX	2.0 WRX	2.0 GX	2.0 RX	2.0 WRX
Body	Overall Lenght mm	4405	4405	4405	4405	4405	4405
	Overall Width mm	1730	1730	1730	1695	1695	1695
	Overall Height @ UM with roof bars mm				1485	1485	1485
	Overall Height 2 UM without roof bars mm	1440	1440	1440	1465	1465	1465
	Wheelbase	2525	2525	2525	2525	2525	2525
	Front Track mm	1485	1485	1485	1465	1465	1465
	Rear Track mm	1475	1475	1480	1455	1455	1455
	Min Road clearance @ UM mm	150	150	155	150	150	155
	Approach Angle deg.	18	18	18	18	18	18
	Departure Angle deg.	20	20	20	20	20	20
	Breakover angle deg.	16	16	17	16	16	17
	Unladen mass (UM) Kgs Manual	1285	1300	1390	1320	1335	1410
	Unladen mass (UM) Kgs Automatic	1305	1320	1460	1340	1355	1430
	Gross Vehicle mass Kgs Man	1760	1760	1820	1800	1800	1860
	Gross Vehicle mass Kgs Auto	1760	1760	1820	1800	1800	1860
	Payload Kgs (inc passengers) Man	475	460	430	480	465	450
	Payload Kgs (inc passengers) Auto	455	440	410	460	445	425
Engine	Type	Horizontal 4 Cylinder	Horizontal 4 Cylinder	Horizontal 4 Cylinder	Horizontal 4 Cylinder	Horizontal 4 Cylinder	Horizontal 4 Cylinder
		SOHC	SOHC	DOHC	SOHC	SOHC	DOHC
	Capacity cc	1994	1994	1994	1994	1994	1994
	Bore x Stroke mm	92 x 75	92 x 75	92 x 75	92 x 75	92 x 75	92 x 75
	Comp. Ratio	10 : 1	10 : 1	8 : 1	10 : 1	10 : 1	8 : 1
	Max output Kw/rpm	92/5600	92/5600	160/5600	92/5600	92/5600	160/5600
	Max Torque Nm/rpm	184/3600	184/3600	292/3600	184/3600	184/3600	292/3600
	Max turbo boost pressure mm Hg (kPa,lb/in2) @ rpm	N/A	N/A	700 (93.3,13.5) @ 4800	N/A	N/A	700 (93.3,13.5) @ 4800
	Turbo A/R ratio	N/A	N/A	13	N/A	N/A	13
	Max allowable Turbo turbine speed rpm	N/A	N/A	190,000	N/A	N/A	190,000
	Power to weight ratio kg/Kw Manual	14	14.1	8.7	14.3	14.5	8.8
	Power to weight ratio kg/Kw Auto	14.2	14.3	N/A	14.6	14.7	N/A
	Power/litre Kw/ Litre	46.1	46.1	80.2	46.1	46.1	80.2
	Fuel system	Multipoint sequential injection			Multipoint sequential injection		
	Fuel Requirement RON (research octane number)	91 minimum	91 minimum	95 minimum	91 minimum	91 minimum	95 minimum
	Alternator	12 volt 75 amp	12 volt 75 amp	12 volt 75 amp	12 volt 75 amp	12 volt 75 amp	12 volt 75 amp
	Battery auto	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr
	Battery manual	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr	12 volt 27 amp hr
Transmission	Type	4-speed elec. Auto full time All-Wheel Drive			4-speed elec. Auto full time All-Wheel Drive		
	Gear ratio 1st	2.785	2.785	2.785	2.785	2.785	2.785
	Gear ratio 2nd	1.545	1.545	1.545	1.545	1.545	1.545
	Gear ratio 3rd	1.000	1.000	1.000	1.000	1.000	1.000
	Gear ratio 4th	0.694	0.694	0.694	0.694	0.694	0.694
	Gear ratio Rev	2.272	2.272	2.272	2.272	2.272	2.272
	Final Drive axle ratio	4.111	4.111	4.111	4.111	4.111	4.111

IMPREZA SPECIFICATIONS

Model		SEDAN			HATCH		
		2.0 GX	2.0 RX	2.0 WRX	2.0 GX	2.0 RX	2.0 WRX
Transmission	Type	5-speed manual full-time All-Wheel Drive			5-speed manual full-time All-Wheel Drive		
	Gear ratio 1st	3.454	3.454	3.166	3.454	3.454	3.454
	Gear ratio 2nd	2.062	2.062	1.882	2.062	2.062	1.947
	Gear ratio 3rd	1.448	1.448	1.296	1.448	1.448	1.366
	Gear ratio 4th	1.088	1.088	0.972	1.088	1.088	0.972
	Gear ratio 5th	0.825	0.825	0.738	0.825	0.825	0.738
	Gear ratio Rev	3.333	3.333	3.333	3.333	3.333	3.333
	Axle ratio	3.900	3.900	4.400	3.900	3.900	3.900
	High/Low ratio	N/A	N/A	N/A	1.447	1.447	N/A
Steering	Type	Power assisted engine speed senitive rack & pinion			Power assisted engine speed senitive rack & pinion		
	Turning circle curb to curb metres	10.40	10.40	11.00	10.40	10.40	11.00
	Tyre size	195/60R15 88H	195/60R15 88H	215/45R17 87W	195/60R15 88H	195/60R15 88H	215/45R17 87W
	Manufacturer	Michelin	Michelin	Bridgestone	Michelin	Michelin	Bridgestone
	Model	MXV3-A	MXV3-A	Potenza RE011	MXV3-A	MXV3-A	Potenza RE011
	Rim size	15 x 6JJ	15 x 6JJ	17 x 7JJ	15 x 6JJ	15 x 6JJ	17 x 7JJ
	Rim offset mm	55	55	55	55	55	55
Suspension	Front	Independent Mcpherson strut coil springs, gas charged dampers			Independent Mcpherson strut coil springs, gas charged dampers		
	Damping rate, Bump/rebound Kgf	1970/516	1970/516	1970/516	1970/476	1970/476	1970/476
	Suspension Travel. Bump/rebound mm	100/100	100/100	80/110	100/100	100/100	80/110
	Spring rate	MT: 24.2 AT : 26.0	MT: 24.2 AT : 26.0	29	MT: 24.2 AT : 26.0	MT: 24.2 AT : 26.0	26.8
	Stabiliser bar diameter mm	N/A	N/A	20	N/A	N/A	20
	Rear	Dual link strut coil springs, gas charged dampers			Dual link strut coil springs, gas charged dampers		
	Damping rate, Bump/rebound Kgf	1323/516	1323/516	1323/516	1323/490	1323/490	1323/490
	Suspension Travel. Bump/rebound mm	115/90	115/90	110/95	115/90	115/90	110/95
	Spring rate	22.6	22.6	27.9	24.8	24.8	25.2
	Stabiliser bar diameter mm	20	20	20	20	20	20
Brakes	System	Diagonally linked dual circuit with proportioning valve			Diagonally linked dual circuit with proportioning valve		
	Front ventilated disc outer diameter mm	277	277	294	277	277	294
	Front brake caliper (pot size)	Twin Piston floating (2 X 42.8 mm)		4 Piston (4 x 40.4 mm)	Twin Piston floating (2 X42.8? Mm)		4 Piston (4 x 40.4 mm)
	Rear disc outer diameter mm	266	266	290	266	266	290
	Rear brake caliper (pot size)	Single Piston floating (1 x 38.1 mm)		Twin Piston (2 x 38.1 mm)	Single Piston floating (1 x 38.1 mm)		Twin Piston (2 x 38.1 mm)
	Brake Booster Type (size mm)	Vacuum suspended tandem type 205 + 230 mm			Vacuum suspended tandem type 205 + 230 mm		
Capacities	Fuel tank litres	50	50	60	50	50	60
	Fuel range Km @ AS2877 combined cycle	MT: 575, AT: 568	MT: 575, AT: 568	652	MT: 575, AT: 568	MT: 575, AT: 568	652
	Engine Oil Litres	4.2	4.2	4.7	4.2	4.2	4.7
	Engine Coolant Litres	MT: 7, AT: 6.9	MT: 7, AT: 6.9	7.7	MT: 7, AT: 6.9	MT: 7, AT: 6.9	7.7
Towing	Unbraked trailer Kgs	500	500	500	500	500	500
	Braked trailer Kgs	900	900	900	900	900	900
	Maximum roof load Kgs	50	50	50	80 with roof rail	80 with roof rail	80 with roof rail
Fuel	AS2877 Litre/100 Km City	9.5	9.5	MT: 11.0, AT: 11.0	10.0	10.0	MT: 11.0, AT: 11.0
	Highway	7.3	7.3	MT: 8.0, AT: 8.5	7.4	7.4	MT: 8.0, AT: 8.5
	Combined	8.51	8.51	MT: 9.7, AT: 9.9	8.83	8.83	MT: 10.0, AT: 9.9
Performance	Max. Speed Km/hr man	190	190	230	185	185	225
	Max. Speed Km/hr auto	181	181	N/A	176	176	N/A
	0-100 Km/hr secs. man	10.2	10.2	6.2	N/A	N/A	6.3
	0-400 m secs	N/A	N/A	N/A	N/A	N/A	N/A

*Ground clearance at unladen mass. **Gear ratio figures listed are international specification, these figures may vary for Australian models. Subaru Australia reserves the right to change mechanical specification and equipment levels with out prior notice.