

## MODULE 2

# ***BASIC AUTOMOTIVE FUNDAMENTALS***

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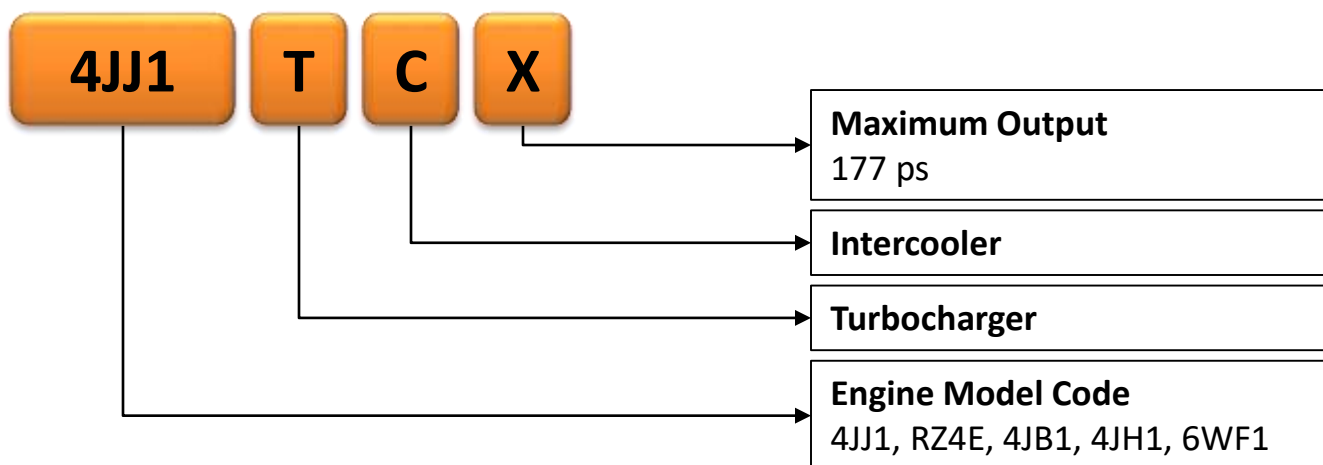
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- A. Engine
- B. Drivetrain
- C. Underchassis
- D. Convenience
- E. Safety

# A. Engine

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4JJ1 - TCX	
Type		4-cylinder In-line Blue Power Diesel engine with turbo intercooler	
Maximum power	PS (kW) @ rpm	177 (130) @ 3,600	
Maximum torque	N-m (kg-m) @ rpm	380 (38.7) @ 1,800-2,800	
Displacement	cc	2,999	
Bore x stroke		95.4 x 104.9	
Compression ratio		16.3 : 1	
Fuel tank capacity	Liters	76	
Fuel system		Common Rail Direct Injection	
Turbocharger		Variable Geometry System (VGS)	

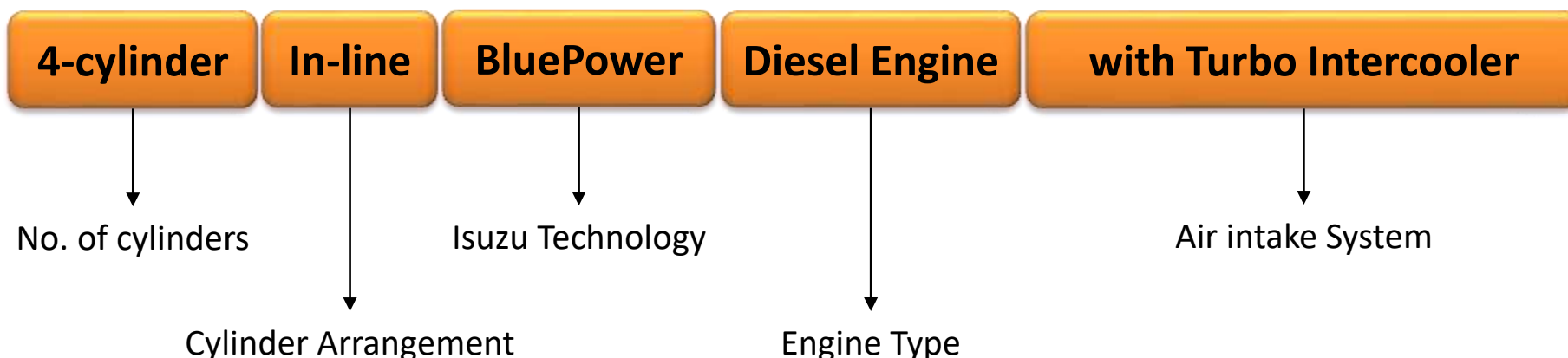
1. Engine Model – Describes the engine model code.



# A. Engine

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4M11 - TCY	
Type		4-cylinder In-line Blue Power Diesel engine with turbo intercooler	
Maximum power	PS (kW) @ rpm	177 (130) @ 3,600	
Maximum torque	N-m (kg-m) @ rpm	380 (38.7) @ 1,800-2,800	
Displacement	cc	2,999	
Bore x stroke		95.4 x 104.9	
Compression ratio		16.3 : 1	
Fuel tank capacity	Liters	76	
Fuel system		Common Rail Direct Injection	
Turbocharger		Variable Geometry System (VGS)	

2. Engine Type – describes the design of the engine and it's features



# A. Engine

4-cylinder

In-line

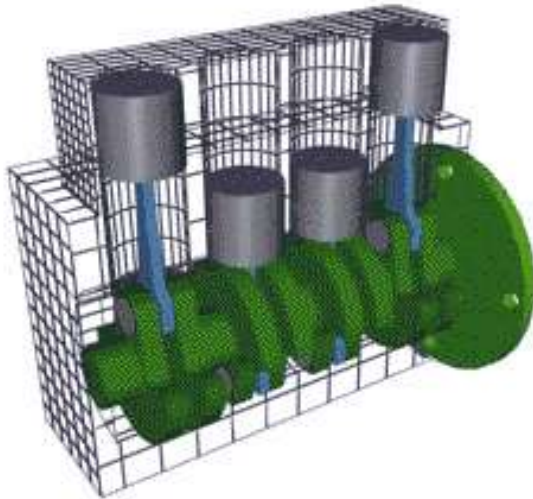
BluePower

Diesel Engine

with Turbo Intercooler

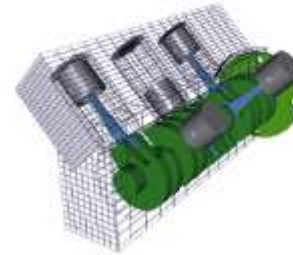


Cylinder Arrangement

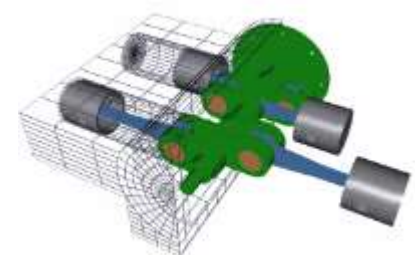


***In-line Cylinder Arrangement***

- Easy to maintain
- Low Production Cost



***V-Type***



***Horizontally Opposed***

- High manufacturing cost
- Heavier weight

# A. Engine

4-cylinder

In-line

BluePower

Diesel Engine

with Turbo Intercooler



Isuzu Technology



- Is an eco-friendly diesel technology developed by Isuzu, in its global commitment to a cleaner environment.

Bluepower technology benefits:

- Maximum Engine Output
- Lowest Emission
- Best Fuel Economy
- Durability

# A. Engine

4-cylinder

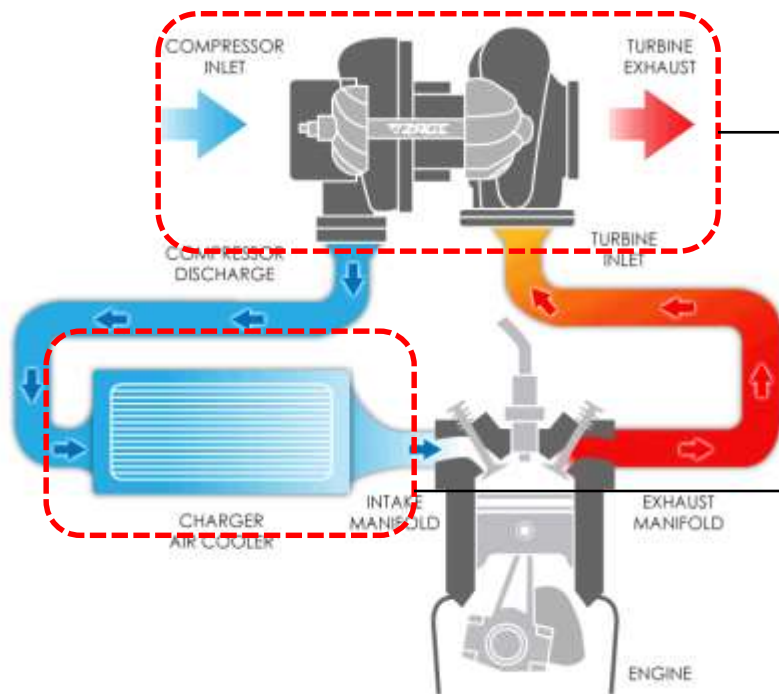
In-line

BluePower

Diesel Engine

with Turbo Intercooler

Air Intake System



## ***Turbocharger***

Increases the amount of air that enters the engine cylinder.

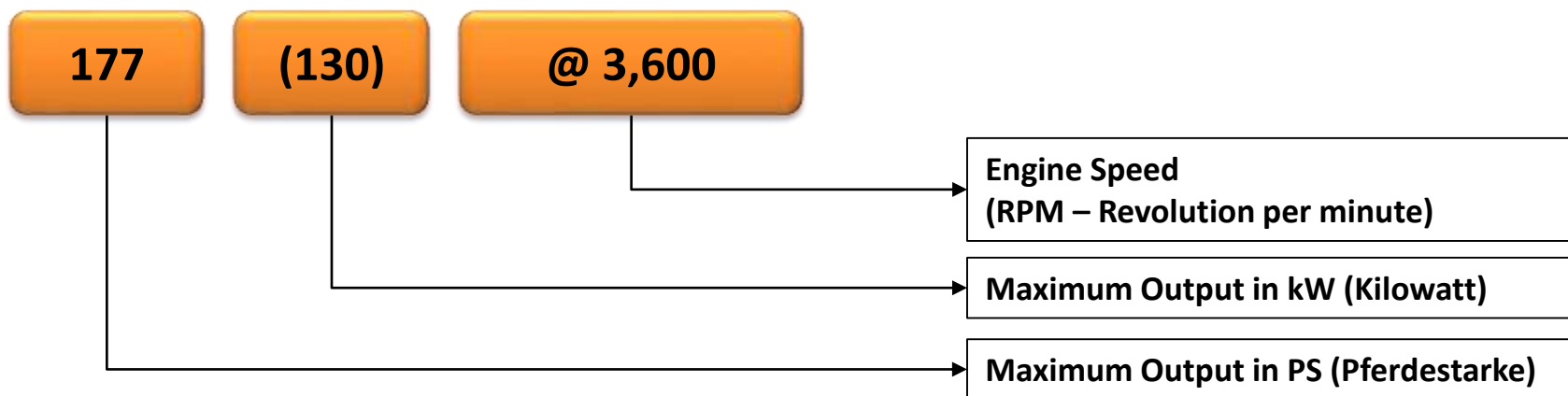
## ***Intercooler***

Cools the air compressed by the turbocharger, reducing the temperature and increase the density of air supplied to the engine.

# A. Engine

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4JJ1 - TCX	
Type		4-cylinder In-line Blue Power Diesel engine with turbo intercooler	
Maximum power	PS (kW) @ rpm	177 (130) @ 3,600	
Maximum torque	N-m (kg-m) @ rpm	380 (38.7) @ 1,800-2,800	
Displacement	cc	2,999	
Bore x stroke		95.4 x 104.9	
Compression ratio		16.3 : 1	
Fuel tank capacity	Liters	76	
Fuel system		Common Rail Direct Injection	
Turbocharger		Variable Geometry System (VGS)	

3. Maximum Output – indicates the engine's capability to produce speed.

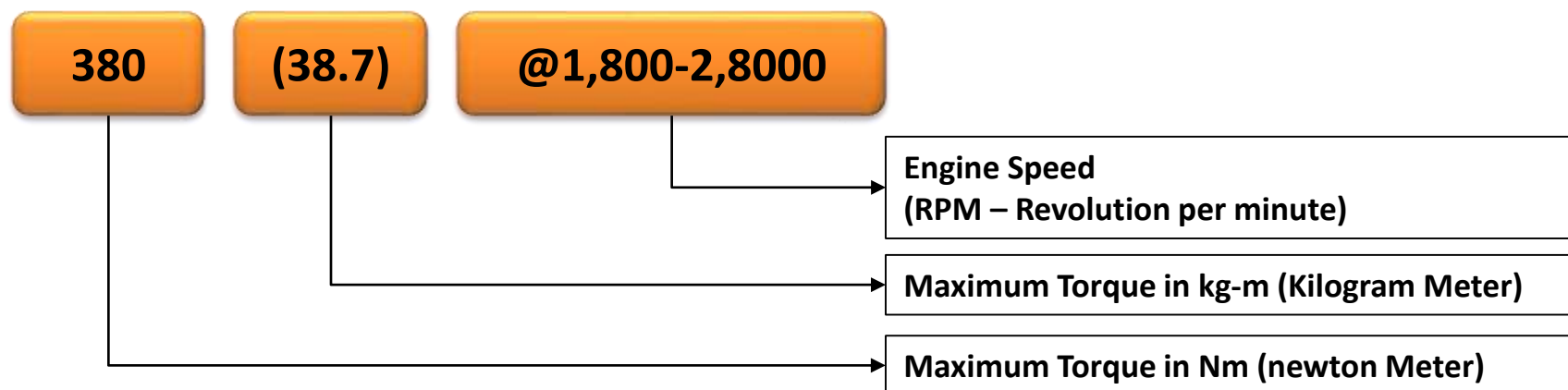




# A. Engine

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4JJ1 - TCX	
Type		4-cylinder In-line Blue Power Diesel engine with turbo intercooler	
Maximum power	PS (kW) @ rpm	177 (130) @ 3,600	
Maximum torque	N-m (kg-m) @ rpm	380 (38.7) @ 1,800-2,800	
Displacement	cc	2,999	
Bore x stroke		95.4 x 104.9	
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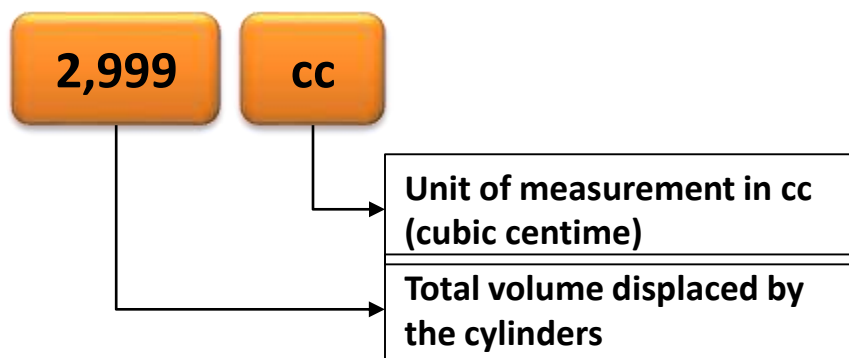
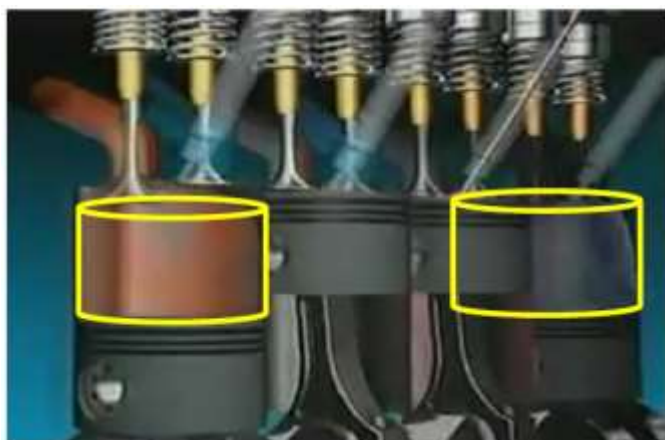
4. Maximum Torque – indicates the maximum pulling power the engine can produce.



# A. Engine

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4JJ1 - TCX	
Type		4-cylinder In-line Blue Power Diesel engine with turbo intercooler	
Maximum power	PS (kW) @ rpm	177 (130) @ 3,600	
Maximum torque	N.m (kg-m) @ rpm	380 (38.7) @ 1,800-2,800	
Displacement	cc	2,999	
Bore x stroke		95.4 x 104.9	
Compression ratio		16.3 : 1	
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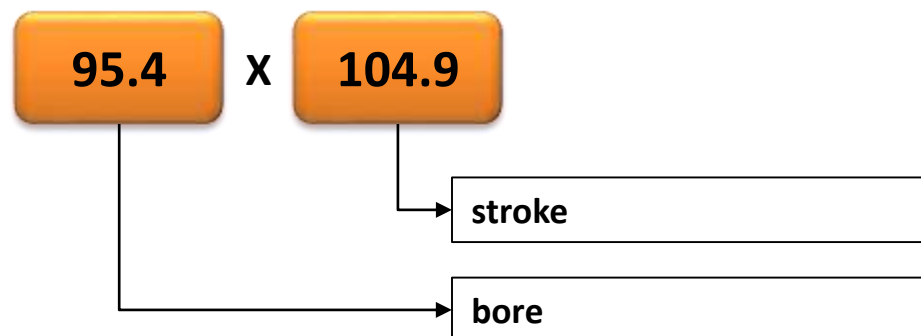
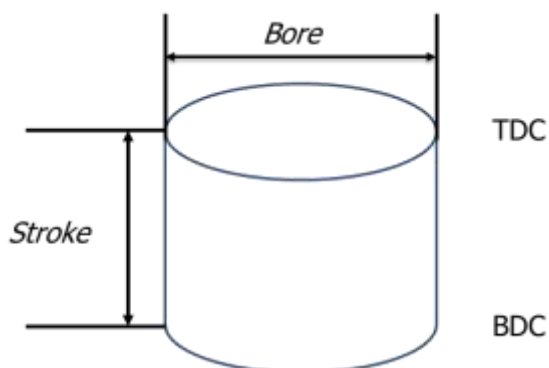
5. Displacement – pertains to the total volume of air and fuel mixture inside the cylinder.



# A. Engine

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Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4JJ1 - TCX	
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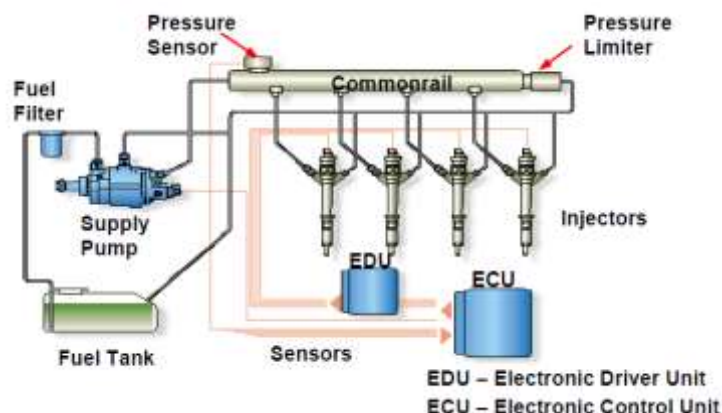
6. Bore and Stroke – indicates the diameter of the cylinder and length of the piston travel inside the cylinder.



# A. Engine

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Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4JJ1 - TCX	
Type		4-cylinder In-line Blue Power Diesel engine with turbo intercooler	
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Compression ratio		16.3 : 1	
Fuel tank capacity	Liters	76	
Fuel system		Common Rail Direct Injection	
Turbocharger		Variable Geometry System (VGS)	

7. Fuel System – Indicates the fuel system used to supply fuel inside the engine.



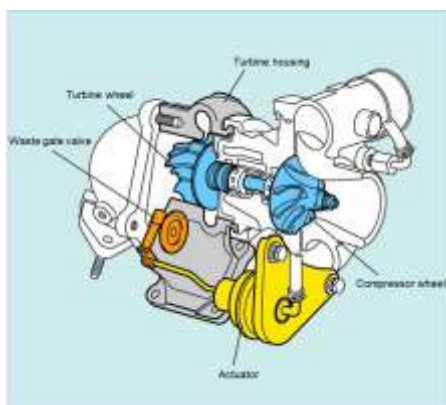
## CRDI

Electronic controlled fuel system that supplies fuel in a controlled amount and pressure.

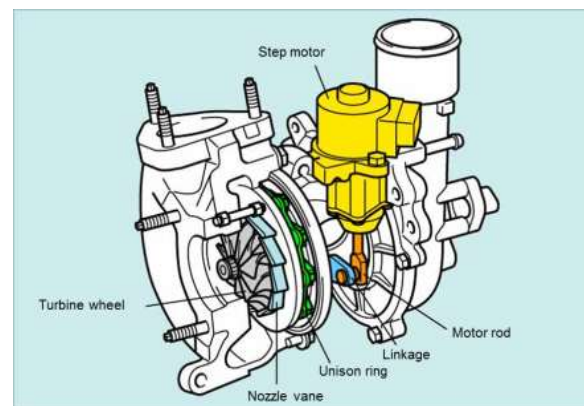
# A. Engine

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
ENGINE			
Model		4JJ1 - TCX	
Type		4-cylinder In-line Blue Power Diesel engine with turbo intercooler	
Maximum power	PS (kW) @ rpm	177 (130) @ 3,600	
Maximum torque	N-m (kg-m) @ rpm	380 (38.7) @ 1,800-2,800	
Displacement	cc	2,999	
Bore x stroke		95.4 x 104.9	
Compression ratio		16.3 : 1	
Fuel tank capacity	Liters	76	
Fuel system		Common Rail Direct Injection	
Turbocharger		Variable Geometry System (VGS)	

8. Turbocharger – increase the amount of air that enters the engine.



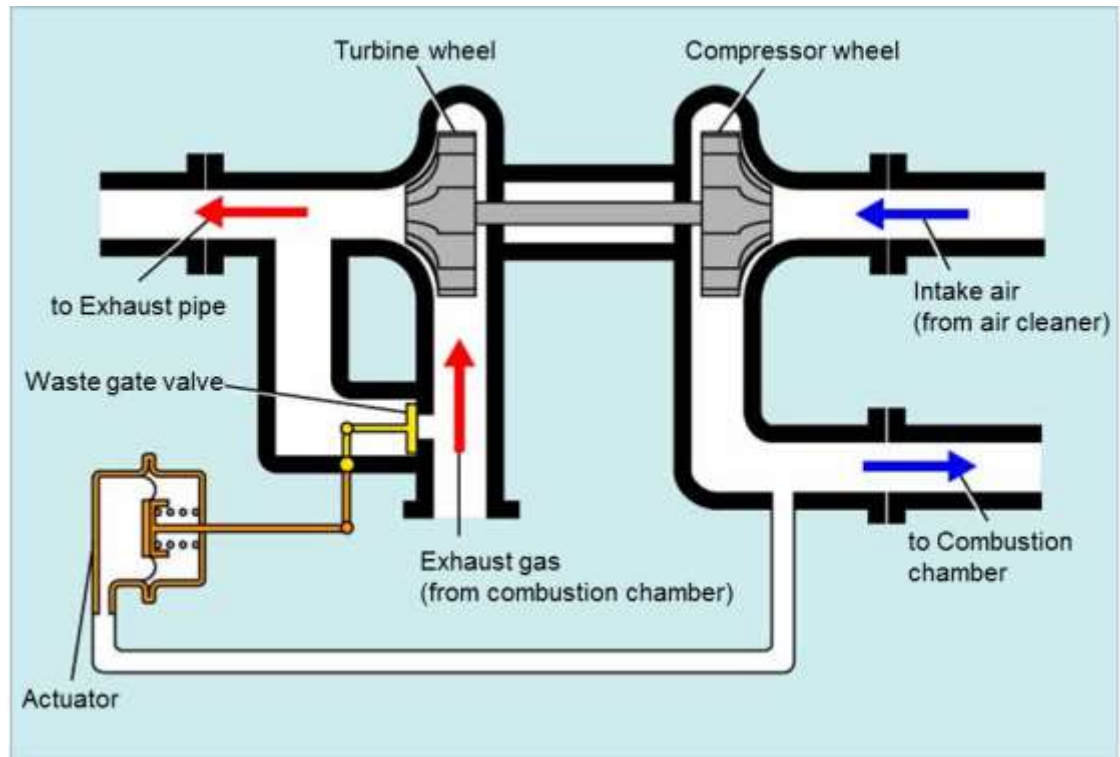
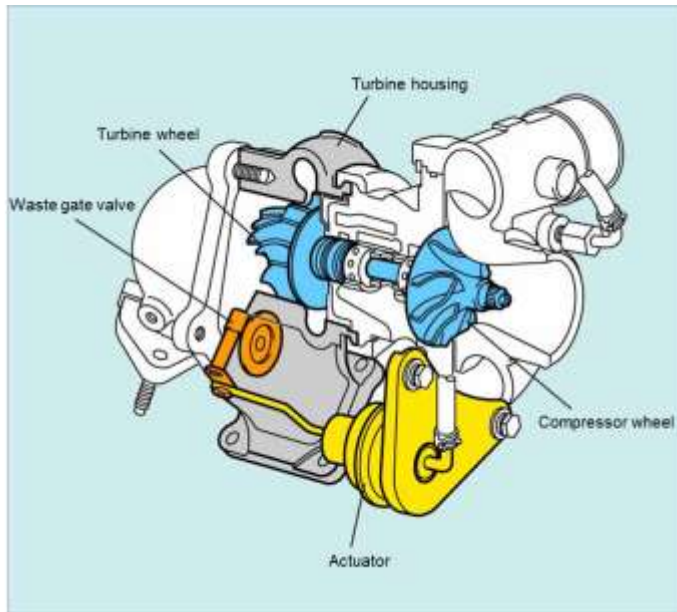
**Waste Gate Type Turbocharger**



**Variable Geometry System**

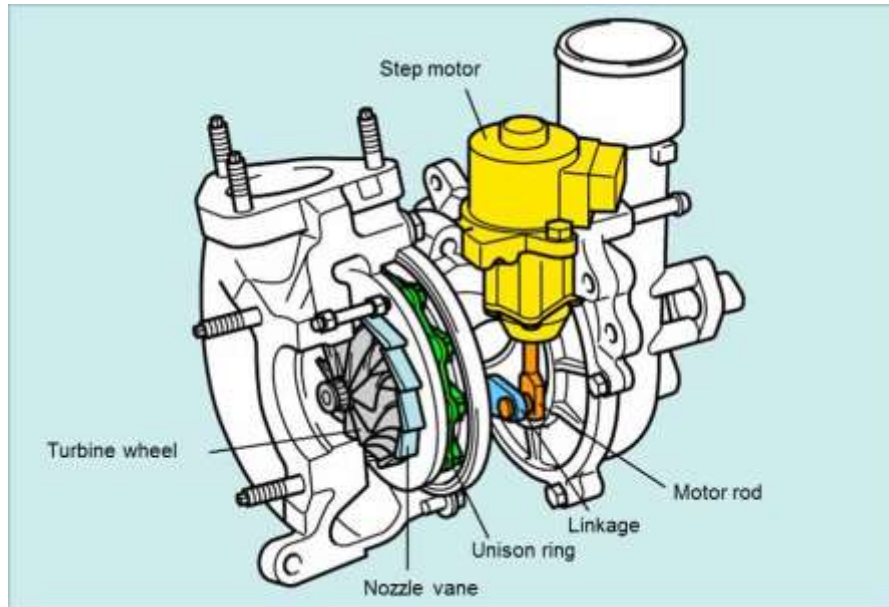
# A. Engine

## Waste Gate Type Turbocharger Operation

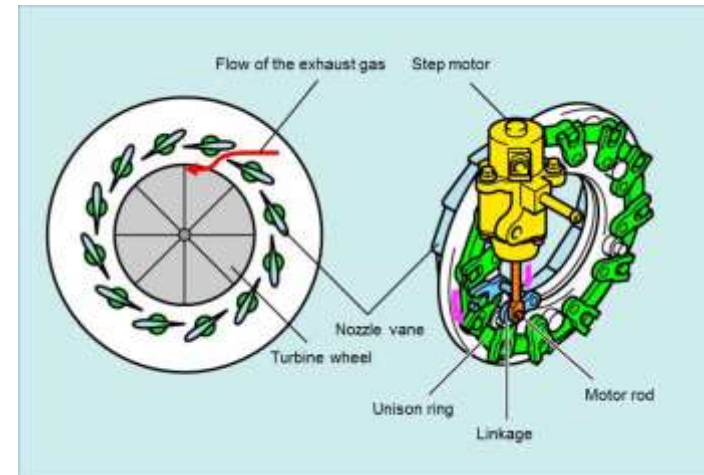


# A. Engine

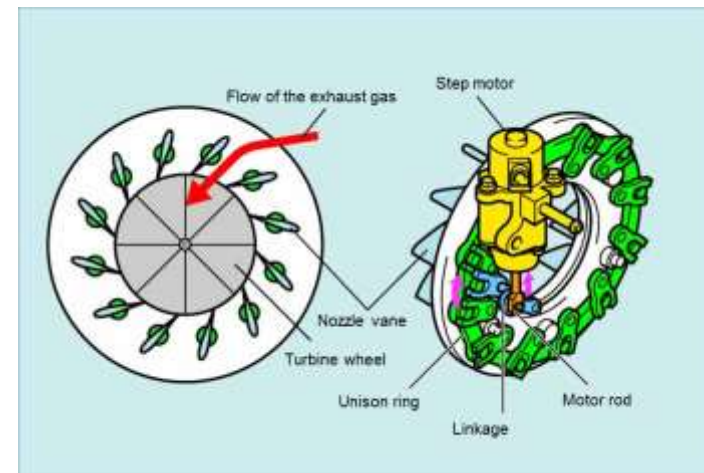
## Variable Geometry System Operation



*VGS at low speed:*



*VGS at high speed:*





# B. Drivetrain

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
<b>DRIVETRAIN</b>			
Transmission	Model	MVL-6N	AWR6B45-II
	Type	6-speed manual transmission with gear shift indicator	6-speed automatic transmission with sequential shift
Gear ratio	1st	4.942	3.600
	2nd	2.430	2.090
	3rd	1.428	1.488
	4th	1.000	1.000
	5th	0.749	0.687
	6th	0.634	0.580
	Reverse	3.727	3.732
	Final	4.597	4.300

1. Transmission – also known as “gearbox”; component that transmit power from engine to the driving wheels.



**Manual Transmission**



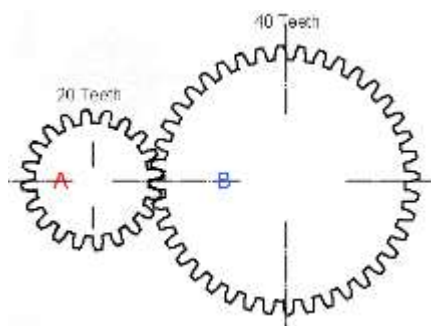
**Automatic Transmission**

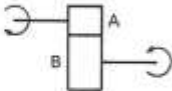
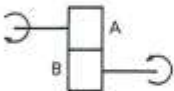
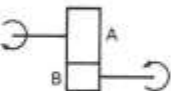
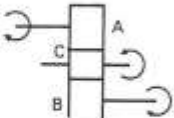


# B. Drivetrain

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
DRIVETRAIN			
Transmission	Model	MVL-6N	AWR6B45-II
	Type	6-speed manual transmission with gear shift indicator	6-speed automatic transmission with sequential shift
Gear ratio	1st	4.942	3.600
	2nd	2.430	2.090
	3rd	1.428	1.488
	4th	1.000	1.000
	5th	0.749	0.687
	6th	0.634	0.580
	Reverse	3.727	3.732
	Final	4.597	4.300

2. Gear Ratio – indicates the ratio between the driven gear and driver gear.

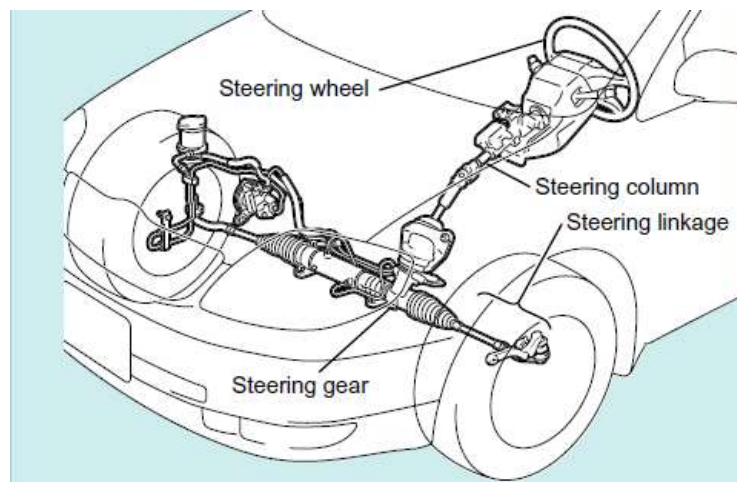


		A: Drive gear		B: Driven gear	
No. of teeth	$A < B$	$A = B$	$A > B$	$A = B$	
Gear combination					
Speed of B against A	Reduced	Equal	Increased	Equal (C is an idle gear)	
Torque of B against A	Increased	Equal	Decreased	Equal	

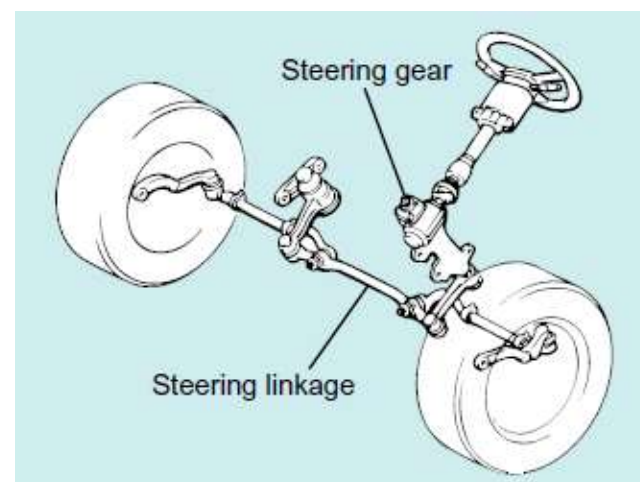
# C. Underchassis

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
CHASSIS			
Steering type		Rack and pinion power assist and tilt adjust	
Brakes	Front	Ventilated disc	
	Rear	Leading and trailing drums	
Suspension	Front	Independent double wishbone with coil spring, monotube nitrogen	
	Rear	Semi-elliptical leaf spring with monotube nitrogen charged shock	
Tires and wheel		265/70 R17 All Terrain tires; Black aluminum alloy wheel	

1. Steering Type – indicates the type of steering equipped to the vehicle.



**Rack and pinion type**

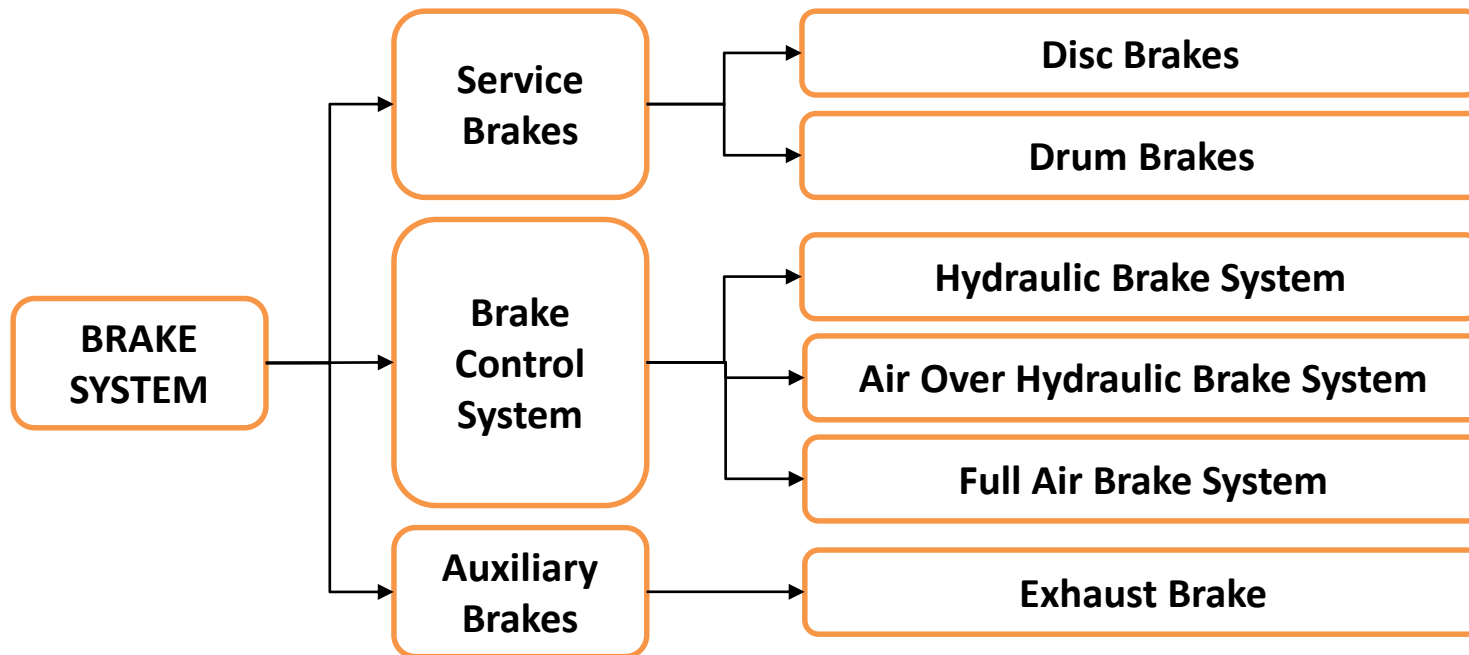


**Recirculating Ball Type**

# C. Underchassis

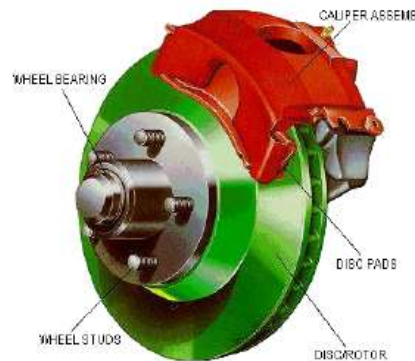
Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
CHASSIS			
Steering type		Rack and pinion power assist and tilt adjust	
Brakes	Front	Ventilated disc	
	Rear	Leading and trailing drums	
Suspension	Front	Independent double wishbone with coil spring, monotube nitrogen	
	Rear	Semi-elliptical leaf spring with monotube nitrogen charged shock	
Tires and wheel		265/70 R17 All Terrain tires; Black aluminum alloy wheel	

2. Brakes – describe the types of brakes installed on front and rear wheels.



# C. Underchassis

## 1. Service Brakes



### *Disc Brake*

Uses calipers to squeeze pairs of pads against a disc.

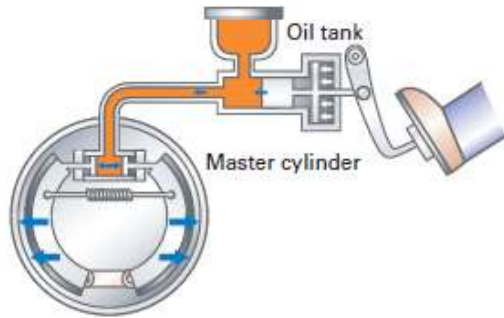


### *Drum Brake*

- Creates a friction by pressing the shoe onto the brake drum.

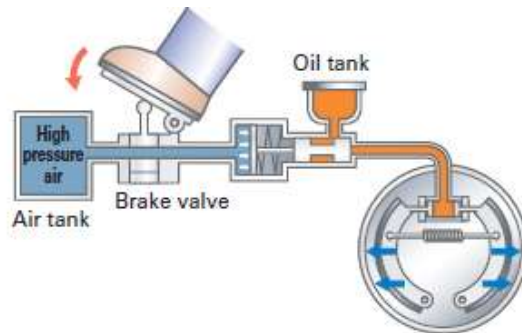
# C. Underchassis

## 2. Brake Control System



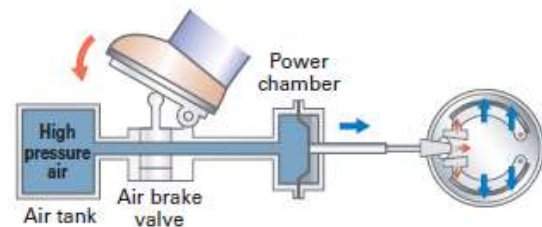
### *Hydraulic Brake System*

Uses brake fluid to transfer pressure from the controlling mechanism to the actual mechanism.



### *Air Over Hydraulic Brake System*

Uses combination of compressed air and hydraulic pressure.

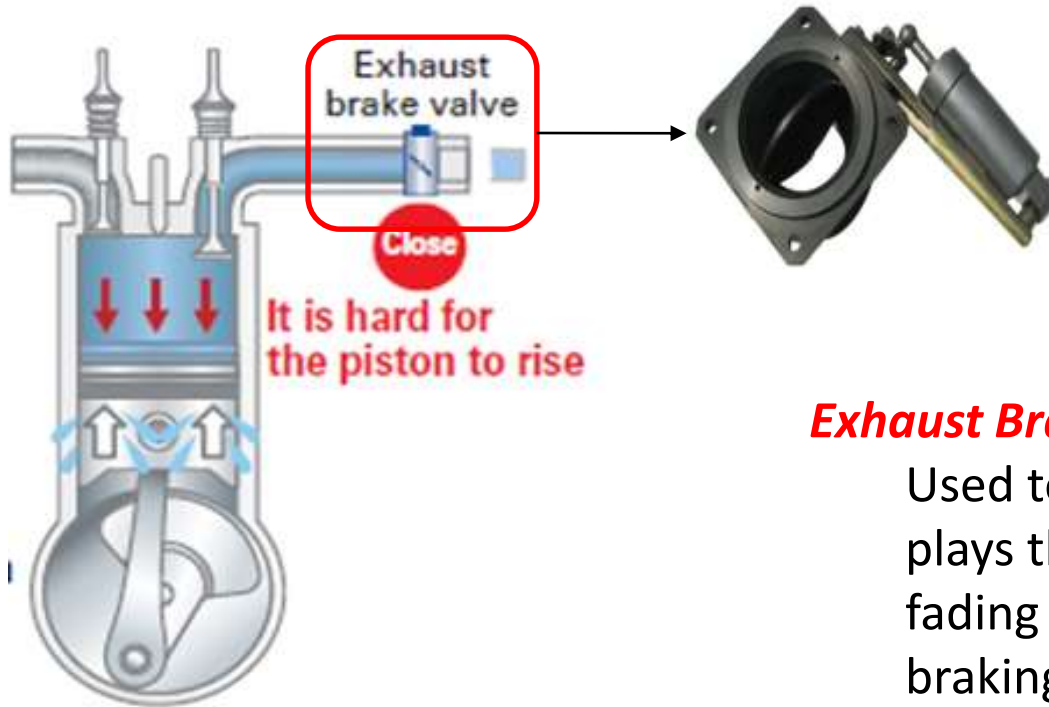


### *Full Air Brake System*

Uses compressed air pressure to pressed the brake shoe onto the drum.

# C. Underchassis

## 3. Auxiliary Brake



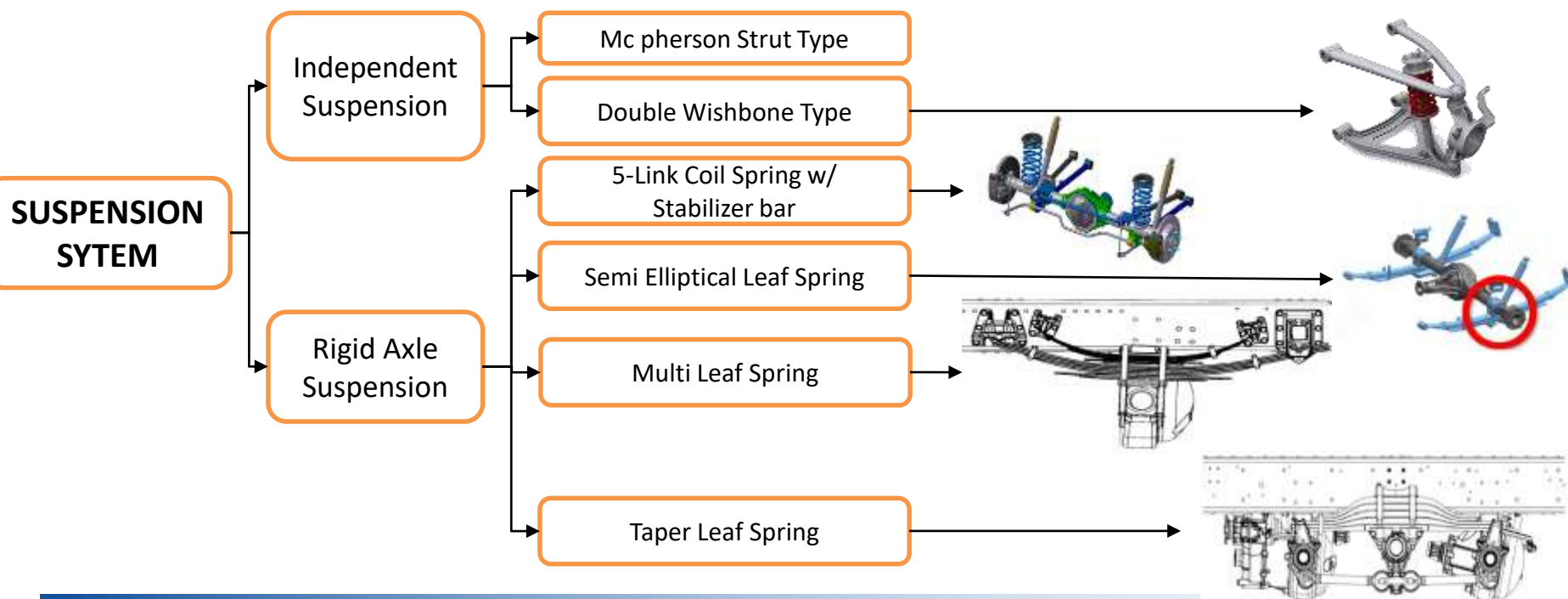
### ***Exhaust Brake***

Used to decelerate a motor vehicle. It plays the role of preventing wheel brake fading and increased the effectiveness of braking.

# C. Underchassis

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
CHASSIS			
Steering type		Rack and pinion power assist and tilt adjust	
Brakes	Front	Ventilated disc	
	Rear	Leading and trailing drums	
Suspension	Front	Independent double wishbone with coil spring, monotube nitrogen	
	Rear	Semi-elliptical leaf spring with monotube nitrogen charged shock	
Tires and wheel		265/70 R17 All Terrain tires; Black aluminum alloy wheel	

3. Suspension – Describes the types of suspension system used on front and rear.

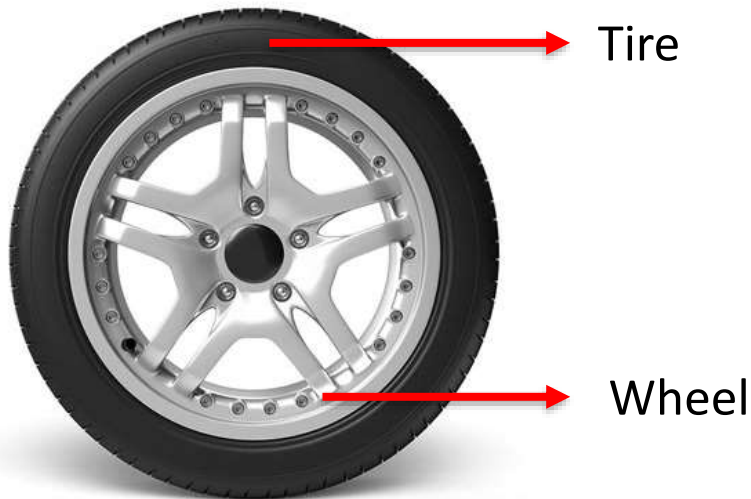




# C. Underchassis

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
CHASSIS			
Steering type		Rack and pinion power assist and tilt adjust	
Brakes	Front	Ventilated disc	
	Rear	Leading and trailing drums	
Suspension	Front	Independent double wishbone with coil spring, monotube nitrogen	
	Rear	Semi-elliptical leaf spring with monotube nitrogen charged shock	
Tires and wheel		265/70 R17 All Terrain tires; Black aluminum alloy wheel	

4. Tires and wheel – describes the size of the tires, size of the wheel and its material.



## ***Tire***

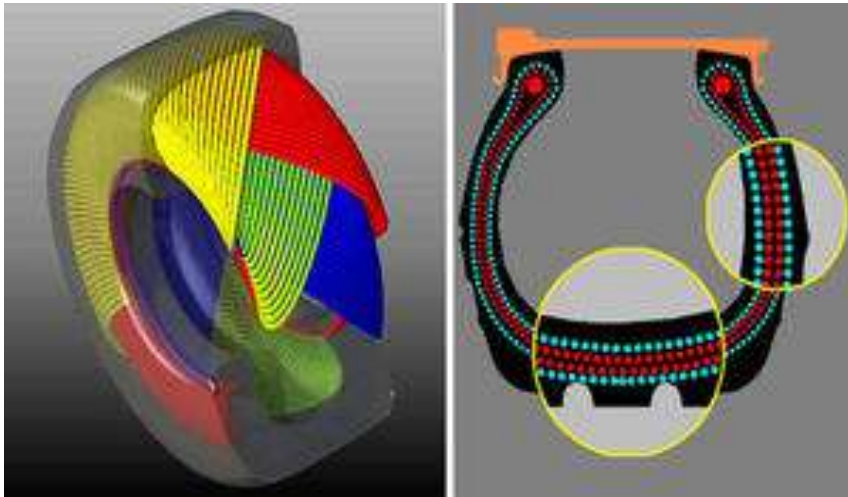
Support vehicle weight, absorb shock while driving, and make the vehicle change direction safely.



# C. Underchassis

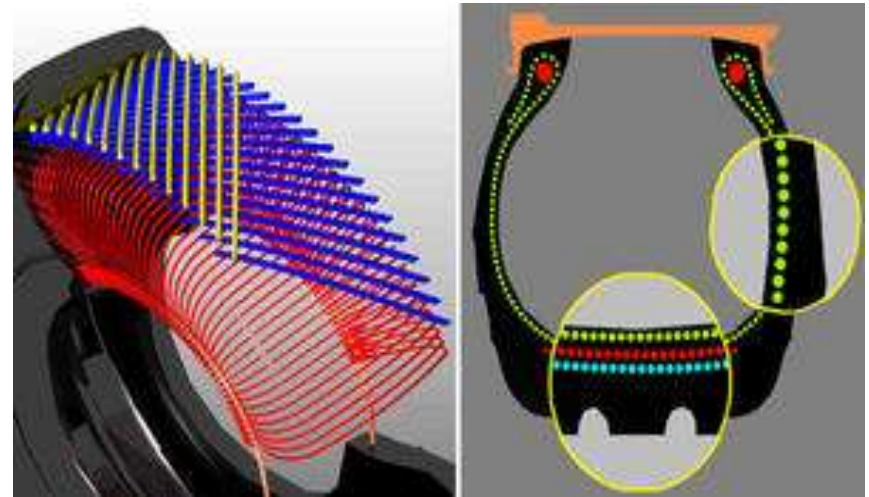
## 1. Types of Tires

*Bias Tire*



- Multiple rubber plies overlap each other.
- Tread and sidewalls are interdependent.

*Radial Tire*

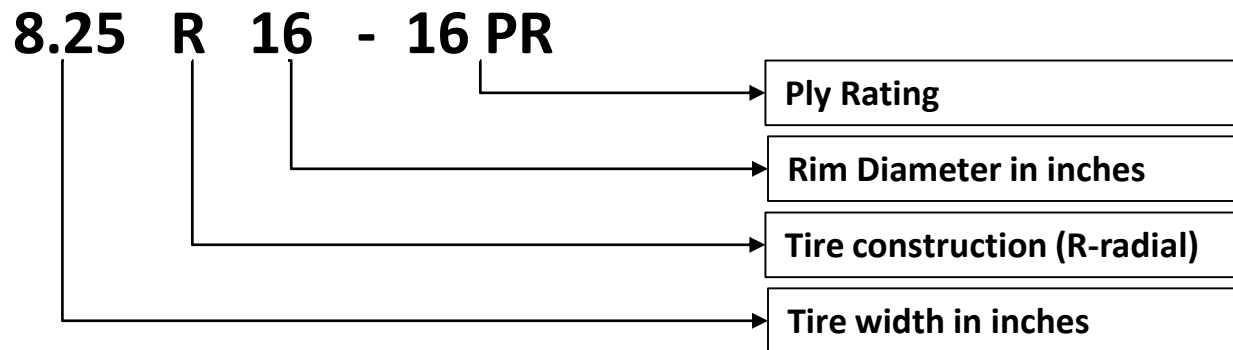


- Sidewalls and tread are functioning as two independent features of the tire.

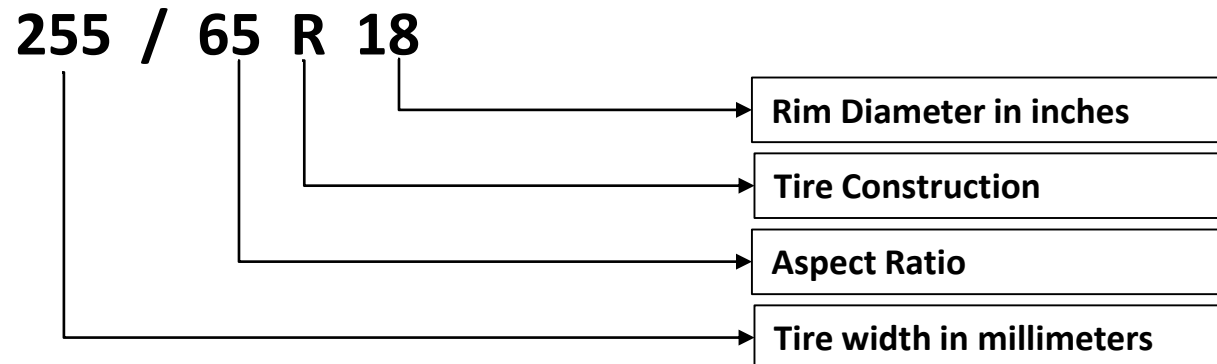
# C. Underchassis

## 2. Tires Size Code

### *JIS Specification*



### *ISO Specification*



# D. Convenience

Model	D-MAX BOONDOCK	
Variant	3.0L LS 4X2 MT	3.0L LS 4X2 AT
<b>CONVENIENCE</b>		
Air conditioning system	Auto-climate control	
Power windows	Equipped with automatic down function for driver side	
Power door locks	Equipped with speed sensing auto door lock	
Entry system / Starting system	Passive entry / Push start-stop system	
12V accessory socket	Equipped	
USB charging port	Three	
Storage compartment / cup holders	Fifteen / Ten	
Glove box	Equipped	
Tow hooks	Front - Driver side	

1. Air-conditioning System – describes the air-condition control used.



**Manual Air-conditioning System**

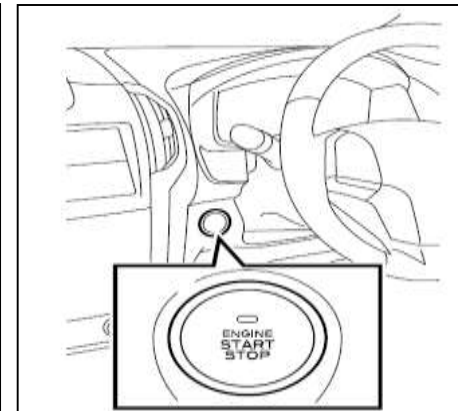
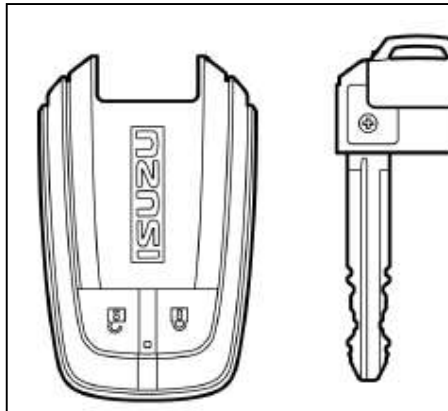
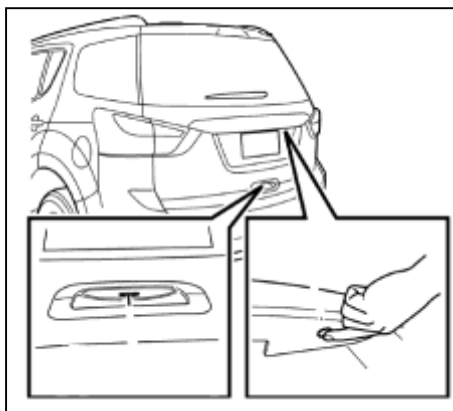
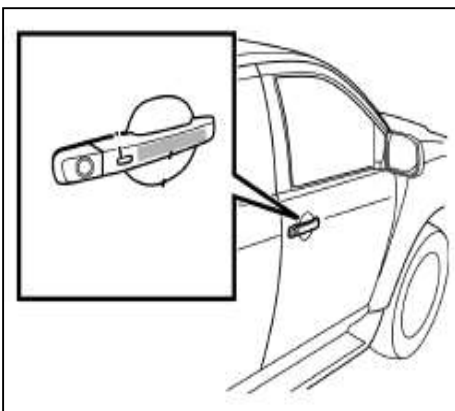


**Auto-climate control**

# D. Convenience

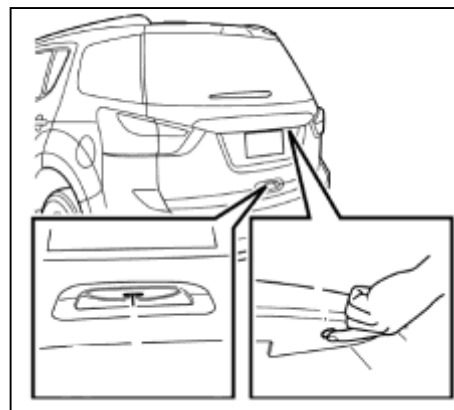
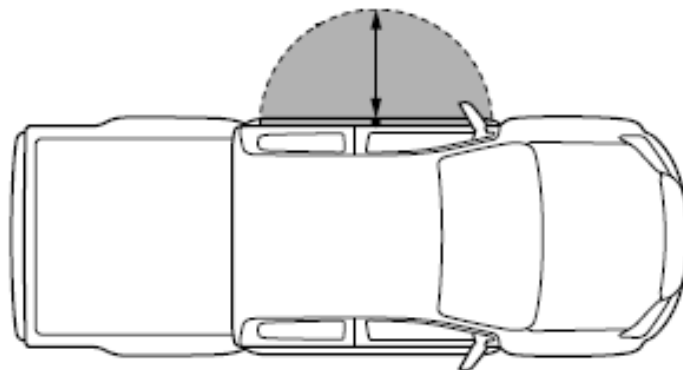
Model	D-MAX BOONDOCK	
Variant	3.0L LS 4X2 MT	3.0L LS 4X2 AT
CONVENIENCE		
Air conditioning system	Auto-climate control	
Power windows	Equipped with automatic down function for driver side	
Power door locks	Equipped with speed sensing auto door lock	
Entry system / Starting system	Passive entry / Push start-stop system	
12V accessory socket	Equipped	
USB charging port	Three	
Storage compartment / cup holders	Fifteen / Ten	
Glove box	Equipped	
Tow hooks	Front - Driver side	

2. Passive Entry and Start System (PESS) – can lock/unlock the doors and start/stop the engine without the need for the key to be inserted.



# D. Convenience

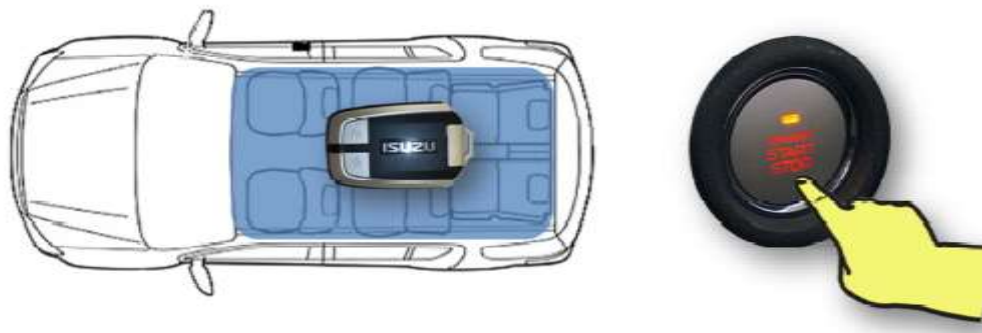
## 1. Passive Entry



- PESS works when the key is within an approx. 80cm (2.6ft.) radius from center of the driver's door handle.
  - PESS will **NOT** lock the doors if the key is **INSIDE** the vehicle.
  - Or if one of the doors or tailgate is open.
  - Doors will automatically relock after 30 seconds if no door is opened.

# D. Convenience

## 2. Start System



- With the electronic key in the vehicle recognition area (cabin).

### Automatic Transmission:

1. Depress brake pedal.
2. Gear selector is in PARK.

### Manual Transmission:

1. Depress clutch pedal.
2. Transmission is in Neutral.

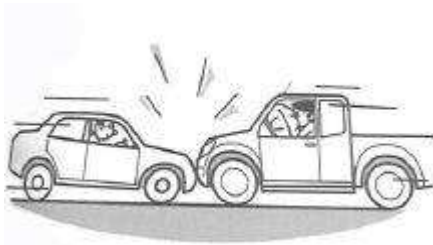
# E. Safety

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
<b>SAFETY</b>			
Dual S.R.S airbags		Equipped	
Seatbelts	1st row	Two Emergency Locking Retractor (ELR) with pre-tensioner and load	
	2nd row	Three Emergency Locking Retractor Type (ELR)	
Child seat tethers for second row		Equipped	
Side door impact beams		Equipped	
Anti-lock Brake System (ABS)		Equipped	
Electronic Brake Force Distribution (EBD)		Equipped	
Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

1. **Dual SRS Airbag** – cushion like device that rapidly inflates during collision.

# E. Safety

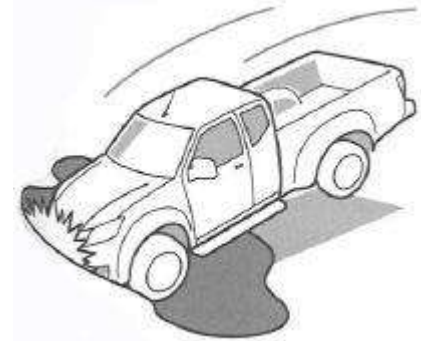
## 1. When does the SRS activate



When the vehicle collides head – on against a parked / stopped or a moving vehicle an impact of a certain level or higher.



When the vehicle collides head – on against a solid wall with an impact of a certain level or higher.

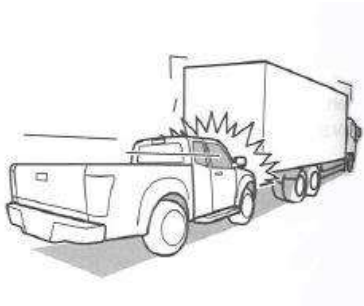


- When vehicle falls into a pothole.
- When the vehicle collides against a curb at high speed.
- When the vehicle falls from the higher ground with an impact of a certain level or higher.



# E. Safety

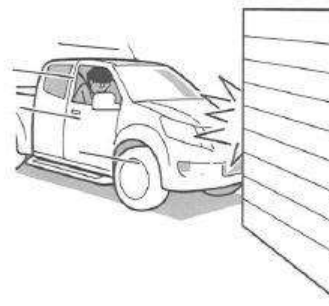
## 2. When does the SRS not likely to activate?



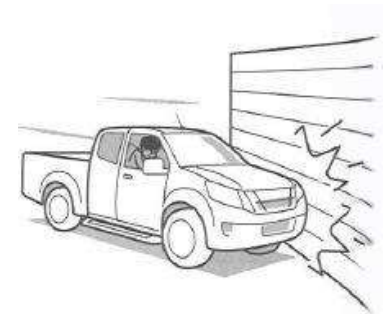
When vehicle gets under a vehicle or obstacle.



Collision against a utility pole or tree.



Frontal angle collision



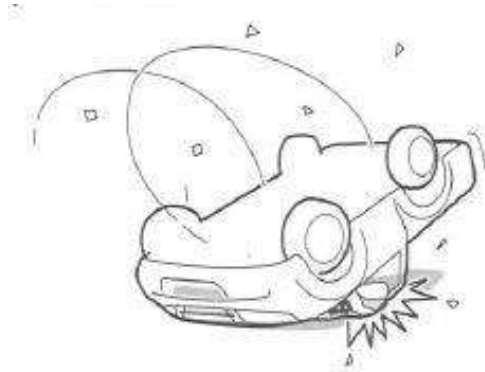
Offset or one sided collision

# E. Safety

## 3. When does the SRS not to activate?



Rear end collision



Roll - over



Side collision

# E. Safety

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Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
SAFETY			
Dual S.R.S airbags		Equipped	
Seatbelts	1st Row	Two Emergency Locking Retractor (ELR) with pre-tensioner and load	
	2nd row	Three Emergency Locking Retractor Type (ELR)	
Child seat tethers for second row		Equipped	
Side door impact beams		Equipped	
Anti-lock Brake System (ABS)		Equipped	
Electronic Brake Force Distribution (EBD)		Equipped	
Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

## 2. *Emergency Locking Retractor*

allows the driver seat belt to freely extend and retract with occupant movement, yet locks the belt during a sudden stop or upon impact.

### Load Limiter



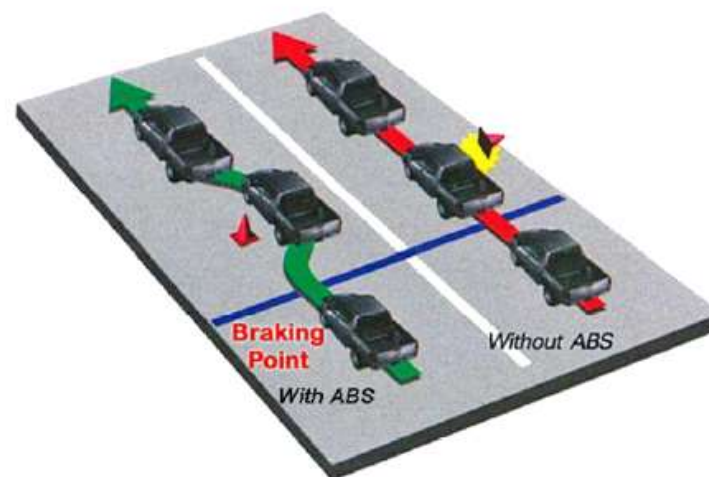
### Pretensioner



# E. Safety

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SAFETY			
Dual S.R.S airbags		Equipped	
Seatbelts	1st Row	Two Emergency Locking Retractor (ELR) with pre-tensioner and load Three Emergency Locking Retractor Type (ELR)	
	2nd row		
Child seat tethers for second row		Equipped	
Side door impact beams		Equipped	
Anti-lock Brake System (ABS)		Equipped	
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Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

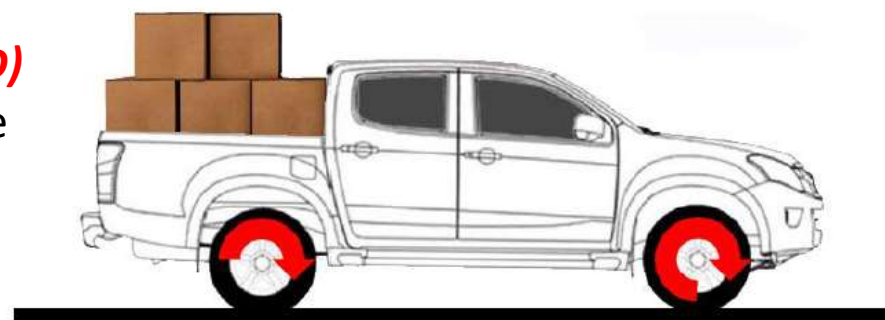
- 3. Anti – lock Brake System (ABS)**  
prevent the wheels from  
locking up during braking.



# E. Safety

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Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

- 4. Electronic Brake Force Distribution (EBD)**  
 automatically varies the amount of force applied to each wheels based on load condition.

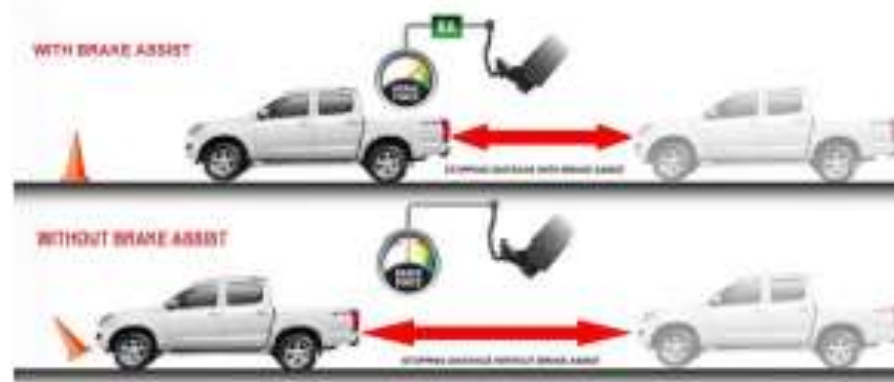


# E. Safety

Model		D-MAX BOONDOCK	
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SAFETY			
Dual S.R.S airbags		Equipped	
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Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	Equipped

## 5. Brake Assist (BA)

increases the brake force during emergency braking.



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Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

- 6. Brake Override System (BOS)**  
prevents vehicle acceleration  
beyond driver's intention.

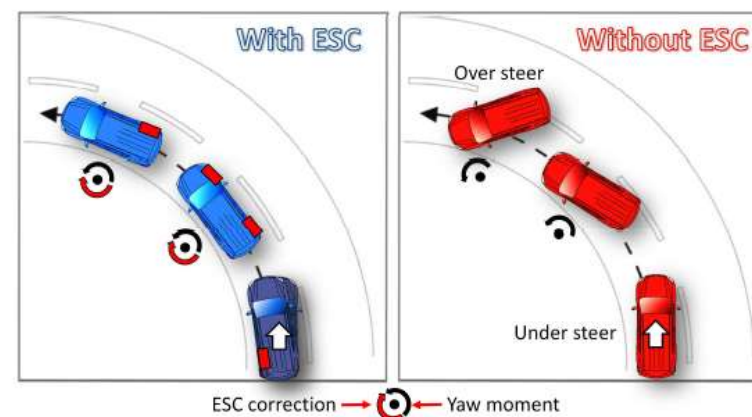


# E. Safety

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
SAFETY			
Dual S.R.S airbags		Equipped	
Seatbelts	1st Row	Two Emergency Locking Retractor (ELR) with pre-tensioner and load Three Emergency Locking Retractor Type (ELR)	
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Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

## 7. Electronic Stability Control (ESC)

prevents over steering and understeering by proactively controlling the brake pressure and engine outputs during dangerous maneuvers

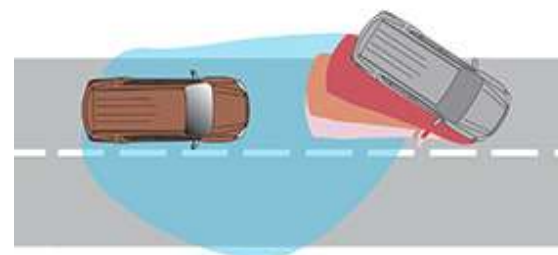




# E. Safety

Model		D-MAX BOONDOCK	
Variant		3.0L LS 4X2 MT	3.0L LS 4X2 AT
SAFETY			
Dual S.R.S airbags		Equipped	
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Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

**8. Traction Control System (TCS)**  
prevents loss of traction of the driving wheels for good acceleration.



Without TCS



With TCS

# E. Safety

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SAFETY			
Dual S.R.S airbags		Equipped	
Seatbelts	1st Row	Two Emergency Locking Retractor (ELR) with pre-tensioner and load	
	2nd row		
Child seat tethers for second row		Equipped	
Side door impact beams		Equipped	
Anti-lock Brake System (ABS)		Equipped	
Electronic Brake Force Distribution (EBD)		Equipped	
Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

## 9. Hill Start Assist (HSA)

prevents the vehicle from rolling backward when vehicle is starting to move up on a slope.



# E. Safety

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Seatbelts	1st Row	Two Emergency Locking Retractor (ELR) with pre-tensioner and load	
	2nd row		
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Side door impact beams		Equipped	
Anti-lock Brake System (ABS)		Equipped	
Electronic Brake Force Distribution (EBD)		Equipped	
Brake Assist (BA)		Equipped	
Brake Override System (BOS)		Equipped	
Electronic Stability Control (ESC)		Equipped	
Traction Control System (TCS)		Equipped	
Hill Start Assist (HSA)		Equipped	
Hill Descent Control (HDC)		Equipped	

## 10. Hill Descent Control (HDC)

assist the driver control by controlling the vehicle's brake to maintain a constant low speed when descending steep slopes.

