

# TECHNICAL DESCRIPTION

## LAND ROVER 110 : HEAVY DUTY 6 X 6



### BACKGROUND:

The new Land Rover 110 range is now expanded by the availability of a heavy duty 6 x 6 derivative — accommodating payloads of up to 3 tonnes, and rear chassis lengths of up to 3.25 metres.

The Australian Army have recently taken delivery of three vehicles for competitive evaluation trials (alongside the Mercedes U1300 Unimog).

The heavy duty Land Rover 110 6 x 6 is being assembled in Australia under an agreement between Land Rover (U.K.) Limited and its Australian affiliate Jaguar Rover Australia, and are being marketed worldwide through the Land Rover sales network and other specialised distributors.

Development of the 110 6 x 6 vehicle commenced in 1981 after extensive market studies had identified a relatively small but significant specialised market for a vehicle having a greater payload and load area than was to be available in the Land Rover 110 range. Several alternatives were examined, including the resurrection of the 101 inch wheelbase forward control military vehicle, a forward control version of the new 110 vehicle, and various 6 x 6 alternatives; and the 6 x 6 route chosen on the basis of:—

- maximum commonality with the basic Land Rover 110 componentry
- excellent access to the underbonnet area
- its potentially high level of cross country mobility, combining excellent traction with low ground pressures and adequate approach, departure and ramp break over angles
- its stable load platform and low loading height

A wide variety of specifications and equipment is available including wheelbase and chassis length variations, body configurations, engine types, and suspension ratings.

### ENGINE

The standard engine offered is the turbocharged 3.9 litre Isuzu 4BD1T four cylinder diesel engine. This is a heavy duty truck derived unit combining excellent highway and cross country

*One of the Australian Army's Land Rover 6 x 6 evaluation vehicles*

minimum specific fuel consumption of 225 gram/kW hour (0.370 lb/bhp hour).

Features of this engine are:

- direct injection system with patented square toroidal combustion chambers
- cast iron cylinder block with replaceable chrome plated dry liners
- forged 5 bearing crankshaft with torsional vibration damper
- stellite faced inlet and exhaust valve seats with chrome plated valve stems
- replaceable valve seats and guides
- cast aluminium pistons with two compression rings and one coil expander type oil control ring
- forced circulation cooling system with integral plate type oil cooler
- glow plug and fuel enrichment assisted engine starting

The Isuzu 4BD1 naturally aspirated diesel engine is optionally available as is Land Rover's well proven 3.5 litre aluminium V8 petrol engine.

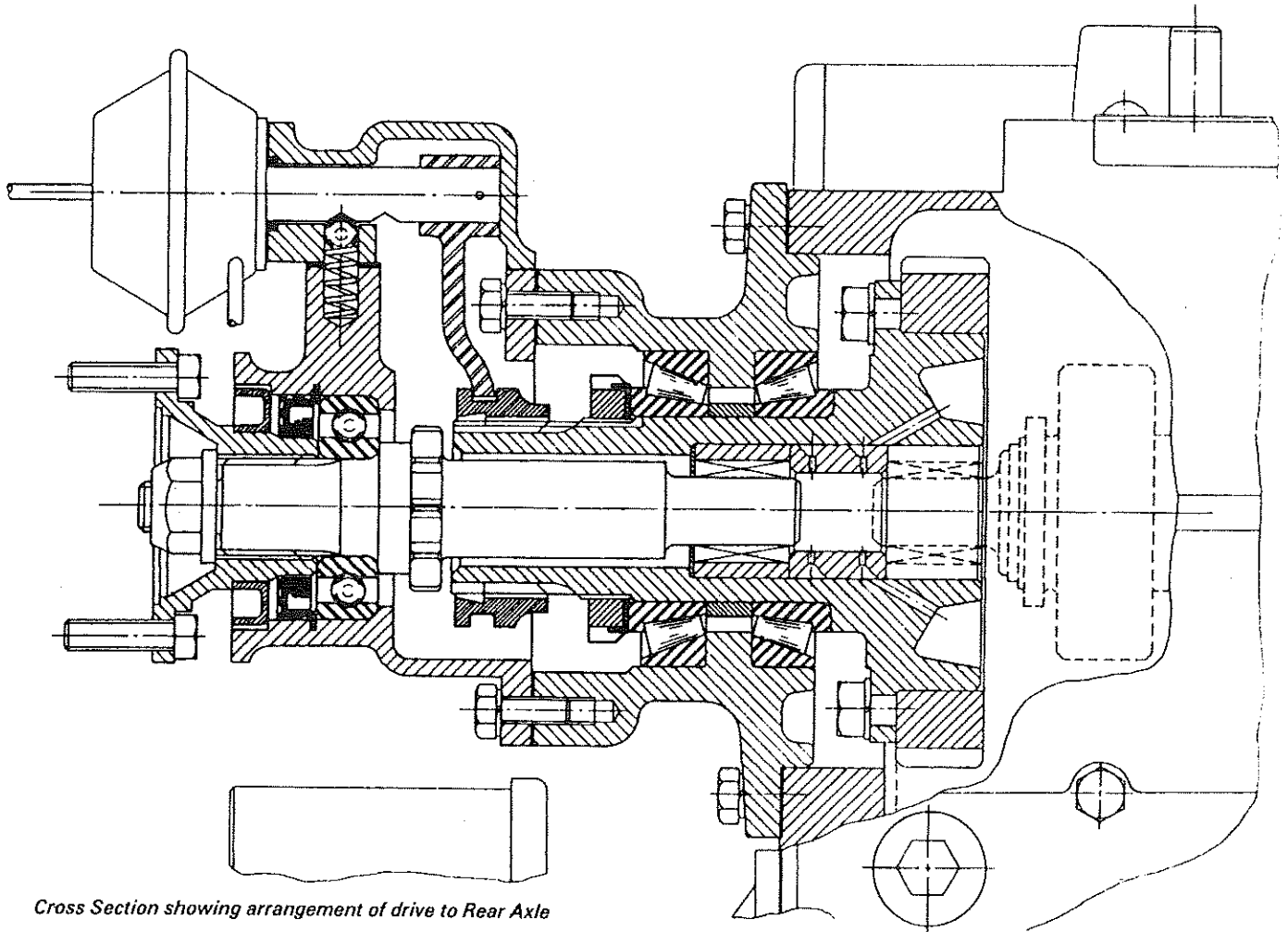
12 volt engine electrics are standard while 24 volt suppressed electrics (to MIL-STD-461A) can also be supplied. The basic diesel engine vehicle utilises a Nippondenso combined alternator/vacuum pump, with 45 amp. output with optional 24 volt/25 amp. alternator/vacuum pump or fully screened EDE 28 volt 100 amp. military alternator and separate vacuum pump.

A Donaldson two stage dry element type air cleaner with filter replacement indicator is used.

The diesel engines feature an integral gear driven power steering pump, while an engine exhaust brake is also available.

### GEARBOX/TRANSFER BOX

Land Rover's high capacity LR95 four-speed all synchromesh gearbox/two-speed transfer box (as fitted to V8 engined Land Rover 110 vehicles) is employed. The transfer box is a three shaft design with a centrally positioned intermediate shaft



*Cross Section showing arrangement of drive to Rear Axle*

rear axle is concentric with the transfer box input shaft, and is engaged or disengaged by a vacuum actuated dog clutch. This arrangement is well proven, being utilised to drive the optional power drive trailers on the Land Rover 101 inch wheelbase forward control military vehicles.

The vehicle operates in four-wheel drive (to the front and centre axles) for on-road operation, with six-wheel drive (with centre differential locked) for off-road conditions.

The optional power take off is fitted to the lower face of the transfer box, chain driven from a sprocket which is electron beam welded to the face of the transfer box drive gear on the main gearbox output shaft. The power take off output can be either forward or rearward facing, and is engaged or disengaged via a push/pull cable actuated dog clutch.

A 254 mm (10 inch) diameter cable operated drum type parking brake is mounted on the rear face of the transfer box.

## FRONT AXLE

An uprated Land Rover 110 front axle is specified for the 6×6 vehicle. This features a fully floating arrangement with spiral bevel gear drive, reinforced axle casing, a heavy duty four pinion differential and high strength axle shafts with involute splines at inboard and outboard ends.

Enclosed outboard constant velocity joints are fitted in the front hubs, which also incorporate large 298 mm (11.7 inch) diameter disc brakes and matching four-piston callipers.

A remote breather is fitted to the axle, with its end mounted high on the engine firewall alongside the gearbox and transfer box breathers.

## REAR AXLES

Twin high capacity Salisbury 8HA fully floating hypoid bevel gear rear axles are fitted. The centre axle differential is offset to the right of the vehicle centreline, while the differential of the rear axle is offset (by the same amount) to the left. The axles are similar to those fitted to 110 4×4 vehicles, but have higher strength axle tubes, wider wheel track, and simple leaf spring mountings.

The centre axle differential pinion is inclined upwards at 2° and

incorporating a rubber mounted centre bearing hung from the chassis crossmember and a double Hookes jointed rear shaft. All prop shafts are fitted with greaseable universal joints.

Existing Land Rover 110 279 mm (11.0 inch) diameter leading/trailing shoe drum brakes are fitted to each rear axle.

Supplementary oil seals are fitted to the inboard ends of the rear axle tubes to accommodate the increased oil capacity which accompanies the higher pinion inclination.

Remote breathers are fitted to both axles, terminating above wading height on the cab back panel.

## CHASSIS

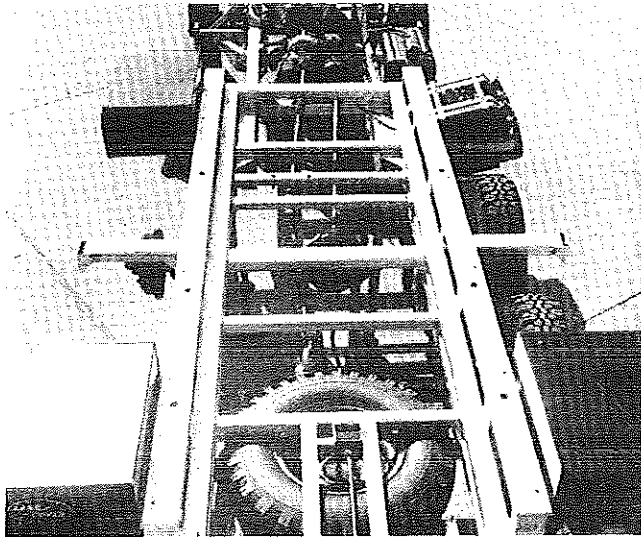
A heavy duty rigid chassis frame is employed for the Land Rover 6×6, fabricated from 350 MPa (50,800 lb/in<sup>2</sup>) minimum yield steel tubing and selected steel pressings. The chassis members are assembled by M.I.G. welding after which the chassis is finished by hot dip galvanising — providing long life corrosion protection for both inner and outer surfaces of the chassis frame.

Upper and lower tubes are used for the centre and rear portions of the chassis frame, separated by tubular crossmembers. This ensures efficient utilisation of material, enables crossmembers to pass through the chassis longitudinals without discontinuity, and confines the majority of welding to low stressed areas.

The rigid chassis concept — a feature of Land Rover vehicles since their introduction in 1948 — was retained for the 6×6, to ensure compatibility with the Land Rover aluminium front bodywork, and to permit efficient, simple and durable mounting of bodywork or components on the rear chassis without resorting to the complexities of three point mountings, or the restrictions imposed by flexible rear bodywork.

Twin longitudinal inverted channels are fitted above the rear chassis longitudinals which in conjunction with the chassis crossmember outriggers, provide a convenient and stable mounting platform for rear bodywork or specialised equipment without interfering with the main chassis members.

The tube frame chassis arrangement also permits the production of alternative wheelbases, rear overhangs or body/equipment mountings without the restrictions of extensive retooling. Bolted



*View of the Land Rover 6 × 6's hot dip galvanised tube frame chassis*

used for Isuzu diesel or V8 petrol engines, and the chassis has been designed to accommodate both left- and right-hand drive.

The basic chassis provides for the mounting of:

- front mounted drum winch (10,000 lb capacity)
- side mounted jerry can, oil can and jack stowage
- side mounted tool boxes
- Additional vehicle/equipment batteries
- front brush guard
- rear roll over bar mountings
- rear load tie downs
- helicopter slinging points
- shipping tie down points
- parachute drop points
- retractable rear step
- rear towing pintle
- front and rear recovery towing points
- central load stowage drawer

## FRONT SUSPENSION

The front suspension is closely based on that of the Land Rover 110 4 × 4 vehicle, with generous bump and rebound travel and precise axle location by rubber bushed radius arms and panhard rod, but featuring:

- high capacity constant rate front springs (2 alternatives are available)
- trim height increased by 25 mm (1.0 inch)
- longer, heavy duty oil filled dampers incorporating high technology seals and polyvon mounting bushes

## REAR SUSPENSION

A number of rear suspension arrangements were investigated during the development phase — including coil sprung layouts (with and without load sharing) and various bogie suspensions. The arrangement finally selected comprised simple dual rate semi-elliptic leaf springs linked on each side by shackles to a rubber bushed load sharing rocker beam.



*The load sharing leaf spring suspension provides, excellent axle articulation — even when unladen as in this view*

- good axle articulation, both laden and unladen
- the potential to accommodate payloads in excess of 3 tonnes
- excellent vehicle ride and handling characteristics on-road and off-road, laden and unladen
- some commonality with existing Land Rover components

The leaf springs supporting the centre axle are mounted inboard of the rear axle springs, crossing over at their shackled ends in side elevation. This has permitted the accommodation of relatively long springs with:

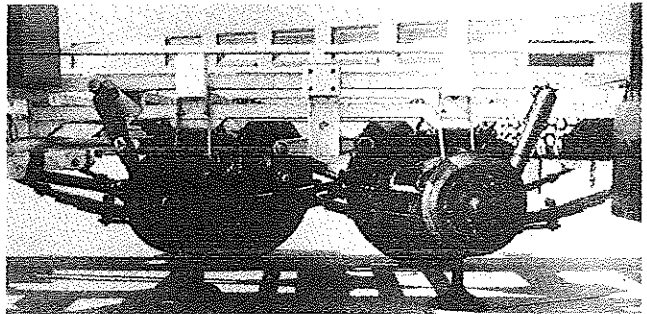
- a reduced number of thicker, stronger leaves
- lower spring friction
- better control over axle wind up
- more adequate axle articulation

than would have been available with shorter springs, whilst retaining the desired close spacing of the centre and rear axles.

Although early prototypes utilised Series III leaf spring componentry, the production design uses:

- larger, higher capacity spring eye bushes
- larger diameter U Bolts (9/16 UNF thread)
- thicker spring steel lower mounting plates

High capacity Land Rover 110 4 × 4 rear dampers and damper mountings are specified, whilst additional axle rebound control is provided by chassis mounted rebound straps. Two alternative rear spring rates are available, to suit particular loads and operating conditions.



*Side view of rear suspension with wheels removed. Note the load sharing rocker beam, crossed dual rate leaf springs, inclined telescopic dampers, chassis mounted rebound straps, tube frame chassis, rear under chassis mounted spare wheel.*

## STEERING

Adwest Varamatic worm and peg type variable ratio power-assisted steering is fitted — as fitted optionally to Land Rover 100 4 × 4 vehicles.

The fitting of power-assisted steering is simplified on Isuzu engined vehicles by the provision of an integral gear driven power steering pump.

A collapsible steering column and telescopic steering damper are standard fitment.

## BRAKES

The Land Rover 110 4 × 4 vehicles axle mounted brake equipment is carried over onto the 6 × 6 vehicles. The disc front/drum centre and rear brakes are linked by a simple two line front/centre and rear split circuit. Early prototypes utilised more complex circuits (front and centre/front and rear — also front and centre left/rear and centre right), but these proved both unnecessary and excessively complex.

A PBR booster is fitted, with 4:1 boost ratio, linked to a 31.75 mm (1.25 inch) diameter Bendix master cylinder.

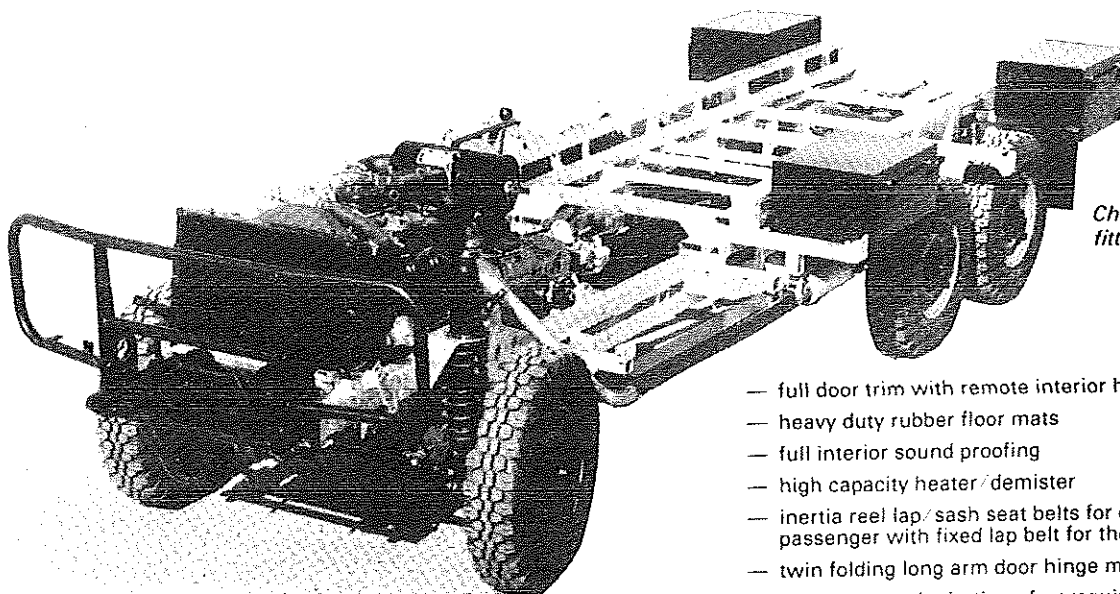
## WHEELS AND TYRES

Standard wheel/tyre equipment on the 6 × 6 vehicle is high strength 5.50 F × 16 pressed steel wheels with 7.50 R 16 LT radial ply tyres.

A wide variety of alternative tyre equipment (with matching wheels) is available including:

- 7.50 × 16 LT
- 10.00 R 15
- 10.50 R 15
- 11.00 R 15
- 230/70 R 15

A spare wheel is provided, housed under the rear of the chassis between the chassis rails, and held by a winch type carrier.



*Chassis assembly prior to fitting of body and rear tray*

## FUEL SYSTEM

The Isuzu diesel engines feature an advanced direct injection system with a Diesel Kiki (Bosch type) in-line distributor pump and a high pressure mechanical feed pump with hand primer. Generous fuel filtration is provided to match the vehicle's off-road capability with:

- chassis mounted fuel sedimenter
- gauze filter in the feed pump intake union
- replaceable element type main filter, mounted on the cylinder head

A 68 litre side mounted pressed steel fuel tank with filler neck in the right-hand side panel is standard fitment. Additional fuel tanks are available as required — their size and location depending largely on bodywork requirements.

## CHASSIS FITTINGS

A wide variety of chassis fittings have been developed for the Land Rover 110 6 × 6. These include:

- front mounted drum type vehicle recovery winch (10,000 lb capacity), mechanically driven from the transfer box lower power take off with automatically resetting torque limiter
- fully hot dip galvanised front brush guard incorporating helicopter slinging points, towing points, parachute drop and shipping tie downs, blackout and reduced headlamp lighting
- chassis side mounted stowage bracket for two standard jerry cans and a standard (5 litre) oil can
- chassis side mounted stowage/tool boxes
- military or civilian towing pintles
- a rear chassis mounted retractable step for access to the rear tray area
- rear towing and tie down points
- rear slinging points — which are stowed within the chassis side rails when not in use
- a large slide out rear stowage drawer supported by nylon rollers on the chassis side posts, fitting underneath the rear tray

Other specialised chassis fittings can be made available to order.

## CAB

Land Rover's two/three man bonneted 110 cab is standard fitment on the 6 × 6 vehicle. This primarily comprises welded aluminium sub-assemblies which are bolted or rivetted together.

All the Land Rover 110 body improvements carry across to the 6 × 6 vehicle including:

- single piece (folding) windscreen
- new fascia and controls
- one piece doors with wind up windows
- bulb type door seals

The following body equipment is also fitted as standard to the 6 × 6 vehicle:

- full door trim with remote interior handles
- heavy duty rubber floor mats
- full interior sound proofing
- high capacity heater/demister
- inertia reel lap/sash seat belts for driver and outboard passenger with fixed lap belt for the centre passenger
- twin folding long arm door hinge mounted rear vision mirrors

Deletion or substitution of unrequired equipment can be negotiated for special orders

A four-door/six-man crew cab will also be available to order.

## REAR TRAY

A wide variety of rear bodywork can be made available.

The standard heavy duty rear tray is of heavy duty aluminium extrusion construction, with a 3.2 metre long × 2.1 metre wide flat floor, fold down removable side boards and tail board, and fixed header board.

Two longitudinal channel section extrusions are used to tie the tray to the inverted channel sections on the chassis, while further support is provided by linking the tray side combings to the ends of the main rear chassis crossmembers.

## REAR TRAY FITTINGS

The heavy duty rear tray has been designed to accommodate a wide variety of fittings and equipment.

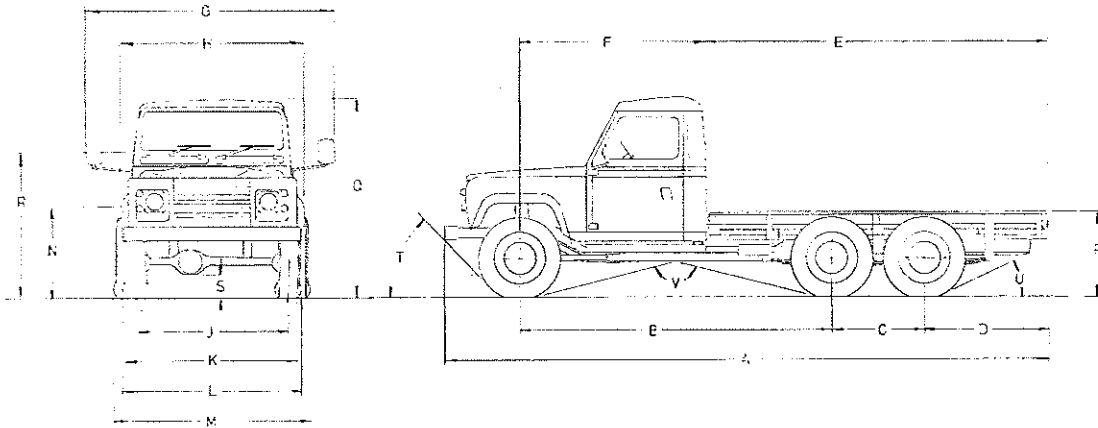
The ties joining the tray combing to the ends of the chassis crossmembers incorporate tie down shackles for the rear load area. The ties also provide the lower mountings for the optional rear tray roll over bars (which also double up as canopy bows). The three roll over bars are tied together at their upper ends by heavy duty longitudinal and diagonal braces.

A heavy duty canvas canopy is available for the rear tray area — supported by twin aluminium hood bows, if rear roll over protection is not required.

Twin longitudinal rear seats each seating six persons are available for the rear tray. These feature a tubular steel frame with extruded anodised aluminium slats on the cushion and squab. The seats may be installed either against the tray sides facing inwards, or back to back down the centre of the tray facing outwards, and can be fitted with padded cushions.

Accommodation can be provided on the chassis for the stowage of the sideboards, tailboard, seats and hood bows when they are required to be removed to clear the rear tray area.





### NOMINAL DIMENSIONS\*

A	Overall Length	6023 mm
B	Intermediate Wheelbase	3040 mm
C	Rear Axle Spacing	900 mm
D	Rear Overhang	1208 mm
E	Rear Chassis Length	3250 mm
F	Axle to Back of Cab	1840 mm
G	Width Over Mirrors	2430 mm
H	Width Over Wings — Front	1780 mm
J	Front Track	1486 mm
K	Rear Track	1660 mm
L	Width Over Tyres — Front	1698 mm
M	Width Over Tyres — Rear	1872 mm
N	Tyre Clearance — Unladen	992 mm
	— Laden	912 mm
P	Chassis Height — Unladen	810 mm
	— Laden	730 mm
Q	Cab Height — Unladen	2040 mm
	— Laden	2010 mm
R	Cut Down Height — Unladen	1550 mm
	— Laden	1470 mm
S	Axle Ground Clearance	232 mm
T	Approach Angle — Unladen	45°
	— Laden	41°
U	Departure Angle — Unladen	31°
	— Laden	28°
V	Ramp Angle — Unladen	148°
	— Laden	152°
	Turning Circle — Wall to Wall	17.2 m
	— Kerb to Kerb	16.8 m

\*Standard dimensions shown. A range of alternative wheelbases and chassis lengths are available to order.

### MASS DATA\*\*\*

Unladen Mass — Front	1200 kg
— Rear	1200 kg
— Total	2400 kg
Gross Vehicle Mass	5500 kg
Gross Combination Mass	7050 kg

\*\*\*Standard chassis cab vehicle with full capacity of water, oil and fuel, plus spare wheel and tyre.

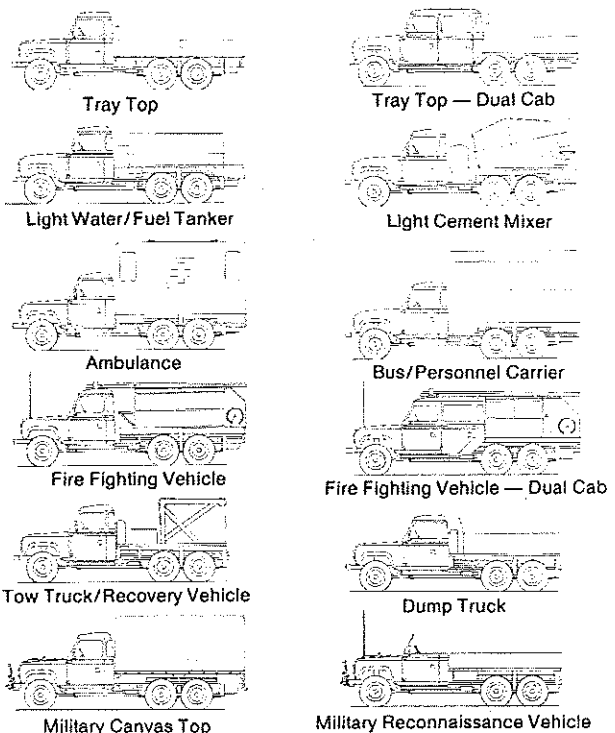
The above data are nominal figures only and apply to the basic vehicle specification. Other ratings may be applicable for particular operating conditions, usage requirements and specification variations.

### PERFORMANCE DATA\*\*

MAXIMUM SPEEDS IN GEARS (km/h) @ MAXIMUM ENGINE r.p.m.		
Engine	4BD1	3.5 V8
Transfer Ratio — High	0.996:1	1.123:1
— Low	3.321:1	3.321:1
Axle Ratio	4.70:1	4.70:1
Max. Engine Speed	3200 rpm	4000 rpm
Low Ratio	1st	7.1
	2nd	11.8
	3rd	19.2
	4th	28.9
	Rev	7.9
High Ratio	1st	23.6
	2nd	39.2
	3rd	63.8
	4th	96.1
	Rev	26.2

\*\*Applicable to base vehicle specification. Data for optional specifications are available on request.

### BODY CONFIGURATIONS\*\*\*\*



\*\*\*\*A wide variety of specialised body configurations can be



<b>ENGINE</b>	<b>ISUZU 4BD1</b>
Type	4 cylinder turbocharged direct injection diesel.
Capacity	3.856 litres.
Max. Power	86 kW @ 3000 r.p.m.
Max. Torque	320 Nm @ 1800 r.p.m. <span style="float: right;">DIN 70020 net</span>
Alternator	12 volt x 45 amp. output, belt driven from crankshaft, incorporating vacuum pump for braking system.
Injection System	Reformed Bosch in line type with combined pneumatic and mechanical governor.
Air Cleaner	Donaldson two stage dry element type with filter replacement indicator.
Exhaust System	Chassis mounted with single silencers discharging on right-hand side of vehicle.
Cooling System	Cross flow radiator with expansion tank. Pressurised to 100 kPa.
Clutch	Repco single dry plate diaphragm spring type. 275 mm dia.
Options	Isuzu 4BD1 naturally aspirated diesel — 72 kW @ 3200 r.p.m. 255 Nm @ 1900 r.p.m. Rover 3.5 litre V8 petrol engine — 85 kW @ 4000 r.p.m. <span style="float: right;">low compression</span> 251 Nm @ 2500 r.p.m. 93 kW @ 4000 r.p.m. <span style="float: right;">high compression</span> 258 Nm @ 2500 r.p.m. 24 volt engine electrics Fully screened 28 volt x 100 amp. military alternator. Vertical discharge exhaust system.

## GEARBOX/TRANSFER BOX LR95

Type	4 speed all synchromesh gearbox with two speed transfer box. Incorporates lockable inter-axle differential, plus vacuum operated dog clutch to engage or disengage drive to rear axle via a heelboard mounted switch.			
	Vehicle operates in four wheel drive (to front and centre axles) for on-road operation with six wheel drive for off-road operation.			
Ratios:	1st	4.069:1	4th	1.000:1
Gearbox	2nd	2.448:1	Rev.	3.664:1
	3rd	1.505:1		
Transfer Box	High	0.996:1	Low	3.321:1
Parking Brake	Mechanical 254 mm dia. drum brake fitted on rear of transfer box output shaft.			
Options	Alternative transfer box high ratios: High 1.123:1 <span style="float: right;">Low 3.321:1</span> 1.336:1 <span style="float: right;">3.321:1</span>			

## FRONT AXLE ROVER SPIRAL BEVEL

Type	Fully floating spiral bevel steer/drive axle with enclosed outboard constant velocity joints, four pinion differential and high capacity driving head.
Capacity	1500 kg
Ratio	4.70
Brakes	298 mm dia. disc front brakes, with four piston callipers.
Options	3.54:1 axle ratio.

## REAR AXLES SALISBURY 8HA

Type	Fully floating hypoid bevel drive axles with offset four pinion differentials.
Capacity	2000 kg/axle
Ratio	4.70:1
Brakes	279 mm dia. drum brakes with leading/trailing shoes.
Options	3.54:1 axle ratios Limited slip differentials.

## CHASSIS & SUSPENSION

Frame	Hot dip galvanised tubular steel frame with welded box section crossmembers. Pressed steel front bumper.
Front Suspension	Long travel coil springs with telescopic dampers. 1500 kg capacity.
Rear Suspension	Dual rate semi-elliptic leaf springs linked via shackles to a rubber bushed load sharing rocker beam. Axle movement is controlled by four long travel telescopic dampers and chassis mounted rebound straps. 4000 kg capacity.
Steering	Adwest power-assisted variable ratio worm and peg type. 17.50:1 ratio — straight ahead.
Brakes	Dual line vacuum hydraulic system.
Wheels	Steel disc wheels. 5.50 F x 16 — 7 off.
Tyres	Steel belted radial ply tyres: 7.50 R16 x 8 ply — 7 off. Spare wheel located between chassis members behind rear axle.
Fuel System	Single 68 litre tank with filler in right-hand side panel.
Battery	12 volt maintenance free type.
Options	Optional wheels and tyres. Additional fuel tank. Rear towing pintle. Helicopter slinging points. Jerrycan stowage. Chassis mounted tool boxes. Chassis mounted recovery winch. Tie down points. Tubular steel front brush guard.

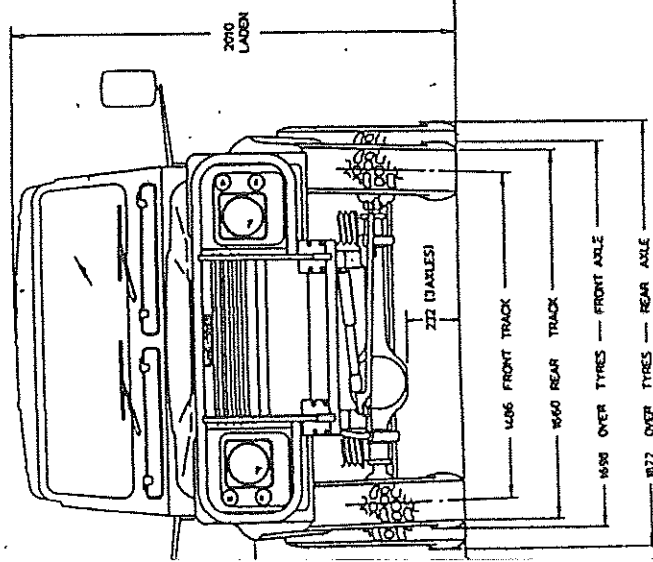
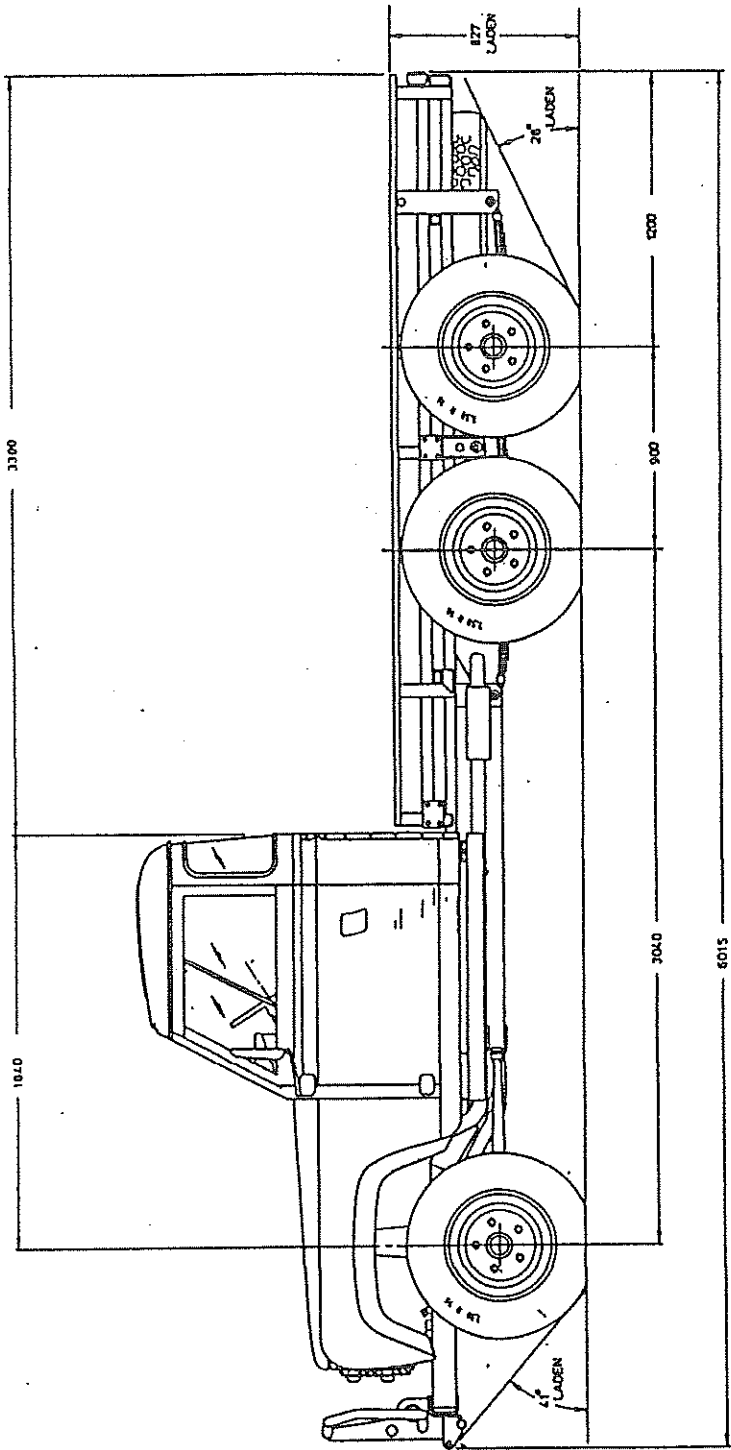
## CAB

Type	<b>LAND ROVER</b> Bonneted cab of welded aluminium alloy construction with bolted sub-assemblies. Readily adapted to low silhouette configuration.
Trim	Fully trimmed interior.
Fittings	Driver's and passenger's seats (3). Fore/aft and rake adjustment provided for outboard seating positions. High capacity heater/demister. Twin sun visors. Inertia reel lap/sash seat belts fitted to outboard seating positions with static lap belt for centre seat.
Glass	Laminated flat glass single piece windscreen. Safety glass in back panel and doors. Wind up side windows.
Controls	Column mounted waterproof switches for indicators, head and side lamps, horns, wipers and washers. Fascia mounted hazard warning and heater blower switches.
Instruments	Fascia mounted speedometer, fuel gauge, water temperature gauge and voltmeter, supplemented by warning lamps.
Options	Blackout lighting. Additional instrumentation. Optional body styles.

## REAR TRAY

Type	<b>ALCAN MILITARY TYPE</b> Heavy duty composite aluminium extrusion construction with removable drop sides and back panel. Dimensions 2.1 m x 3.2 m.
Options	Removable roll-over bars for rear occupant protection. Heavy duty canvas canopy. Rear seats — inward/outward facing (12 troops). Rear lap type seat belts. Stowage for side and back panels, roll-over bars, seats and canvas canopy.





MASS DATA

UNLADEN MASS	FRONT	1000kg
	REAR	2400kg
	TOTAL	3400kg
GROSS VEHICLE MASS	STANDARD SPECIFICATION	4500kg
	OPTIONAL SPECIFICATION	3500kg
GROSS COMBINATION MASS		7050kg

STANDARD CHASSIS CAB VEHICLE WITH FULL CAPACITY OF WATER, OIL AND FUEL, PLUS SPARE WHEEL AND TYRE.

COACH-BUILDERS - LAND ROVER 6 X 6 CHASSIS CAB