

University
of Toyota



4RUNNER

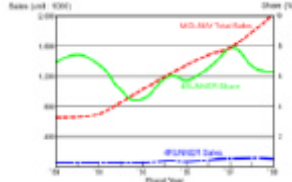
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35-60_profile



Market_Trend

I. 2003 4RUNNER

A. 4th generation of the 4Runner

1. continues it's legacy of mid-SUV class-leader in:
 - a. on-road comfort,
 - b. all-weather safety, and
 - c. off-road capability
2. all-new model for US, Japan, & export markets
 - a. new model related to the Land Cruiser Prado, a 7/8-size Land Cruiser not previously offered in US
 - b. severs the connection to the Tacoma truck line
3. mid-SUV class continues to grow in the US:
 - a. this class of vehicles offers a good view of the road,
 - b. easy ingress/egress,
 - c. roomy passenger space,
 - d. large payload and towing capacities,
 - e. on-road comfort & handling,
 - f. go-anywhere off-road capabilities.

4. new 4Runner is larger in many key dimensions:

- | | | | |
|--------------------|------------|----|---------------------|
| a. overall length | > 4½" | to | 187.8" |
| b. wheelbase | > 4½" | | 109.8" |
| c. ft leg room | > 2" | | 44" |
| d. rr leg room | > 1½" | | 38¼" |
| e. headroom | > ½" | | 39.7" ft / 39.1" rr |
| f. pass-pass width | > 2" | | 30" |
| g. shoulder room | > 4½" / 4" | | 58" ft / 57.2" rr |
| h. hip room | > 5½" / 4" | | 55.3" ft & rr |
| i. track | > 2½" | | 62" |
| j. overall width | > 3" | | 73.8" |



profile_dimensions.jpg



Cross_Section



SR5



Sport



Limited

II. 3-GRADE STRATEGY

A. SR5

1. Gray metallic bumpers, fender flares, lower cladding
2. 16" steel wheels w/ 265/70R16 tires
3. all models: std roof rack w/ 120 lb capacity

B. Sport

1. Gray metallic bumpers, flares, lower cladding
2. silver painted grille & roof rack rails
3. hood scoop
4. fog lamps
5. color-keyed outside mirrors
6. 17" alloy wheels w/ 265/65R17 white-letter tires

C. Limited

1. Color-keyed bumpers, cladding, flares, door handles
2. silver painted running boards
3. fog lamps
4. color-keyed outside mirrors
5. 17" alloy wheels w/ 265/65R17 tires



1GR-FE_v2

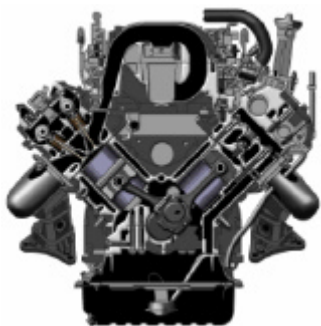
III. ENGINES

80% of mid-SUV segment buyers want 6-cylinder engines to compete against strong competitors, the new 4L V6 had to succeed in many areas:

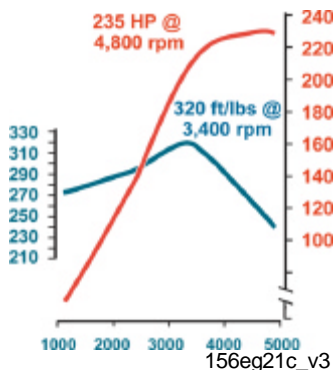
- high output
- low-mass
- high durability / low maintenance
- high fuel efficiency / low emissions
- sharing of engineering & tooling costs

A. 1GR-FE 4.0L 60° V6

1. available ~90 days after product launch
2. DOHC 24V
3. Very long-stroke high-torque design:
 - a. bore X stroke = 3.70" X 3.74" (94 X 95 mm);
 - b. prev 3.4L 5VZ-FE V6 = 3.68" X 3.23" (93.5 X 82 mm)
 - c. 10:1 compression ratio
4. 245 Hp @ 5,200 rpm: 283 ft/lbs @ 3,400 rpm (on 91 octane Premium fuel)
5. Toyota's 1st ever
 - a. aluminum truck engine
 - b. VVTi truck engine
 - c. variable intake (ACIS) truck engine
 - d. application of an all-new family of V6 engines
 - e. use of 3D modelling in an engine design
6. low maintenance / low NVH:
 - a. chain-driven cams for more accurate cam timing
 - b. serpentine accessory drive belt w/ auto tensioner
 - c. piston crowns cooled by oil jets in main galley
 - d. cross-bolted main caps
7. High performance with environmental efficiency
 - a. LEV certified:
 - emissions systems designed for future LEV-II stds
 - b. blend of high performance with fuel economy new link-less ETCS-i
 - c. Class II towing capacity: 5,000 lbs
 - d. about 130 lb lighter than the V8 in comparably-equipped vehicles
 - e. lead-free crank bearings & valve seats



199eg54c



156eg21c_v3

B. 2UZ-FE 4.7L DOHC V8

1. 4Runner buyers will enjoy the mid-SUV class' newest V8 engine
 - a. related to the *i-Force* V8 engine in Sequoia, Land Cruiser, Tundra
2. 235 Hp @ 4,800 rpm; 320 ft/lbs @ 3,400 rpm (Premium 91 octane recommended)
 - a. DOHC 32V
 - b. bore X stroke = 3.70" X 3.31" (94 X 84 mm)
 - c. iron block w/ aluminum heads
 - d. 9.6:1 compression ratio
 - e. superior acceleration & high-torque pulling power
 - f. iridium tipped spark plugs for 100,000 mile service interval
 - g. all-new A750Ei/Fi 5-spd A/T std
 - h. Class II towing capacity: 5,000 lbs
 - i. LEV emission certified:
 - emissions systems design to meet future LEV-II stds



ETCS-I_TPS_b



ETCS-I_TPS_a



Fuel_Tank



Carbon_Filter

C. Common improvements to V6 & V8

1. link-less ETCS-i

a. 3rd generation of Toyota electronic throttle control

1) successful implementations in:

- a) passenger car V8s (2000 LS 430 & GS 430),
- b) in-line sixes (2001 GS 300, IS 300),
- c) V6 (2002 ES 300 & Avalon), and
- d) 4 cylinder (2002 MR-2 SMT).

2) no cable between pedal and throttle

3) reduced NVH transmission through dash panel

4) life-long, no maintenance or adjustments required

b. fail-safe:

1) ECM control of injector volume, # of injectors, and ignition timing for limp-home mode

c. two (2) Hall-effect sensors each in the accelerator pedal & throttle redundantly detect

1) accelerator pedal position (APP1 & APP2)

2) throttle shaft position (TPP1 & TPP2)

3) no contact with the shaft

2. new 7-layer plastic fuel tank

a. lightweight, dampens noise from fuel pump

b. improves leak-resistance of fuel line fittings for "near zero evaporative emissions"

c. mounts completely inside frame rails for impact resistance

d. with steel outer liner for puncture protection

3. new ultra-fine cell ceramic catalyst cores

a. faster light-off of cat

b. less back-pressure

c. coupled with new high-temp O2 sensors

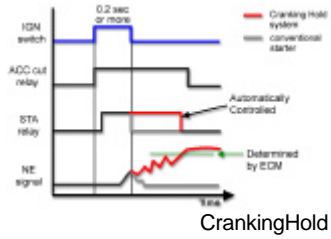
4. new long-life recyclable engine coolant

5. carbon filter above air filter in intake housing

a. captures and holds evaporative emissions from intake manifold & combustion chamber during hot soak

b. for subsequent combustion after restart

c. no service interval



d. crank-hold feature for improved starting & lower emissions

- 1) the ECM controls the STA relay & ACC CUT relay;
- 2) once the ignition key has been turned to the START position for more than 0.2 sec, STA relay will continue to be engaged until the ECM determines the engine has started (max: 30 sec.);
- 3) all accessories (e.g.: DRL) are cut off during cranking;
- 4) starter cannot be accidentally re-engaged once engine is running (try it!)



155ch01



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IV. TRANSMISSIONS

A. A340E-i (V6 2WD) & A340F (4WD)

1. electronically-controlled 4 spd automatic
2. sim to current 4AT in V6 4Runner, Tundra, Tacoma

B. A750E-i (V8 2WD) & A750F-i (4WD)

1. Toyota's 1st use of 5 A/T in a truck
 - a. five ratios from just three planetary gearsets
 - 1) no weight penalty compared to A340
 - b. four of the five ratios are lower than the A340, OD 5th is slightly higher

Engine Type		2UZ-FE 4.7L V8		1GR-FE 4.0L V6	
Drive Train		2WD*	4WD full-time	2WD*	4WD multi-mode
Transmission		A750E	A750F	A340E	A340F
Gear Ratio (counter gear ratio included)	I	3.520	←	2.804	←
	II	2.042	←	1.531	←
	III	1.400	←	1.000	←
	IV	1.000	←	0.705	←
	V	0.716	←	–	–
	R	3.224	←	2.393	←
Transfer Case Reduction Ratio		–	2.566	–	2.566
Final Drive Ratio		3.727		3.909	

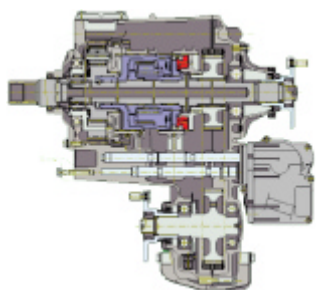
*(2WD model only for USA)

- c. good combination of acceleration & economy
 - d. All-new in the 4Runner (also in LX 470 & LC 100)
 - e. not related to current Tundra or Sequoia 4ATs
2. super ECT with w/ Artificial Intelligence:
 - a. ATF temp & comparison of AT input shaft speed w/ output shaft speed
 - 1) Detects start & completion of shifts for
 - 2) engine torque control and shift solenoid hydraulic pressure control =
 - 3) delivers smooth output shaft torque
 - b. ATF line pressure control for smoother shifts
 - c. Uphill & Downhill shift logic based on detecting driver's intention
 - d. Flexible lock-up of torque converter clutch in low- to mid-speed operation for improved fuel economy

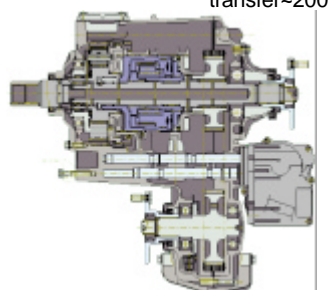
V. TRANSFER CASES

A. VF4AM (V6) & VF4BM (V8)

1. Both types are all new designs –
 - a. 2-speed planetary w/ 2.566 Low range for off-road use
 - b. ~ 2" shorter, 5 lbs lighter than previous transfer case
 - c. increased torque capacity over previous models
2. world's 1st application of a Torsen limited-slip center differential in a mid-SUV transfer case
 - a. center differential lockable by driver selection in H4 or L4
 - 1) for maximum traction on extremely slippery or uneven surfaces
 - b. the Torsen worm gears transfer torque to the carrier during the transition between static, front-bias, and rear-bias conditions:
 - 1) clutches transmit torque directly through the carrier as long a axial thrust (traction difference) continues
 - 2) maintain fixed torque-split until drive torque is reduced
 - c. once worm gears develop axial thrust, they apply pressure to 2-disc clutch packs on each end
 - 1) clutches transmit torque directly through the carrier as long a axial thrust (traction difference) continues
 - 2) maintain fixed torque-split until drive torque is reduced
 - d. static rear-drive bias favors stable tracking on- or off-road, decelerating or accelerating
 - 1) Static ft:rr torque split of 40:60% is determined by the ratio of the radii of the sun gear (inner that drives the front wheels) and the ring gear (outer gear that send torque to the rear axle)
 - 2) three dynamic torque split ratios depending on available traction:
 - a) static torque split favors the rear 40:60% when both axles have equal traction;
 - b) when front wheels begin to slip, the difference in ft:rr torque causes up to 70% of torque to be sent to the rear wheels;
 - 3) when rear wheels slip, up to 53% of torque is directed to the front wheels.



transfer-200



transfer-202



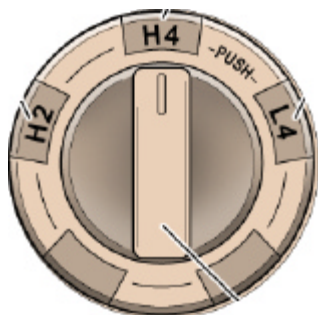
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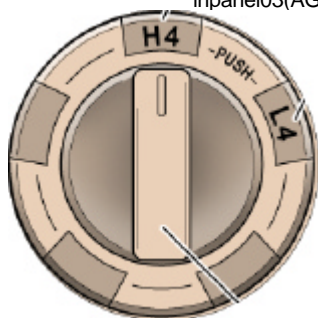
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Torsen_end



inpanel03(AG)



inpanel03(A)



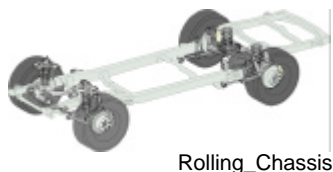
differential_lock

3. V6 VF4AM:

- a. shift-on-the-fly multi-mode
 - 1) H2, H4, H4L, L4, L4L
- b. double motor-drive actuator
- c. low-range & diff lock (w/ synchro)
- d. Automatic disconnecting front differential (ADD)

4. V8 VF4BM:

- a. full-time 4WD
 - 1) H4, H4L, L4, L4L
 - b. double electric motors
 - c. low-range & diff lock (no synchro)
5. Ctr Diff lock switch on dash panel

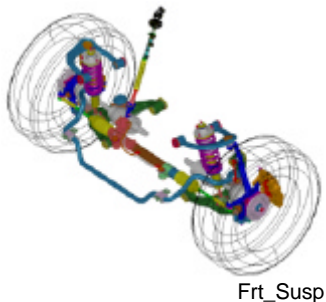


Rolling_Chassis

VI. CHASSIS & SUSPENSION

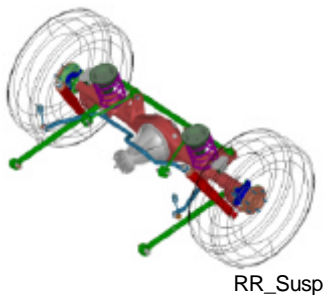
A. All new chassis design

1. Full-length boxed section frame rails
 - a. cross section= 6.3" X 3.3" (160 X 85 mm)
 - b. previous: 5.5" X 3" (140 X 80 mm)
 - c. large diameter body-mounts
 - 1) increase Torsional rigidity of entire vehicle
 - 2) improve cabin isolation from road & drivetrain vibration
2. 9 fully-welded crossmembers
 - a. new front & rear crossmembers
 - b. previous: 8
3. ft bumper box-beam cross member mounted low, between frame rails:
 - a. to prevent under-ride of vehicle in front during a collision
 - b. reduced injury to pedestrians through contact with 'softer' sheet-metal and plastic grille.
4. passenger cell protection provided by
 - a. crumple-points ahead of ft axle
 - b. "plane bend" diagonal shear area between ft axle and 2nd cab mounts
5. 2" tow hitch receiver built into rear frame crossmember
 - a. towing capacity of all models = Class III: 5,000 lbs
 - 1) reqs available engine & trans oil coolers;
 - 2) best is w/ opt air spring suspension
 - b. 7-pin trailer wiring socket attached to rear frame cross-member as std



B. Double A-arm front suspension

1. long-stroke design
2. front coil-springs over shocks
 - a. reduces unsprung mass for better on-road tracking
3. power assisted variable-gear rack & pinion steering
 - a. steering rack has increasing-pitch teeth at ends of stroke for 12% faster ratio at extreme steering angles during low-speed maneuvers
 - b. steering rack is hollow (gun-drilled) to reduce mass for more responsive steering
 - c. rack passes through frame cross-member for increased rigidity, improves steering feedback
4. anti-roll bar is hollow; $\text{Ø} = 1.14''$ (29 mm) 2WD / 1.18'' (30 mm) 4WD



C. 4-link rear suspension

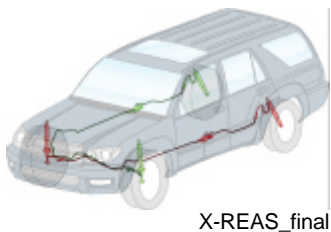
1. solid axle w/ Panhard rod
2. standard rear coil springs on SR5 model
 - a. shocks angled down for smoother on-road ride
 - b. 0.83'' (21 mm) Ø rear anti-roll bar

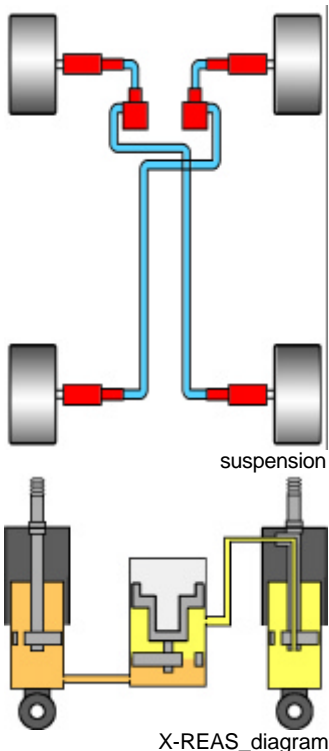
D. Ground clearance

1. 2WD = 8.9'' (226 mm)
2. 4WD = 9.1'' (231 mm)

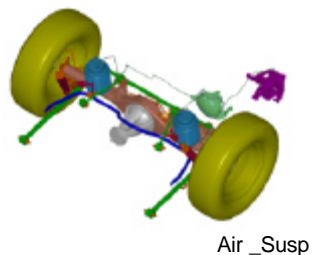
E. X-REAS: Diagonal-linked Relative Absorber System

1. Sport Enhancement Suspension
2. std on Sport model, available on Limited (not on SR5)
3. developed by Yamaha;
 - a. previously used in domestic Toyota models
 - b. worlds 1st use in a mid-SUV





(VIDEO)



4. the compression chamber of each shock is cross-linked to its diagonal mate
 - a. via a "center control absorber":
 - b. the center absorber has a free piston pushing against a low pressure Nitrogen charge;
 - c. orifice below the piston passes small motions across the vehicle from front to rear
5. X-REAS is designed to
 - a. dampen overall suspension compression & extension motions;
 - b. dampen diagonal roll & pitch motions
 - c. improve on-road stability & handling, especially in transition
 - d. reduce vehicle bottoming

F. Rear air suspension

1. optional on V8 Limited models; only coupled w/ X-REAS
 - a. air-filled reinforced rubber springs
 - b. replace steel coils to support rear vehicle mass
 - c. superior ride comfort
 - d. improved performance for towing, occasional heavy loads
2. automatic load-leveling
 - a. dynamically adjusts ride height based on height sensors
3. also driver selectable via ctr console switches:
 - a. raises up to 1½" (40 mm) < 19 mph for clearance, increased ramp & departure angles
 - b. lowers ¾" (20 mm) < 7 mph for loading, ingress/egress, hitching trailer
4. cross-link gate valve opens with transfer case in L4 to increase rear articulation
 - a. reduces antiroll effect – like dynamic roll-bar on Range Rover



16in_stl_whl
232mo09



16in_AL_whl
232mo10



17in_AL_Sportlwhl
232mo12



17n_AL_whl
232mo11

G. Tires & Wheels

1. 7 X 16" silver steel wheels are std on the SR5,

2. 7 X 16" alloy wheels available

a. 265/70 R 16 M+S tires

1) 30.61" Ø

3. 7½ X 17" 6-spoke alloys are unique to Sport model;

4. 5-spoke 7½ X 17" alloys w/ diamond-machined surface
std on Limited, opt on SR5

a. 265/65 R 17 M+S tires

1) 30.56" Ø

b. all models w/ std full-size spare,
steel or alloy as appropriate

c. all wheels 6 X 5.5" bolt circle, 30 mm offset



Interior_Dash



interior_LTD

VII. INTERIOR

A. New interior materials & layout

1. fully-integrated center stack arranges all entertainment & HVAC controls & displays
2. much larger cabin space
3. SR5 model in Stone (grey) or Taupe
 - a. dark charcoal upper IP
 - b. black & metallic silver trim
4. Sport in Stone only
 - a. dark charcoal upper IP
 - b. black & metallic silver trim
5. Limited in Stone or Taupe
 - a. dark charcoal upper IP
 - b. granite & metallic silver trim



FT_door_pocket



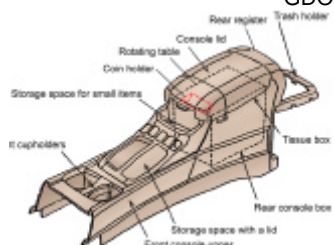
RR_door_pocket

B. Interior

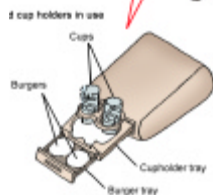
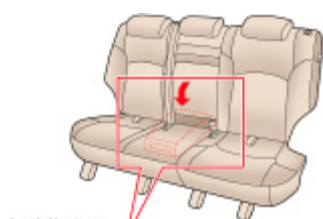
1. Front doors
 - a. Auto up/down drivers window
 - b. w/ jam protection
 - 1) digital motor speed sensor
 - 2) senses speed / torque fluctuations
 - 3) reverses window motion
 - c. hold large-format books, maps
 - d. ½ L single-size water bottle
2. Rear doors
 - a. hold two ½ L water bottles



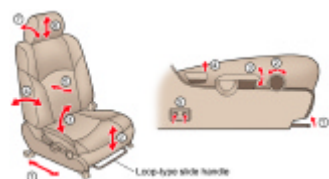
GDO



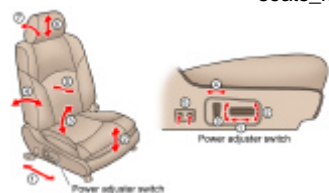
storage_02a



storage_03



seats_ft



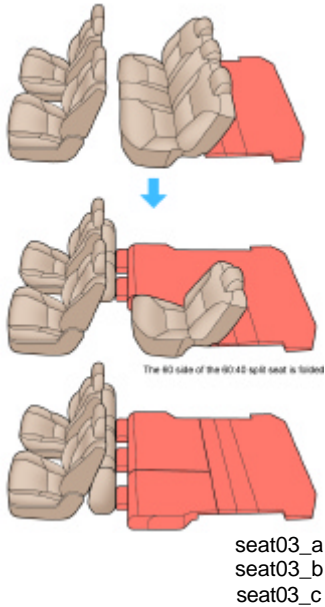
seats_ft_pwr

C. Convenience Features

1. std sunglasses holder in overhead console
2. available Homelink® garage door opener (std on Limited)
 - a. integrated into front map-light assembly
 - b. 3-channels
 - c. rolling-code technology
3. front console
 - a. std w/ A/C ducts for rear
 - b. trash-bag holder supports grocery bags
4. very wide, stable rear center armrest
5. fold-out convenience tray in front console
6. slide-out convenience tray in rear armrest
 - a. holds multiple cup/can sizes

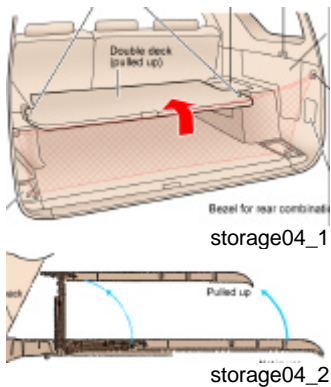
D. Seats

- a. adjustable height & bottom cushion angle
- b. SR5 & Sport:
 - 1) manual 8-way driver's seat std
 - 2) manual 4-way passenger (tilt & recline)
 - 3) power lumbar support
 - 4) unique ratchet height adjuster
 - a) 'pump' lever repeatedly to gradually raise/lower seat
- c. Limited:
 - 1) power 8-way driver's seat
 - 2) power 4-way passenger seat (tilt & recline)
 - 3) power lumbar support



E. Rear seats

1. 60/40 for flexible configuration
2. fold flat with one hand
 - a. no need to remove head rest
3. flat, fully finished, load floor



F. Rear storage area

1. 70" load floor (5' 10" / 1775 mm) with seat backs down
2. 57" (1450 mm) at widest
3. includes structural steel tie-down hooks on floor
4. additional storage hooks on sides
5. storage areas ahead of wheel-wells

G. "Double Decker" rear storage shelf

1. std on Limited, available others
2. includes luggage net
3. one hand collapsible
 - a. folds flat or lift up
 - b. locks to wheel wells



Double_Deck



Double_Deck2



Double_Deck_Westsuit



Double_Deck_golf



bicycles

- c. supported by wheel-wells
- 4. organizes cargo in two large levels
- 5. capacity up to 66 lbs (30 Kg)



SR5_Cluster



LTD_Cluster

VIII. BODY ELECTRICAL ACCESSORIES

- A. two 12 VDC power points
 - 1. ft of ctr console
 - 2. in rear luggage area
- B. 115 VAC power inverter
 - 1. outlet inside ctr console box, std on Limited
- C. Combination Meters
 - 1. Amber backlit illumination via high-efficiency white LEDs
 - a. instant on,
 - b. reduces current consumption & heat,
 - c. reduce Lead from fewer soldered connections
 - 2. meter incorporates a Vehicle Level Sensor
 - a. detects vehicle inclination
 - b. digitally compensates fuel gauge reading
 - c. unique to 4Runner
 - 3. Oil "MAINT" light
 - a. blinks for 12 sec after starting when vehicle has gone 5000 miles since an oil change
 - b. stays on steady whenever the engine is running after 7,500 miles since an oil change
 - c. driver resettable
 - 4. unique instrument cluster on Limited
 - a. all-black meter faces
 - b. illuminated pointer tips & gauge rings
- D. Multi Information Display
 - 1. std on all models: shows -
 - a. clock
 - b. ambient temp
 - c. remaining distance
 - d. average speed
 - e. average fuel consumption
 - 2. also displays A/C mode, temp setting, and fan speed
 - 3. links to other vehicle computers via multiplexing
 - a. serial data



DCS_cropped



RR_AC_ducts



AC_Control



AC_Control2



DSC_panel



Steering_Whl

E. Climate Control

1. A/C w/ automatic climate control std in SR5 & Sport models
 - a. rear seat HVAC ducts & registers
 - b. clean air filter
2. new style non-rotary controls
 - a. direct touch controls for easy function recognition
 - b. climate control status is indicated on the multi-display
3. dual-zone L-R temperature controls std on Limited

F. GPS Navigation system

1. available on all models; coupled w/ JBL Synthesis audio system
2. 7" pressure-sensitive touch screen control
3. voice guidance through driver's door speaker
4. ECU & DVD drive in right rear side panel
 - a. over 2 Million points of interest in the Toyota map database
 - b. very fast multiple route searches
 - c. split-screen display
 - d. intersection preview

IX. AUDIO

A. Standard equipment audio system

1. 6 speakers
 - a. 1 tweeter & 1 woofer in ea ft door
 - b. 1 full-range in each rr door
2. Amplifier
 - a. 4 amplifier channels
 - b. Total power = 160 watts
3. in-glass diversity antenna for omnidirectional reception

B. audio controls on steering wheel

1. std on Sport & Limited models; optional SR5
2. mode = source
3. track/tune up/down
4. volume up/down

C. Rear Seat Audio System

1. std on Limited, available on all others
2. second set of playback channels for rear seat passengers
 - a. wireless headphones available from dealer
 - b. can select the same sound source (e.g.: AM, FM, CD, cassette) as the front audio
 - 1) controllable from front or rear
 - c. or a separate source
 - 1) display in headliner
 - 2) controlled by wireless remote



RR_seat_-172



RR_seat_-170



RSAS_remote



JBL_Synthesis



JBL_spkr

3. JBL "Synthesis" System
 - a. optional on all models
 - b. proprietary surround technology
 - 1) creates a surround listening experience from any audio source
 - c. 8 channels of power amps:
 - 1) 360 Watts max power
 - d. 10 speakers, including -
 - 1) center channel speaker in dash
 - 2) rear: upper D-pillars in place of backup mirrors
 - 3) subwoofer in right rear quarter panel (17 L enclosure)
 - e. linked with Rear Seat Audio system
 - f. 3 versions of JBL Synthesis:
 - 1) single CD
 - 2) 6-disc changer in dash
 - 3) NAV w/ integrated audio



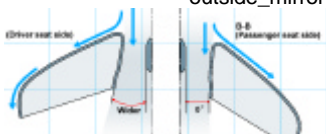
X. BODY FEATURES

A. Body Structure

1. all-new design & construction
2. front clip is integrated with the body-shell for front impact energy absorption and torsional stiffness
3. single-piece exterior side stampings increase side-impact strength and improve surface finish
4. hood, ft fenders, door skins, & rear hatch all in high-strength steel
5. tubular door beams for side impact protection



outside_mirror



func_ext01



DSC_0235



outside_mirror

B. Side mirrors

1. asymmetric housings:
 - a. improves field of view
 - b. minimizes wind-noise around A-pillars
3. power heated mirrors std on Sport & Limited

C. Sunroof

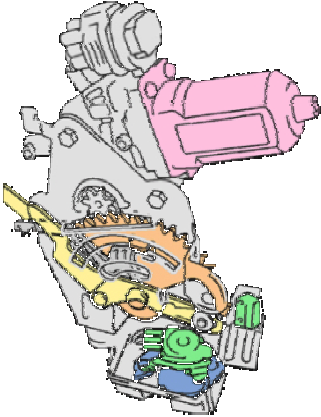
1. AUTO open and close
 - a. w/ digital torque-sensing pinch protection
2. two-stage automatic pop-up wind-deflector to minimize wind-noise & booming noise
 - a. raises to full height when roof is fully open < 45 mph
 - b. lowers to intermediate height > 55 mph

D. Exterior body features

1. power locks std
 - a. auto lock when shift out of PARK or > 4 mph
 - b. auto unlock when shift into PARK or open driver's inside handle
 - c. driver selectable to disable
2. power windows std
 - a. driver's AUTO up/down
 - b. w/ pinch protection via digital torque sensing
3. windshield & ft door glass cut 94% or more of UV
4. std privacy glass on all rear windows: 100% UV cut
5. std hydrophilic glass:
 - a. windshield, side windows, & side mirrors
 - b. water-repellent layer on outer surface
 - c. causes water to form large drops, easily shed by gravity or wind



Rearhatch_Easy_Opening



Bk_door_closer

E. Back hatch features

1. std power rr window
 - a. remote controllable
 - b. w/ jam protection
 - 1) digital motor speed sensor
 - 2) senses speed / torque fluctuations
 - 3) reverses window motion
 - c. new double-cable regulator
previous: cross-arm
2. electric release switch & power opener
 - a. for easy opening, esp. in icy weather
3. std power closer
 - a. for tight seal of gasket

XI. SAFETY SYSTEMS

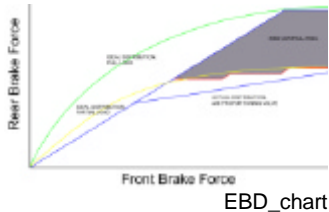
as SUV have entered the automotive mainstream in the US market,

safety has become an increasingly important factor in the purchase decision;

2003 4Runner incorporates as standard equipment many active and passive safety features to protect driver and passengers both on-road and off.

A. Brakes, mechanical

1. 12.6" (320 mm) \emptyset ventilated front rotors w/ 4-piston calipers
2. 13.3" (338 mm) ft rotors on Sport model w/ 17" whls
3. 12.3" (312 mm) ventilated rear discs w/ / 2-piston calipers std
4. foot-pedal parking brake for improved emergency reaction time
5. hydraulic power assist for brakes
6. 4-channel ABS is STD on all models of 4Runner
 - a. w/ BA & EBD



B. Brake Control System

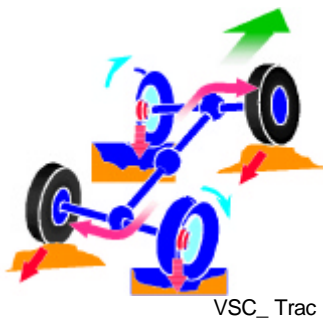
1. STD electronic chassis systems on the 4Runner:
 - a. 4 sensor, 4 channel Anti-skid Brake System preserves steering control during threshold braking
2. with following features –

C. Brake Assist (BA)

1. Interprets a quick, hard push of the brake pedal as emergency (panic) braking and, if the driver has not stepped hard enough on the brake pedal to activate the anti-lock brake system, Brake Assist will supplement the applied braking pressure
2. also can use the ABS actuator to provide additional braking force in the event of power booster failure
3. new this year: master cylinder pressure sensor to improve detection of panic-braking situation

D. Electronic Brake-force Distribution (EBD)

1. Independent proportioning of brake force between all 4 wheels
 - a. Controls brakes front-to-rear and side-to-side based on dynamic wheel loads and braking conditions
 - b. uses ABS sensors, ECU, & actuators
 - c. works by measuring minute amounts of wheel slip under braking to balance individual wheel cylinder pressures to available traction
 - d. eliminates mechanical F-R proportioning valve



E. VSC & TRAC, 2WD models

1. controls wheelspin to preserve steering control when accelerating on slippery surfaces on-road or off-.
 - a. 2-way communication between the Skid Control ECU and the ECM:
 - b. reduced throttle opening via ETCS-I
 - c. selective brake application transfers torque across each axle to the wheels with traction, like an LSD
 - d. TRAC OFF switch on dash for deep snow / sand
 - e. VSC is disabled in 4L mode

F. VSC & TRAC, 4WD models

1. work with, not against, Torsen center differential
2. additional Yaw sensor, Deceleration sensor, and control algorithms
3. smooth torque delivery on any surface

(VIDEO)

G. Hill-start Assist Control (HAC) std on all models

1. increases stability for improved control during hill climbing and starting & stopping on slippery surfaces
2. works to prevent vehicle rolling backwards or slipping sideways during transition from stopped to climbing an up-slope
3. conditions:
 - a. always engaged: no switch;
 - b. transmission in any forward gear (not in Reverse);
 - c. any wheel rotating backwards.
4. operation:
 - a. HAC system will control the brakes to stop the individual wheel or wheels and prevent the vehicle rolling backward;
 - b. VSC indicator blinks & buzzer sounds;
 - c. brake lights illuminate when pressure is applied to any caliper.

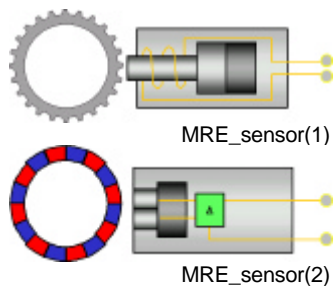
(VIDEO)



DAC-HAC_indicators

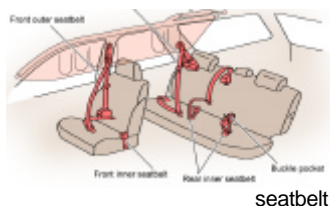
H. Downhill Assist Control (DAC) std on 4WD models

1. enabled by MRE wheel speed sensors
2. assists engine braking to improve directional control during descent of steep or slippery surfaces
3. conditions:
 - a. driver selectable via “DAC” switch on console;
 - b. transfer case in L4;
 - c. initial speed less than 18 mph;
 - d. no brake pedal or accelerator pedal input.
4. operation:
 - a. DAC system will maintain a target speed of 2 – 4 mph forward, slower in Reverse
 - b. controls brakes and throttle (via ETCS-i)
 - c. DAC indicator blinks;
 - d. brake lights illuminate when pressure is applied to any caliper.
 - e. comparable to hill descent systems in BMW X5 or Range Rover



I. Active (solid-state) wheel speed sensors

1. World's 1st use:
2. senses wheel speed and direction of rotation
3. down to 0 mph
 - a. conventional inductive sensors cannot tell direction,
 - b. voltage drops at slow speeds:
no useable reading < ~ 4 mph
4. MRE: magnetic resistance elastography
 - a. 48 bi-pole magnets in a ring in the wheel bearing
 - b. pair of Hall-effect sensors at each wheel
 - c. generate symmetrical 5V digital signal when rotating forward; asymmetric signal when rolling backward
 - d. sensors can detect wheel rotation accurately down to 0.1 kph



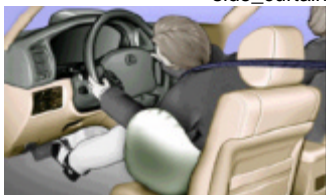
J. Supplemental Restraint System (Airbags)

1. 3-sensor system
 - a. Airbag sensor in SRS ECU
 - b. two electronic (variable) front impact sensors
 - 1) front (satellite) airbag sensor RH & LH
 - 2) integrated electronic type deceleration sensors
 - a) prev: single mechanical type in (ECU)
 - 3) detects relative severity of impact

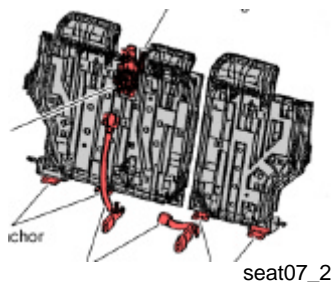
- c. two igniter circuits for driver & passenger front airbags:
 - 1) front airbags can be deployed at one of several inflation speeds or stages
 - 2) severe impact: both initiators ignite at the same time to quickly deploy airbag
 - 3) lesser impact: initiator "B" is delayed after "A"
 - a) based on speed / severity of impact
 - b) milder startup pressure curve
 - c) help reduce secondary passenger injury
- d. drivers side only: seat position switch
 - 1) drivers close to the steering wheel may get extra low deployment force in a lower impact crash
- e. seatbelt bucket switch
 - 1) front airbag deploys at full force if seatbelt is not buckled
- f. Occupant sensor
 - 1) front passenger airbag, side airbag, & pretensioner will not deploy if seat is not occupied
- 2. 1st Toyota w/ seamless dash cover over passenger airbag
- 3. tilt & telescope steering column std
 - a. improves seating position for a wider range of drivers
- 4. Side curtain shield airbags & Seat-mounted side airbags
 - a. optional in all models
 - b. cool compressed-gas inflator in C-pillar
 - c. deploys separately for each side of vehicle, tethered at base of A-pillar
 - 1) head injury protection for
 - 2) side impacts
 - d. driver & passenger and rear outboard seat positions
 - e. side airbags
 - 1) for torso & upper arm protection
 - 2) for side impacts
 - 3) front seats only
 - f. Deployed by either B-pillar or C-pillar sensor
 - 1) Can deploy individually, independent of driver, passenger, and side SRS systems
 - g. side impact sensor at the base of "B" pillar
 - 1) for side curtain only
 - h. side impact sensor at the base of "C" pillar
 - 1) deploys side and curtain sensor



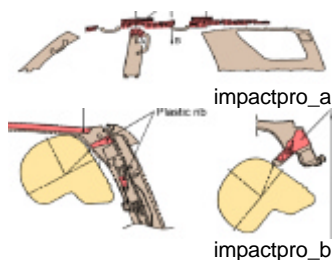
side_curtain



side_airbag



5. 3-point belts for all 5 seating positions
 - a. front belts w/ pretensioners & force limiters
 - b. center rear attaches to seatback frame
 - c. all belts ELR, for comfort
 - d. all but drivers ALR, for child seat
6. Three CRS tether behind rear seat back; two lower ISO-FIX anchor bars



K. Interior impact protection

1. deformable structures behind interior trim
2. reduces facial and cranial injuries
3. due to secondary impacts inside the vehicle during collision or roll-over

L. Daytime running lights

1. optional for all models
 - a. use the front turn signals
 - b. special high-wattage, long-life lamps
2. other lighting
 - 1) running board lights on Limited model



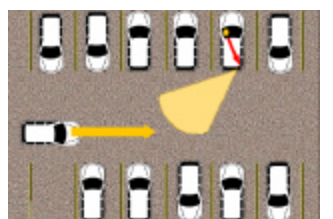
runningbrd_lites



parking_mirrors

M. Cargo area backup mirrors

1. std on all models (exc: conflict w/ JBL 10-speaker system)
2. mounted high on D-pillar
3. look thru the rear-view mirror to see reflections of pedestrians or vehicles moving perpendicular to 4Runner's axis
4. helps to reduce side blind-spots when backing out of a parking space



pkg_assist_mirrors

TECHNICAL ILLUSTRATIONS

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