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Harrop Supercharger kit – Toyota 3UR-FE 5.7L V8 (Tundra, Land-Cruiser 200, Lexus LX570)

2007-2019 Toyota Tundra and Sequoia (USA, UAE)

2007-2019 Land-cruiser 200 Series (USA, UAE 2011 ONWARDS)

2007-2019 Lexus LX570 (USA, UAE, AUS, JAP)

Harrop Supercharger kit – Toyota 3UR-FE 5.7L V8 (Tundra, Land-Cruiser 200, Lexus LX 570)

Harrop engineering develops and manufactures premium supercharger kits in Melbourne, Australia. Through 60 years of automotive performance Engineering, Harrop Engineering have successfully manufactured and supplied Superchargers to Automotive OEM programmes including TRD, Lotus Cars and Ford Australia.

Harrop Engineering is certified to meet ISO 9001 standards of quality. OEM Quality, performance and vehicle integration are the foundation of Harrop Supercharger kits.

Overview:

Harrop TVS2650 FDFI Supercharger Tuner Kit for Toyota 3UR-FE V8 engines. Note that this is a Tuner kit; a full kit will be available once an Executive Order (EO) number from CARB has been obtained. For off-road use only in North America without EO number.

Tuner kit includes all components required for installation into Toyota Tundra, Land-Cruiser 200 and Lexus LX 570 with 5.7L V8 Engines.

- Supercharger intake manifold including charge-air intercooler
- Harrop TVS2650 FDFI Supercharger with RH inlet cover – Toyota Throttle bolt pattern
- 8PK FEAD idler bracket, Coolant cross-over pipe, 8PK Supercharger drive belt
- Replacement high flow injectors – 650cc (where applicable. See table on page 4)
- Replacement High flow fuel pump including filter kit – 340 L/hr (where applicable. See table on page 4)
- Plug-in wiring looms for all necessary engine sensors – IAT breakout from MAF sensor, Throttle loom extension and Intercooler pump loom
- Front-mount intercooler radiator, Electric Intercooler pump, Coolant Reservoir and moulded hoses
- Interfaces with OE throttle body including RFC, FEAD and 3rd Gen onwards (2014 – current) Air-box. Interface with 2nd gen and TRD air-boxes are being developed. Aftermarket Air-boxes can be utilised, AFE is recommended
- Retains all factory ancillaries including A/C, Viscous engine fan, Power Steering, etc.
- Detailed installation instructions

Technical specifications:

- Eaton TVS2650 supercharger technology. The TVS2650 supercharger is 40% larger than the TVS1900 (2650cc vs 1900cc)
- Integrated Supercharger Bypass system which relieves boost under light load conditions, reducing drive loss and improving fuel economy
- High density water to air intercooler system:
    - Front mount heat exchanger: Close pitch core matrix at 28mm thick. Overall size is 590x390mm
    - In-manifold intercoolers, X 2: Close pitch dual pass cores with high density fin at 73mm thick
- Stage 1 kit Includes Ø85mm Supercharger pulley and must be installed as supplied without any modifications.
- Stage 1 kits can be installed without re-calibration. Minimum 98-RON (93-AKI) fuel must be used. Verification of knock control, Air/Fuel ratios and Boost pressure on dyno is recommended. Refer to pages 7 & 8 for more information.
- Re-calibration of the ECU is required with Stage 2 kits.
- Stage 2 kits can include optional Supercharger drive pulleys at Ø75 or Ø80mm using the supplied 8PK2990 belt.
- Flex Fuel vehicles require custom fuel pump, engine calibration and suitable injectors which are not included in Stage 1 or 2 kits.

Supercharger Pulley Ø	Harrop part number	Supercharger Belt
75	99-PLY11583	8PK2990
80	99-PLY11584	8PK2990
85	99-PLY11585	8PK2990

Performance:

- Over 50% gain in Engine Power and Torque are achievable while maintaining the OE RPM limit, depending on Calibration.

| Texas Tundra | Harrop TVS2650			
Boost	**Pulley Ø mm**	**Wheel Power kW (hp)**	**Wheel Torque Nm (lbf-ft)**
Stage 1– 7 PSI*	85	350 (470)	631 (465)
Stage 2– 8 PSI*	80	385 (517)	696 (513)

*Boost pressure can vary 1.0-1.5 PSI depending on ambient conditions and other modifications

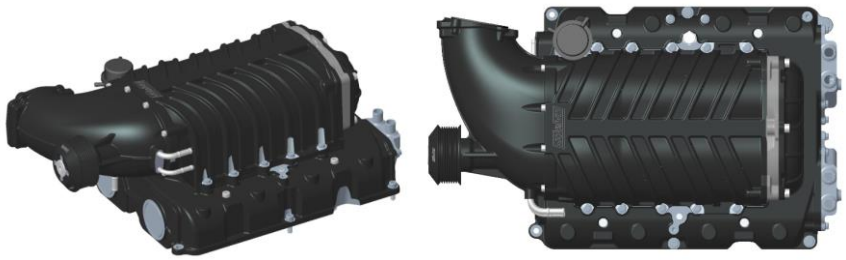
Watch Texas Tundra on the Harrop Dyno: https://www.youtube.com/watch?v=Oo8d1e-1yJQ

The Harrop TVS2650 Supercharger is capable of producing over 1000 hp with further supporting modifications including suitable intake and throttle, Supercharger drive, built engine, exhaust and custom calibration.

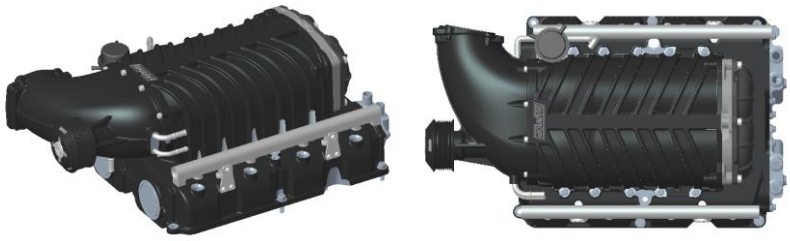
Variants:

Harrop Part Number	Toyota/Lexus LC200 / Tundra / LX570 - 3URFE 5.7L V8
99-KSM51K34	FDFI2650 Supercharger kit - LC200 / LX570 Stage 1 (Inc fuel pump & regulator upgrade)
99-KSM51K31	FDFI2650 Supercharger kit - LC200 / LX570 Stage 2 (Inc injectors & fuel pump upgrade, requires custom tuning)
99-KSM51K33	FDFI2650 Supercharger kit - Tundra Stage 1 (Inc fuel pump & regulator upgrade)
99-KSM51K30	FDFI2650 Supercharger kit - Tundra Stage 2 (Inc injectors & fuel pump upgrade, requires custom tuning)
99-KSM51K32	FDFI2650 Supercharger TRD Upgrade kit- Tundra 2007-2017 Does not include Intercooler radiator and pump, Injectors or Fuel pump. The existing TRD items are re-used for these components

For customised race applications optional upgraded manifold utilises secondary fuel rails to enable 16 injectors to maximise fuel delivery. Fuel-rail option includes additional machined injector bosses in the manifold, fuel-rails and mount brackets. Harrop Part Number: 99-KSM52K30.



Harrop TVS2650 3UR-FE Supercharger Manifold Assembly



Harrop TVS2650 3UR-FE with fuel-rails option

Toyota Tundra TRD Upgrade (TRD or aftermarket 1900 Supercharged 3UR-FE engine): 99-KSM51K32

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Lexus 570 Stage 1 installation kit (OE Naturally Aspirated 3UR-FE engine): 99-KSM51K34

Calibration of Toyota 3UR-FE Engine ECU for Harrop Supercharged engines

Tuning of Supercharged Engines is always recommended to achieve safe and predictable performance targets. Recently, manufacturers have begun increasing security around the OEM ECU, limiting accessibility and therefore tunability of modified engines.

As there is high demand for modifications on 3UR-FE powered Vehicles, Harrop Engineering have undertaken both Dyno and road testing on their own development Vehicle – a 2018 Toyota Tundra 3UR-FE.

When assessing the vehicle software for suitability with mechanical modifications, we looked primarily at Ignition, fuelling, load calculation and torque output. From looking at multiple similar stock calibrations we were able to reasonably assess the upper limit of the existing tuning maps.

After installing the Harrop 2650 Tundra Stage 1 Supercharger kit, Harrop were able to make a number of assessments based on comparative ignition timing, fuel enrichment, engine loads, and torque output. Logged data, in combination with access to earlier 3UR-FE calibrations allows for some reasonable assumptions.

Ignition:

The factory maps are very conservative on ignition timing. In Australia fuels vary from 91 through 95 and 98 RON. The Harrop test vehicle was delivered on 91 RON fuel, and logs showed the vehicle to be running on the knock sensors. i.e. the stock ECU was retarding ignition timing due to knock on 91 RON fuel. 'Knock Ears' were used to confirm the effectiveness of the knock control and sensitivity.

With the Supercharger installed running on 98 RON fuel, similar low-level knock retard was evident, in general no more than 2-3 degrees of knock retard was recorded. Audible knock at the knock ears was no greater than experienced using 91 RON stock. Knock was only audible with knock ears; no knock was audible in the cabin as per manufacture.

Assessing knock sensitivity is a common tuning requirement due to mechanical modifications that impact engine noise. Noisier mechanical components can result in false knock detection and low power output. Fortunately, the Toyota knock strategy proved to be very robust and well dialled in. Like many OE calibrations the Toyota spark strategy starts from being retarded, in this case 3 degrees, and adapt up or down from there. If we take an example from our logs and spark tables and compare them to other accessible 3UR-FE calibrations, our run spark is actually only 2-3 degrees lower than the commanded spark table at loads above 60%. This is on par with the stock vehicle and low(standard) octane fuel.

Fuelling:

In regards to fuelling the 3UR-FE are MAF (Mass Air Flow) based, so boost pressure is not a factor for the ECU. The limiting factors are MAF flow and any ECU limits relating to flow. The stock mapping extends to load of 110%. Observed peak load supercharged is 140%, therefore it is important to know what is going to happen when you go "off the map".

The additional airflow proved to be of no concern to the ECU, peak airflow of 450 g/s was measured with the supercharged unit.

Testing at higher boost did reveal limits, both an ECU 512 g/s calculation limit and the MAF voltage ceiling. In addition, at higher flow levels the standard injectors do not have sufficient flow.

So maximum airflow was set at 450 g/s by selecting the Ø85 Supercharger pulley. To provide a further factor of safety, the Harrop Supercharger kit includes a high-volume Fuel Pump and Fuel pressure Regulator modification. Higher outputs beyond the Harrop Stage 1 kit will require tune scaling, larger MAF pipes and supporting fuel hardware.

The mixture commanded in the stock tune is very rich under load for catalyst and component protection, something most tuners would lean out for greater gains. The Harrop fuel system upgrades in no way alter the normal overheating protections. These fuelling protections are modelled in the ECU and are based on airflow, not boost as no MAP sensor is present in the OE manifold by design. The advantage here is that the protections will be available at the same rate of air flow as stock, no "performance tuning" means engine longevity is less compromised as the aftermarket tuner will generally lower or remove the factory protections in favour of Power. The modifications made to the fuel system also ensure the ECU hits is commanded target fuel, and logged fuel trims are +/- 10%.

Torque output and engine load:

The output torque is clearly higher, the concern around output torque is that it is calculated correctly. The relative torque output calculation is important for transmission shift quality and torque reduction. Harrop are able to log airflow and load calculations on their Hub Dyno. By retaining the stock MAF and therefore stock airflow reading, the transmission will see the relative torque increase and apply the required pressure and torque reduction changes.

To summarize, Harrop recognise a tuned option would be best. Where one does not exist, Harrop opted to test the operation of the stock tune with the Supercharger and are content that the modest boost upgrade of the Stage 1 kit works within the limits of the factory tune. The parameters of the stock tune extend satisfactorily to within the increased airflow of the upgrade as is evident by timing and knock control when combined with 98RON (93 AKI) fuel, component enrichment protection, increased shift torque reduction and the absence of modification induced MIL light from increased air flow.

Very recently, tuning has become available on some 3UR-FE ECUs so further analysis of higher output and the respective limits became possible. The results were that re-calibration of 3UR-FE Vehicles was not advantageous for the Stage 1 kit (Ø85mm pulley), as long as the Harrop Supercharger kit is Installed as supplied, completely and without further modifications.