Elan Factory Customer Projects

July 2007

Customer details

The owner of this immaculate 2005 Elise has recently moved from Adelaide to Melbourne. Whilst living and working in the UK, the owner purchased this Elise new and then imported it to Australia.

Vehicle details

This Elise was brought to The Elan Factory for a periodic service and the blower motor unit to be changed. The blower unit had previously been changed under warranty whilst the owner was living in the UK. What started out to be a straightforward task soon developed into wrestling match when attempting to remove the front body-section. Despite the fasteners being stainless steel 316 grade, most of them were frozen to the body mounts.

Work in progress

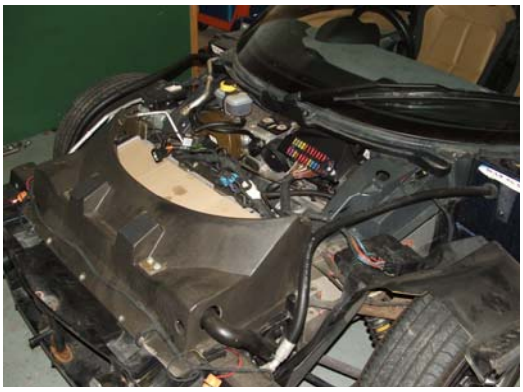
Seized stainless steel fastener at the bottom of passenger side windscreen pillar

Fastener access is severely restricted

Passenger door removed to improve access

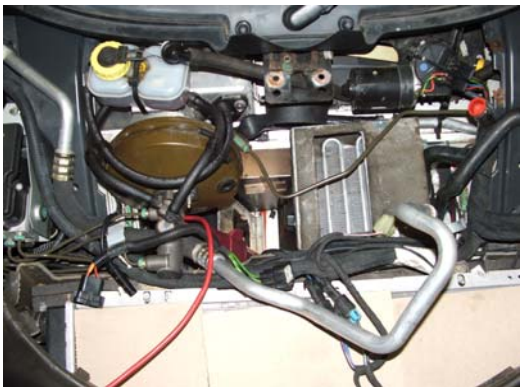
Offending “frozen screw” and driver bit

Passenger side door hinge mounting



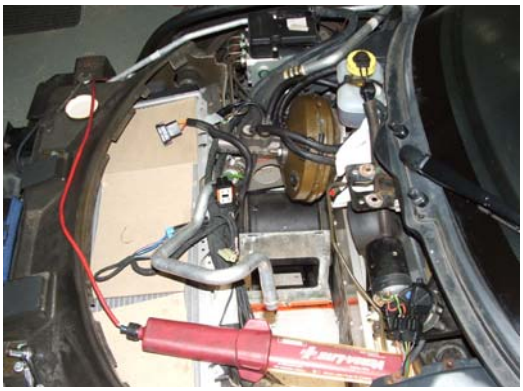
Protective cover installed on top of radiator

Blower motor unit is located under the brake servo

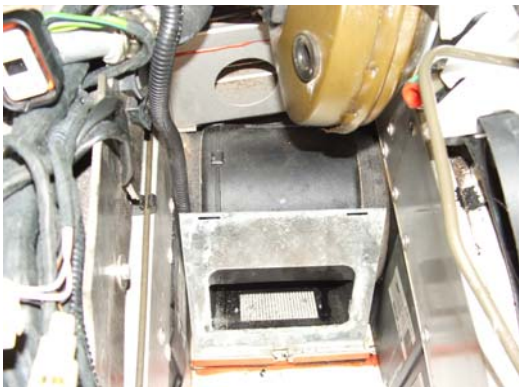


Heater & A/C unit rotated

Heater & A/C unit slides upwards to remove



Blower unit is located under the chassis rail



Blower unit has to be moved over to the centre of the vehicle before it can be lifted out

Replacing the blower motor and/or speed resistor pack involves removing the complete front body section car to gain access to these components. This is normally straightforward providing the stainless steel fasteners are easy to remove. This particular Elise had been exposed to a UK winter where the body fasteners had started to corrode. This resulted in having to remove the passenger door to gain full access to the "frozen screw" located at the bottom of the windscreen pillar. This problem could easily be avoided by if the good people at Lotus Cars would take a few extra minutes to coat all relevant fasteners with an anti-seize product. This would save so much pain and expense to servicing personal and Elise owner's.

Genuine Lotus parts were supplied from the UK but when compared, it was discovered they were slightly different.

The part number on the original blower unit was B117P0025F
The part number on the new blower unit was B117P0163F
The part number on the new resistor pack was LA117P6000S

There was no point in returning these parts to the UK so a decision was made to adapt what was supplied and improve on the original installation. A quick check revealed the blower unit had no cut-out in the plastic casing for the resistor pack to be installed in its original position. In addition to this the resistor pack had the incorrect plug installed on the end of the cable.

This job is a "non trivial task" and it does not appear to be possible to achieve the recommended Lotus repair times because of the large number of components that need to be removed. To gain access to the motor and resistor pack it is necessary to remove several significant components and plumbing. During this process it will be necessary to discharge the gas in the A/C system. The gas will need to be replaced and this is very straightforward as there is excellent access to the A/C system charging valves in the engine compartment.

Corroded speed control unit mounted outside

Replacement blower unit is not the same as the original

Speed control unit mounted inside blower

Passenger side view of the cockpit

Front view

Front side view

Items to be removed to access the blower unit and resistor pack include, the brake servo/master cylinder vacuum hose, windscreen wiper motor cover, heater coolant hoses, A/C dryer/receiver, A/C pipes, A/C exchanger/heater unit. All these of items need to be removed to gain access so the blower fan unit can be moved side-ways and then finally withdrawn upwards.

The "troublesome blower motor" is located underneath the brake servo unit and is firmly tucked under the chassis rail. But first, the heater-A/C unit had to be rotated to allow it to be withdrawn from the rectangular chassis compartment.

Once this was removed then it was possible to slide the blower motor towards the passenger side and then withdraw it upwards. When the blower motors are side by side, there are some subtle differences – please see photograph above. This may explain the different Lotus part numbers.

The resistor pack is very basic as it's a series of nickel-chrome wire wound resistors mounted inside an aluminium case. Unfortunately the resistor pack is mounted externally (underneath the blower plastic case) and not subjected to any air flow to help cool it. The "cheese-grater fins" on the resistor pack case are intended to provide a heat sink cooling surface (but is on the wrong surface as the resistor pack sits proud on the other side of the casing) This arrangement can be improved upon by mounting the resistor pack inside the fan assembly so it sits in the air stream and not subject to water.

The compartment had a significant amount of water in it and had to be drained before all the components could be installed back in their original locations. This was determined by the tide mark on the black plastic tape covering the resistor pack. Once the water got into the resistor pack and the connectors, this has initiated the corrosion process. Once the corrosion had taken a hold of the connectors, this in turn has caused a high resistance joint. Once you have a high resistance joint, then a volt drop develops across the connector. When a volt drop is established across an electrical connector, then heat is developed and the final result is what you see in the photograph above.

This is a piece of poor engineering on the behalf of Lotus
1) The resistor pack is prone to being bathed in water
2) The resistor pack sits in a "dead zone" where air cannot circulate around it
3) The resistor pack cannot be accessed easily from a service point of view

Unfortunately there is not an elegant solution to this particular problem as there are constraints imposed by the existing components and their layout. However, it would be straightforward to design an external solid state speed controller mounted on an aluminium heat-sink. This could simply be bolted to the body/chassis to be easily accessible and not have to dismantle half the vehicle to access the blower unit/resistor pack.

Water ingress in to the front compartment is a well known problem and there is a Service Bulletin that suggests drilling four holes, 6mm in diameter in each corner of the front compartment to drain the water out. This is a not a satisfactory suggestion as it does not address the basic problem to prevent the water from entering the vehicle in the first instance. After examining this vehicle in detail, it was concluded that water can enter the front compartment through the front air-intake (radiator intake) and via the two fresh air intake ducts. Rain water also enters the compartment through the tubular suspension chassis pick-up points. This will occur when the vehicle is driven at speed when it rains. The Lotus factory has made an attempt to prevent the water entering the top rear suspension pick-up point by introducing a foam plug in to the tubular chassis section.

A decision was made to install four drain holes but these were covered underneath the vehicle by a midget stainless steel clam vent (usually fitted to yachts). The opening of these vents face rearwards ensuring no further water enters the vehicle. Installing the vents in this manner also has a venturi effect to suck out any residual fluid. These items are quite unobtrusive and do not affect ground clearance.

After examining the short falls in the original blower motor and resistor pack installation, a decision was made to mount the resistor pack internally within the blower unit.

This provides the following benefits:
a) The resistor pack is away from any water source.
b) The resistor pack is directly in the air stream and is cooled whenever the fan is operated.

The following measurements and calculations were carried out during the final checks when modifying the blower unit and resistor pack.

Resistance values measured at plug with motor and resistor pack assembled
Black wire (-ve or earth connection) to Yellow wire = 0.8 Ohm (slow speed)
Black wire (-ve or earth connection) to Red wire = 0.4 Ohm (intermediate speed)
Black wire (-ve or earth connection) to Orange wire = 0.2 Ohm (high speed)

Motor steady state current values measured at relevant speed settings
Slow speed setting = 8.5 Amps
Intermediate speed setting = 10.8 Amps
Fast speed setting = 15.1 Amps

Here are the calculated values for the electrical energy dissipated by the resistor pack.
Ohms Law states the following:
Current in $Amps^2$ (Amps squared) x Resistance = Watts

Slow speed setting = 57.8 Watts
Intermediate speed setting = 46.65 Watts
Fast speed setting = 45.6 Watts

The above calculations illustrate the amount of heat that resistor pack is expected to dissipate. It is only possible to do this in a reliable manner if the speed control pack is cooled by fan-forced air. If you attempt to hold a regular 60 watt light bulb, then you will soon appreciate how hot it gets – too hot to hold!

A number of checks with the motor running at various speeds were carried out to ensure the resistor pack did not over heat. This was achieved by running the motor continuously for 10 minutes and checking the resistor pack casing with an infra-red digital thermometer. At an ambient temperature of 15 degrees Centigrade, the maximum case temperature observed was 22 degrees Centigrade. The maximum temperature was seen at the slowest speed setting where the nickel-chrome resistor dissipates 57.8 Watts

Summary
From simple modification described above, the resistor pack is not expected to experience over heating problems during normal service.
However, if the resistor pack fails again then the same problem exists when having to dismantle the front of the vehicle.

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