Description and Operation

The exhaust systems fitted to the Scorpio range of vehicles are designed to safely, quietly and efficiently conduct exhaust gases away from the engine at all engine speeds without adversely affecting fuel consumption.

All the exhaust systems comprise a manifold, downpipe/catalyst or downpipe and catalyst (for T DsI Diesel), front, centre muffler and a rear muffler assembly. The rear muffler assembly is made from an aluminised material which helps to increase the service life of the system. In addition, the internals and end plates of the rear muffler assembly are of stainless steel to provide increased protection against the corrosive products of combustion held in the exhaust gas condensate.

The exhaust systems are of two or three-piece construction for production and four or five-piece construction for service. Each system is secured at the front by the manifold flange and supported in the middle and at the rear by rubber insulators.

Manifolds

The manifolds bolt directly to the catalyst/ downpipe assembly on the petrol engined variants (dual downpipe on the V6). The flange is sealed by a special sealing ring and is secured by studs and nuts. The downpipe on the diesel variant bolts directly to the turbocharger flange, the flange is sealed by a special sealing ring and two nuts.

Downpipe/Catalyst Assembly

A catalyst is fitted to petrol and diesel models of the Scorpio range; this resembles a small muffler assembly. Because of the high temperatures at which the converter operates, the vehicle body areas around the catalyst are protected by heat shields.

The catalyst is designed to convert exhaust gas emissions to levels which comply with territorial legislation.

There are two types of catalyst, one being the conventional Oxidation Catalyst (COC) which controls HC and CO emissions. The other type is known as the Three-Way Catalyst (TWC) and controls three emissions: HC, CO and NO_x.

- HC= Hydrocarbons (unburnt fuel)
- CO= Carbon Monoxide
- NO_x=oxides of Nitrogen (TWCs only)

Which convert to

- CO_2= Carbon Dioxide
- N_2= Nitrogen
- H_20= Water

Internally there are two components, these being the support mat and the coated substrate (catalyst).

The Support Mat

This is used to mount the catalyst in the converter assembly. The support mat is made of a high temperature ceramic fibre (alumina silicate) containing vermiculite.

Vermiculite causes the support mat to expand as the temperature of the catalyst increases, thus maintaining adequate holding force on the catalyst under all operating conditions.

The Coated Substrate

The substrate is covered by a washcoat impregnated with precious metals.

The Substrate

This is the component on which the catalytic materials are supported. Its honeycomb structure provides a high geometric surface area for the exhaust gases to pass over. Ceramic substrates are of a porous material which gives good washcoat adhesion.

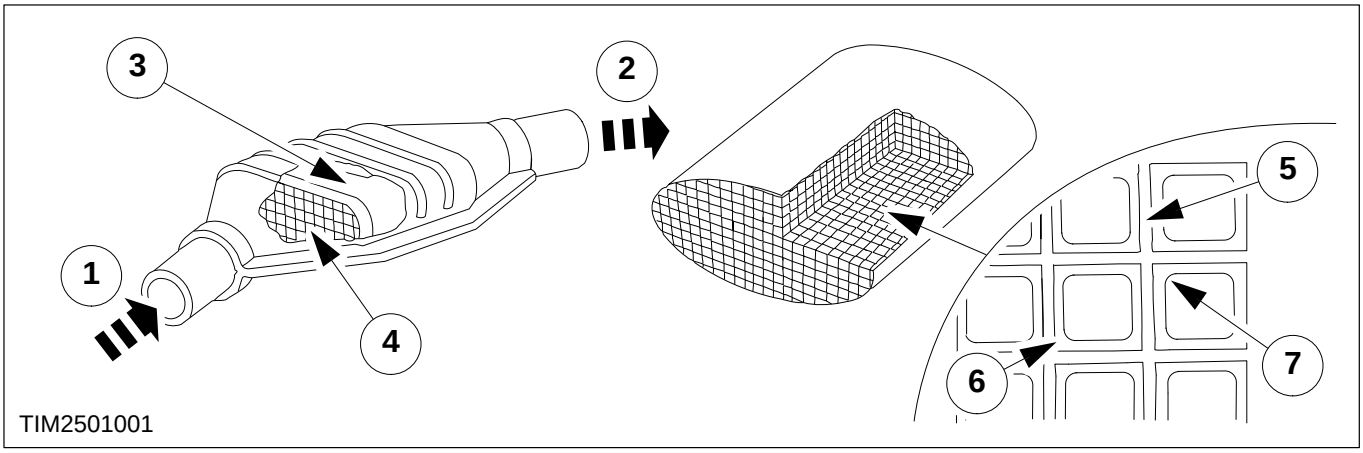
Washcoat

This is an alumina-based material which is applied to the substrate to provide a high surface area for optimum precious metal dispersion. The complex structure of the washcoat effectively increases the surface area of the substrate, this feature being necessary to achieve a high degree of catalytic activity. Precious metals are the active catalytic components and are dispersed onto the washcoat as precious metal salts. The three precious metals used in automotive catalysts are platinum, palladium and rhodium.

Catalyst Operation

To function, the catalyst needs to reach a minimum operating temperature. Once this temperature has been attained the catalyst starts to react and rapidly approaches peak conversion efficiency, generating its own heat. Below 320˚C conversion of exhaust gases is negligible.

In order for catalyst to covert efficiently it is essential that the air/fuel ratio is correctly controlled. This is particularly true for the TWCs which will only operate effectively within a narrow band. To operate within this band, closed-loop fuelling is employed to achieve the more stringent emission standards.



Item	Description
1	Exhaust gases from the engine HC CO NOx
2	Converted gases into the exhaust system H20 CO2 N2
3	Support mat
4	Catalyst
5	Substrate
6	Precious metal deposits
7	Washcoat

Catalyst Deactivation due to Poisoning

Lead (Pb) in fuel can cause severe deactivation at levels above 5mg per litre of fuel. It is therefore essential that catalyst-equipped vehicles always operate on unleaded fuel.

Zinc (Zn) and Phosphorous (P) present in some engine oils, can cause deactivation when oil consumption levels are high.

Sulphur (S) in fuel can also cause deactivation but the effect of sulphur is felt most if it is released from the catalyst as Hydrogen Sulphide (H_2S).

This has an unpleasant odour similar to rotten eggs. Under normal operating conditions, sulphur released from the fuel during combustion becomes stored on the washcoat. During rich operation this stored sulphur combines with hydrogen sulphide. It is this storage/release phenomenon that causes the hydrogen sulphide to be emitted at levels detectable by smell. Normally this situation will improve as the catalyst ‘ages’; renewing the catalytic converter will only serve to promote the phenomenon. To minimise hydrogen sulphide emissions it is essential that the idle CO is within specification (preferably at the lower end of the emission range). It is therefore important that the engine management system is functioning correctly.

NOTE: Changing the fuel source or manufacturer may also help in reducing this phenomenon.

Thermal deactivation of the catalyst occurs throughout the life of the exhaust, but is most severe over the first 6,500 km (4000 miles). Catalysts are intended to operate at temperatures up to 850˚C; under these conditions normal deactivation takes place.

Advanced thermal ageing occurs when temperatures exceed 850˚C. The ageing process accelerates rapidly at temperatures above 1000˚C.

If temperatures exceeding 1400˚C are achieved, the catalyst substrate will melt. Catalyst melts are normally accompanied by loss of power due to excessive exhaust gas back pressure.

High substrate temperatures are caused by malfunction of the ignition or fuel systems, or by driver abuse (such as switching off the ignition when the vehicle is still in motion). These causal factors allow unburnt fuel to enter the catalyst, which ignites, producing localised high temperatures within the catalyst.

WARNING: Catalyst are fairly tolerant of low engine speed misfire. However misfire at high engine speed may result in an almost instantaneous melt. It is therefore important that the cause of the misfire is identified and rectified if subsequent melts are to be prevented.

Front Muffler Assembly

The front muffler provides early expansion of the exhaust gases.

Centre Muffler Assembly

The centre muffler reduces exhaust gas noise by the use of sound absorbing materials.

Rear Muffler Assembly

The rear muffler further reduces exhaust gas noise by the use of sound absorbing materials.

Service-Fit Exhaust System

These comprise a downpipe/catalyst (or downpipe and catalyst on the T DsI Diesel), front muffler assembly and rear muffler assembly.

It is not possible to replace a centre section of the production exhaust system on its own. Should it be necessary to replace this section, a new centre and rear muffler assembly must be fitted.

The cut points for production systems, when fitting a service system, are shown in the relevant operation of this section.