

SB005

Diesel Piston Crown Erosion

A diesel injection system must deliver (meter) the right amount of fuel, in the right form (atomised), in the right place (spray pattern), at the right time (system timing). With everything correct, combustion takes place without liquid fuel being deposited on the combustion chamber surfaces. A thin boundary layer of gas should be maintained between the surfaces and the burning mixture. In turn, this provides thermal protection of the combustion chamber by limiting the heat transfer to the components. The boundary layer is very thin (measured in microns) but the insulation it provides is of the utmost importance (Fig 1).

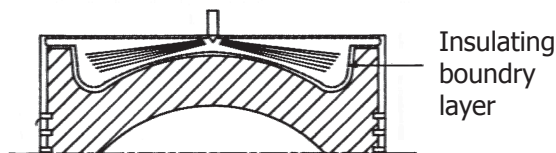


Figure 1.
Fuel burns before contacting
surfaces.

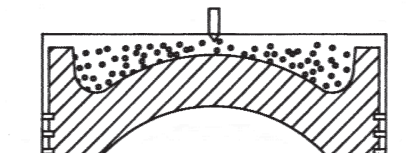


Figure 2.
Poor atomisation. Fuel droplets
contact piston.

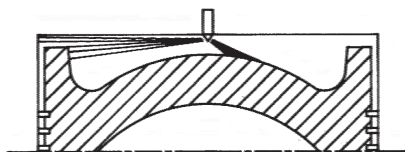


Figure 3.
Incorrect spray pattern. Fuel
impinges on crown and bore.

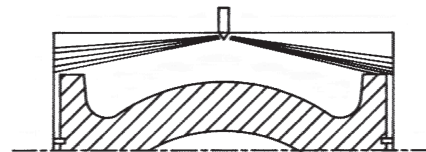


Figure 4.
Incorrect timing. Fuel impinges on
bore wall.

A malfunction, or the incorrect adjustment of the fuel injection system will often cause fuel to wet the combustion chamber surfaces (Figures 2 to 4). When this happens, the fuel burns in direct contact with the surfaces without the protective boundary layer being present. The rate of heat transfer from the combustion gases increases dramatically and temperatures rapidly exceed the melting point of piston alloys. Piston crown erosion inevitably follows.

The illustration shows a typical example of crown erosion and melting. An unatomised fuel spray acts like a 'flame thrower', melting and blasting through the crown of the piston. A mixture of molten crown alloy and burning diesel has eroded and melted behind the Alfin insert and exited out through the oil ring groove and down the skirt.



When crown erosion is discovered in a diesel engine, make an immediate and thorough check of the whole fuel injection system. A piston alloy has not yet been invented that will resist fuel burning on its surface, and blaming the component's metallurgy will simply delay identification of the true cause - a fuel injection system malfunction.