PRODUCT INFORMATION

SWIRL FLAPS/TUMBLE FLAPS

WHAT IS THE DIFFERENCE?

Pierburg intake manifolds, as used in modern petrol and diesel vehicles, often have swirl or tumble flaps in their inlet ports.

SWIRL FLAPS

Swirl flaps produce a swirl along the cylinder axis. They are used in diesel vehicles to improve the mixing of the air-fuel mixture at low engine speeds. For this purpose, the air is fed to each cylinder through two separate channels in the intake manifold. One of the two channels can be closed with a swirl flap. This creates a swirling of the fresh air. Better mixing reduces fuel consumption and pollutant emissions. At higher engine speeds and torques, the swirl flap is opened to achieve better volumetric efficiency. The swirl flaps are also opened when starting the engine and in overrun operation.

A swirl flap is also called an "inlet port shut-off".

In the Opel Twinport engine, the swirl flap reduces the throttle losses during part-load operation.

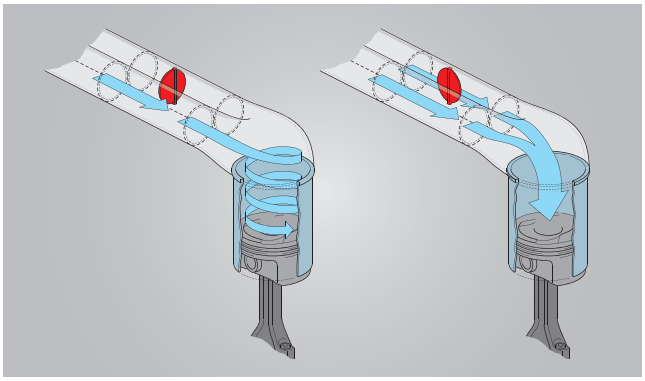

Fig. 1: Swirl flap: swirl in axial direction of the piston
Left: part load, swirl flap closed, strong swirling
Right: full load, swirl flap open, high volumetric efficiency

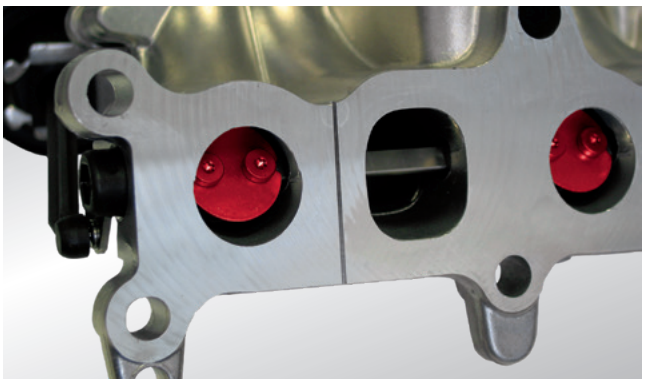

Fig. 2: Two channels for each cylinder:
Swirl flaps (highlighted in red) in the Pierburg intake manifold, e.g. in the Opel Astra J 1.7 CDTi

TUMBLE FLAPS

Tumble flaps produce a swirl perpendicular to the axial direction of the piston.
This is achieved by either dividing the air intake channel into two separate channels, of which one channel can be closed by the tumble flap (Fig. 3), or by turning one flap sideways into the air flow (Fig. 4).

Tumble flaps are used in vehicles with petrol direct injection (e.g. in FSI engines) to realise stratified charge operation.
In stratified charge operation, by means of this specifically produced air flow and special geometry of the piston, the air-fuel mixture is agglomerated directly around the spark plug and ignited. This means there is clean air around the edges of the combustion chamber. The clean air serves as insulation during combustion and reduces heat loss. Further reduction of fuel consumption is achieved by dethrottling the engine.

At higher engine speeds and torques, the tumble flap is opened to achieve better volumetric efficiency. During this "homogenous operation", the engine functions like a conventional fuel injection engine, but with higher efficiency due to the higher compression. This enables a reduction of fuel consumption in the low engine speed range, without sustaining losses of power or torque at higher engine speeds.

Tumble flaps are also called "charge movement flaps".

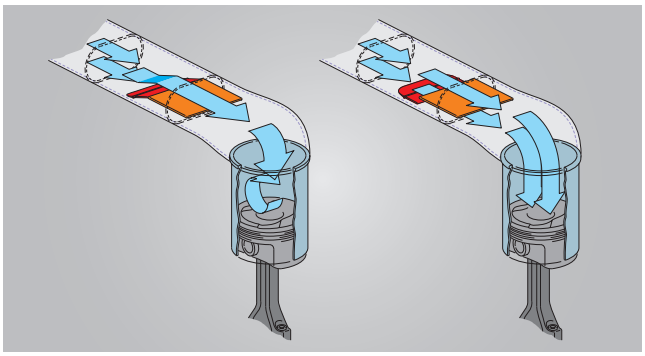

Fig. 3: Tumble flap: swirl perpendicular to axial direction of the piston
Left: stratified charge operation; right: homogenous operation

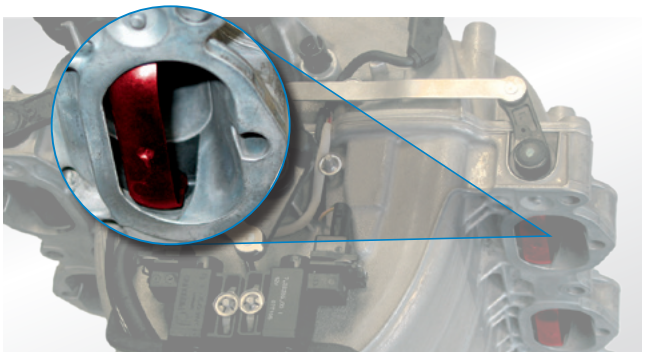

Fig. 4: Tumble flaps (highlighted in red) in the Pierburg intake manifold, e.g. in the Mercedes E-Class 500

NOTE:
Throttle losses/dethrottling

A not completely opened throttle valve in the intake air system constricts the fresh air supply. This results in resistance which causes throttle losses. Every action taken to open the throttle flap (dethrottling) further reduces the throttle losses and therefore fuel consumption.

Fig. 5:
Pistons from Kolbenschmidt with special piston crown for stratified charge operation