

Issue no. 09/2021

Cavitation damage in the cooling circuit

Vapor bubbles in the cooling circuit can cause serious damage. Thorough maintenance is key to prevention.

Definition

Cavitation refers to the formation and sudden collapse of vapor bubbles in fast-flowing liquids. The implosion of the gas bubbles creates enormous pressure differences, causing microscopic pieces to be torn out of the material. Over time, more and more holes of increasing size form in the surface until the component is finally completely destroyed.

Causes

In most cases, a defect or inadequate maintenance is responsible for cavitation damage to cooling circuit components. If sufficient pressure can't build in the system, the boiling point of the coolant drops, which in turn encourages the formation of vapor bubbles. A number of factors can trigger cavitation:

- Insufficient or no coolant additive (antifreeze) in the coolant (boiling point too low)



Figure 1: Coolant pump blade showing erosive wear caused by cavitation



Figure 2: Cylinder liner with cavitation damage in the area around the top dead center

- Stale and worn coolant (lack of additives and inhibitors, e.g., to prevent foaming)
- A defective pressure valve in the expansion tank cap (pressure does not build up)
- Residue or foreign objects in the cooling water (sealant residue or deposits)

Damage

Cavitation in the cooling circuit can lead to a whole host of defects:

- At an advanced stage, if the cylinder liners are wet (i.e., bathed in coolant), coolant can leak into the cylinder, leading to total engine failure due to hydraulic shock.
- If a foreign object becomes lodged inside a heat exchanger (e.g., in a stacked plate or retarder oil cooler), the flow of fluid around this obstruction can lead to turbulence and vapor bubble formation, resulting in leakage between the oil and coolant sides.
- Cavitation in coolant pumps causes abrasion to the pump wheel blades. Over time, the delivery rate reduces until finally no recirculation takes place at all.

Important!

A properly functioning cooling system is crucial to avoiding cavitation damage. Coolant should be replaced regularly according to the manufacturer's specifications. If there are any foreign objects or deposits in the cooling circuit, it must be cleaned and flushed. In the case of heat exchangers (oil coolers), the leaktightness of both circuits is essential to prevent cross contamination.