- Report-

Test of a Boundary Cooling Device

The idea of the "Boundary Cooling Device" was developed by Lloyds Register and presented to the ABERO project partners. It was decided to implement and test this BDC as a prototype.

The basic idea

Figure 1 shows the idea of the device. This device should consist of two pipes, which are equipped with nozzles to cool the underbody (battery/gas tank) as well as to create a water wall between the vehicles. To supply the two parts of the device, a Storz C type extinguishing water connection is required, as both parts can be connected together via a manifold. In order to achieve the simplest and clearest possible operation, both pipes are to be set up symmetrically.

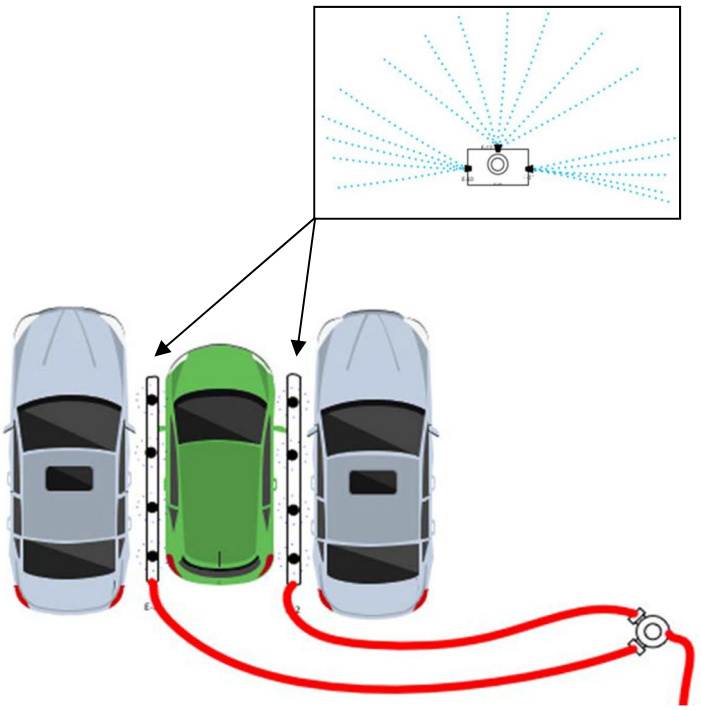

Figure 1 Basic idea of the Boundary Cooling Device

The Prototype

The prototype of the device was manufactured by FKFS. In order to be able to refine the device and to find out which parameters have the greatest influence on the cooling performance and operability, two variants of the tubes were designed. Figure 2 shows the two manufactured variants of the tube. The "simple" variant shows the basic construction of the tube. The device consists of a 1½" inch tube to which 6 side nozzles are attached that are used to cool the underbody. These nozzles have a spray angle of 60° to distribute the water along the length of the vehicle. To create the water wall, two nozzles (120° spray angle) are mounted vertically on the pipe. The pipe has no side "facing the endangered" vehicle and a Storz C coupling on both sides so that the water supply can be independent of the positioning of the pipes. A simple, square steel profile serves as the stand.

The "enhanced" version has the same structure, but the following adaptations:

- three adjustable lateral nozzles on one side of the pipe to be able to adjust the angle of the nozzles in relation to the ground. (Optimization of the angle possible in further tests).
- use of rubber pads under the stand to prevent slipping on the steel deck.
- reduction of the height between the pipe and the support.

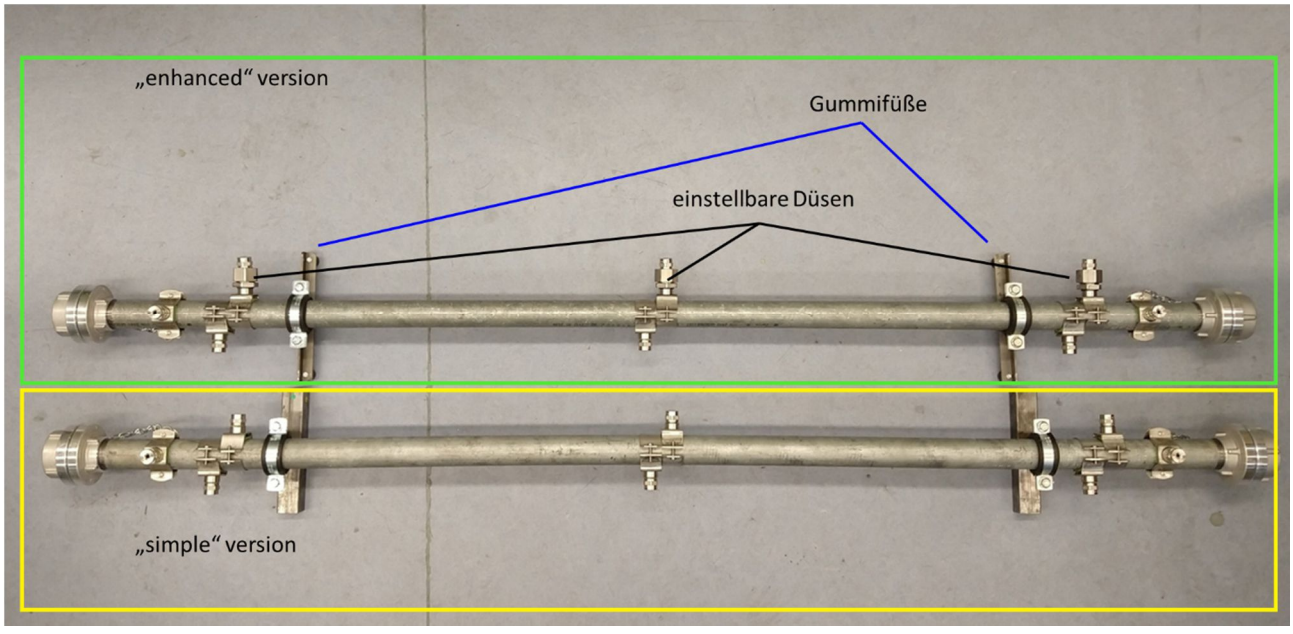

Figure 2 Prototype of the Boundary Cooling Device

First functional test

A short function test was carried out to check the basic function of the device. During this test, the function of the nozzles as well as the tightness and functionality were checked up to a water pressure of 5.5 bar. Figure 3 shows the "simple" version during the function test. It can be seen that the nozzles function as intended and that no unintentional leakage occurs.

Figure 3 Functional test of the Boundary Cooling Device

Handling Test at Sweden (cooperation with LASH FIRE Project)

In cooperation with the LASH FIRE project, the Boundary Cooling Device was sent to Sandö in Sweden for handling tests. There, as part of the LASH FIRE project, handling tests were carried out on various extinguishing devices for cooling and containing fires on alternatively powered vehicles.

At the time of writing, the final report of the tests performed has not been completed yet, so only preliminary information can be presented here.

Figure 4 Positioning of a pipe (Handling Tests)

Figure 4 shows the handling of a pipe of the boundary cooling device during the tests. It can be seen that the positioning can be done by one person.

Figure 5 shows the boundary cooling device in operation. The tests were carried out in a building with ceiling and walls in the area of the three positioned vehicles. A propane gas flame burned on the engine hub of the middle vehicle, representing the damaged vehicle.

Figure 5 Boundary Cooling Device in operation (Handling Tests)

It can be seen that the pipes bring a large amount of water under the vehicles as intended. The vertical nozzles create a wall of water between the damaged vehicle and the vehicles to be protected to prevent the fire from spreading.

This test series led to the following findings:

- the device is still too heavy
- the device is unhandy due to its length (transport and stowage)
- the device distributes the water between and under the vehicles as planned

Summary

The designed boundary cooling device works as expected, but offers further potential for optimization. For example, the water distribution under the vehicle could be investigated in more detail depending on the distance between the vehicle underbody and the ground as well as the distance between the vehicle and the pipe. Likewise, issues such as material (steel aluminum) and positioning aids (e.g. rollers) could still be optimized to improve manageability. Additionally the effectiveness of the cooling should be checked in a suitable test.