Pressure Boosters in Hydraulic Systems – A Solution Which Is Often Overlooked

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In the leading industrial countries such as Germany, the USA and Japan, money, space and weight are saved by incorporating pressure boosters in hydraulic systems.

The company miniBOOSTER Hydraulics A/S specialises in the production of the miniBOOSTERTM hydraulic pressure booster.

As much as 95% of production goes to export markets, where the pressure booster is used widely in many different types of machines and systems.

High Pressure
In hydraulic systems, it is often necessary to use varying operating pressures. A system which works perfectly with a high rate of efficiency can be achieved only if it is possible to adjust the pressure precisely to the load in question.

You often see systems in which most of the pump station oil flow passes through a pressure relief valve which is set to an unnecessarily high pressure. This is because, for a short time, there is a need for high pressure at a certain time in the cycle of the machine in question. The rate of efficiency of such systems is very low, and the integrated components are subject to a high level of wear because the pressure drop creates a high surface pressure between the moving parts.

In order to counter this problem, a system is often constructed from several pumps which are connected in such a way that the volume flow delivered depends on the operating pressure in question. In a large system, the pump may have a variable displacement, and its regulator is then able to operate at several different operating pressures.

However, in many machines, the high pressure is only required for a very short interval of the machine’s cycle. This is the case, for example, in all machines used for compression tasks. In these machines, a large part of the energy is used to move tools, mould plates or press plates and only a small part for the pressing operation itself because this does not involve any movement, just compression of the oil in the cylinder.

The Pressure Booster Offers Several Advantages
Using pressure boosters, designers have greater flexibility with regard to choice of operating pressure. The hydraulic load becomes more uniform throughout the machine’s cycle. The pressure booster starts to work only when there is a need for a high pressure. The rest of the time it is passive, has no internal consumption and thus does not influence the performance of the system.

The use of pressure boosters offers a number of advantages over traditional high-pressure and low-pressure systems:

- Higher performance and longer life on account of a lower operating pressure
- More compact system
- Greater safety due to lower pressure in general
- Integrated valves
- No dynamic seals
- Intensification ratio adapted to requirements

How the Pressure Booster Works
Figure 1 shows a schematic diagram of a pressure booster.

![Figure 1. Schematic diagram of pressure booster](image_url)

All the company’s pressure boosters are of the oscillating type. They increase a supplied hydraulic pressure to a higher end pressure. When oil is supplied, the pressure booster automatically starts to work to build up the required end pressure. When the required end pressure has been achieved, the pressure booster stops and will only work to maintain the end pressure, for example to compensate for consumption or any leak. The pressure booster works according to a patented system.

The oil is supplied to the IN port and passes through the check valves KV1, KV2 and DV (option) to the high-pressure side. At the same time, the R port is connected to the tank. Now the entire flow of the pump will pass straight through the miniBOOSTER, and a cylinder on the high-pressure side H will move rapidly forwards. When the pressure rises on the high-pressure side, KV2 and DV close, and the oil will now fill Vol. 1. In Fig. 1, Vol. 2 is connected via the bistable valve BV1 to Vol. 3, which is connected to the tank. The pressure build-up in Vol. 1 causes the pistons HP and LP to move up.

When the high-pressure piston HP passes Pilot string 1, the latter is pressurised, and BV1 changes position. This occurs because the area above BV1 is greater than the area below it, where Pilot string 2 is constantly pressurised. Vol. 2 is thus connected to the pump, and the pistons LP and HP move up as the area below LP is greater than the area above HP. The oil in Vol. 1 is led to the high-pressure side. When the opposite end of HP passes Pilot string 1 (as shown in Fig. 1), the latter is depressurised, and BV1 returns to its original position. This continues until the pressure on the high-pressure side has increased by a factor equivalent to the ratio between the areas of LP and HP. If the pressure on the high-pressure side falls, a new cycle starts automatically.
Pressure can be relieved from the high-pressure side by leading the pump flow into the R port and connecting the IN port to the tank. Pilot string 3 is thus pressurised and DV opens. The oil from the high-pressure side is now led directly back to the tank through DV and the IN port.

Figure 2 shows a typical course of the relation between the pressure and the volume flow in port H, when the pressure in the IN port can be maximum 150 bar and the load on the high-pressure port goes from zero to 480 bar. The pressure booster in the example has an intensification ratio of 1:3.2.

If the cylinder has to move forwards at a higher speed than the volume flow through the pressure booster allows, the integrated pilot-operated check valve can be replaced with an external valve.

In systems in which the pump is dimensioned not only to operate a single cylinder, as shown in Figure 3, but must also supply a number of other consumers, the volume flow supplied can increase the pressure booster's operating frequency to a level at which its life will be reduced. In such systems, it would be a good idea to place a throttle valve before the pressure booster.

A particularly well-suited area of application for the pressure booster is in existing systems where there is a need for a higher pressure than the original design allows. The costs of expanding such a system in the traditional fashion to achieve a higher pressure are generally very high and involve a lot of trouble. With the pressure booster, an existing system can be upgraded to the increased operating pressure just by integrating a booster. The necessary volume flow must, of course, be available.

Examples of Use
Since the pressure booster came onto the market, it has been used in a large number of systems. The list below gives an idea of its versatility and shows its typical areas of application:

- Hydraulic clamping tools
- Maintenance equipment for railways
- Injection moulding machines: locking of mould parts, core holders
- Hydraulic tools of various kinds, for example: cutting, spreading and clamping tools
- Torque wrenches, bolt drawers, etc.
- Rotating couplings for lathes
- Test equipment up to 3000 bar
- Fork turners on trucks
- Concrete crushers
- Offshore: wellhead control panels (WCW, MCW, SSSV), blowout preventors
- Hydraulic tools on ROVs (Remotely Operated Vehicles)
- Power packs
- Filter presses

Fig. 4 shows a diagram from Danfoss A/S of hydraulic clamping in a STAMA processing machine. 2 miniBOOSTERs with intensification ratio 4:1 are mounted directly in the tool on a clamping plate each. With the existing hydraulic system pressure of 40 bar, the necessary pressure of 160 bar is achieved in the clamping tool. Figure 5 shows the actual structure of the system.
Type | Properties
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HC1 | The most compact miniBOOSTER with very small dimensions and low weight.
HC2 | Standard miniBOOSTER for most retaining and clamping tool applications.
HC3 | Version of the HC2 miniBOOSTER for NG6 integration.
HC4 | Outlet flow up to 5 l/min for applications where more flow is required at higher pressure.
HC5 | Double miniBOOSTER with 2 high-pressure outlets.
HC6 | Outlet flow up to 11 l/min for applications where more flow is required at higher pressure.
HC8 | Version of the HC2 miniBOOSTER developed for outlet pressure up to 2000 bar. (3000 bar on request)

All pressures up to 2000 bar (higher pressure on request) can be achieved from all low-pressure hydraulic units, for example the hydraulic system on a processing machine or a vehicle.

The miniBOOSTER™ is available with up to 11 different intensification factors.

The compact design of the miniBOOSTER™ means that it can be installed precisely where the high pressure is required. It requires a minimum of space and is easy to integrate in both existing and new systems.

Lower system pressure means reduced energy consumption and thus lower production costs.

**International Success and New Name**

The success achieved on the international market has meant that the company has found it sensible to change its former name, Iversen Hydraulics ApS, to the more international sounding miniBOOSTER Hydraulics A/S.

When you look at miniBOOSTER Hydraulics A/S’ list of references, containing the names of all motor vehicle manufacturers and producers of processing machines throughout the world, it is easy to understand this name change.