SAUER DANFOSS

the circuit

Inside

Technology on the cutting edge

The new Sauer-Danfoss Integrated Brake Function meets the high-performing needs of CNH combines | page 4

SAUER-DANFOSS NEWS MAGAZINE ISSUE NO. 4 OCTOBER 2004

the circuit

Stay in touch

Open communication with our customers is a key commitment for us at Sauer-Danfoss. So it is with great pleasure that we now bring our customer newsletter, The Circuit, to the North American market.

The Circuit was launched in 2003 in Europe, where it has proven a successful vehicle for communicating about new product launches, the systems we develop for specific applications, the customers that use them and the technological developments we see emerging in the future. Published twice a year, the newsletter is also intended to tell you more about us - the company behind the Sauer-Danfoss name.

On these pages, you will be able to read about the many, very special ways in which mobile hydraulic technology can be put to cost-effective use. Even projects for some of the smallest niche markets can inspire global developments in the mobile hydraulic field. And that's worth knowing about.
We hope you will enjoy reading The Circuit.

Kells Hall
Vice President Sales & Marketing Americas

Power to

Sauer-Danfoss works with marine power supplier Mercury to bring hydraulic power steering to the waves

The world's first fully integrated outboard hydraulic steering system is on the market. And it comes complete with a specially designed mini-steering unit supplied by Sauer-Danfoss.

Designed and manufactured by US-based Mercury, the leading supplier of marine power, the new Verado system is marketed as "the end of compromise" for speedboat owners, giving them everything they ever wanted in one package – including unrivalled power and acceleration, unparalleled sound quality and, for the first time, hydraulic power steering.

Steering unit type	OSPM ON				OSPM PB		
DP* cm^3/rev [in^3/rev]	32 [1.95]		40 [2.44]	50 [3.05]	63 [3.84]	80 [4.88]	100 [6.10]
RV** bar [psi]	75 [1087]	80 [1160]	90 [1305]	100 [1450]	110 [1595]	125 [1812]	no relief valve
Shock valve bar [psi]	130 [1885]	140 [2030]	150 [2175]	160 [2320]	170 [2610]	185 [2683]	no shock valves
Check valve in P-line		Yes			No		

DP* = Displacement. RV** = Pilot pressure relief valve

part the waves

The launch of Verado also marks a first for the Sauer-Danfoss OSPM mini-steering unit, which has never before been used for a water-based application. Before Mercury made the final decision to use the unit, Sauer-Danfoss entered a development project with the company to prove the OSPM was the right choice for the job.

"One of the big challenges for us was to ensure the OSPM we supplied could resist corrosion," says technical sales support engineer Bjarne Schmidt. "To guarantee that, the OSPM and the OTPM steering column we supply with it are treated with a special coating."

Easy and responsive

The OSPM steering system works with a hydraulic pump, delivering a precise oil flow for easy and responsive power steering - just as it has been successfully doing in tractors, mowers, forklift trucks and other vehicles since 1995. The exceptionally low input torque far outshines that of conventional hydraulic systems, which call for considerable muscle power when turning the steering wheel.

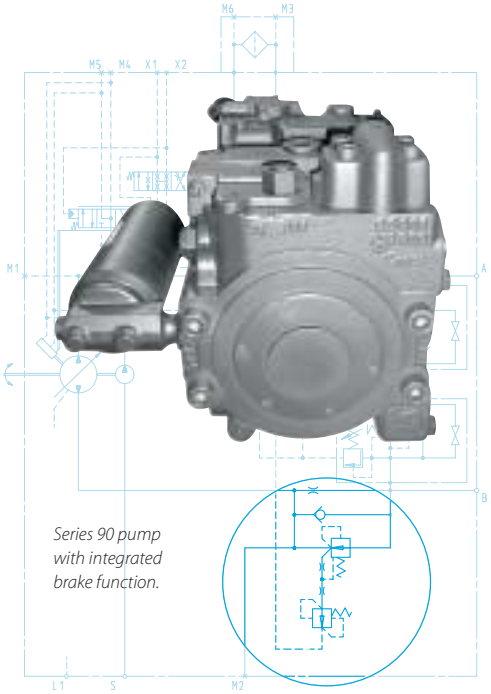
"The OSPM makes it possible to turn sharp angles faster, more easily and at top speed," says Bjarne Schmidt.

Sauer-Danfoss currently supplies Mercury with 10 variants of the lightweight and compact mini-steering unit, using 40cm^3 and 50cm^3 displacements with a maximum pressure load of 125 bars. The unit is connected to the steering wheel via the tiltable OTPM steering column, which may be integrated in the unit as needed. Variable angle options allow the steering wheel to be positioned as required for optimum driver comfort.

High potential

Mercury expects great things of its new Verado system, and Sauer-Danfoss anticipates significant growth in the number of mini-steering units it will supply over the next four years. The very positive response from the marine power market so far suggests the newest application for the OSPM has only just begun to show its potential.

Article 1. *For further information: TheCircuit@Sauer-Danfoss.com*



Series 90 pump with integrated brake function.

A world-leading manufacturer of agricultural machinery, including the global New Holland and Case IH brands, CNH demands great things of its hydraulic system supplier. Sauer-Danfoss lives up to expectations, most recently with the integrated brake function for combine harvesters and a new feeder drive stop block for forage harvesters.

Economical, lighter and more compact, a turbo-charged seven-liter diesel engine is infinitely preferable to a traditional 10-liter engine used on large agricultural machinery in Europe. But one major drawback is the danger of excessive RPMs due to reduced braking capability.

CNH became aware of the problem when designing its new generation of combine harvesters and contacted Sauer-Danfoss, already the supplier of the hydrostatic propel drive and steering unit, for a solution. The Sauer-Danfoss Integrated Brake Function (IBF) was soon in development.

The problem of excessive engine RPM is a direct result of the limited braking torque of turbo-charged diesel engines when used in heavy machinery. As braking capability is dependent on the volume of the engine, a reduction in engine size from 10 to seven liters has an impact. With excessive RPMs comes the risk of expensive damage to the diesel engine and other attached components.

Farming

with smarter functions

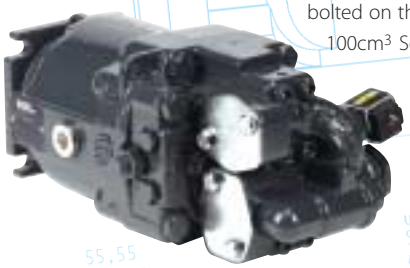
Full braking power

The IBF is designed for use with Sauer-Danfoss Series 90 pumps. Comprised of a check valve, orifice and pilot-operated, pressure-reducing valve, it draws on the diesel engine's full braking power in every situation. This optimum performance is secured by the closure of the pressure-reducing valve at a braking pressure of about 200 bars, equivalent to the diesel engine's braking capability. At the same time, the maximum braking pressure of 450 bars is maintained across the motor. This not only prevents overheating of the hydraulic circuit but also eliminates the need for additional service brakes.

Today, CNH has successfully implemented the IBF on its combine harvesters. The solution is also broadly suitable for many other types of heavy-duty machinery.

Function integration

After more than 30 years of working with CNH, Sauer-Danfoss is well versed in the hydraulic needs of all the group's agricultural machinery. That includes the New Holland and Case IH ranges of forage harvesters, which are now equipped with a hydrostatic feeder drive stop block (FDSB) that combines a number of functions for improved flexibility, performance and a longer working life.

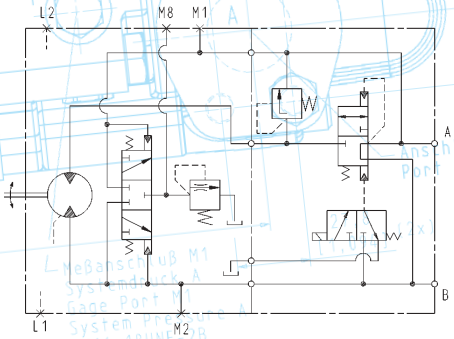


The FDSB enables machine operators to vary the speed of the feed rolls, and hence the cut length of forage, instantly and effortlessly from the cabin. An emergency stop function also brings the feeder to a halt in under 20 milliseconds if metal is detected in the crop - for example, a small piece of fence wire is enough to cause severe damage to the knives if allowed to enter the cutter drum. For cleaning purposes, the FDSB has a reverse function for easy removal of foreign objects or forage that has become stuck between the feed rolls.

The FDSB is constructed as a manifold, comprised of a solenoid pilot valve, a stop valve with a bypass function and a pressure relief valve, which is bolted on the endcap of 75cm³ and 100cm³ Series 90 motors. If metal is detected, the solenoid pilot valve closes the outlet port of the hydraulic motor, while the stop valve prevents cavitation by maintaining oil flow to the pump. The relief valve guards against excessive pressure build up while the motor is shut off.

Altogether, the FDSB represents a compact and cost-efficient combination of functions on New Holland and Case IH forage harvesters. And that means fewer components and reduced maintenance requirements - responding to two more of today's popular market trends.

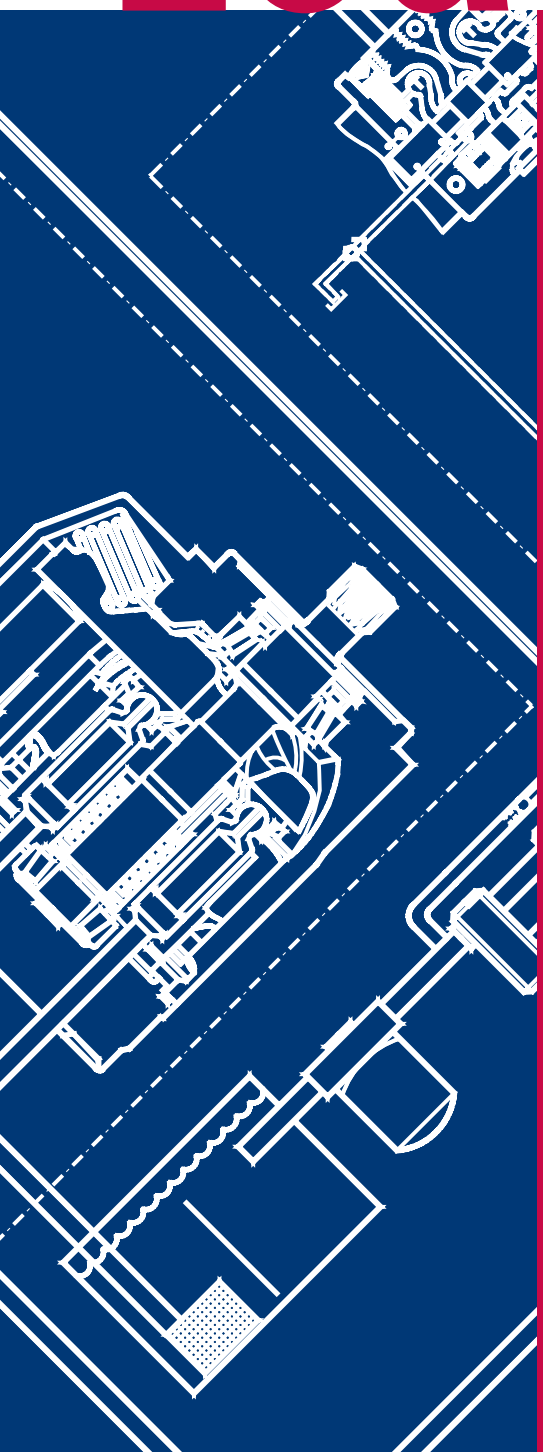
A global company committed to meeting global needs, CNH is fulfilling its mission with the new generation of combine harvesters and forage harvesters - supported by Sauer-Danfoss hydraulic systems all the way.



Series 90 motor with feeder drive stop block.

Article 2. *For further information: TheCircuit@Sauer-Danfoss.com*

Loads of goo



The principle of using one variable pump to distribute oil flow to several hydraulic functions appeared with the first hydraulic load-sensing systems in the 1970s. Since then, technological developments have refined and extended the functional opportunities. Sauer-Danfoss supplies complete load-sensing solutions with a full range of performance-optimizing, flexible, energy-saving and noise-reducing benefits.

No matter what the load or how many functions are in operation at the same time, a hydraulic load-sensing (LS) system guarantees consistent, high performance. That's why so many manufacturers of agricultural, construction and material-handling vehicles have already chosen to replace their standard work hydraulics with LS, and why many more are considering a similar move.

Sauer-Danfoss has long since recognized the trend. Load-sensing steering systems, Series 45 open circuit axial piston pumps and the PVG 32 range of proportional valves are key elements in the company's load-sensing package, supplemented by priority valves, hydraulic integrated circuits (HICs) and joysticks.

Competitive issues

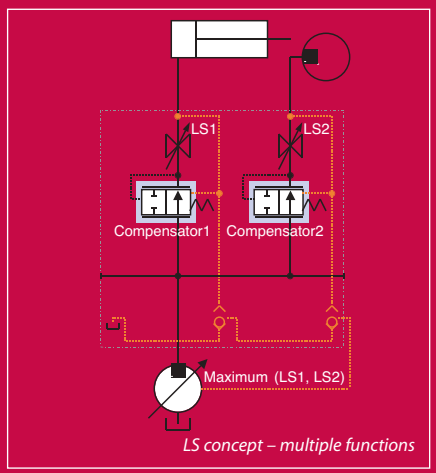
Today, the growing focus on LS has highlighted functional benefits that go beyond the obvious – the sheer practical advantage of using one pump to serve all - and respond to many of the most pressing competitive issues for vehicle manufacturers.

Flexibility is one of them. In vehicles designed for a variety of purposes and working conditions, LS lends itself perfectly to tailor-made solutions. The result is compact, energy-efficient and easy-to-operate vehicles. On top of it all, LS systems are easy to extend with additional functions.

Controlled performance

PVG 32 proportional valves are built together to ensure high performance in relation to a variety of lifting and rotating functions. In some cases, PVG 32 valves and HIC blocks are combined – the aim being to secure an optimum solution for each individual machine.

Performance relies on the individual load-sensing signals, which can control single compensators. The highest of these signals is transmitted to a variable pump via a hydraulic connection. Informed of the load, the pump then supplies the pressure required for all functions, plus a little extra to allow for natural loss. Low-noise and compact, Series 45 pumps are designed to work with PVG 32 valves in such highly responsive LS systems.



LS concept – multiple functions

Compared to traditional hydraulic systems, the simultaneous operation of functions is

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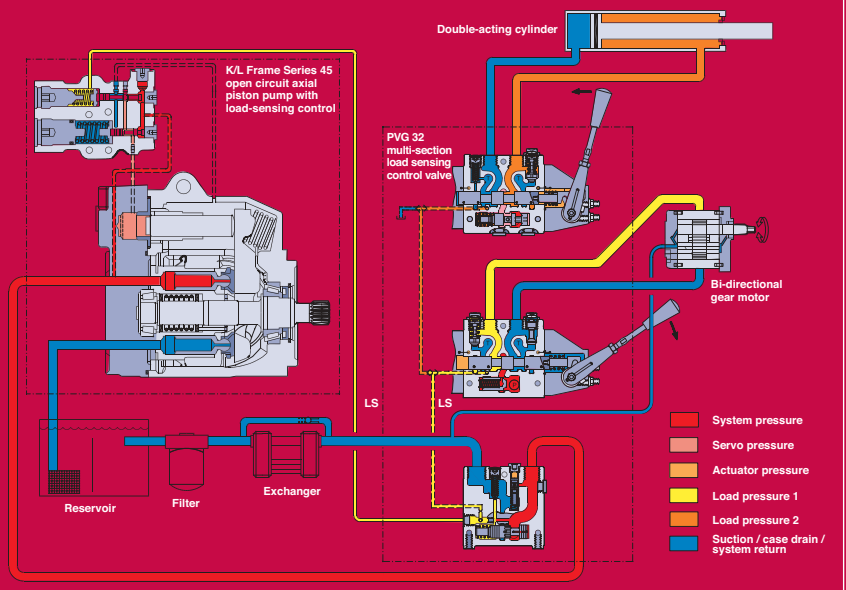


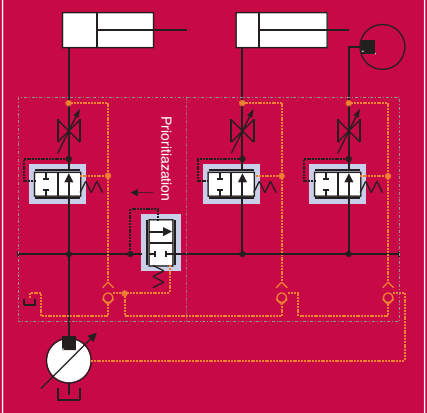
Sauer-Danfoss basic LS system

improved due to the close match between pressure supplied and pressure required. At the same time, a minimum of excess flow is returned to the tank, and loss of fluid is significantly reduced. This, in turn, creates less heat and reduces the need for cooling capacity - again saving space in the vehicle construction.

Meeting greater needs

A large number of work functions may exceed the ability of the pump to provide sufficient oil flow to all functions simultaneously. Because of this, the installation of a priority valve may be the solution, giving highest priority to selected functions while borrowing from others.

But there are still occasions where a variety of functions on one vehicle can detract from its energy-efficient performance, particularly when the functions have widely differing pressure requirements. In reality, the ultimate energy efficiency can only be obtained by installing a separate variable pump for each function, but the extra cost of doing so will often outweigh the performance improvement.

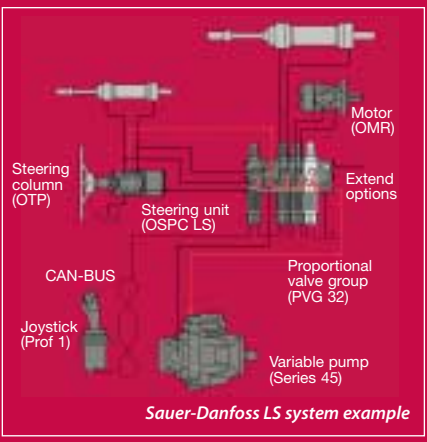


LS concept with priority

A compromise solution is the best alternative. By grouping the work functions according to their pressure needs, it is often possible to achieve optimal efficiency using one variable pump to serve each group. For the vehicle driver, operating the work functions is still as easy as ever, a Sauer-Danfoss joystick enabling control of most functions with one hand.

Responsive steering

In addition to meeting the pressure needs of the work functions, the pump can also supply a LS steering unit. Sauer-Danfoss has three standard LS units in its range: OSP LS Static, OSP LS Dynamic and OSPF LS Dynamic. As with the work functions, the steering unit sends a load-sensing signal to a priority valve and the pump, which then controls the oil flow. Drivers benefit from light and highly responsive steering.



Sauer-Danfoss LS system example

Technological developments within LS are ongoing. Today, the load-sensing signal is sensed by a hydraulic line. Sauer-Danfoss is looking to a future when LS will be synonymous with intelligent systems that adapt vehicle performance automatically to working conditions.

Performance under pressure

Sauer-Danfoss presents a new orbital motor that proves size isn't everything

Small- and medium-sized vehicles can be fitted for big, heavy-duty challenges with the new TMK motor from Sauer-Danfoss. High performance, a long life and a flexible design make the TMK a prime addition to the now complete range of Sauer-Danfoss orbital motors.

The TMK motor has been designed for vehicles with a total weight of 1000kg and above. Like all Sauer-Danfoss motors, it includes a wheel version - the TMKW– with a recessed mounting flange, making it possible to attach a wheel hub so the radial load lies between the two motor bearings. This light and compact solution achieves optimum utilization of the bearing capacity and a longer bearing lifetime.

The new TMK is ideal for a number of applications, including lawn and turf mowers, multi-purpose vehicles, scissor lifts, skid steer loaders and road rollers - an important supplement to the Sauer-Danfoss TMT motor introduced in 1999 to meet increasing demands on motor performance, especially higher pressure levels.

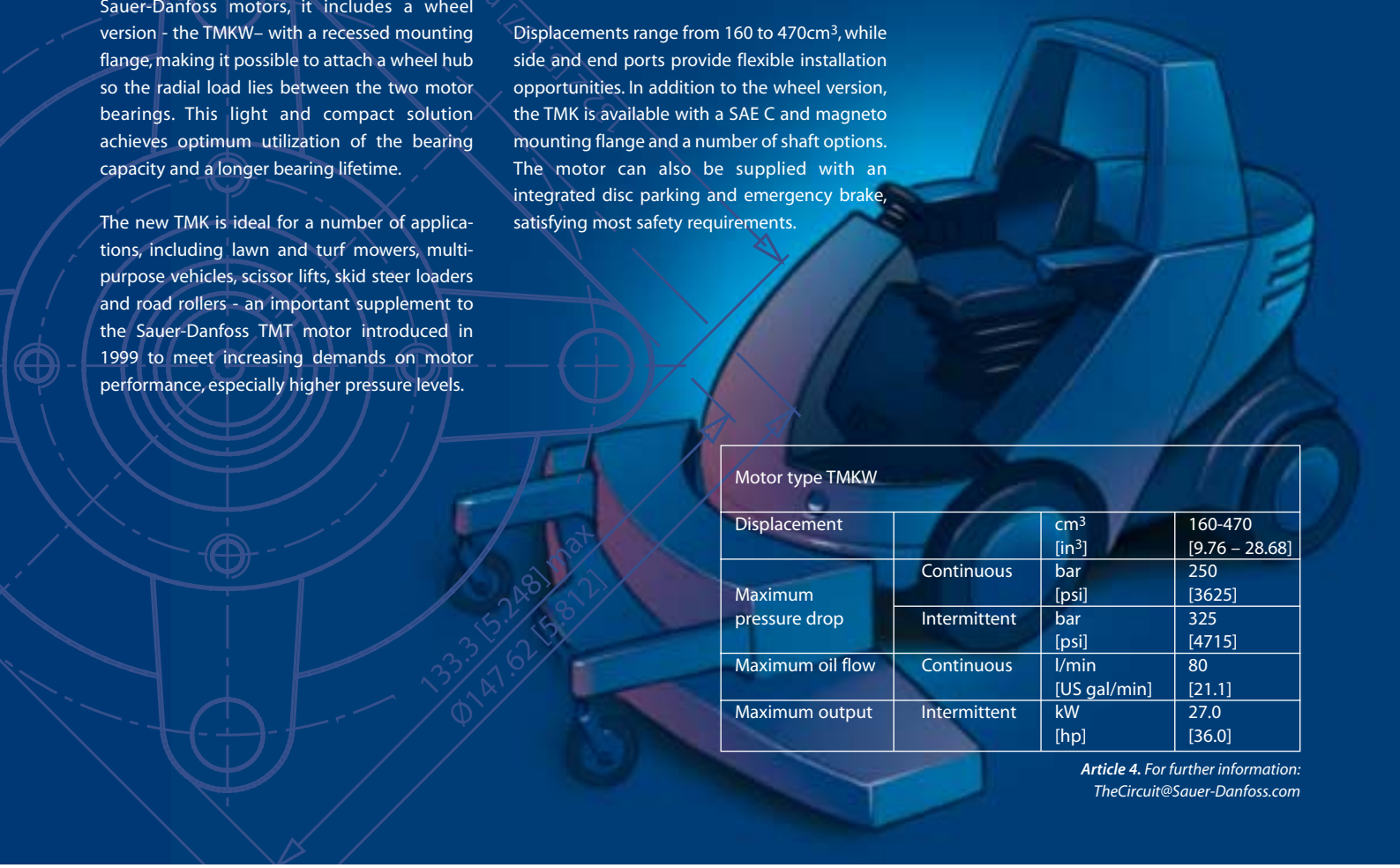
Higher performance

All the know-how associated with the original TMT motor for larger applications is present in the TMK. For small- and medium-sized vehicles, it provides the benefits of a high-performance motor with a long lifespan at pressures of up to 325 bar. Thanks to the design focus on efficiency, vehicle manufacturers will see a reduction in the combustion engine's fuel consumption and emissions. High-starting torque further contributes to the motor's suitability for rough and hilly terrain.

Displacements range from 160 to 470cm^3, while side and end ports provide flexible installation opportunities. In addition to the wheel version, the TMK is available with a SAE C and magneto mounting flange and a number of shaft options. The motor can also be supplied with an integrated disc parking and emergency brake, satisfying most safety requirements.

More range improvements

Along with the development of the TMK, Sauer-Danfoss has introduced a series of new features to other members of the wheel motor range. The OMEW has gained a specially designed gearwheel set for improved low-speed performance, and the OMSW is now available in a new end-port version. Both can be fitted with an external drum brake – another improvement designed to keep Sauer-Danfoss motors in the market spotlight.



Motor type TMKW			
Displacement		cm^3 [in^3]	160-470 [9.76 – 28.68]
Maximum pressure drop	Continuous	bar [psi]	250 [3625]
	Intermittent	bar [psi]	325 [4715]
Maximum oil flow	Continuous	l/min [US gal/min]	80 [21.1]
Maximum output	Intermittent	kW [hp]	27.0 [36.0]

Article 4. *For further information: TheCircuit@Sauer-Danfoss.com*

PLUS 1 by SAUER-DANFOSS

Strong guide to clever controls

A number of OEM manufacturers are already finding out you don't have to be a computer expert to work with the new user-friendly programming tool PLUS 1™ GUIDE from Sauer-Danfoss

Developing fully customized control systems for mobile machinery is a smooth and simple process using the PLUS 1 Graphical User Integrated Development Environment (PLUS 1 GUIDE). Add the fact any necessary adjustments identified during field tests can be made on the spot – and the road to efficient performance is paved.

Since the April launch of the PLUS 1 GUIDE, part of the complete PLUS 1 package of microcontrollers, I/O modules and software, Sauer-Danfoss has issued well over 200 licences to OEM manufacturers eager to try out the powerful programming tool. A PLUS 1 GUIDE test kit is also available for download from the company website.

First test

One of the first customers to test a machine – a snowgroomer - with a control system based on the PLUS 1 GUIDE is Hydrolink in Finland.

"The PLUS 1 GUIDE has given us the opportunity to make our own solution according to our own needs," says Hydrolink development manager and joint owner Tore Carlson. "We also see some possibilities to build on the system in the future."

Software library

Using the PLUS 1 GUIDE, individual control functions can be selected from a library of software control objects, eliminating the need to develop software from scratch. A member of the Sauer-Danfoss mobile electronics technical support team, Börje Stensby pinpoints major advantages such as ease of use, speed of development and the ability to combine hydrostatic propel drives with work hydraulics in one system.

"The PLUS 1 GUIDE is a graphical tool which shows the control functions as icons that are connected together. This makes the whole system very visible. To work with it, all you need is a good understanding of how the machine should work," he says.

All in one

The limitless ability of the PLUS 1 GUIDE to bring all the hydraulic functions of a machine together in one system makes it possible to achieve a constant performance, no matter which functions are in operation at the same time. Input and output signals can also be logged for easy and efficient performance monitoring.

"Because the program translates our drawing of the control system, we no longer need an external compiler," says Tore Carlson at Hydrolink. "And we can adjust the control software while testing - even if we're standing in the middle of the Alps. That saves us money and time and gives great flexibility."

Sauer-Danfoss will continuously expand and improve the PLUS 1 GUIDE, issuing new upgrades on a regular basis.

Article 5. *For further information: TheCircuit@Sauer-Danfoss.com*

Hydrolink, Finland

Ready for takeoff

Sauer-Danfoss supplies key components to the world's most powerful airport snow blower with the capacity to clear a 11,483 feet runway in just 15 minutes

Norwegian Øveraasen is clearing the way for minimum delays at airports where heavy snow is a regular problem. The Øveraasen TV-1260 airport snow blower has the capacity to move 10,000 tons of snow an hour from snowbound runways – equivalent to three small cars thrown 197 feet up in the air every second.

Designed to meet the ever-increasing needs of large airports for efficiency and capacity, the 38-ton, 1713 horsepower TV-1260 is the largest, fastest and most powerful machine of its kind on the market - with a hydrostatic transmission system and hydraulic work function supplied by Sauer-Danfoss and a circuit designed by Sauer-Danfoss distributor in Switzerland, Bibus Hydraulik.

"Top speeds of 34-37 mph an hour and the machine size presented a great challenge for the transmission," says Thor Øveraasen, the owner and managing director of Øveraasen. "Depending on whether the task is clearing a narrow strip of snow or compacted snow that is more than 6.5 feet high, the machine has to be able to work at high speed and low traction and vice versa."

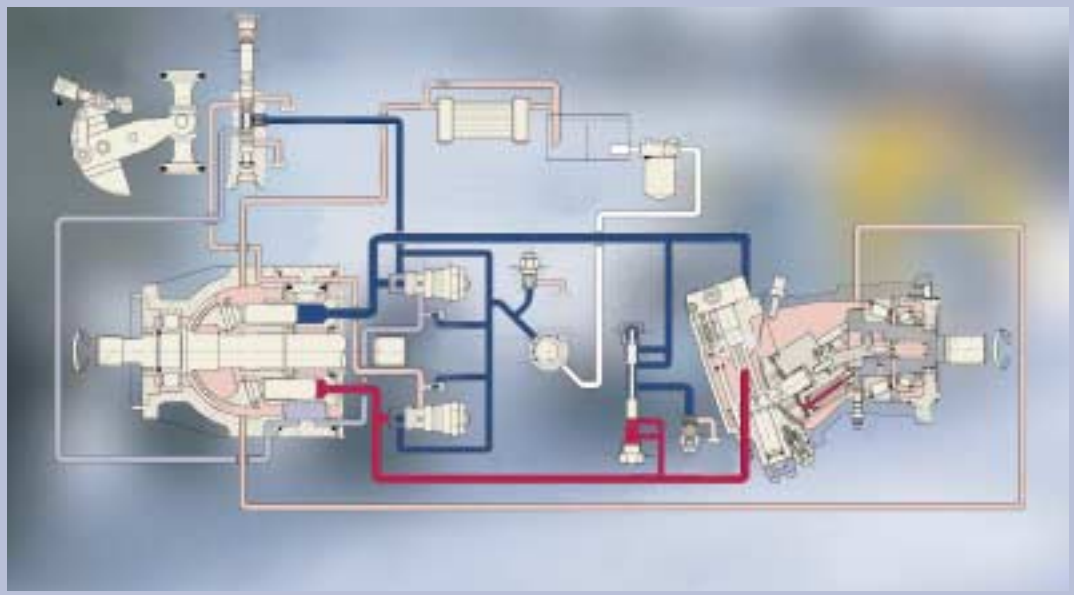
To meet these heavy-duty needs, the TV-1260 has two hydrostatically driven axles on the chassis, enabling four-wheel steering and four-wheel drive. Two 130cm³ Sauer-Danfoss Series 90 variable displacement closed circuit pumps and two 250cm³ Series 51 variable displacement motors drive a mechanical two-step gearbox, catering for low- and high-speed requirements. The entire transmission system is controlled by an electronic microprocessor.

Once the TV-1260 is on the move, two 130cm³ Series 90 pumps in combination with two high torque, low speed motors drive the corkscrew-like auger in the blower head, which can clear snow in strips up to 11.2 feet wide. The work hydraulics, responsible for positioning the auger system, are based on the load-sensing principle with a 57cm³ Series 45 open circuit pump and PVG 32 proportional valve group. A hydrostatically driven cooling system, comprised of a 42cm³ Series 90 variable displacement closed circuit pump and a 42cm³ Series 90 constant motor, protects against overheating.

"The system meets our requirements 100% there are no compromises," says Thor Øveraasen, whose company works closely with large European airports.

The TV-1260 joins the extensive range of Øveraasen snow blowers – all built to withstand extreme weather conditions and all fitted with Sauer-Danfoss hydrostatic transmission systems and maneuver hydraulics.

Article 6. *For further information: TheCircuit@Sauer-Danfoss.com*



Sales are going well for Swedish Lundberg Hymas following the launch of its load-sensing tool carrier, the Lundberg 345 LS, with Sauer-Danfoss hydraulics

Compact answer to a complex need

A new hydraulic system was the only answer for Lundberg Hymas and its popular tool carrier. Growing functional demands and the development of more complex tools set the scene for a major change. So, when Sauer-Danfoss came to present its Series 45 open circuit axial piston pumps for load-sensing systems, owner and managing director of Lundberg Hymas David Gustafsson was open to new ideas.

"It was obvious the technical level of our existing hydraulics did not do the job anymore," says David Gustafsson. "We needed to supply more customer value and performance. Since Sauer-Danfoss is well known and has a complete hydraulic range, it was only natural to contact them."

Sole supplier

Having supplied Lundberg Hymas with steering components for some years, Sauer-Danfoss was appointed sole supplier of hydraulic components for the new-generation machine - comprised of a load-sensing system for the work hydraulics, a hydrostatic transmission system and auxiliary hydraulics. And there was no time to waste.

"As a small company that depends on one product, development projects have to be carried out very fast. If any rumors get to the market that a new Lundberg is on the way, it could stop production of the old model," David Gustafsson explains.

So, while similar development projects for larger companies can take up to a year, Sauer-Danfoss was subject to a considerably shorter deadline.

A five-ton machine with a narrow, compact construction, the Lundberg tool carrier is widely used in the Nordic countries for municipal tasks such as road sweeping, grass cutting and building maintenance. For Sauer-Danfoss, one of the main challenges was to equip the new Lundberg for more complicated functions while maintaining its handy, easily maneuverable size.

The solution involved removing the conventional fixed-displacement pumping system and replacing it with a load-sensing system comprised of a Series 45 open circuit axial piston pump, PVG 32 proportional valves and an OSPC 200 LS dynamic steering unit.

Space and flexibility

"The load-sensing system has enabled us to take away a lot of hydraulic components and hoses, giving us more space in the machine and great flexibility," says David Gustafsson. "It has also increased available flow to the various tools, giving the machine more capacity. The new Lundberg is more cost-effective and has great opportunities for further expansion."

An ergonomic Sauer-Danfoss joystick with a button panel means more functions can be controlled with one hand. Thanks to the optimized hydrostatic transmission, the new Lundberg has also gained improved performance when on the road.

"The modern technology now in the machine and the greater opportunities it provides have put us ahead of our competitors," says David Gustafsson.

Article 7. *For further information: TheCircuit@Sauer-Danfoss.com*

Comatrol adds strength

The full acquisition of the Italian company Comatrol, one of Europe's leading suppliers of hydraulic cartridge valves and manifolds, has enabled Sauer-Danfoss to expand its product portfolio and reinforce its position as a supplier of total system solutions.

Comatrol's well-known products have been integrated in the existing Sauer-Danfoss range. From now on, the hydraulic cartridge valves and manifolds will be marketed under the Sauer-Danfoss name.

Prior to the acquisition, Sauer-Danfoss owned a majority share in Comatrol, which is based in Reggio Emilia. The purchase of the remaining Comatrol shares has added further to Sauer-Danfoss' growing market strength, particularly in Europe.

Customers' opinions count

Approximately 1,000 customers around the globe have expressed their view on Sauer-Danfoss products and services in an online customer perception study.

The study, which is carried out every two or three years, is an important supplement to Sauer-Danfoss' day-to-day contact with customers, reinforcing the company's commitment to open communication. Customer responses also provide valuable input for Sauer-Danfoss' continuous improvement program.

The results of the 2004 study are currently being assessed. **Thank you to the many customers who took part.**

Drop us a line

Don't forget to get in touch if you have any comments or questions about any of the articles published in The Circuit. Just send an e-mail to **thecircuit@sauer-danfoss.com.**

Global focus on quality goals

Quality, its importance and tools for addressing quality issues brought 100 Sauer-Danfoss leaders from around the world together for a quality workshop in Chicago. The aim: To drive Sauer-Danfoss more effectively and efficiently towards its quality objectives.

President and chief executive officer Dave Anderson defined the bare facts behind every company's need for a quality policy: "We are seen by our customers, shareholders and the industry only to be as strong as our weakest link. Our company reputation is defined by our lowest quality product or service."

With this in mind, the workshop participants spent time discussing how to instill a quality mindset in employees right through the Sauer-Danfoss organization. Discussions also covered the consistent and global application of proven quality tools to achieve and maintain common quality goals such as reduced defects per million and improved delivery accuracy.

Executive vice president and chief operating officer Jim Wilcox stressed the ultimate goal: "Through common understanding, common tools and the constant use of common metrics, Sauer-Danfoss will enhance global leadership, organizational alignment and accountability for its quality."

On the road

Sauer-Danfoss will participate in a number of major trade fairs this fall. Catch up with us at:

- HPS Poland, the international fair for hydraulics, pneumatics, control and drives, **October 19-21**, hall 3, stand no. 3028.
- EIMA, Italy, the international fair for agricultural and gardening machine manufacturers, **November 10-14.**
- Bauma 2004, China, the international trade fair for construction machinery, building material machines, construction vehicles and equipment, **November 16-19**, Hall 4, booth No. 4166.

Many customers also met us in August and September at the Oil-Air Product Show and the OPEI Show in the US, METKO in Finland and FTS-Fachtagung in Germany.

the circuit

"The Circuit" is published by Market Communication, Sauer-Danfoss Sales & Marketing, and has a circulation of approximately 12,000 copies in English, German, French and Italian.

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