SAUER DANFOSS

the circuit

Inside

Power, precision, performance

The first Sauer-Danfoss H1 165ccm pumps pumps take on demanding field terrain... | page 4

Lean way to staying competitive
Times have changed since improved quality and productivity were strictly matters for the factory shop floor. Customer demand for better, faster support and proposals – not to mention higher value products – has created an ongoing need to keep all areas of our business finely tuned and operating at an optimum.

At Sauer-Danfoss, we take this challenge seriously. That is why we have now assigned new sales and marketing leaders responsible for managing continuous quality improvements, using Lean principles to maximize the efficiency of all processes that touch our customers. Quoting, technical proposals, customer part number cross-references and product return responsiveness are just some of the improvement areas in focus.

We are convinced that our commitment to the Lean way of thinking is the right way forward for our company – and our customers. From the first customer enquiry to the delivery of the final system, we aim to ensure the fastest possible throughput – by ensuring all our employees fully understand their role and by optimizing the amount of value-added time spent on each step of the process.
Whether assembling pumps, painting motors or creating quotes, staying competitive means staying aware of new improvement opportunities. Our aim is to achieve global alignment of the improvement principles that Lean embraces – providing the same high level of service to our customers all over the world.

Wolfgang P. Weisser
Vice President Sales & Marketing Europe

When heavy

The explosive growth of the Chinese railway network means big business for Kirow Leipzig in Germany, the world's leading supplier of railway cranes and special-purpose transporters. Sauer-Danfoss delivers components for the KSC 900 – a giant span carrier designed to convey 900-tonne [992-US ton] bridge segments for China's new high-speed railways.

Trains will travel at speeds of up to 300km [186 miles] an hour on the new railway covering the 1220km [758 mile] stretch from Wuhan and Guangzhou in China. Every aspect of building a railway to meet such high-speed demands has enormous proportions – including the specially designed span carriers that convey pre-cast bridge segments from the plant to the bridge construction site.

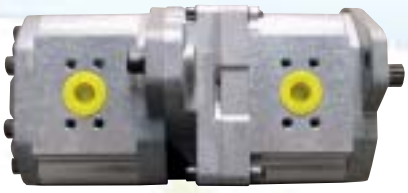
When Kirow Leipzig won its initial order from China's Major Bridge Engineering Corporation for eight KSC 900 span carriers, as with many of Kirow's previous projects, Sauer-Danfoss was part of the development team from the outset.

At 45 meters [147 feet] long and capable of carrying bridge spans from 20.6 to 32.6 meters [67.5 to 107 feet] in length and weighing up to 900 tonnes [992-US ton], the giant transporter has massive power and control requirements. Of the 34 two-wheel bogies that make up most of the KSC 900's length, 12 have hydraulic drives, while another 12 have pneumatic brakes.

duty calls

Flexibility and specific needs

Sauer-Danfoss components are key to the working hydraulics. In the auto-pilot steering system that manages the 34 steered bogies, Sauer-Danfoss' modular load-sensing PVG 32 valves demonstrate their supreme flexibility in meeting highly specific needs. For this, Kirow employs eight groups of PVG 32 valves, divided into four compact sections, plus a single group with two sections. Four more PVG 32 groups in four sections provide the necessary hydraulic flow for the carrier's lifting functions – efficiently accommodating up, down and tilting movements.



In connection with the two eight-cylinder 380kW diesel engines, two Group 3 tandem gear pumps with displacements of 90 and 38cm³ and two gear motors manage the side functions – a combined cooling system that takes care of the cooling water, turbo air and hydraulic oil for each engine. Another 17cm³ [1.04in³] Group 2 pump supplies hydraulic flow to the fan drive system that provides air conditioning in the front cabin. Designed by Sauer-Danfoss for Kirow, the 90cm³ [5.49in³] gear pump is unique on the market.

Kirow delivered the first KSC 900 to its Chinese customer just eight months after the order was placed. Providing fast and professional support and high-quality components, Sauer-Danfoss continues to live up to Kirow's expectations. The KSC 900 is a heavy-duty success.

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

Combine in a

Of all the combine harvesters sold in Europe today, one in every three is produced by Germany-based Claas. The largest Claas combine – the LEXION 600 - has become the first machine to be launched with the new Sauer-Danfoss servo-controlled H1 165ccm pump.

Working relations have been particularly close between Claas and Sauer-Danfoss over the past years. While Claas focused on developing its 32-tonne [35.2 US ton] LEXION 600 combine – among the world's most powerful, Sauer-Danfoss was underway with a whole new range of hydrostatic pumps for the needs of electrohydraulic mobile machinery. Both have come up with sophisticated, forward-thinking solutions that will rise to market challenges for some time to come.

"Claas has been very closely involved in the development and testing of the H1 165ccm pump," says project manager Björn Bullwinkel. "Making the customer part of our development process is very important. It makes finding the optimum solution easier."

H1 propel drive

The compact and highly efficient H1 pump is a central element in the closed circuit propel drive system of the LEXION 600. Other components are a Series 51 bent axis variable displacement motor, microcontroller and control software – all supplied by Sauer-Danfoss. With this system, the LEXION 600 is capable of a top road speed of 30km/h [18.6 miles/h], keeping unproductive transport time to a minimum.

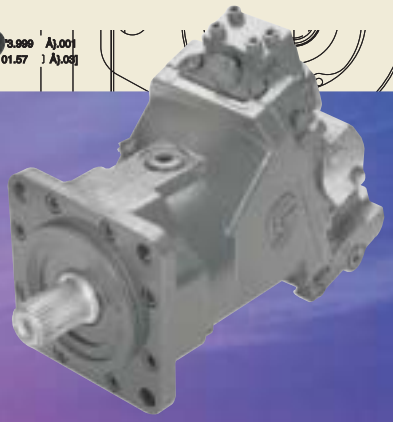
An integrated overspeed protection (ISL) and control override function (COR) are significant safety features of the pump. Guarding against overspeeding in the 16 litre/V8 diesel engine, the ISL function secures a longer, more efficient engine life. The COR is an important feature in meeting international road safety laws. Its role: to put the pump out of action in the event of a controller failure or loss of supply voltage, bringing the machine to a halt in all conditions.

The control software for the propel drive system was specially designed by Sauer-Danfoss for the LEXION 600 and provides valuable advantages both when driving on the road and in the field.

Cutting costs and emissions

Because the pressure in the hydraulic system controls engine speed, it is possible to drive the harvester at a particularly low engine rpm while on the road – saving fuel and cutting noise and emissions. Driving uphill is also no problem as the resulting increase in pressure causes the pump's hydraulic sensors to send signals to the microcontroller requesting more torque. A cruise control feature for field use enables the machine to be set to auto-pilot mode, freeing the driver to focus attention on harvesting performance.

COMPLIANT



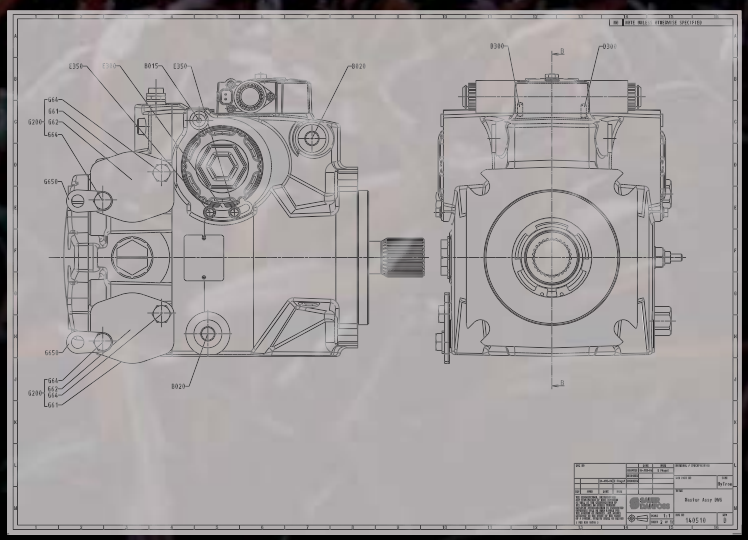
new class

Displacement size 147/165ccm – single pump:						
Feature		**Unit**	**Frame Size**			
			147		**165**	
Input Speed	Minimum	Min^{-1} [rpm]	500			
	Rated		3000			
	Maximum		3100			
System Pressure	Rated	Bar [psi]	450	[6500]	400	[5800]
	Maximum		480	[6960]	430	[6235]
	Minimum low loop		10 [150]			

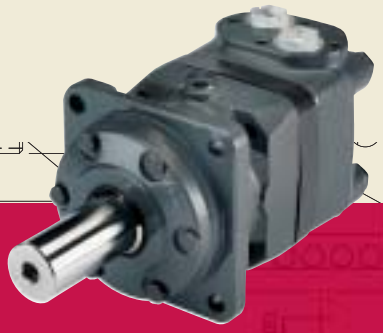
In line with these control functions, the Series 51 motor works with a two-speed gear box, reducing the number of stops and starts for gear-shifting operations. One gear for the road and one for the field make driving the LEXION 600 simplicity itself.

"The system is responsive and has very good control behavior. Due to the ability to drive at low speeds, attaching tools is easily carried out," says Björn Bullwinkel.

As combines get heavier and larger, the H1 pump package gives the power, control and stable hydraulic pressure that demanding work functions require. And this is only the beginning of the H1 story. More additions to the H1 family of pumps and motors are on the way – for simpler, more compact systems that provide increasingly complex functionality.



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



A performance hard to beet

Italian Barigelli has chosen Sauer-Danfoss as the sole supplier of the hydraulic and electronic components on its harvesting machinery. The Barigelli six-row sugar beet harvester is a model of the efficiency and flexibility a Sauer-Danfoss PLUS+1™ system can provide.

Picture courtesy of Gennaio magazine, January 2006

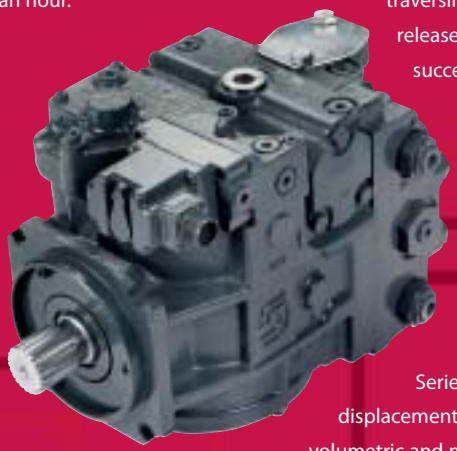
A beet capacity of 18 tonnes, 19.8 US tons [456HP] diesel engine and 12-meter [39-foot] long construction make the Barigelli six-row sugar beet harvester the biggest of its type. The hydraulic system also makes it one of the most powerful with an array of top-tuned work functions for efficient beet harvesting, defoliating and cleaning, covering 1.5 hectares [3.7 acres] an hour.

Comprising a Sauer-Danfoss 250 ccm/rev Series 90 variable piston pump and a Series 51 variable piston motor, the hydrostatic transmission is one of the most well-tried and high-powered solutions on the market. The motor is flanged onto the two-gear box that caters for low-speed fieldwork and a road speed of up to 28km/hour.

A load-sensing PVG 32 valve looks after the autopilot function, monitoring the hydraulic pressure and, consequently, the necessary engine rpm for traversing rough, uneven territory. Operator time is then released for the many work functions involved in a successful beet harvest.

Seamless interface

Eight PLUS+1 microcontrollers, two DP600 graphical color displays with two video cameras and a customized Prof1 joystick are connected in a CAN-Bus network and linked to the electronic microcontroller on the diesel engine. This seamless man-machine interface not only ensures a highly efficient performance but, via the graphical displays, also provides the operator with key engine data such as temperature, oil level, emissions and maintenance needs.



Optimum tool control

Controlled by PLUS+1, the tools remain at an optimum level parallel to the ground at all times, enabling digging to a uniform depth in order to bring the beets to the surface. Large OMS, OMT and OMV orbital motors connected to Series 42 and Series 90 axial piston variable displacement pumps bring high volumetric and mechanical efficiency to the front tool, conveyors, lift, vibration tool and augers.

E1 COMPLIANT

Rolls-Royce

Propulsion at perfect pitch

The marine market is big for Sauer-Danfoss in Norway, and the demands for quality and performance are high - especially when the customer is Rolls-Royce, among the largest international manufacturers of marine technology, products and systems.

Precision, easier regulation and cost efficiency are words that keep cropping up when describing the hydraulics on the Rolls-Royce Kamewa Ulstein™ range of controllable pitch propellers for off-shore vessels.

Sauer-Danfoss has contributed to the design of two compact, integrated solutions that cater for varying propeller needs when accelerating, decelerating or travelling at a constant speed. Both include an HIC block that is conveniently top-mounted on a load-sensing PVG 32 valve group. For higher flow requirements, the larger of the two solutions utilizes the new PVG 100 valve, with a 250-litre [66 US gal] maximum inlet flow, on the inlet-outlet section.

Continuous accuracy

The PVG 32 valves control the propeller pitch with infallible accuracy. Once the propeller is at the required angle, the PVG valves are switched off and the pressure-regulating over-center cartridge valves in the HIC prevent leakage, ensuring the pitch remains precisely angled until a change in the ship's movement calls for its adjustment.

"When the PVG valves are not in use, we can reduce the pressure on the hydraulics and cut fuel consumption. Cargo carriers can then maintain the same pitch for days," says design engineer at Rolls-Royce Marine, Hallstein Lynge. In the case of an electrical actuator failure, a special safety function on the larger solution enables the HIC to shut down the faulty valve section so the propeller can continue running at reduced power.

High pressure needs

With regard to clutch control, the PVG valves keep the clutch pressure above its basic 24-bar [348 psi] requirement, ensuring the valve's load-sensing capability can easily meet higher pressure needs as they arise. The range of spools available for the PVG 100 gives design engineers particularly great flexibility in creating systems that deliver more or less flow.

"PVG valves are effective solutions, and we have had good experiences with them on our other applications," remarks Hallstein Lynge.

Specially redesigned for these two-section pitch control systems, PVG valves have once again proven their strong capabilities within marine propulsion – a top-performing record that suggests this application will not be the last.

For Barigelli, PLUS+1 hardware and compatible components and the icon-based PLUS+1 GUIDE software have brought untold flexibility. Easy to implement and adapt to changing market needs, PLUS+1 gives the Barigelli six-row sugar beet harvester the performance and control that large-scale farmers will soon be unable to live without.

Article 3. *For further information: TheCircuit@Sauer-Danfoss.com*

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

Survival of the toughest

Harsh off-highway environments are no problem for Sauer-Danfoss' new cartridge valve coil. Come rain or shine, sleet or snow, this is a coil built for extremes.

Current Draw at 12VDC & 70°F		
	13 mm	1.31 Amps
	16 mm	1.74 Amps
Environmental Protection	IP69K	
Duty Cycle Rating		100%
Ambient Temperature Rating		-40°F to +160°F
Input Voltage Tolerance		75% to 133%

OEMs can pack away their worries about valve coil failures caused by exposure to excessive voltages, elevated temperatures, water, mud or snow. Sauer-Danfoss has designed a cartridge valve coil that can tolerate every extreme – reducing service needs and increasing the overall lifetime of asphalt machinery, snow plows, salt spreaders and agricultural equipment that is subject to chemical and power wash.

A protective layer of encapsulated plastic surrounded by a solid metal frame is responsible for the coil's high tolerance threshold. When the plastic is applied, a special molding technique prevents moisture build-up. The fact that the metal frame is outside the plastic accounts for the coil's ability to resist the most dramatic temperature changes. Thanks to the high level of chemical and environmental resistance built into the design, previous essentials such as an O-ring seal are rendered unnecessary.

Environmental tests

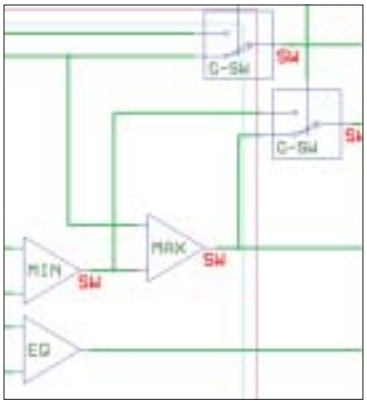
Comprehensive environmental testing has confirmed the coil's outstanding robustness. A high-pressure spray test, shock and vibration test, thermal shock and dunk test, salt fog test, chemical spray test and combined temperature, humidity and voltage test all produced excellent results. The IP69K environmental protection rating complements the -40°-+71°C [-40°-160°F] ambient temperature rating for continuous operation. Input voltage tolerance ranges from 75-133% of nominal.

"In designing this coil, we targeted applications that operate under conditions that are particularly demanding for the components," says product portfolio manager Dave Wohlsdorf. "Our coil may

not be the most noticeable part of an application, but it does a very important job in helping to prevent vehicle down-time and, thereby, saving time and money for OEMs and end-users alike."

The neat, compact coil is smaller than most competing products, making it possible to fit cartridge valves closer together in vehicle HIC blocks and, consequently, reducing installation time and adding design flexibility. Available with a choice of three electrical connectors with optional integral diodes, the coils are color coded for easy voltage identification.

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



Easy guide to flexible controls

Formal training in PLUS+1™ GUIDE is capturing the imagination of Sauer-Danfoss distributors and their customers, who welcome the user-friendly opportunity to program their own control systems for diverse mobile applications.

"We see PLUS+1™ GUIDE as a major driver for increasing our market share in the foreseeable future. A significant number of our people have been through the training. Every one of them has come out adequately trained."

Director of mobile sales at Berendsen Fluid Power in the US, Buck Anthony has only praise for the week-long PLUS+1 GUIDE training run by Sauer-Danfoss in Minneapolis. Just two years after the innovative mobile control package was launched, Berendsen has a team of application specialists dedicated to PLUS+1 system sales. Some of the distributor's customers have also been through the training program.

"For the most part we relied on Sauer-Danfoss to provide software programming in the past," says Buck Anthony. "Now we are more involved in generating application programs because it is so easy to do. Most customers are very happy with the result."

Forward-thinking tool

PLUS+1 GUIDE – or, by its full name, Graphical User Integrated Development Environment – is the powerful programming tool that accompanies the PLUS+1 series of microcontrollers, I/O modules, graphical terminals and joysticks. Together, they make up the most forward-thinking toolbox for custom configuration and precise tuning of work and propel functions.

The built-in flexibility of PLUS+1 GUIDE makes it suitable for all hardware platforms - a benefit that will be increasingly felt as more products within the Sauer-Danfoss portfolio become PLUS+1-compliant. Aided by the user-friendly graphics, application specialists can draw on GUIDE's library

of application-based function blocks to build up almost any control system and give it finely-tuned operating parameters.

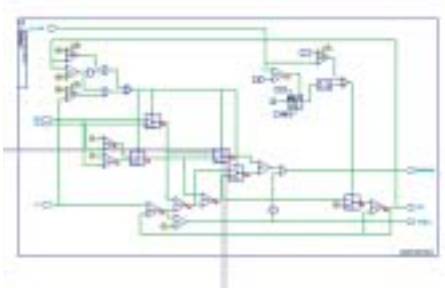
Close customer involvement

At Connecticut-based Hydro Air, president Craig Roser recognizes the tool as a means of giving customer development projects even stronger support. In addition to participating in the training, Hydro Air has made use of the back-up support provided via the Sauer-Danfoss hotline and web-based facilities.

"Sauer-Danfoss provides us with the fundamentals. Help desk support is readily available, and the online videos are a wonderful learning resource and selling tool," says Craig Roser and adds: "Our customers have gained access to a knowledgeable, trained supplier, who can help them conceive of and develop the items they sell. At the same time, they have gained insight into machine control and now save time on control issues."

By offering formal training in PLUS+1 GUIDE, Sauer-Danfoss has put the needs of distributors and their customers firmly in focus. In the US, more than 100 distributor, customer and OEM employees have undergone training so far.

A similar program is underway within the Sauer-Danfoss sales organization in Europe – giving all customers ready access to PLUS+1 and its endless programming flexibility.



TruPath™ gives fine-tuned prizes

GPS turned out to be hot news at Agritechnica in Hanover, where Sauer-Danfoss presented TruPath™ – the world's first fully integrated auto-guidance system for agriculture. And, for the three winners of the TruPath competition, the revolutionary control system has already brought returns.

Phil Brintrup, 16, had not long passed his tractor driving test when he visited the Sauer-Danfoss stand, where the TruPath presentation demonstrated the future for farmers seeking maximum uptime and precision performance.

Another 16-year-old visitor, Toni Gärtner had just started training to be an agricultural machine mechanic.

The third competition winner was a customer representative who also correctly answered the competition questions on the many end-user benefits of TruPath – among them more efficient use of wide tractor implements, increased hours of operation and multiple functions in a single pass. All three won an Apple iPod music player presented by Sauer-Danfoss sales engineers Horst Urban and Burkhard Sauer.

Burkhard Sauer and Toni Gärtner.

Burkhard Sauer and Phil Brintrup.

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

Lean philosophy puts quality first

Implementation of Six Sigma methodology has instigated continued quality improvements at the Sauer-Danfoss plant in Wroclaw, Poland. Production deviations have been reduced and teamwork strengthened – a success story that has now convinced the plant to widen the use of Six Sigma to other areas.

The Polish experience reconfirms Sauer-Danfoss' company-wide commitment to Six Sigma – the data-driven quality measure for eliminating defects. In Wroclaw, process engineers, specialists and managers have been trained as Six Sigma "Black Belts", responsible for initiating and implementing quality improving projects.

Sauer-Danfoss is currently in the process of deploying Lean throughout its global organization – the overall aim being to eliminate waste in every area of the business, including product design, supplier networks and factory management. Progress is followed via measurements of throughput, inventory turns and employee engagement.

Workshops have so far introduced 200 Sauer-Danfoss leaders to the philosophy, and a number of projects are underway. Customers can expect a faster, more efficient response to their needs in the future – and products distinguished by even higher quality standards.

More info on the web

Two new Sauer-Danfoss websites have been launched – a new site for investor relations and another that specifically serves the Asia-Pacific region.

The new investor relations website provides a keen insight into the company's financial affairs and stock exchange status. In addition to information about the board of directors and historical data on share prices and dividend payouts, the website provides an e-mail alert service, informing subscribers when Sauer-Danfoss posts new information on the site.

Sauer-Danfoss' joint venture sales and marketing company, Sauer-Danfoss-Daikin, is behind the new website for the Asia-Pacific region, covering Australia, China, Korea, Singapore and Japan. Information on the website is available in English, Chinese and Japanese.

Office move in Korea

Sauer-Danfoss-Daikin is now serving customers in South Korea from a new representative office in downtown Seoul. The local team covers the entire product portfolio and is responsible for coordinating warehousing and customer service.

The ongoing development of the manufacturing industry has made Korea an important growth market for Sauer-Danfoss. In recent years, many large Korean OEMs have entered the international scene.

Sauer-Danfoss-Daikin has its headquarters in Osaka, Japan, where the joint venture manufacturing company – Daikin-Sauer-Danfoss – is also located.

New ISO stamp of approval

Sauer-Danfoss Slovakia has added its name to the growing number of Sauer-Danfoss plants that have earned a certificate for compliance with the ISO 14001 environment management standard. Joining the plant's ISO 9001:2000 certificate for quality management, the new certificate strongly supports the company strategy to establish one integrated system for quality, environment and safety by 2007.

Member of the global environment, health and safety core team, Egon Hansen congratulated the Slovakian team on their achievement. "We look forward to learning from Slovakia as we move forward in other locations," he added.

Other Sauer-Danfoss locations with ISO 14001 certification include Wroclaw, Poland; Easley, USA; and Nordborg, Denmark. The Sauer-Danfoss sales company in Ganløse, Denmark, has also recently celebrated its newly won ISO 9001:2000 certificate for a well-functioning quality management system.

Exhibition update

Meet up with Sauer-Danfoss representatives at these exhibitions during 2006:

Finland	METKO	Aug. 31-Sept. 2
Norway	Industridagene	Sept. 19-22
Poland	HPS	Oct. 19-21
Italy	EIMA	Nov.15-19
China	Bauma China	Nov. 21-24

the circuit

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