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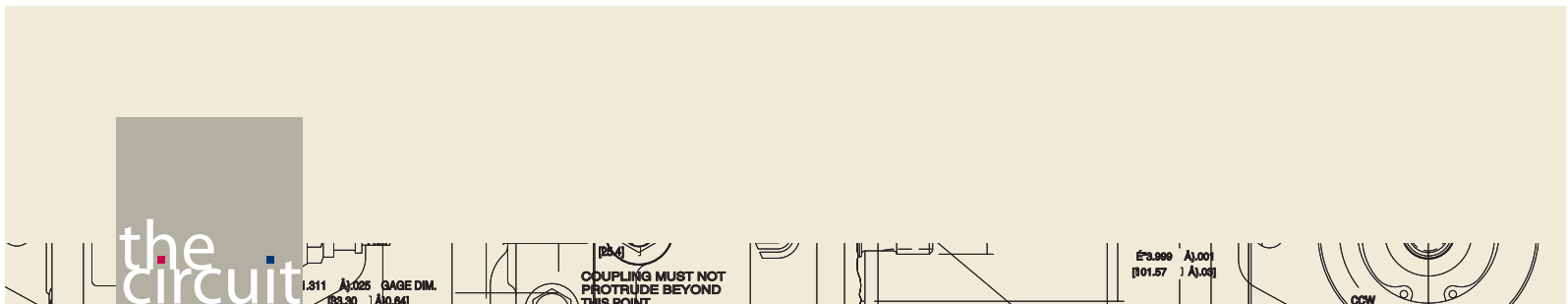
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the circuit

A composite image showing two satellites in space. One satellite is larger with two large solar panel arrays, and the other is smaller. They are positioned over a view of the Earth from space, with the Moon visible in the background. Beams of light from the satellites point towards the Earth's surface.

Steering by satellite

Sauer-Danfoss presents the world's first fully integrated auto-guidance system for agriculture | page 6



Making a high-tech impact

Exciting innovation is a hallmark of the international agricultural machinery show Agritechnica. At the November 2005 event held in Hanover, Germany, we pulled out all the stops to make our name as a leading supplier of hydraulic systems to this increasingly high-powered industry.

As a number of top agricultural suppliers confirm with their latest product launches, the strength of our solutions for infinitely variable transmissions has made a definite impact on the power-split scene. The high-power John Deere 8030 Series and the JCB fast truck, with a top speed that allows motorway driving, were among the big news items at Agritechnica - both featuring our power-split propel technology. Two completely new telehandler models presented by Claas also make use of our 45° kit in a transmission box driven by our H1 pumps.

In addition to their stepless driving possibilities, our power-split solutions secure low fuel consumption and increased power take-off efficiency in tractors up to 300hp. We expect to continue and expand our involvement in the development and application of this technology in the future. On our stand at Agritechnica, we demonstrated another of our forward-thinking developments - TruPath™, the first fully integrated auto-guidance system for tractors. This sophisticated combination of hydraulics and global positioning technology heralds vast improvements in efficiency and increased hours of operation for farmers all over the world.

Our ongoing development efforts have brought us a long way on the tractor market. We remain firmly committed to our goal to become a total system supplier to the tractor industry and the many others where mobile hydraulics perform an essential role.

Tim Hanson
Vice President Sales & Marketing Americas

Harness the

The Massey Ferguson MF 8480 was declared Tractor of the Year 2005 at the EIMA show in Bologna, Italy. Sauer-Danfoss has supplied key components to all four members of the MF 8400 series - today the flagship of the Massey Ferguson brand owned by the US AGCO Corporation.

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



might of variable control

Infinitely variable speed control makes the tractors in the Massey Ferguson MF 8400 series high-power workhorses for any job under any condition. Branded Dyna-VT, the innovative transmission secures the huge outputs necessary for cost-effective operation in intensive fieldwork, all with minimum driver input.

Sauer-Danfoss components have a central function in the Dyna-VT, which breaks the traditional link between engine speed, ground speed and PTO speed. Specially designed 45° piston kits, Series 45 J60 60cc load-sensing piston pumps and a custom-made 19cc gear pump easily satisfy requirements for a flexible operation with high flow. And, as is the norm in Massey Ferguson tractors, the steering unit in the MF 8400 series is also of Sauer-Danfoss design



Automatic drive

Specialist tractor manufacturer Fendt, another arm of the AGCO Corporation to which Massey Ferguson belongs, produces the unique Dyna-VT for the series. Sauer-Danfoss supplies three piston kits – one for the pump and two for the motor – without housing for full integration in the transmission, where they take care of the fully automatic drive function. A microcontroller adjusts the speed within two infinitely variable ranges: 0-28km/hour for field applications and 0-40km/hour for transport applications.

The Sauer-Danfoss Series 45 J60 piston pump, a proven performer in many other mobile hydraulic applications, is a relative newcomer to the tractor world. In the MF 8400 series, it plays a significant role in meeting a widespread demand among farmers for more flow to the auxiliary valve. Capable of maximum available flow of 150 litres/minute (40 gallons/minute), this robust, efficient pump makes it possible to achieve more speed and gain a faster response from the many large and heavy implements used in modern agriculture.

With the priority valve flanged onto its cast iron rear cover, the customized Sauer-Danfoss gear pump provides a two-in-one solution that cuts costs and saves on fittings and connections. From this compact unit, priority flow is distributed to the steering mechanism, the remaining flow going to other tractor functions. A new feature of this Massey Ferguson series is the integration of both the gear pump and piston pump in the oil tank.



Safe, efficient steering

A load-sensing OSPD steering unit with two-gear wheel sets gives large tractors a big safety advantage and accommodates their high power requirements. Should a situation arise where no flow is available from the gear pump, the wheel sets enable manual steering, giving the steering unit a temporary pump function. Another advantage is the load-sensing ability to save power and fuel, drawing only the flow required for steering and releasing more power for other functions.

At EIMA 2004, the Tractor of the Year 2005 award was presented to the largest model in the MF 8400 range – the 290hp rated and 315hp maximum power MF 8480. The Dyna-VT transmission largely responsible for this prestigious accolade is now also a standard feature on Massey Ferguson's entire MF 7400 series, providing even more outstanding performance with Sauer-Danfoss components.

Technical Specifications – Series 45 – J60:

Feature	Unit	Data
Maximum displacement	Cm ³ [in ³]	60 [3.97]
Flow at rated speed (theoretical)	l/min [US gal/min]	156 [41.2]
Input torque at maximum displacement (theoretical)	N-m/bar [lbf-in/1000 psi]	0.956 [583.6]
Input Speed	Min-1 [rpm]	500 [500]
	Continuous	2600 [2600]
	Maximum	3120 [3120]
Working Pressure	Bar [psi]	310 [4495]
	Maximum	400 [5800]

Technical Specifications – OSPD Load Sensing Steering unit:

Feature	Unit	Data
Displacement normal steer	Cm ³ [in ³]	185–440 [11.29 – 26.85]
Rated oil flow	l/min [US gal/min]	19–44 [5.02 – 11.62]
Maximum pressure on connections	P System Pressure T Tank Pressure L.R Shock valves at	210 [3045] 40 [580] 280 [4061]

the
circuit

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PLUS +1™ by SAUER-DANFOSS

Advanced electronic control has come to the South American road-building industry with the new AF 4500 asphalt paver from Ciber. Efficient, low-cost and versatile, the machine's sophisticated control system has been achieved with PLUS+1™ technology from Sauer-Danfoss.

Brazilian Ciber had set its sights on market differentiation when it started developing a low cost, highly mobile paver that would complete its range. Sauer-Danfoss presented its customer with PLUS+1™ and work began on the AF 4500, the South American paver market's most innovative machine yet.

Having relied on Sauer-Danfoss components for many years, Ciber Equipamentos Rodoviaros Ltda – part of the German Wirtgen group – was quick to recognize the potential of its supplier's PLUS+1 microcontrollers and software. Close collaboration between Sauer-Danfoss and Ciber engineers

Streets ahead with urban paving



led to the successful integration of PLUS+1 in a hydraulic system largely based on Sauer-Danfoss pumps, motors and valves.

Fine, accurate control

Two MC50 microcontrollers, the largest in the PLUS+1 range, put the AF 4500 at the top end of available technology. Powered by Digital Signal Processor (DSP) technology, the MC50 secures fine, accurate control of steering, speed, acceleration and deceleration, supported by CAN-based communication, which ensures a fast and reliable flow of data to and from the paver's central components.

The microcontrollers drive two Sauer-Danfoss Series 90 - 55cc pumps with electronic displacement control for the propel and steering systems, with two joysticks for easy and accurate driver operation. For other work functions, the system employs tandem gear pumps, OMT motors and SNM2 gear motors. PVG 32 proportional valves are incorporated in the efficient asphalt delivery system. Overall machine performance is monitored by a DP600 graphical display terminal, which keeps factors such as temperature, speed and driving conditions under constant supervision.

Compact performer

The smooth integration of these PLUS+1-controlled components gives the Ciber AF 4500 exceptional work and propel function, securing outstanding performance for a machine of its size. Due to the high flexibility of the graphical programmable language, Ciber has obtained an expandable platform with great prospects for future improvement. In South America, a new era of urban paving has begun.

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

PLUS+1™
by SAUER-DANFOSS

PLUS+1™
COMPLIANT



Chassis that keep their cool

Leading US manufacturer of premium chassis, Freightliner Custom Chassis Corporation, has chosen Sauer-Danfoss to supply variable, electro-hydraulic power to the fan drive on chassis for motor homes.

On-road vehicles with rear or mid-mounted engines have always had special cooling requirements. Today's tightening emission standards only add to their cooling needs. Top chassis manufacturer with a 50% share of the US diesel motor home market, Freightliner Custom Chassis Corporation looked to Sauer-Danfoss and found the right solution for the job.

Sauer-Danfoss has long led the way on the US hydraulic fan drive market, where the company has a proven track record. For Freightliner, the key priorities were to improve efficiency and tackle the higher temperatures unavoidable in diesel engines designed in response to the US Tier 3 emission standard. Using its new SGM3Y electro-hydraulic proportional fan drive motor combined with a tandem gear pump and microcontroller, Sauer-Danfoss was able to oblige.

The SGM3Y is based on Sauer-Danfoss gear motors and is used on Freightliner chassis with Group 3 motors from 22 to 44cc/rev. The PRV proportional solenoid bypass relief valve, which controls the oil flow through the fan drive motor, is integrated in the rear cover, contributing to the motors' compact design. Following the recent changeover from an alu-

minum to a cast-iron rear cover, the SGM3Y can withstand pressures as high as 200-210 bar – compared to the previous maximum of 170-180 bar – and, consequently, provide higher fan speeds for even greater cooling efficiency.

The motor provides continuously variable control of the fan speed in response to the engine temperature data sent from the vehicle's engine control module to the microcontroller. Thanks to this precise electronic modulation, the fan drive may only need to run at full power for a fraction of the operating time – saving power and improving fuel economy. The hydraulic flow to the fan drive is supplied by the tandem gear pump which, with its integrated priority valve, also supplies flow to the steering unit.

Sauer-Danfoss' fan drive solution accompanies a range of other advanced components on Freightliner motor home chassis, which are known for their high maneuverability, reliability and exceptional workmanship. A division of DaimlerChrysler, the world's largest commercial vehicle manufacturer, Freightliner has a reputation for delivering the best. By choosing Sauer-Danfoss, that reputation is safe.

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



TruPath™ – the world's first fully integrated auto-guidance system for agriculture – was presented by Sauer-Danfoss at Agritechnica in November. More efficient use of wide tractor implements, increased hours of tractor operation and multiple functions in a single pass are just some of the benefits that will make TruPath a valuable future aid to efficient, high-tech farming.

Auto-guidance systems for tractors are fast becoming the future for farmers seeking maximum uptime and precision performance in the field. TruPath is set to be the first fully integrated system of its kind – a fact that not only makes it a smaller investment than competitor systems sold as add-on equipment, but also highlights the optimized combination of global positioning technology and hydraulics behind its development.

TruPath was created by TSD Integrated Controls, a joint venture established in 2001 between Sauer-Danfoss and Topcon Positioning Systems. Until now, TSD Integrated Controls has made its name in GPS automated control systems for the road-building and construction industries. But the growing demand for GPS auto-steering in farming has encouraged the company to broaden its area of focus.

Tom Rudolph, product portfolio manager for Sauer-Danfoss steering, praises the joint venture that has made the development of TruPath possible. "Sauer-Danfoss has worked with elec-

tro-hydraulic steering components for auto-steering for several years. The TSD joint venture brings together experts from the hydraulic world with experts from the GPS world – forming the world's first fully integrated auto-steering system for agriculture OEMs, all the way from the GPS receiver to the controlled wheels. The system will be sold through the established Sauer-Danfoss global sales organization."

Repeatable performance

Michael Gomes, project manager for TruPath, explains, "The trends within the tractor industry have inspired the development of this pioneering integrated system. For example, tractors are getting larger, have higher horsepower and have to manage larger areas. There is also a need to increase hours of operation in the tight time windows of the spring and autumn seasons," he says. "Using GPS for auto-steering gives precise, repeatable performances day and night. All operators have to do is plot two points to make a line and the system will steer that line, whether it is straight, curved or on a centre pivot."


Fitted on the roof of a tractor, TruPath comprises a satellite receiver with a built-in radio and sensors that sense the direction and acceleration. The receiver is connected to the vehicle ISOBUS and

TruPath

Precision



Read about other
product high-
lights displayed
at Agritechnica on
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steering CAN BUS systems, which communicate directly with the Sauer-Danfoss electro-hydraulic steering components – an EH with a PVED-CL steering controller – and DP600 graphical display terminal. The PVED-CL controls the tractor wheels based on input received from the Topcon receiver and the Sauer-Danfoss SASA steering wheel sensor, which the PVED-CL then compares with feedback from the wheel sensor.

This constellation of components makes GPS auto-steering possible and takes maximum advantage of the steering software in the PVED CL. The customization of steering characteristics to each tractor operation secures improved driver comfort and performance.

Round-the-clock operation

One of TruPath's major strengths is its ability to receive positioning signals from the US-based GPS and Russian-based GLONASS satellites. While most GPS receivers only have 12 channels and, consequently, experience daily downtime, TruPath can pick up 40 channels – ensuring 24-hour satellite contact no matter what the geographical location and giving more precise positioning all year round.

"Previously tractor operation was limited to the hours

of visibility in the day. TruPath doubles or even triples tractor productivity by increasing the hours of operation. And, as steering is no longer skill dependent, the operator can increase tractor speed and no longer has to work the path right next to the last one," says Michael Gomes.

More focus on functions

The introduction of wider tractor implements makes the opportunity for wider turns at the end of a row an important one. With the tractor following a set of plotted coordinates, it is possible to skip a row and come back to it later, safe in the knowledge that the driving operation will be precisely repeated anywhere

in the field. Without the need to focus on steering, the operator will experience less fatigue and can concentrate more on monitoring work functions – even carrying out tilling, planting and spraying in a single pass. At the same time, optimized drive performance reduces fuel consumption and emissions.

"The integration of global positioning technology, sensors and hydraulics requires core competencies in a number of areas," says Michael Gomes. "This unique combination of skills is brought together in the joint venture that has created TSD Integrated Controls."

Out of this world technology

A desire to focus on the development of electronic control systems for off-highway vehicles has come to fruition in the joint venture between Sauer-Danfoss and Topcon Positioning Systems. By combining the strengths of two market leaders in TSD Integrated Controls, the resulting systems for pavers and construction equipment are today widely used in the US and by a number of manufacturers in Europe and Asia.

For Sauer-Danfoss, the joint venture has given access to pioneering GPS/GLONASS technology and Topcon's substantial research facility in Moscow, where work on core global positioning and inertial sensor technologies has given Topcon a strong competitive advantage. Topcon has gained from Sauer-Danfoss' hydraulic expertise and strong relationships with manufacturers of off-highway equipment and worldwide distribution channels. Together, they have come up with the world's leading automated positioning and machine management systems.

farming in orbit

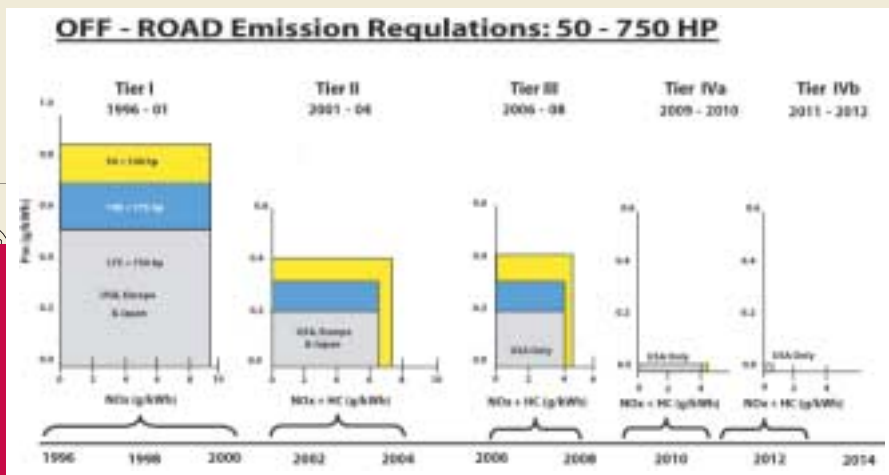
Article 4. For further information: TheCircuit@Sauer-Danfoss.com

Tier 3 has become the byword for emission standards within the mobile hydraulics industry. In theory the regulation milestones set by the US Environmental Protection Agency (EPA) only have legislative weight in the US. In practice their impact is effectively global.

Waiting for the future to happen has never been Sauer-Danfoss' style. So it is several years since the company's development projects started to consider the Tier 3 emission standards due to be phased in from 2006-2008 – and affecting off-road engines above 302hp from this year. Sauer-Danfoss currently has a range of intelligent components to tackle the issues that arise when diesel emissions are dramatically reduced.

The crusade to cut emissions of nitrogen oxides – a main contributor to smog – and particulate matter has already slashed the level of pollutants spewed out by diesel exhausts. In the US, legislation has reduced such emissions by 90% compared to 14 years ago. But, by stepping up from the currently enforced Tier 2 requirements for off-road vehicles to Tier 3, the EPA takes another significant stride towards its ultimate goal to reduce nitrogen oxides and particulate matter by an overall 98%. This has presented the off-road industry with a whole new set of testing challenges.

Article 5. For further information:
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"The move from Tier 2 to Tier 3 is a quantum leap," says Frank Ramm, Sauer-Danfoss product portfolio manager. "Compared to the regulations currently in force in Europe, these are considerably tougher, and there is every likelihood that they will become the global standard."

The key to cooling

A main issue is the effect on the cooling systems that maintain optimum engine and hydraulic system temperatures. To satisfy Tier 3, combustion engines will require high thermal efficiency and, possibly, start using new diesel formulations with a maximum sulfur content of 15ppm. As a result, more combustion heat will be lost, reducing the net power available from the engine by 5kW.

"OEMs and engine manufacturers are looking to other component and system suppliers to make up for losses in engine efficiency," says Frank Ramm. "Here, more sophisticated cooling solutions play a particular role. For this reason, we have developed SNM2Y and SNM3Y electro-hydraulic proportional fan drive motors that only go into action when required – improving efficiency and power management."

Intelligent components

The Sauer-Danfoss H1 and PVG 100 valve series have also been designed in view of Tier 3 needs. Within the H1 series, the hydrostatic pumps and, soon to be launched, bent axis motors represent an opportunity to maximize operating efficiency by combining a lower pump input speed with a higher motor output speed. The PVG 100 series of post-compensated, load-independent directional control valves supplements this by catering for limited energy hydraulic systems – distributing flow proportionally to multiple machine functions according to variable load and pressure requirements. To provide the electrical actuation necessary for intelligent power management, Sauer-Danfoss can offer the PLUS+1™ package of microcontrollers, I/O modules and software and has an ongoing launch program for PLUS+1-compatible components.

"The ability to share engine information with the hydraulic components based on the power available is a key element in our Tier 3 strategy," says Frank Ramm. "Why wait for the future, when tomorrow's solutions are already here?"

PLUS+1™
by SAUER-DANFOSS

Technical Specifications – PVG100:

Feature	Unit		Data	
Max. pressure	Port P continuous	Bar [psi]	350	[5075]
Oil flow, rated	Port P	l/min [US gal/min]	250	[66]



Stepping up to
Tier 3



Valve experts make it global

Sauer-Danfoss has consolidated its specialized capabilities within cartridge valves and hydraulic integrated circuits (HICs) to form a global range. New products fill the remaining gaps in the portfolio.

OEMs can expect faster delivery of systems and components following the integration of three previously separate product lines into one. The move brings together the best practices and processes employed at Sauer-Danfoss plants in the US and Italy, streamlining the design of the company's innovative cartridge valves and custom-built HICs for numerous applications.

Sauer-Danfoss gained two of the three product lines when it acquired Oregon-based Compact Controls and Comatrol S.p.A. in Reggio Emilia, Italy. These have now been tied together with the line produced by the Sauer-Danfoss plant formerly known as Fluid Controls in South Carolina – creating a global range backed by easily accessible technical support.

“Our extensive experience and globally coordinated approach to product development allows us to give OEMs a faster, more flexible custom design process and a shorter time-to-market,” says product portfolio manager for North America, Dave Wohlsdorf. “The design engineers in all our locations are highly skilled and have the expertise to create custom solutions within manufacturers’ time schedules. With production facilities in three countries, we can deliver the exact products required, no matter where the OEM is located.”

Universally useful

Compact, low-cost components that can be used for directional, pressure or flow control in hydraulic systems, cartridge valves can be combined to form almost any hydraulic circuit. A custom HIC based

on cartridge valves provides a compact hydraulic control package that is easy to install and service and has fewer leak points than traditional hydraulic systems. Following the consolidation of resources, the quality, performance and lifetime of all valves and HICs meet Sauer-Danfoss’ global standard. All new products are designed to fit industry standard cavities and manifolds.

Technical support team manager based at Reggio Emilia in Italy, Giovanni Iori, highlights the strategic decision behind the development of a comprehensive cartridge valve range to which more, innovative functions will be added in the future.

“Today many cartridge valves can be integrated into Sauer-Danfoss motors, pumps and sectional valves to offer a complete sub-system from one supplier. This gives OEMs the ability to reduce labor on their assembly line and the number of different suppliers – and fulfils our mission to supply our customers with systems rather than single components,” he says.

Flexible launches

Filling some of the last gaps in the cartridge valve range, the PRV proportional valve and SV solenoid-operated directional control valve series are among the recent launches.

The PRV is a useful choice for a diversity of mobile hydraulic applications, including hydraulic fan drives which reduce energy use by regulating pressure proportional to the valve input signal. In fan drive applications, the pressure management provided by the PRV is responsible for controlling fan speed. The provision of maximum relief pressure secures pressure protection when there is no signal due to loss of electrical input. Used in HICs, the PRV is rated for pressures up to 250 bar (3600 psi), offering optimal machine performance, improved comfort and safety and smoother driving, lifting



Hillsboro, USA



Easley, USA



Reggio Emilia, Italy

and loading work functions. Two sizes are available for 10-2 and 12-2 cavities with a flow capability of 80 litres/minute (21 gallons/minute) and 180 litres/minute (50 gallons/minute) respectively.

Equally useful, the SV series is the result of the global rationalisation of the solenoid-controlled valve range, comprising spool and poppet types. The wide variety of options includes two to four-way, two or three position valves with flows up to 80 litres/minute (21 gallons/minute) and pressures up to 230 bar (3300 psi).

Technical catalogue

Sauer-Danfoss has listed its current global line of the most commonly used valves and HIC applications in a new technical catalogue, available to customers and distributors on request or by downloading from the Sauer-Danfoss website. To ease the ordering process, all components have the same global part number, regardless of whether they are produced in Italy or the US – a particular benefit to OEMs that produce identical machines at various plants around the world. All the parts in the catalogue will become compliant with Sauer-Danfoss PLUS+1™ technology in the near future.

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

Forestry machine manufacturer Silvatec was among the first companies in Denmark to use Sauer-Danfoss PVG proportional valves in the 1980s. Some 20 years on, the company still uses them. A PVG 32 load-sensing solution controls the many work and steering functions in the Silvatec 878 CH, a wood chipper in a class of its own.

Compact and narrow enough to drive between rows of trees in managed forests, the Silvatec 878 CH is a rare example of a machine dedicated to chipping wood for use as bio-fuel. Many a Danish forest owner prizes its ability to chip wood where it falls, eliminating the need to drag logs out of the forest, causing damage to young trees in the process. Elsewhere in Europe, many forest owners are now looking to the Silvatec 878 CH as the answer to their needs.

Three Sauer-Danfoss PVG 32 groups, comprising 19 sections in all, are responsible for the machine's many hydraulic work functions. This equips the cylinder that raises and lowers the wood chip container to perform additional tasks, such as keeping the container upright on a slope. The valve block also meets the high flow demands of the two Sauer-Danfoss OMV 400cc low speed/high torque orbital motors that drive the

feeding rollers and the crane that grabs fallen tree trunks and feeds them into the disc chipper.

The combination of PVG 32 valves and OMV motors enables an in-feed speed of up to 70 metres a minute and feeding power of 2000kp. "Our customers require efficient machines with a high capacity and consistent wood chip quality," explains Henrik Høgh, construction engineer at the Silvatec plant in northern Denmark. "PVG valves are highly flexible and service-friendly and enable us to give our customers good after-sales support."

A Sauer-Danfoss OSPB steering unit works with the PVG 32 to provide light and responsive steering of the 19.5 tonne machine. When in the forest, the steering wheel can be set aside, and comfortable operation is obtained using

the ergonomic Sauer-Danfoss Prof 1 joystick.

"Most of our machines are custom-made. In our day-to-day communication with Sauer-Danfoss, any problems that arise are solved in a satisfactory way and any special requirements we may have are met," says Henrik Høgh.

This good relationship is not limited to the Silvatec 878 CH. The Silvatec range of harvester heads - sophisticated tree-felling solutions - feature two Sauer-Danfoss OMV 630cc and 800cc motors, which drive the feeding rollers. Yet another project is in the pipeline. As more countries in Europe recognise the value of wood chip bio-fuel, Silvatec and Sauer-Danfoss expect to carry on having plenty to talk about.

Wood chips fuel a business

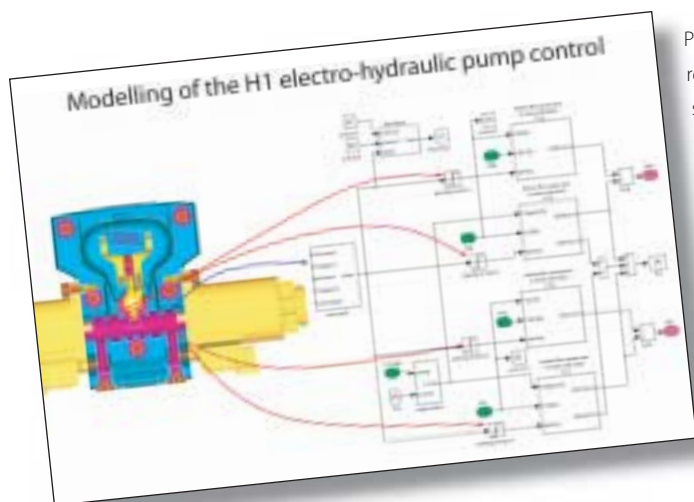
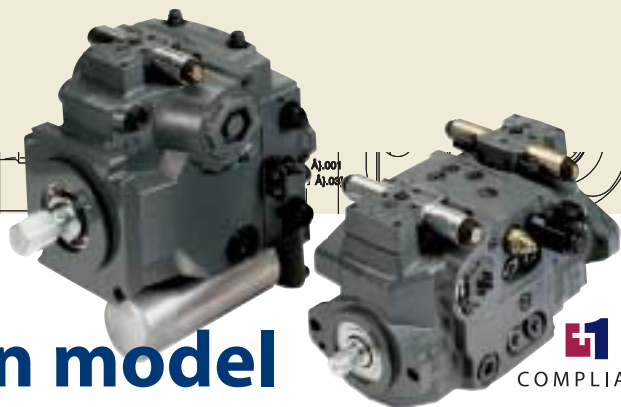
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Real life is a simulation model



Computer simulation has been identified as a core global competency within Sauer-Danfoss - and ambitions are high. Optimized system functionality, lower product development costs and a faster time-to-market are among the advantages in sight.

Mathematical models and simulation play an essential part in the ongoing development of Sauer-Danfoss' forward-looking H1 series of hydrostatic pumps and motors. In the development of torque-assisted steering on a walk-behind pallet truck, computer simulation has also provided the basis for the initial performance tests.

Although Sauer-Danfoss has used models and simulation for some 30 years, the company has made a strategic decision to move up a level – drawing on its global organization to develop models for use as building blocks when putting new components and systems together. A global model library will store all the models for future reference and inspiration.

Per Lindholdt, who has global responsibility for modeling and simulation, explains, "Previously simulation took place locally in individual product departments. Today we want models that do not just show specific problems but that can be used more generally, enabling us to make more flexible use of existing application knowledge to find a solution and put it to the test."

In the case of H1, models helped answer many of the initial development questions – the appropriate orifice sizes for best response behavior, the speed of signal data processing, the signals required to detect all driving conditions. The employment of models in computer simulation provides data equivalent to that obtained from tests on real machines. Alterations and improvements can then be made quickly and easily on the keyboard before the first prototype has even been produced.

"Modeling and simulation requires in-depth knowledge of the relevant technology and how it works. You also have to know what you want to achieve and have a description of the application," says Per Lindholdt. "But, when properly applied, it enables us to reduce trial and error in our development work. That means we can save costs and speed up time-to-market."

The increased use of a computer to demonstrate

functionality will help Sauer-Danfoss in the ongoing effort to meet quality goals. It also makes it considerably easier to present functional benefits to a customer.

All the models are based on mathematical calculations which are then fed into a computer for processing. The computer measurements of, for example, pressure or movement, are identical to real-life measurements. In most cases, a microcontroller is used to control the model, just as it controls tests on the physical application.

"Real-time simulation enables us to test basic functions before using the real hardware and in situations where no real test terrain is available. Control parameters can be pre-optimized and the influence of external parameters investigated. We can also detect concept errors and test new software concepts," says Per Lindholdt. "After that we can build the prototype."

Work on developing models for all Sauer-Danfoss components and systems is still at an early stage. For all new product development projects, standard guidelines have been set to ensure models are an integrated part of the process. Eventually sufficient models will be available to simulate all Sauer-Danfoss products – new and existing.

Displacement size 45/53 ccm – H1 single or tandem pump:						
Feature		Unit	Frame Size			
			45		53	
Input Speed	Minimum	Min ⁻¹ [rpm]	500			
	Rated		3300			
	Maximum		3700			
System Pressure	Rated	Bar [psi]	400	[5800]	350	[5075]
	Maximum		430	[6235]	380	[5510]
	Minimum low loop		10 [150]			

Displacement size 147/165 ccm – H1 single pump:						
Feature		Unit	Frame Size			
			147		165	
Input Speed	Minimum	Min ⁻¹ [rpm]	500			
	Rated		3300			
	Maximum		3700			
System Pressure	Rated	Bar [psi]	450	[6500]	400	[5800]
	Maximum		480	[6960]	430	[6235]
	Minimum low loop		10 [150]			



Award from John Deere

John Deere Harvester Works in the US has again selected Sauer-Danfoss in Easley, South Carolina for a top supplier award.

The Partner Award, which Sauer-Danfoss received for the second time, recognized the company's strong cooperation with John Deere in 2004. Of John Deere Harvester Works' 3,300 suppliers, just 168 received the award. Sauer-Danfoss has previously also received three awards for key status.

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

Green smiles all round

The Sauer-Danfoss plant in Nordborg, Denmark can now display a green smiley awarded by the Danish Working Environment Authority. Published on the authority's website, green smiley status is given to all Danish companies with a recognized working environment certificate.



Environment coordinator at Nordborg, Gert Lumbye, welcomes the public recognition of Sauer-Danfoss' efforts.

"The working environment certificate means our working environment initiatives are subject to a management system. If we find faults, we are expected to correct them ourselves. In addition, the certificate means the working environment authority does not make control visits to our plant," he says.

For more information about the smiley symbols awarded by the Danish Working Environment Authority, visit www.at.dk/sw12201.

Agritechnica showcase

Agritechnica, Europe's largest agricultural machinery show held in Hanover in early November 2005, provided Sauer-Danfoss with a week of opportunity to showcase its fully integrated agricultural auto-guidance system TruPath™ and present its extensive range of system solutions for tractors.

For combine harvesters, beet harvesters, skid steer loaders and telehandlers, Sauer-Danfoss demonstrated the opportunities for advanced electro-hydraulic control with PLUS+1™ technology. Other show highlights included the first products available in the new H1 series of hydrostatic pumps, the PVG 100 load-sensing valves for high performance at lower horsepower and the S45 series of open circuit axial piston pumps.

Visit Sauer-Danfoss at these shows in 2006:

- Golf Industry Show, Texas, US, 9-11 February
- World of Asphalt (with TSD), Las Vegas, US, 4-16 March
- Intermat, France, 24-29 April
- Ad Machinery, Iowa, US, 1-3 May
- Agrishow, Brazil, May
- Feira De Mecanica, Brazil, 23-27 May
- M&T Expo, Brazil, 6-10 June
- METKO, Finland, 31 August - 2 September
- Industriadagene, Norway, 19-22 September
- Aandrijfstechniek, Holland, 3-6 October
- HPS, Poland, October
- EIMA, Italy, November
- China Bauma, Shanghai, November 21-24



Innovation award for PLUS+1™

PLUS+1 microcontrollers with GUIDE programming software have been selected as one of the top 50 innovative new products introduced last year. The accolade comes from the American Society of Agricultural Engineers (ASAE), making Sauer-Danfoss a 2005 AE50 winner.

Every year the society's AE50 program recognizes the companies responsible for engineering the most outstanding product or system technology innovations launched on the market for use in food processing, agricultural production or the development and production of biological products.

"It is very rewarding to have our efforts publicly recognized like this," says PLUS+1 product manager Dan Ricklefs. "It took a global effort to create PLUS+1, and we are proud of the success it is having."

Sauer-Danfoss has already been an AE50 winner on several occasions: for the Series 45 open circuit pump in 1995 and 2001 and for the Series 42 closed circuit pump in 1994.