

**MANUAL FOR**  
**ANDERSEN 6000STH 2+1**



*Sail Handling by*  
 **ANDERSEN**  
Stainless Steel Winches

**Serial No.: PS0017582**

## CONGRATULATIONS

You have purchased an ANDERSEN high quality winch. This product is a result of many years of development and experience in producing winches for sailboats. This winch gives you a high degree of functionality and many years of safe and easy sail handling.

## CONTENTS

General information: Slow gear.....	3
Fast gear.....	4
Flow, Advantages and Facts.....	5
Mounting.....	6
Safety.....	7
Hydraulic Installation.....	8
General Service Instructions.....	9
Spare parts list and exploded view: Winch cpl.....	10
Drum cpl.....	12
Manuel Gear.....	14
Hydraulic Gear.....	16
Technical Data for Hydraulic motor .....	18
Warranty.....	33
Worldwide Distributions & Service .....	35

## GENERAL INFORMATION

***Please read following before installing your new ANDERSEN hydraulic winch.***

The Andersen 6000 winch combine high performance with a high rate and efficiency

The winch is designed for use on sailboats, for sail handling of halyards and sheets.

**Continuously operation 4500 kg, max 180 bar**

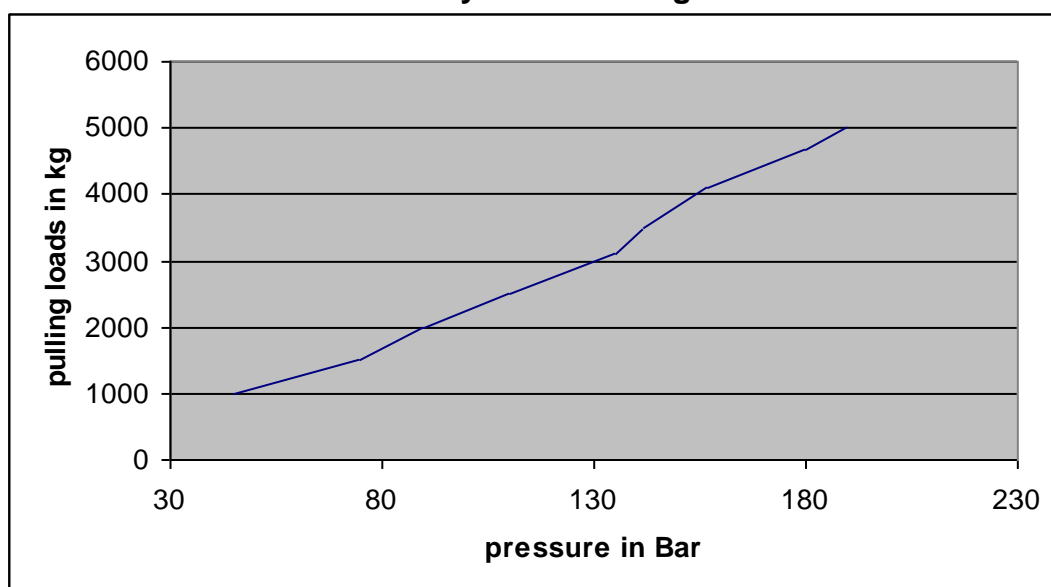
**Peak operation 6000 kg, max 230 bar**

**Winch performance-hydraulic gear:**

Slow Gear																		
Pull (kg)	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000	6000	7000	8000	9000	10000	11000	12000
Bar			45	75	90	110	135	142	153	176	190	230						

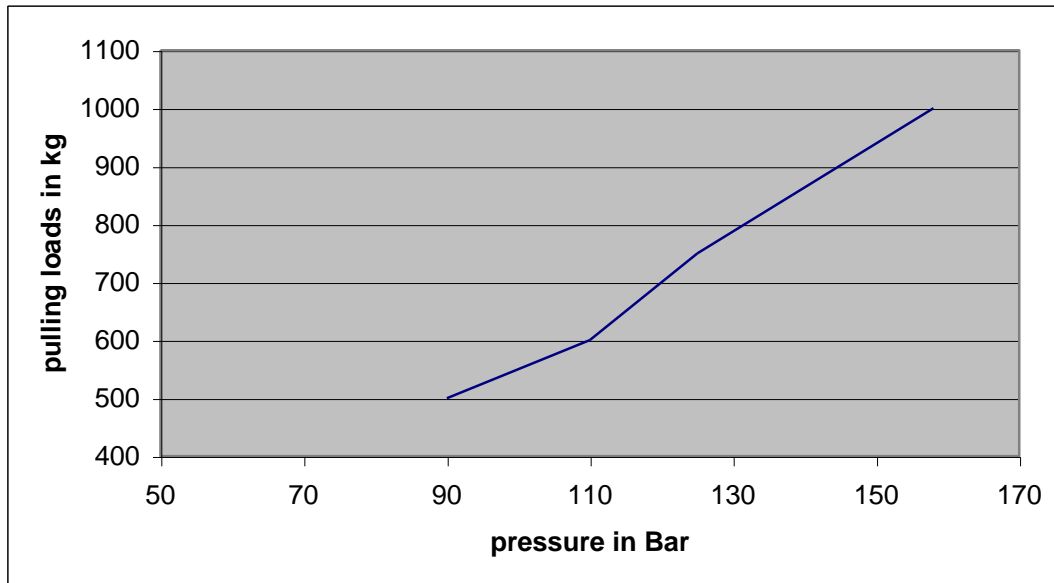
Fast Gear																		
Pull (kg)	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000	6000	7000	8000	9000	10000	11000	12000
Bar	90	125	158															

**Hydraulic slow gear**



## GENERAL INFORMATION

### Hydraulic fast gear



### Winch performance-manual gear:

Slow Gear						
Nm	25	50	75	100	125	200
Kg (handle)	10,2	20,4	30,6	40,8	51,0	81,5
Pull (kg)			1625		2480	3530
Efficiency (%)			78,5		71,8	63,9

Fast Gear						
Nm	25	50	75	100	125	200
Kg (handle)	10,2	20,4	30,6	40,8	51,0	81,5
Pull (kg)			310		510	850
Efficiency (%)			94,2		94,8	95,0

## HOLDING LOADS

10 ton without deformation.

## **FLOW**

Unloaded he winch require following:

High speed: 1Meter / min. requires 1.1 Litre / min. (Flow= Req. line speed x 1,1)

Low speed: 1Meter / min. requires 3.6 Litre / min. (Flow= Req. line speed x 3.6)

## **ADVANTAGES**

The ANDERSEN 6000 STH is fabricated in Stainless steel and Aluminium bronze.

The Built-in Hydraulic gear unit is running in a oil bath.

The new developed pawl spring is tested with more than 3 million activations without any failure.

The Stripper-arm is turn able in 6 horizontal steps 60° between.

The Hydraulic motor is turn able in 4 horizontal steps 90° between.

The entire winch is lifted by a lifting eyebolt connected to the centre shaft.

The winch is easy converted for backwind function

The winch is easily convertible to hydraulic multi speed function

## **FACTS**

Motor: Sauer-Danfoss 51-1 V-max = 80cc/rev ; V-min = app. 24.6cc/rev

Materials: Drum and housing : AISI316 L Stainless steel and Aluminium-bronze  
Driving and carrying parts Gear, centre shaft etc. is made in Aluminium-bronze and AISI431 Stainless steel.  
Hydraulic epicyclical gear is made in 34CRNIMO6

Gearbox: The gearbox contains 0.75 Litre of Castrol universal gearoil

Weight : 130 kg

## **MOUNTING INFORMATION**

### **GENERALLY:**

#### ***DO NOT REMOVE CONTRA VALVE ON DRAIN***

Ensure that ALL HOLES in the deck is bedded.  
Be careful not to put bedding compound in thread holes in the base plate  
Ensure that the mounting surface is absolutely straight.

Mounting the winch can be done in two different ways:

A) with motor attached to winch

To mount the winch this way use template A.

- 1) Cut and drill the required holes in the deck according to template
- 2) Dismount hydraulic 1 inch SAE flanges on Sauer-Danfoss motor
- 3) Mount the lifting eyebolt in the centre shaft
- 4) The winch must be tipped app. 30° contra valve on drain L1 pointing down.
- 5) Lower the winch until the contra valve is below deck
- 6) Put winch back to vertical and lower the rest of the way.
- 7) The winch is mounted with 8 x M12 bolts (not included). The bolts are tightened with the head below the deck and are screwed into the thread prepared in the base plate of the winch. The bolts should be 30-35 mm long plus the thickness of the deck.
- 8) Mount SAE flanges. The big 10 bar contra valve is to be mounted on GATE A. and connect the winch hydraulic and electric.

B) With motor and winch disassembled (if space below deck is plenty.)

To mount the winch this way use template B

- 1) Cut and drill the required holes in the deck according to template
- 2) Dismount the hydraulic motor.
- 3) Place the winch and bolt to the deck tighten 8 bolts M12 (not included)
- 4) The winch is mounted with 8 x M12 bolts (not included). The bolts are tightened with the head below the deck and are screwed into the thread prepared in the base plate of the winch. The bolts should be 30-35 mm long plus the thickness of the deck
- 5) Re-mount the motor. The big 10 bar contra valve is to be mounted on GATE A. Connect the winch hydraulic and electric.

## **SAFETY**

### **IMPORTANT:**

Be aware of the winch's power. Only competent sailors should operate the winch. Every time the winch is to be used, be sure that children and other crew are standing well clear of the winch and rope to be pulled. Always be aware of what the winch is pulling on as well as the rope on the winch. A rope snagged or jammed on a sail, spar or rigging can result in dangerous overloading. This is especially important when using a powerful primary winch for less demanding tasks like hoisting the mainsail where the winch is many times more powerful than necessary for the task at hand.

Under no circumstances should children be allowed to play with the Hydraulic winch.

## HYDRAULIC INSTALLATION

Hydraulic installations is to be done by qualified personnel.

Hoses/pipes are recommended to a minimum. ½ inch.

Keep all surfaces clean.

The Power pack should be installed with suction filter. (consult power pack manual)

The motor is SAUER-DANFOSS 51-1 bent axis motor with electro-hydraulic two position control-options.

See datasheets from SAUER-DANFOSS Series 51, Technical Information.

On Port A and B there are mounted 1inch SAE flanges, and on port A there is furthermore a 10 bar non-return valve.

On drain L1 there is mounted a ½ bar non-return valve.

**This valve should not be removed.**

If it is accidentally removed the motor must be refilled with hydraulic oil to lubricate the top – bearings in the motor.



## GENERAL SERVICE INSTRUCTIONS

The hydraulic drive unit is lubricated and sealed for life and need no further maintenance.

The winch drum and manual gear system is a standard self tailing winch which needs normal service. We recommend dismantling, cleaning and lubricating once a year. During extensive use such as racing we recommend 2 services a year.

We strongly recommend always to use Andersen Winch Grease or KLÜBERs TOPAS. Both greases is high quality products with characteristics ideal for winches.

Check frequently the winch from leaking as well as hoses / pipes.

*IMPORTANT:* Damaged hoses or pipes must be changed immediately

For dismantling and assembling the winch see exploded views.

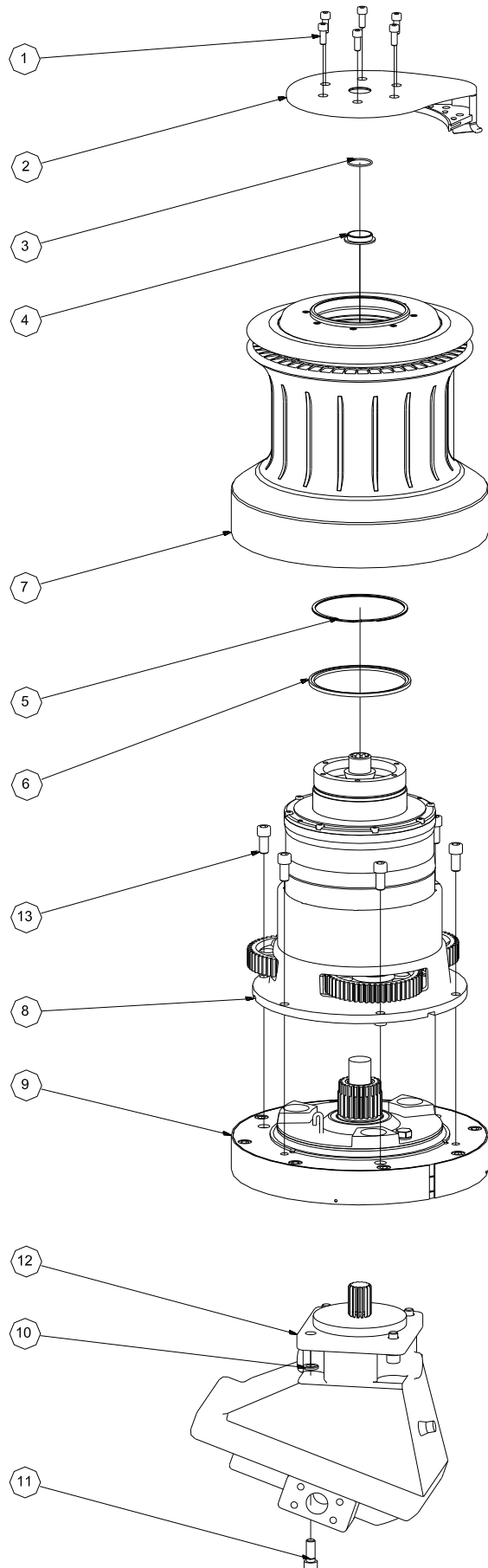
Required Tools:

- 1 set of metric Allen keys from 2 to 10mm.
- 2 small flathead screwdrivers (pawl/spring mounting)
- Circlip pliers external. (Only if disassembling the hydraulic gear system).

## SPARE PARTS LIST FOR WINCH CPL.

Pos.	Qty.	Description	No.
1	6	Cylinder Head Cap Screw	DIN912-M8x20
2	1	Self-tailing arm	511883
3	1	O-ring	RD100641
4	1	Polymer Bearing	511804
5	1	Lock ring	592500U
6	1	Stop for Drum	512033
7	1	Drum complete	511890
8	1	Manuel Gear complete	511985
9	1	Hydraulic Gear complete	511810
10	10	Lock washer	DIN127B-12,2
11	4	Cylinder Head Cap Screw	DIN912-M12x30
12	1	Hydraulic motor 2+1	RD100460
13	6	Cylinder Head Cap Screw	DIN912-M12x25

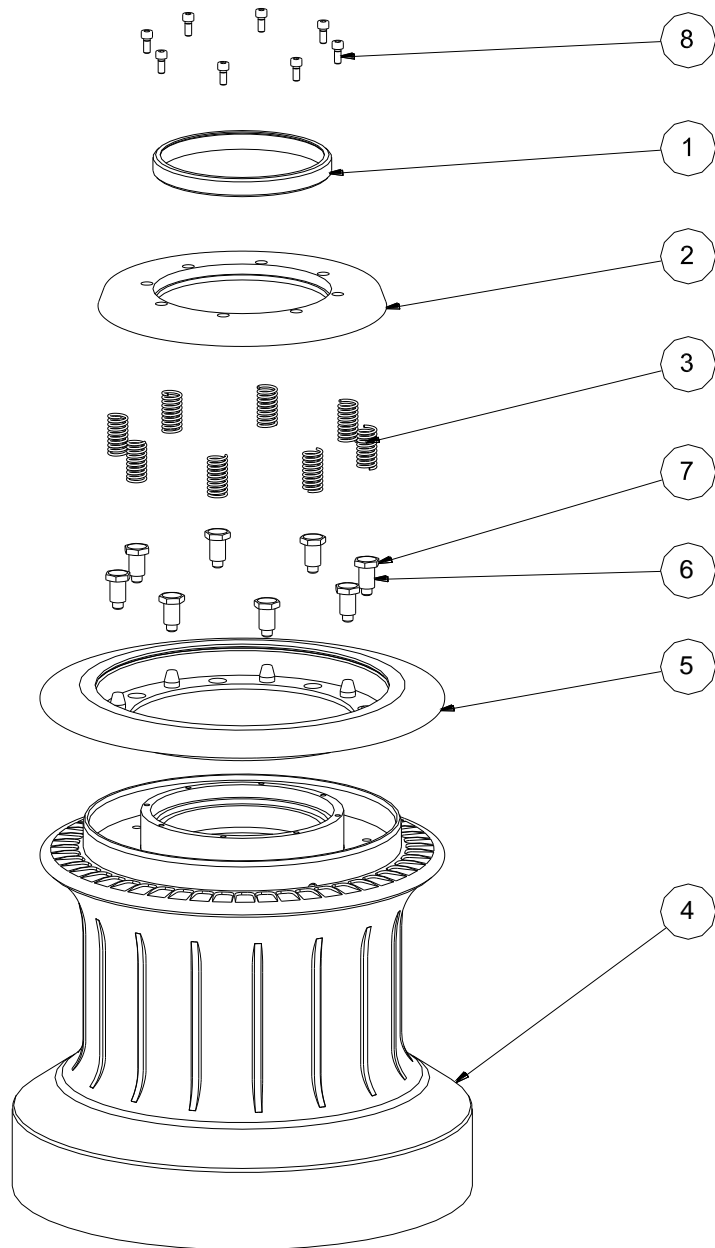
## EXPLODED VIEW FOR WINCH COMPLETE



## SPARE PARTS LIST FOR DRUM part No. 511890

Pos.	Qty.	Description	No.
1	1	Sealing Ring	511894
2	1	Top Ring	511870
3	8	Spring	RD100451
4	1	Drum	511860
5	1	Driving Plate	511877
6	8	Bushing	511253
7	8	Bolt	511252
8	8	Cylinder Head Cap Screw	DIN912-M5x12

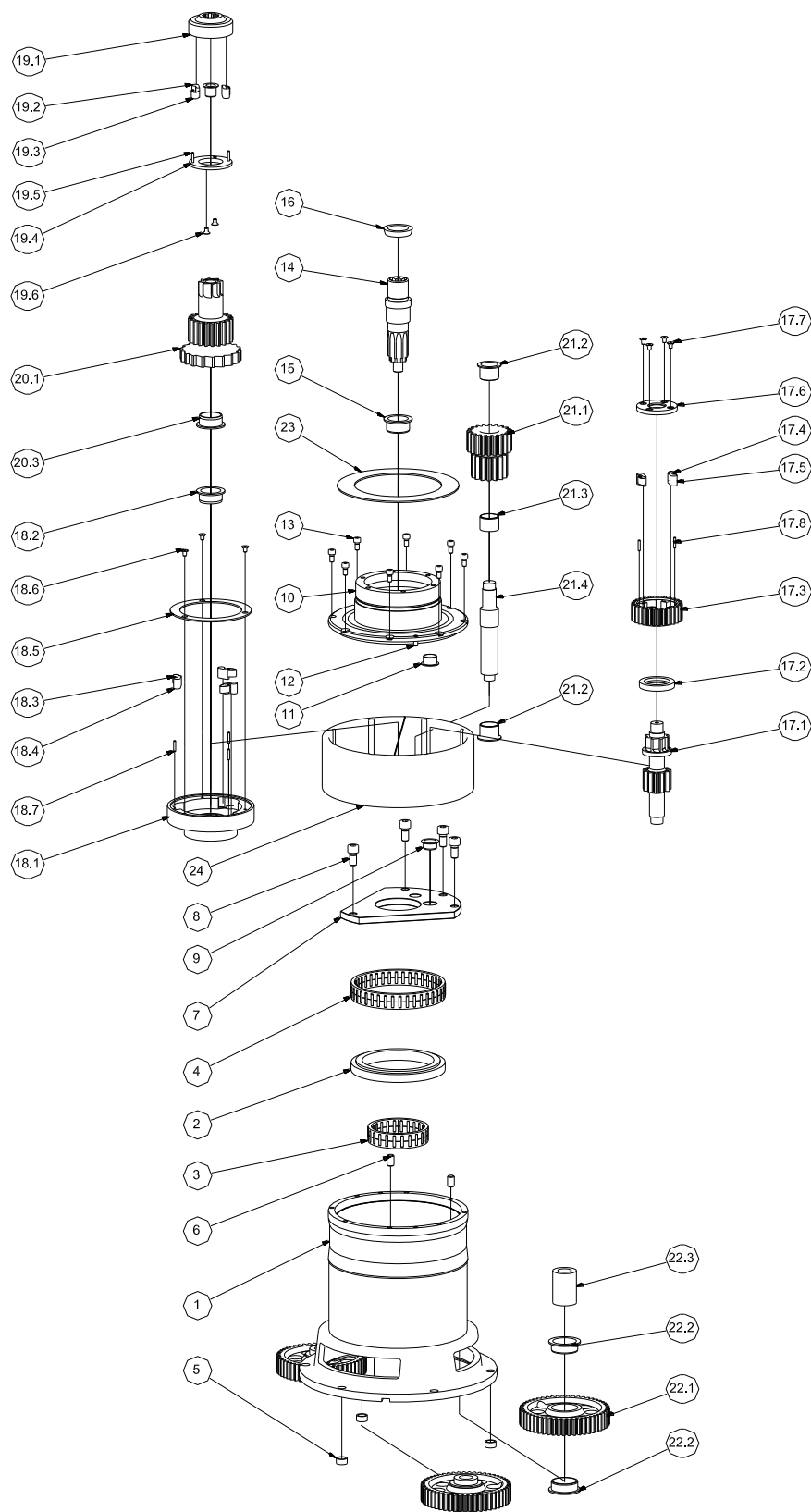
## EXPLODED VIEW FOR DRUM COMPLETE



## SPARE PARTS LIST FOR MANUEL GEAR part No. 511985

Pos.	Qty.	Description	No.
1	1	Upper Base	511829
2	1	Polymer Space	511835
3	1	Roller Bearing	525905
4	1	Roller Bearing	588001
5	3	Bushing	511837
6	2	Parallel Pin	511807
7	1	Mounting Plate	511841
8	4	Cylinder Head Cap Screw	DIN912-A4-M10x20
9	1	Polymer Bushing	511803
10	1	Top Plate	511850
11	1	Polymer Bearing	RD100634
12	2	Parallel Pin	511809
13	8	Cylinder Head Cap Screw	DIN912-A4-M6x12
14	1	Drive Shaft	511857
15	1	Polymer Bearing	511806
16	1	Bushing	512004
17	1	Ratchet Gear	511971
17.1	1	Free Wheel	511844
17.2	1	Bearing	511853
17.3	1	Free Wheel	511845
17.4	2	Spring	511984
17.5	2	Pawl	511969
17.6	1	Cover for Free Wheel	511852
17.7	4	Screw	DIN7991-A2-M5x8
17.8	2	Parallel Pin	DIN7-A1-3H8x16
18	1	Ratchet Gear, Lower	511972
18.1	1	Free Wheel	511847
18.2	1	Polymer Bearing	RD100648
18.3	3	Spring	511984
18.4	3	Pawl	511969
18.5	1	Cover for Free Wheel	511854
18.6	3	Hexagon socket countersunk head cap screws	DIN7991-A4-M5x8
18.7	3	Parallel Pin	DIN7-A1-3H8x16
19	1	Ratchet Gear, Upper	511973
19.1	1	Free Wheel	511849
19.2	2	Pawl	511969
19.3	2	Bladfjeder	511984
19.4	1	Cover for Free Wheel	511855
19.5	2	Parallel Pin	DIN7-A1-3H8x16
19.6	2	Screw	DIN7991-A2-M5x8
20	1	Center Gear Complete	511974
20.1	1	Center Gear	511848
20.2	1	Polymer Bearing	RD100650
20.3	1	Polymer Bearing	RD100648
21	1	Intermediate Gear Complete	511975
21.1	1	Intermediate Gear	511842
21.2	2	Polymer Bushing	RD100651
21.3	1	Polymer Bushing	RD100652
21.4	1	Shaft for Intermediate Gear	511843
22	3	Drive Gear Complete	511976
22.1	1	Drive Gear	511830
22.2	2	Polymer Bearing	511802
22.3	1	Drive Shaft	511831
23	1	Polymer Space	512120
24	1	Polymer Bearing	511986

## EXPLODED VIEW FOR MANUEL GEAR

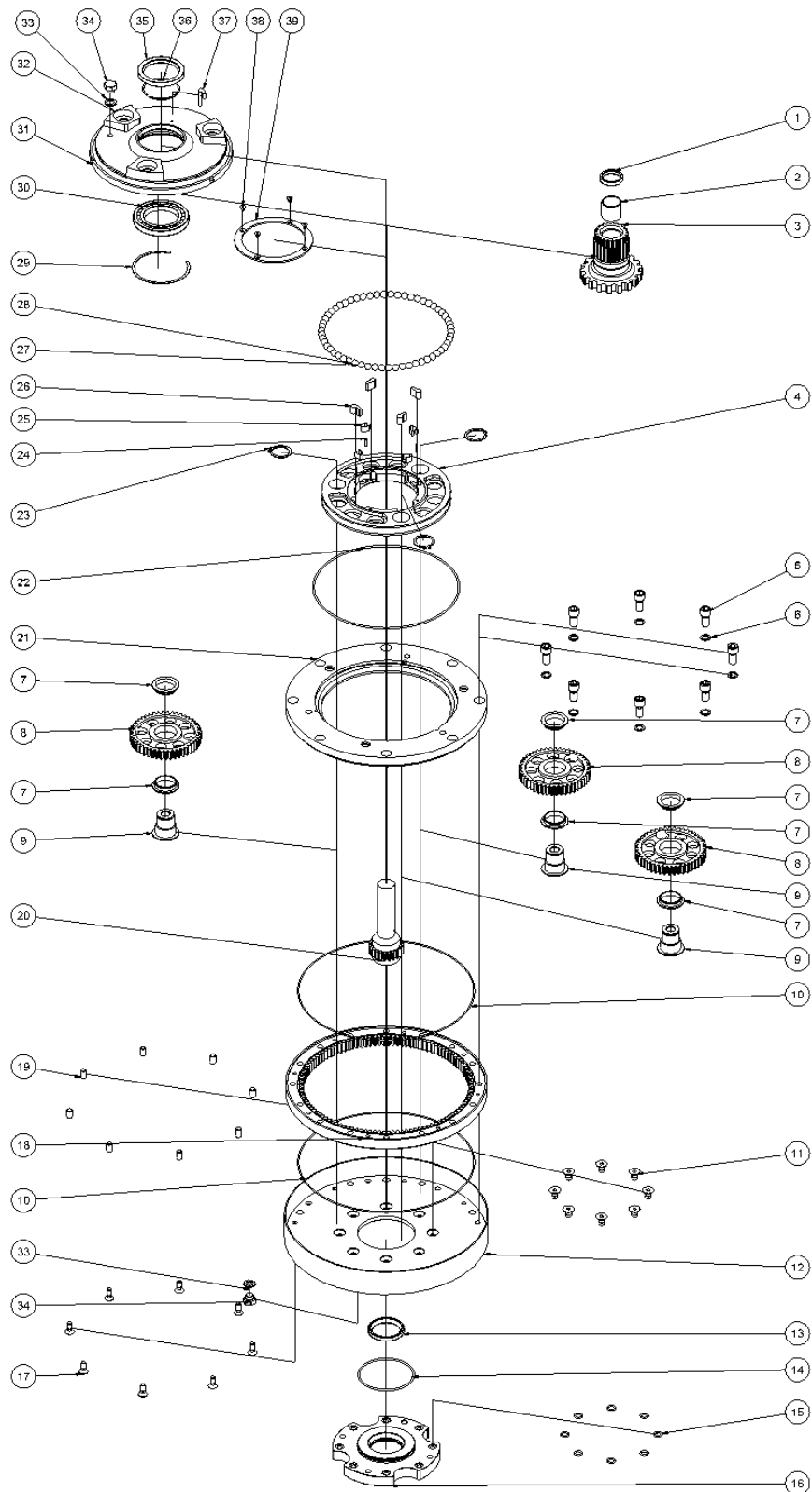


## SPARE PARTS LIST FOR HYDRAULIC GEAR part No. 511810

Pos.	Qty.	Description	No.
1	1	Sealingring	RD100428
2	1	Polymer Bearing	00637
3	1	Sun Gear for Drive	511820
4	1	Epicyclic Stage	511815
5	8	Cylinder Head Cap Screw	DIN912-M12x25
6	8	Bonded Seals	RD100447
7	6	Polymer Bearing	511801
8	3	Epicyclic Gear	511813
9	3	Shaft for Epicyclic Gear	511816
10	2	O-Ring	RD100423
11	8	Countersunk Screw	DIN7991-M10x16
12	1	Base Plate	511818
13	1	Sealing Ring	RD100426
14	1	O-Ring	RD100425
15	8	O-Ring	RD100399
16	1	Motor Flange	511821
17	8	Countersunk Screw	DIN7991-M8x20
18	1	Toothedrim Epicyclic	511812
29	8	Parallel Pin	511807
20	1	Sun Gear	511822
21	1	Top Plate for Gearbox	511814
22	1	O-Ring	RD100424
23	3	Seegerring	DIN471-A2-A30
24	4	Parallel Pin	DIN7-A1-Ø3H8x16
25	4	Spring	511984
26	4	Pawl	511969
27	29	Ball	RD100435
28	29	Ball	RD100429
29	1	Seegerring	511838
30	1	Ball Bearing	RD100448
31	3	Parallel Pin	511808
32	1	Base Plate for Drive Gear	511819
33	2	Bonded Seals	RD100449
34	2	Plug	RD100112
35	1	Sealing Ring	RD100427
36	1	Seegerring SW60	RD100441
37	1	Breether	512018
38	4	Countersunk Screw	DIN7991-M5x8
39	1	Coverplate	511823



## EXPLODED VIEW FOR HYDRAULIC GEAR



# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Description

### GENERAL DESCRIPTION

Series 51 and 51-1 variable displacement motors are bent axis design units, incorporating spherical pistons.

These motors are designed primarily to be combined with other products in closed circuit systems to transfer and control hydraulic power. Series 51 and 51-1 motors have a large maximum / minimum displacement ratio (5:1) and high output speed capabilities. SAE, cartridge, and DIN flange configurations are available.

A complete family of controls and regulators is available to fulfill the requirements of a wide range of applications.

Motors normally start at maximum displacement. This provides maximum starting torque for high acceleration.

The controls may utilize internally supplied servo pressure. They may be overridden by a pressure compensator which functions when the motor is operating in motor and pump modes. A defeat option is available to disable the pressure compensator override when the motor is running in pump mode.

The pressure compensator option features a low pressure rise (short ramp) to ensure optimal power utilization throughout the entire displacement range of the motor. The pressure compensator is also available as a stand-alone regulator.

- The series 51 and 51-1 motors – Advanced technology today
- The most technically advanced hydraulic units in the industry
- SAE, cartridge, and DIN flange motors
- Cartridge motors designed for direct installation in compact planetary drives
- Large displacement ratio (5:1)
- Complete family of control systems
- Proven reliability and performance
- Optimum product configurations
- Compact, lightweight

© 2002, Sauer-Danfoss

Sauer-Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Sauer-Danfoss reserves the right to alter its products without prior notice. This also applies to products already ordered provided that such alterations can be made without subsequent changes being necessary in specifications already agreed. All trademarks in this material are properties of the respective companies. Sauer-Danfoss and the Sauer-Danfoss logotype are trademarks of the Sauer-Danfoss Group. All rights reserved.

Front page: F300550, F300542, F300541, F300549, P001964E

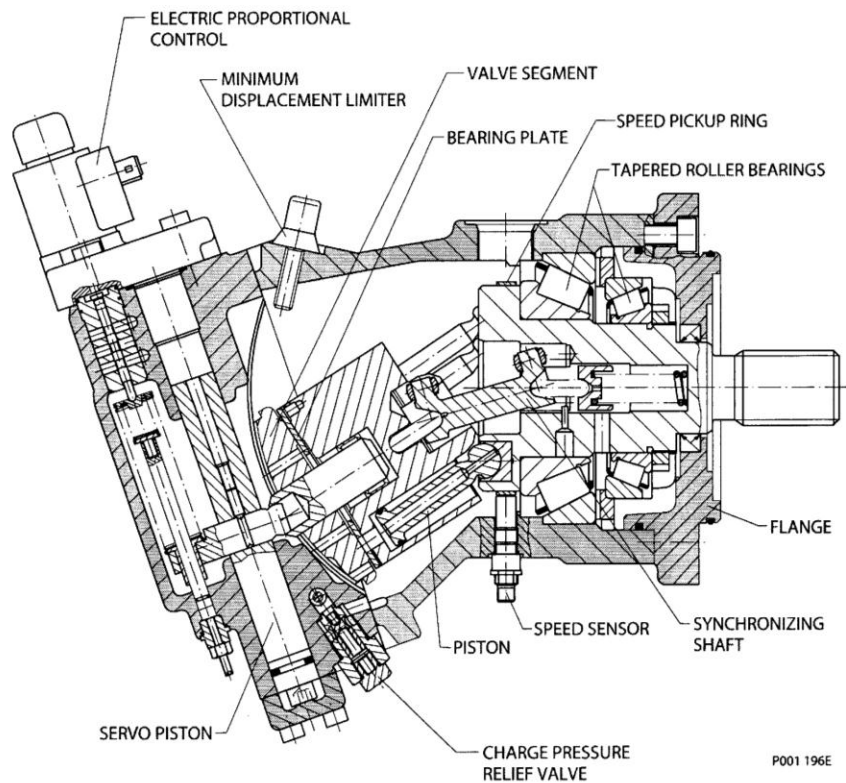
DKMH.PK.340.A1.02 520L0440 - 02/2002

# TECHNICAL DATA FOR HYDRAULIC MOTOR



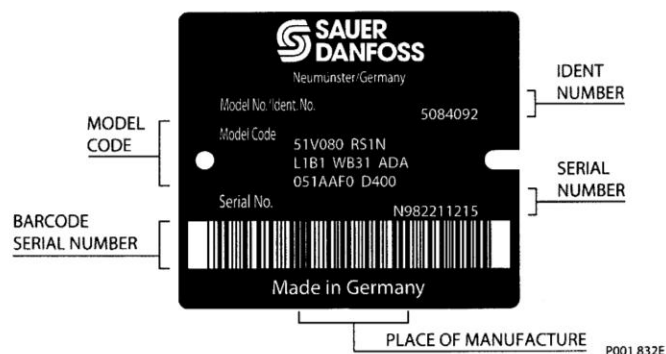
## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information Sectional View

### SERIES 51, PROPORTIONAL CONTROL



P001 196E

### Name Plate



P001 832E

# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information Technical Specifications

### GENERAL SPECIFICATIONS

Most specifications for bent axis variable displacement motors are listed on these pages. For definitions of the various specifications, see the related pages in this publication. Not all hardware options are available for all configurations; consult the series 51 and 51-1 model code supplement or price book for more information.

General Specifications	
Motor type	Axial piston motor with variable displacement bent axis design.
Direction of rotation	Clockwise and counter-clockwise (bi-directional).
Installation position	Discretionary, the housing must always be filled with hydraulic fluid.
Other system requirements	Independent braking system, circuit overpressure protection, suitable reservoir.

### SPECIFIC DATA

Specific Data							
Dimension			Frame size				
			060	080	110	160	250
Displacement maximum	$V_{g_{max}}$	cm <sup>3</sup> [in <sup>3</sup> ]	60.0 [3.66]	80.7 [4.92]	109.9 [6.71]	160.9 [9.82]	250.0 [15.26]
Displacement minimum	$V_{g_{min}}$	cm <sup>3</sup> [in <sup>3</sup> ]	12.0 [0.73]	16.1 [0.98]	22.0 [1.34]	32.2 [1.96]	50.0 [3.05]
Rated flow	Q	l/min [US gal/min]	216 [57]	250 [66]	308 [81]	402 [106]	550 [145]
Maximum flow	$Q_{max}$	l/min [US gal/min]	264 [70]	323 [85]	396 [105]	515 [136]	675 [178]
Maximum corner power	P corner max.	kW [hp]	336 [450]	403 [540]	492 [660]	644 [864]	850 [1140]
Weight with control HZ	m	kg [lb]	28 [62]	32 [71]	44 [97]	56 [123]	86 [190]
Mass moment of inertia of the internal rotating parts	J	kgm <sup>2</sup> [lb·ft <sup>2</sup> ]	0.0046 [0.1092]	0.0071 [0.1685]	0.0128 [0.3037]	0.0234 [0.5553]	0.0480 [1.1580]
Type of mounting	Four (4) bolt flange, SAE or DIN-flange configuration. Two (2) bolt flange cartridge motor configuration.						
Pipe connections	Main pressure ports: SAE-flange. Remaining ports: SAE straight thread O-ring boss.						
Controls	N1, HZ, E1, E2, E7, F1, F2, T1, T2, TA, TH, EP, EQ, L1, L2, L7, D7, D8, HS						
Displacement limiter	All Series 51 motors incorporate mechanical minimum and maximum displacement limiters.						
Shaft configuration	Splined ANSI or DIN shaft.						

# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information Technical Specifications

### SPECIFIC DATA (continued)

Case Pressure		
	bar	[psi]
Rated pressure	3	[44.0]
Maximum pressure (cold start)	5	[73.0]
Minimum pressure (at rated speed)	1	[14.5]

System Pressure Range, Input		
Maximum delta pressure	480 bar	[7000 psid]
Minimum low pressure	10 bar	[145 psig]
Maximum pressure	510 bar	[7400 psig]

Speed Limits						
min <sup>-1</sup> (rpm)						
Frame size		060	080	110	160	250
Rated speed	at max. disp.	3600	3100	2800	2500	2200
	at min. disp.	5600	5000	4500	4000	3400
Maximum speed <sup>1)</sup>	at max. disp.	4400	4000	3600	3200	2700
	at min. disp.	7000	6250	5600	5000	4250

<sup>1)</sup> Contact your Sauer-Danfoss representative for max. speed at displacements between max. and min. displacement.

Theoretical Torque						
Frame size		060	080	110	160	250
At maximum displacement	Nm/bar	0.95	1.28	1.75	2.56	3.98
	[lbf·in/1000 psi]	[583]	[784]	[1067]	[1563]	[2428]
At minimum displacement	Nm/bar	0.19	0.26	0.35	0.51	0.80
	[lbf·in/1000 psi]	[117]	[156]	[214]	[313]	[486]

### FLUID SPECIFICATIONS

Temperature Range <sup>1)</sup>		
	°C	[°F]
Minimum	-40	[-40]
Rated	104	[220]
Maximum	115	[240]

<sup>1)</sup> At the hottest point, normally the case drain port.

Viscosity		
	mm <sup>2</sup> /s	[SUS]
Minimum	7	[49]
Recommended operating range	12-80	[70-370]
Maximum	1600	[7500]

Cleanliness Level and $\beta_x$ -Ratio	
Required fluid cleanliness level	ISO 4406 Class 18/13
Recommended $\beta_x$ -ratio for suction filtration	$\beta_{35-45}=75$ ( $\beta_{10} \geq 2$ )
Recommended $\beta_x$ -ratio for charge pressure filtration	$\beta_{15-20}=75$ ( $\beta_{10} \geq 10$ )
Recommended inlet screen size for charge pressure filtration	100 $\mu$ m-125 $\mu$ m

# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Technical Specifications

### CASE PRESSURE

Under normal operating conditions, case pressure must not exceed the **rated pressure**. Momentary case pressure exceeding this rating is acceptable under cold start conditions, but still must stay below the **maximum pressure** rating. The **minimum pressure** provides proper lubrication at high speeds. Operation with case pressure in excess of these limits may result in external leakage due to damage to seals, gaskets, and/or housings.

Case Pressure		
	bar	[psi]
Rated pressure	3	[44.0]
Maximum pressure (cold start)	5	[73.0]
Minimum pressure (at rated speed)	1	[14.5]

### SPEED RANGE

**Rated Speed** is the speed limit recommended at full power condition and is the highest value at which normal life can be expected.

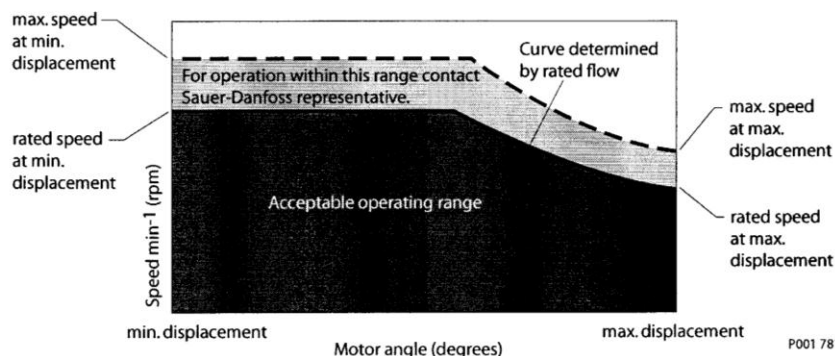
**Maximum Speed** is the highest operating speed permitted and cannot be exceeded without reduction in the life of the product or risking immediate failure and loss of driveline power (which may create a safety hazard). In the range between rated and maximum speed please contact your Sauer-Danfoss representative.

**Warning:** The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or "neutral" mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

Speed Limits						
		min <sup>-1</sup> (rpm)				
Frame size		060	080	110	160	250
Rated speed	at max. disp.	3600	3100	2800	2500	2200
	at min. disp.	5600	5000	4500	4000	3400
Maximum speed <sup>1)</sup>	at max. disp.	4400	4000	3600	3200	2700
	at min. disp.	7000	6250	5600	5000	4250

<sup>1)</sup> Contact your Sauer-Danfoss representative for max. speed at displacements between max. and min. displacement.

### Speed Limits



# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Technical Specifications

### PRESSURE LIMITS

System pressure is the dominant operating variable affecting hydraulic unit life. High pressure, which results from high load, reduces expected life in a manner similar to the affects of high load on other mechanical assemblies such as engines and gear boxes. There are load-to-life relationships for the rotating group and for the shaft anti-friction bearings.

Continuous pressure is the pressure at which the hydrostatic system could operate continuously and still achieve acceptable hydrostatic life. This pressure level varies depending on operating speed, and on the life requirements for a particular application. While most mobile applications require system pressure to vary widely during operation, a "weighted average" pressure can be derived from a machine duty cycle. (A duty cycle is a means of quantifying the pressure and speed demands of a particular system on a percent time basis). Once a duty cycle has been determined or estimated for a specific application, contact your Sauer-Danfoss representative for system life ratings for the application.

**Maximum delta pressure** is the highest intermittent pressure allowed, and is the relief valve setting. It is determined by the maximum machine load demand. For most systems, the load should move at this pressure.

**Maximum pressure** is assumed to occur a small percentage of operating time, usually less than 2 % of the total. Both the continuous and maximum pressure limits must be satisfied to achieve the expected life.

**Minimum low pressure** must maintained under all operating conditions to avoid cavitation.

System Pressure Range, Input		
Maximum delta pressure	480 bar	[7000 psid]
Minimum low pressure	10 bar	[145 psig]
Maximum pressure	510 bar	[7400 psig]

### LOOP FLUSHING

An integral non-adjustable loop flushing valve is incorporated into all these motors. Installations that require fluid to be removed from the low pressure side of the system circuit because of cooling requirements or contamination removal will benefit from loop flushing.

The integral loop flushing valve is equipped with an orificed charge pressure relief valve designed with a cracking pressure of 16 bar [232 psi]. Valves are available with several orifice sizes to meet the flushing flow requirements of all system operating conditions.

The total system charge pump flow should be of sufficient volume to accommodate:

- The number of motors in the system
- System efficiency under worst case conditions
- Pump control requirements
- External needs

# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors

### Technical Information

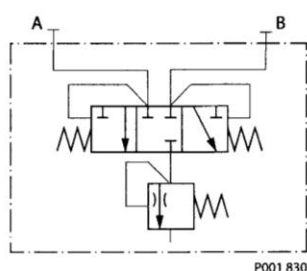
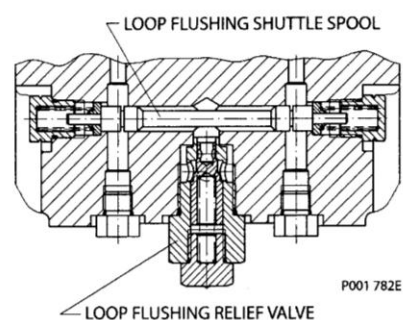
### General Technical Specifications

#### LOOP FLUSHING (continued)

Although charge pump sizing requires the consideration of many system variables, the following table gives a recommendation of what charge pump displacement may be required to accommodate the flushing flow of each available charge relief valve orifice.

Recommended Charge Pump Displacement							
Loop flushing valve	E4	E6	F0	F3	G0	G3	H0
Charge pump size (cm <sup>3</sup> )	8	8	11	14	17 or 20	26	34, 47 or 65

**Warning:** The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or "neutral" mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

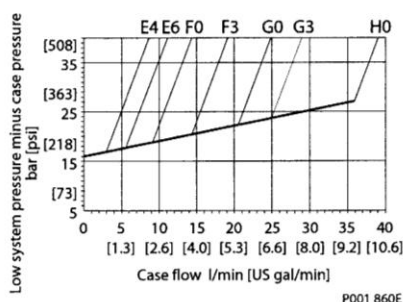


#### Equation:

$$Q_{\text{Flush}} = \frac{Q_{\text{Charge}} - Q_{\text{Leak}}}{2 \cdot k_{\text{Mo}}}$$

#### Where:

- $Q_{\text{Flush}}$  = flushing flow per motor
- $Q_{\text{Charge}}$  = charge flow at operating speed
- $k_{\text{Mo}}$  = number of motors fed by one pump
- $Q_{\text{Leak}}$  = sum of external leakages including
  - motor leakage
  - pump leakage + internal consumers: 8 l/min [2.11 US gal/min] for displacement control pumps
- or**
- for non-feedback controlled pumps at 200 bar [2900 psi]
- external consumers (e.g. brakes, cylinders, and other pumps)





# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Technical Specifications

### MINIMUM DISPLACEMENT LIMITER

All Series 51 and 51-1 motors incorporate mechanical displacement limiters. The minimum displacement of the motor is preset at the factory with a set screw in the motor housing. A tamper-proof cap is provided.

### HYDRAULIC FLUIDS

Ratings and data are based on operating with hydraulic fluids containing oxidation, rust and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion and corrosion of the internal components.

Fire resistant fluids are also suitable at modified operating conditions. Please see Sauer-Danfoss literature *Hydraulic Fluids and Lubricants Technical Information* for more information.

It is not permissible to mix hydraulic fluids. For more information contact your Sauer-Danfoss representative.

Suitable Hydraulic fluids:

- Hydraulic fluids per DIN 51 524, part 2 (HLP)
- Hydraulic fluids per DIN 51 524, part 3 (HVLP)
- API CD, CE and CF engine fluids per SAE J183
- M2C33F or G automatic transmission fluids (ATF)
- Agricultural multi purpose oil (STOU)
- Premium turbine oils  
(for Premium turbine oils contact your Sauer-Danfoss representative).

### TEMPERATURE AND VISCOSITY

Temperature and viscosity requirements must be concurrently satisfied. The data shown in the tables assume petroleum-based fluids, are used.

The high temperature limits apply at the hottest point in the transmission, which is normally the motor case drain. The system should generally be run at or below the **rated temperature**. The **maximum temperature** is based on material properties and should never be exceeded.

Cold oil will generally not affect the durability of the transmission components, but it may affect the ability to flow oil and transmit power; therefore temperatures should remain 16 °C [30 °F] above the pour point of the hydraulic fluid. The **minimum temperature** relates to the physical properties of component materials.

For maximum unit efficiency and bearing life the fluid viscosity should remain in the **recommended operating range**. The **minimum viscosity** should be encountered only during brief occasions of maximum ambient temperature and severe duty cycle operation. The **maximum viscosity** should be encountered only at cold start.

Heat exchangers should be sized to keep the fluid within these limits. Testing to verify that these temperature limits are not exceeded is recommended.

# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Technical Specifications

### TEMPERATURE AND VISCOSITY (continued)

Temperature Range <sup>1)</sup>		
	°C	[°F]
Minimum	-40	[-40]
Rated	104	[220]
Maximum	115	[240]

<sup>1)</sup> At the hottest point,  
normally the case drain port.

Viscosity		
	mm <sup>2</sup> /s	[SUS]
Minimum	7	[49]
Recommended operating range	12-80	[70-370]
Maximum	1600	[7500]

### FLUID AND FILTRATION

To prevent premature wear, it is imperative that only clean fluid enter the hydrostatic transmission circuit. A filter capable of controlling the fluid cleanliness to ISO 4406 Class 18/13 (SAE J1165) or better under normal operating conditions is recommended.

The filter may be located either on the inlet (suction filtration) or discharge (charge pressure filtration) side of the charge pump. The selected filtration system must maintain a cleanliness level of 18/13 per ISO 4406.

The selection of a filter depends on a number of factors including the contaminant ingress rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Filters are selected to meet the above requirements using rating parameters of efficiency and capacity.

Filter efficiency may be measured with a Beta ratio<sup>1)</sup> ( $\beta_x$ ). For simple suction-filtered closed circuit transmissions and open circuit transmissions with return line filtration, a filter with a  $\beta$ -ratio within the range of  $\beta_{35-45} = 75$  ( $\beta_{10} \geq 2$ ) or better has been found to be satisfactory. For some open circuit systems, and closed circuits with cylinders being supplied from the same reservoir, a considerably higher filter efficiency is recommended. This also applies to systems with gears or clutches using a common reservoir. For these systems, a charge pressure or return filtration system with a filter  $\beta$ -rotation in the range of  $\beta_{15-20} = 75$  ( $\beta_{10} \geq 10$ ) or better is typically required.

Since each system is unique, the filtration requirement for that system will be unique and must be determined by test in each case. It is essential that monitoring of prototypes and evaluation of components and performance throughout the test program be the final criteria for judging the adequacy of the filtration system. Please see Sauer-Danfoss literature *Hydraulic Fluids and Lubricants Technical Information* for more information.

<sup>1)</sup> Filter  $\beta_x$ -ratio is a measure of filter efficiency defined by ISO 4572. It is defined as the ratio of the number of particles greater than a given diameter ("x" in  $\mu\text{m}$ ) upstream of the filter to the number of these particles downstream of the filter.

Cleanliness Level and $\beta_x$ -Ratio	
Required fluid cleanliness level	ISO 4406 Class 18/13
Recommended $\beta_x$ -ratio for suction filtration	$\beta_{35-45} = 75$ ( $\beta_{10} \geq 2$ )
Recommended $\beta_x$ -ratio for charge pressure filtration	$\beta_{15-20} = 75$ ( $\beta_{10} \geq 10$ )
Recommended inlet screen size for charge pressure filtration	100 $\mu\text{m}$ -125 $\mu\text{m}$

# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Technical Specifications

### INDEPENDENT BRAKING SYSTEM

---

**Warning:** The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or "neutral" mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

---

### RESERVOIR

The function of the reservoir is to remove air and to provide make up fluid for volume changes associated with fluid expansion or contraction, possible cylinder flow, and minor leakage.

The reservoir should be designed to accommodate maximum volume changes during all system operating modes and to promote deaeration of the fluid as it passes through the tank.

A minimum reservoir volume equal to 1/2 to 1 1/2 times charge pump flow/min is suggested. This allows 30 seconds fluid dwell for removing entrained air at the maximum return flow. This is usually adequate to allow for a closed reservoir (no breather) in most applications. The reservoir outlet to the charge pump inlet should be above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the charge inlet line.

The reservoir inlet (fluid return) should be positioned so that the flow to the reservoir is discharged below the normal fluid level, and also directed into the interior of the reservoir for maximum dwell and efficient deaeration.

# TECHNICAL DATA FOR HYDRAULIC MOTOR

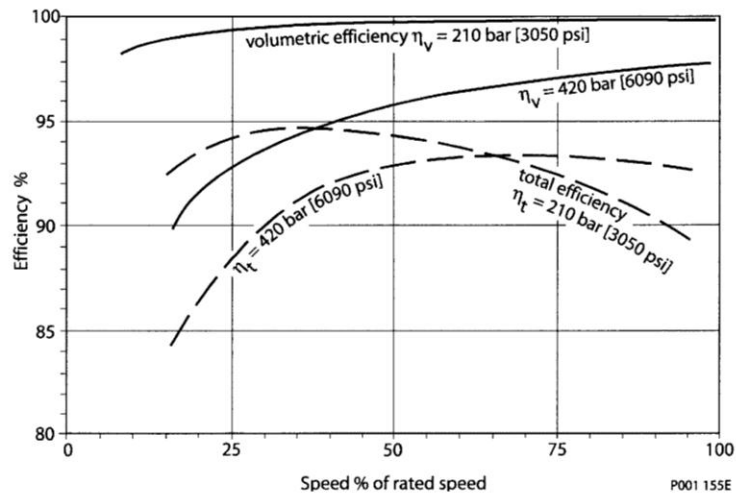


## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Technical Specifications

### EFFICIENCY GRAPHS AND MAPS

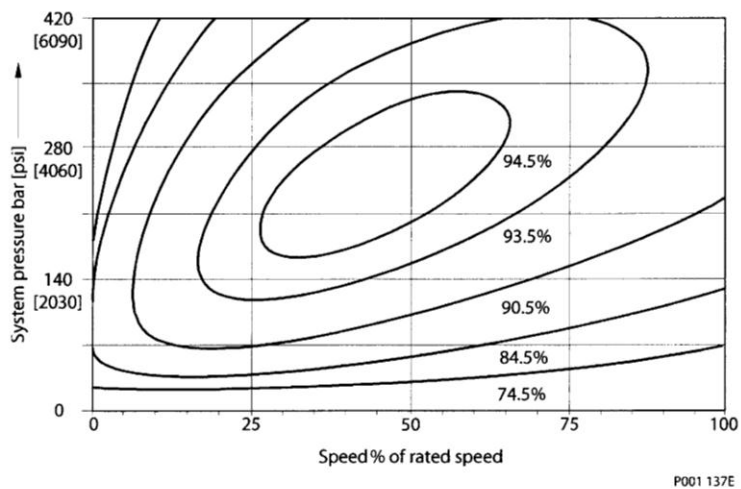
This graph provides the volumetric and overall efficiencies for a typical Series 51 and 51-1 motor operating at maximum displacement, system pressures of 210 and 420 bar [3050 and 6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s [53 SUS]. These efficiencies can be used for all frame sizes.

**Overall efficiency and volumetric efficiency at maximum displacement**



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s [53 SUS]. These efficiencies can be used for all frame sizes.

**Overall efficiency at maximum displacement**



# TECHNICAL DATA FOR HYDRAULIC MOTOR

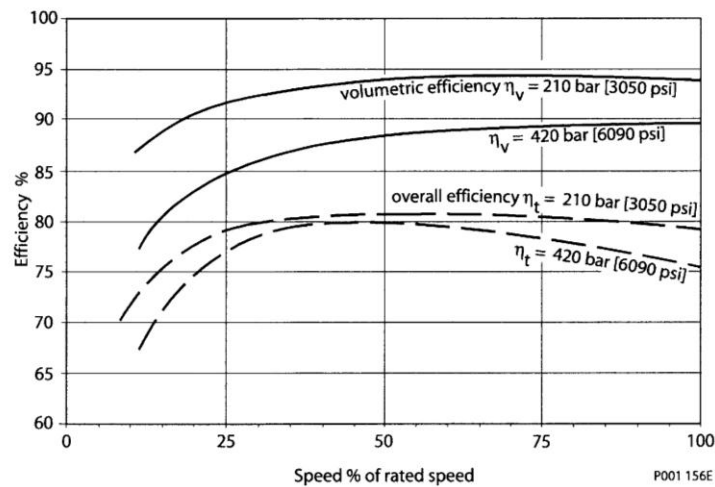


## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Technical Specifications

### EFFICIENCY GRAPHS AND MAPS (continued)

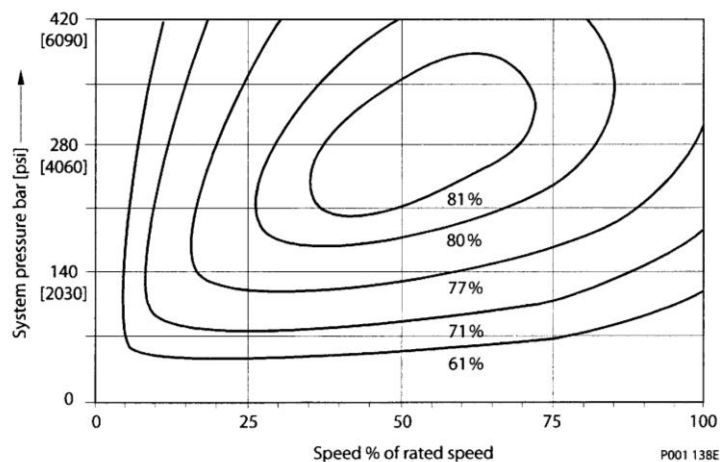
This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at 30% of maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s (53 SUS). These efficiencies can be used for all frame sizes.

**Overall efficiency and volumetric efficiency at 30% of maximum displacement**



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at 30% of maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s (53 SUS). These efficiencies can be used for all frame sizes.

**Overall efficiency at 30% of maximum displacement**



# TECHNICAL DATA FOR HYDRAULIC MOTOR



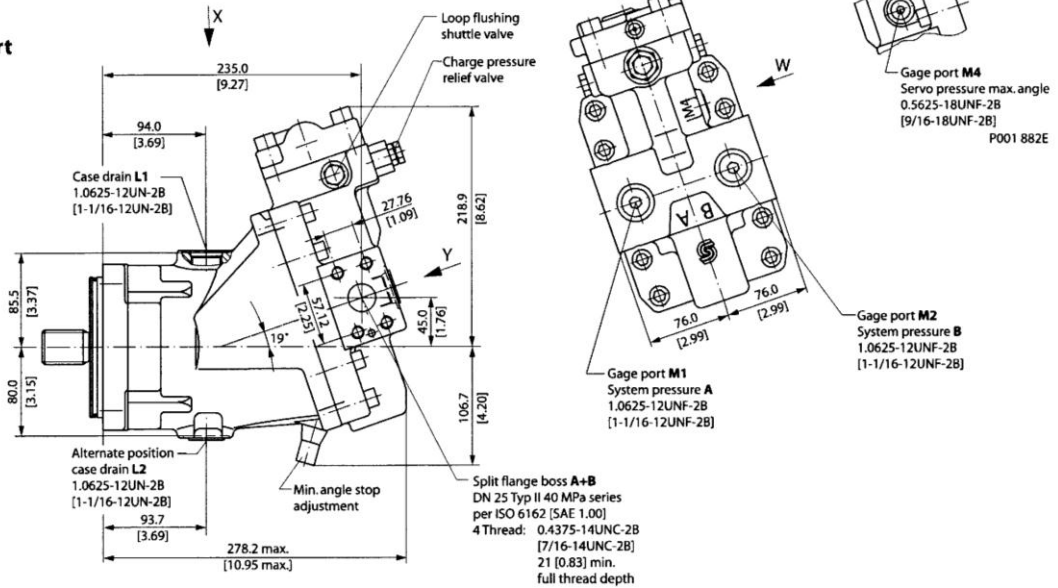
## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Dimensions – Frame Size 080

SAE FLANGE DESIGN  
PER ISO 3019/1

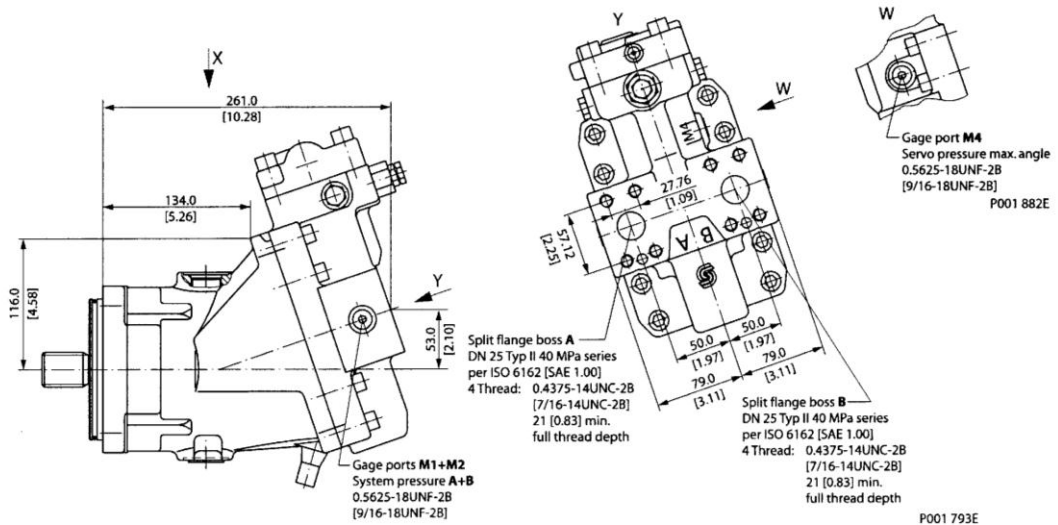
51V080-1 Two Position Control, N1NN

mm  
[in]

### Side Port



### Axial Port



# TECHNICAL DATA FOR HYDRAULIC MOTOR



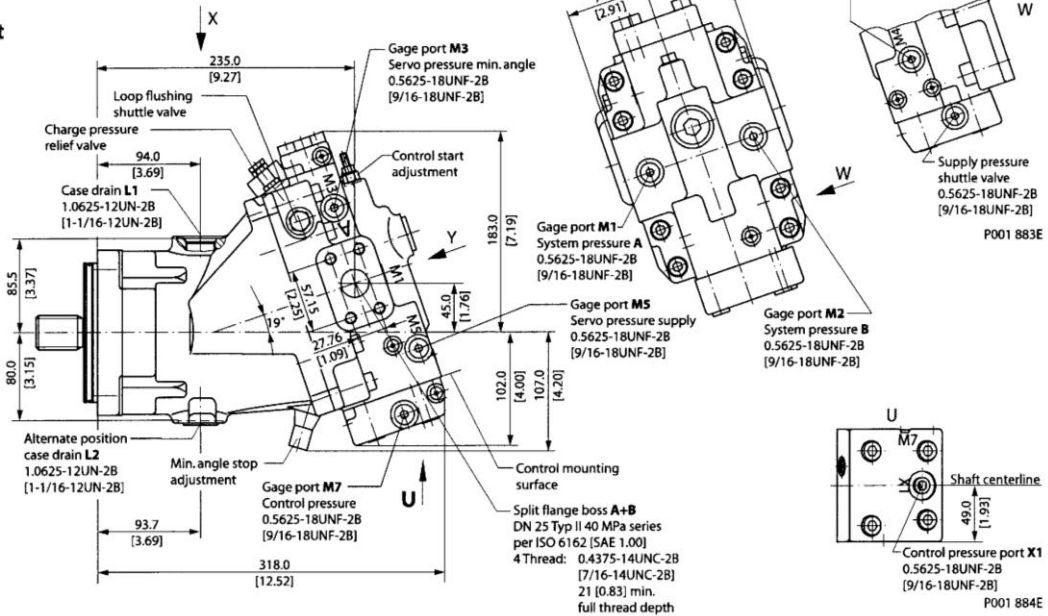
## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information General Dimensions – Frame Size 080

SAE FLANGE DESIGN  
PER ISO 3019/1  
(continued)

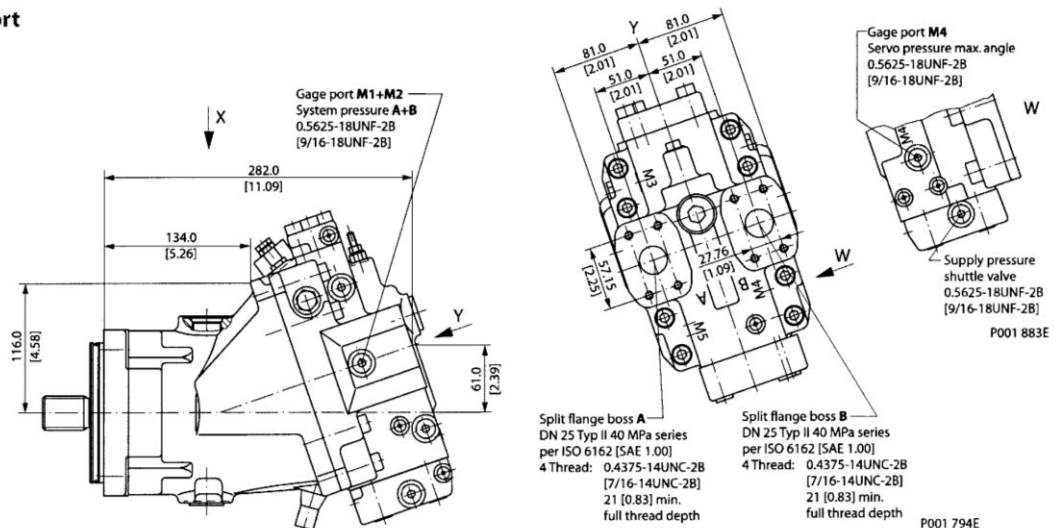
51V080 Proportional and Two-Position Control, HZB1

mm  
[in]

### Side Port



### Axial Port



# TECHNICAL DATA FOR HYDRAULIC MOTOR



## Series 51 and 51-1 Bent Axis Variable Displacement Motors Technical Information Dimension – Controls

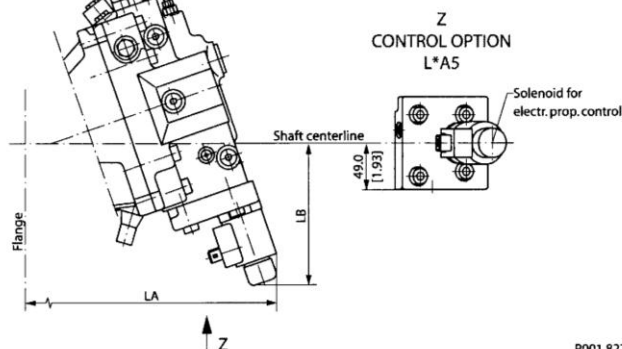
### ELECTROHYDRAULIC PROPORTIONAL CONTROL – OPTIONS

L1A5, L2A5, L7A5

FOR 51

FRAME SIZE  
060, 080, 110, 160, 250

mm  
[in]



P001 827E

Control Options L1A5, L2A5, L7A5 for 51															
Frame size	060			080			110			160			250		
Design	V	D	C	V	D	C	V	D	C	V	D	C	V	D	C
LA mm [in]	321 [12.63]	296 [11.66]	236 [9.31]	344 [13.55]	320 [12.60]	242 [9.52]	363 [14.28]	331 [13.02]	248 [9.77]	402 [15.84]	370 [14.58]	266 [10.47]	454 [17.87]	—	—
LB mm [in]	144 [5.66]			150 [5.90]			151 [5.96]			159 [6.27]			168 [6.61]		

V = SAE-flange, D = DIN-flange, C = Cartridge-flange  
— = not available

### Solenoid Connectors

**Solenoid plug face  
for DIN 46350**  
(Supplied Connector)

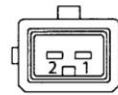
Mating Connector  
No.: K09129  
Id.-No.: 514117



P001 752E

**AMP Junior Timer  
two pin connector**  
(Supplied Connector)

Mating Connector  
No.: K19815  
Id.-No.: 508388



P001 751E

Shaft rotation is determined by viewing from shaft end.

Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

Splite flange boss A and B per ISO 6162 is identical with high pressure series SAE J518 code 62 (6000 psi).

Contact your Sauer-Danfoss representative for specific installation drawings.



## **LIMITED WARRANTY**

1.1 Andersen issue a three-year warranty on all their products covering manufacturing and material defects on condition that the products are used in normal fashion. The warranty shall apply for three years from the moment ANDERSEN sell the product concerned (to the first buyer).

1.2 Within the period of the warranty, and in accordance with the terms of the warranty, ANDERSEN undertake to replace or repair all defective components which have been used in normal fashion.

1.3 However, the warranty is subject to the limitations and exceptions outlined below.

### **2. Conditions and limitations:**

2.1 ANDERSEN's liability shall be limited to repair or replacement of components which are defective owing to manufacturing or material defects.

2.2 ANDERSEN assume no other liability than this, not even liability for indirect losses caused by defect concerned, including operating losses, loss of profits, or damage caused to real property or moveable property occurring while the product concerned is in the position of the Buyer.

2.3 The Buyer alone shall bear the responsibility and risk involved as to whether the products is suitable for the application intended. ANDERSEN assume no liability in this connection.

2.4 ANDERSEN assume no liability for defects which occur due to use of their products for purposes for which they are not intended, or for defects which occur owing to incorrect installation, corrosion, ultraviolet degradation, lack of maintenance, or any alteration or repair of the product carried out incorrectly by the Buyer. Finally, ANDERSEN assume no liability for normal wear and tear, or for depreciation of value.

2.5 Nor do ANDERSEN assume any liability for service carried out by anyone other than authorised representatives of ANDERSEN, unless such service is carried out pursuant to guidelines laid down by ANDERSEN and in accordance with good craftsmanship.

2.6 The buyer shall inform ANDERSEN in writing of any defects with no undue delay once defects have been registered. Products being dealt with under the warranty shall be returned to ANDERSEN for repair unless any other agreement has been reached in writing.

2.7 ANDERSEN shall not cover costs incurred by the Buyer in connection with the transport or wages involved in a warranty case. Such costs shall be met by the Buyer in full.

### **3. Exceptions:**

3.1 The warranty is only valid for one year in respect of components bought for the products concerned, such as electric motors, electric equipment, hydraulic pumps, motors and valves.

3.2 ANDERSEN assume no liability for consequential damage of ships, equipment, property or people by defects in ANDERSEN's products.

3.3 The company's products are subject to continuous development, and consequently ANDERSEN reserve the right to change designs and specifications without prior notice.

# WORLDWIDE DISTRIBUTION & SERVICE

## ANDERSEN Argentina

Argen Mast & Systems s.r.l.  
Av. Tiscornia 963  
(1642) San Isidro  
Buenos Aires  
Tel.: 11 4742 44 62  
Fax: 11 4742 44 62  
E-mail: info@argenmast.com.ar  
Web: www.argenmast.com.ar

## ANDERSEN Australia

Allyacht Spars Australia 1853 Lytton Rd.,  
Lytton  
Queensland  
Australia 4178  
Tel.: 07 3893 2233  
Fax: 07 3893 2478  
E-mail: info@allyachtspars.com.au  
Web: www.allyachtspars.com.au

## ANDERSEN Austria

Robert Lindemann KG  
Wendenstrasse 455  
D-20537 Hamburg  
Tel.: 040 21 11 970  
Fax: 040 21 11 97 30  
E-mail: info@lindemann-kg.de  
Web: www.lindemann-kg.de

## ANDERSEN Belgium

Jupiter Handelsmijl. BVBA  
Helststraat 51/12  
B-2630 Aartselaar  
Tel.: 03 457 43 81  
Fax: 03 457 68 21  
E-mail: info@jachtenjupiter.com  
Web: www.jachtenjupiter.com

## ANDERSEN Canada

Rekord Marine Enterprises Ltd  
8194 Ontario Street  
Vancouver, B.C., V5X 3E3  
Tel.: 604 325 5233  
Fax: 604 325 0326  
Toll free fax: 1-800-663-6424  
E-mail: jeremy@rekord-marine.com  
Web: www.rekord-marine.com

## ANDERSEN Croatia

Navela  
Castropola 54  
HR-52100 Pula  
Croatia  
Tel.: 052 214 542  
Fax: 052 213 558  
E-mail: navela@pu.t-com.hr  
Web: www.navela.hr

## ANDERSEN Czech Republic

Nereide Yachting Ltd.  
Vybiralova 972/70  
CZ-19800 Prague 9  
Tel: 605 25 98 82  
Fax: 257 94 17 84  
E-mail: office@nereide-yachting.com  
Web: www.nereide-yachting.com

## ANDERSEN Denmark

WATSKI A/S  
Savsvinget 4  
DK-2970 Hørsholm  
Tel.: 45 76 40 11  
Fax: 45 76 40 12  
E-mail: kontaktdk@watski.com  
Web: www.watski.dk

## ANDERSEN Finland

Ky Jotiko-Marine Kb  
Unioninkatu 45  
SF-00170 Helsinki  
Tel.: 103 870 500  
Fax: 103 870 509  
E-mail: info@jotiko-marine.com  
Web: www.jotiko-marine.com

## ANDERSEN France

Greement Import – Head office:  
13 rue du Chêne Lassé  
Z.I. BP 284  
44803 Saint Herblain  
Tel.: 02 28 03 01 01  
Fax: 02 28 03 19 91  
E-mail: contact@greementimport.fr  
Web: www.greementimport.fr

## ANDERSEN Germany

Herman Gotthardt GmbH  
Leunastrasse 50  
D-22761 Hamburg  
Tel.: 040 851 50 50  
Fax: 040 850 91 33  
E-mail: info@gotthardt-yacht.de  
Web: www.gotthardt-yacht.de

## ANDERSEN Great Britain

IMP  
Jarman Way  
Royston  
Hertfordshire SG8 5HW  
Tel.: 01 763 241 300  
Fax : 01 763 241 770  
E-mail: sales@improducts.co.uk  
Web: www.improducts.co.uk

## ANDERSEN Greece

Meltemi Yachting Ltd.  
4, Metamorfoseos st Alimos  
GR-17455 Athens  
Tel.: 210 9849983  
Fax: 210 9844356  
E-mail: info@meltemi-yachting.gr  
Web: www.meltemi-yachting.gr

## ANDERSEN Hong Kong

Storm Force Marine Ltd  
1204 Dominion Centre  
43-53 Queens Road East  
Wanchai, Hong Kong  
Tel.: +852 2866 0114  
Fax: +852 2866 9260  
E-mail:simon@stormforcemarine.com  
Web:www.stormforcemarine.com

## ANDERSEN Hungary

Marina Yacht Sport  
Bécsi út 118. H-1037 Budapest  
Tel.: 1 322 86 55  
Fax: 1 322 9834  
E-mail: iroda@marina.hu  
Web: www.marina.hu

## ANDERSEN Italy

TOMASONI TOPSAIL S.p.A.  
Via E.Toti 55  
16035 Rapallo (GE)  
Tel.: 0185 2001  
Fax: 0185 263 160  
E-mail: vela@tomasoni.com  
Web: www.tomasoni.com/tecnico

## ANDERSEN Netherlands

Nautec Engineering B.V.  
Muyterweg 17  
6075 AM Herkenbosch  
Tel.: 0475 537760  
Fax: 0475 537759  
E-mail: info@nautec.nl  
Web: www.nautec.nl

## ANDERSEN New Zealand

Nordic Marketing Ltd.  
P.O. Box 100669  
NSPS, North Shore City  
Tel.: 09 488 7605  
Fax: 09 488 7608  
E-mail: nordic@xtra.co.nz  
Web: www.nordic.co.nz

## ANDERSEN Norway

Skaane Marine AS  
Bromsveien 5  
N-3183 Horten  
Tel.:33 02 05 90  
Fax:33 02 05 99  
E-mail: post@skaane.no  
Web: www.skaane.no

## ANDERSEN Poland

Sail Service  
ul.Sienna 45  
80-605 Gdansk  
Tel.: 58 3 222 822  
Fax: 58 3 222 802  
E-mail: office@sailservice.com.pl  
Web: www.sailservice.com.pl

## ANDERSEN Portugal

Just Boats  
Lote 32, Urb. Goldra  
8100-263 Loulé  
Tel.: 289 994 204  
Fax: 289 994 485  
E-mail: info@just-boats.net  
Web: www.just-boats.net

## ANDERSEN Russia

Yachtglanz - Marine Equipment  
Portugiesischer Weg 14  
D-44143 Dortmund  
Tel.: +49 (0)231 996 48 35  
Fax: +49 (0)231 530 74 47  
E-mail: info@yachtglanz.com  
Web: www.yachtglanz.com

## ANDERSEN Singapore

Alquest Marketing  
66, Tannery Lane  
#02-06B Sindo Building  
Singapore 347805  
Tel.: 6749 9359  
Fax.: 6749 9360  
E-mail: jason@alquest.com.sg  
Web.: www.alquest.com

## ANDERSEN Slovenia

Tramontana  
Tesovnikova 88  
1000 Ljubljana  
Tel.: 01 568 37 32  
Fax: 01 565 48 88  
E-mail: info@tramontana-net.si  
Web: www.tramontana-net.si

## ANDERSEN South Africa

Manex & Power Marine  
5 Industry Street  
P.O. Box 173  
Paarden Eiland 7420 Cape Town  
Tel.: 021 511 7292  
Fax: 021 510 1487  
E-mail: manex@manex.co.za  
Web: www.manex.co.za

## ANDERSEN Spain/Mallorca

Yacht Riggers Mallorca, s.l.  
Passeig República Argentina, 34 bajos  
E-07200 FELANITX (Mallorca)  
Tel.: 971 58 41 30  
Fax: 971 58 41 31  
E-mail: info@yachtriggers.com  
Web: www.yachtriggers.com

## ANDERSEN Spain/Barcelona

Pertrechos Nauticos S.L.  
Buscarons, 6 bj. local 2  
08022 Barcelona  
Tel.: 93 418 66 32  
Fax.: 93 418 56 48  
info@pertrechosnauticos.com  
www.pertrechosnauticos.com

## ANDERSEN Sweden

Navimo Nordic AB  
Lundenvägen 2  
S-473 31 Henån  
Tel.: 0304 360 60  
Fax: 0304 307 43  
E-mail: info@navimo.se  
Web: www.navimo.se

## ANDERSEN Switzerland

Robert Lindemann KG  
Wendenstrasse 455  
D-20537 Hamburg  
Tel.: 040 21 11 97 0  
Fax: 040 21 11 97 30  
E-mail: info@lindemann-kg.de  
Web: www.lindemann-kg.de

## ANDERSEN Trinidad & Tobago

Soca Sails  
Crewsinn Marina, Chaguaramas  
P.O. Box 608  
Trinidad, West Indies  
Tel.: 868 634-4178  
Fax: 868 634-1044  
E-mail: info@socasails.com  
Web: www.socasails.com

## ANDERSEN Turkey

Enigma Yachts Supply & Services Ltd.  
İstanbul Deri ve End serbest Bölgesi  
Hasan Yelmen Cad No 12  
34957 Tuzla; Istanbul.  
Tel.: 216 394 21 44  
Fax: 216 394 22 19  
E-mail: turkey@andersenwinches.com  
Web: www.andersenwinches.com

## ANDERSEN Ukraine

Yachtglanz - Marine Equipment  
Portugiesischer Weg 14  
D-44143 Dortmund  
Tel.: +49 (0)231 996 48 35  
Fax: +49 (0)231 530 74 47  
E-mail: info@yachtglanz.com  
Web: http://www.yachtglanz.com/

## ANDERSEN U.S.A.

Scandvik Inc.  
423 4th place SW  
Vero Beach  
Florida 32962  
Tel.: 772 567 2877  
Fax: 772 567 9113 Toll Free 1-800-535-6009  
E-mail: info@scandvik.com  
Web: www.scandvik.com