FFS Fire Fighting Systems	DATA SHEETS FIRE PUMPS	Date:	30.10.2008
		Prep. By:	BSI
		Sheet no.:	1

Project No.:	07-013C
Customer ref.:	C653.1310.1958
Shipowner:	NA
Shipyard:	Astilleros Zamakona S.A.
Hull no.:	C653
Type of vessel:	Barcelona Tugs
Vessel name:	NA
Vessel Class	LRS
Fi-Fi Class	1

PROJECT ITEM NO. 06

CONTENTS

Item No:	Qty	Type	Location	Sheet No
06	2	SFP 250x350 HD 1365 m3/h 117 mlc	Stbd & Port	2
6A	2	1 ½ - 2 – 2 ½ Stripping Ejector	Stbd & Port	4

FFS Fire Fighting Systems	DATA SHEETS FIRE PUMPS	Date:	30.10.2008
		Prep. By:	BSI
		Sheet no.:	2

ITEM NO. 06 SFP Stbd & Port

General information		
Quantity	2	
Pump series	SFP	
Model	SFP 250x350 HD	
Manufacturer	FFS/Scanpump	
Design	Centrifugal	
Execution	Horizontal	
Casing	Radial split	
Suction	Single	
Design Criteria		
Fluid	Sea water	
Suction flange	DIN 350	
Discharge flange	DIN 250	
Pressure class, suction	PN16	
Pressure class, discharge	PN25	
Technical data		
Direction of rotation seen from input shaft	C.W.	
Capacity	1365	m3/h
Head	117	mlc
Speed	1800	rpm
Power	566	kW
NPSH (R)	7,3	meter
Impeller diameter	519	millimeter
Hydraulic efficiency	79,1	%
Weight	420 kg	kg
Shaft seal	Gland packing	
Material		
Casing	Nodular Cast Iron	
Shaft and Impeller	AISI329	
Impeller	AISI329	
Surface Treatment		
Base	Primer	
Coating	Epoxy, RAL3002	
Documentation		
Work test certificate	Yes	
Pump curve	07-013	
Approval	LRS	
Dimension print	X2000-950	
Engine room arrangement	07013	E1
Instruction manual	FFS-244, -245,- 251, 253	
TVC input	07013	T1
General data	FFS-252	
Sectional drawing	X-2000-150-PL	
Parts list	X-2000-600PL	

FFS Fire Fighting Systems	DATA SHEETS Priming ejector	**Date:**	30.10.2008
		Prep. By:	BSI
		Sheet no.:	4

ITEM NO. 6A Stripping Ejector Stbd & Port

General information	
Qty	2
Description	Stripping Ejector
Series	NA
Model	1 ½ - 2 – 2 ½
Manufacturer	Teamtec AS
Design	Water driving ejector
Execution	NA
Design Criteria	
Medium	Water
Integrated shut-off valve	NA
Compressed air solenoid valve	NA
Flange standard	PN10/16
Technical data	
Operating Voltage	NA
Protection Class	NA
Specific suction capacity	20m3/h@3mwc
Specific driving water capacity	8m3/h@9-8bar
Weight	23kg
Material	
Float chamber and ejector casing	NA
Nozzles	AISI316L
Body	Bronze
Coating	NCS5010G50Y
Documentation	
Work test certificate	Yes
Approval	NA
Dimension/Arrangement drawing	2301295 / 07013P2
Instruction manual	NA
General data	Yes

07-013C

Document No: FFS-252
Written by: OIB
Rev.01 / 03.01.2006

SFP HD
FIRE PUMP
SFP 250x350HD

Description

The **SFP HD** fire pump is a single stage centrifugal pump with horizontal inlet and vertical outlet. The pump offers a unique combination of high performance in relation to weight and dimensions.

The **SFP HD** fire pump is an extremely robust and short built unit, making it ideal for confined spaces like engine rooms. The pump is tailor-made for fire fighting duty with reliable operation and minimum maintenance requirements as main features. The pump is manufactured and performance tested in Scandinavia in accordance with the highest quality standards.

The sturdy pump feet are an integrated part of the pump casing – thus making the pump less susceptible of deformation caused by excessive pipe forces. The standard material for pump shaft and impeller is duplex stainless steel with superb strength and corrosion resistance. Ball bearing is permanently grease filled, and re-lubrication is not needed.

The suction performance of the impeller (NPSH) has been optimized by using the latest technology in 3D flow design. The double volute pump casing greatly reduces radial forces during operation and ensures maximum bearing life. The complete pump rotor assembly is balanced prior to installation to maintain a vibration free function in the total range of the pump.

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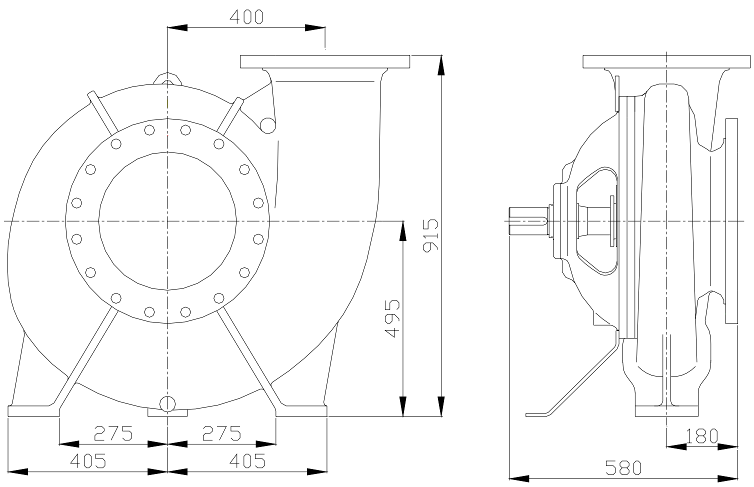
SFP HD
FIRE PUMP
SFP 250x350HD

Dimensions



The shown dimensions are a SFP pump with CW rotation. Note that the CCW rotation pump has mirrored dimensions.

Technical data

1 bar = 0,1 Mpa = 14,5 psi

Pump weight	420 kg
Direction of rotation	CW and CCW
Pump casing materials	Standard: Nodular cast iron
	Optional: Stainless steel and nickel-aluminium-bronze
Impeller and pump shaft	Duplex stainless steel
Shaft seal	Standard: Gland packing
	Optional: Mechanical seal
Static seal	Moulded O-ring
Wear rings	Renewable wear rings in pump casing and pump cover
	Material: High quality bronze
Coating	External red colour coating (RAL 3002)
Static pressure testing	24 bar for all pressure exposed parts
Performance testing	All pumps individually tested
Pump head/capacity curve	Each curve based upon factory testing
Nominal speed	1800 rpm
Nominal capacity	1641 m³/h
Nominal head	140 mlc
Inlet flange	DN350/PN16 (DIN 2526 Form A)
Outlet flange	DN250/PN25 (DIN 2526 Form A)

Certificate of Type Approval / Bureau Veritas

Certificate of Design Assessment / American Bureau of Shipping

Product subjected to technical changes without prior notice

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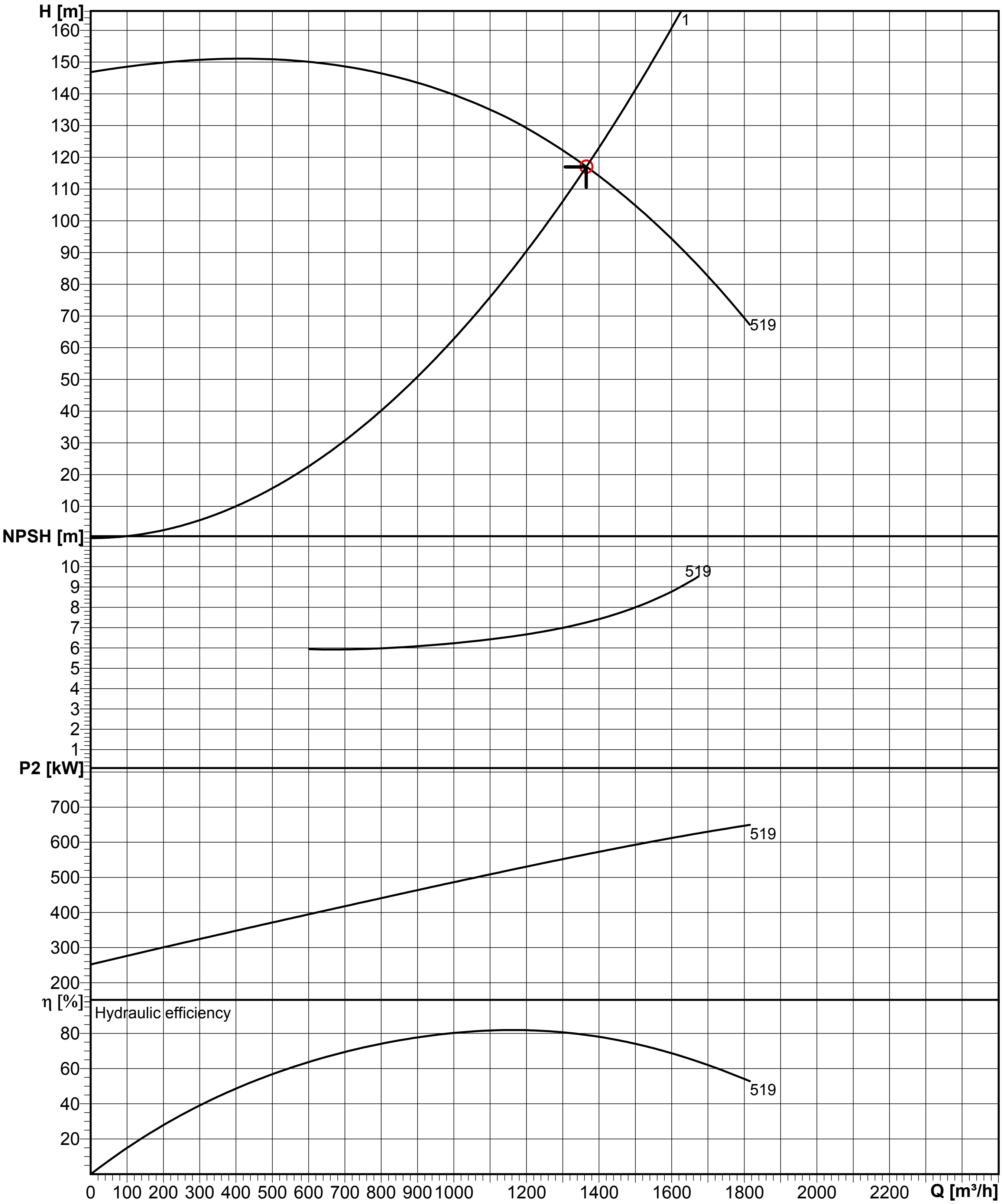
COST-EFFECTIVE PUMPING

Pump performance curves
SFP 250X350 HD

			Curve number 07-013	
			Reference curve 8093-1	
FFS fifi pumps for Zamakona C651,C652 & C653			Discharge DN250	Frequency 60 Hz
Density 1025 kg/m³	Viscosity 1 mm²/s	Testnorm ISO 2548C	Rated speed 1800 1/min	Date 2007-04-30
Flow 1365 m³/h	Head 117 m	Rated power 566 kW	Hydraulic efficiency 79,1 %	NPSH 7,3 m



Impeller size 519 mm	N° of vanes 6	Impeller SFP Closed multivane impeller	Solid size 80 x 63 mm	Revision 2003-03-10

ProcSel 1.7 / 2002-12-16

Calculation of suction side losses and NPSHa

Project: 07-013
Customer: Zamakona C651/C652/C653
Calc. by: BSI
Date: 16.08.2007 00:00

Following conditions apply:
Atmospheric pressure: 1,013x10^5 N/m^2
Liquid: Seawater
Hot dip galvanized pipes and bends
Bends 90 deg.

Drag coefficient ζ for reducers: 0,02
Sea chest area is twice the largest suction pipe area

Input chart

x): Input not necessary if calculating suction side losses only

Required NPSHr : x)		7,3	*m*
Note: To be found from pump curve			
Liquid level above impeller centreline: x)		0,073	*m*
Note: Negative value if liquid level is below impeller			
Seawater temperature: x)		20	°C
Note: Choose either 20 or 30 deg.C			
Flow in suction line :		1365	*m3/h*
Pipe A:	Inside diameter :	0,323	*m*
	Length :	5,5	*m*
Pipe B:	Inside diameter :		*m*
	Length :		*m*
Bend C:	Inside diameter :	0,323	*m*
	Number of bends :	2	
	Radius ratio (R/d) :	1	
Bend D:	Inside diameter :		*m*
	Number of bends :		
	Radius ratio (R/d) :		
Reducer E:	Outlet diameter :	0,35	*m*
	Number of reducers :	1	
Reducer F:	Outlet diameter :		*m*
	Number of reducers :		
Valve G:	Cv-factor :	10850	
Valve H:	Cv-factor :		
Strainer:	Cv-factor:	6285	
Flex. bellow:	Cv-factor :		
	Additional losses :		*m*

Result chart

Velocity in line A :	4,63	*m/s*
Velocity in line B :		*m/s*
Suction side losses:		
Pipe A :	0,335	*m*
Pipe B :		*m*
Bend(s) C :	1,113	*m*
Bend(s) D :		*m*
Reducer(s) E :	0,016	*m*
Reducer(s) F :		*m*
Valve G :	0,208	*m*
Valve H :		*m*
Sea chest	0,290	*m*
Strainer :	0,618	*m*
Flexible bellow :		*m*
Additional losses :		*m*
Total suction side losses :	**2,579**	*m*
Available NPSHa :	**7,334**	*m*
Required NPSHr :	**7,300**	*m*

The following condition must be satisfied :

NPSHa > NPSHr

Condition satisfied

FFS Fire Fighting Systems

Pump capacity calculation

Project:	07-013
Customer	C651/652/653
Calc.:	BSI
Date:	04.01.2008 00:00

Following conditions apply:
Estimated 3x90° bends, 2 reducers
Water velocity 4 m/s
Hot dip galvanized pipes and bends

Estimated 2x reducer/difusor
Discharge valve - butterfly valve
Component drop is based on monitor capacity

SYSTEM CAPACITY

Monitor 1	1200	m^3/h
Monitor 2	1200	m^3/h
Monitor 3		m^3/h
Monitor 4		m^3/h
Monitor 5		m^3/h
Monitor 6		m^3/h
Monitor 7		m^3/h
Monitor 8		m^3/h
Monitor 9		m^3/h
Monitor 10		m^3/h
Waterspray	250	m^3/h
Deck head 1	40	m^3/h
Deck head 2	40	m^3/h
Deck head 3		m^3/h
		m^3/h
		m^3/h
		m^3/h
		m^3/h
Tot. capacity	2730	m3/h

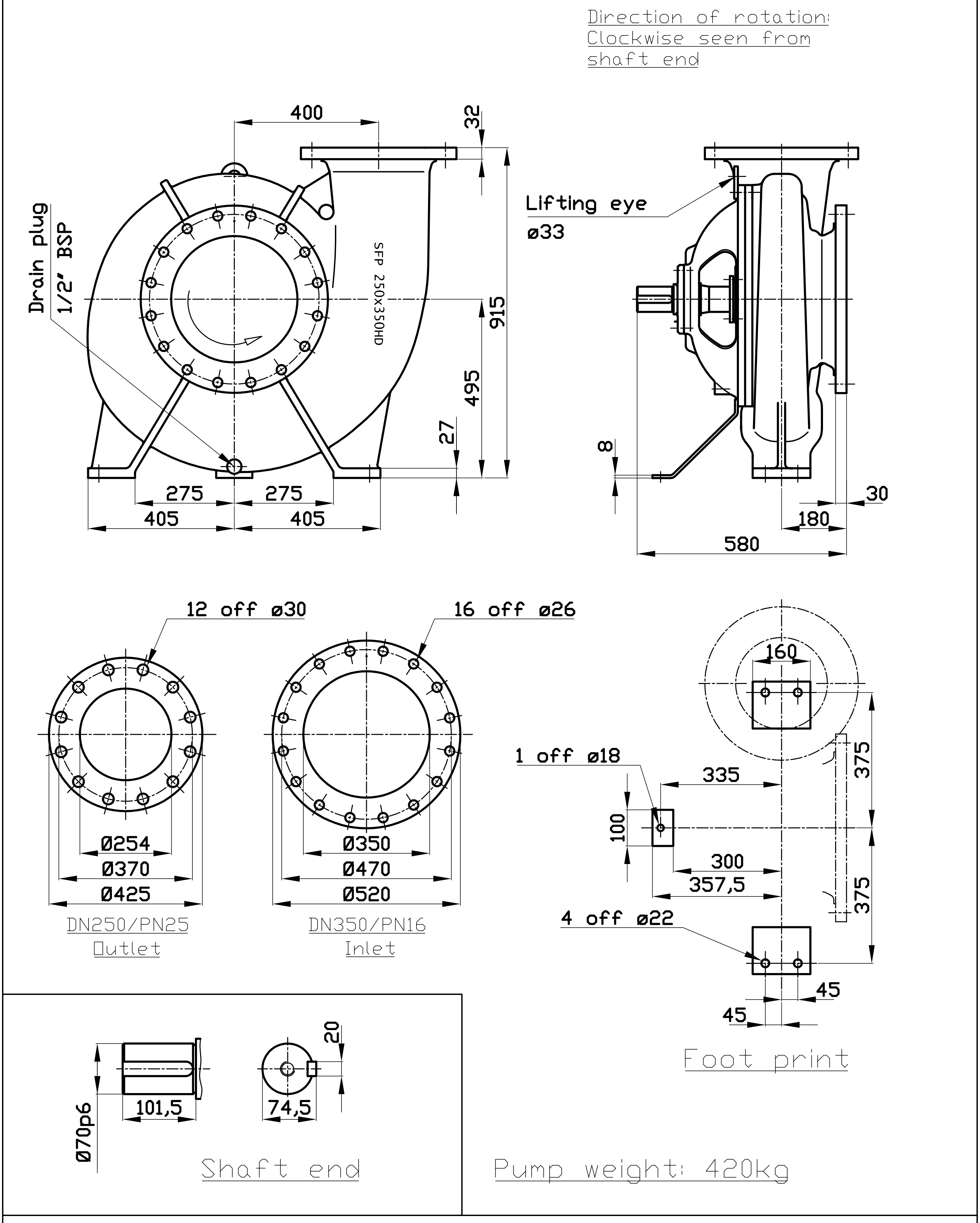
Pump schedule :

Pump 1	1365
Pump 2	1365
Pump 3	
Pump 4	
Pump 5	
Pump 6	

PUMP HEAD

Pump capacity
-for monitors 1200 m^3/h

Monitor inlet	105,0	m		
Altitude	5,0	m		
Pipe loss	6,0	m		
Foam propoportione	0,00	m	..PP-	
Discharge valve	0,55	m	..DN-	250
Backvalve	0,00	m	..DN-	
Compensator		m	..DN-	
Additional losses		m		
Pump head	116,6	m		



Customer:	Rev.no: 01	Date: 2003.02.04	Issued by: MJ	Approved by: OIB	Projection:	FFS Fire Fighting Systems
	ORIGINAL 00	Date: 000625	Issued by: OIB	Approved by:		
Hull no.:	Description: Fi-Fi Pump SFP 250x350 Outline Drawing/CW rotation				Drawing no.: X-2000-950	
Project no:						
	System:				Place of issue:	Scale: 1:15 · Orig.size: A4

Rev.	Design change	Date	Sign.	Checked
01	Misc. modifications	00.03.28	OIB	RS
02	Misc. text modifications	00.12.05	OIB	RS
03	Modifications of items 1, 16, 34, 36, 39 and 47	02.09.11	OIB	RS

Note A

Install gland packing acc. to specified procedure
Do NOT overtighten gland nuts
Always have a small leakage during operation

Note B

Lock studs with Omnifit 100M

Note C

Protect ball bearing with Molykote 111C

Note D

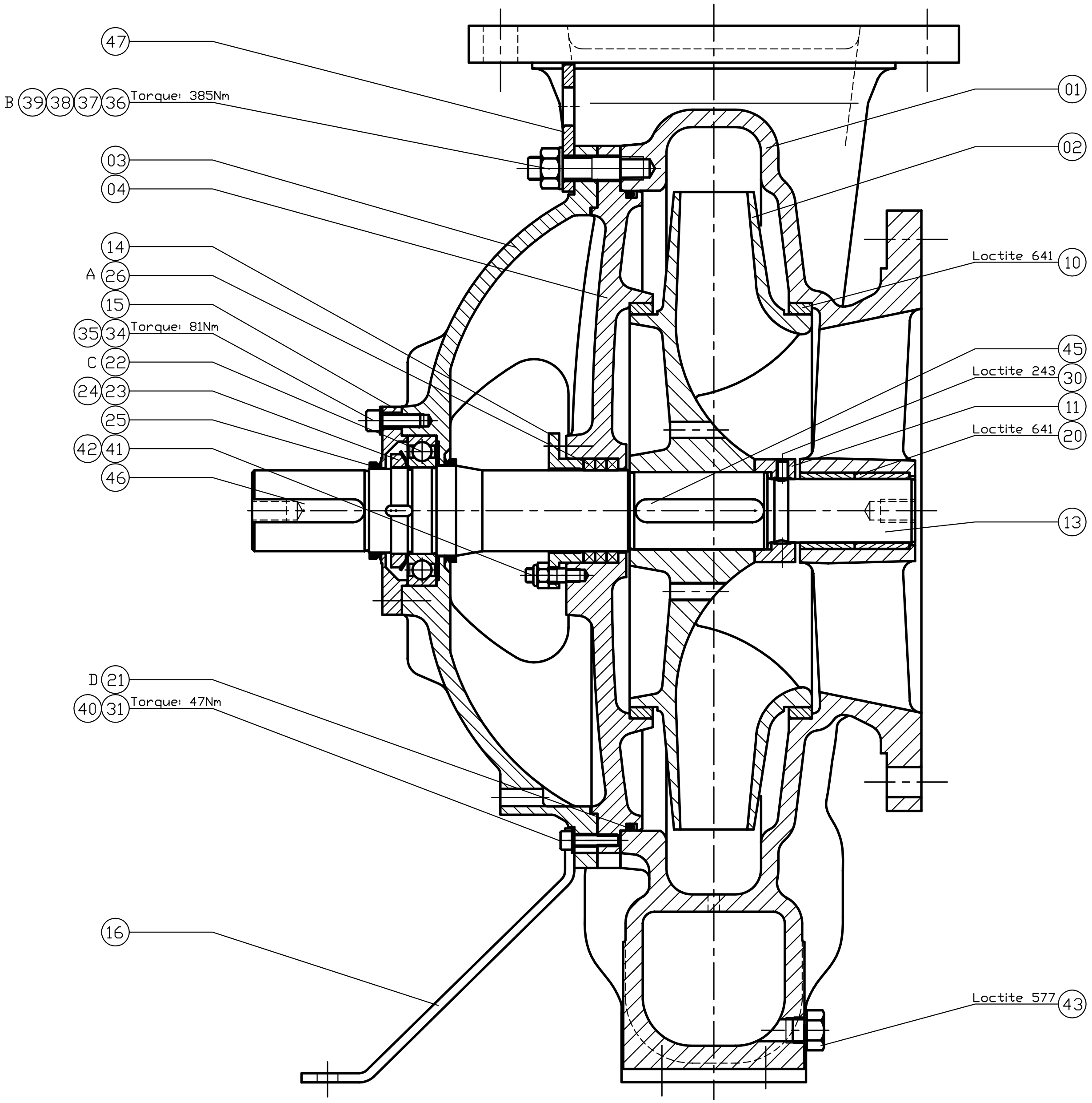
Smear O-ring/groove/bore with Molykote 111C

Note E

Install by freeze fitting or pressing

Miscellaneous

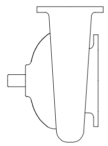
Use Chesterton Ultra on mild steel faces
Use anti seize compound for interference fits



This drawing covers both directions of rotation

Rev.no:	Date:	Issued by:	Approved by:	Projection:	
03	11.09.2002	OIB	TAa		FFS Fire Fighting Systems
ORIGINAL 00	Date: 28.06.1999	Issued by: OIB	Approved by: TAa		
Description: Pump Unit SFP 250x350HD				Drawing no.: X-2000-150PL	
System: External Fire Fighting				Place of issue: Moss	Scale: 1:2,5 Orig.size: A1

FFS Fire Fighting Systems



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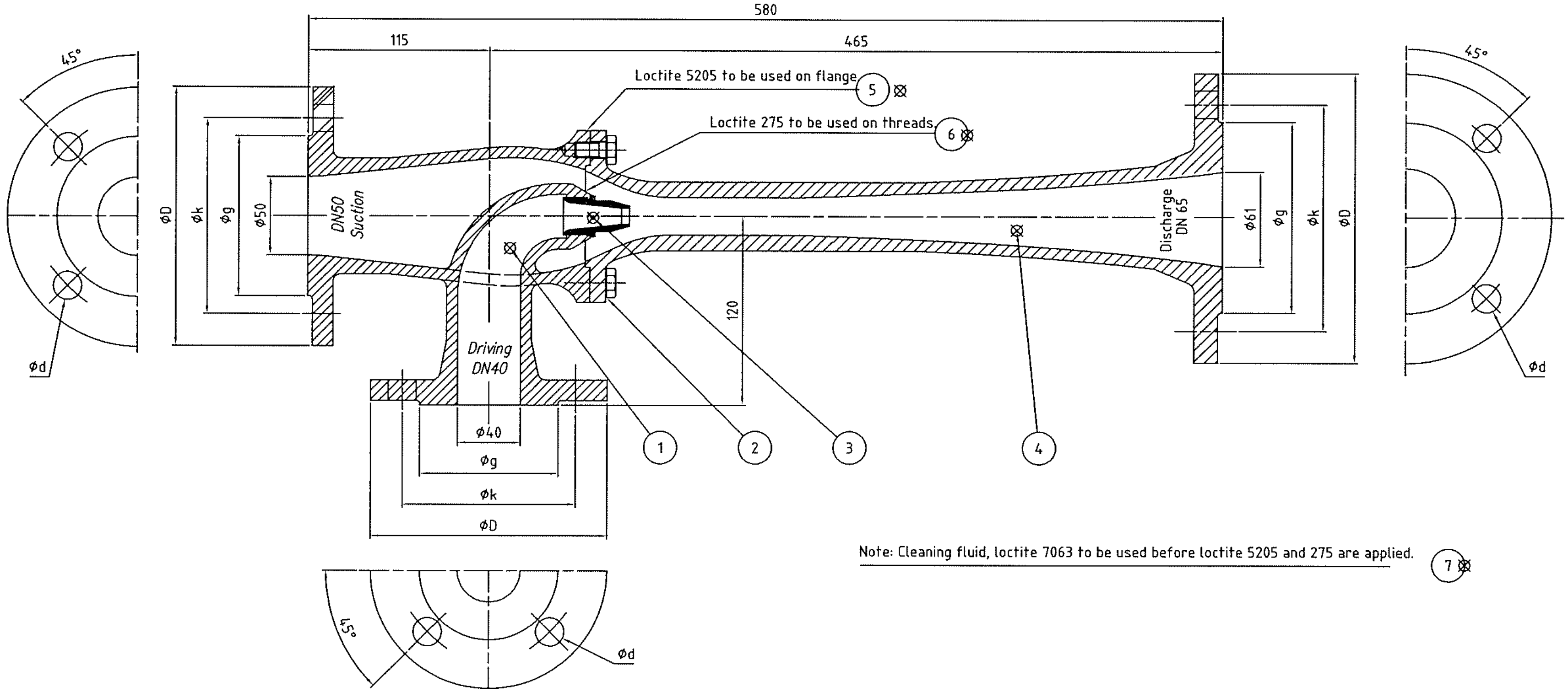
Parts list No. **X-2000-600PL**

Sectional Drawing No. X-2000-150PL

SFP 250x350 / CW rotation / iron casing / duplex impeller / stuffing box

Item No.	No. off	Part No.	Name of part	Material	Remarks
1	1	X-2000-211	Pump Casing	Nodular cast iron	ISO 400-12
2	1	X-2000-111	Impeller	Duplex stainless steel	AISI 329
3	1	X-2000-511	Bearing Housing	Nodular cast iron	ISO 400-12
4	1	X-2000-411	Pump Cover	Nodular cast iron	ISO 400-12
10	2	X-2000-903	Wear Ring	Bronze	SS 5465-03
11	1	X-2000-904	Retaining Ring	Bronze	SS 5465-03
13	1	X-2000-906	Pump Shaft	Duplex stainless steel	AISI 329
14	1	X-2000-901	Seal Gland	Bronze	SS 5204-03
15	1	X-2000-902	Bearing Cover	Steel	SS 1672
16	1	X-2000-905	Pump Support	Steel	SS 1312
20	1	X-2000-20	Sleeve Bearing	Bronze matrix	Bearing consists of two halves
21	1	X-2000-21	O-ring	Nitrile rubber	
22	1	X-2000-22	Ball Bearing	Steel	
23	1	X-2000-23	Shaft Nut	Steel	
24	1	X-2000-24	Locking Ring	Steel	
25	2	X-2000-25	V-ring	Nitrile rubber	
26	3	X-2000-26	Gland Packing	PTFE impregnated fibre	
30	8	X-2000-30	Set Screw	Stainless steel	DIN 916
31	2	X-2000-31	Socket Screw	Stainless steel	DIN 912
34	2	X-2000-34	Socket Screw	Steel EZN	DIN 912
35	4	X-2000-35	Washer	Steel EZN	DIN 125
36	12	X-2000-36	Stud Bolt	Steel EZN	DIN 938
37	12	X-2000-37	Hexagon Nut	Steel EZN	DIN 934
38	12	X-2000-38	Washer	Steel EZN	DIN 125
39	2	X-2000-39	Socket Screw	Steel EZN	DIN 912
40	2	X-2000-40	Washer	Steel EZN	DIN 125
41	2	X-2000-41	Stud Bolt	Stainless steel	DIN 938
42	2	X-2000-42	Locking Nut	Stainless steel	DIN 985
43	1	X-2000-43	Hexagon Plug	Stainless steel	
45	1	X-2000-45	Key	Duplex stainless steel	DIN 6885 A
46	1	X-2000-46	Key	Steel	DIN 6885 A/B



Note: Cleaning fluid, loctite 7063 to be used before loctite 5205 and 275 are applied. (7)

Nom. size. DN	Standard	Outside dia. of flange. D	Dia. of bolt-circle k	Dia. of raised face g	Dia. of bolt holes d	Number of bolt-holes.
Driving DN 40 1 1/2"	DIN PN 10	150	110	88	18	4
	DIN PN 16	150	110	88	18	4
	ANSI 150	127	98,6	73	15,8	4
	JIS 5K	120	95	75	15	4
	JIS 10K	140	105	81	19	4
	JIS 16K	140	105	81	19	4
Suction DN 50 2"	DIN PN 10	165	125	102	18	4
	DIN PN 16	165	125	102	18	4
	ANSI 150	152,4	120,7	92,1	19,1	4
	JIS 5K	130	105	85	15	4
	JIS 10K	155	120	96	19	4
	JIS 16K	155	120	96	19	8
Discharge DN 65 2 1/2"	DIN PN 10	185	145	122	18	4
	DIN PN 16	185	145	122	18	4
	ANSI 150	177,8	139,7	104,8	19,1	4
	JIS 5K	155	130	110	15	4
	JIS 10K	175	140	116	19	4
	JIS 16K	175	140	116	19	8

Coating: One layer Edel semi gloss, NCS 5010 G50Y.

Weight: 23 Kg.

Item	Qty.	Description	Standard	Material	Weight	Article No.
7	1	Cleaning fluid		Loctite 7063	0.00	13535
6	1	Sealant fluid		Loctite 275	0.00	13534
5	1	Sealant fluid		Loctite 5205	0.00	13533
4	1	Diffusor for type 11/2-2-21/2	3300889	Rg9	8.10	3300889
3	1	Nozzle for type 11/2-2 -21/2, ø10,2	4301110	AISI 316	0.25	4301110
2	6	Bolt, hex. M10x20 ELZn	ISO 4017	8.8	0.02	1823
1	1	House for type 1 1/2-2 -2 1/2	3300888	Rg9	14.00	3300888

UNLESS OTHERWISE SPECIFIED:
Tolerances: NS-ISO 2768-1-m

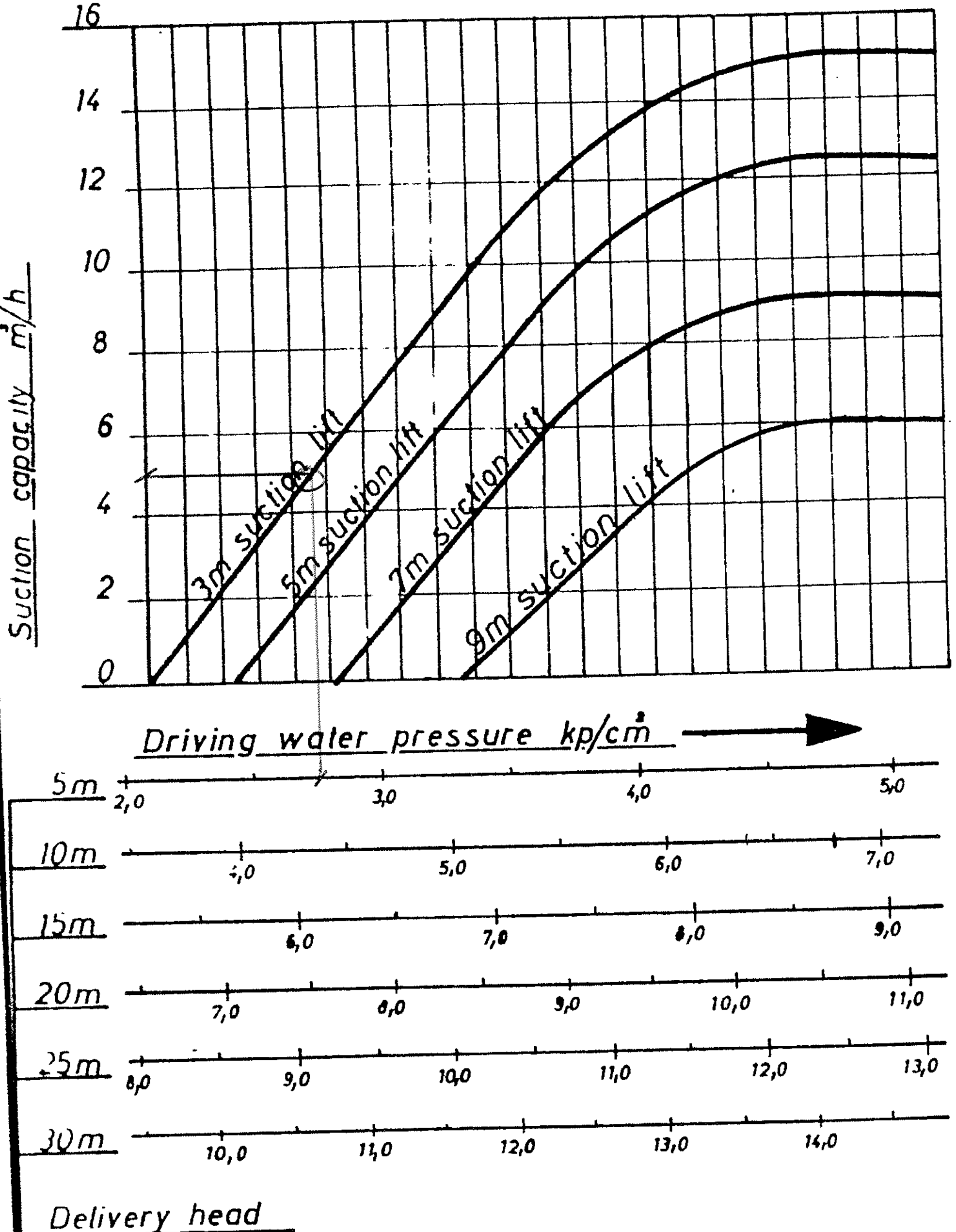
Date	Drawn by	Traced by	Scale	
29.10.2004	EPN		1:2	TeamTec Tvedestrand - Norway
Checked by	Std. checked by	Approval	Format A2	

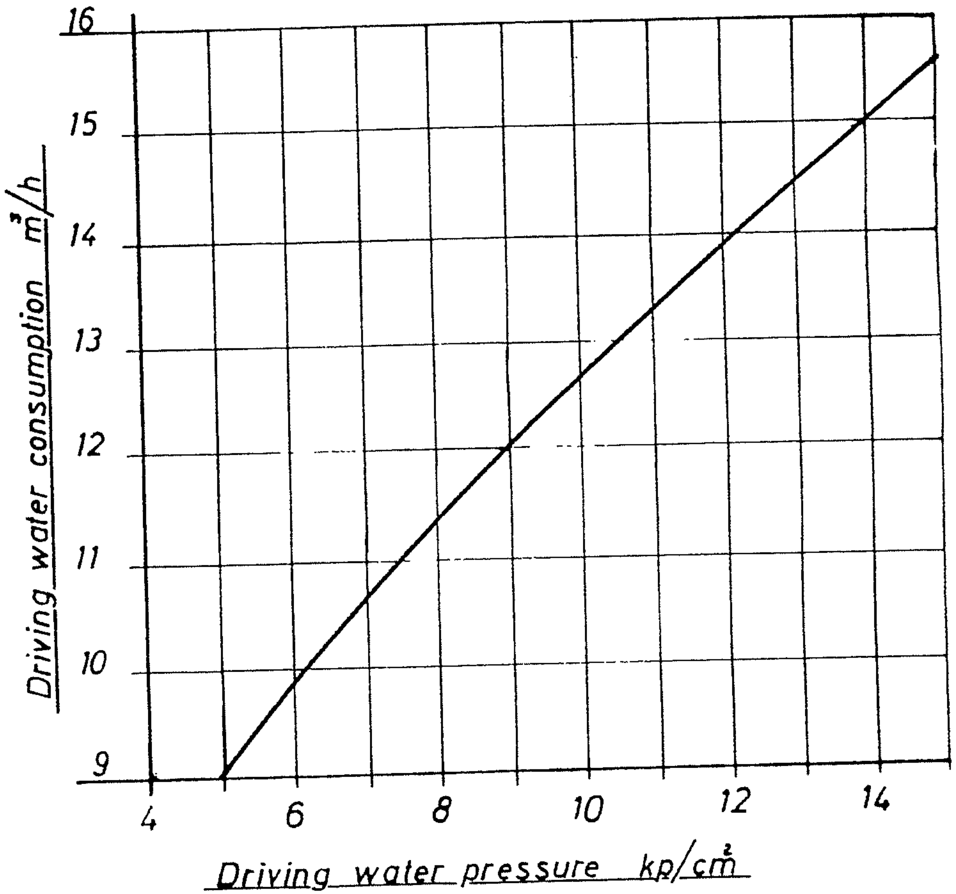
Stripping ejector type 1 1/2-2-2 1/2

Replacement for: Replaced of:

2301295 Rev.

Project	Reference	File name	Plot date	Article no.	Page
		2301295		-	-





Date	Drawn by	Scale	TeamTec A/S Norway
Aug. 21.–78	O.J.G.	~	
Checked by	Approval	Projection method	

Performance curves for Golar Stripping Ejector type 1 1/2–2–2 1/2

Replacement for: 63075, 40223

Replaced of:

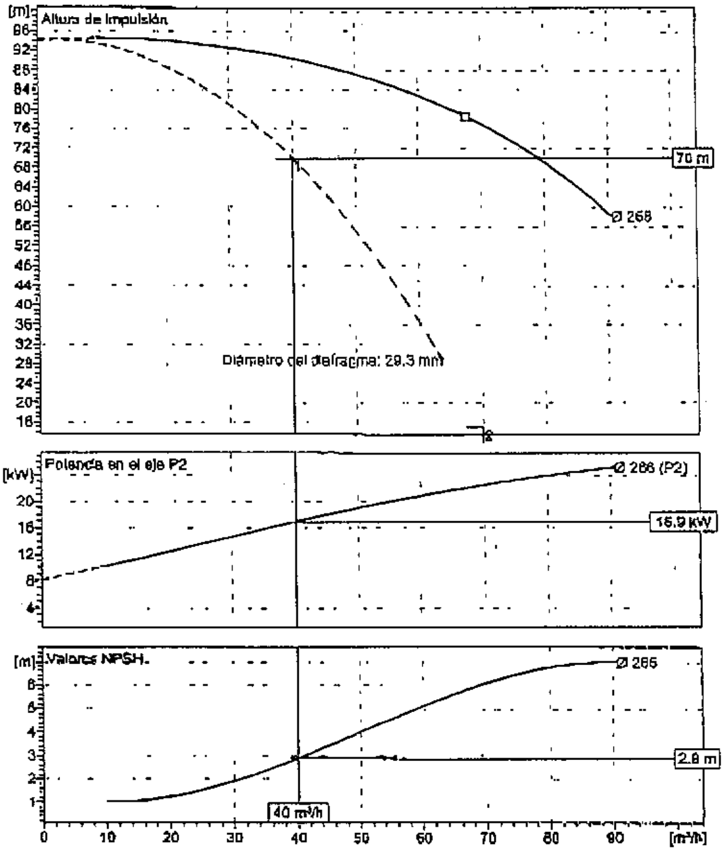
4 300295

Reference

BOMBAS ITUR	**BOMBAS ITUR, S.A.**	**Datos Técnicos**	Oferta Nº **F699066-D005-00** Proyecto **C611 & C612** Fecha 2004-10-27 Página **4** / 6

Nº de cliente 699066 Posición **2** **Lastre,sentinas,baldeo y C.I.**

Cliente ASTILLEROS ZAMACONA, S.A. Plazo de entrega: General



Características de funcionamiento requeridas

Fluido Agua, agua de mar *100 %*

Temp: 32 °C *Dens: 1.0251 kg/dm³* *Visc: 0.76005 mm²/s*

Caudal	40	m³/h
Altura	70	m

Datos de la bomba

Tipo	**ILCS-50/250**	
Tipo de construcción	Grupo ILCS con Motor	
Tipo de impulsor	Cerrado	
Diámetro impulsor	Ø 266	mm
Ancho de salida	5	mm

PLACA DE ORIFICIO EN LA IMPULSION DIAM.29,3MM

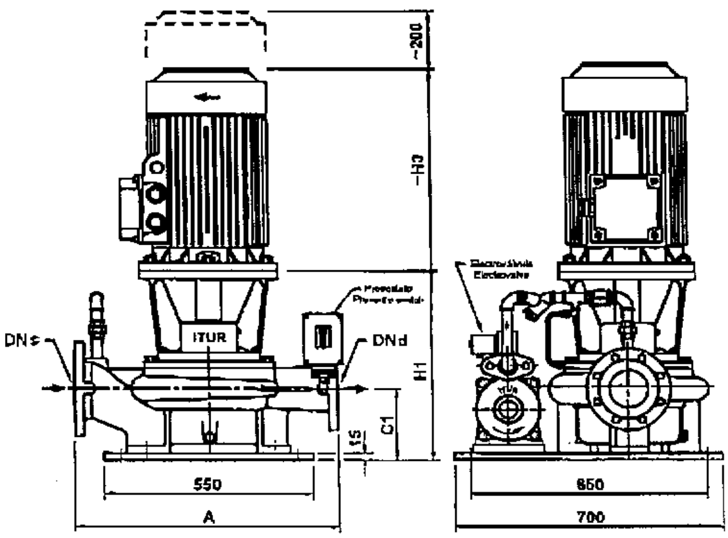
Datos hidráulicos (según ISO 9906-2A)

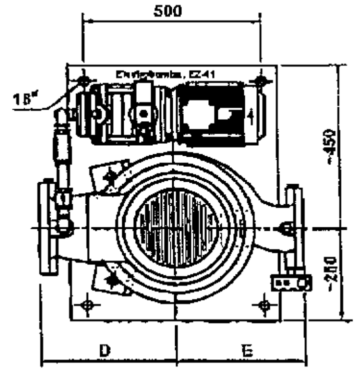
Caudal suministrado	40	m³/h
Altura manométrica	70	m
Revoluciones	2940	1/min
Rendimiento	46.3	%
Potencia absorbida	16.9	kW

Materiales	**Ejecución: 1403**
Cuerpo de bomba	Bronce (RG-5)
Tapa de bomba	Bronce (RG-5)
Impulsor	Bronce (SN-10)
Eje de bomba	Acero Inoxidable (AISI-316L)
Anillo desgaste cuerpo	Bronce (RG-7)
Soporte	Hierro Fundido (GG-25)

Sellado del eje	CierreSimple
Tipo	ITUR 5H2
Materiales / Junta	CE/GR-NI

Datos del motor	**Trifásico Marino IP-55**			
Potencia nominal P2	29		kW	
Revoluciones	2940	1/min	50	Hz
Tensión nominal	400		V	
Intensidad nominal	49.4		A	
Tipo de protección	IP 55			
Clase de aislamiento	F			
Clase de temperatura	F(90K)			



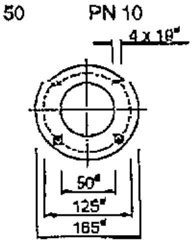


Bocas

DNd Lado impulsión

DIN

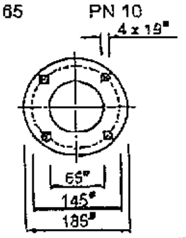
DN 50 PN 10



DNs Lado aspiración

DIN

DN 65 PN 10

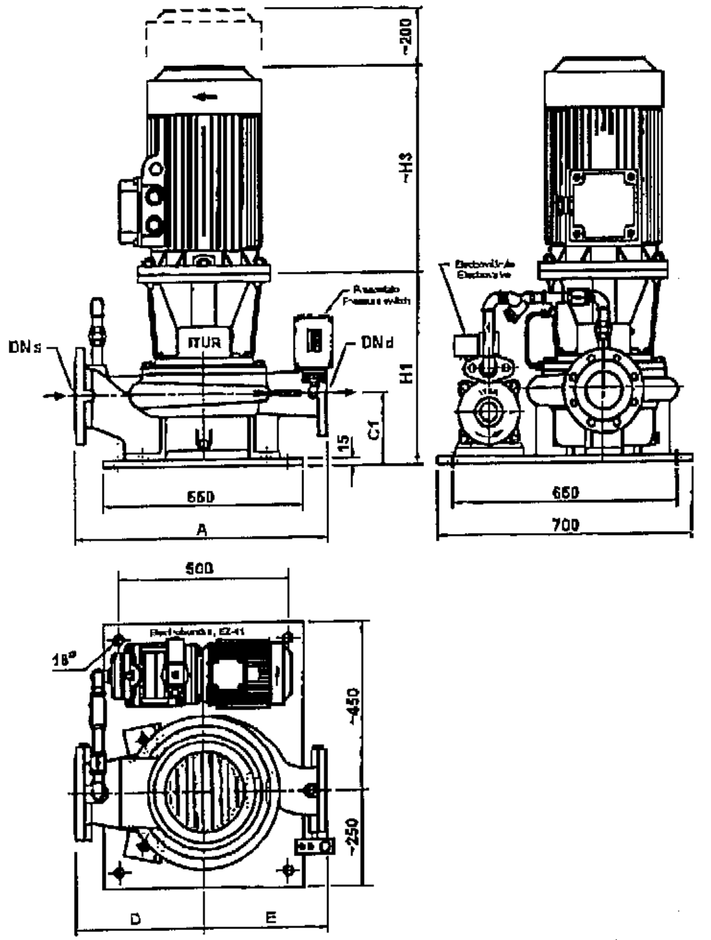


Dimensiones en mm

A	615
C1	140
D	302
DNd	50
DNs	65
E	[illegible]
G	15
H1	359
H3	592
J	230
K	162
L	173
M	85
N	100
S	24

Peso 259 kg

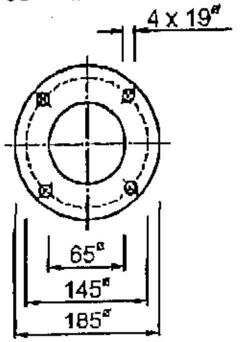
ILCS-50/250



Bocas

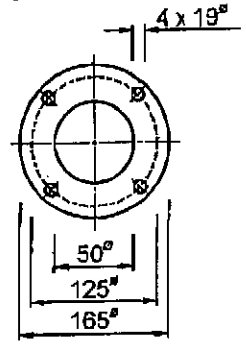
DNs Lado aspiración

DN 65 DIN PN 10



DNd Lado impulsión

DN 50 DIN PN 10



Dimensiones en mm			
A	615		
C1	140		
D	302		
DNd	50		
DNs	65		
E	313		
G	15		
H1	359		
H3	592		
J	230		
K	162		
L	173		
M	85		
N	100		
S	24		

Peso **259 kg**

Nº de cliente	699066
Cliente	**ASTILLEROS ZAMACONA, S.A.**
Oferta Nº	**F699066-D005-00**
Posición	**0** **Lastre,sentinas,baldeo y C.I.**
Proyecto	**C611 & C612**

Página 5 / 6 Fecha 2004-10-27

PLANO DIMENSIONAL

BOMBAS ITUR

Use of Flexible Bellows in Fi-Fi Pump Applications

Flexible Bellow on Pump Suction Side

A flexible bellow on the suction side of the pump is not a requirement, but this arrangement can sometimes be useful (Fig. 1). In this way pipe stresses caused by installation errors or movements of the vessel is not so easily transferred to the pump.

If a flexible bellow is used, it must be located between the pump flange and the inlet valve. This is for safety reasons in case of bellow rupture.

The bellow should have an inside diameter corresponding to the diameter of the connected pipe. To minimise suction losses, the inside diameter of the bellow must have a smooth cylindrical surface.

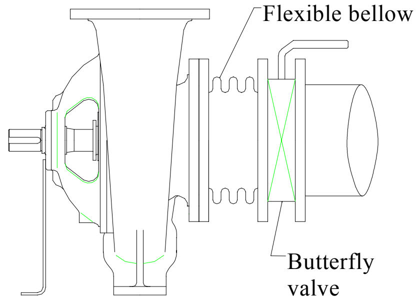


Fig. 1 Pump with flexible bellow on suction side

Flexible Bellow on Pump Pressure Side

A flexible bellow on the pressure side of the pump can sometimes be useful to simplify the pipe installation. As with the bellow on the suction side, these components are not required by FFS.

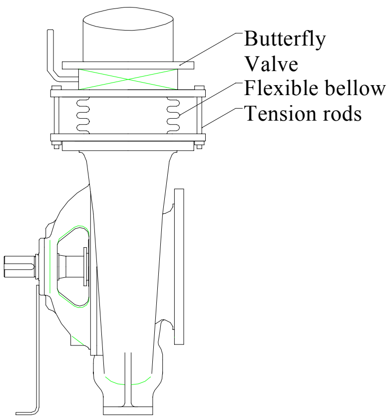


Fig. 2 Pump with flexible bellow on pressure side

Important

The flexible bellow must have a pressure rating corresponding to the maximum outlet pressure of the pump.

A flexible bellow on the pump pressure side MUST be equipped with tension rods (Fig. 2) These rods must be adjusted to absorb pipe forces after pump and piping has been installed and aligned. Without correct installation of tension rods, there will be a hydraulic piston effect between pump and piping. These forces can reach values of 100 000 – 200 000N and cause great damage to the installation.

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Installation

1.1 Storage

If the pump is to be stored for a lengthy period, the following points should be noticed:

- Vibration levels that could damage bearings must be avoided.
- Covers fitted to suction and discharge should be retained in place.

ATTENTION!

- If there is a risk of freezing, any cavities that cannot be emptied should be filled with anti-freeze.
- If the pump is to be stored for more than six months, gland packings should be removed.
- In case of long storage period, the interior of the pump casing should be protected with suitable preservation oil.

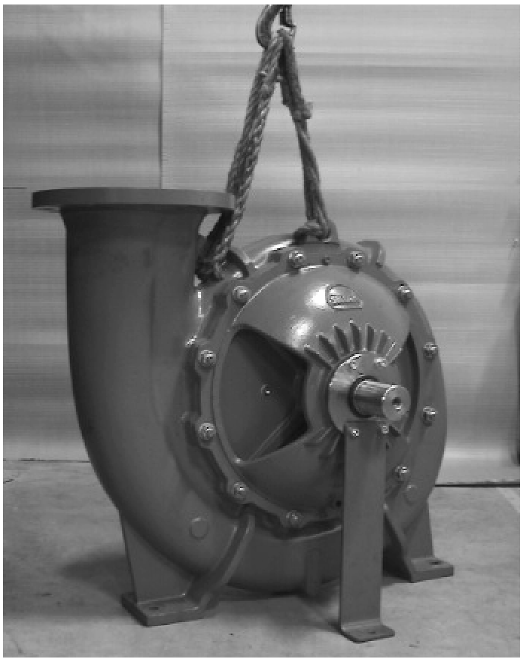

Fig. 1 Lifting a complete pump

1.2 Handling

ATTENTION!

Care in handling is required to prevent damage to parts and personnel. Lifting using slings as shown in Fig. 1 is suggested. **Never** lift the pump by means of the pump shaft.

1.3 Location

Pumps should preferably be installed to make inspection and servicing easy. Ensure that adequate space exists around the pump.

Note that the rear pump bearing is air-cooled. Make sure there is sufficient air circulation at this side of the pump. The preferred arrangement is to have the outlet of an air duct near the pump.

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1.4 Fixing

The construction of the foundation shall be so that vibrations are prevented, pipe stress absorbed and distributed. The foundation must be designed to have a structural stiffness to limit displacement of the pump shaft in relation to the driver shaft.

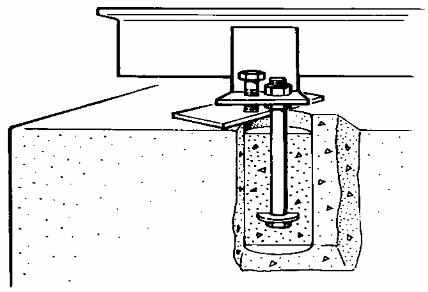

Fig 2 Grouting of foundation bolts

A guideline for foundation stiffness can be a maximum allowable shaft displacement of about 0.10 mm during full load conditions.

When designing the pump foundation, the nozzle loadings given in for example API standard 610, could be used as input for stiffness calculations.

Depending upon the type of installation, there are several suitable methods for securing the SFP pump unit to the foundation. The pump could for example be supplied mounted on a baseframe including the driver. In this case the normal procedure is to align the baseframe with jacking screws before grouting the foundation bolts (Fig. 2). When the grouting has hardened sufficiently, necessary height adjustment can be done. Then the space under and around the baseframe can be grouted. A high quality epoxy grout is recommended. It must be applied in accordance with the grout manufacturer's detailed procedure.

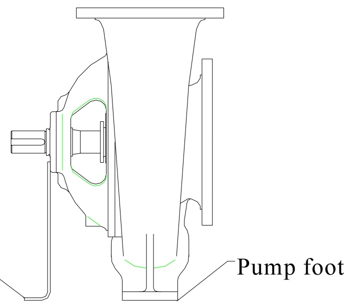

Fig. 3 SFP pump

ATTENTION!

The pump is normally supplied as a separate unit. See the SFP Outline Drawing for detailed foot print dimensions. Note that the rear pump support is meant to facilitate transport and installation, and shall also be connected to the foundation. All loads must be carried by the sturdy feet, which are an integrated part of the pump casing (Fig. 3).

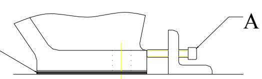

Fig. 4 Sidewise adjustment

The pump feet are fully machined flat and parallel. Corresponding surfaces must be in the same plane. If shims are used for height adjustment, the shims shall cover all the foot area. For sidewise adjustment, brackets with adjustment bolts makes this operation easier (Fig. 4).

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1.5 Fitting a Coupling

Check that the key fits properly and lubricate the shaft end with assembly paste – for example graphite grease. Preferably fit the coupling using a special pressing tool or a fully threaded screw in combination with a nut and a steel bar. Alternatively, the coupling hub can be preheated to about 120ºC and pushed on by hand.

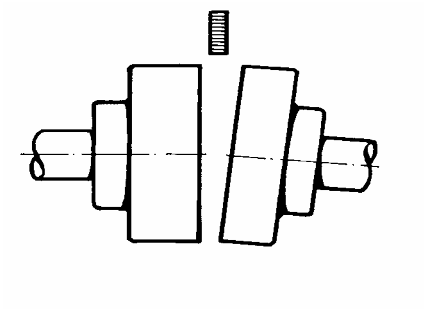

Fig. 5 Angular alignment

Normally there is an interferrence fit between coupling and pump shaft. A shaft tolerance of p6 and coupling bore tolerance of H7 is widely used for the SFP pump. See pump and coupling dimensional drawings for details.

ATTENTION!
Always check the requirements of the coupling manufacturer before fitting. Some couplings may require special installation procedures or tools.

1.6 Alignment

If the pump has been supplied mounted together with the driver on a common baseframe, preliminary alignment has been done prior to dispatch from our works. Ensure that the baseframe is evenly supported on the foundation bed. In this way alignment is not affected when tightening the baseframe bolts to the foundation.

In other cases the SFP pump is supplied as a loose item, and must be properly aligned to prime mover.

ATTENTION!
Final alignment must be carried out after the following activities are completed:

- Fixing bolts have been correctly tightened with torque according to bolt size and type.
- Piping has been connected and pressure tested. Pipe supports are carrying the loads.
- Pump has been operating until a stable bearing temperature has been reached.
- The pump support does not carry any load.

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Proper alignment will reduce vibrations, excessive wear on coupling parts and shaft seal and prevent overheating of bearings. Alignment can be done with feeler gauge, clock gauge or laser equipment.

In most cases the required alignment tolerances are given in the documentation from the coupling manufacturer. If these tolerances are not known, the following values can be used as guidelines:

- The angular displacement (Fig. 5) is maximum 1/1000th of coupling diameter.
- The radial displacement (Fig. 6) is maximum 1/2000th of coupling diameter.

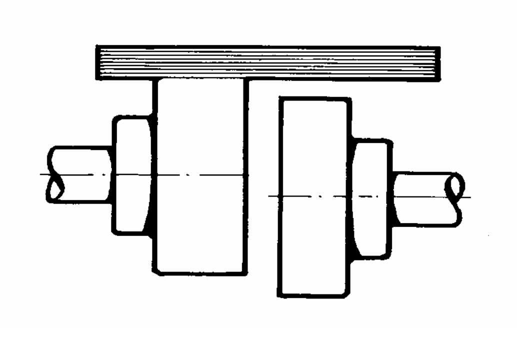

Fig. 6 Radial alignment

1.6.1 Alignment with Feeler Gauge

Start by eliminating angular misalignment (Fig. 5). Mark reference points on the coupling flanges. Measure the distance between the coupling halves with a feeler gauge. Measure at one quarter, one half and three-quarter turns from the original position. Adjust with shims under pump or driver so that the difference is max. 1/1000th of the coupling diameter, e.g. 0.10mm for each 100mm diameter, or according to the specific coupling specification.

To obtain radial alignment (Fig. 6) place a steel ruler on the coupling and measure the difference at four positions around the periphery. By adjusting uniformly under pump or driver feet the difference should be brought down to an acceptable value, typically 1/2000th of the coupling diameter, e.g. 0.05mm for each 100mm diameter.

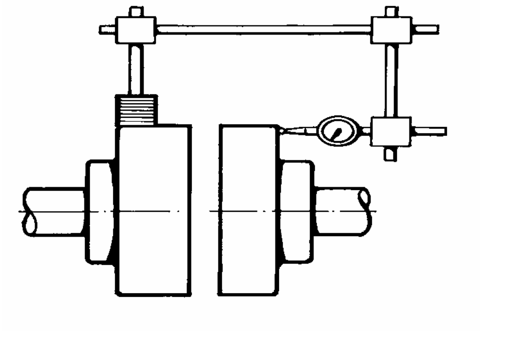

Fig. 7 Angular alignment with clock gauge

1.6.2 Alignment with Clock Gauge

Attach a clock gauge to one of the coupling halves, letting the point of the gauge rest on the other half. Turning both shafts and reading the gauge will reveal necessary adjustments.

Place the clock gauge on the side of the opposite half to measure the angular displacement (Fig. 7). The clock gauge must be placed on top of the opposite half to measure the radial displacement (Fig. 8).

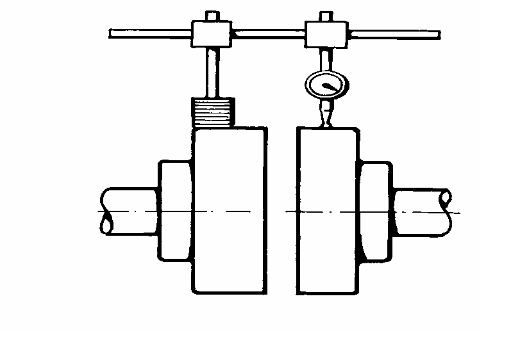

Fig. 8 Radial alignment with clock gauge

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1.6.3 Alignment with Laser

Alignment with laser is normally the fastest and most accurate way of doing this job. Follow the laser manufacturer's procedure for the specific equipment to be used.

1.7 Piping

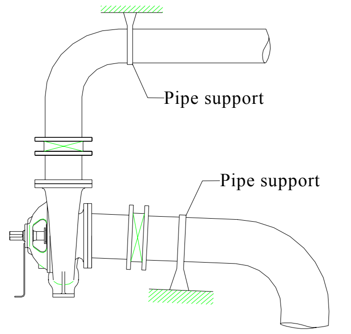

Fig. 9 Supporting pipes

ATTENTION!

Several factors related to the piping system can seriously affect the function of pump. The piping must first of all be properly engineered regarding water velocities.

Loads on the pump flanges arising from pipe stresses must be kept at a minimum level. Excessive pipe stresses can deform the pump casing resulting in locked rotor. Piping and valves shall be carefully supported. Remember that the pump is **NOT** a foundation for the piping (Fig 9).

Ensure that pipes and pump are properly cleaned before connection. Debris in the pipes can lead to seizures and unnecessary wear. Bear in mind that some of the rotating clearances inside the pump are only a few tenths of a mm.

1.7.1 Suction Side Piping

Correct design of the piping system is particularly important on the suction side of the pump. Mistakes can easily result in a cavitating pump. Cavitation is caused by too low inlet pressure, which will allow the water to "boil" at the suction side of the impeller. Vapour takes up space so the capacity of the pump drops dramatically. In addition vibrations can cause serious damage to bearings, seals and the impeller. At an early stage in most projects, Fire Fighting Systems AS run a comprehensive NPSH calculation to avoid this situation.

Water velocities on the suction side of the pump should normally **not exceed 2 meters per second**. The specific value for each case must be checked against the requirements of the classification society or others.

The suction pipe should be as short and straight as possible. The piping must be continuously rising towards the pump to avoid air pockets (Fig. 9). The outlet from sea chest should be funnel shaped (Fig. 10) A parallel outlet has a tendency to throttle the flow.

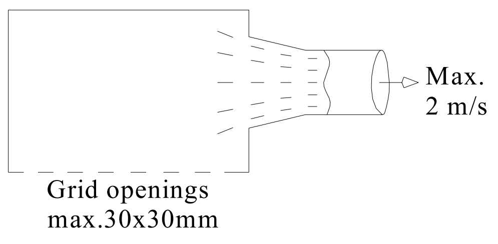

Fig. 10 Sea chest

The sea chest must have some sort of grid to prevent debris from entering the suction line. The maximum opening in this grid shall be **30x30mm** to protect the SFP pump's internal flow channels (Fig. 10). In some cases a strainer or filter is necessary between sea chest and pump.

The sea chest intake must have a sufficiently large area not to restrict the flow. The absolute minimum flow area through the grid is **two times** the area of the largest suction pipe.

To minimise losses further, always use long radius bends and avoid sudden pipe diameter changes.

Flexible bellow

A flexible bellow on the suction side of the pump is not a requirement, but this arrangement can sometimes be useful (Fig. 11). In this way pipe stresses caused by installation errors or movements of the vessel is not so easily transferred to the pump. If a flexible bellow is used, it must be located up-stream of the inlet valve in case of rupture. The bellow should have an inside diameter corresponding to the diameter of the connected pipe. To minimise suction losses, the inside diameter of the bellow must have a smooth cylindrical surface.

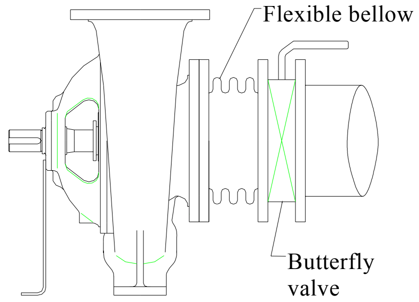

Fig. 11 Pump with flexible bellow and valve

1.7.2 Discharge Side Piping

A stop valve is normally located in the discharge line close to the pump. There is also a small size by-pass line for filling the piping system during start-up. A check valve is frequently used to prevent back-flow to the pump. This valve should be located up-stream of the stop valve (Fig. 12).

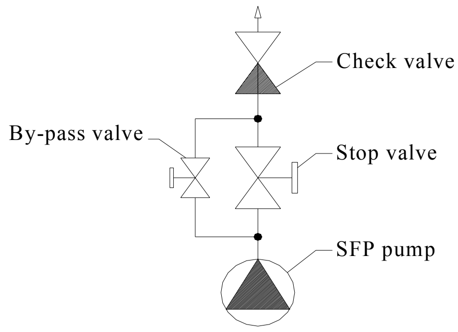

Fig. 12 Discharge side piping arr.

Acute branch angles and sudden changes in pipe diameter give unnecessary losses and may cause noise.

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Water velocities in the discharge side of the pump should normally **not exceed 4 meters per second**. Check the requirements for each specific application.

1.7.3 Suction Valve

A suction line valve must be used for isolation only – never to throttle the flow. During operation this valve must be fully open. Globe and angle valves should normally not be used since these types can lead to increased suction losses. For most Fi-Fi application a butterfly valve is the first choice, also because of simple design and ease of operation.

ATTENTION!

A butterfly valve must **never** be mounted directly to the SFP pump inlet flange. The valve disc will not be able to open fully, since it will protrude from the valve body and hit the guide ribs in the pump casing. Always use a spool piece between pump inlet and a butterfly valve, if a flexible bellow is not installed (Fig. 11).

1.7.4 Drain Line

It is strongly recommended to drain the pump casing after operation. Flushing with fresh water is beneficial. Stagnant seawater can cause corrosion at high temperatures often existing in an engine room. A permanently installed drain line + valve makes draining more easy (Fig. 13)

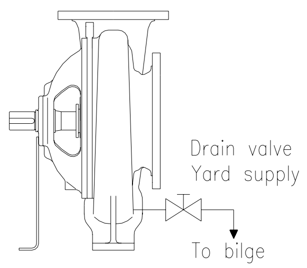

Fig. 13 Pump with drain line to bilge

1.7.5 Minimum Flow

Remember that all centrifugal pumps need a certain flow for self-cooling and lubrication. This minimum flow requirement is often considered to be about 10% of the nominal flow. See the actual pump curve for the relevant figures. A pump likely to operate below its minimum flow rate for more than one minute, should have a by-pass line installed. A temperature probe in the pump casing could also be used for protection purposes.

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1.7.6 Maximum Flow

If the pump is operating at a very low counter-pressure, the power consumption will be high. A typical situation is too many consumers in relation to available capacity. Excessive power consumption can result in damage to driver, couplings or pump.

Too avoid this situation consult the pump curve for the specific application. The power consumption at a given capacty must not exeed the rating of the system.

ATTENTION!
Suction and discharge valves must never be closed when the pump is running. This will lead to rapid overheating and serious damage to the equipment.

1.8 Pressure Testing of Piping

ATTENTION!
When the piping system is pressure tested, the pump is often isolated to avoid damage to sealing system or other components. This is important to remember if the test pressure is above the working pressure of the pump. If in doubt – consult Fire Fighting Systems AS. Before any pressure testing, pump and piping must be properly vented.

1.9 Pressure Transients and Fluctuations

ATTENTION!
The SFP pump is supplied for a certain pressure rating. If this pressure is exceeded due to pressure transients (pressure fluctuations), continued satisfactory operation of the pump can not be guaranteed.

Pressure transients occur if the flow in a pipe is changed. The more rapid the rate of change, the larger the pressure fluctuation. In a long pipe even a slow rate of change may cause a strong pressure surge.

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Starting and stopping pumps or opening and closing valves are obvious causes of fluctuations. Any centrifugal pump should be started against a closed or partially closed valve installed near the pump outlet. The valve must then be opened slowly. The pump is normally stopped in the reversed order.

Quick acting valves and long pipelines, particularly those which are inadequately vented or gas- or airfilled, call for special attention with regards to pressure fluctuations.

If the power supply should fail, the pump speed suddenly drops and the flow in the system will change in an uncontrolled way. With long pipelines the consequences of such an interruption should be considered at the design stage.

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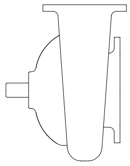

Start –up and Running Maintenance

2.1 Before Start-up

ATTENTION!

- Ensure that the pump turns freely by hand. If it does not, check for foreign matter in the pump, or pipe stresses causing the impeller to seize in the casing.
- Ensure that the gland nuts are not over-tightened.
- Check the direction of rotation by running the pump for a few seconds.
- Fill the pump casing by opening the suction valve or in rare cases through a filling pipe.

2.2 Starting

- The pump is normally started against closed discharge valve. For filling the piping system in a safe way, a small size line by-passing the discharge valve is preferred.
- If possible, run the pump at low speed when filling the piping system.

ATTENTION!

Never run the pump for more than 30 seconds against a completely closed discharge valve if a by-pass line is not installed. Otherwise there is a danger of overheating and serious damage to the pump.

- Gradually open the discharge valve until the required pumping capacity is achieved. Rapid valve movements can sometimes cause water hammer problems.
- If the pumping capacity is significantly exceeding the duty point, it possible that motor, couplings and pump may be overloaded. Find capacity at duty point from the pump curve supplied with every SFP pump.
- Check the shaft seal.

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ATTENTION!

Standard seal arrangement
Soft packed gland
Check that the gland is dripping adequately. If overheating occurs, loosen the gland nuts to increase the leakage and thereby the cooling effect. If leakage is excessive, tighten the nuts 1/6 turn at 5 – 10 minute intervals. Leakage at 30 – 60 drips per minute is normal. These adjustments should preferably be made with the pump stationary.

Non-standard seal arrangement
Mechanical seal
Check that overheating does not occur. Mechanical seals must never run dry.

2.3 After Start-up

- Check the shaft seal. A packed gland must be dripping, otherwise the packing will heat-up and rapid wear will occur. A mechanical seal should be virtually leak-free.
- Check rear bearing temperature. Bearing temperature will normally stabilise after a few hours of operation. After the pump has been run for the first time and a stable bearing temperature is reached, note that the next time the pump is run (after complete cooling) the temperature will be roughly 10ºC lower. The bearing temperature must not exceed 100ºC for long periods.
- Check that the sound and vibration levels do not increase.

2.4 Matching the Pump to the System Requirement

If the pump during normal operation is operating far away from the specified duty point, this situation can cause increased vibrations, bearing temperature and wear. Consult Fire Fighting Systems AS for possible solutions.

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2.5 Stopping

- Close the discharge valve slowly to avoid excessive pressure fluctuations.
- Stop the pump maximum 30 seconds after closing the valve to avoid overheating.

2.5.1 Draining

It is strongly recommended to drain the pump casing after operation. Flushing with fresh water is beneficial. Stagnant seawater can cause corrosion at high temperatures often existing in an engine room.

A ½" BSP plug is located in the lowest part of the pump casing for drainage purpose. (Fig. 1)
A permanently installed drain line + valve makes drainage more easy (Fig. 2)

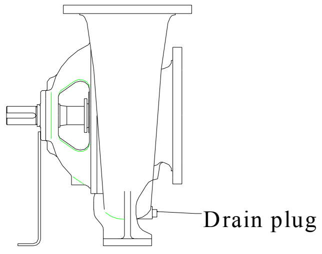

Fig. 1 Drain plug location

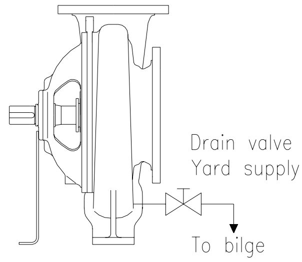

Fig. 2 Pump with drain line to bilge

2.6 Running Maintenance

2.6.1 Sleeve Bearing

The front-end sleeve bearing is located in the suction side of the pump. This radial bearing is cooled and lubricated by the pumped water. No routine maintenance is required.

2.6.2 Ball Bearing

The combined radial and axial bearing is located in bearing housing at the rear end of the pump. This bearing is permanently grease-filled with sealing covers on both sides. No re-lubrication is necessary.

2.6.3 Shaft Seal

2.6.3.1 Gland Packing

Check the gland packing regularly. Leakage should be 30 – 60 drips per minute. Smaller leakage can cause overheating and the packing lubricant will disappear, resulting in increased packing and shaft wear.

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When stuffing box leakage is excessive, tighten the gland nuts 1/6 turn and re-check leakage after 10 minutes. If it is still excessive, re-tighten the nuts another 1/6 turn. Allow packing to resettle, then re-check. These adjustments should preferably be made when the pump is stationary.

After a period of operation the packing will have shrunk due to loss of lubricant. Another ring of packing can be inserted, but this topping-up should not be repeated. When the seal is no longer effective, complete re-packing is necessary.

2.6.3.2 Mechanical Seal

Normally leak-proof, mechanical seals may nevertheless occasionally drip. Should heavy leakage begin, the seal must be replaced right away. The mechanical seal used in the SFP pump is of the cartridge type. It is removed and fitted as a complete unit.

2.7 Operational Problems

Various problems may arise. Some are listed here together with likely causes.

When investigating, always note important data such as capacity, discharge head, speed and power consumption.

2.7.1 Pump Capacity Inadequate

1. Wrong direction of rotation
2. Air in the pump inlet, due to
   - air pockets or leaks in suction piping
   - air being sucked through shaft seal
3. Bad design of suction piping causing cavitation
4. Suction lift too high
5. Impeller wear ring clearance too large
6. Impeller blocked
7. Friction losses in suction or discharge piping too large
8. Debris clogging seachest or strainer

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2.7.2 Shaft Seal Leakage

2.7.2.1 Gland Packing

1. Vibrations, "beating" the packing
2. Badly worn shaft
3. Burnt packing rings
4. Stuffing box incorrectly packed
5. Liquid pressure too low
6. The shaft is running concentrically

2.7.2.2 Mechanical Seal

1. Vibrations
2. Incorrect seal assembly
3. Seal blocked by impurities
4. Cracks in seal faces
5. Damaged O-rings
6. Worn-out
7. Dry running
8. Excessive shaft run-out

2.7.3 Ball Bearing Over-heating

1. Improper pump/driver alignment
2. Excessive pipe forces on pump casing
3. Pump operating far from duty point
4. Bearing worn-out

2.7.4 Vibrations

1. Solids trapped in impeller
2. Pump unit inadequately secured
3. Misalignment
4. Faulty inlet conditions
5. Over-throttling, i.e. the flow is too small
6. Cavitation

2.8 Disconnecting Driver or Piping

ATTENTION!
If the pump driver has been disconnected, the unit must always be re-aligned. Re-alignment is also necessary if the suction or discharge pipes have been disconnected.

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2.9 Stand still

During lengthy stand still, the pump shaft should be occasionally rotated to prevent binding of bearings and other moving parts. In sub zero ºC conditions, the pump must be completely drained.

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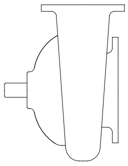

Fi-Fi Pump type SFP
Operating Instruction 3

Dismantling and Assembly

The pump sectional drawing must be available before starting any dismantling. This instruction covers complete dismantling and re-assembly procedures, including cleaning and checking. For less complete servicing, only the appropriate paragraph(s) need be referred to.

Please note that the way of performing dismantling and assembly can vary slightly depending upon type of installation and the reason for doing it. In some cases the pump may be opened on site for inspection only. In other cases the most practical solution is to bring the complete unit to a workshop for a complete overhaul.

ATTENTION!
Before starting to dismantle a pump in service, ensure that the driver is locked (including any remote controls). Suction and discharge valves must normally be closed. The pump should be drained.

3.1 Dismantling

1. Remove coupling guard and bolts connecting pump-coupling hub to driver hub.
2. Disconnect necessary piping and connections to make it possible to remove the pump rotor. In many cases that means to loosen the pump from the foundation and to pull the complete unit forward.
3. Remove the nuts on the stud bolts connecting pump cover/bearing housing to the pump casing. At this stage, do not remove the two socket screws holding together pump cover and bearing housing (Fig. 1). The screws keep the assembly together.

Fig. 1 Socket screw

Fig. 2 Removing rotor unit

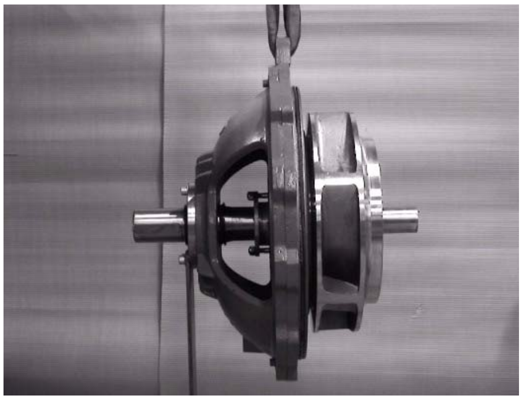

Fig. 3 Lifting rotor unit

Product subjected to technical changes without prior notice

4. Withdraw the complete rotor from the casing using levers, if necessary (Fig. 2).
5. Remove the rotor unit safely, e.g. by using a lifting arm or slings (Fig. 3). Depending upon the reason for dismantling, it is often convenient to support the unit under the outer flange of the bearing housing with the impeller pointing upward.

3.1.1 Impeller
Unscrew the setscrews in the impeller retaining ring. Remove the ring (Fig. 4).

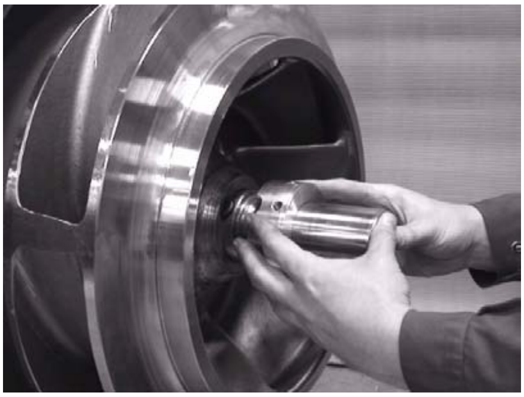

Fig. 4 Removing retaining ring

Pull off the impeller (Fig. 5). If necessary use a special hub puller. Levers might also be used to prise off the impeller.

Fig. 5 Removing impeller

3.1.2 Ball Bearing Assembly
To do a complete dismantling of the bearing assembly, it is most suitable to position the unit with the input shaft pointing upward.

1. Remove outer V-ring and bearing cover.
2. Use an eyebolt in the shaft centre and carefully lift the shaft from the bearing housing (Fig. 6). If the pump is fitted with a mechanical seal, the rotating seal parts must be locked before doing this operation. See paragraph 3.3.6, Mechanical Seal of Cartridge Type
3. Remove shaft nut and bearing locking ring.
4. Pull off the ball bearing using a hydraulic press with the inner races fully supported by a spool piece. A puller tool can also be used for removing the bearing.

Fig. 6 Removing shaft unit

3.1.2 Sleeve Bearing
The sleeve bearing can be removed from the pump casing using an arbor in combination with a hydraulic press. Remember to support the outside of the bearing carrier during this operation, so that coaxiality of the bore is not disturbed.

Depending upon the condition of the bearing and the reason for dismantling, the most practical solution can sometimes be to chisel out the sleeve bearing.

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3.2 Cleaning and Inspection

Clean all parts after dismantling. Pay special attention to sealing faces, spigots and bores.

Inspect other parts such as gland, O-ring and V-rings. Change if necessary.

Sleeve Bearing Clearance
Replace sleeve bearing if clearance is outside maximum value given in Fig. 7.

Wear Ring Clearance
Change wear rings if clearance is outside maximum value given in Fig. 8.

SFP 250x350:

Diametrical clearance bearing/shaft new pump: 0.13mm

Max. allowable diametrical clearance: 0.45mm

Fig. 7 Sleeve bearing clearance

3.3 Assembly

The procedure is basically the reverse of that for dismantling, but note the following:

- See the pump unit sectional drawing for correct bolt torques.
- Consult sectional drawing for correct use of assembly paste, threadlocking agent and other important notes.
- If a mechanical seal is used, the seal assembly drawing must be available.

SFP 250x350:

Diametrical clearance wear ring/impeller new pump: 0.40 – 0.50mm

Max. allowable diametrical clearance: 1.20mm

Fig. 8 Wear ring clearance

3.3.1 Wear Rings

One wear ring to be installed in the pump casing and one in the pump cover. There is an interferrence fit between the rings and the bores. In addition to securing the rings, Loctite 641 should be used to prevent crevice corrosion.

The wear rings are most easily installed by freeze fitting. The rings must have a temperature of minus 20ºC or lower. Lightly tapping with a suitable hammer can also be used for getting the rings into position (Fig. 9).

Fig. 9 Wear ring installation

3.3.2 Sleeve Bearing

There is interference fit between the bearing and the bore in the pump casing inlet. Use Loctite 641 when installing the bearing. Note that the bearing consists of two identical parts. The parts must be positioned together to align the lubrication grooves inside the bearing. A driver pin is included in the assembly for this purpose.

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Freeze fitting is strongly recommended for sleeve bearing installation. The bearing must have a temperature of minus 30ºC or lower. A hydraulic press in combination with an arbor can also be used as an alternative bearing installation. Remember to support the bearing carrier well during this operation.

ATTENTION!
Do not use a gas flame or similar to heat the bearing bore in the pump casing. Heating will disturb the close tolerances in the bore.

3.3.3 Ball Bearing
Heat the ball bearing to 100ºC in an oven. Lubricate the shaft with assembly paste. Push the bearing onto the shaft by hand (Fig. 10). After cooling down completely, smear outside of bearing with ample quantities of Molykote 111C for corrosion protection.


Fig. 10 Ball bearing installation

Install bearing locking ring and shaft nut on the shaft.

3.3.4 Impeller
There is normally a slight clearance fit between pump shaft and impeller. There is an interference fit between key and keyway in pump shaft, and a clearance fit between key and keyway in impeller.

Lubricate the shaft and key well with a suitable assembly paste, for example molybdenum-disulphide. Push the impeller onto the shaft until it is positioned against the shaft shoulder.

Secure the impeller by installing the retaining ring. The ring must rest against the front side of the impeller hub.

ATTENTION!
When tightening the setscrews in the retaining ring, Loctite 243 or a similar threadlocking agent must be used (Fig.11). Otherwise there is a chance that the impeller can loosen.

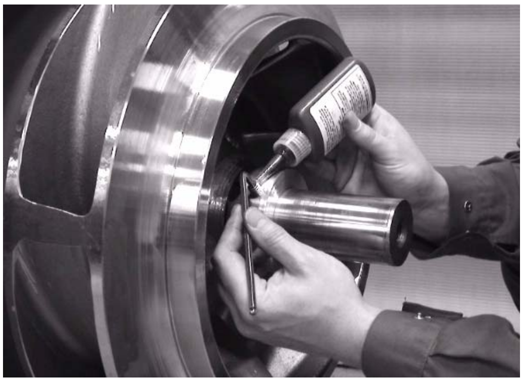
Fig. 11 Retaining ring installation

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3.3.5 Pump Casing Sealant

An O-ring is used for sealing between pump casing and pump cover. This O-ring should normally be replaced after each pump dismantling. Always use an original moulded O-ring supplied by Fire Fighting Systems AS. A glued ring is only an emergency solution with a limited lifetime.

Smear the O-ring, the groove in the pump cover and the corresponding bore in the pump casing with Molykote 111C (Fig.12).

ATTENTION!
It is especially important to smear O-ring and adjacent surfaces with Molykote 111C if pump casing and pump cover is not made from a corrosion resistant alloy. Otherwise leakages can gradually develop.

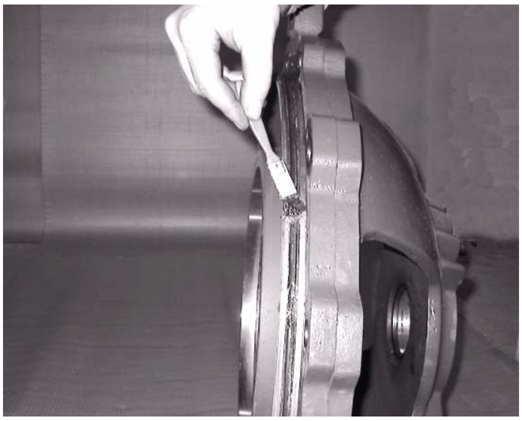

Fig. 12 O-ring installation

3.3.6 Mechanical Seal of Cartridge Type

The SFP pump can be equipped with a mechanical seal as an optional seal arrangement. In these cases a single mechanical seal of the cartridge type is used (Fig. 13). A mechanical seal contains two rings with a high quality surface finish running against each other. One ring is stationary and the other rotates with the shaft. Spring force and liquid pressure hold the faces together.

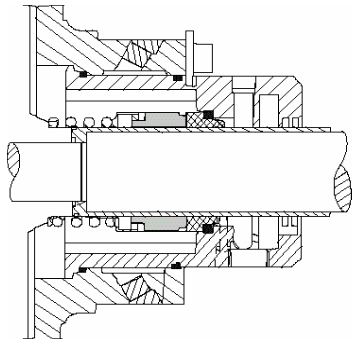

Fig. 13 Mechanical seal (typical)

The mechanical seal is almost leak free, and should normally pass only a few cubic centimetres of liquid per hour during operation. This small leakage will usually evaporate.

ATTENTION!
A mechanical seal must never run dry. If the friction heat is not dissipated, the rapid temperature rise will quickly lead to overheating and seal failure.

Installing the Seal Cartridge

Always refer to the seal assembly drawing before installing the cartridge.

1. Check that the O-rings for sealing against shaft and pump cover are properly seated in their respective grooves. Lubricate the O-rings with soft soap. Do not use grease or oil.

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2. Attach the cartridge to the pump cover. Tighten the connection bolts carefully so that angular misalignment is avoided.
3. Connect pump cover/seal unit with shaft/bearing unit.
4. Disconnect the cartridge clips (red colour) locking the seal during transport and fitting.

3.3.7 Gland Packing

Gland packing is the standard shaft seal arrangement for the SFP pump. The shaft is sealed by compressing the soft packing rings until leakage is just sufficient to dissipate the frictional heat (Fig 14).

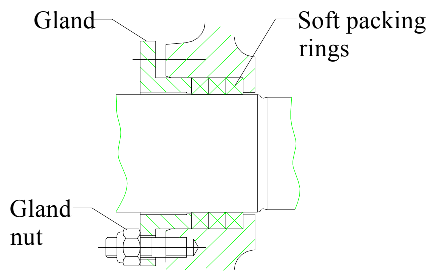

Fig. 14 SFP gland packing

Installing Gland Packings

1. Check the pump shaft and the gland. If they are scored or worn, grind or replace them.
2. Select new PTFE impregnated fibre packing with the correct cross section.
3. Each ring should be long enough for the ends to be pressed together when inserted in the stuffing box. Cut the ends at right angles using a sharp knife. If it is difficult to insert the packing, roll it with a pipe on a clean, flat surface.
4. Oil the packing rings and shaft with e.g. machine oil, before inserting the rings.
5. The gland must move easily into the stuffing box. Push in the rings using the gland and stagger the joints half a turn (Fig. 15). The gland should have a guiding depth of minimum 3-5 mm into the stuffing box. Ensure that the gland is at right angle in relation to the shaft.
6. The gland nuts must be carefully tightened until it is no longer possible to turn the pump rotor freely by hand (Fig. 16). Then loosen the nuts slowly until it is possible to turn the rotor again.

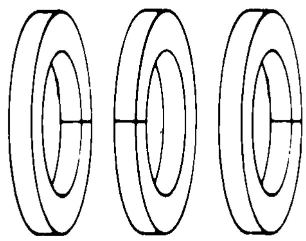

Fig. 15 Staggered packing rings

Fig. 16 Adjusting gland nuts

3.3.8 Running-in Gland Packing

See Operating Instruction 2:
Start-up and Running Maintenance
Paragraph 2.6.3.1 Gland Packing