OPERATION AND MAINTENANCE MANUAL

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RICE LAKE STATE FISH AND WILDLIFE AREA
UPPER MISSISSIPPI RIVER RESTORATION
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
FULTON COUNTY, ILLINOIS

SEPTEMBER 2021

APPENDIX E

PROJECT PHOTOGRAPHS

APPENDIX E

PROJECT PHOTOGRAPHS

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BUILDING STRONG®

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Control Building March 2012

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Control Building deck and support beam reinforcing steel in place and tied

Control Building March 2012

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Control Building May 2012

Rice Lake Habitat Rehabilitation Enhancement, Stage 1, W912EK-11-C-0090, Update #9, May 16, 2012
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Control Building Masonry Walls being constructed.

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Control Building August 2012

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Control Building October 2012

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Control Building November 2012

Control Building Complete

Control Building November 2014

Discharge Channel December 2011

Discharge Channel March 2012

Eagle Nest 400 feet from edge of Outfall Structure Location at Slim Lake. Cannot work in this Area until July.

Discharge Channel April 2012

Rice Lake Habitat Rehabilitation Enhancement, Stage 1, W912EK-11-C-0090, Weekly Update, April 12, 2012

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Discharge Channel excavation to Station 4+00

Discharge Channel May 2012

Discharge Channel excavation full after Illinois River water level crested at Minor Flood Stage

Discharge Channel June 2012

Rice Lake Habitat Rehabilitation Enhancement, Stage 1
W912EK-11-C-0090, June 11, 2012, Work Update #10

Discharge Channel drained after May Flooding

Discharge Channel June 2012

Discharge Channel excavation continues. Berms being built as work progresses

Discharge Channel July 2012

Discharge Channel progress to Station 20+00 looking toward Banner Dyke Road

Discharge Channel August 2012

Discharge Channel Excavation and Construction at Station 20+00

Discharge Channel August 2012

Discharge Channel Excavation and Construction at Station 40+00 looking East to Banner Dyke Road

Discharge Channel Sept 2012

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Discharge Channel excavation progress to Station 54+00

Discharge Channel October 2012

Discharge Channel Clearing and Grubbing complete at Slim Lake

Discharge Channel October 2012

Discharge Channel Seeding approximately 50% compete. Photo taken next to Banner Dyke Road

Discharge Channel Nov 2012

Rice Lake Habitat Rehabilitation Enhancement, Stage 1, W912EK-11-C-0090, Update #17, December 4, 2012
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48-inch Gates and CMP discharge to Rice Lake complete in area of Eagle Nest.

Discharge Channel Dec 2012

Discharge Channel Dec 2012

Discharge Channel July 2013

Condition after record high event in April 2013

Discharge Channel July 2013

Condition after record high event in April 2013

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Discharge Channel Nov 2014

Overflow Spillway March 2012

Rice Lake Habitat Rehabilitation Enhancement, Stage 1, W912EK-11-C-0090, Weekly Update, March 22, 2012
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Overflow Spillway alignment stakes across Goose Lake behind equipment

Overflow Spillway March 2012

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Overflow Spillway July 2012

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Overflow Spillway October 2012

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Overflow Spillway Dec 2012

Overflow Spillway July 2013

Condition after record high event in April 2013

Overflow Spillway Dec 2014

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80 cubic yards of concrete poured for Outlet Foundation.

Outlet Structure May 2012

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Outlet Structure May 2012

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Outlet Structure June 2012

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Outlet Structure August 2012

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Outlet Structure Stop Logs and Gate installed. Excavation of Channel from Goose Lake in progress

Outlet Structure Dec 2012

Outlet Structure July 2013

Condition after record high event in April 2013

BUILDING STRONG®

Outlet Structure Dec 2014

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SEPTEMBER 2021

APPENDIX F

PUMP STATION SUBMERSIBLE PUMPS

APPENDIX F

PUMP STATION SUBMERSIBLE PUMPS

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SULZER

OPERATION AND MAINTENANCE MANUAL

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Submersible Pump, Axial & Mixed Flow-Type

PROJECT:	Rice Lake Habitat Rehab and Enhancement
LOCATION:	Illinois Waterway, Lagrange Pool, Fulton County IL
CONTRACTOR:	SAF, Inc.
ABS REP:	Flow Technics, Inc. Frankfort, IL

PREPARED BY:	Mike Stroh	**DATE:**	3/7/2013
REVIEWED BY:	Mark Jaminet	**DATE:**	3/7/2013
APPROVED BY:		**DATE:**	

ABS USA 140 Pond View Drive, Meriden, CT 06450 203-238-2700 www.absgroup.com

abs
We know how water works

SULZER

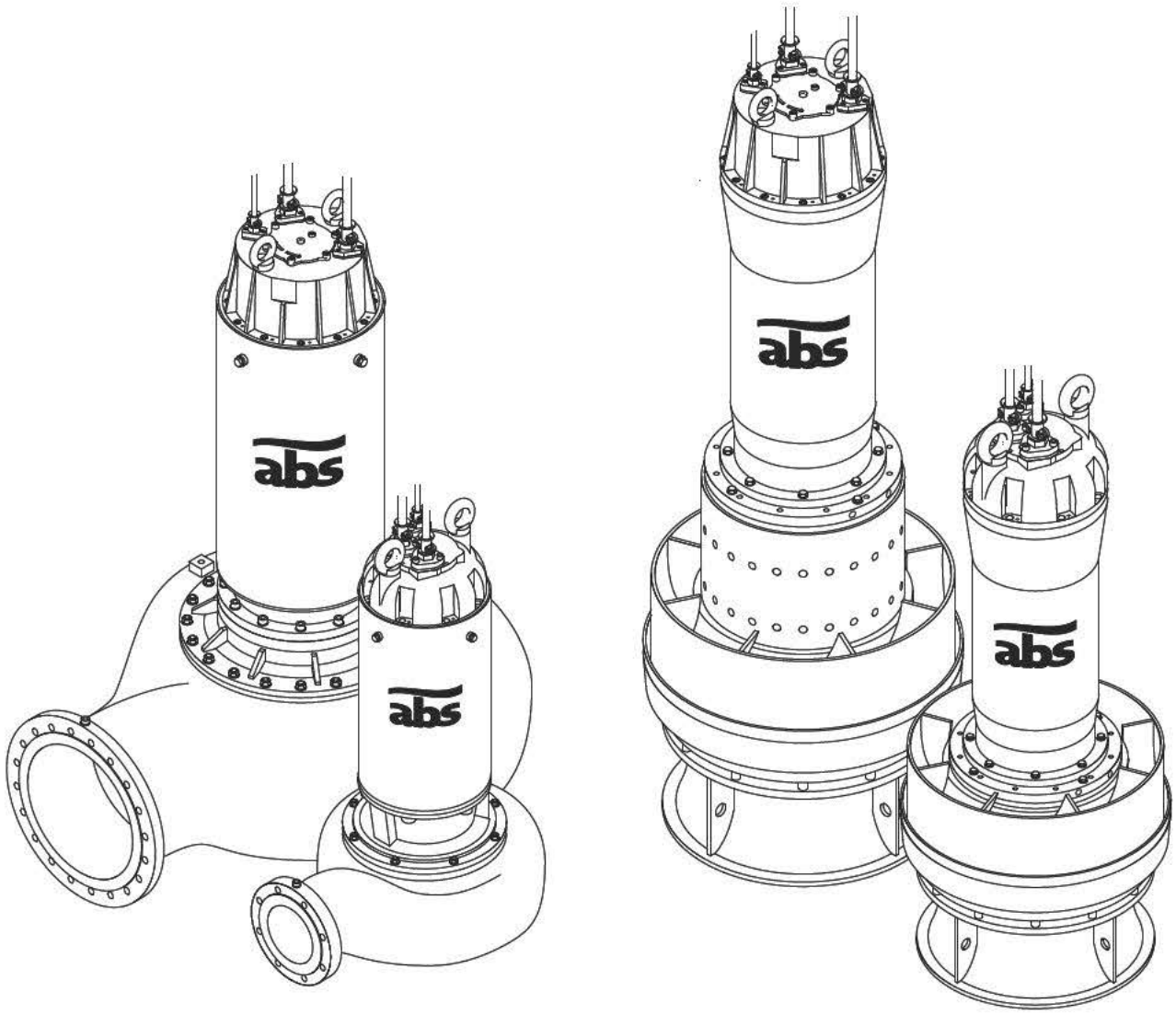
CONTACT LIST

1. **Flow-Technics, Inc.**
   181 Ontario Street
   Frankfort, IL. 60423
   815-277-2600
   815-534-5311 (Fax)

2. **ABS Main Office (Corporate head office & warehouse for N America)**
   Sulzer Pumps
   ABS USA
   140 Pond View Drive
   Meriden, CT 06450
   Phone (203) 514-4276
   Fax (203) 238-0738

SULZER

ABS submersible sewage pumps AFP M8, M9
ABS submersible mixed flow column pumps AFL and M8, M9
ABS submersible propeller pumps VUP M8, M9



1 597 0521 GB 02.2013

en

Installation and Operating Instructions

Translation from original instruction

www.sulzer.com

GB 0521-C

Installation and Operating Instructions

for ABS submersible sewage pumps,

Motors M8+M9 with AFP-Hydraulics

AFP 4003 (50/60 Hz)	AFP 5002 (50/60 Hz)	AFP 6001 (50/60 Hz)	AFP 8001 (50/60 Hz)
AFP 4004 (60 Hz)		AFP 6003 (50/60 Hz)	
		AFP 6004 (50/60 Hz)	

Motors M8+M9 with AFLX-Hydraulics

AFL 1202

AFL 1203

AFL 1207

Motors M8+M9 with VUPX-Hydraulics

VUP 0801	VUP 1001	VUP 1201
VUP 0802	VUP 1002	VUP 1202

Table of contents

1 General

1.1 Introduction

These **Installation and Operating Instructions** **Safety Hints** contain basic
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T y of

ATTENTION ***Appears at safety hints, the non-observance of which could damage the unit or affect its functioning.***

NOTE ***Used for important pieces of information.***

Illust 3/2 T f

1.2 Correct usage of the products

T y
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T only if y fec afe y
of ally T **of the installation and operating instructions** afe y y
y

T manufac / y y fo T y
In f f y **Sulzer Pump Solutions Germany** fo

In of y fault immediately f T fault
immediately if y y

1.3 Application restrictions of the submersible pumps

T of
TE II 2 dII T4 for 5 F C 5 Clas I, D C&D T3C for 6

Limitations: F 4 °C 4 F)
Immer 20 65 f

ATTENTION ***If cable length is less than 20 m/65 ft the max. immersion depth reduces accordingly. In special cases an immersion depth greater than 20 m/65 ft is possible. In order to do this you need the written approval from the manufacturer Sulzer.***

Pumping of

nly of y

For the operation of units as explosion-proof execution the following applies:

In of
y ly
y of y

ATTENTION ***The ex versions***
the oil chamber. There is an option of an external seal monitor for the ex versions

For the operation of explosion-proof submersible pumps in wet-well installation without cooling jacket applies:

It f y fully

For the operation of explosion-proof submersible pumps applies:

T of of y **bimetallic temperature limiters** DI 44 5
C 4/ / C

For the operation of explosion-proof submersible pumps with frequency inverter applies:

T of (PTC DI 44 5 T
C 4/ / C

y frequency
of 5 6

1.4 Application areas for the submersible pumps

1.4.1 Application areas for the series AFP

The ABS submersible sewage pumps of the **AFP series** fo
of y

They are suitable for pumping of the following liquids:

Cl fo

Faecal matter

F
fo supply
f

Sewage

In yst ly
ally f endly T fo y
installation.

1.4.2 Application areas for the series AFL

T of **AFL series** for
supply of

They are suitable for the following liquids:

- Raw water with solid or fibrous material.
- Sewage
- Surface water, rain water, drainage water
- Sludge

The AFL pumps are installed in a **concrete sump** or in a **steel pressure pipe** using a suitable coupling ring

1.4.3 Application areas for the series VUP

ABS submersible propeller pumps of the **VUP series** are designed for those applications where large water volumes must be pumped at low heads (up to 10 m/33 ft).

They are suitable for the following liquids

- Fresh and process water pumping
- Raw water for drinking water supply
- Surface and rain water

Die VUP pumps are installed in a **concrete sump** or in a **steel pressure pipe** using a suitable coupling ring.

1.5 Identification coding

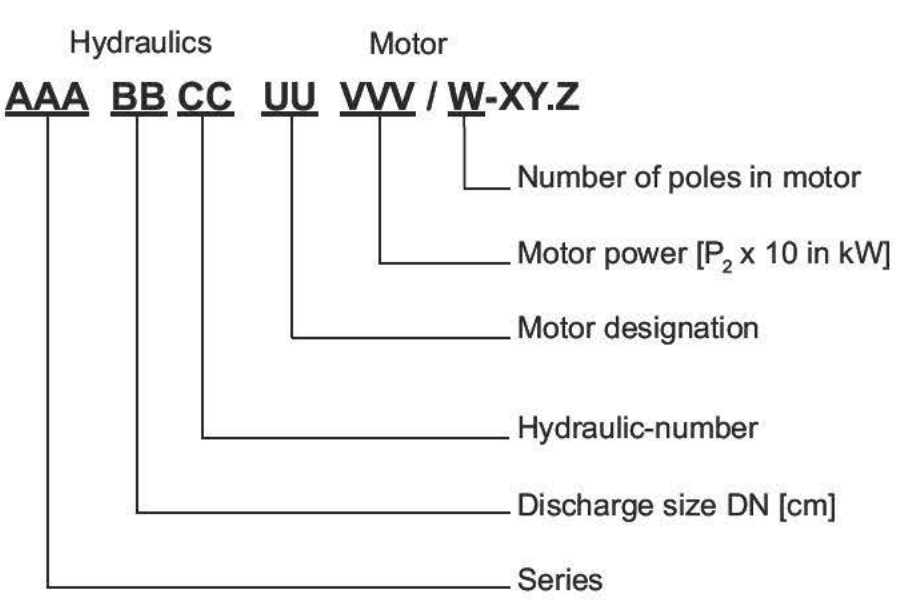


Figure 1 Identification coding

X: Part of the manufacturing code for the motor size **X** gives the motor size

Y: Part of the manufacturing code for the motor size **Y** indicates the stator length. Selection here is between a motor frame size and number of poles 1 to n.

Z: Information on the motor (50 Hz) or FM (60 Hz) for explosion proof versions.

1.6 Technical data

The electrical data is dependent on the operating point for which the unit was designed. Please take the technical data from the name plate or from the ABSEL data files.

The maximum noise level of the units of this series is ≤ 70 dB(A). In some types of installation and at certain operating points on the performance curve it is possible that the noise level of 70 dB(A) or the measured noise level will be exceeded.

1.7 Dimensions and weights

The dimensions of the unit can be found on the relevant dimensional sheet. The hydraulic curves and impeller type can be found on the ABSEL hydraulics curve sheet. Please take the technical data and the weight of the units from the nameplate.

1.8 Nameplate

We recommend that you record the data from the original nameplate *Figure 2* so that you can refer to the data at any time.

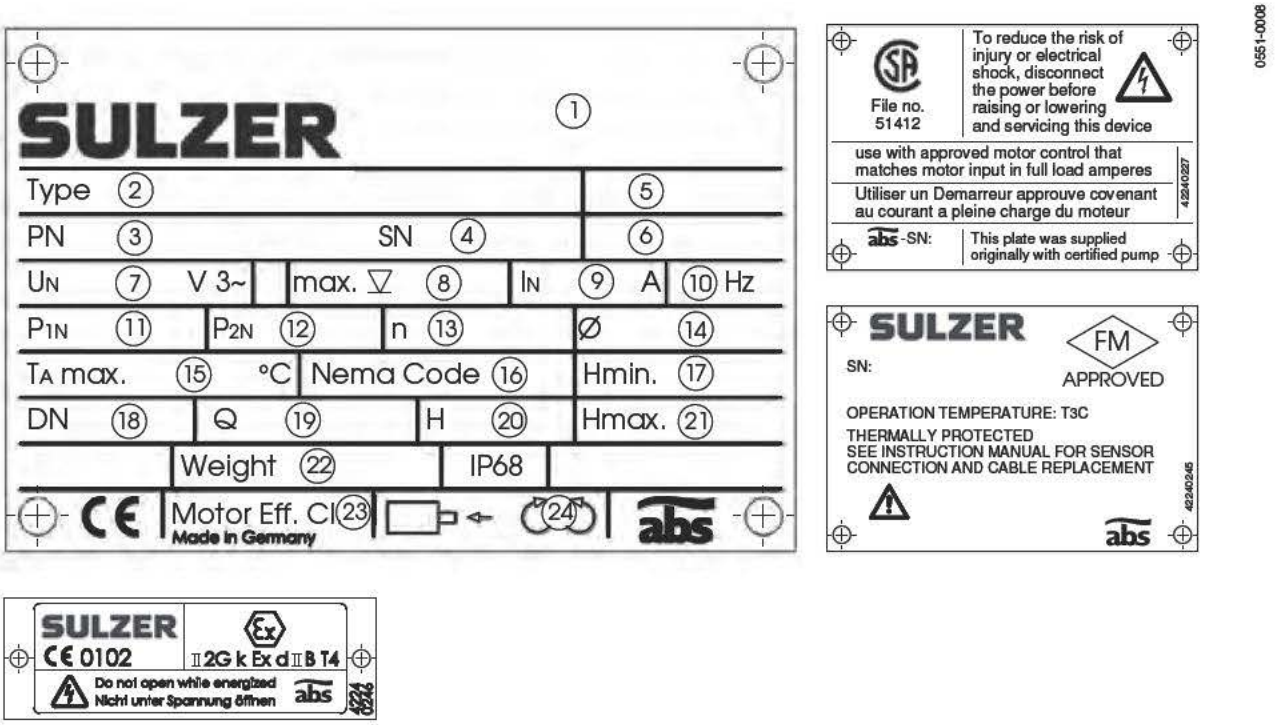


Figure 2 Nameplates 42242501/0246/0227/0245

Legend

1 Address
2 Type designation
3 Art. no.
4 Serial number
5 Order number
6 Year of manufacture [month/year]
7 Nominal voltage
8 Max. immersion depth [flexible unit]
9 Nominal current
10 Frequency
11 Power (consumption) [flexible unit]
12 Power (output) [flexible unit]
13 Rotation speed [flexible unit]
14 Impeller/Propeller ø [flexible unit]
15 Max. ambient temperature [flexible unit]
16 Nema Code Letter (only at 60 Hz, e.g., H)
17 Min. pumping height [flexible unit]
18 Nominal width [flexible unit]
19 Pumping quantity [flexible unit]
20 Pumping height [flexible unit]
21 Max. pumping height [flexible height]
22 Weight (without attached parts) [flexible unit]
23 Motor efficiency class
24 Motor shaft direction of rotation

NOTE ***In all communication please state type of the unit, item and serial number!***

NOTE ***Additional country specific nameplates possible.***

2 Safety

T afe y **Safety Hints.** If anything is not clear or you have any questions as to safety make certain to contact the manufacturer Sulzer.

3 Transport and storage

3.1 Transport

T y

D of fac y fo transportation.

D y y fastene y of

Take note of the entire weight of the unit The adequately fo of omply afe y regulations.

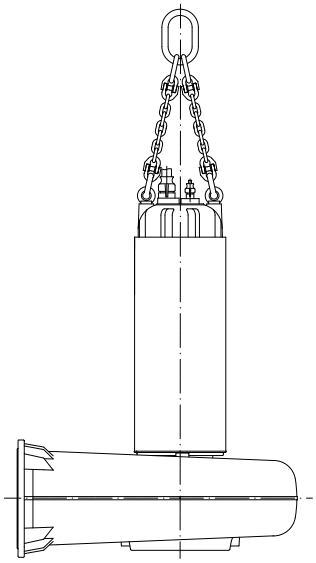
T f

T f y adequately tely face taking care that it cannot topple over.

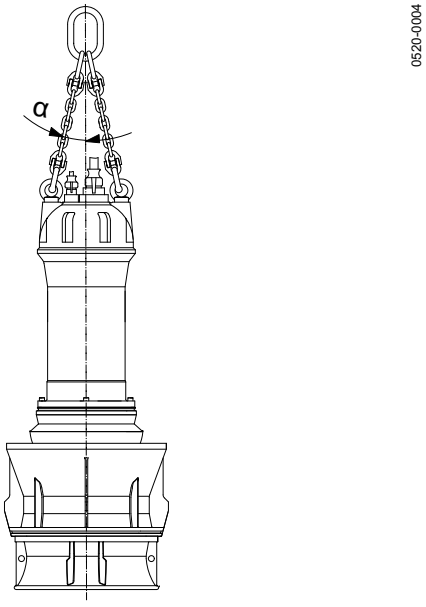
D y of

T lif of of lif

3.1.1 Standing transport



3 S AFP



S AFL VUP

The safety hints in the section above must be observed!

3.1.2 Transport in a horizontal manner

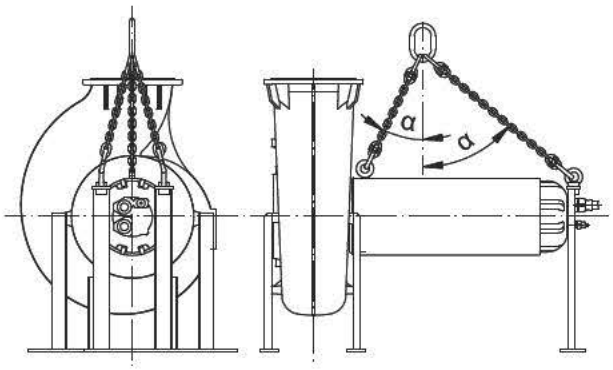


Figure 5 Transport in a horizontal manner AFP

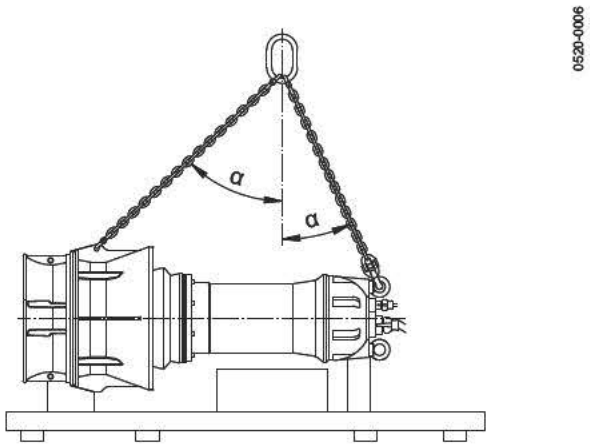


Figure 6 Transport in a horizontal manner AFL/VUP

ATTENTION ***α max. ≤ 45°. The angle α between the centre line of the unit and the lifting tools should not exceed 45°.***

The safety hints in the previous sections must be observed!

Submersible pumps are only transported in a horizontal position if they have been built for horizontal installation.

The submersible pump can be placed on the mounting frame fitted on the pump and transported.

ATTENTION ***Avoid point loading. If necessary, place the pump on a secure robust pallet and tie down using steel bands or other fixing methods.***
Only lift up the submersible pump if it is suspended horizontally on the crane hooks. If necessary, adjust the chain accordingly.

3.2 Transport securing devices

3.2.1 Motor connection cable moisture protection

The motor connection cables are protected against the ingress of moisture along the cable by having the ends sealed at the works with protective covers.

ATTENTION ***These protective covers should only be removed immediately prior to connecting the pumps electrically.***

Particular attention is necessary during storage or installation of pumps in locations, which could fill with water prior to laying and connection of the power cable of the AFP-motor. Please note that the cable ends, even where fitted with protective sleeves, cannot be immersed in water.

ATTENTION ***These protective covers only provide protection against water spray or similar and are not a water tight seal. The ends of the cables should not be immersed in water, otherwise moisture could enter the connection chamber of the motor.***

NOTE ***If there is a possibility of water ingress then the cables should be secured so that the ends are above the maximum possible flood level.***

ATTENTION ***Take care not to damage the cable or its insulation when doing this!***

3.2.2 Transport securing device for AFP submersible pump shafts

NOTE ***Does not apply to all models.***

In order to avoid damage to the pump shaft or the bearings during horizontal transport, the shaft is clamped in an axial direction when leaving the works.

ATTENTION ***The transport securing device on the pump shaft should only be removed immediately before installation or connecting up the pump.***

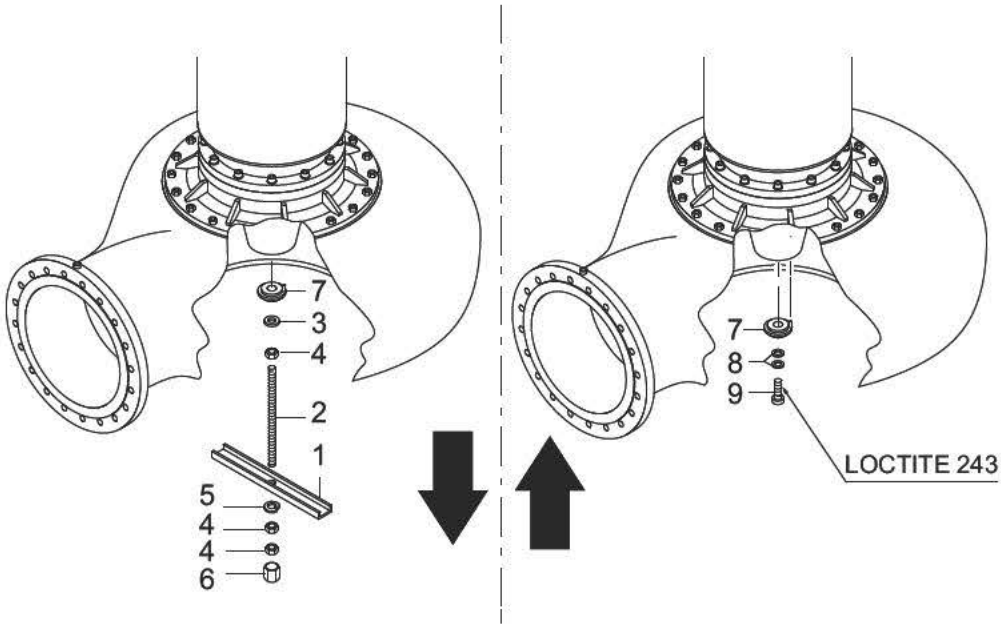


*Figure 7 Removal of the transport securing devices AFP (**without** holes on the suction side)*

- Before commissioning remove securing device (7/1-6). Fit impeller washer with securing pin (7/7) and impeller screw (7/9) complete with lock washers (7/8).

ATTENTION ***Hold the impeller washer (7/7) in position when unscrewing the threaded rod (7/2). The impeller screws of the M4 motors are in addition secured with LOCTITE Type 243 (LOCTITE will be supplied if required).***

- Insert the impeller washer (7/7) so that the securing pin of the washer fits into the drilled hole of the shaft. Fasten the socket head screw (7/9) together with the lock washers (7/8).

ATTENTION ***Ensure that the fitting position and tightening torque of the Nord-Lock® securing washers is correct as in Figure 8 and table for tightening torque!***

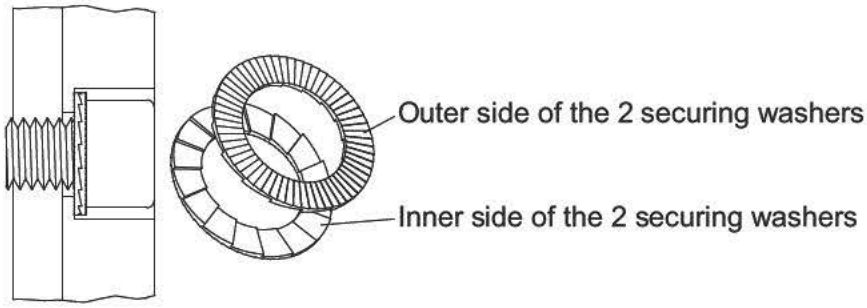


Figure 8 Correct fitting position of the Nord-Lock® securing washers

Tightening torque for ABS stainless steel screws A4-70:							
Thread	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tightening torque	6.9 Nm	17 Nm	33 Nm	56 Nm	136 Nm	267 Nm	460 Nm

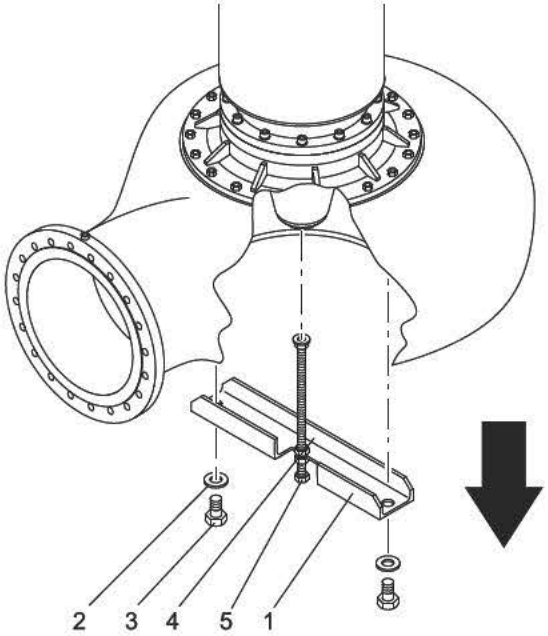


*Figure 9 Removal of the transport securing devices AFP (**with** holes on suction side)*

- Before commissioning, remove the transport securing devices (9/1-5).

ATTENTION ***After fitting of the impeller washer, check that the impeller can be turned by hand.***

3.2.3 Transport security of pump and impeller for motors with an impeller installed

The safety hints in the previous sections must be observed!

- Before commissioning, remove the transport securing devices (10/1-5).

ATTENTION ***The transport securing device on the pump shaft should only be removed immediately prior to installation or connecting to the pump.***

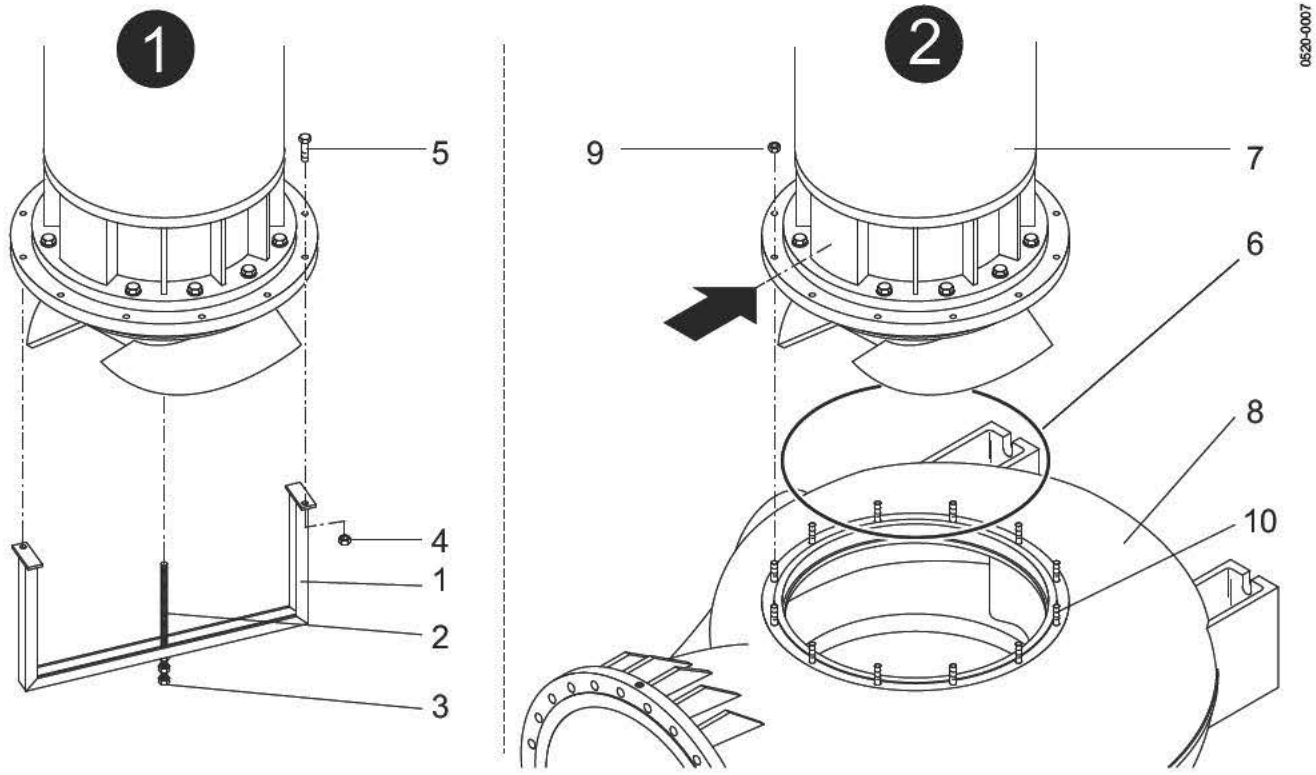


Figure 10 Removal of the transport devices in motors with an impeller installed and a volute to be fitted at the construction stage

3.2.4 Constructional assembly of the volute for motors with an impeller installed

The safety hints in the previous sections must be observed!

- Lightly grease the O-Ring (10/6) and draw it carefully over the impeller and insert into the centring seating of the oil chamber flange.
- Using a suitable hoist, carefully set up the motor (10/7) over the volute (10/8) so that the cast on lugs in the oil chamber point in the direction of the discharge flange (*See arrow illustrated in Figure 10).*

ATTENTION ***When lowering the motor with impeller into the volute care should be taken that the impeller slides in a straight manner into the wear ring.***

- Lower the motor so that the flanged holes in the oil chamber line up with the pre-assembled studs (10/10) on the volute (10/8). Place the motor on the pump housing.
- Tighten the hex. nuts (10/9) using the recommended tightening torque.

ATTENTION ***After fitting of the impeller washer, check that the impeller can be turned by hand.***

3.2.5 Transport securing device for submersible pump shafts AFL/VUP

NOTE ***Does not apply to all models!***

In order to avoid damage to the pump shaft or bearings during horizontal transport, the shaft is clamped in an axial direction when leaving the works.

The safety hints in the previous sections must be observed!

ATTENTION ***The transport securing device on the motor shaft should only be removed immediately prior to installation or connecting up to the pump.***

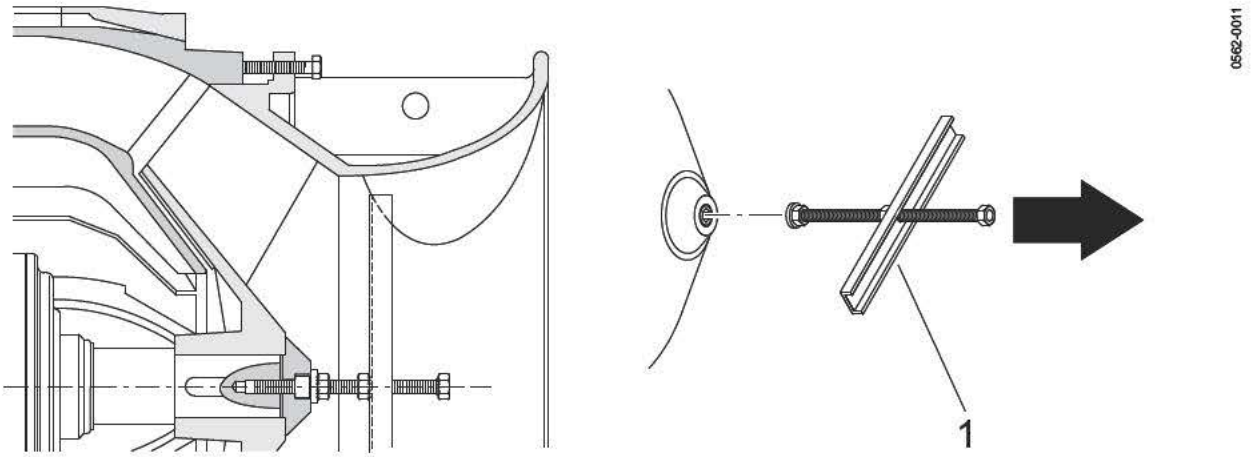


Figure 11 Removal of the transport devices on VUP and AFL pumps

- Remove the transport securing device (11/1).

3.3 Storage of the units

ATTENTION ***The ABS products must be protected from weather influences such as UV from direct sunlight, high humidity, aggressive dust emissions, mechanical damage, frost etc. The ABS original packaging with the relevant transport securing devices (where used) ensures optimum protection of the unit. If the units are exposed to temperatures under 0 °C/32 °F check that there is no water in the hydraulics, cooling system, or other spaces. In the case of heavy frosts, the units and cable should not be moved if possible. When storing under extreme conditions, e.g. in tropical or desert conditions suitable additional protective steps should be taken. We would be glad to advise you further.***

NOTE ***ABS units do not generally require any particular maintenance during storage. After long storage periods (after approx. one year), the transportation locking device on the motor shaft (not with all versions) should be disassembled. By rotating the shaft several times by hand, new lubricating oil or, depending on the version, a small amount of coolant (which also serves to cool or lubricate the mechanical seals) is applied to the sealing surfaces, thus ensuring perfect operation of the mechanical seals. The bearings supporting the motor shaft are maintenance-free.***

4 Product description

4.1 Structural design

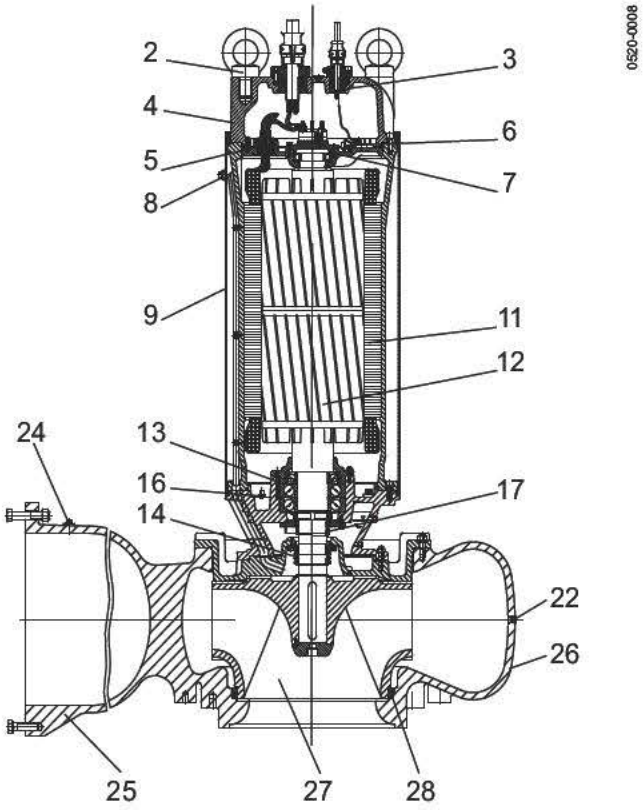


Figure 12 AFP M8

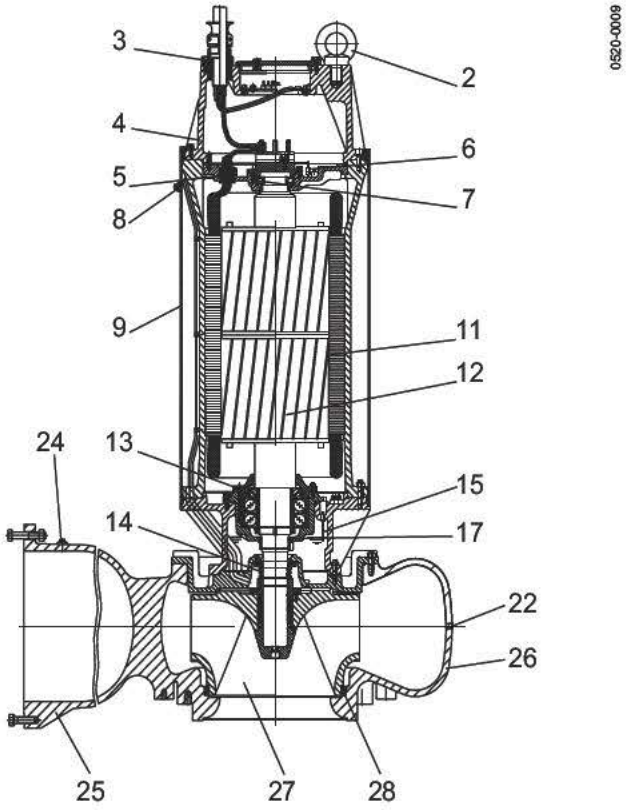


Figure 13 AFP M9

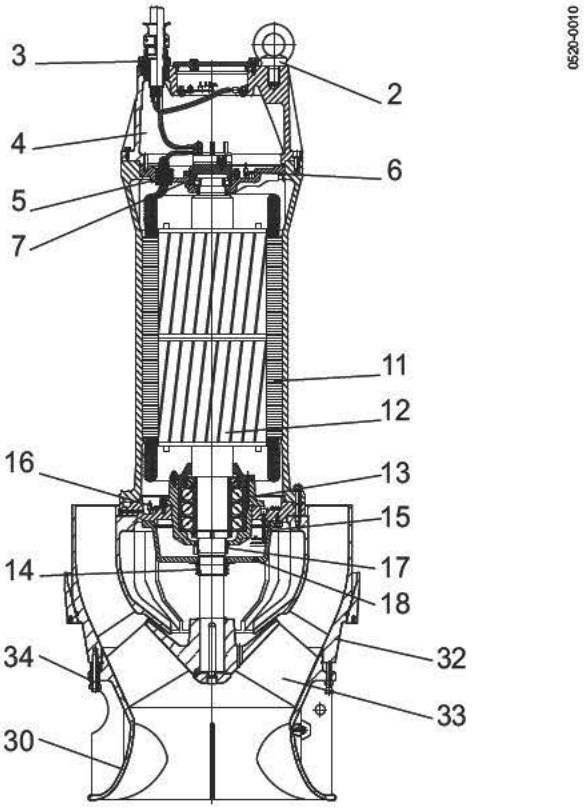


Figure 14 AFL 1200

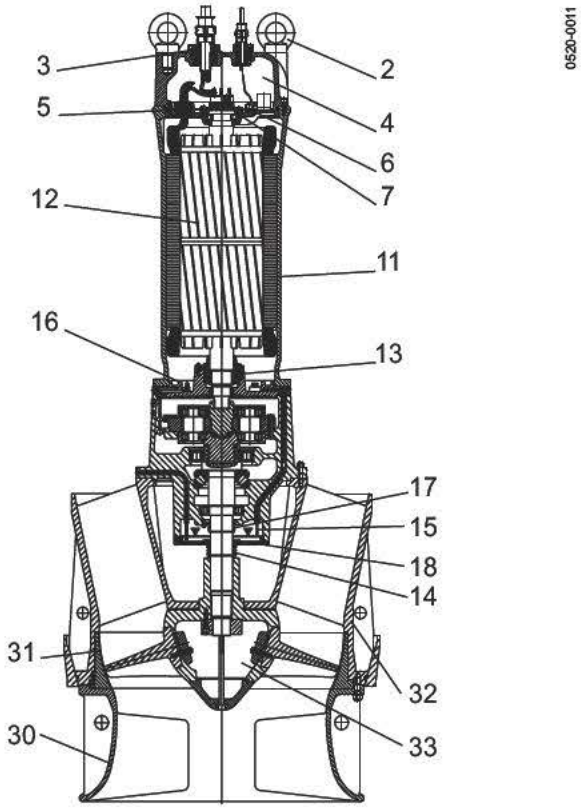


Figure 15 VUP 1200

Legend

	L f
2	Eyebolts (Option)
3	Cable inlet
4	Connection chamber
5	C
6	(DI
7	Temperature monitoring upper bearing (option)
	F
9	Cooling jacket
	C
11	Stator
12	Rotor shaft
13	Temperature monitoring lower bearing (Option)
4	
5	(DI
16	Seal monitoring (DI) motor chamber
7	
19	Plug screw motor chamber
20	Contrablock (CB) - impeller
21	Contrablock (CB) - bottom plate
22	y
23	fo
24	Connection for pressure monitoring/venting
25	D
26	Volute
27	I
28	Wear ring in the volute
29	Wear ring on the impeller (option)
30	Bellmouth
3	fo
32	
33	Propeller VUP, impeller AFL
34	fo FL

4.2 Motor monitoring system

Motor equipment:

Motors		**ME8/ME9**		
Monitoring		**Standard**	**Ex**	**FM**
Stator	Bimetallic			
	Thermistors (PTC)			
	PT 100		-	-
Seal monitor	Oil chamber		nly FP	
	Motor chamber			
	Connection chamber			
Bearing temperature Upper /lower	Bimetallic			
	Thermistors (PTC)			
	PT 100			

4.2.1 Temperature monitoring of the stator

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y elf

The

onally (PT fo

4.2.2 DI-Electrode

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of

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ATTENTION ***Thermistors or PT 100 devices must never be directly connected into the control or power system. They must always be connected to a suitable evaluation device.***

Operating voltage **...AC/...DC**	**...500 V ~/...101 V=**
AC	**250 V**
AC cos φ = 1,0	**2.5 A**
AC cos φ = 0,6	**1.6 A**
max. switching current at $\mathbf{I_N}$	**5.0 A**

device with PTB-Approval number.

4.2.3 Temperature monitoring of the bearings.

If of

T off of

y of

Switching temperature of motors of insulation class F :

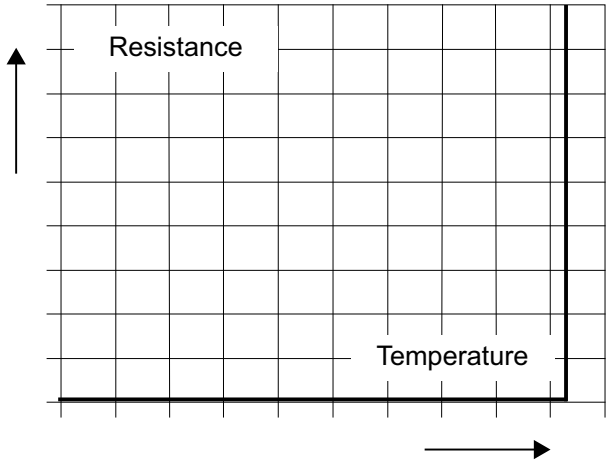
4 °C/284 F

20 °C/24 F

/PTC PT

4.2.4 Temperature indication

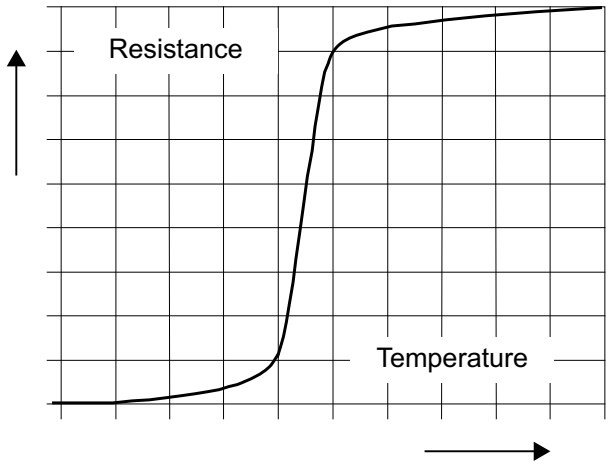
of
F y of yp PT
T y of
resistance rise is proportional to the temperature rise.



0562-0017

Application	Option
Function	Temperature switch using the bimetallic principle, which opens
	T allowable switching current, ly the control circuit

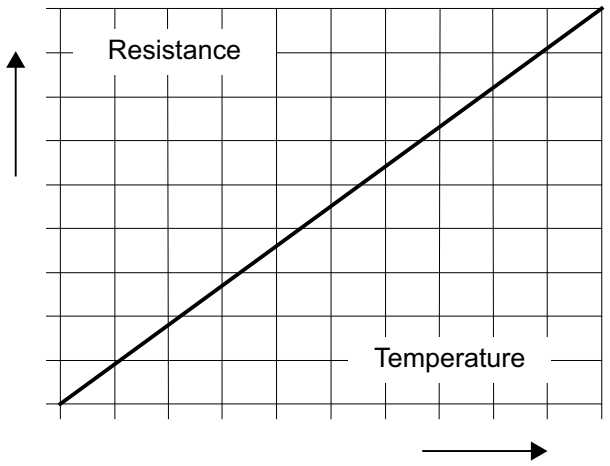
C v howi f f b



0562-0018

Application	Option
F	T resistance (no switch) curve with stepwise behaviour Cannot the control circuit. Evaluation of y suitable electronic equipment

C v howi f f ther



0562-0019

Application	Option (not for Ex)
F	F resistance (no switch). The linear curve allows continuous of the temperature Cannot the control circuit. Evaluation of y suitable electronic equipment

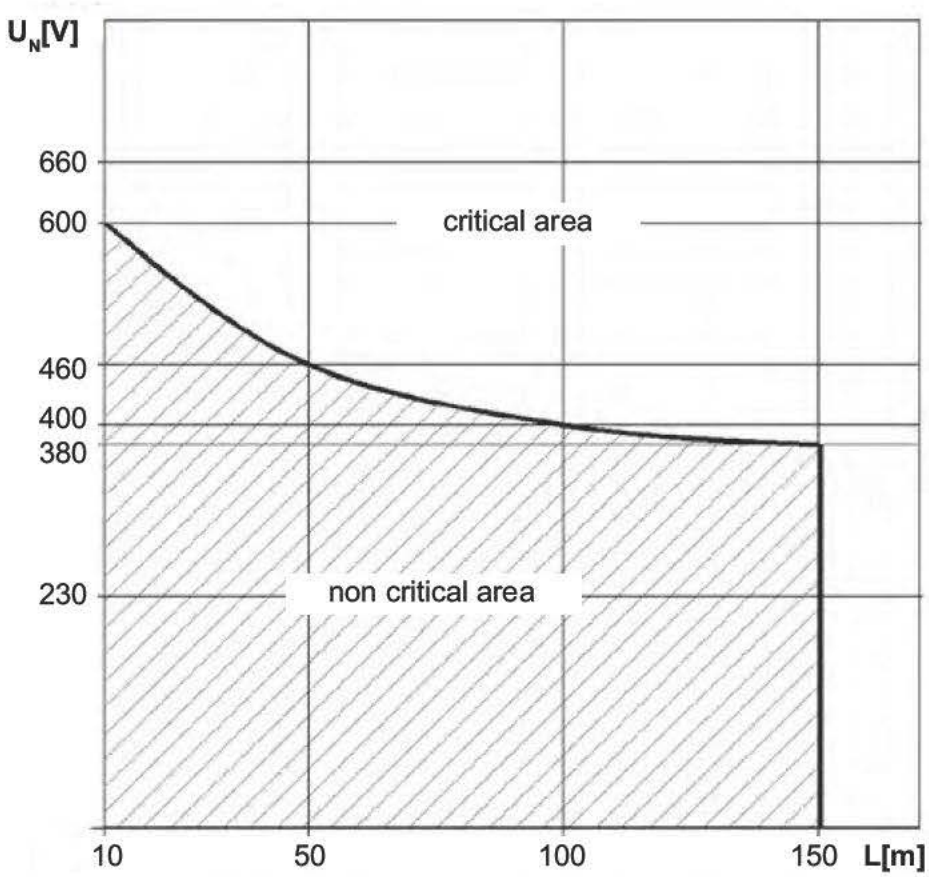
8 C v howi f f PT

4.3 Operation with frequency inverters

The stator design and the insulation grade of the motors from Sulzer means that they suitable for usage with fre-quency inverters. It is however essential that the following conditions are met when the motors are used with frequency inverters:

- The guidelines for EMC (electromagnetic compatibility) are complied with.
- Explosion-proof motors must be equipped with thermistors (PTC temperature sensors).
- Machines designated as Ex machines may never, without exception, be operated using a mains frequency that is greater than the maximum of 50 or 60 Hz as indicated on the type plate.
- Machines that are not designated as Ex machines may only be operated using the mains frequency indicated on the type plate. Greater frequencies can be used but only after consulting with and receiving permission from the Sulzer manufacturing plant.
- For operation of ex-motors on frequency inverters special requirements in relation to the tripping times of the thermo control elements, must be observed.
- The lowest frequency must be set so that the minimum fluid velocity of 1 m/s is present in the volute.
- The maximum frequency must be set so the rated power of the motor is not exceeded.

Modern frequency inverters are using higher wave frequencies and a steeper rise on the flanks of the voltage wave. This means that motors losses and motor noise is reduced. Unfortunately these inverter output signals cause higher voltage spikes in the stator. Experience has shown that, depending on rated voltage and the length of the cable between the inverter and the motor, these voltage spikes can adversely affect the life of the motor. In order to avoid this, inverters of this type must equipped with sinus filters when used in the critical zone *(see Figure 19)*. The sinus filter chosen must be suitable for the inverter with regard to rated voltage, inverter wave frequency, rated current of the inverter and maximum inverter output frequency.



L = total length (from frequency inverter to motor)

Figure 19 Critical/non critical area

5 Installation

T afe y

5.1 Installation of the AFP submersible pumps

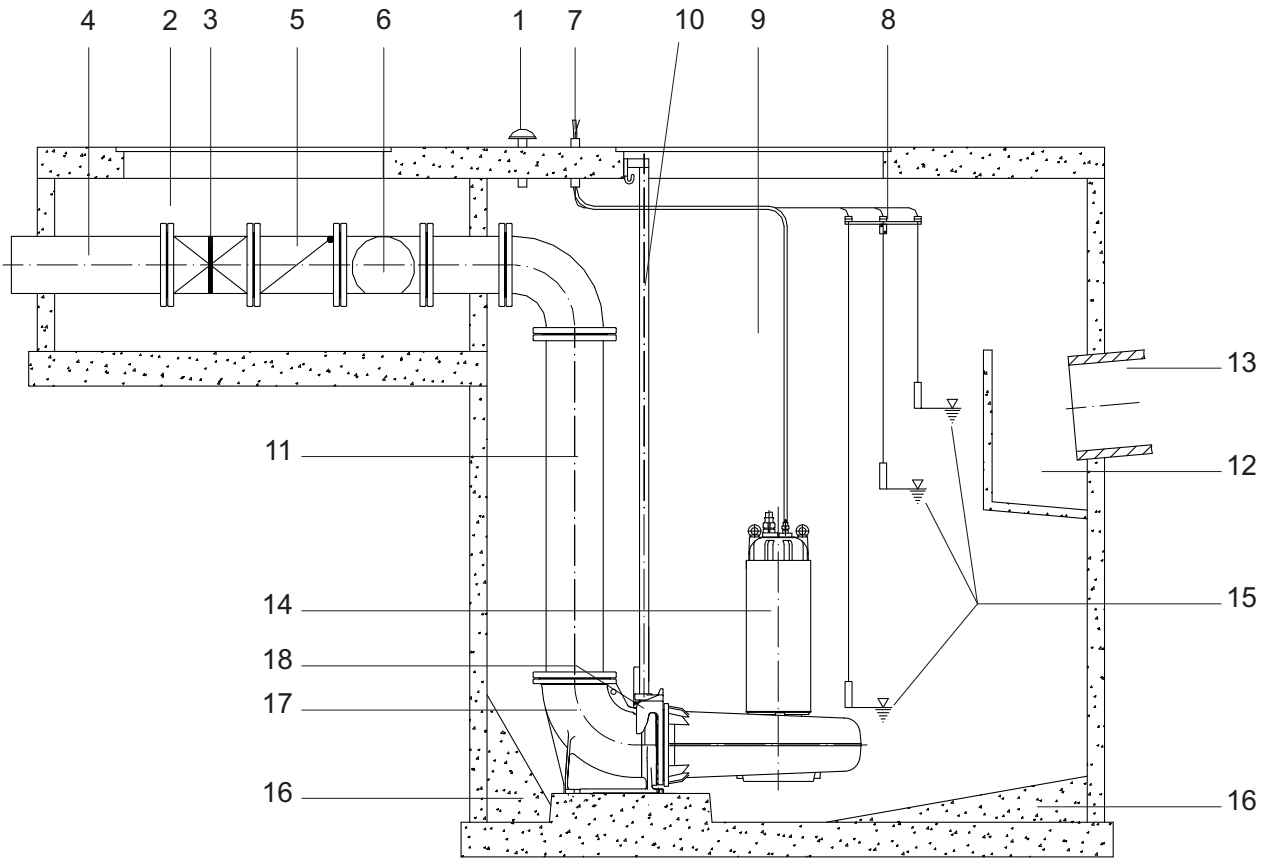
5.1.1 Installation options for the AFP submersible pumps

There are three main installation options for the submersible pumps:

1. Wet installation vertical with ABS automatic coupling system
2. D y
3. Dry installation horizontal (with cooling jacket)

NOTE ***The dimensional sheets and foundation plans for each type of installation are***

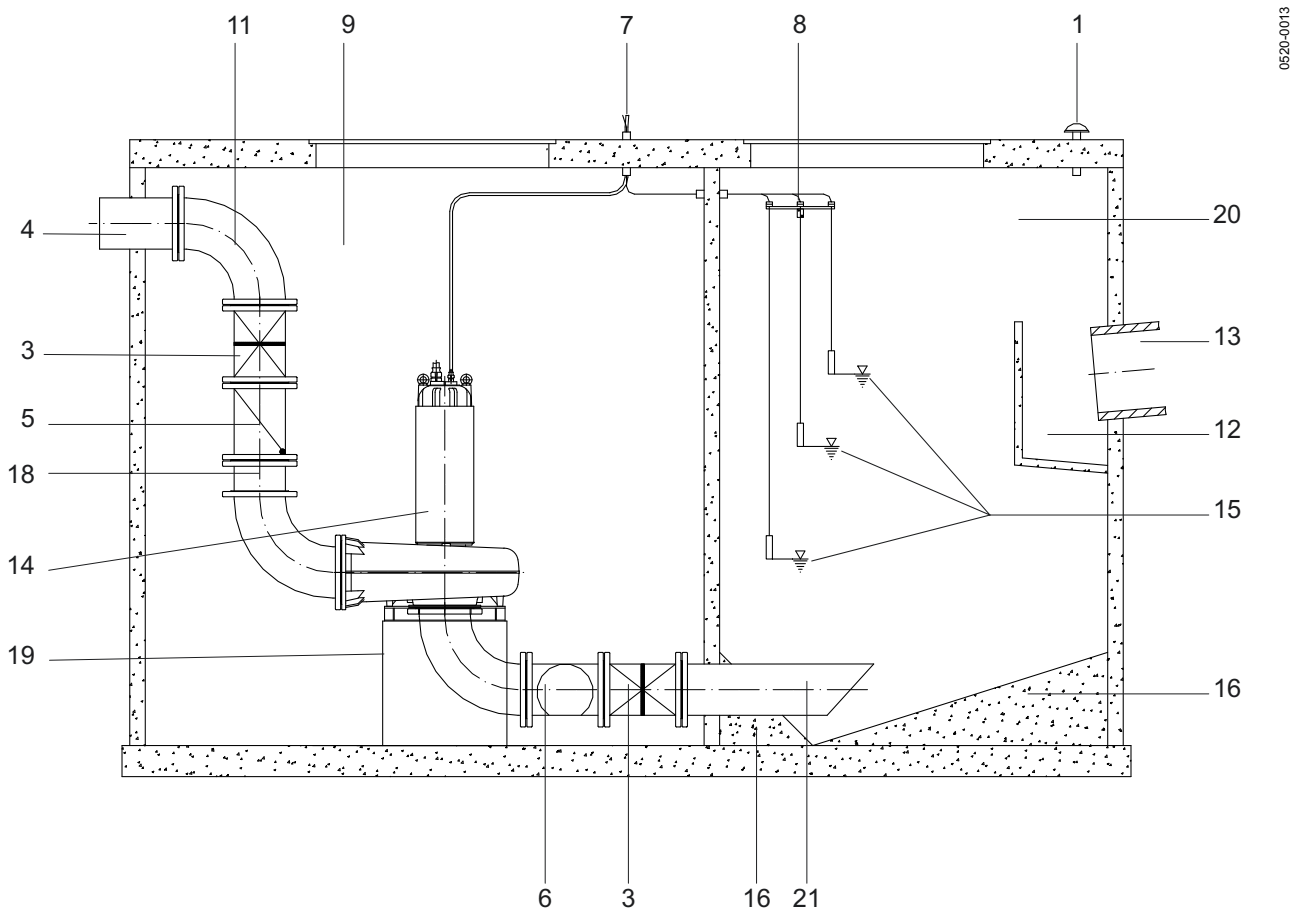
5.2 Installation examples



W v wi h ABS ys

Legend

V
2 Valve chamber
3 ff
4
5 Non-return valve
6 Fitting for valve removal
7 C
fo
9 Collection sump
11 Discharge line
2 I
3 I
14 ABS submersible sewage pump
15 Automatic level control
6 C
7 P
18 Bracket

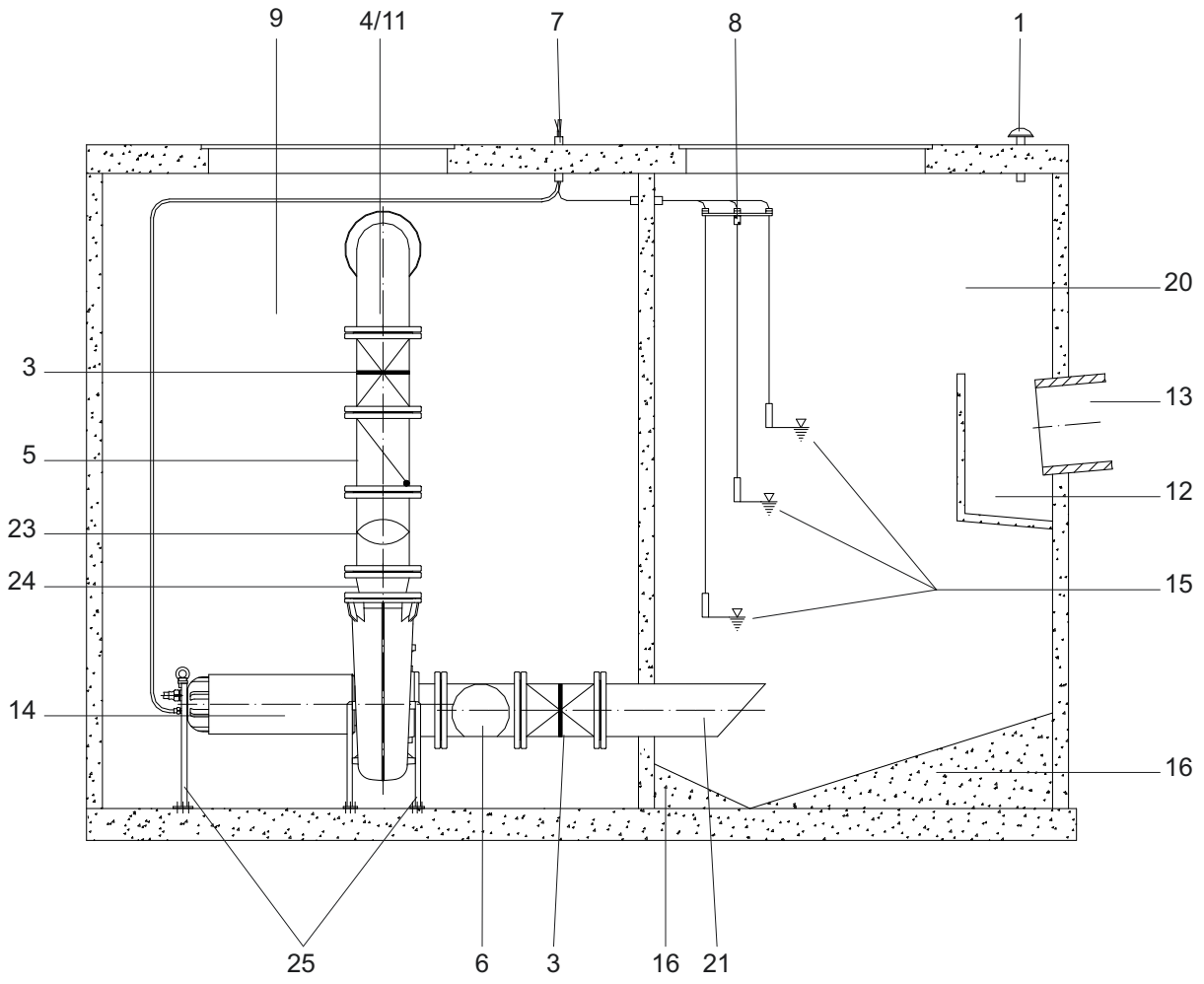


y wi h

Legend

	V
3	V
4	
5	Non-return valve
6	Fitting for removal valves
7	C fo
9	Pump sump
11	Discharge line
2	I
3	I
4	
15	Automatic level control
16	Concrete benching (after installation of suction pipe)
	Fl
20	Collection sump
21	Suction line

NOTE ***Any support frame needed for the submersible pump should be erected on site used.***



H z y

Legend

	V
3	Shut-off valve
4	
5	Non-return valve
6	Fitting for removal valves
7	C
	fo
9	Pump sump
	D
2	I
3	I
14	ABS submersible pump
5	
16	Concrete benching (after installation of suction pipe)
20	Collection sump
2	
23	C
24	Diffuser
25	/

NOTE ***Any support frame needed for the submersible pump should be erected on site used.***

5.2.1 Wet installation of the AFP submersible pump

T afe y

Fit a hoist to the submersible pump.

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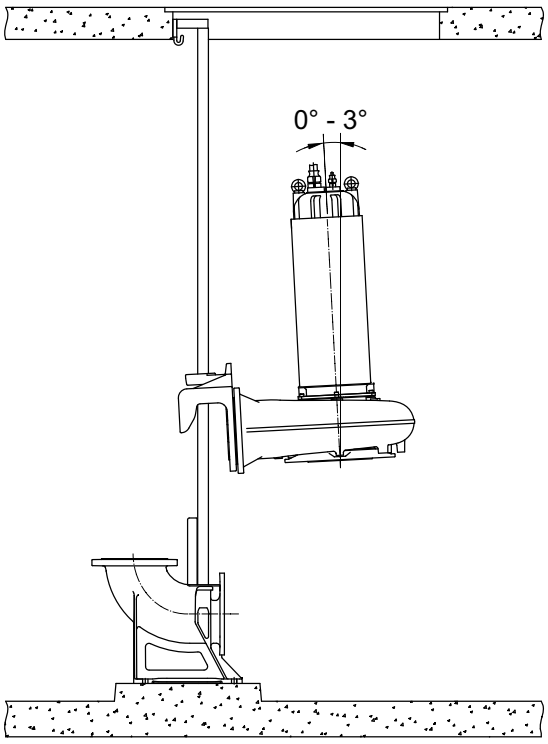
ally y of

.5.



23 Lower f the AFP

5.2.2 Installation of the AFP submersible pump in a dry sump

T afe y

Fit a hoist to the submersible pump.

of fully f fast

F

If

5.3 Fitting the pedestal

Care, ensure that adhesive does not come into contact with skin or eyes! Wear goggle and gloves!

The groove of the guide piece and O-ring must be clean and free of grease. The instant adhesive LOCTITE type 406 (supplied with the unit) is spread evenly on the base of the groove in the bracket (24/1) and the O-ring inserted immediately.

NOTE ***The hardening time of the adhesive is only about 10 seconds!***

The guide piece (24/3) must be screwed on as shown in the drawing! Fasten the guide piece (24/3) with the two M12 screws (24/2). Tighten the screws with a torque of 56 Nm.

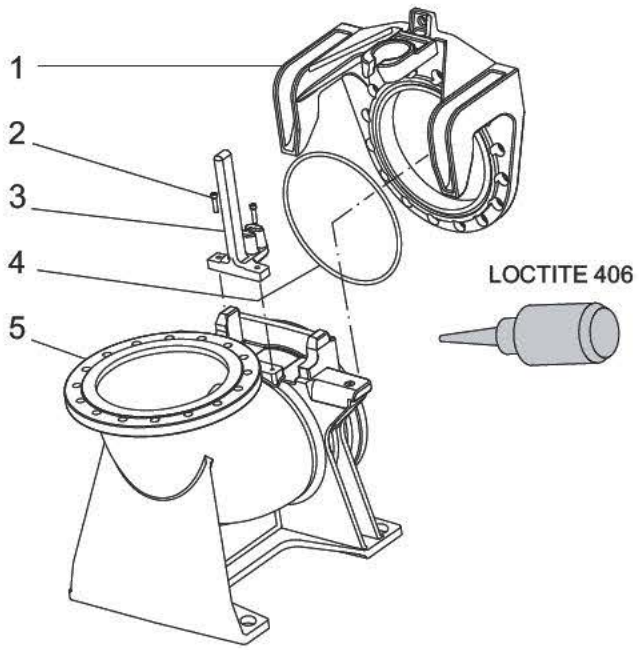


Figure 24 HD- Pedestal DN 100 - 500

Legend

1 Bracket (is fitted to the pump)
2 Screws (2 off)
3 Guide piece
4 O-ring
5 Pedestal

5.4 Installation of the AFL and VUP submersible pumps

T afe y

5.4.1 Types of installation of the AFL and VUP submersible pumps

There are two main types of installation possible with the AFL/VUP submersible pumps.

1. **Installation in a steel discharge pipe in accordance with *Figure 25***
2. **Installation in a concrete sump in accordance with *Figure 26***

T fo **AFL pumps** T
y f y fro

Type of hydraulics	Clean water	Runoff water, river water, used water, rain water, pre-screened liquid, recirculation
	Bar spacing in mm	
AFL 0600	4	2
AFL 0800	6	3
AFL 1200		5
If		

T fo **VUP pumps** T
y f y fro

Type of hydraulics	Clean water	Runoff water, river water, used water, rain water	pre-screened liquid, recirculation
	Bar spacing in mm	Bar spacing in mm	Bar spacing in mm
VUP 0400	3	25	6
VUP 0600	5		
VUP 0800	6		
VUP 1000			
VUP 1200			
If			

ATTENTION ***When setting the switching off level the minimum cover as given in the installation documents must be adhered to.***

5.4.2 Installations examples with AFL and VUP submersible pumps

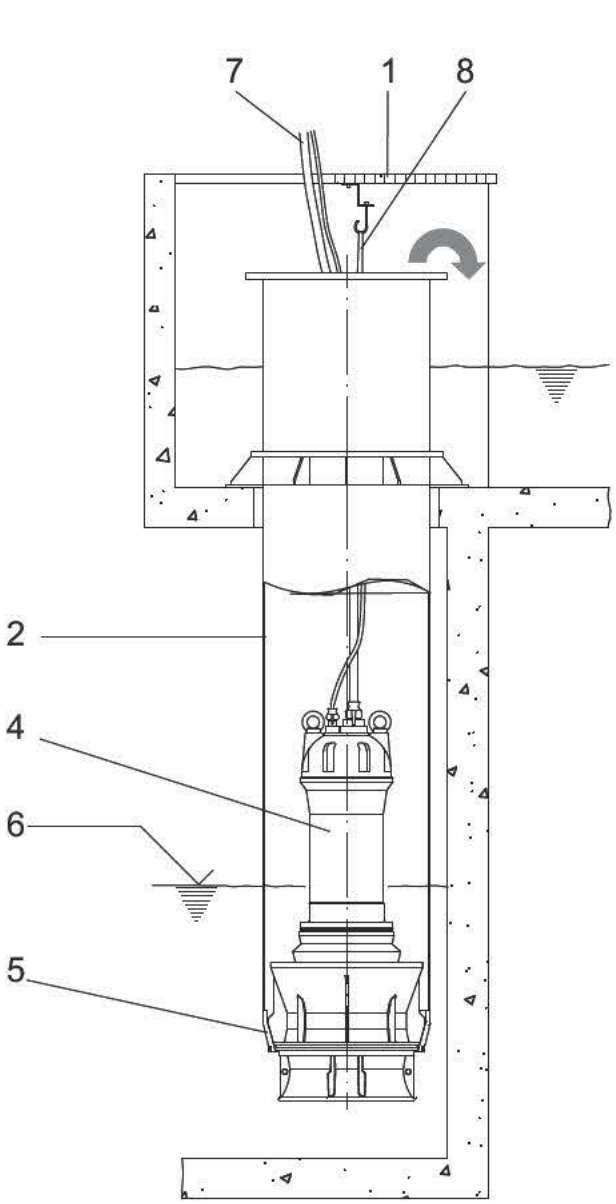


Figure 25 VUP/AFL in a steel discharge pipe

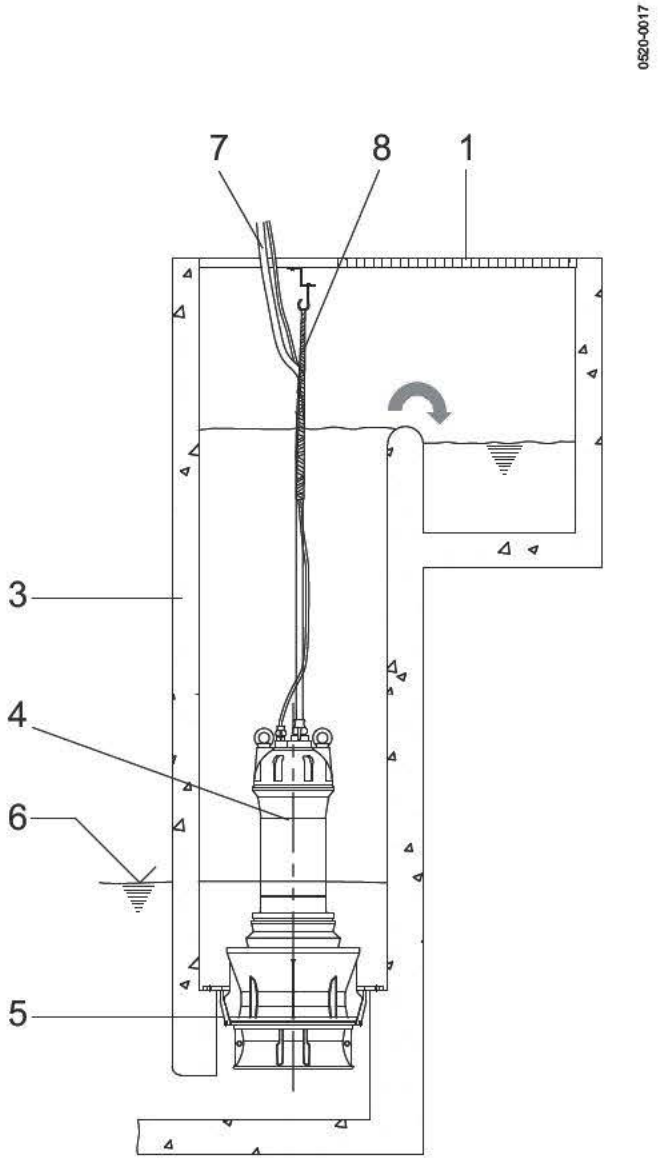


Figure 26 VUP/AFL in a concrete sump

Legend

1 Tank cover
2 Discharge pipe (riser pipe)
3 Concrete sump
4 AFL/VUP submersible pump
5 Coupling ring
6 Minimum water level (see installation drawings)
7 Connection cable
8 Cable support (for fixing the power cable)

5.4.3 Installation of the AFL and VUP submersible pumps

T afe y

ATTENTION ***The power cables should be handled carefully during installation and removal of the pumps in order to avoid damage to the insulation.***

T fo of FL/V P already
shown in . Before installation of the pump a suitable support (hook) for the chain, as well as an
fo

hydraulics mounted to the gearbox are supplied separately.

fo f
P y
weight of the hanging cable especially in the area of the cable inlet.

ATTENTION ***When raising the submersible pump out of the concrete sump or the steel discharge pipe with the hoist ensure that the connection cables are lifted out simultaneously as the pump itself is being raised.***

5.4.4 Lowering of the AFL and VUP submersible pump into the coupling ring

ATTENTION ***Before lowering the pump a direction of rotation check should be carried out, see***

D of

be taken that any paint remnants are completely removed from the conical surfaces on the pumps or on the coupling ring. These conical surfaces must then be greased.

pipe.

Carefully of T
usly
lif

T faste f

off in a watertight manner.

T only suf ly
of T

If y off

5.5 Electrical connection

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fo of y
able. Earthing, neutral, earth leakage circuit breakers, etc. must comply with the regulations of the local electric-
y supply y fec

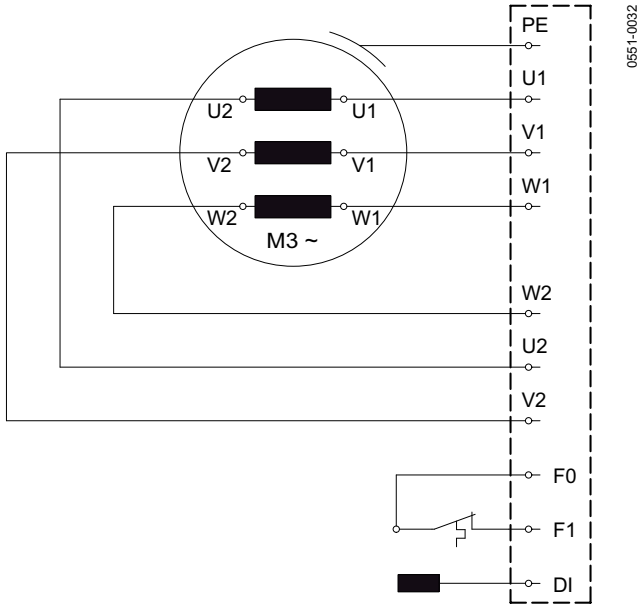
with regard to cross-sectional area and maximum voltage drop. The voltage stated on the nameplate of the pump must correspond to that of the mains.

The incoming power supply as well as the connection of the pump itself to the terminals on the control
omply of
y

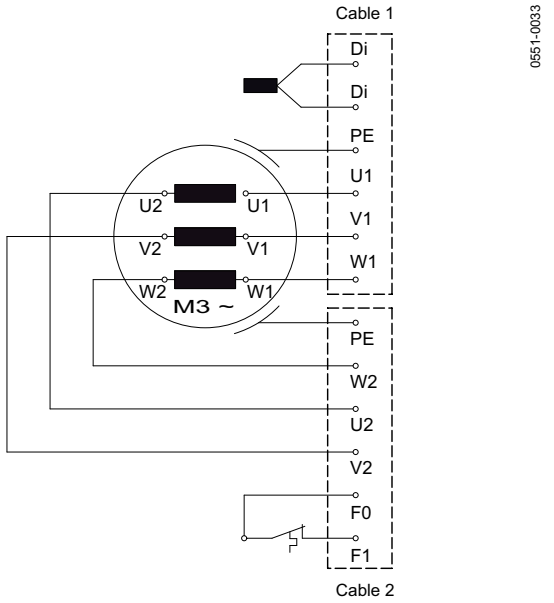
T supply y adequately f
of

ATTTENTION ***The unit should only be operated with the overload relay and thermal sensors/limiters connected.***

5.5.1 Standard connection diagrams, mains voltage 380 - 420 V at 50 Hz/460 V at 60 Hz.

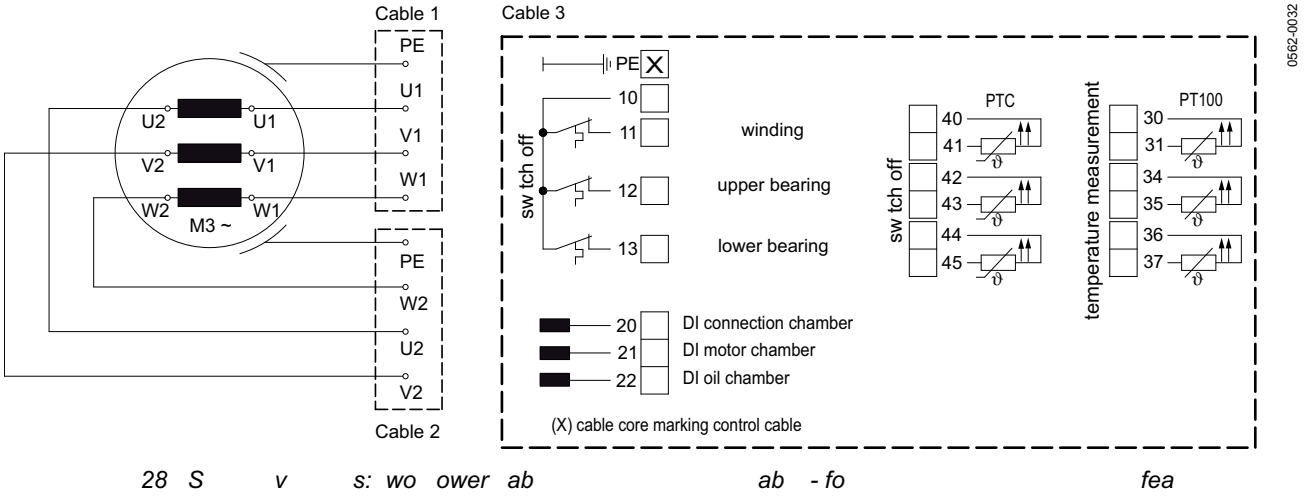


O ower ab wi h

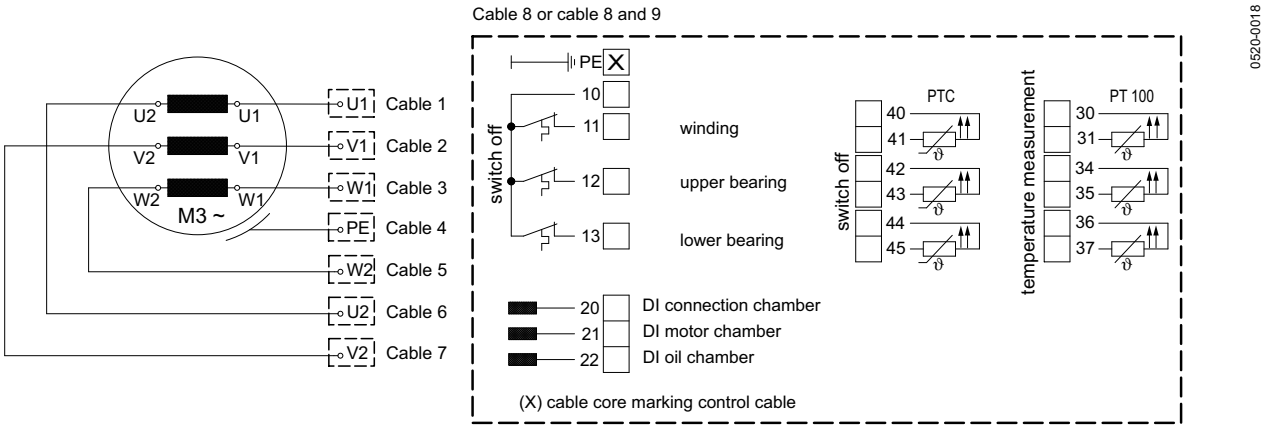


b Tw ower ab , h wi h

5.5.2 Standard connection diagrams, mains voltage 400 V at 50 Hz/460 V at 60 Hz, M8/M9 motors



28 S v s: wo ower ab ab - fo fea



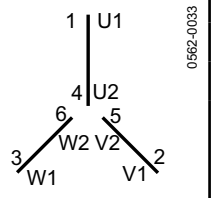
28b Six ower ab + h ab + wo ab
- fea

ATTENTION ***The cable leads are routed out of the motor. No switching takes place in the motor!***

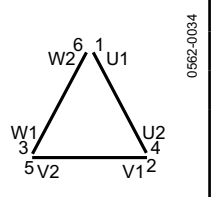
NOTE ***Information on the type of starting can be obtained from the nameplate of the pump.***

5.5.3 Lead designations

Direct starting in star				
	L1	L2	L3	Join
North America	1	2	3	4 5 6
Sulzer/Germany	U1	V1	W1	U2 V2 2



Direct starting in delta				
	L1	L2	L3	-
North America	6	2 4	3 5	-
Sulzer/Germany	2	V U2	V2	-



5.5.4 Checking direction of rotation

The safety hints in the previous sections must be observed!

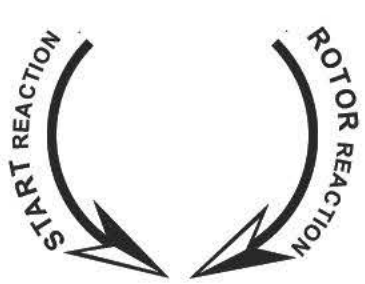
When three phase units are being commissioned for the first time and also when used on a new site, the direction of rotation must be carefully checked by a qualified person.

When checking the direction of rotation, the submersible pump should be secured in such a manner that no danger to personnel is caused by the rotating impeller, or by the resulting air flow. Do not place your hand into the hydraulic system!

The direction of rotation should only be altered by a qualified person.

When carrying out the direction of rotation check as well as when starting the unit pay attention to the **START REACTION.** This can be very powerful.

ATTENTION
The **direction of rotation** is correct if the imeller/propeller rotates in a **clockwise** manner when viewing down from the top of the placed unit



ATTENTION
The **start reaction** is **anti clockwise**

Figure 29 Rotor rotation

NOTE ***If a number of pumps are connected to a single control panel then each unit must be individually checked.***

ATTENTION ***The mains supply to the control panel should have a clockwise rotation. If the leads are connected in accordance with the circuit diagram and lead designations, the direction of rotation will be correct.***

5.5.5 Changing direction of rotation

The safety hints in the previous sections must be observed!

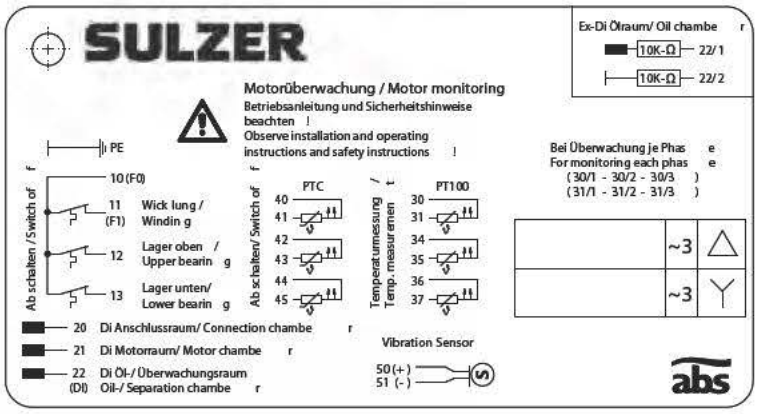
The direction of rotation should only be altered by a qualified person.

If the direction of rotation is incorrect then this is altered by changing over two phases of the power supply cable in the control panel. The direction of rotation should then be rechecked.

NOTE ***The direction of rotation measuring device monitors the direction of rotation of the mains supply or that of an emergency generator.***

5.5.6 Connection of the control circuit leads

The safety hints in the previous sections must be observed!



0562-0036

Control circuit leads for submersible pumps

10 = Common lead
11 = Stator upper
12 = Bearing upper
13 = Bearing lower
20 = DI-connection chamber
21 = DI-Motor chamber
22 = DI-Oil chamber

= PE (green/yellow)

Figure 30 Designation of control circuit leads

NOTE ***The available connections can be obtained from the relevant connection diagram.***

5.5.7 Connection of the seal monitoring unit to the control panel

The submersible pumps are supplied as standard with DI-probes for seal monitoring. In order to integrate this seal monitoring function into the control panel of the pump it is necessary to fit an ABS DI-module and connect this in accordance with the circuit diagrams below.

ATTENTION ***If the DI-seal monitoring is activated the unit must be immediately taken out of service. Please contact your Sulzer service centre.***

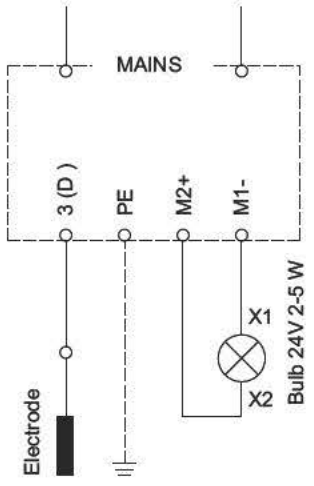
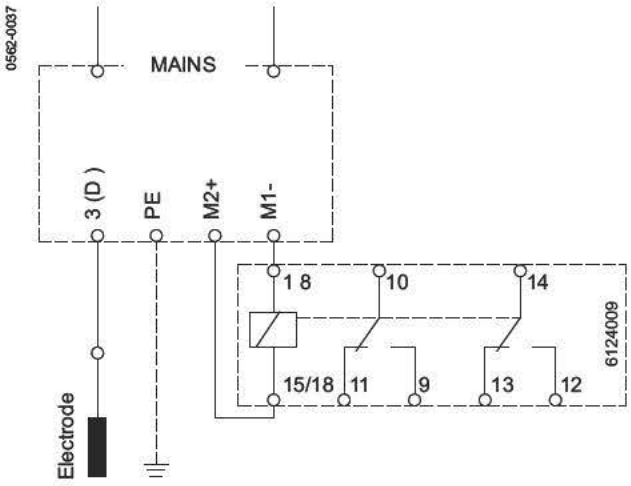


Figure 31 Electronic amplifier with signal lamp

0562-0037



0562-0038

Figure 32 Electronic amplifier with floating contact

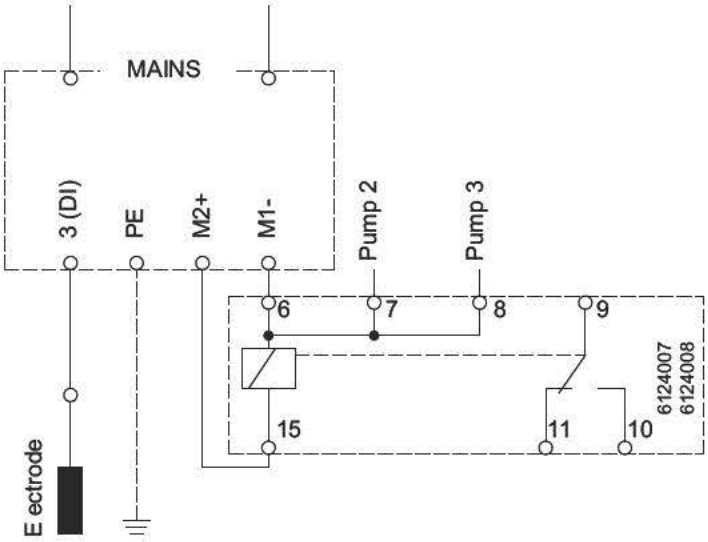


Figure 33 Electronic amplifier with collective signalling

Electronic amplifier for 50 Hz		Electronic amplifier for 60 Hz	
110 V	(Art.-Nr./Part No.: 6 124 0113)	115 V	(Art.-Nr./Part No.: 6 124 0170)
230 V	(Art.-Nr./Part No.: 6 124 0114)	230 V	(Art.-Nr./Part No.: 6 124 0171)
400 V	(Art.-Nr./Part No.: 6 124 0115)	460 V	(Art.-Nr./Part No.: 6 124 0172)
440 V	(Art.-Nr./Part No.: 6 124 0116)	575 V	(Art.-Nr./Part No.: 6 124 0173)

ATTENTION ***Maximum relay contact loading: 2 Ampere.***

6 Commissioning

The safety hints in the previous sections must be observed!

Before commissioning the pump/pump station should be checked and a functional test carried out. Particular attention should be paid to the following:

In explosive zones care must be taken that during switching on and operation of the pumps the pump section is filled with water (dry running) or alternatively is submerged or under water (wet installation). Ensure in this case that the minimum submergence given in the data sheet is observed, Other types of operation e.g. snore operation or dry running are not allowed.

- Have the electrical connections been carried out in accordance with regulations?
- Have the thermal sensors been connected?
- Is the seal monitoring device (where fitted) correctly installed?
- Is the motor overload switch correctly set?
- Have the power and control circuit cables been correctly fitted?
- Was the sump cleaned out?
- Have the inflow and outflows of the pump station been cleaned and checked?
- Is the direction of rotation of the pump correct - even if run via an emergency generator?
- Are the level controls functioning correctly?
- Are the required gates valves (where fitted) open?

AFP

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AFL/VUP

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fac

6.1 Starting frequency of the motors

The f uency from from the works).

Motor power	maximum starts per hour	at interval in minutes
	20	3
11 - 160 kW	15	4
> 160 kW	10	6

manufacturer of these devices.

7 Maintenance

T afe y

7.1 General maintenance hints

fo y ly f

y ly

NOTE ***The maintenance hints given here are not designed for „do-it-yourself“ repairs as***

of y ly y

y manufac

apply.

y f Lubr

fo life y

malf y

for assistance.

T ly if inually off y y

the thermal sensors/limiters of the thermo-control system or by the seal monitoring system (DI).

ATTENTION ***The lifting tools like chains and shackles should be visually checked in regular***

T y y y y y

in solving your pumping problems.

NOTE ***The Sulzer warranty conditions are only valid provided that any repair work has been carried out in Sulzer approved workshops and where original ABS spare parts have been used.***

7.2 Maintenance hints if the submersible pump is out of use for a considerable period

NOTE ***If the pumps have remained idle for more than 12 months then we recommend that you ask Sulzer or an approved distributor for advice.***

7.2.1 Before installation

The covers giving moisture protection of the cables *3.2.* only immediately
fore of f f f
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y

7.2.2 After installation

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7.3 Removal of the submersible pump

T afe y

7.3.1 Removal of the AFP submersible pump from a wet sump

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7.3.2 Removal of the AFP submersible pump when dry installed

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If
Install lifting gear, *3.* on the submersible pump.
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If y fast fully lif ff .
Plac fac

7.3.3 Removal of the AFL and VUP submersible pump

- If present, the discharge pipe cover should be removed and the water pressure-tight cable inlet opened.
- Raise the submersible pump out of the concrete sump or the steel discharge pipe with the hoist. While doing this the connection cables should be drawn out as the pump itself is being raised.
- Place the submersible pump with propeller housing vertically on a solid surface, taking care that it cannot tip over.

8 Assembling the gearbox AFL/VUP

8.1 Assembling the motor and the gearbox/hydraulic unit (M8)

The safety hints in the previous sections must be observed!

Pay close attention to the assembly instructions and work in the indicated sequence, in order to guarantee that both main parts (34/1) and (34/2) are perfectly assembled. First check that all required additional parts as well as LOCTITE type 243 and suitable hoisting devices are available.

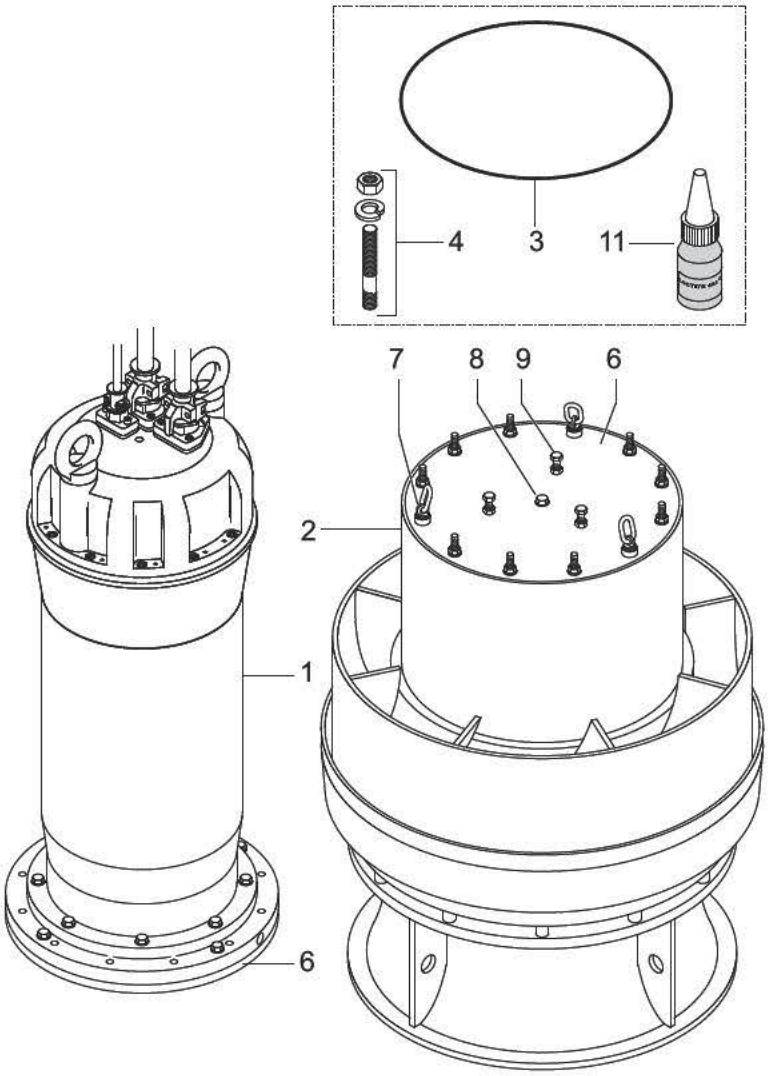

Figure 34 Assembling the motor and the gearbox/hydraulic unit

Legend

1	Motor with transport securing device	7	Swivel connection
2	Gearbox/hydraulic unit with transportation lock	8	Hex. screws
3	O-ring for motor/gearbox assembly	9	Fixing screws
4	3 x stud, with nuts and spring washers	11	LOCTITE type 243
6	Transport securing device		

8.2 Remove transport securing device (M8)

- Connect a suitable hoist of adequate capacity to the eye bolt screws (35/1) of the motor and hoist it.
- Loosen the hex screw (35/2) in the center (shaft lock).
- Loosen the hex screw (35/3) at the motor flange.
- Remove the transportation securing device (35/6).
- Store the motor (35/7) on a suitable support (35/8), e.g. two thick planks of hardwood, in such a way that the motor shaft is not damaged.

For safety reasons, the hoist must always remain connected during all assembly steps.

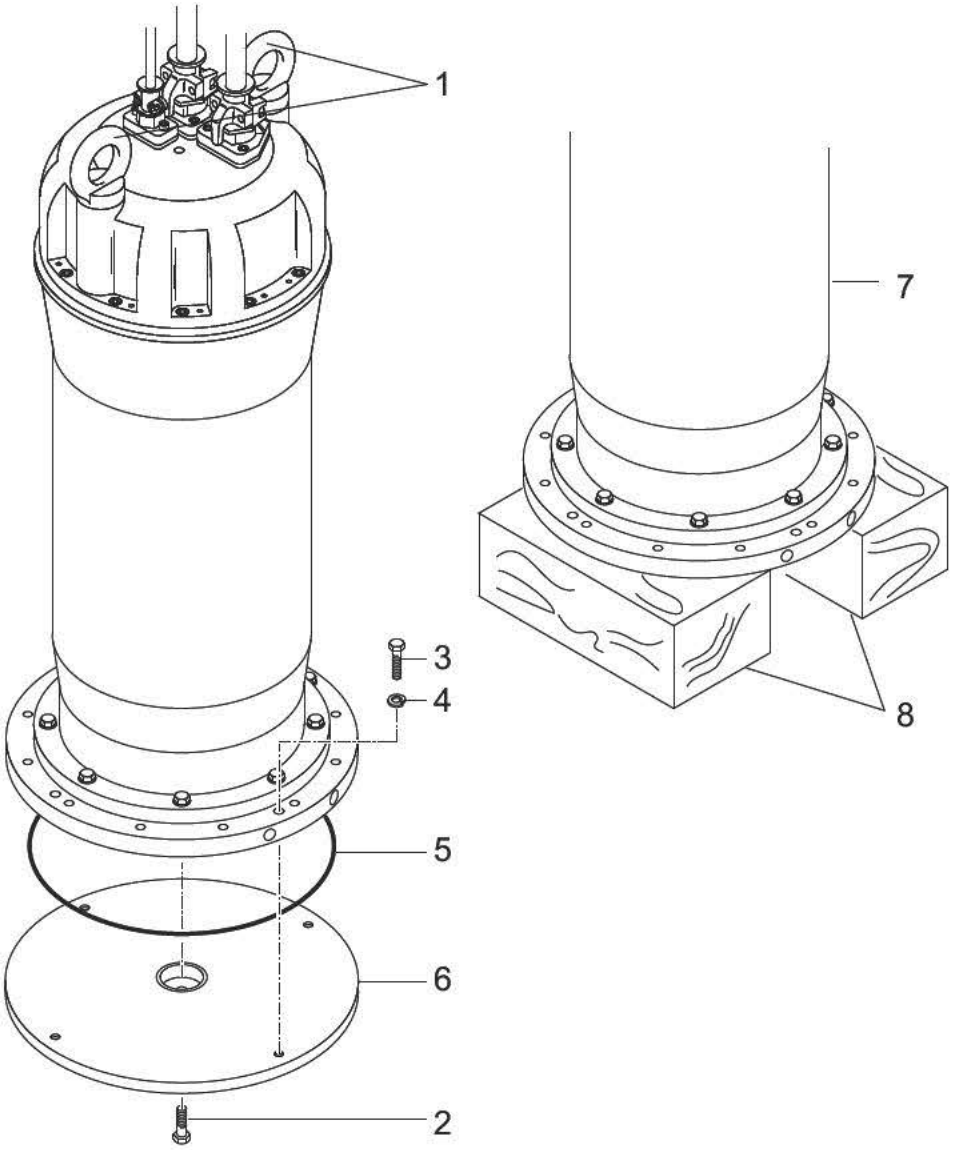

Figure 35 Remove transport securing device

8.3 Remove transport securing device of the gearbox (M8)

ATTENTION ***When removing the transport securing device and when assembling the parts, ensure that these are absolutely clean. Ensure that no contaminants enter the gear box!***

- Remove the transport securing device for pump shafts *according to para. 3.2.5.*

NOTE ***There is a threaded hole in the middle of the cover (36/6) into which an eye bolt can be inserted.***

- Loosen the securing screws (36/8) and screw an eye bolt (M12) into the central threaded hole of the transport securing device (36/6).
- Connect a suitable hoist to the eye bolt.
- Loosen the nuts (36/3) of the studs and loosen the swivel connection (36/5).

NOTE ***The 3 locked screws (36/1) (not on all versions) need not be loosened.***

- Using the hoist carefully lift off the transport securing device (36/6).
- Moisten the missing studs (36/7) with LOCTITE (type 243, medium strength) and screw them in all the way.

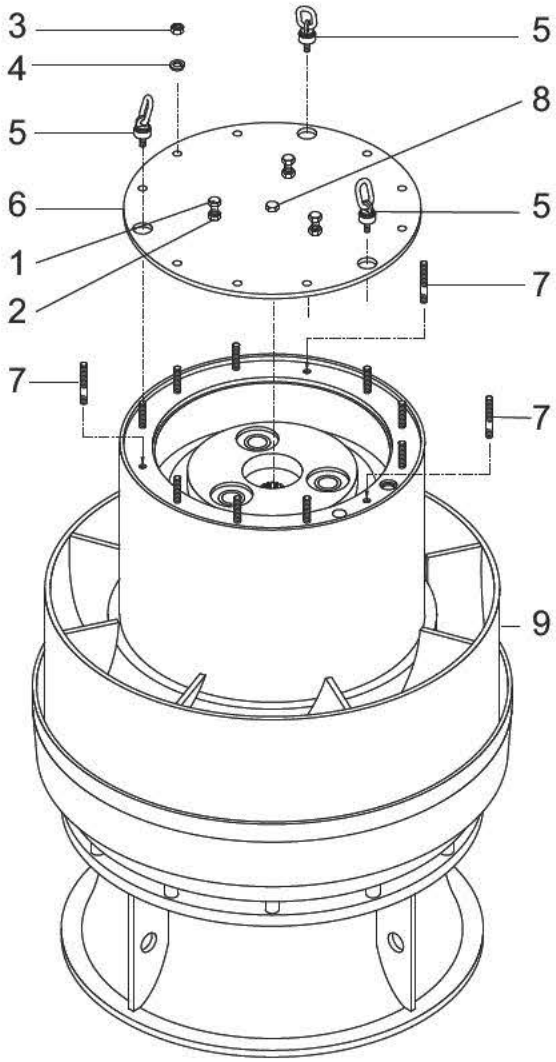

Figure 36 Remove transport securing device of gearbox

8.4 Assembly instructions for gearbox/motor housing (M8)

- Use a suitable hoist to position the motor over the gearbox-hydraulic part in such a way, that the DI probe (37/6) with the counter-pole (37/7) (or in case of Ex pumps the sealing washer (37/12)) is in position - aligned with the drilling in the intermediate flange.
- Lower the motor just so far as to reduce the distance between the gearbox housing and the intermediate flange to 20-30 cm.
- Push the slightly-greased O-ring (37/4) over the centring seat of the intermediate flange.
- Carefully centre the motor over the gearbox and lower it slowly, until the studs of the gearbox flange are in the holes of intermediate flange.

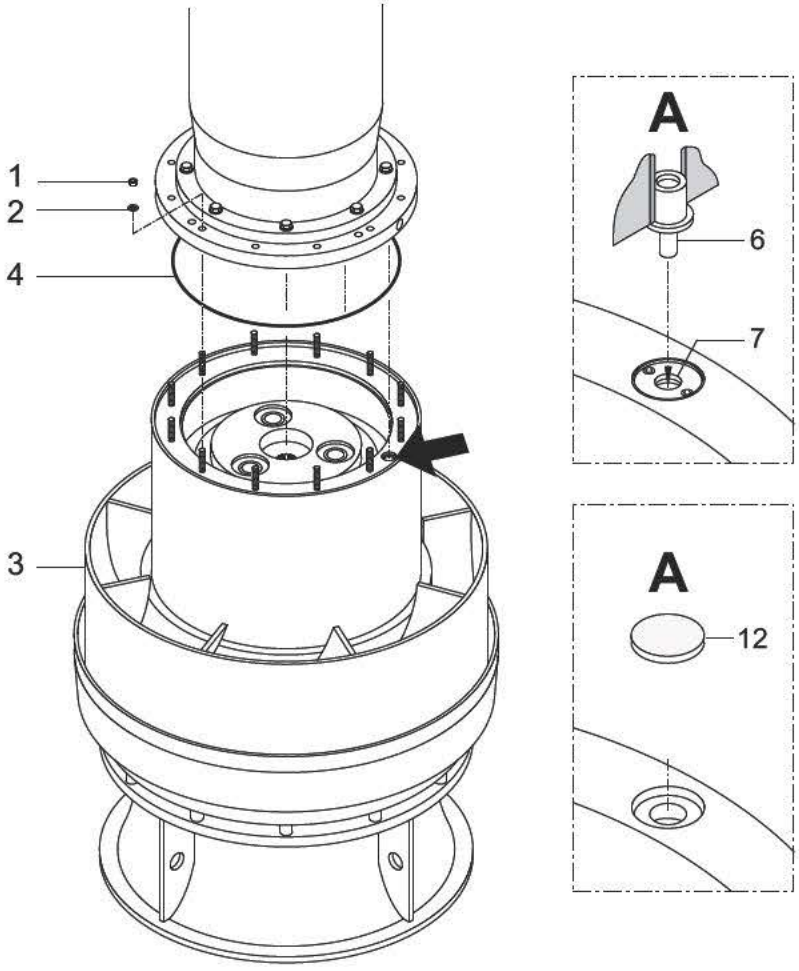

Figure 37 Assembly instructions gearbox/motor housing

ATTENTION ***Before lowering the motor, check the position of the DI (or in case of Ex pumps the sealing washer) in relation to the hole in the gearbox flange!***

- Now carefully lower the motor until the teeth of the motor shaft lock in the relevant slots of the gearbox shaft.

NOTE ***Should the teeth not interlock (teeth between teeth), then the motor should again be lifted slightly and the incorrect position remedied by rotating the propeller by hand (about a few degrees).***

- When the motor shaft is correctly centred or interlocked, lower the motor all the way and securely bolt it and the gearbox into position (observe the tightening torque!).

NOTE ***The propeller should be capable of being turned by hand.***

8.5 Assembling the motor and the gearbox/hydraulic unit (M9)

The safety hints in the previous sections must be observed!

Pay close attention to the assembly instructions and work in the indicated sequence, in order to guarantee that both main parts (38/1) and (38/2) are perfectly assembled. First check that all required additional parts as well as LOCTITE type 243 and suitable hoisting devices are available.

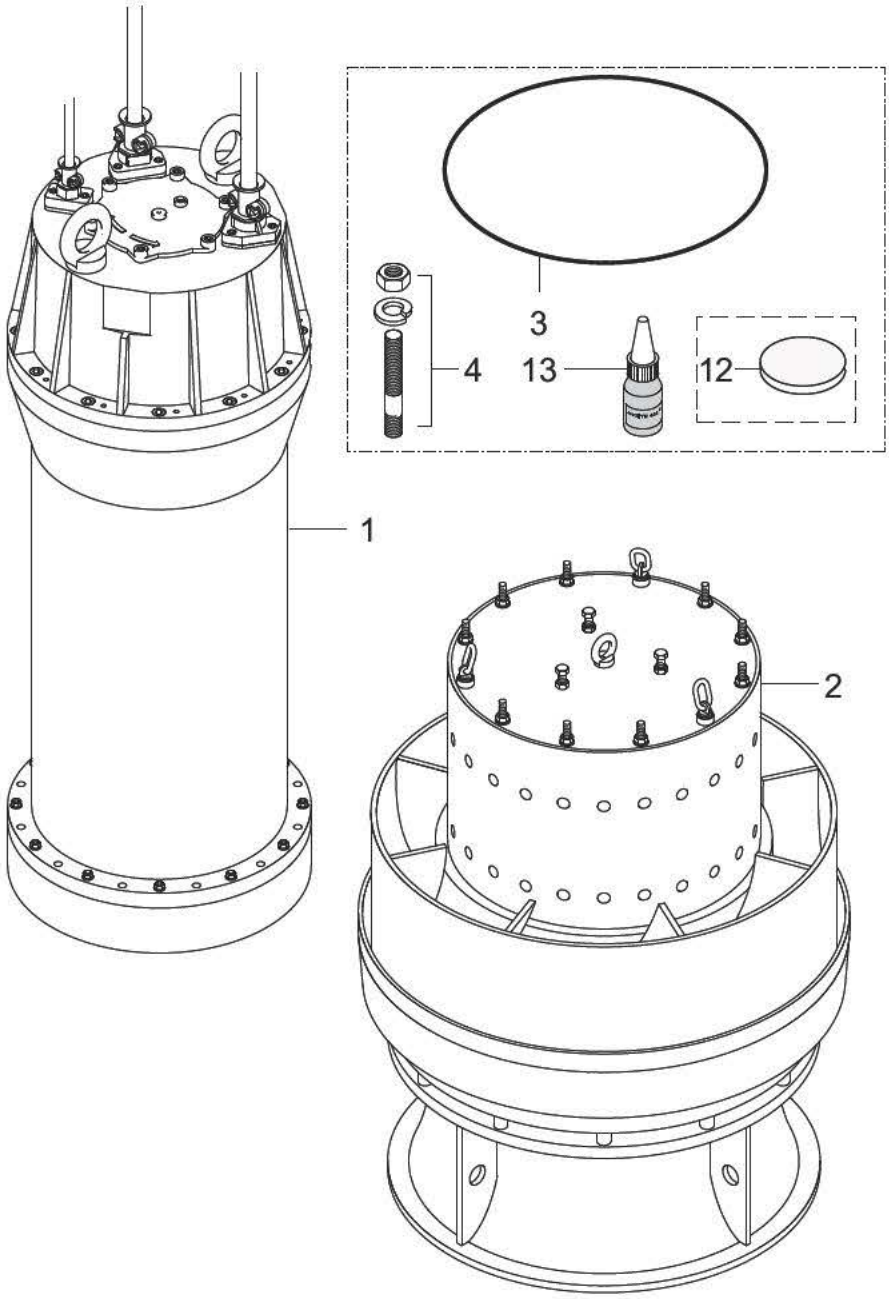

Figure 38 Assembling the motor and the gearbox/hydraulic unit

Legend

1 Motor
2 Gearbox/hydraulic unit with transportation lock (Outer jacket only M9)
3 O-ring for motor/gearbox assembly
4 3 x stud, with nuts and spring washers
12 Seal (not on all versions)
13 LOCTITE type 243

8.6 Remove transport securing device (M9)

C f y y 3 / f

Lo 3 /7 3 /6

3 /8 of y

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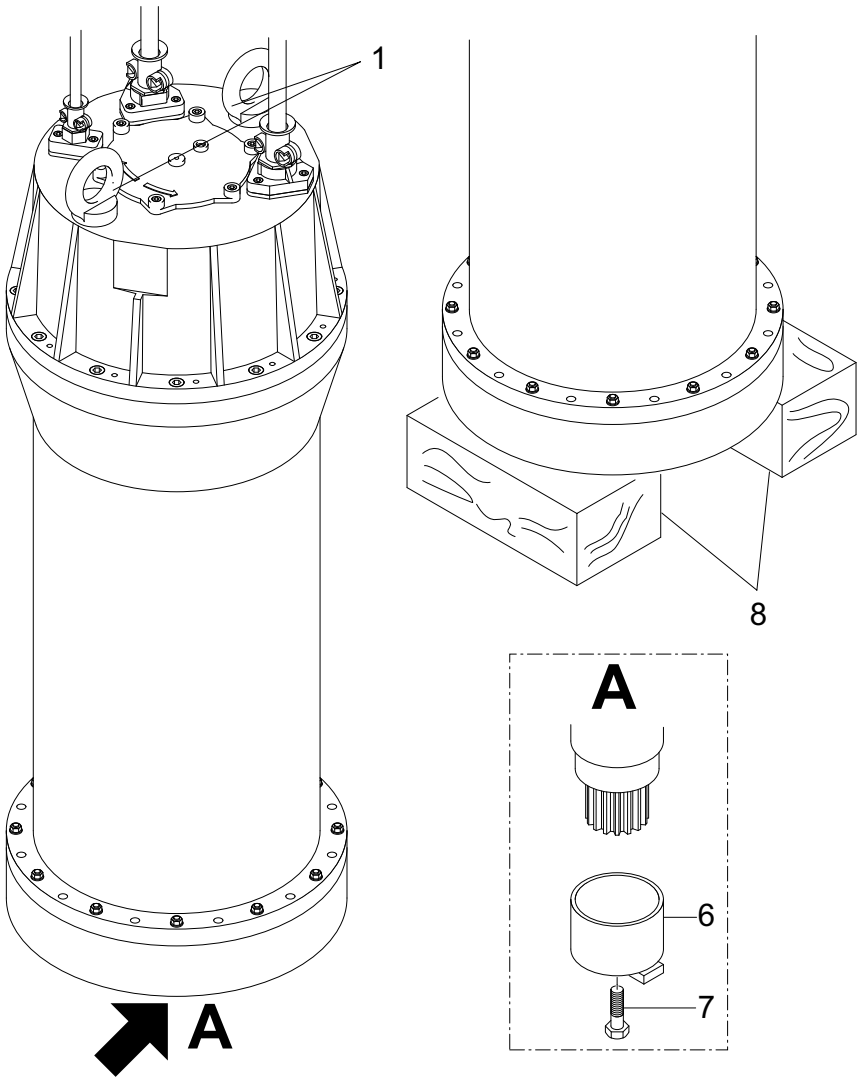


0520-0024

39 R v v

8.7 Remove transport securing device of the gearbox (M9)

ATTENTION ***When removing the transport securing device and when assembling the parts, ensure that these are absolutely clean. Ensure that no contaminants enter the gearbox!***

fo shaf *. 3.2.5.*

Connect a suitable hoist to the eye bolt.

Lo 4 /3 of 4 /5

NOTE ***The 3 locked screws (40/1) need not be loosened.***

- Carefully lift off the transport securing device (40/6) using the hoist.
- Moisten the missing studs (40/7) with LOCTITE (type 243, medium strength) and screw them in all the way.

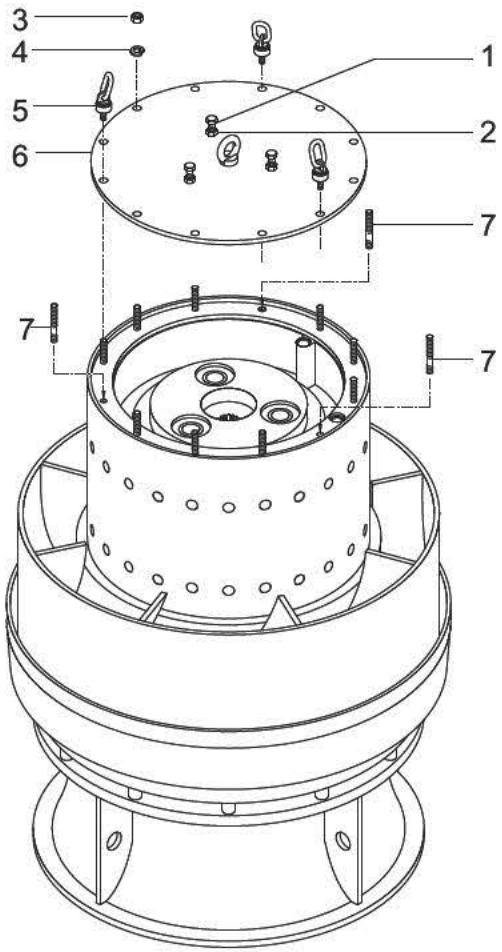


Figure 40 Remove transport securing device of the gearbox

8.8 Assembly instructions for gearbox/motor housing (M9)

- Use a suitable hoist to position the motor over the gearbox-hydraulic part in such a way, that the cam with the DI probe (41/6) with the counter-pole (41/7) (or in case of Ex pumps the sealing washer (41/12)) is in position - aligned with the cam in the intermediate flange.
- Lower the motor just so far as to reduce the distance between the gearbox housing and the intermediate flange to 50 cm.
- Push the slightly-greased O-ring (41/4) over the centring seat of the intermediate flange.
- Carefully centre the motor over the gearbox and lower it slowly, until the studs of the gearbox flange are in the holes of intermediate flange.

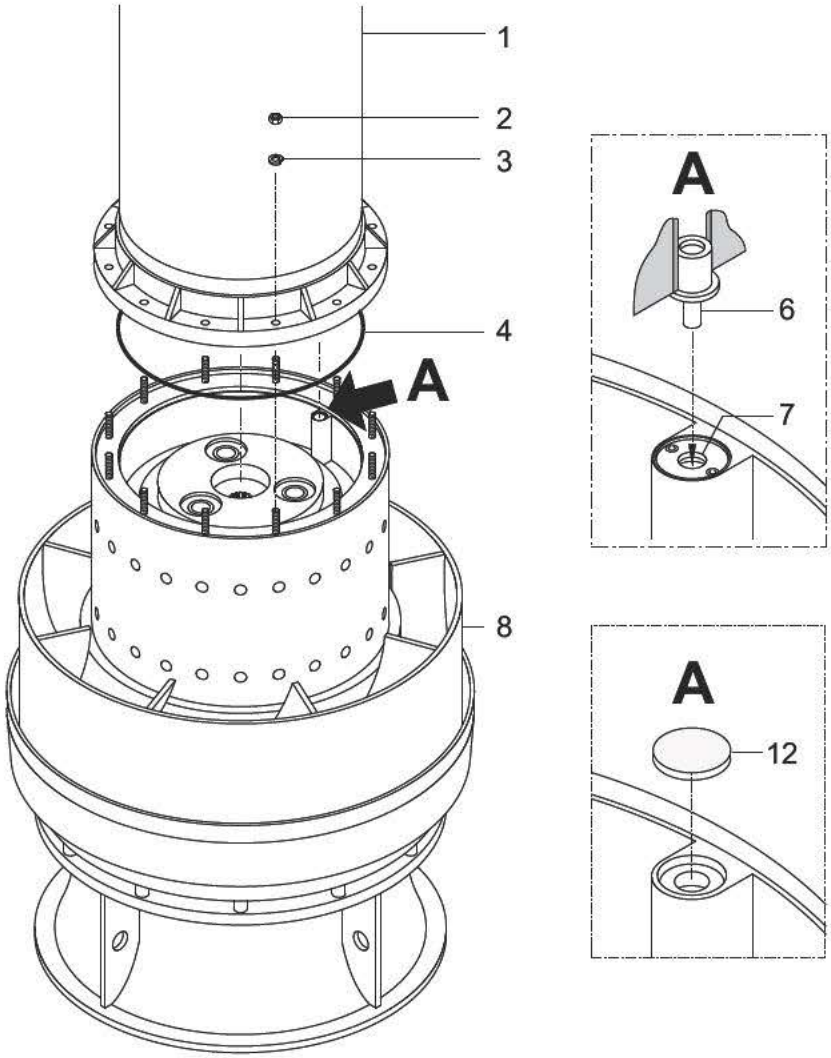
ATTENTION ***Before lowering the motor, check the position of the DI (or in case of Ex pumps the sealing washer) in relation to the hole in the gearbox flange!***

- Now carefully lower the motor until the teeth of the motor shaft lock in the relevant slots of the gearbox shaft.

NOTE ***Should the teeth not interlock (teeth between teeth), then the motor should again be lifted slightly and the incorrect position remedied by rotating the propeller by hand (about a few degrees).***

- When the motor shaft is correctly centred or interlocked, lower the motor all the way and securely bolt it and the gearbox into position (observe the tightening torque!).

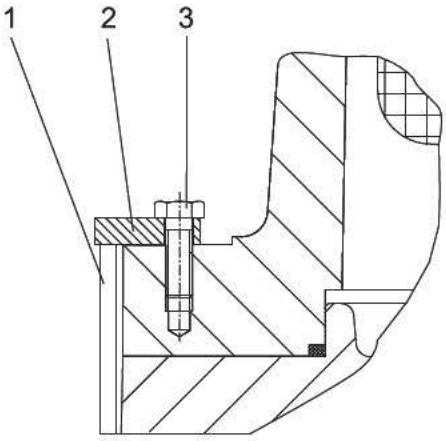
NOTE ***The propeller should be capable of being turned by hand.***



0520-0026

Figure 41 Assembly instructions for gearbox/motor housing

- Fasten the outer jacket (42/1) with the six fixing clamps (42/2) and the six M10 screws for these (42/3).



0520-0027

Figure 42 Fixing of the outer jacket

SULZER

I Pump Germany I 30-38, D-53797 Lohmar Germany I
I Tel. +49 22 46 900 0 I Fax +49 22 46 900 200 I www.sulzer.com I

GB 0521-C

Report of a factory witness test of three submersible pumps (axial flow) 16. and 17. April 2013

(Written and witnessed by Benjamin Peschke, USACE Europe District, CENAU-EC-CH, DSN 314-570-2938, Benjamin.v.peschke@usace.army.mil)

As required by the specifications 2.7.4 Witness Test a witness test of three pumps manufactured and dedicated for the project has been conducted at the SULZER pump factory:

SULZER Pump Solutions Germany GmbH
Scheiderhoerher Strasse 30-38
D-53797 Lohmar, Germany

The test program was based on the attached factory test program and scheduled for two days:

16. April 2013 (from 09.00h to 18.00h)

A. Pump, Serial number #58886

- Pump performance test
- Vibration test during operation
- NPSH test with reduced water level

B. Pump, Serial number #58885

- Pump performance test
- Vibration test during operation
- NPSH test with reduced water level

17. April 2013 (from 10.00 to 16.00h)

C. Pump, Serial number #58884

- Pump performance test
- Vibration test during operation
- NPSH test with reduced water level
- Vibration test in dry conditions

The tested pumps were the same type/ model:

Submersible Pump type VUP M2200 12-92.60 with

Designed operating duty point:

H= 15’ (4.57m)/ Q=44400 gpm (168054 l/min or 10078.8 m3/h)

Electric engine:

12ea poles, rotations: n=595 u/min (RPM)
Rated voltage: 460V/ 60 Hz
Rated currant: 466A
Rated input/ power: 239kW (P1), 220kW (P2)

Mechanical components:

Propeller: 14 deg angle, 3ea vanes, stainless steel (1.4581 – GX5CrNiMoNb19-11-2 (very similar to V4A (AISI 316Ti))
Shaft: Stainless steel 1.4021 (X20Cr13) AISI 420, NBR (Nitrile butadiene rubber) seal
Lifting hub: Galvanized steel, remainder cast iron with 2K epoxy varnish (black)

Between the different tests it was possible to witness the manufacturing process in the factory. Approximately 280 people are working in the factory. Generally the factory (once independent (named ABS), now owned by Sulzer) is organized to produce individual pumps designed to particular needs. Therefore the factory consists of a research and design department, a department to develop produce models/ prototypes and testing assemblies, the actual manufacturing section, and a quality control department IAW ISO 9000. At the factory visit the production of submersible (axial) pumps, radiator pumps, pumps for stirring and large in-pipe mounted propeller pumps could be witnessed manufactured for multiple international clients.

The factory in Scheiderhoehe takes pre-manufactured components and continues the manufacturing process by finishing the products and assembling the devise ready for delivery to the site. At the visit we were able to witness the production of the propellers, the angle adjustment (between 4 – 20 deg angle using reference formed plates and fine adjustment by testing), shaping of the vanes, the correction of the weighting of each propeller and installation of the finished component on the shaft. The majority of the electric engines are produced (including the windings) in the factory as well. The electric engines are designed in a manner that a replacement/ repair of defective windings are possible. Each pump will be tested

individually in the flexible testing assembly used for the testing of the pumps subject to this report too.

The testing assemble for submersible pumps consists of a tube for mounting the pump (DN1500), a DN1200 discharge pipe controlled by a butterfly valve and a flow meter installed on a segment of the pipe. The water level in the tank can be adjusted by adding water or pumping water into a neighboring tank.

For the vibration dry test, the pump has been lifted out of the devise and placed on the concrete flooring.

Testing Gear

All equipment has been calibrated with a reference gear that has been forwarded to the respective institute for calibration. Based on this master reference unit, the actually used unit has been calibrated. The attached contractors report contains the calibration data for the master unit and the calibrated unit.

Flow meter/ probe/ sensor:

- Magnetic- inductive sensor, type MG 711 E (Turbo Werke – Koeln)
- Measurements for the flow meter were shown on the display in real time. Since the actual flow fluctuated slightly after adjusting the valve the mean/ average between the highest and the lowest shown measurement has been calculated and recorded.
- Last calibration: 02/2013

AC Power Analyzer:

- Multi-measurement unit for measuring voltage, amperage, electric power consumption and supplied frequency, type Norma D5255
- During the test intervals the power consumption and amperage has been recorded. Diesel generator provided currency has been frequently corrected/ adjusted to supply the required 460V.
- Last calibration: 08.11.2012

Vibration/ displacement measurement device:

- RION Co. VM-82 (display device), PV-57 A (sensor)
- Since the pump has been mounted in a self-tightening fitting in the tube, the measurement was taken at the top hatch (the sensor was screwed into a hole drilled into the top hatch). In order to verify the vibration of the pump in dry conditions the sensor was mounted at side of the actual pump. During the test intervals the actual vibration was measured at the same time as the power consumption and amperage.
- Last calibration: 02/2013

J-type static head (H st) single limb manometer:

- In order to adjust the static Head (H st) for the different test intervals a J-type (single limb U-tube) manometer has been used. Attached is a description of this manometer.
- During the test the butterfly valve has been adjusted based on the reading of this J-tube. Due to the size of the pipe and quantity of water there was a slight swing in the reading. The pressure pipes leading to the J—tube manometer was frequently drained of air in between the test intervals.

Apart from that the barometric pressure has been recorded for the cavitations test using a Testo 511 electronic barometer.

Details to the conducted tests

Pump curve/ performance and vibration reading:

- In preparation for the test, the actual pump has been mounted in the testing assemble and was running warm for approximately one to two hours
- The water temperature has been recorded and the Diesel Generator provided power supply set/ corrected to 460V.
- Also the J-tube was drained of any possible air in the system.
- The water level in the tank was adjusted to z=2.55m (please see attached drawing) so between inlet and water surface was 6.25m – 0.25m – 2.55m – 1.25m + 0.395m = 2.595m (102 in)
- Using the J-tube and the butterfly valve the static head has been adjusted to 6.00m.
- After the readings on the J-tube were fairly steady, a snapshot of the AC meter readings have been taken.

- Then the vibration meter readings have been recorded.
- Since the flow reading kept fluctuating slightly, the high and lowest reading has been recorded and the average flow calculated.
- The testing assistance repeated the actions (under surveillance of the testing engineer) for declining heads (from 6.00m to 0.50m).
- The testing engineer entered the recorded parameters into a computer program and printed the pump performance curves (highlighting the design duty point), the vibration curve, and the calculated efficiency.
- The test results have been checked IAW the required operation/ duty point conditions and previous factory test results. No deficiency/ issue or significant difference has been detected.

Cavitations/ NPSH test:

- In preparation for the test the water level was lowered. The pump kept running during that time to maintain operating temperature.
- For pump #58886 the water level in the tank was z=4.55m. As a result the actual water coverage between water level in the tank (surface) and pump intake of: 6.25m – 0.25m – 4.55m – 1.25m + 0.395m = 0.595m (23 in)
  For pump #58885 the water level in the tank was z=4.10m so 1.045m (41 in)

  Verifying these conditions proofed to be a little bit difficult due to no accessibility into the tank. Therefore for verification water heights have been measured with weighted tape meter from different spots. In the meantime the factory testing engineer assembled the structural heights of the actual tank. At the end of the day it became apparent, that the water level above the inlet was higher than the previously transmitted reports. Therefore sufficient amount of water has been removed from the assembly to reach a z=4.70m.
  For pump #58884 the resulting water level after pumping the water from the tank was z= 4.70 so 0.445m (18 in)

  Nonetheless the resulting test curves for NPSH did not show a significant difference/ impact of the water level to the pump behavior. Therefore the NSPH test has not been repeated on the other two pumps.

- The test for each pump was conducted in the same manner as for the pump performance test except the vibration meter readings.
- Again the test result from H st=6.00m to 0.50m have been recorded and entered into a computer program for the curves.
- Again the curves have been discussed and compared to the previous tests. Despite the different water levels (#86 z=4.55m, #85 z=4.10m, #84 z=4.70m) the no apparent impact on the behavior has been detected.

Dry vibration test:

- The vibration test as required by the contract specifications is not foreseen or will be tested differently in Europe, the last pump (#58884) has been lifted out of the pipe section and placed on the floor in a upright position.
- The vibration sensor has been attached to the pump hull.
- After activating the pump, the vibration reading has been recorded. (The pump stood firm, and produced very little noise (normal respectively even lower voice conversation was possible))
- After deactivation of the pump, the sensor has been removed and the hole sealed.
- The test results have been discussed in regard to the contract requirements utilizing the Entek IRD General Machinery Vibration Severity Chart, DIN 10816-3/ -7 (Mechanical vibration – Assessment on machines with measurement on non rotation members Part 3: Industrial machines more than 15kW 120 RPM to 15000 RPM)- Class Q6.3, VDI 2060 (Assessment parameters for weighting conditions of rotating stiff objects)- 7.1mm/sec. The results were within respectively far below the maximum permitted parameters.

<u>Remarks</u>

So far the tests were successful and considering the safety standards, organization of the workshops, preparations, and shown solutions (the engineer even demonstrated a computerized sample calculation of a similar pump for design) the factory left a very good impression. Repairs of even older pumps are possible – during the factory visit an approx.10 year old pump was in the factory for repair. The factory will provide a spare part list. For further information the weighting certificates for the propellers have been attached to the factory test.

Upon enquiry, how the long the pump can run in dry conditions, the factory engineer recommended maximum 5 minutes dry run. The longer the pump runs in dry conditions the higher risk of the seals become hot and get damaged cause by baking together. Therefore the general guidance is to avoid running the pumps dry.

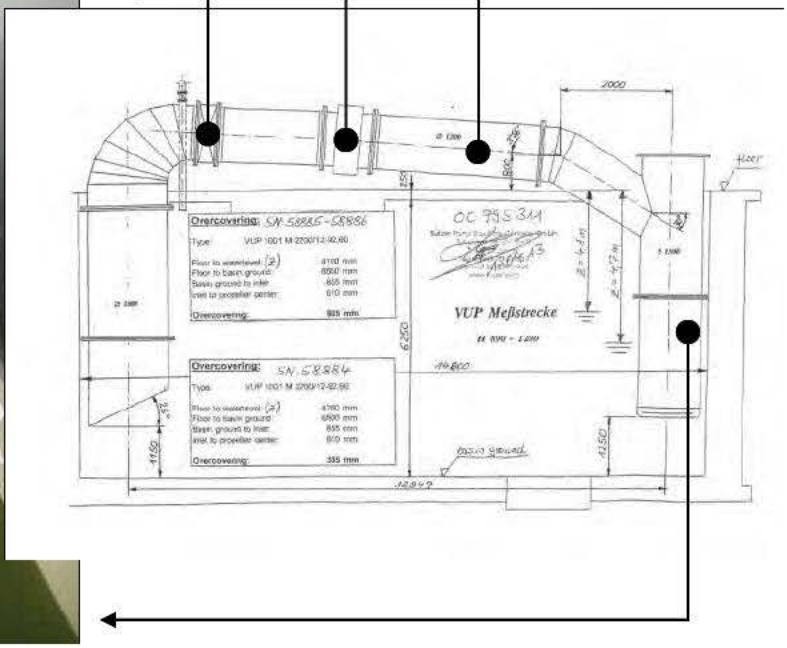
Pictures

At the factory pictures from the actual pumps and the testing assembly was permitted only. They are for the use/ purpose of this witness test report and this project only. Please contact USACE Europe District (Benjamin Peschke) for pictures with higher resolution.

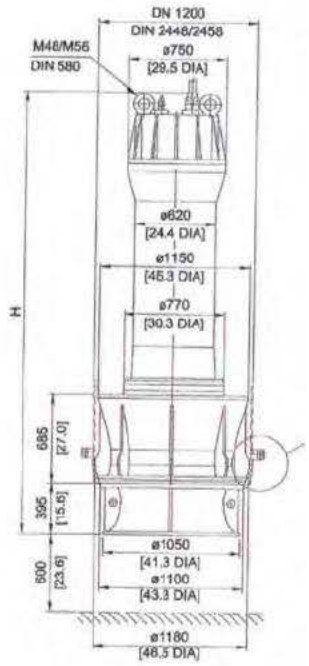
Picture collection of Pumps
SN #58886 &58884 (16/17 APR 13)

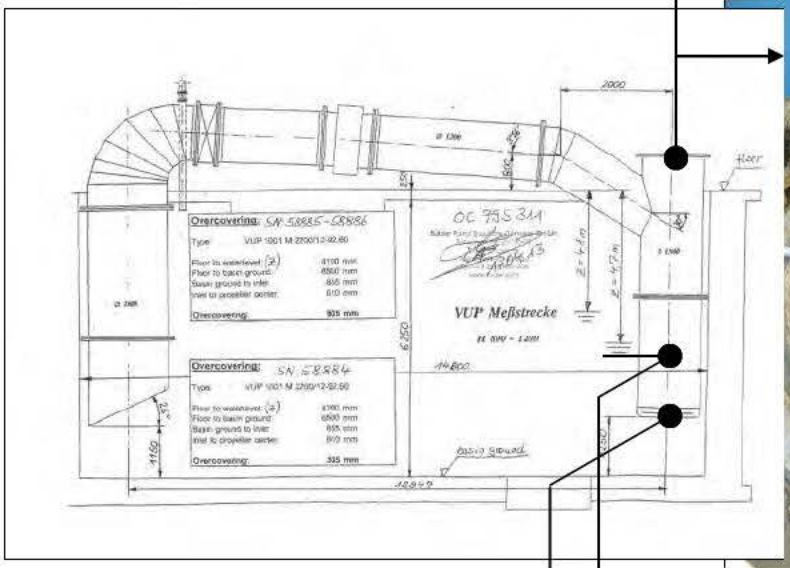
Picture collection of Pump
SN #58885 (16 APR 13)

Picture collection of Testing Assembly Part 1



Picture collection of Testing Assembly Part 2

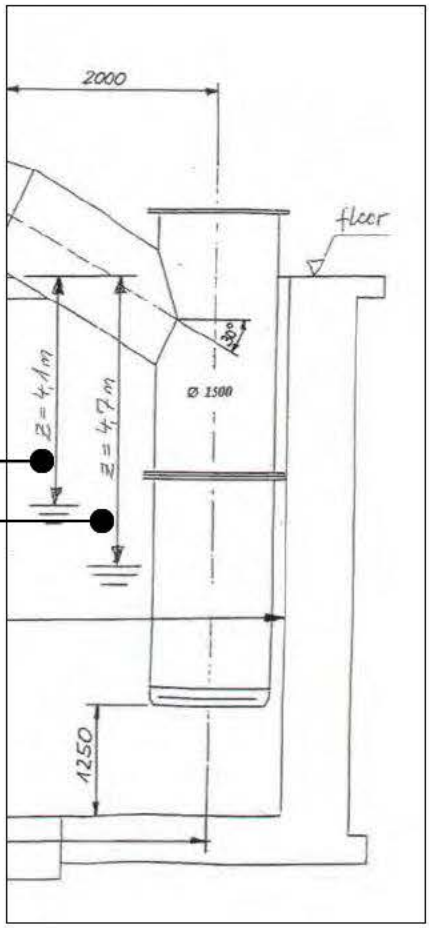




Water levels in the tank

Level for
Performance Test

Levels for
NPSH Test



Pictures from the Measurement Gear


J-Tube


Vibration Meter


Vibration Sensor


Flow Meter


AC Power Analyzer


Digital Barometer


Flow Sensor

Pictures from Vibration Test in Dry Conditions (Pump #58884)

Vibration Meter


Vibration Sensor

SULZER

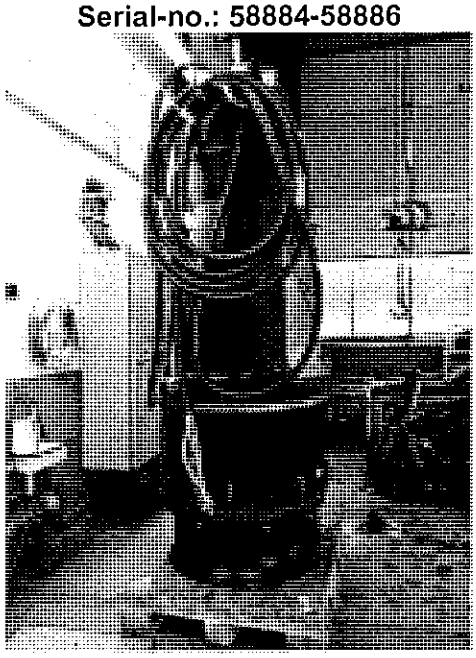
Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar
Germany
Phone +49 (2246) 900 0
Fax +49 (2246) 900 200
www.sulzer.com

Witness test

Order-no.: DEM 795311 – PO 165647

Project: Rise Lake

3x VUP 1001 M2200/12-92.60
Part-no.: VUBN1121BC3P5A2
Serial-no.: 58884-58886



All pumps have been select by producer and successfully tested in condition of installation in wet well test bay.

Final tests and acceptance of the pumps will be conducted at site at actual installation condition.

Sulzer Pump Solutions Germany GmbH, date 16.-17.04.2013

Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar
Tel. Int. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

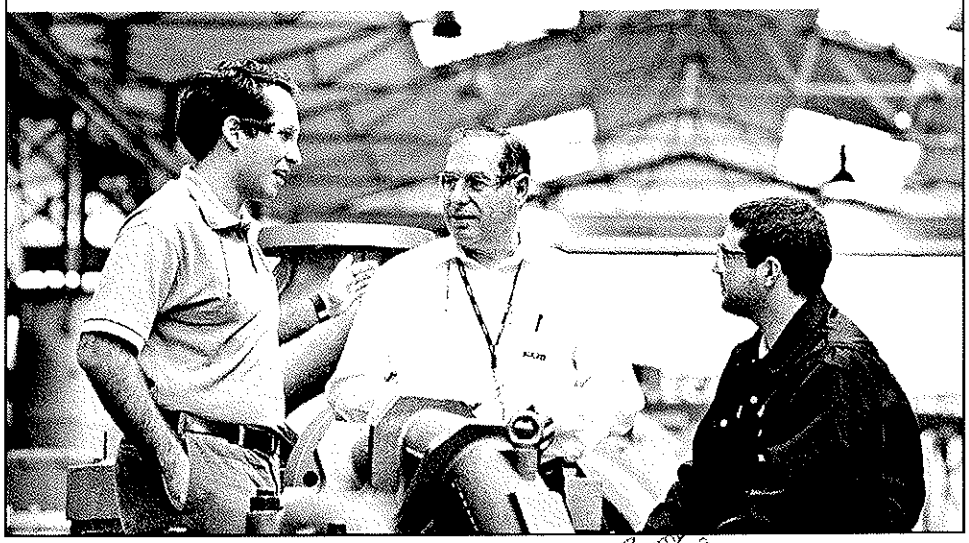
i.A. Holger Hofmann
Application Specialist / Technical Support

SULZER

Sulzer Pumps

Customer presentation for witness test at Sulzer Pump Solutions Germany GmbH

Holger Hofmann | April 2013



SULZER

Sulzer Pumps

GENERAL INFORMATION

1. Sulzer Safety Briefing for visitors (OQM-156)

It is not permitted to visit our factory without detail information.
- Health and Safety hazards

Status of the protection process for people who do not constantly in the endangered areas, so visitors and colleagues / interior from other areas of the house: for these people, no security process is defined.

Environments are:
- Mechanical
- Tool
- Locksmith
- Packaging
- Test Field (when grinding take place at the workbench)
- Grinding room (Here is a special protective equipment worn).

Visitors and employees who have not received your permanent job in the atmospheres and accessing areas, have to wear goggles.

(It can not be ruled out that chips, particles, wood splinters fly in the transition region.)

abs

SULZER

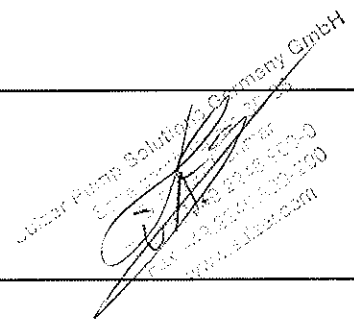
Standard test procedure VUP/VUPX

Sulzer Pumps

1. Test of components (internal)
   - Stator winding
     - Surge voltage test of stator winding
   - Resistance test of stator winding
   - Continuity test of thermal switches
   - Dynamical balancing
     - Shaft incl. rotor
     - Propeller
   - Leakage test

2. After complete assembly (internal)
   - No load test with verification of rotation direction
   - Performance test of complete unit

abs



SULZER

Standard test procedure VUP/VUPX

Sulzer Pumps

2.1 ABS submersible propeller pump VUP/VUPX
   - National and International norms
     - Hydraulic Institute „Level A" and „Level B"
   - Measuring pipes in the test area
     - Axial (DN 1200)
   - Measuring data recorded in the test area
   - Pump performance data

3. Calibration certificate of measurement equipment
   see attached files (only for witness test)

4. Special tests (price list)
   see attached files (only if ordered)

abs

SULZER

Measured data at the test area

Sulzer Pumps

1. Measuring data recorded in the test area

H_{stat}	[mWs]	- measured static head
Q	[m³/h]	- measured flow of pump
P_1	[kW]	- measured input power
I	[A]	- measured input current
U	[V]	- measured input voltage

2. Additional data shown on test certificate

H_{tot}	- total discharge head of pump
p.f.	- power factor of motor
P_2	- shaft power of motor
η_{mot}	- motor efficiency
η_{pump}	- pump efficiency
η_{tot}	- overall efficiency of unit

abs

SULZER

Measured data at the test area

Sulzer Pumps

3. Pump Performance data

H_{dyn} [mWs] velocity correction
$= v^2 / 2 * g$ with $v = 4 * Q / \pi * d^2$; d = measured Ø; g = 9,81 m/s²;

H_{tot} [mWs] total discharge head of pump
$= H_{stat} + H_{dyn}$

p.f. [/] power factor of motor
$= P_1 / U * I * \sqrt{3}$

P_2 [kW] shaft power of motor
$= P_1 * \eta_{mot}$

η_{tot} [%] overall efficiency of unit
$= (Q * H_{tot}) / (367 * P_1) * 100$

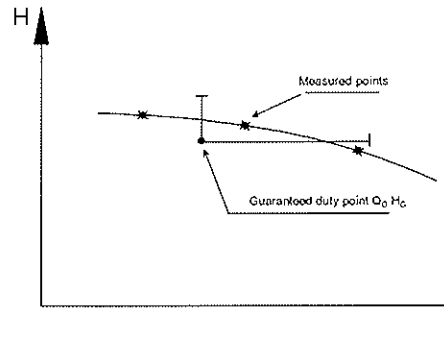
η_{mot} [%] motor efficiency
has been determined in a model test before (motor braking)

η_{pump} [%] pump efficiency
$= \eta_{tot} / \eta_{mot}$

abs

Acceptance test in accordance with Hydraulic Institute "Level A" and "Level B"

SULZER
Sulzer Pumps

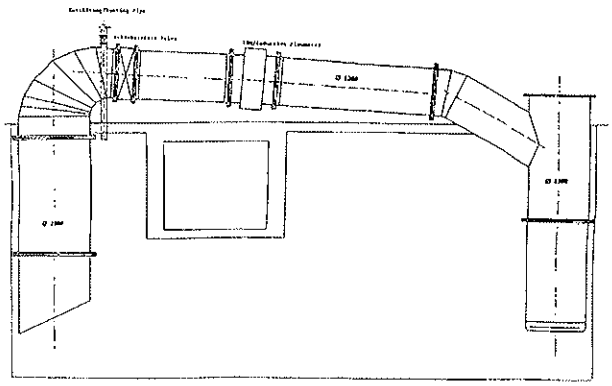


Permissible tolerances within Hydraulic Institut Standard „Level A"	
Pump head:	At Q_{Nenn} +5% in height
Pump capacity:	At H_{Nenn} +10% in capacity
Pump efficiency:	no negative tolerances (-0%)
Permissible tolerances within Hydraulic Institut Standard „Level B"	
Pump head:	At Q_{Nenn} +5%/-3% in height
Pump capacity:	At H_{Nenn} +5%/-5% in capacity
Pump efficiency:	100/[(120/eta hydr.)-0,2]

abs

Standard test facility VUP/VUPX

SULZER
Sulzer Pumps



abs

SULZER

Messprotokoll
Test Report

OT 01
Rev. 03

Typ : / Type :	VUP 1001 M 2200/12-92.60			Auftrags-Nr. : / Order No. :	795331
Nr. : / No. :	58884	Nennspannung : / Rated voltage :	U 460 [V]	RM-Nr. : / RM-No. :	510736
Laufrad ∅ : / Impeller ∅ :	/ [mm]	Nennfrequenz : / Rated frequency :	f 60 [Hz]	SRM-Nr. : / SRM-No. :	/
Einstellwinkel : / Adjustment angle :	14° [°]	Nennstrom : / Rated current :	I 466 [A]	1. Betriebspunkt: / 1. Duty point :	4,57 m 10083,7 m³/h
Schaufelzahl : / No. of vanes :	3	Nennleistung : / Rated power :	P_1 239 [kW]	2. Betriebspunkt: / 2. Duty point :	/ m / m³/h
Laufradtyp : / Type of impeller :	Propeller	Nennleistung : / Rated power :	P_2 220 [kW]	Prüfer : / Tester :	Baran
Druckstutzen : / Discharge pipe :	DN 1200	Nenndrehzahl : / Rated speed :	n 595 [min⁻¹]	Prüfdatum : / Test date :	17.04.2013
Meßstutzen : / Test discharge :	990 [mm]	Meßstrecke : / Test line :	VUP 1200	Prüffeld : / Test field :	II
Prüfspannung : / Test voltage :	460 [V]	Manometer : / Pressure gauge :	[bar]	Feld : / Field :	4 1200/1 A
z :	2,65 [m]	J-Rohr : / J-pipe : ☑	U-Rohr : / U-pipe : ☐	Dieselgenerator : / Diesel generator:	☒

	H_{tot} m	H m	Q m³/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	η_{ges} %		v_{eff} mm/s		
Anlauf / Start														
Leerlauf / no load														
1		6,0	9388	221,6				466				4,5		
2		5,5	9658	208,6				450				3,8		
3		5,0	9942	195,0				434				2,8		
4		4,5	10178	183,1				422				2,9		
5		3,9	10404	167,1				406				2,4		
6		3,5	10649	160,2				398				2,7		
7		3,0	10888	148,3				387				2,6		
8		2,5	11080	142,8				382				2,7		
9		2,0	11296	128,6				370				2,3		
10		1,5	11601	117,0				361				1,5		
11		1,0	11812	106,8				355				1,6		
12		0,5	11972	96,87				349				1,4		
13														
14														
15														
16														
17														
18														

Bemerkungen :
Remarks :

Sulzer Pump Solutions Germany GmbH
Regierungsstr. 30-38
D-53797 Lohmar
Tel. Int. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Abnahme
Witness test ☒

ESACE, 17APR13

Stempel u. Unterschrift / Stamp and signature

SULZER

Test Certificate

OT 13
Rev.00

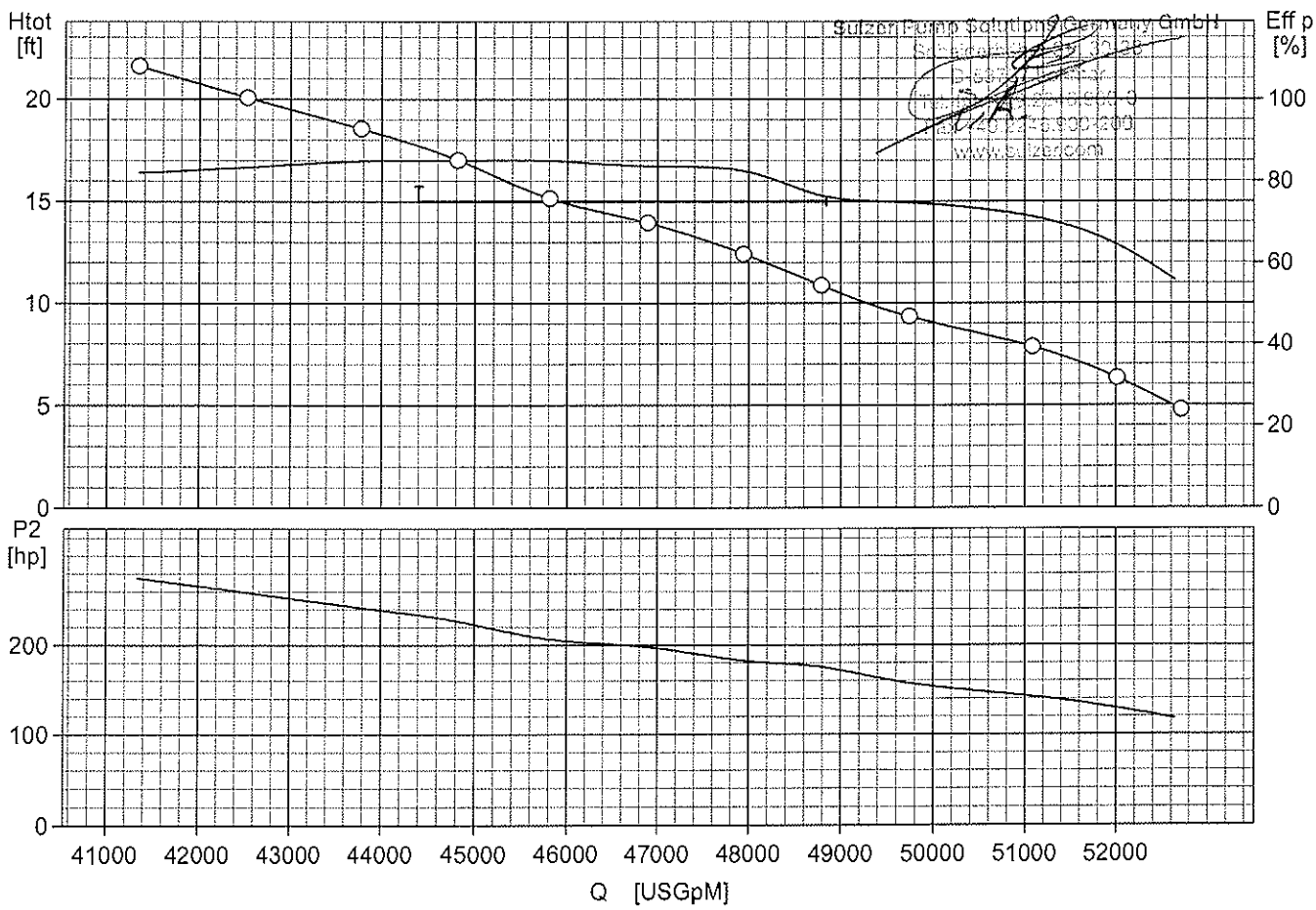
VUP 1001 M 2200/12-92.60 (witness test)

60 Hz

pump No.	58884	rated voltage (U)	460	V	duty point(s)		order No.	795331
impeller	14°	rated input (P1)	239	kW	H [ft]	Q [USGpM]	RM - No.	510736
vane	3	rated power (P2)	220	kW	15	44400		
discharge	DN 1200	rated current (I)	466	A				
meas-DN	990 mm	rated speed (n)	595	1/min				
meas-voltage	460 V	type of hydraulic	VUP 1001					

Htot [ft]	Q [USGpM]	Hst [m]	Q [m³/h]	P1 [kW]	I [A]	p.f.	Eff tot [%]	Eff mot [%]	Eff p [%]	P2 [hp]
21,61	41338	6,00	9388	222	466	0,60	76,0	92,7	82,0	275
20,08	42527	5,50	9658	209	450	0,58	77,2	92,6	83,3	259
18,56	43778	5,00	9942	195	434	0,56	78,6	92,6	84,9	242
17,02	44817	4,50	10178	183	422	0,54	78,6	92,5	85,0	227
15,15	45812	3,90	10404	167	406	0,52	78,4	92,2	85,0	207
13,95	46891	3,50	10649	160	398	0,51	77,0	92,1	83,6	198
12,42	47943	3,00	10888	148	387	0,48	75,8	91,8	82,5	183
10,88	48789	2,50	11080	143	382	0,47	70,1	91,7	76,4	176
9,34	49740	2,00	11296	129	370	0,44	68,1	91,2	74,7	157
7,85	51083	1,50	11601	117	361	0,41	64,7	90,7	71,3	142
6,32	52012	1,00	11812	107	355	0,38	58,0	90,2	64,3	129
4,76	52716	0,50	11972	96,9	349	0,35	48,9	89,5	54,6	116

Acceptance test according to Hydraulic Institute (in clear water)



date : 17.04.2013

tested by : Baran

SULZER Meßprotokoll / Test Report

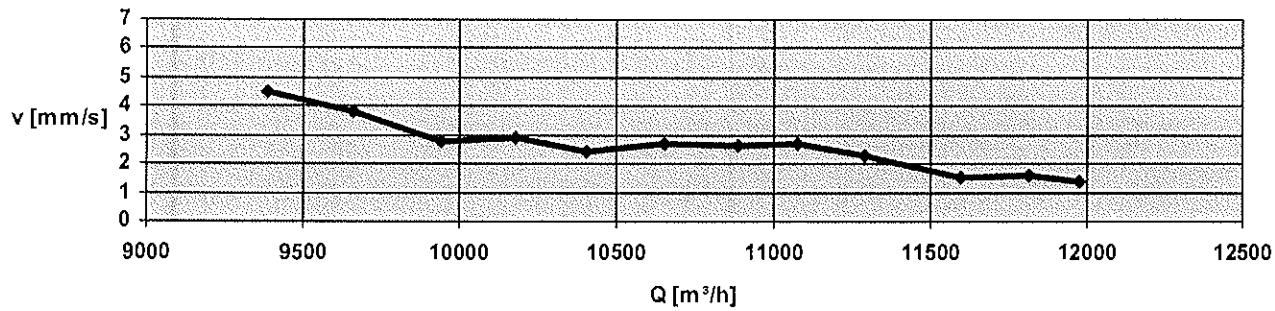
OT 04
Rev.01

Typ : Type :	VUP 1001 M 2200/12-92.60						Auftrags-Nr. : Order No. :	795331
Nr. : No. :	58884		Nennspannung : Rated voltage :	U	460	[V]	RM-Nr. : RM-No. :	510736
Laufrad Ø : Impeller Ø :		[mm]	Nennfrequenz : Rated frequency :	f	60	[Hz]		
Einstellwinkel : Adjustment angle :	14	[°]	Nennstrom : Rated current :	I	466	[A]	1. Betriebspunkt: 1. Duty point :	15 ft 44400 gpm
Schaufelzahl : No. of vanes :	3		Nennleistung : Rated power :	P_1	239	[kW]	2. Betriebspunkt: 2. Duty point :	ft gpm
Laufradtyp : Type of impeller :	Propeller		Nennleistung : Rated power :	P_2	220	[kW]	Prüfer : Tester :	Baran
Druckstutzen : Discharge pipe :	DN 1200		Nenndrehzahl : Rated speed :	n	595	[min^{-1}]	Prüfdatum : Test date :	17.04.2013
Meßstutzen : Test discharge :	990	[mm]	Meßstrecke : Test line :		VUP 1200		Prüffeld : Test field :	II
Prüfspannung : Test voltage :	460	[V]	Manometer : Pressure gauge :			[bar]	Feld : Field :	/ 1200 A
z :	2,65	[m]	J-Rohr : J-pipe : ☒		U-Rohr : U-pipe : ☐		Dieselgenerator : Diesel generator:	☒

Schwingungsstärkenmessung / Vibration Test

Volumenstrom Flow [m^3/h]	Weg Length [µm]	Geschwindigkeit Velocity [mm/s]	Beschleunigung Acceleration [m/s^2]
9388		4,5	
9658		3,8	
9942		2,8	
10178		2,9	
10404		2,4	
10888		2,6	
11080		2,7	
11296		2,3	
11601		1,5	
11812		1,6	
11972		1,4	

Schwinggeschwindigkeit / Vibration velocity = f(Q) 04-2



Bemerkungen :
Remarks :

Sulzer Pump Solutions Germany GmbH
Schützenstraße 95
D-57482 Wenden
Tel. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Abnahme
Witness test ☒

WACG, 17 APR 13

Stempel u. Unterschrift des/Stamp and signature of Test Inspector

SULZER

Messprotokoll
Test Report

OT 01
Rev. 03

Typ : / Type :	VUP 1001 M 2200/12 - 92 . 60			Auftrags-Nr. : / Order No. :	795331
Nr. : / No. :	58884	Nennspannung : / Rated voltage :	U 460 [V]	RM-Nr. : / RM-No. :	510736
Laufrad Ø : / Impeller Ø :	/ [mm]	Nennfrequenz : / Rated frequency :	f 60 [Hz]	SRM-Nr. : / SRM-No. :	/
Einstellwinkel : / Adjustment angle :	14° [°]	Nennstrom : / Rated current :	I 466 [A]	1. Betriebspunkt: / 1. Duty point :	4,57 m / 10083,24 m³/h
Schaufelzahl : / No. of vanes :	3	Nennleistung : / Rated power :	P_1 239 [kW]	2. Betriebspunkt: / 2. Duty point :	/ m / m³/h
Laufradtyp : / Type of impeller :	Propeller	Nennleistung : / Rated power :	P_2 220 [kW]	Prüfer : / Tester :	Baran
Druckstutzen : / Discharge pipe :	DN 1200	Nenndrehzahl : / Rated speed :	n 595 [min⁻¹]	Prüfdatum : / Test date :	17.04.2013
Meßstutzen : / Test discharge :	990 [mm]	Meßstrecke : / Test line :	VUP 1200	Prüffeld : / Test field :	II
Prüfspannung : / Test voltage :	460 [V]	Manometer : / Pressure gauge :	[bar]	Feld : / Field :	4 1200 / 1 A
z :	4,70 [m]	J-Rohr : / J-pipe :	☒ U-Rohr : / U-pipe : ☐	Dieselgenerator : / Diesel generator:	☒

	H_{tot} m	H m	Q m³/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	η_{ges} %				
Anlauf / Start														
Leerlauf / no load														
1		6,0	9468	224,4				463						
2		5,5	9716	208,9				446						
3		5,0	9972	203,7				440						
4		4,5	10212	194,7				429						
5		3,9	10409	178,2				412						
6		3,5	10618	167,0				400						
7		2,5	11116	139,4				374						
8		2,0	11372	135,2				370						
9		1,5	11599	123,2				362						
10		1,0	11842	104,2				347						
11		0,5	12088	102,5				347						
12														
13														
14														
15														
16														
17														
18														

3p.

Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar
Tel. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Bemerkungen :
Remarks :

air pressure : 1024,7 mbar

water temperature : 30,4 °C

Abnahme
Witness test ☒

Stempel u. Unterschrift / Stamp and signature

SULZER

Test Certificate

OT 13
Rev.00

VUP 1001 M 2200/12-92.60 (witness test)

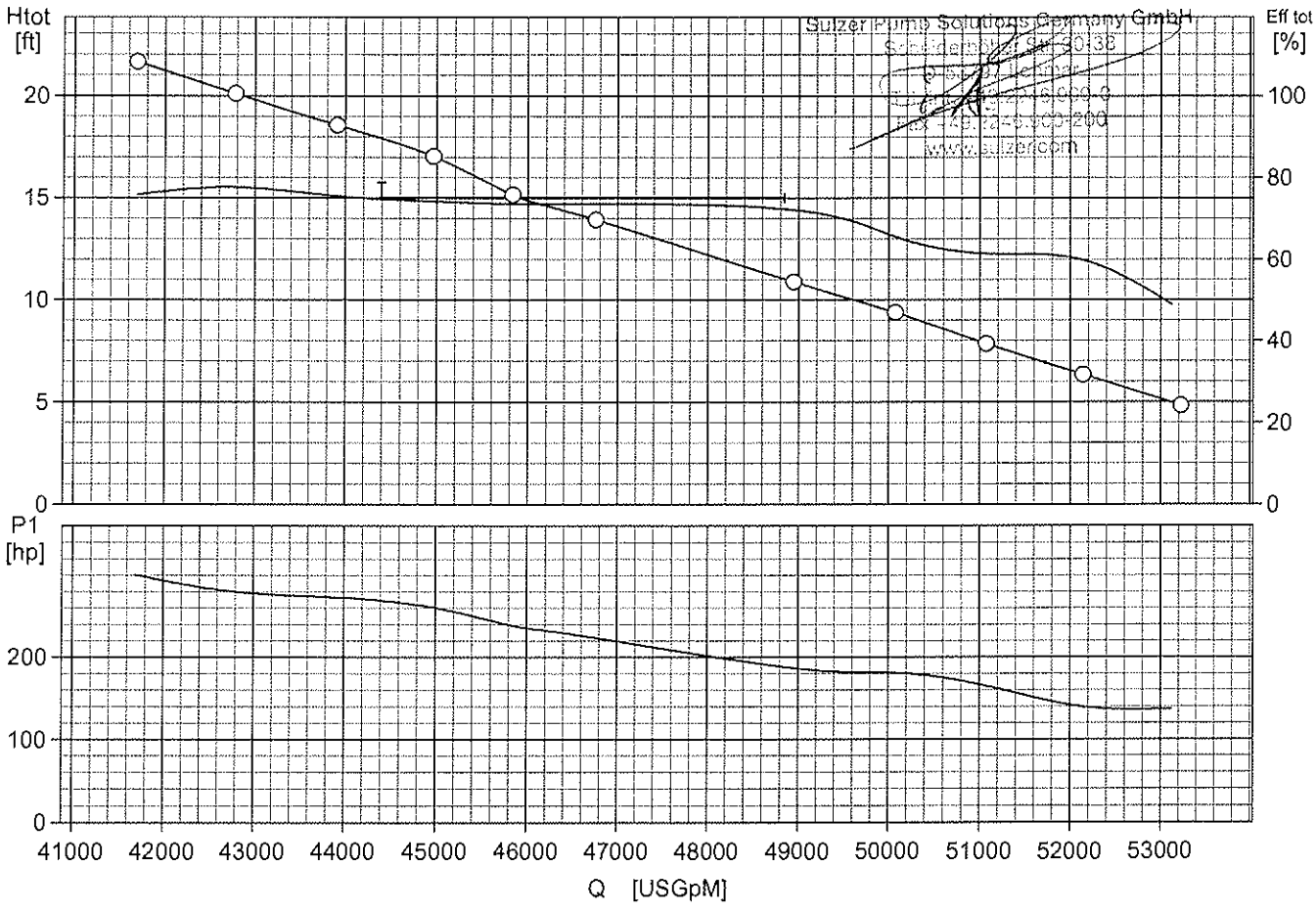
NPSH-test (z = 4,7 m)

60 Hz

pump No.	58884	rated voltage (U)	460	V	duty point(s)		order No.	795331
impeller	14°	rated input (P1)	239	kW	H [ft]	Q [USGpM]	RM - No.	510736
vane	3	rated power (P2)	220	kW	15	44400		
discharge	DN 1200	rated current (I)	466	A				
meas-DN	990 mm	rated speed (n)	595	1/min				
meas-voltage	460 V	type of hydraulic	VUP 1001					

Htot [ft]	Q [USGpM]	Hst [m]	Q [m³/h]	P1 [kW]	I [A]	p.f.	Eff tot [%]
21,64	41690	6,00	9468	224	463	0,61	75,8
20,10	42782	5,50	9716	209	446	0,59	77,6
18,57	43910	5,00	9972	204	440	0,58	75,5
17,04	44966	4,50	10212	195	429	0,57	74,2
15,16	45834	3,90	10409	178	412	0,54	73,5
13,94	46754	3,50	10618	167	400	0,52	73,6
10,89	48947	2,50	11116	139	374	0,47	72,1
9,38	50074	2,00	11372	135	370	0,46	65,5
7,85	51074	1,50	11599	123	362	0,43	61,4
6,33	52144	1,00	11842	104	347	0,38	59,8
4,82	53227	0,50	12088	103	347	0,37	47,2

Acceptance test according to Hydraulic Institute (in clear water)



date : 17.04.2013 tested by : Baran

SULZER Meßprotokoll / Test Report

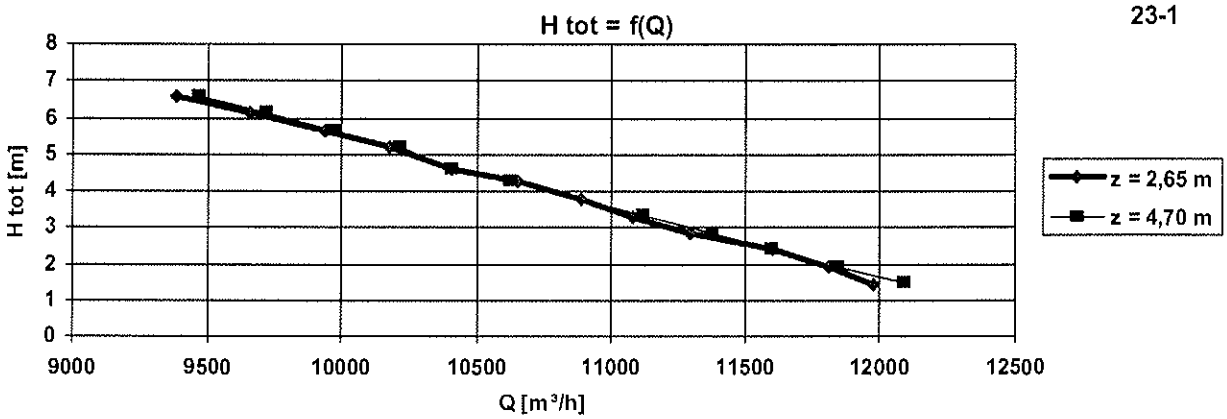
OT 23 Rev.01

Typ : Type :	VUP 1001 M 2200/12-92.60						Auftrags-Nr. : Order No. :	795331	
Nr. : No. :	58884		Nennspannung : Rated voltage :	U	460	[V]	RM-Nr. : RM-No. :	510736	
Laufrad ∅ : Impeller ∅ :	14°	[mm]	Nennfrequenz : Rated frequency :	f	60	[Hz]			
Einstellwinkel : Adjustment angle :		[°]	Nennstrom : Rated current :	I	466	[A]	1. Betriebspunkt: 1. Duty point :	15 ft	44400 gpm
Schaufelzahl : No. of vanes :	3		Nennleistung : Rated power :	P_1	239	[kW]	2. Betriebspunkt: 2. Duty point :	ft	gpm
Laufradtyp : Type of impeller :	Propeller		Nennleistung : Rated power :	P_2	220	[kW]	Prüfer : Tester :	Baran	
Druckstutzen : Discharge pipe :	DN 1200		Nenndrehzahl : Rated speed :	n	595	[min^{-1}]	Prüfdatum : Test date :	17.04.2013	
Meßstutzen : Test discharge :	990	[mm]	Meßstrecke : Test line :		VUP 1200		Prüffeld : Test field :	II	
Prüfspannung : Test voltage :	460	[V]	Manometer : Pressure gauge :			[bar]	Feld : Field :	/ 1200	A
z :	2,65 / 4,70	[m]	J-Rohr : J-pipe : ☒		U-Rohr : U-pipe : ☐		Dieselgenerator : Diesel generator:		☒

NPSH Messung / NPSH Test

A	Luftdruck	/	barometric pressure	1024,7	[mbar]
B	Sättigungsdampfdruck	/	vapour pressure	43,67	[mbar]
C	spez. Dichte	/	density of water	995,53	[kg/m³]
D	Erdbeschleunigung	/	earth gravity	9,81	[m/s²]
E	Wassertemperatur	/	water temperature	30,4	[°C]
F	Volumenstrom	/	discharge volume	12088	[m³/h]
G	Wasserspiegelhöhe	/	submergence height	0,34	[m]

NPSH [((A - B) / (C x D)) + G] < 10,39 [m]



Bemerkungen :
Remarks :

Sulzer Pump Solutions Germany GmbH
Sch[illegible] 30-38
D[illegible]
Tel. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Abnahme
Witness test ☒

Stempel u. Unterschrift des/Stamp and signature of Test Inspector

SULZER

Messprotokoll
Test Report

OT 01
Rev. 03

Typ : / Type :	VUP 1001 M2200/12-92.60			Auftrags-Nr. : / Order No. :	795331
Nr. : / No. :	58884	Nennspannung : / Rated voltage :	U 460 [V]	RM-Nr. : / RM-No. :	510736
Laufrad Ø : / Impeller Ø :	/. [mm]	Nennfrequenz : / Rated frequency :	f 60 [Hz]	SRM-Nr. : / SRM-No. :	/.
Einstellwinkel : / Adjustment angle :	14° [°]	Nennstrom : / Rated current :	I 466 [A]	1. Betriebspunkt: / 1. Duty point :	4,57 m 1008,24 m³/h
Schaufelzahl : / No. of vanes :	3	Nennleistung : / Rated power :	P_1 235 [kW]	2. Betriebspunkt: / 2. Duty point :	/. m /. m³/h
Laufradtyp : / Type of impeller :	Propeller	Nennleistung : / Rated power :	P_2 220 [kW]	Prüfer : / Tester :	Baran
Druckstutzen : / Discharge pipe :	DN 1200	Nenndrehzahl : / Rated speed :	n 595 [min⁻¹]	Prüfdatum : / Test date :	17.04.2013
Meßstutzen : / Test discharge :	990 [mm]	Meßstrecke : / Test line :	VuP 1200	Prüffeld : / Test field :	II
Prüfspannung : / Test voltage :	460 [V]	Manometer : / Pressure gauge :	[bar]	Feld : / Field :	2 1200/1 A
z :	/. [m]	J-Rohr : / J-pipe : ☐	U-Rohr : / U-pipe : ☐	Dieselgenerator : / Diesel generator:	☑

	H_{tot} m	H m	Q m³/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	ηges %		Veff m/s		
Anlauf / Start														
Leerlauf / no load				10,69	317	324	323	321				0,5		
1														
2														
3														
4														
5														
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7														
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10														
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18														

Bemerkungen :
Remarks :

dry run test

Sulzer Pump Solutions Germany GmbH
Schlebuscher Str. 30-38
D-53797 Lohmar
Tel. int. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Abnahme
Witness test

Stempel u. Unterschrift / Stamp and signature

SULZER Meßprotokoll / Test Report

OT 01 Rev. 01

Typ : Type :	VUP 1001 M 2200/12-92.60					Auftrags-Nr. : Order No. :	795331
Nr. : No. :	58884	Nennspannung : Rated voltage :	U	460	[V]	RM-Nr. : RM-No. :	510736
Laufrad Ø : Impeller Ø :	[mm]	Nennfrequenz : Rated frequency :	f	60	[Hz]		
Einstellwinkel : Adjustment angle :	14 [°]	Nennstrom : Rated current :	I	466	[A]	1. Betriebspunkt: 1. Duty point :	ft gpm
Schaufelzahl : No. of vanes :	3	Nennleistung : Rated power :	P_1	236	[kW]	2. Betriebspunkt: 2. Duty point :	ft gpm
Laufradtyp : Type of impeller :	Propeller	Nennleistung : Rated power :	P_2	220	[kW]	Prüfer : Tester :	Baran
Druckstutzen : Discharge pipe :	DN 1200	Nenndrehzahl : Rated speed :	n	595	[min^{-1}]	Prüfdatum : Test date :	17.04.2013
Meßstutzen : Test discharge :	[mm]	Meßstrecke : Test line :				Prüffeld : Test field :	II
Prüfspannung : Test voltage :	460 [V]	Manometer : Pressure gauge :			[bar]	Feld : Field :	/ 1200 A
z :	[m]	J-Rohr : J-pipe : ☐		U-Rohr : U-pipe : ☐		Dieselgenerator : Diesel generator:	☒

	H_{tot} m	H m	Q m^3/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	η_{ges} %		v mm/s		
Anlauf / Start														
Leerlauf / no load				10,69	317	324	323	321	0,042			0,5		
1														
2														
3														
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17														
18														

Bemerkungen : Remarks :

Sulzer Pump Solutions Germany GmbH
Schlebuscher Str. 30-38
D-53797 Lohmar
Tel. Int. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

dry run test

Abnahme
Witness test ☒

WAKE, 17APR13

Stempel u. Unterschrift des/Stamp and signature of Test Inspector

SULZER

Messprotokoll / Test Report

OT 01 Rev. 03

Typ : / Type :	VUP 1001 M2200/12 - 92.60			Auftrags-Nr. : / Order No. :	795331
Nr. : / No. :	58885	Nennspannung : / Rated voltage :	U 460 [V]	RM-Nr. : / RM-No. :	510736
Laufrad Ø : / Impeller Ø :	~ [mm]	Nennfrequenz : / Rated frequency :	f 60 [Hz]	SRM-Nr. : / SRM-No. :	~
Einstellwinkel : / Adjustment angle :	14 [°]	Nennstrom : / Rated current :	I 466 [A]	1. Betriebspunkt: / 1. Duty point :	4,57 m 10084,84 m³/h
Schaufelzahl : / No. of vanes :	3	Nennleistung : / Rated power :	P_1 239 [kW]	2. Betriebspunkt: / 2. Duty point :	~ m ~ m³/h
Laufradtyp : / Type of impeller :	Propeller	Nennleistung : / Rated power :	P_2 220 [kW]	Prüfer : / Tester :	Hehn
Druckstutzen : / Discharge pipe :	DN 1200	Nenndrehzahl : / Rated speed :	n 585 [min^{-1}]	Prüfdatum : / Test date :	16.04.2013
Meßstutzen : / Test discharge :	930 [mm]	Meßstrecke : / Test line :	VUP1200	Prüffeld : / Test field :	II
Prüfspannung : / Test voltage :	460 [V]	Manometer : / Pressure gauge :	[bar]	Feld : / Field :	1200/1 A
z : NPSH 2,55 ~ [m]		J-Rohr : / J-pipe : ☒	U-Rohr : / U-pipe : ☐	Dieselgenerator : / Diesel generator:	Feld 4 ☒

	H_{tot} m	H m	Q m³/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	η_{ges} %	Veff mm/s			
Anlauf / Start														
Leerlauf / no load														
1		6,0	9318	212,0				451			4,0			
2		5,5	9617	200,9				438			3,1			
3		5,0	9870	190,2				425			2,6			
4		4,5	10117	179,5				414			2,5			
5		3,9	10360	165,5				400			2,3			
6		3,5	10536	155,7				389			2,1			
7		3,0	10755	145,8				380			2,0			
8		2,5	10982	136,5				372			1,7			
9		2,0	11277	124,2				361			1,8			
10		1,5	11490	114,7				354			1,6			
11		1,0	11715	102,1				345			1,3			
12		0,5	11988	88,35				337			1,2			
13														
14														
15														
16														
17														
18														

Bp.

Bemerkungen : / Remarks :

Abnahme / Witness test ☒

Stempel u. Unterschrift / Stamp and signature

SULZER

Test Certificate

OT 13
Rev.00

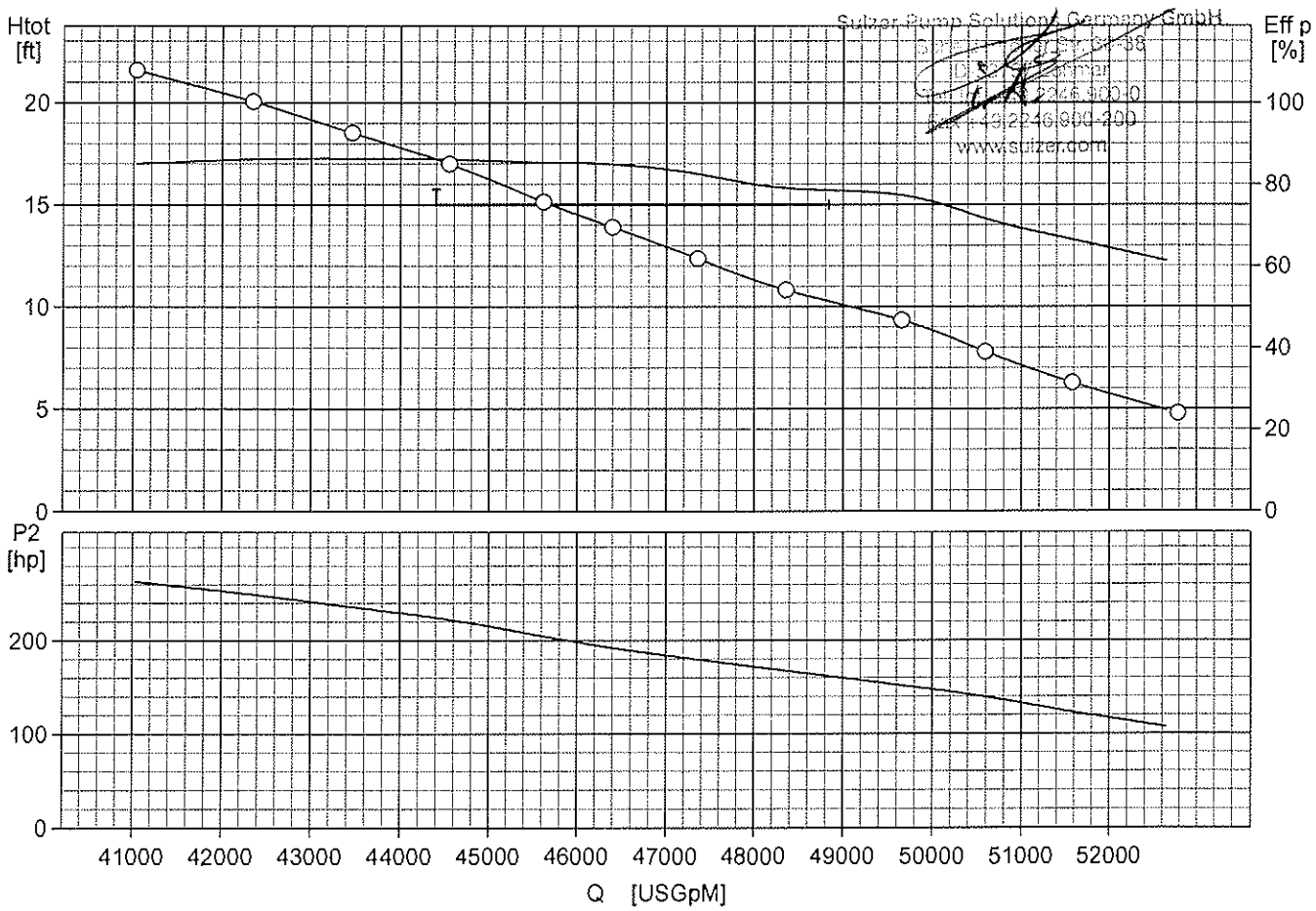
VUP 1001 M 2200/12-92.60 (witness test)

60 Hz

pump No.	58885	rated voltage (U)	460	V	duty point(s)		order No.	795331
impeller	14°	rated input (P1)	239	kW	H [ft]	Q [USGpM]	RM - No.	510736
vane	3	rated power (P2)	220	kW	15	44400		
discharge	DN 1200	rated current (I)	466	A				
meas-DN	990 mm	rated speed (n)	595	1/min				
meas-voltage	460 V	type of hydraulic	VUP 1001					

Htot [ft]	Q [USGpM]	Hst [m]	Q [m³/h]	P1 [kW]	I [A]	p.f.	Eff tot [%]	Eff mot [%]	Eff p [%]	P2 [hp]
21,58	41030	6,00	9318	212	451	0,59	78,8	92,6	85,0	263
20,06	42347	5,50	9617	201	438	0,58	79,7	92,6	86,1	249
18,53	43461	5,00	9870	190	425	0,56	79,8	92,5	86,3	236
16,99	44548	4,50	10117	180	414	0,54	79,5	92,4	86,1	222
15,13	45618	3,90	10360	166	400	0,52	78,7	92,2	85,3	205
13,90	46393	3,50	10536	156	389	0,50	78,1	92,0	84,9	192
12,36	47357	3,00	10755	146	380	0,48	75,7	91,8	82,5	179
10,83	48357	2,50	10982	137	372	0,46	72,4	91,5	79,1	167
9,33	49656	2,00	11277	124	361	0,43	70,4	91,1	77,3	152
7,80	50594	1,50	11490	115	354	0,41	64,9	90,6	71,6	139
6,27	51585	1,00	11715	102	345	0,37	59,7	89,9	66,4	123
4,77	52787	0,50	11988	88,4	337	0,33	53,8	88,8	60,5	105

Acceptance test according to Hydraulic Institute (in clear water)



date : 16.04.2013

tested by : Hehn

SULZER Meßprotokoll / Test Report

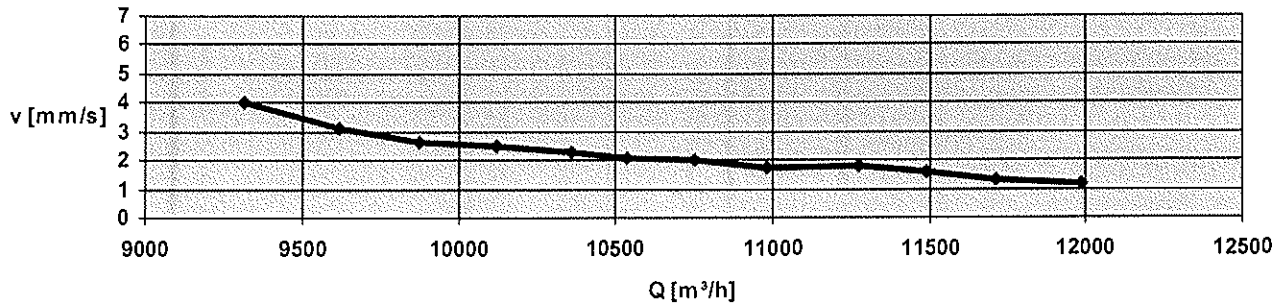
OT 04 Rev.01

Typ : / Type :	VUP 1001 M 2200/12-92.60						Auftrags-Nr. : / Order No. :	795331
Nr. : / No. :	58885		Nennspannung : / Rated voltage :	U	460	[V]	RM-Nr. : / RM-No. :	510736
Laufrad ∅ : / Impeller ∅ :		[mm]	Nennfrequenz : / Rated frequency :	f	60	[Hz]		
Einstellwinkel : / Adjustment angle :	14	[°]	Nennstrom : / Rated current :	I	466	[A]	1. Betriebspunkt: / 1. Duty point :	15 ft 44400 gpm
Schaufelzahl : / No. of vanes :	3		Nennleistung : / Rated power :	P_1	239	[kW]	2. Betriebspunkt: / 2. Duty point :	ft gpm
Laufradtyp : / Type of impeller :	Propeller		Nennleistung : / Rated power :	P_2	220	[kW]	Prüfer : / Tester :	Hehn
Druckstutzen : / Discharge pipe :	DN 1200		Nenndrehzahl : / Rated speed :	n	595	[min^{-1}]	Prüfdatum : / Test date :	16.04.2013
Meßstutzen : / Test discharge :	990	[mm]	Meßstrecke : / Test line :		VUP 1200		Prüffeld : / Test field :	II
Prüfspannung : / Test voltage :	460	[V]	Manometer : / Pressure gauge :			[bar]	Feld : / Field :	/ 1200 A
z :	2,55	[m]	J-Rohr : / J-pipe : ☒		U-Rohr : / U-pipe : ▨		Dieselgenerator : / Diesel generator:	☒

Schwingungsstärkenmessung / Vibration Test

Volumenstrom Flow [m³/h]	Weg Length [µm]	Geschwindigkeit Velocity [mm/s]	Beschleunigung Acceleration [m/s²]
9318		4,0	
9617		3,1	
9870		2,6	
10117		2,5	
10360		2,3	
10755		2,0	
10982		1,7	
11277		1,8	
11490		1,6	
11715		1,3	
11988		1,2	

Schwinggeschwindigkeit / Vibration velocity = f(Q) 04-2



Bemerkungen : / Remarks :

Sulzer Pump Solutions Germany GmbH
Schlumbergerstr. 30-36
D-68307 Mannheim
Tel. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Abnahme / Witness test ☒

17 APR 13

Stempel u.Unterschrift des/Stamp and signature of Test Inspector

SULZER

Messprotokoll
Test Report

OT 01
Rev. 03

Typ : / Type :	VUP 1001 M1200/12-92.60			Auftrags-Nr. : / Order No. :	795331
Nr. : / No. :	58885	Nennspannung : / Rated voltage :	U 460 [V]	RM-Nr. : / RM-No. :	510736
Laufrad Ø : / Impeller Ø :	/ [mm]	Nennfrequenz : / Rated frequency :	f 60 [Hz]	SRM-Nr. : / SRM-No. :	/
Einstellwinkel : / Adjustment angle :	14 [°]	Nennstrom : / Rated current :	I 466 [A]	1. Betriebspunkt: / 1. Duty point :	4,57 m 10084,24
Schaufelzahl : / No. of vanes :	3	Nennleistung : / Rated power :	P_1 239 [kW]	2. Betriebspunkt: / 2. Duty point :	/ m / m³/h
Laufradtyp : / Type of impeller :	Propeller	Nennleistung : / Rated power :	P_2 220 [kW]	Prüfer : / Tester :	Hehn
Druckstutzen : / Discharge pipe :	DN 1200	Nenndrehzahl : / Rated speed :	n 595 [min⁻¹]	Prüfdatum : / Test date :	16.04.2013
Meßstutzen : / Test discharge :	990 [mm]	Meßstrecke : / Test line :	VUP 1200	Prüffeld : / Test field :	II
Prüfspannung : / Test voltage :	460 [V]	Manometer : / Pressure gauge :	[bar]	Feld : / Field :	1200/1 A
z :	4,1 [m]	J-Rohr : / J-pipe : ☒	U-Rohr : / U-pipe : ☐	Dieselgenerator : / Diesel generator:	Feld 4 ☒

		H_{tot} m	H m	Q m³/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	η_{ges} %				
Anlauf / Start															
Leerlauf / no load															
1		6,0	9376	222,5				460							
2		5,5	9590	208,4				443							
3		5,0	9842	200,1				434							
4		4,5	10142	181,8				413							
5		3,9	10415	170,1				402							
6		3,5	10555	161,7				392							
7		2,5	11017	139,9				372							
8		2,0	11283	125,4				359							
9		1,5	11482	117,3				353							
10		1,0	11650	101,7				343							
11		0,5	11921	94,53				338							
12															
13															
14															
15															
16															
17															
18															

Bp.

Sulzer Pump Solutions Germany GmbH
Schnaidtshöher Str. 33-38
D-53797 Lohmar
Tel. Int. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Bemerkungen :
Remarks :

air pressure : 1020,8 mbar
water temperature : 30,5 °C

Abnahme
Witness test ☒

16.04.13

Stempel u. Unterschrift / Stamp and signature

SULZER

Test Certificate

OT 13
Rev.00

VUP 1001 M 2200/12-92.60 (witness test)

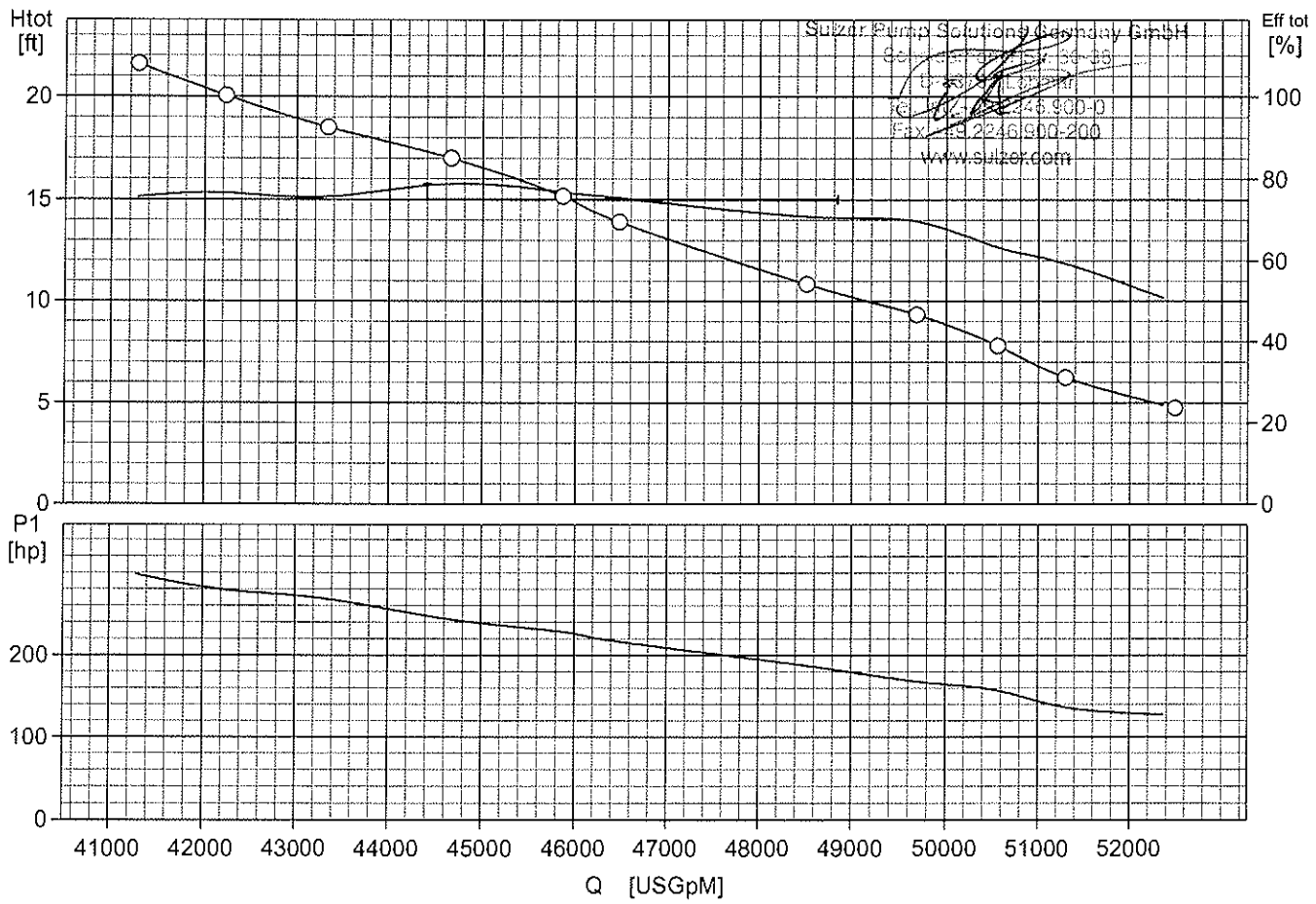
NPSH-test (z = 4,1 m)

60 Hz

pump No.	58885	rated voltage (U)	460	V	duty point(s)		order No.	795331
impeller	14°	rated input (P1)	239	kW	H [ft]	Q [USGpM]	RM - No.	510736
vane	3	rated power (P2)	220	kW	15	44400		
discharge	DN 1200	rated current (I)	466	A				
meas-DN	990 mm	rated speed (n)	595	1/min				
meas-voltage	460 V	type of hydraulic	VUP 1001					

Htot [ft]	Q [USGpM]	Hst [m]	Q [m³/h]	P1 [kW]	I [A]	p.f.	Eff tot [%]
21,60	41285	6,00	9376	223	460	0,61	75,6
20,05	42228	5,50	9590	208	443	0,59	76,6
18,51	43337	5,00	9842	200	434	0,58	75,6
17,00	44658	4,50	10142	182	413	0,55	78,8
15,16	45860	3,90	10415	171	402	0,53	76,8
13,91	46477	3,50	10555	162	392	0,52	75,4
10,85	48511	2,50	11017	140	372	0,47	70,9
9,33	49682	2,00	11283	125	359	0,44	69,7
7,79	50559	1,50	11482	117	353	0,42	63,3
6,24	51298	1,00	11650	102	343	0,37	59,3
4,74	52492	0,50	11921	94,5	338	0,35	49,6

Acceptance test according to Hydraulic Institute (in clear water)



date : 16.04.2013 tested by : Hehn

SULZER Meßprotokoll / Test Report

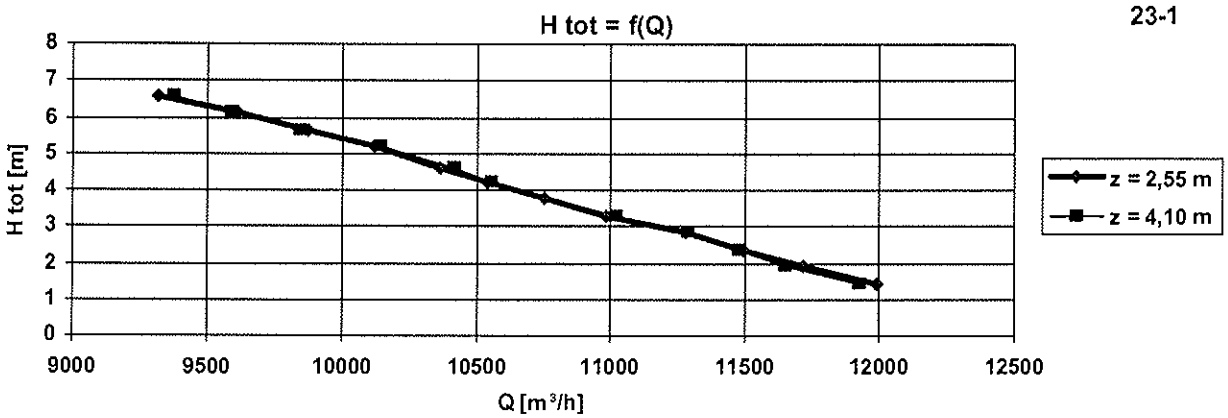
OT 23
Rev.01

Typ : / Type :	**VUP 1001 M 2200/12-92.60**						Auftrags-Nr. : / Order No. :	**795331**	
Nr. : / No. :	**58885**		Nennspannung : / Rated voltage :	U	460	[V]	RM-Nr. : / RM-No. :	**510736**	
Laufrad ∅ : / Impeller ∅ :	14°	[mm]	Nennfrequenz : / Rated frequency :	f	60	[Hz]			
Einstellwinkel : / Adjustment angle :		[°]	Nennstrom : / Rated current :	I	466	[A]	1. Betriebspunkt: / 1. Duty point :	15 ft	44400 gpm
Schaufelzahl : / No. of vanes :	3		Nennleistung : / Rated power :	P_1	239	[kW]	2. Betriebspunkt: / 2. Duty point :	ft	gpm
Laufradtyp : / Type of impeller :	Propeller		Nennleistung : / Rated power :	P_2	220	[kW]	Prüfer : / Tester :	Hehn	
Druckstutzen : / Discharge pipe :	DN 1200		Nenndrehzahl : / Rated speed :	n	595	[min^{-1}]	Prüfdatum : / Test date :	16.04.2013	
Meßstutzen : / Test discharge :	990	[mm]	Meßstrecke : / Test line :		VUP 1200		Prüffeld : / Test field :	II	
Prüfspannung : / Test voltage :	460	[V]	Manometer : / Pressure gauge :			[bar]	Feld : / Field :	/ 1200	A
z :	2,55 / 4,10	[m]	J-Rohr : / J-pipe : ☒		U-Rohr : / U-pipe : ☐		Dieselgenerator : / Diesel generator:		☒

NPSH Messung / NPSH Test

A	Luftdruck	/	barometric pressure	1020,8	[mbar]
B	Sättigungsdampfdruck	/	vapour pressure	43,67	[mbar]
C	spez. Dichte	/	density of water	995,53	[kg/m³]
D	Erdbeschleunigung	/	earth gravity	9,81	[m/s²]
E	Wassertemperatur	/	water temperature	30,5	[°C]
F	Volumenstrom	/	discharge volume	11921	[m³/h]
G	Wasserspiegelhöhe	/	submergence height	0,93	[m]

NPSH [((A - B) / (C x D)) + G] < 10,94 [m]



Bemerkungen :
Remarks :

Sulzer Pump Solutions Germany GmbH
Schlachthofstraße 96-98
D-58300 Wetter
Tel. +49 2246.900-0
Fax +49 2246.900-200
www.sulzer.com

Abnahme
Witness test ☒

Stempel u. Unterschrift des/Stamp and signature of Test Inspector

SULZER

Messprotokoll
Test Report

OT 01
Rev. 03

Typ / Type: VUP 1001 M 2000/12-92.60			Auftrags-Nr. / Order No.: 795331
Nr. / No.: 58886	Nennspannung / Rated voltage: U 460 [V]		RM-Nr. / RM-No.: 510736
Laufrad Ø / Impeller Ø: / [mm]	Nennfrequenz / Rated frequency: f 60 [Hz]		SRM-Nr. / SRM-No.: /
Einstellwinkel / Adjustment angle: 14° [°]	Nennstrom / Rated current: I 466,00 [A]		1. Betriebspunkt / 1. Duty point: 4,57 m 1008324 m³/h
Schaufelzahl / No. of vanes: 3	Nennleistung / Rated power: P_1 239,00 [kW]		2. Betriebspunkt / 2. Duty point: / m / m³/h
Laufradtyp / Type of impeller: Propeller	Nennleistung / Rated power: P_2 220,00 [kW]		Prüfer / Tester: Baran
Druckstutzen / Discharge pipe: DN 1200	Nenndrehzahl / Rated speed: n 595 [min⁻¹]		Prüfdatum / Test date: 16.04.2013
Meßstutzen / Test discharge: 990 [mm]	Meßstrecke / Test line: VuP 1200		Prüffeld / Test field: II
Prüfspannung / Test voltage: 460 [V]	Manometer / Pressure gauge: [bar]		Feld / Field: 1200/1 A
z: 2,55 [m]	J-Rohr / J-pipe: ☒ U-Rohr / U-pipe: ☐		Dieselgenerator / Diesel generator: Feld 4 ☒

	H_{tot} m	H m	Q m³/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	η_{ges} %		v_{eff} mm/s		
Anlauf / Start														
Leerlauf / no load														
1		6,0	9196	217,6				452				3,3		
2		5,5	9505	204,4				437				2,9		
3		5,0	9783	187,3				416				2,1		
4		4,5	10014	178,9				406				2,3		
5		3,9	10335	165,5				392				2,4		
6		3,5	10515	157,1				384				1,7		
7		3,0	10800	144,1				371				1,9		
8		2,5	11002	136,6				365				1,6		
9		2,0	11238	124,7				354				1,2		
10		1,5	11418	115,8				347				1,1		
11		1,0	11697	103,2				338				0,9		
12		0,5	11909	97,69				334				1,1		
13														
14														
15														
16														
17														
18														

BP

Sulzer Pump Solutions Germany GmbH
Scheiblerhöhe Str. 30-38
D-53797 Lohmar
Tel. int. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Bemerkungen / Remarks:

Abnahme / Witness test

USTCE, 16.04.2013

Stempel u. Unterschrift / Stamp and signature

abs

SULZER

Test Certificate

OT 13
Rev.00

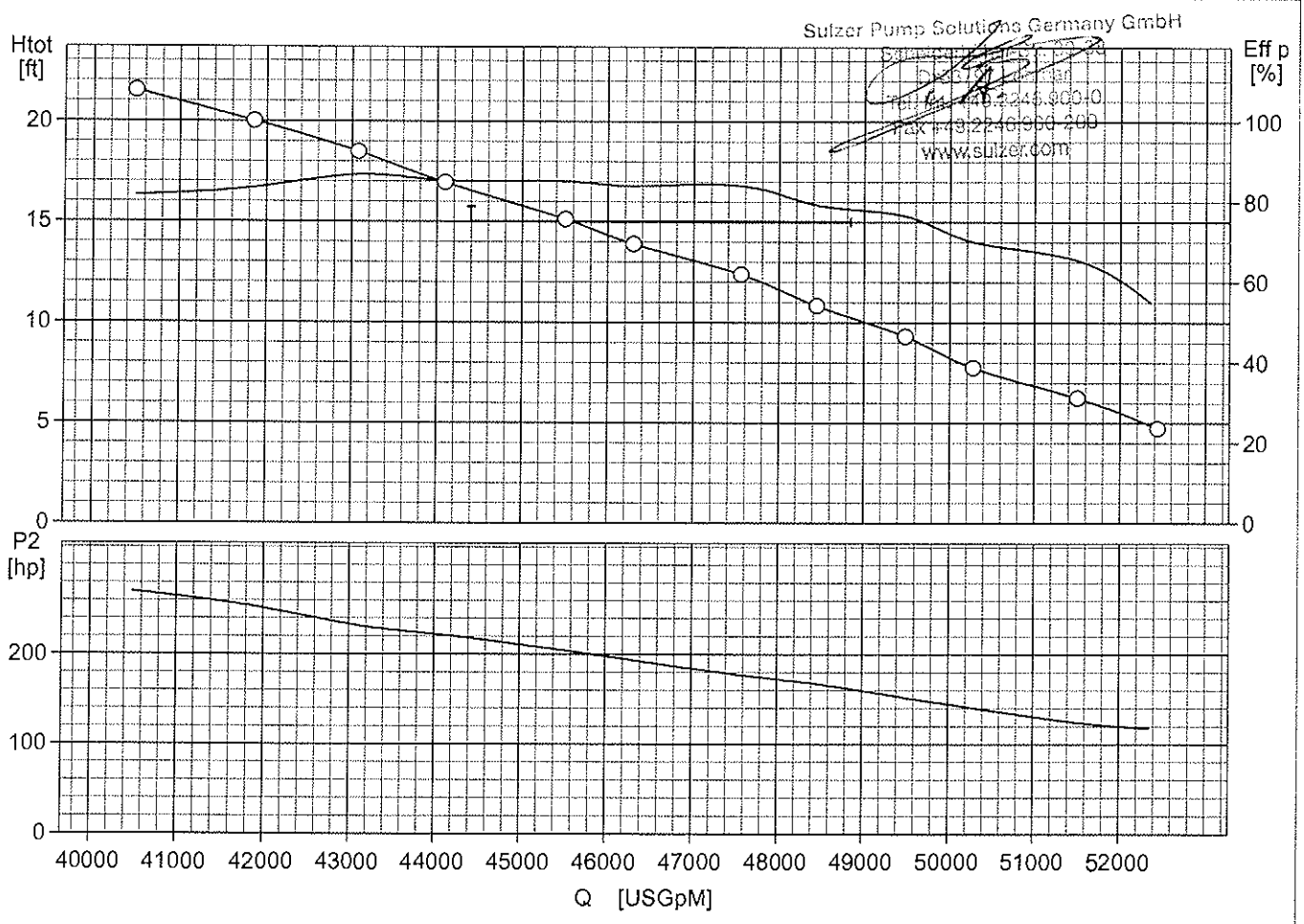
VUP 1001 M 2200/12-92.60 (witness test)

60 Hz

pump No.	58886	rated voltage (U)	460	V	duty point(s)		order No.	795331
impeller	14°	rated input (P1)	239	kW	H [ft]	Q [USGpM]	RM - No.	510736
vane	3	rated power (P2)	220	kW	15	44400		
discharge	DN 1200	rated current (I)	466	A				
meas-DN	990 mm	rated speed (n)	595	1/min				
meas-voltage	460 V	type of hydraulic	VUP 1001					

Htot [ft]	Q [USGpM]	Hst [m]	Q [m³/h]	P1 [kW]	I [A]	p.f.	Eff tot [%]	Eff mot [%]	Eff p [%]	P2 [hp]
21,53	40493	6,00	9196	218	452	0,60	75,6	92,7	81,5	270
20,01	41853	5,50	9505	204	437	0,59	77,3	92,6	83,4	254
18,49	43077	5,00	9783	187	416	0,57	80,2	92,5	86,7	232
16,95	44095	4,50	10014	179	406	0,55	78,8	92,4	85,3	222
15,12	45508	3,90	10335	166	392	0,53	78,4	92,2	85,1	205
13,89	46301	3,50	10515	157	384	0,51	77,2	92,0	83,9	194
12,38	47556	3,00	10800	144	371	0,49	77,1	91,7	84,0	177
10,84	48445	2,50	11002	137	365	0,47	72,5	91,5	79,2	168
9,31	49484	2,00	11238	125	354	0,44	69,7	91,1	76,5	152
7,76	50277	1,50	11418	116	347	0,42	63,5	90,7	70,1	141
6,26	51505	1,00	11697	103	338	0,38	58,9	90,0	65,5	125
4,73	52439	0,50	11909	97,7	334	0,37	47,9	89,6	53,4	117

Acceptance test according to Hydraulic Institute (in clear water)



date : 16.04.2013

tested by : Baran

SULZER Meßprotokoll / Test Report

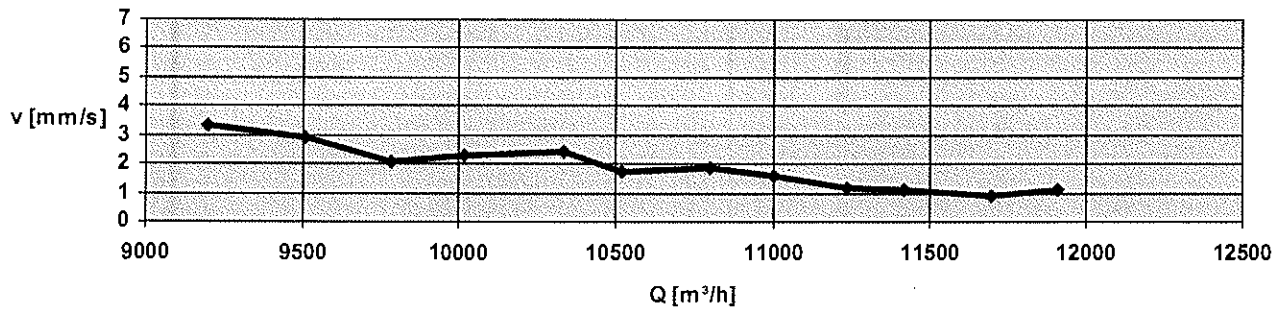
OT 04
Rev.01

Typ : Type :	VUP 1001 M 2200/12-92.60						Auftrags-Nr. : Order No. :	795331
Nr. : No. :	58886		Nennspannung : Rated voltage :	U	460	[V]	RM-Nr. : RM-No. :	510736
Laufrad ∅ : Impeller ∅ :		[mm]	Nennfrequenz : Rated frequency :	f	60	[Hz]		
Einstellwinkel : Adjustment angle :	14	[°]	Nennstrom : Rated current :	I	466	[A]	1. Betriebspunkt: 1. Duty point :	15 ft 44400 gpm
Schaufelzahl : No. of vanes :	3		Nennleistung : Rated power :	P_1	239	[kW]	2. Betriebspunkt: 2. Duty point :	ft gpm
Laufradtyp : Type of impeller :	Propeller		Nennleistung : Rated power :	P_2	220	[kW]	Prüfer : Tester :	Baran
Druckstutzen : Discharge pipe :	DN 1200		Nenndrehzahl : Rated speed :	n	595	[min^{-1}]	Prüfdatum : Test date :	16.04.2013
Meßstutzen : Test discharge :	990	[mm]	Meßstrecke : Test line :		VUP 1200		Prüffeld : Test field :	II
Prüfspannung : Test voltage :	460	[V]	Manometer : Pressure gauge :			[bar]	Feld : Field :	/ 1200 A
z :	2,55	[m]	J-Rohr : J-pipe : ☒		U-Rohr : U-pipe : ☒		Dieselgenerator : Diesel generator:	☒

Schwingungsstärkenmessung / Vibration Test

Volumenstrom Flow [m^3/h]	Weg Length [µm]	Geschwindigkeit Velocity [mm/s]	Beschleunigung Acceleration [m/s^2]
9196		3,3	
9505		2,9	
9783		2,1	
10014		2,3	
10335		2,4	
10800		1,9	
11002		1,6	
11238		1,2	
11418		1,1	
11697		0,9	
11909		1,1	

Schwinggeschwindigkeit / Vibration velocity = f(Q) 04-2



Bemerkungen :
Remarks :

Sulzer Pump Solutions Germany GmbH
Schlei[illegible]30-38
D[illegible]
Tel. [illegible]49.2246.900-0
Fax [illegible]49.2246.900-200
www.sulzer.com

Abnahme
Witness test ☒

Stempel u. Unterschrift des/Stamp and signature of Test Inspector

SULZER

Messprotokoll / Test Report

OT 01 Rev. 03

Typ / Type: VUP 1001 H 2200/12-92.60				Auftrags-Nr. / Order No.: 795331	
Nr. / No.: 58886	Nennspannung / Rated voltage:	U	460	[V]	RM-Nr. / RM-No.: 510736
Laufrad Ø / Impeller Ø: ~ [mm]	Nennfrequenz / Rated frequency:	f	60	[Hz]	SRM-Nr. / SRM-No.: ~
Einstellwinkel / Adjustment angle: 14° [°]	Nennstrom / Rated current:	I	466	[A]	1. Betriebspunkt / 1. Duty point: 4,57 m 10087,24 m³/h
Schaufelzahl / No. of vanes: 3	Nennleistung / Rated power:	P_1	239	[kW]	2. Betriebspunkt / 2. Duty point: ~ m ~ m³/h
Laufradtyp / Type of impeller: Propeller	Nennleistung / Rated power:	P_2	220	[kW]	Prüfer / Tester: Baran
Druckstutzen / Discharge pipe: DN 1200	Nenndrehzahl / Rated speed:	n	595	[min⁻¹]	Prüfdatum / Test date: 16.04.2013
Meßstutzen / Test discharge: 990 [mm]	Meßstrecke / Test line: VUP 1200				Prüffeld / Test field: II
Prüfspannung / Test voltage: 460 [V]	Manometer / Pressure gauge:			[bar]	Feld / Field: 4 1200/1 A
z: 4,1 [m]	J-Rohr / J-pipe: ☑	U-Rohr / U-pipe: ☐			Dieselgenerator / Diesel generator: ☑

	H_{tot} m	H m	Q m³/h	P_1 kW	I_U A	I_V A	I_W A	I_m A	cosφ /	η_{ges} %				
Anlauf / Start														
Leerlauf / no load														
1		6,0	9265	220,3				449						
2		5,5	9631	206,6				432						
3		5,0	9888	194,8				418						
4		4,5	10128	183,7				406						
5		3,9	10352	165,7				387						
6		3,5	10545	166,0				387						
7		2,5	11004	138,9				361						
8		2,0	11265	124,7				350						
9		1,5	11488	117,6				344						
10		1,0	11706	107,3				336						
11		0,5	11912	95,03				328						
12														
13														
14														
15														
16														
17														
18														

Bp.

Sulzer Pump Solutions Germany GmbH
Schlieffenstr. 30-38
D-53797 Lohmar
Tel. int. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Bemerkungen / Remarks:

Air pressure: 1021,4 mbar

Water temperature: 30,4 °C

Abnahme / Witness test ☒

Stempel u. Unterschrift / Stamp and signature

SULZER

Test Certificate

OT 13
Rev.00

VUP 1001 M 2200/12-92.60 (witness test)

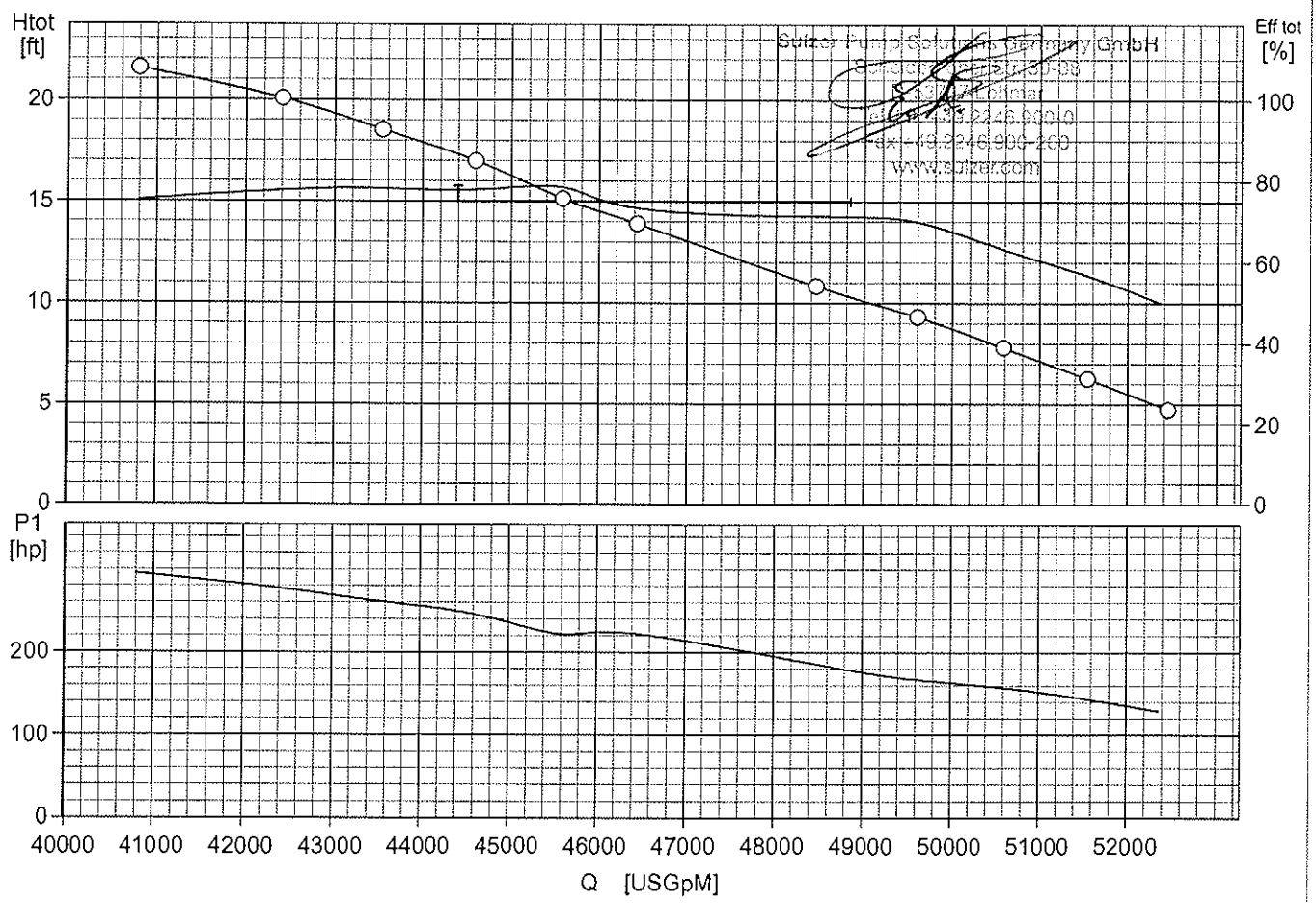
NPSH-test (z = 4,1 m)

60 Hz

pump No.	58886	rated voltage (U)	460	V	duty point(s)		order No.	795331
impeller	14°	rated input (P1)	239	kW	H [ft]	Q [USGpM]	RM - No.	510736
vane	3	rated power (P2)	220	kW	15	44400		
discharge	DN 1200	rated current (I)	466	A				
meas-DN	990 mm	rated speed (n)	595	1/min				
meas-voltage	460 V	type of hydraulic	VUP 1001					

Htot [ft]	Q [USGpM]	Hst [m]	Q [m³/h]	P1 [kW]	I [A]	p.f.	Eff tot [%]
21,56	40797	6,00	9265	220	449	0,62	75,3
20,07	42408	5,50	9631	207	432	0,60	77,7
18,53	43540	5,00	9888	195	418	0,58	78,1
17,00	44597	4,50	10128	184	406	0,57	77,8
15,13	45583	3,90	10352	166	387	0,54	78,5
13,90	46433	3,50	10545	166	387	0,54	73,4
10,84	48454	2,50	11004	139	361	0,48	71,3
9,33	49603	2,00	11265	125	350	0,45	70,0
7,80	50585	1,50	11488	118	344	0,43	63,2
6,26	51545	1,00	11706	107	336	0,40	56,8
4,73	52452	0,50	11912	95,0	328	0,36	49,2

Acceptance test according to Hydraulic Institute (in clear water)



date : 16.04.2013

tested by : Baran

SULZER Meßprotokoll / Test Report

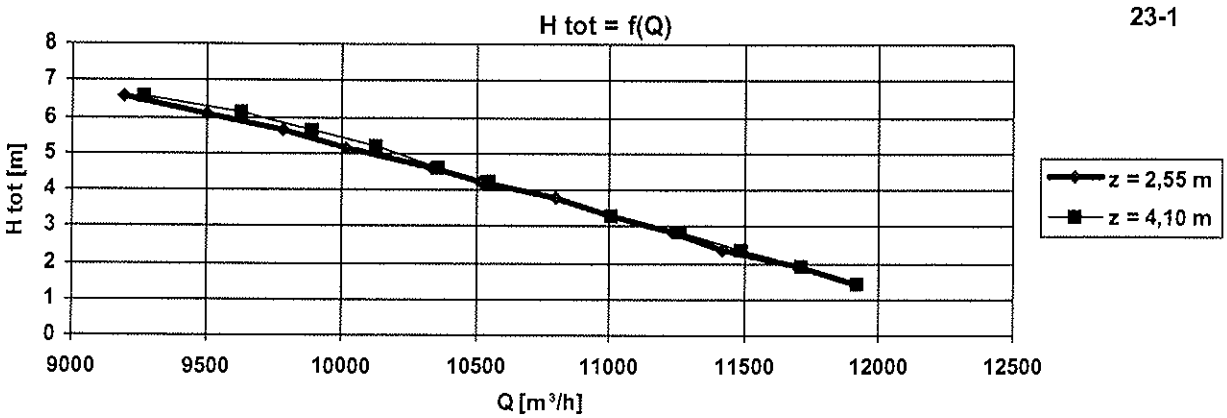
OT 23
Rev.01

Typ : / Type : **VUP 1001 M 2200/12-92.60**							Auftrags-Nr. : / Order No. : **795331**	
Nr. : / No. : **58886**			Nennspannung : / Rated voltage :	U	460	[V]	RM-Nr. : / RM-No. : **510736**	
Laufrad ∅ : / Impeller ∅ :	14°	[mm]	Nennfrequenz : / Rated frequency :	f	60	[Hz]		
Einstellwinkel : / Adjustment angle :		[°]	Nennstrom : / Rated current :	I	466	[A]	1. Betriebspunkt: / 1. Duty point :	15 ft 44400 gpm
Schaufelzahl : / No. of vanes :	3		Nennleistung : / Rated power :	P_1	239	[kW]	2. Betriebspunkt: / 2. Duty point :	ft gpm
Laufradtyp : / Type of impeller :	Propeller		Nennleistung : / Rated power :	P_2	220	[kW]	Prüfer : / Tester :	Baran
Druckstutzen : / Discharge pipe :	DN 1200		Nenndrehzahl : / Rated speed :	n	595	[min^{-1}]	Prüfdatum : / Test date :	16.04.2013
Meßstutzen : / Test discharge :	990	[mm]	Meßstrecke : / Test line :		VUP 1200		Prüffeld : / Test field :	II
Prüfspannung : / Test voltage :	460	[V]	Manometer : / Pressure gauge :			[bar]	Feld : / Field :	/ 1200 A
z :	2,55 / 4,10	[m]	J-Rohr : / J-pipe : ☒		U-Rohr : / U-pipe : ☐		Dieselgenerator : / Diesel generator:	☒

NPSH Messung / NPSH Test

A	Luftdruck	/	barometric pressure	1021,4	[mbar]
B	Sättigungsdampfdruck	/	vapour pressure	43,67	[mbar]
C	spez. Dichte	/	density of water	995,53	[kg/m³]
D	Erdbeschleunigung	/	earth gravity	9,81	[m/s²]
E	Wassertemperatur	/	water temperature	30,4	[°C]
F	Volumenstrom	/	discharge volume	11912	[m³/h]
G	Wasserspiegelhöhe	/	submergence height	0,93	[m]

NPSH [((A - B) / (C x D)) + G] < 10,94 [m]



Bemerkungen :
Remarks :

Sulzer Pump Solutions Germany GmbH
Schaufelstraße 35-38
D-53757 Sankt Augustin
Tel. +49.2246.900-0
Fax +49.2246.900-200
www.sulzer.com

Abnahme
Witness test ☒

Stempel u. Unterschrift des/Stamp and signature of Test Inspector

SULZER
Pump Solutions Germany GmbH

Calibration and Control Report

Master equipment:

Object:	*AC Power-Analyser*	*Manufacturer:*	*Siemens*
Type:	*B 1083*	*Serial number:*	*H 489172 N*
Date of last calibration:	*15.05.2012*	*Calibration mark:*	*100491_120522*

Instrument:

Object:	*AC Power-Analyser*	*Manufacturer:*	*NORMA*
Type:	*D 5255*	*Serialnumber:*	*FD 78667 LE*

specified accuracy:

-current measurement: *45...65 Hz* *±(0,1% Rdg. + 0,1% o.r.)*

-voltage measurement: *45...65 Hz* *±(0,1% Rdg. + 0,1% o.r.)*

-power measurement:

45...65 Hz	*cosφ = 1*	*± 0,10% Rdg.*		*45...65 Hz*	*cosφ = 1*	*± 0,16% Rdg.*	
100%	*cosφ = 0,5*	*± 0,15% Rdg.*		*50%*	*cosφ = 0,5*	*± 0,28% Rdg.*	
U_N ; I_N	*cosφ = 0,1*	*± 0,55% Rdg.*		U_N ; I_N	*cosφ = 0,1*	*± 1,20% Rdg.*	

Result: *Discrete calibration values*

Master AC Power-Analyser				*Instrument reference for calibration*				*Comment*
U [V]	*I [A]*	*P_1 [W]*	*f [Hz]*	*U [V]*	*I [A]*	*P_1 [W]*	*f [Hz]*	
650,0	49,90	-	50,0	650,0	49,89	-	50,0	Ch 1
-	-	-	-	+ 0,00	-0,02	-	+ 0,00	Error %
650,0	49,90	-	50,0	650,0	49,89	-	50,0	Ch 2
-	-	-	-	+ 0,00	-0,02	-	+ 0,00	Error %
650,0	49,90	-	50,0	650,0	49,90	-	50,0	Ch 3
-	-	-	-	+ 0,00	+ 0,00	-	+ 0,00	Error %
400,0	10,22	11,338	50,0	400,0	10,21	11,336	50,0	3 ~
-	-	-	-	+ 0,00	-0,10	-0,02	+ 0,00	Error %
400,0	45,74	30,249	50,0	400,0	45,73	30,244	50,0	3 ~
-	-	-	-	+ 0,00	-0,02	-0,02	+ 0,00	Error %
460,0	49,88	48,929	60,0	460,0	49,88	48,926	60,0	3 ~
-	-	-	-	+ 0,00	+ 0,00	-0,01	+ 0,00	Error %

Comments:
■ *values after internal calibration process*
☐ *values before and after calibration are the same*

Date: *10.01.2013*

Seal:

Sulzer Pump Solutions Germany GmbH
Schlickumer Str. 31-33
D-53757 Sankt Augustin
Tel. Int. +49 2246 920-0
Fax +49 2246 920-200
www.sulzer.com

Person responsible: *Achim Thielen*

Signum:

AKL Messtechnik

Kalibrierlaboratorium für elektrische Messgrößen
Registrier-Nr. Siemens Calibration Service SCS PTD T 10
Das Labor ist zertifiziert nach DIN ISO EN 17025

Calibration laboratory for electrical measurements
Registration No. Siemens Calibration Service SCS PTD T 10
This laboratory is certified according to DIN ISO EN 17025

85757 Karlsfeld, Dieselstrasse 9

Kalibrierschein / Calibration Certificate

Gegenstand *Object*	Funktionmeter
Hersteller *Manufactor*	Siemens
Typ *Type*	B1083
Fabrikate/Serien-Nr. *Serial No.*	H489172N
Inventar-/Ident-Nr. *Inventory No.*	
Auftraggeber *Customer*	Sulzer Pump Solutions Germany GmbH Scheiderhöher Str. 30-38 53797 Lohmar
Auftragsnummer *Order No.*	12103-01
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	17
Kalibrierdatum *Date of calibration*	15.05.2012
Ausstellung des Kalibrierscheines *Date of issue*	15.05.2012
Nächste Kalibrierung *Next Calibration*	15.05.2014
Auswertung *Evaluation*	Die ermittelten Messwerte liegen innerhalb der vom Hersteller angegebenen Toleranzgrenzen

Kalibrierschein-Nr.
Calibration Certificate No.

100491

Die Kalibrierung erfolgt entweder durch Vergleich mit Normalen oder Normalmesseinrichtungen oder auf der Grundlage dokumentierter Kalibrierverfahren.

Die Normale und Normalmesseinrichtungen sind rückführbar auf nationale Normale der Physikalisch-Technischen Bundesanstalt (PTB) oder auf andere nationale Normale.

Die Kalibrierergebnisse beziehen sich ausschließlich auf den Gegenstand. Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen unserer Genehmigung.

Kalibrierscheine ohne Stempel und Unterschrift haben keine Gültigkeit.

The calibration is performed by comparison with reference standards, with standard measuring equipment or on the basis of documented calibration procedures.

The reference standards and standard measuring equipment are traceable to the national measurement standards maintained by the Physical-Technical Federal Institute (PTB) or to national reference standards.

The calibration results refer exclusively to the object. This calibration certificate may not be circulated other than in full, except with our permission.

Calibration certificates without stamp and signature have not validity.

Stempel
Company Stamp

Calibration Laboratory Messtechnik SCS PTD T 10

Kontrolle
Checked
W. Karl
Stv. Kalibrierlaborleiter

Bearbeiter
Person responsible
R. Lechner
Kalibrierlaborleiter

SULZER
Pump Solutions Germany GmbH

Calibration and Control Report

Master equipment:

Object:	Flow Probe	**Manufacturer:**	TURBO Werke / Köln
Type:	MIS 2/25 ndf P2-A	**Serial number:**	261663 / A3 244608 / A
Date of last calibration:	05.04.2011	**Calibration mark:**	MECON Flow-Control-Systems Calibration Certificate 2011-347736/4

Instrument:

Object:	Flow Meter	**Manufacturer:**	TURBO Werke / Köln
Type:	MG 711 E Sitrans FM	**Serial number:**	244608 A 2009 342274/B01
max. Range:	0-30000 m^3/h	**Diameter:**	1200 mm
specified accuracy:	±0,5% o.r. ±0,05% f.s.	**CFH-faktor:**	284,01

Result: Loop calibration values after adjustment

Master Flow Probe		**Digital Output** reference for calibration		**Comments** only for internal use
mA	m^3/h	m^3/h	Error / %	Line: VUP 1200
0	0	0	0	range 0 - 10179 m^3/h v = 2,5 m/s c_1 = 4,22 c_x = 1,672
3,54	1801,7	1790	-0,65	
8,29	4219,2	4200	-0,45	
14,33	7293,3	7270	-0,32	
19,87	10112,8	10100	-0,13	
0	0	0	0	range 0 - 30015 m^3/h v = 7,372 m/s c_1 = 4,22 c_x = 0,567
4,02	6033,0	6000	-0,55	
8,88	13326,7	13250	-0,58	
12,07	18114,1	17990	-0,68	
16,34	24522,3	24400	-0,50	
18,72	28094,0	27960	-0,48	

Comments: values before and after calibration are the same

Date: 25.05.2012

Seal:

Sulzer Pump Solutions Germany GmbH
Schlieperstr. 32-38
D-32312 Lübbecke
Tel. Int. +49 5741 326-0
Fax +49 5741 326-200
www.sulzer.com

Person responsible: Achim Thielen

Signum:

MECON
FLOW-CONTROL-SYSTEMS

Kalibrierprüfzeugnis
Calibration Certificate

QUALITÄTSPRÜF - ZERTIFIKAT / QUALITY INSPECTION CERTIFICATE DIN 55350-18-4.2.2
Zertifiziert DIN EN ISO 9001:2000 / Certificated DIN EN ISO 9001:2000

Geräte Informationen/ Device Data

Aufnehmer Typ/ Flow Sensor Type	**Sonde MIS 2/25**
Bestell- Nr./ Product number	**2011-347736/4**
Fertigungsnummer/ Serial number	**261663/A3**
TAG- Nr./ TAG-No.	

Kalibrierinformation/ Calibration Information

Kalibriermethode/ Calibration Method:	**Kalibriernormal/ Referenz Meter**
Kalibrierstand/ Reference Unit Id No.	**1303**
Messungenauigkeit Kalibrierstand/ Uncertainly of Reference Unit	**< 0,25 % of rate**

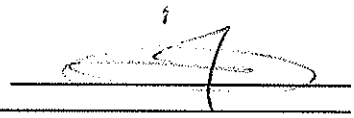
Kalibrierfaktoren/ Meter Factor:

Hydr. Nullpunkt: **0,02 mA** Cx: **0,567** für v=7,372 m/s

	Messbereichswert/ Scale value	Belastung/ Set Value	zul. Abweichung Allowable Deviation	Fehler Abweichung Actual Deviation
	l/h	%	%	%
	0,00	0,00	0,00	0,00
Messwert 1/ Calibration Point 1	1796,00	100,00	0,50	0,18
Messwert 2/ Calibration Point 2	898,00	50,00	0,50	0,20
Messwert 3/ Calibration Point 3	359,20	20,00	0,50	0,24
	--	--	--	--
	--	--	--	--
	--	--	--	--

Das Messgerät ist auf Richtigkeit im oben angegebenen Bereich geprüft worden.
The Flowmeter has been tested at the calibration test rig within the above mentioned range.
Das Kalibrierergbnis ist innerhalb der zulässigen Abweichung.
The calibration result is within specified limits.

Ort / Location: Kerpen Datum / Date: 05.04.2011 Unterschrift / Signatur:



Die Kalibrierung ist rückfürbar auf nationale Normale des Eichamt Düsseldorf zertifiziert durch die deutsche Physikalisch - Technische Bundesanstalt (PTB).
The calibration facility is tracteable to the "Measurement of Eichamt Düseeldorf" certified ny the german national standard authrity Physikalisch - Technische Bundesanstalt (PTB).

MECON GmbH
Röntgenstr. 105
D-50169 Kerpen
Telefon +49(0)241 41369 - 0
Telefax +49(0)241 41369 - 40
info@mecon.de
www.mecon.de

SULZER
Pump Solutions Germany GmbH

Calibration and Control Report

Master equipment:

Object:	Vibrationskalibrator	**Manufacturer:**	Brüel & Kjaer
Type:	4294	**Serial number:**	2028944

Instrument:

Object:	Schwingungsanalysator Beschleunigungsaufnehmer	**Manufacturer:**	RION Co. RION Co.
Type:	VM-82 PV-57 A	**Serial number:**	35095718 93480
specified accuracy:	Acceleration Velocity Displacement	Range full scale ± 2% Range full scale ± 3% Range full scale ± 5%	

Result: Discrete calibration values in the year 2013 / quarterly period

Date:	Master m/s²	Instrument m/s²	Error %	Seal / Signum
04.01.2013	10,0	10,0	0,0	
Date of Master Calibration:		23.04.2012		
Calibration mark:		B&K C 1202912		
measuring mode:		acceleration 3 Hz - 1 kHz		
person responsible:		Achim Thielen		
04.04.13	10,0	10,0	0,0	Sulzer Pump Solutions Germany GmbH
Date of Master Calibration:		23.4.12		
Calibration mark:		B&K C 1202912		
measuring mode:		acceleration 3 Hz - 1 kHz		
person responsible:		Achim Thielen		
Date of Master Calibration:				
Calibration mark:				
measuring mode:				
person responsible:				
Date of Master Calibration:				
Calibration mark:				
measuring mode:				
person responsible:				

Brüel & Kjær

The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

C/O Tel.: +49 (0)421-1787-172 Fax.: +49 (0)421-1787-150
bkservice.de@bksv.com

Kalibrierzertifikat

Kalibrierung von:

Gerät : **4294** Seriennr: **2028944**
Kunden Ident. : -

Manufacturer: Brüel & Kjær

Kunde:

Cardo Production Lohmar GmbH
Scheiderhöher Strasse 30-38
53797 Lohmar
Germany

Auftragsnummer: 434042 vom 17.04.2012

Kalibrierbedingungen:

Akklimatisierung:	4 Stunden bei 23° C ± 3° C		
Umgebungsbedingungen:	Lufttemperatur :	23 ° C	± 3° C
	Luftdruck:	101,3 kPa	± 5kPa
	Luftfeuchtigkeit:	50 % RH	± 25% RH

Verfahrensweise:

Das Gerät wurde gemäss der Kalibrieranweisung des Herstellers kalibriert.
Die Rückführbarkeit auf nationale Normale ist durch kalibrierte Messgeräte gewährleistet.

Ergebnisse:

Die aktuellen Messwerte des durchgeführten Tests befinden sich auf Seite 2 des Zertifikats.

Datum der Kalibrierung : 2012-04-23

Zertifikat erstellt: 2012-04-23

Nils Johansen
Kalibriertechniker

Henning Plogg
Zeichnungsberechtigter

SULZER

Calculation of the true scale length in connection with single limb and tube manometers

The increasing volume of fluid in the graduated tube is in exact accordance to the reduced volume in the tank (lowering surface).

Tank volume (index 2) =	tube volume (index 1)
Round tank diameter = d2	tube diameter (round) = d1
Reduce tank volume = h2	increase tube volume = h1

1.)

$$\pi * \frac{d_2^2}{4} * h_2 = \pi * \frac{d_1^2}{4} * h_1$$

$$d_2^2 * h_2 = d_1^2 * h_1$$

With a density of 1,0 g/cm^3 and mm-graduation (pressure 100 mmWS)

2.)

$$h_1 + h_2 = 100mm \qquad h_2 = 100 - h_1$$

Place 2.) in 1.)

$$d_2^2 * (100 - h_1) = d_1^2 * h_1$$

dissolved yields:

True scale length for 100 mmWS pressure (difference) with a density of 1 g/cm^3

3.) [mm]

$$h_1 = \frac{d_2^2}{(d_1^2 + d_2^2)} * 100$$

Lowering surface in tank

4.) [mm]

$$h_2 = \frac{d_1^2}{(d_1^2 + d_2^2)} * 100$$

In addition 1 mbar = 10,197 mmWS

But: The capillary effect in the tube can not be calculated.
Because of which the exact length as an average was determined via 50 readings from different instruments.

For the scales, a reduced graduation results
(the lowering of the surface was taken into consideration):

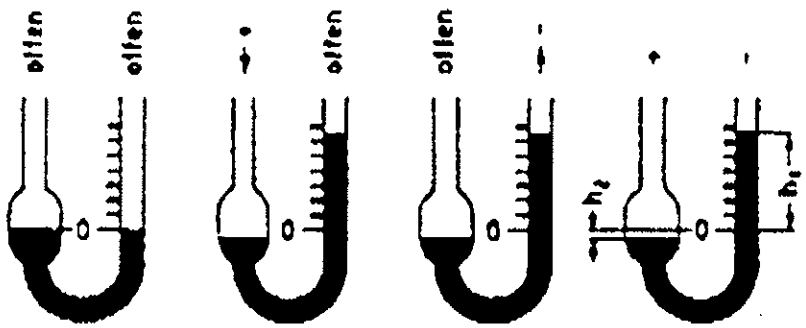
1 mbar = 96,7 mm graduation length

Operating instructions for single limb U-tubes
(J-tube-manometer, tank manometer, single limb manometer)

The manometer is hung up vertically and filled with confining liquid up to zero point. The exact zero point setting is determined by adjusting the scale. The connection to the measuring point follows:

With excess pressure at the tank limb (plus), the other end remains open.

With negative pressure at the end of the measuring tube (minus), the tank limb remains open.



filling pressure negative pressure difference

With differential pressure on both limbs, the higher pressure however, is connected to the tank limb (plus). Normal instruments are not suitable for higher static pressure. If the static pressure exceeds the range of the manometers, special versions are available.

After having connected the excess pressure, the fluid surface in the tank will sink by the small amount of h_2 (large tank), while the fluid in the tight measuring limb will rise by the large amount h (same large tank). The graduation is only applied on the measuring limb, although the slightly lower surface in the tank h_2 is taken into consideration (**reduced graduation**). The pressure reading can be determined directly on the scale.

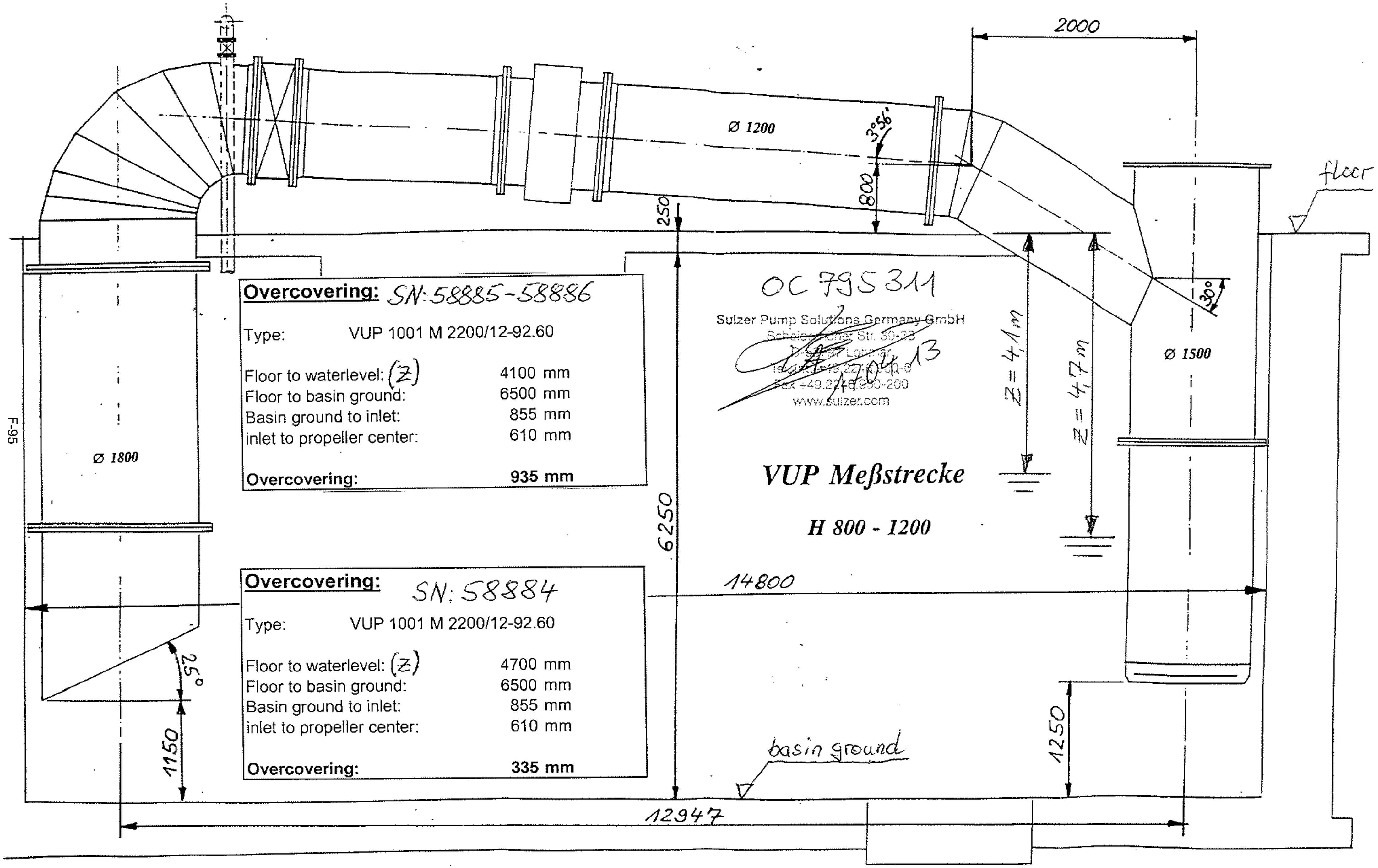
Scales: The possible graduations for the direct reading, when filling in the measuring fluid marked on the scale:

mbar for mercury (density 13,55 kg/dm^3 at 20°C).
When using mm-FS-graduation (fluid column) the pressure p results as follows:

(2) p = h. . s . 0.0981 in mbar
(2a)p = h. . s = h. in mmbar

h. = Reading at measuring limb in mm FS (reduced mm-graduation)
s = Density of the measuring fluid in kg/dm3

Measuring accuracy: with lengths up to 1000mm, better than 1 mm scale length (= 0,1% of final value).



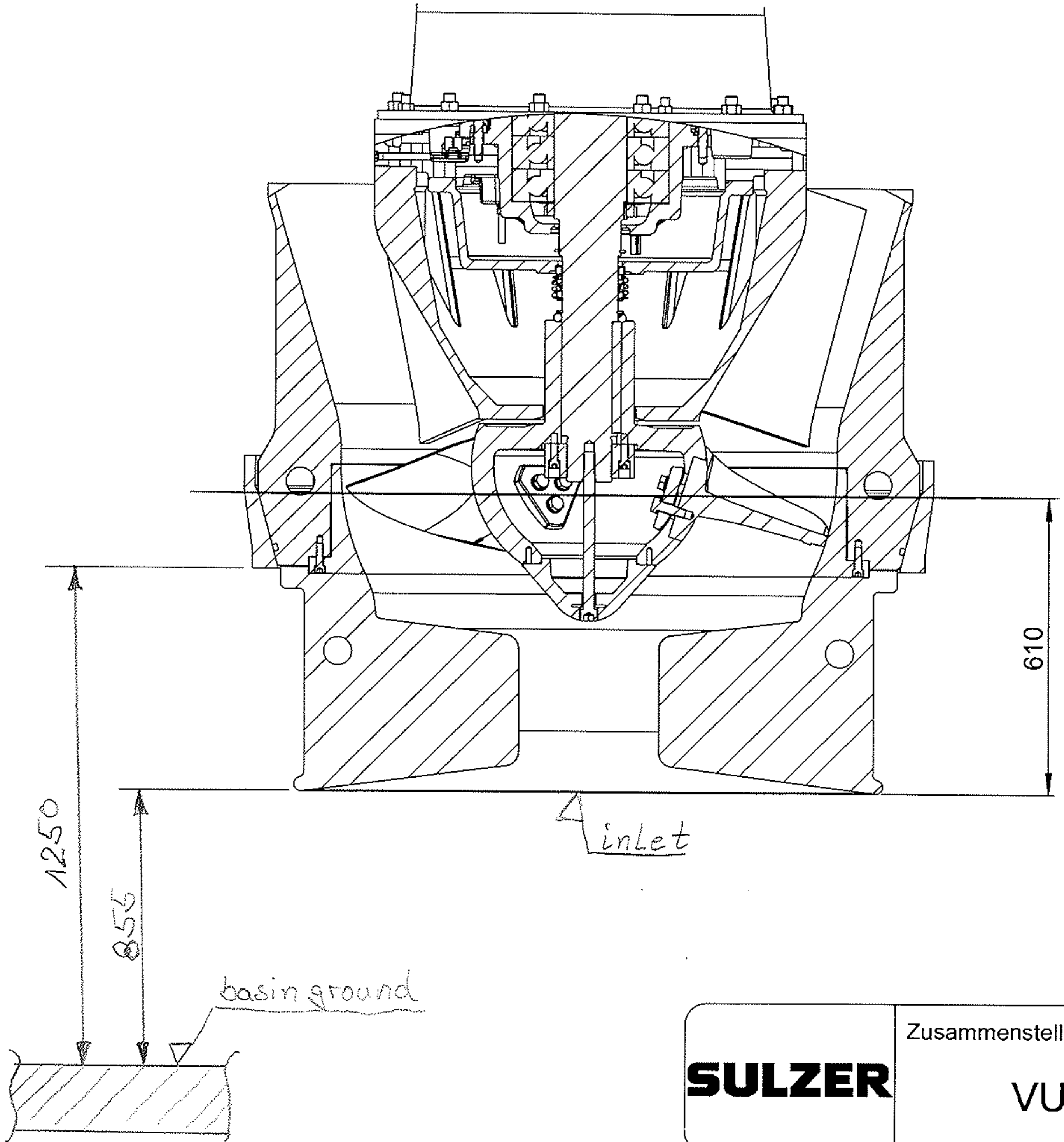
2000
Ø 1200
3°56'
800
250
floor
Ø 1800
Ø 1500
30°
OC 795311
Sulzer Pump Solutions Germany GmbH
www.sulzer.com
Z = 4,1 m
Z = 4,7 m
VUP Meßstrecke
H 800 - 1200
6250
14800
25°
1150
1250
basin ground
12947
F-95
Overcovering: SN: 58885-58886
Type: VUP 1001 M 2200/12-92.60
Floor to waterlevel: (Z) 4100 mm
Floor to basin ground: 6500 mm
Basin ground to inlet: 855 mm
inlet to propeller center: 610 mm
Overcovering: 935 mm
Overcovering: SN: 58884
Type: VUP 1001 M 2200/12-92.60
Floor to waterlevel: (Z) 4700 mm
Floor to basin ground: 6500 mm
Basin ground to inlet: 855 mm
inlet to propeller center: 610 mm
Overcovering: 335 mm

F-96

OC 795311

Sulzer Pump Solutions Germany GmbH
www.sulzer.com

17.04.13



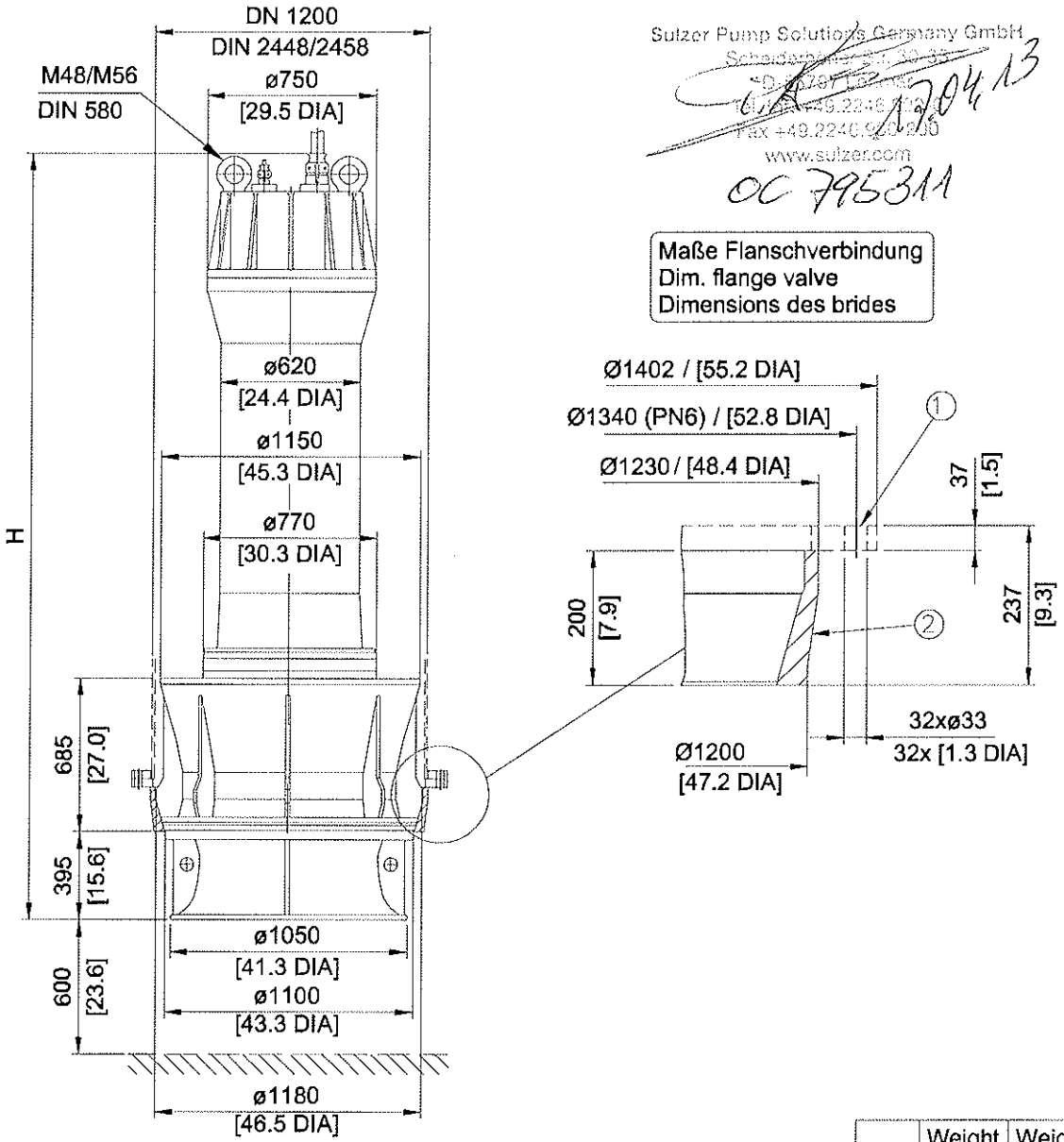
SULZER	Zusammenstellung / Assembly drawing	S-XXX
	VUP 1000	Änderungen vorbehalten Technical changes reserved
		Gewicht nach Maßblatt Weight acc. Dim. sheet

SULZER

VUP 1000

Dimension sheet M9
Maßblatt M9
Plan d'encombrement M9

No: M-10.0088 - 10
Dat/Nam.: 31.01.2013 / M.Brauer
Cad Code: M_100088
Technical changes reserved
Änderungen vorbehalten
ABS se réserve le droit de changer ses caractéristiques techniques



Maße Flanschverbindung
Dim. flange valve
Dimensions des brides

① auf Anfrage / on request / sure demande

	Weight Gewicht Poids (~kg)	Weight Gewicht Poids (~lbs)
①	100	220
②	165	365

Type Typ Tipo 50 Hz	Type Typ Tipo 60 Hz	Weight Gewicht Poids (~kg)	Weight Gewicht Poids (~lbs)	H (mm)	H (inch)
M 2500/10-91		4410	9724	3210	126.4
M 3000/10-92		4780	10540	3330	131.1
M 3500/10-93		5460	12039	3590	141.3
M 1600/12-91	M 1850/12-91.60	4180	9217	3090	121.7
M 2000/12-92	M 2200/12-92.60	4460	9834	3210	126.4
M 2500/12-93	M 2800/12-93.60	4900	10805	3440	135.4
M 3000/12-94	M 3350/12-94.60	5600	12348	3590	141.3

abs

[mm [inch]]

SULZER

Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar
Germany
Phone +49 (2246) 900 0
Fax +49 (2246) 900 200
www.sulzer.com

Certificate of Balancing

VDI 2060 - Q 6,3.

Customer: Sulzer Pumps Solutions (US)INC **Type:** VUP 1001 M2200/12-92.60

Customer-Order-No.: 165647 **Part-No.:** VUBN1121BC3P5A2

ABS-Reference-No.: 795331 **Serial-No.:** 58884

Quantity: 1

We hereby certify that

The impeller are balanced dynamically on two levels, according to VDI 2060 - Q 6,3.

Test attribute	**Remaining unbalance**
The remaining unbalance is less than	57 gr. (D = 340 mm)
Actual value No. 1	29 gr.
No. 2	
No. 3	
No. 4	
No. 5	
No. 6	

Lohmar, 26.02.2013

Tested by
Quality department
H.Bakir

Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar

SULZER

Certificate of Balancing

VDI 2060 - Q 6,3.

Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar
Germany
Phone +49 (2246) 900 0
Fax +49 (2246) 900 200
www.sulzer.com

Customer: Sulzer Pumps Solutions (US)INC **Type:** VUP 1001 M2200/12-92.60

Customer-Order-No.: 165647 **Part-No.:** VUBN1121BC3P5A2

ABS-Reference-No.: 795331 **Serial-No.:** 58885

Quantity: 1

We hereby certify that

The impeller are balanced dynamically on two levels, according to VDI 2060 - Q 6,3.

Test attribute	**Remaining unbalance**
The remaining unbalance is less than	57 gr. (D = 340 mm)
Actual value No. 1	24 gr.
No. 2	
No. 3	
No. 4	
No. 5	
No. 6	

Lohmar, 26.02.2013

Tested by
Quality department
H.Bakir

Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar

SULZER

Sulzer Pump Solutions Germany
GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar
Germany
Phone +49 (2246) 900 0
Fax +49 (2246) 900 200
www.sulzer.com

Certificate of Balancing

VDI 2060 - Q 6,3.

Customer: Sulzer Pumps Solutions (US)INC **Type:** VUP 1001 M2200/12-92.60

Customer-Order-No.: 165647 **Part-No.:** VUBN1121BC3P5A2

ABS-Reference-No.: 795331 **Serial-No.:** 58886

Quantity: 1

We hereby certify that

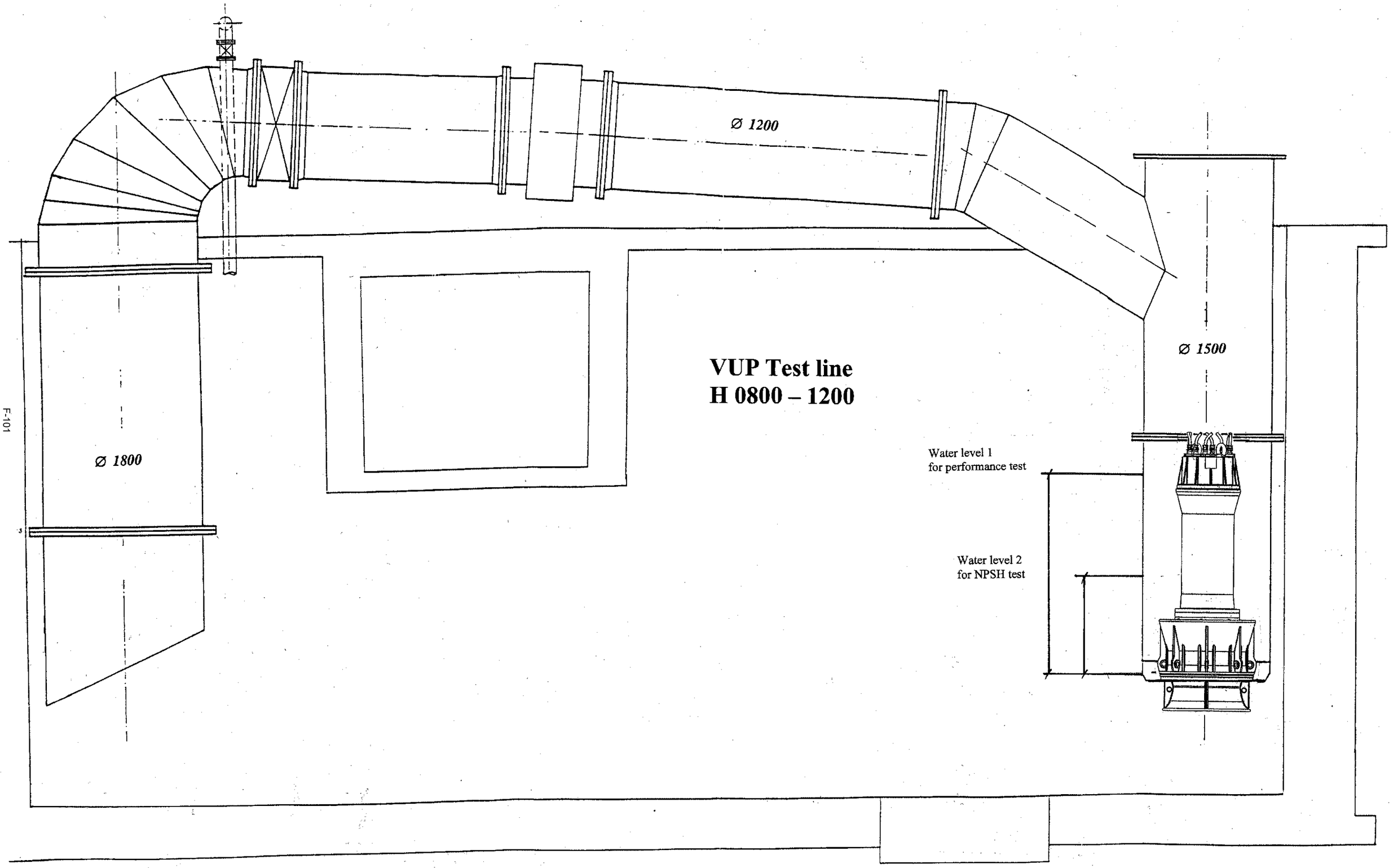
The impeller are balanced dynamically on two levels, according to VDI 2060 - Q 6,3.

Test attribute	**Remaining unbalance**
The remaining unbalance is less than	57 gr. (D = 340 mm)
Actual value No. 1	49 gr.
No. 2	
No. 3	
No. 4	
No. 5	
No. 6	

Lohmar, 26.02.2013

Tested by
Quality department
H.Bakir

Sulzer Pump Solutions Germany GmbH
Scheiderhöher Str. 30-38
D-53797 Lohmar


Ø 1200
Ø 1500
Ø 1800
VUP Test line
H 0800 – 1200
Water level 1
for performance test
Water level 2
for NPSH test

F-101

FLOW-TECHNICS, INC.

Evaluation Report

For

U.S. Army Corps of Engineers
Rice Lake Habitat
Banner, IL

Submitted by:
FLOW – TECHNICS, INC.
Frankfort, IL.
PHONE: 815-277-2600
FAX: 815-534-5311

Revised 6/9/2016

Equipment

Introduction

Three VUPX 1001 Submersible Pumps were delivered on Monday, May 9, 2016 to Flow-Technics, Inc. motor shop, Joliet Equipment. The disassembly and evaluation of all three pumps were completed on the following dates.

- Pump #1, serial number 58884, disassembled Thursday, May 12, 2016
- Pump #2, serial number 58885, disassembled Friday, May 13, 2016
- Pump #3, serial number 58886, disassembled Monday, May 16, 2016

Evaluation

We were able to turn the propeller freely. The suction bell was then removed. The propeller cap and locking bolts were removed from the propeller nut.

The unit was laid on its side. We removed the propeller nut and loosened bolts for the wear ring.

The unit was stood back up and we removed the bolts for the wear ring. The unit was lifted up to remove the propeller and wear ring. The stator bolts were then removed and the stator was pulled off. The stator was full of water.

We pulled the rotor assembly out of the discharge diffuser and drained the seal oil. The seal oil was clean.

We removed the upper seal and the bolts for the bearing cover. The rotor was lifted out of the bearing housing which was full of water. The rotor was laid on a skid to remove the bearings and bake the rotor.

We then removed the junction box cover and removed the cable entries.

The upper connection chamber was then removed.

We removed the upper bearing cover and bearing and then the upper bearing housing. All three units were found in the same condition.

The rotors and stators were cleaned and baked on May 18, 2016 and May 19, 2016. All items tested good and do not need rewinding (See attached reports).

The Stainless Steel Cable Tension Systems were delivered to Flow-Technics, Inc. on May 26, 2016 for all three (3) pumps and were evaluated.

Conclusion

Based on the evaluation of the pumps it is concluded that all three pumps require all new cables, cable entries, cable seals, bearings, mechanical seals, terminal boards, and corresponding hardware to repair the pumps. Additional cable sockets, (part numbers 12180120, 12180087, and 12180065) were ordered from the manufacturer at no additional cost to the customer. Also recommended is new Shrinking Hose to protect the new cables. It is recommended that each stator winding be dipped in varnish and baked as the existing varnish is light and the magnet wire does move at no additional cost to the customer. Upon evaluation of the steel cables, it is recommended that the Kellem Grips be replaced as it would be virtually impossible to reattach the used grips. The total additional cost for the recommended parts is $2,792.40 (see chart for part listing) Phase I is completed and it is recommended that Phase II be started.

Additional Parts Recommended:

Part Number	Description	Qty.	Unit Price	Ext. Price
12116004	Shrinking Hose 3 – 20 foot sections	60 ft.	$19.90	$1,194.00
13036017	Kellem Grip, 2.00-2.49	6	$227.70	$1,366.20
13036016	Kellem Grip, .63-.74	3	$77.40	$232.20
			TOTAL:	**$2,792.40**

JOLIET

TEST RESULTS MOTORS • REPAIR

MOTOR DATA

H.P.	295	MFR.	ABS
VOLTS	460	AMPS	465
TYPE		FRAME	PUMP
RPM	595	JOB NO.	242863A

CUSTOMER
FLOW TECHNICS
#1
s/n 58884

DATE 5/18/16

P/I CURRENT / TIME TEST WITH _____ VOLTS D.C.

TIME (MIN.)	LEAKAGE CURRENT uA	MEGOHMS E/I
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Notes:

HiPot Test
***Ground RTD's and/or Heaters 1st**

2 x Motor Volts _____
\+ 1000
_____
X 1.7
_____
X .60
Test Volts 2140

HEATER RES
1 _____
1 _____

RTD RES
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Lead Condition
Repair: ☐ O.K.: ☐

HiPot
0. 30 sec.
1. Min. 0.319uA

Phase Balance
Volt 100 A 78 B 78 C 78 Amps
Res.
1-2 _____ 2-3 _____ 3-1 _____

Craftsman
1. Bill Atkinson
2. _____

Meg. Voltage 590

Motor Temp. _____ F°
Relative Humidity
1. _____ %

Megohms 6,860G ohms

Joliet Instruments ID#
DX15
JRT76
JDS98A

Leakage at 1 Minute
1. _____

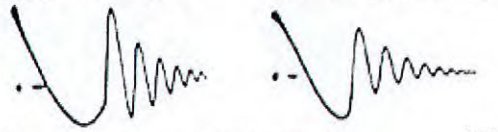
Leakage at 10 Minutes
1. _____

P.I. _____

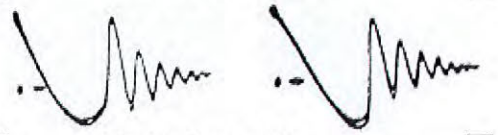
SURGE TESTER

Check the box that best shows the patterns corresponding with the motor being tested
2110 A.C. Volts
Check what type of connection, if known.
Waveshapes for typical winding faults.

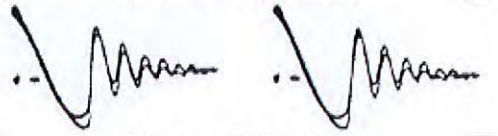
☐ Wye Connected Delta Conneced ☐



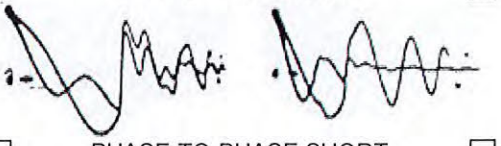
☒ GOOD WINDING ☒



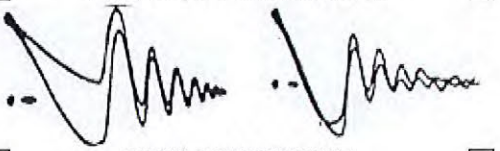
☐ TURN-TO-TURN SHORT ☐



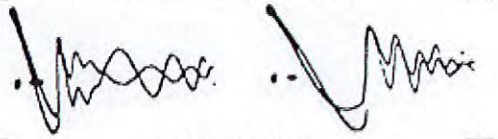
☐ COIL-TO-COILSHORT ☐



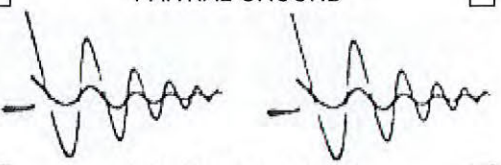
☐ PHASE-TO-PHASE SHORT ☐



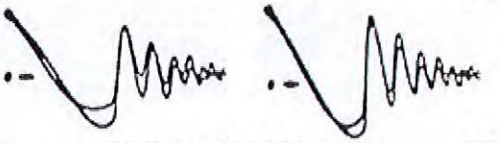
☐ OPEN CONNECTION ☐



☐ PARTIAL GROUND ☐



☐ COMPLETE GROUND ☐



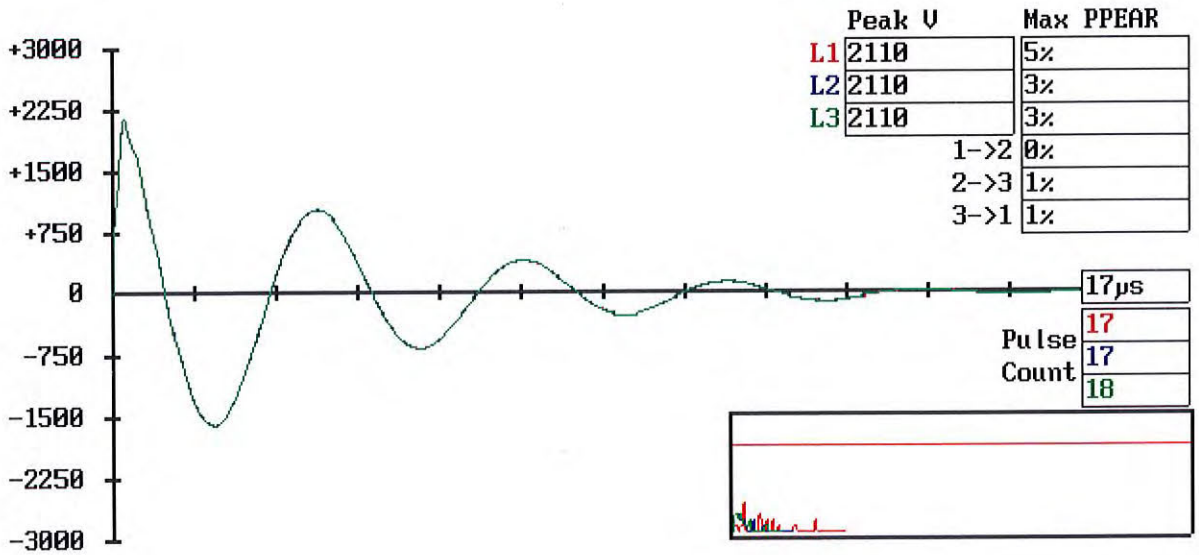
☐ REVERSE CONNECTION ☐

FORM 9.37B Rev. 07

Folder Name:	FLOW TECHN		
Record Name:	242863 A	Test Date/Time:	18-MAY-2016 04:05:57 PM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

3 Phase Surge Test Results



	Peak V	Max PPEAR
L1	2110	5%
L2	2110	3%
L3	2110	3%
1->2		0%
2->3		1%
3->1		1%

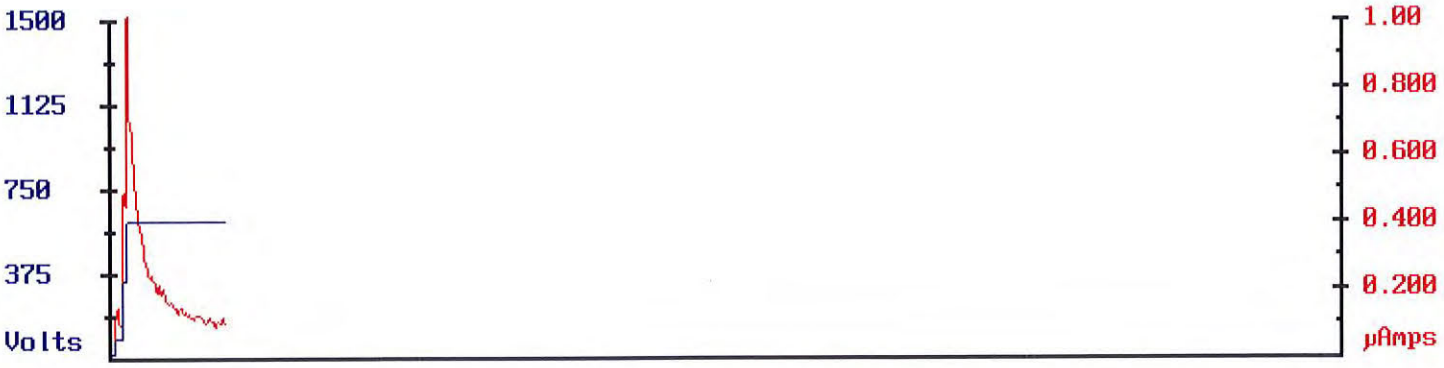
17µs	
Pulse Count	17
	17
	18

Folder Name:	FLOW TECHN		
Record Name:	242863 A	Test Date/Time:	18-MAY-2016 04:02:32 PM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

DC Tests Results

	IR	DA/PI	DC Hipot
Test Voltage (V)	590		
Leakage I (µA)	0.091		
IR (MΩ)	6484		
Corr 30.0°C (MΩ)			

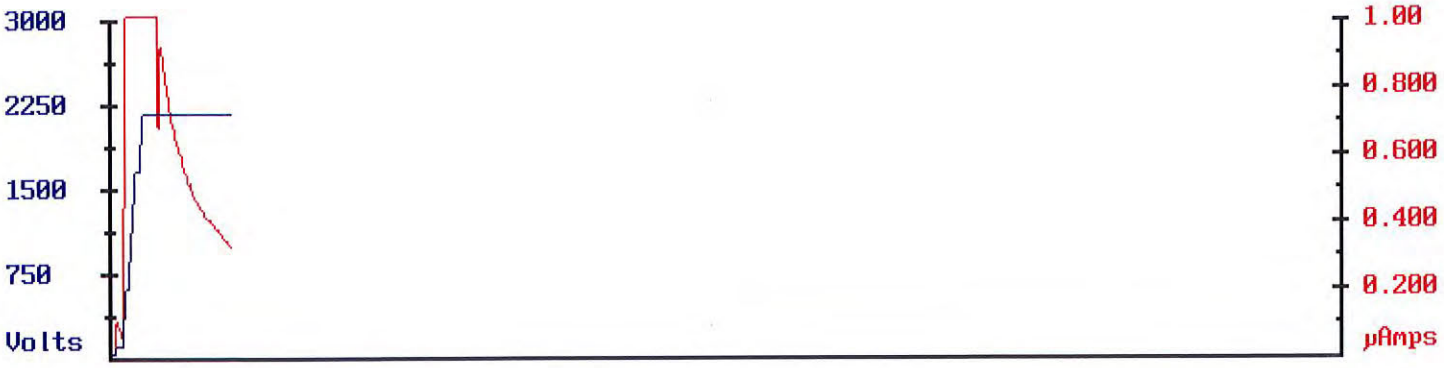


Folder Name:	FLOW TECHN		
Record Name:	242863 A	Test Date/Time:	18-MAY-2016 04:04:56 PM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

DC Tests Results

	IR	DA/PI	DC Hipot
Test Voltage (V)			2140
Leakage I (µA)			0.329
IR (MΩ)			6505
Corr 30.0°C (MΩ)			



Folder Name:	FLOW TECHN		
Record Name:	242863 A	Test Date/Time:	18-MAY-2016 04:10:47 PM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

RLC Tests Results

HGG	Lead 1:	Lead 2:	Lead 3:	Unbal(%)
DC Resistance	14.8377 m	14.7249 m	14.6364 m	0.7
Temp Cor Res	14.8377 m	14.7249 m	14.6364 m	
Temp (°C)	25.0			
Impedance/Ang	0.140/ 83.6	0.141/ 83.7	0.140/ 83.6	0.3/0.0
Inductance mH	0.370	0.371	0.369	0.3
Z D/Q	0.112/ 8.943	0.111/ 8.986	0.112/ 8.919	
Frequency Hz	60.0			
Capacitance nF	100.0			
Cap D/Q	0.019/ 52.7			

JOLIET

TEST RESULTS MOTORS • REPAIR

MOTOR DATA

H.P.	295	MFR.	ABS
VOLTS	460	AMPS	465
TYPE		FRAME	PUMP
RPM	595	JOB NO.	242863C

CUSTOMER
FLOW TECHNICS
#2
s/n 58885

DATE 5/19/16

P/I CURRENT / TIME TEST WITH _____ VOLTS D.C.

TIME (MIN.)	LEAKAGE CURRENT uA	MEGOHMS E/I
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Notes:

HiPot Test
***Ground RTD's and/or Heaters 1st**

2 x Motor Volts _____
\+ 1000
_____
X 1.7
_____
X .60
Test Volts 2130

HEATER RES
1 _____
1 _____

RTD RES
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Lead Condition
Repair: ☐ O.K.: ☐

HiPot
0. 30 sec.
1. Min. 0.203uA

Phase Balance

Volt 100 A 78 B 78 C 78 Amps
Res.
1-2 _____ 2-3 _____ 3-1 _____

Craftsman
1. Bill Atkinson
2. _____

Meg. Voltage 590

Megohms 7.97G ohms

Motor Temp. _____ F°
Relative Humidity
1. _____ %

Joliet Instruments ID#
DX15

JRT76

Leakage at 1 Minute
1. _____

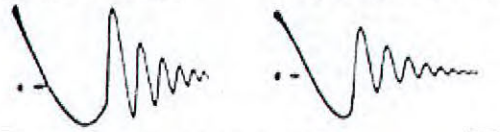
Leakage at 10 Minutes
1. _____

P.I. _____

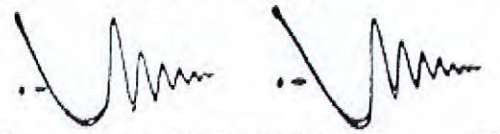
SURGE TESTER

Check the box that best shows the patterns corresponding with the motor being tested
2110 A.C. Volts
Check what type of connection, if known.
Waveshapes for typical winding faults.

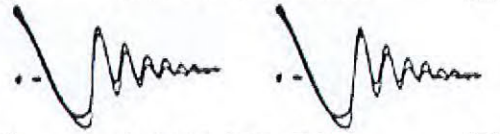
☐ Wye Connected Delta Conneced ☐



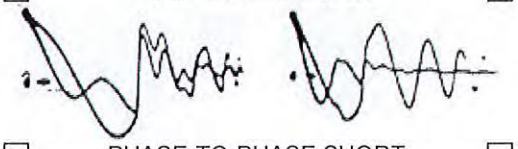
☒ GOOD WINDING ☒



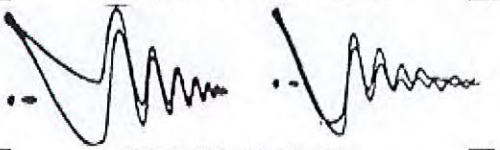
☐ TURN-TO-TURN SHORT ☐



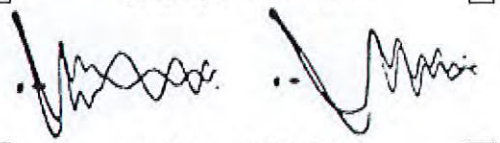
☐ COIL-TO-COILSHORT ☐



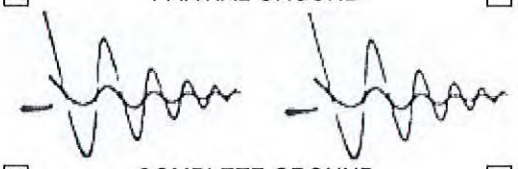
☐ PHASE-TO-PHASE SHORT ☐



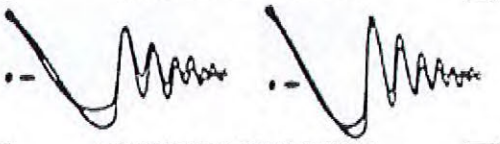
☐ OPEN CONNECTION ☐



☐ PARTIAL GROUND ☐



☐ COMPLETE GROUND ☐



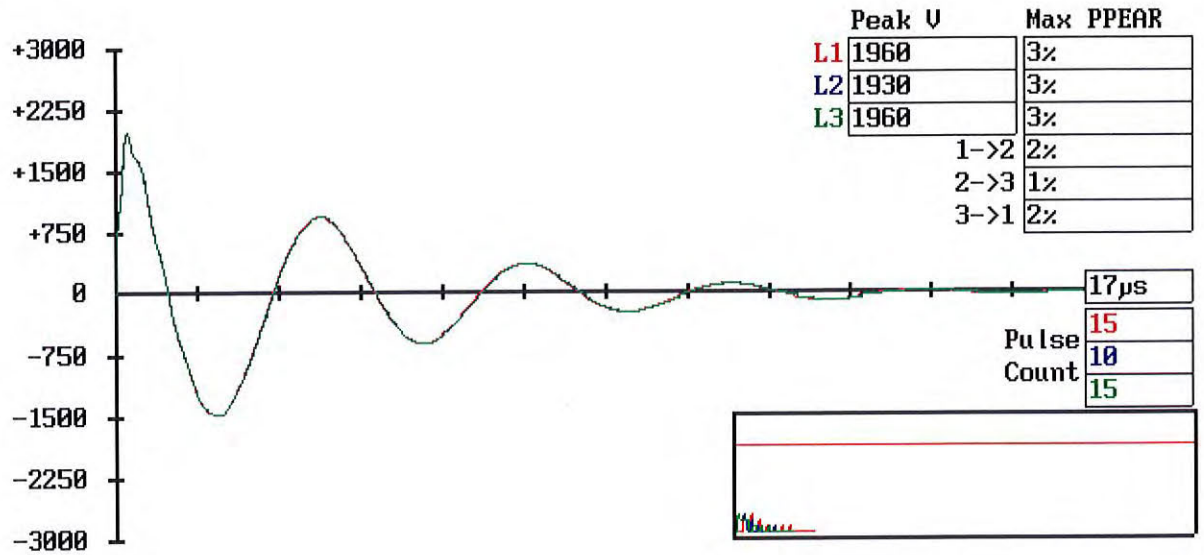
☐ REVERSE CONNECTION ☐

FORM 9.37B Rev. 07

Folder Name:	FLOW TECHN		
Record Name:	242863 B	Test Date/Time:	19-MAY-2016 08:49:18 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

3 Phase Surge Test Results



	Peak V	Max PPEAR
L1	1960	3%
L2	1930	3%
L3	1960	3%
1->2		2%
2->3		1%
3->1		2%

17µs	
Pulse Count	15
	10
	15

Folder Name:	FLOW TECHN		
Record Name:	242863 B	Test Date/Time:	19-MAY-2016 08:45:23 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

DC Tests Results

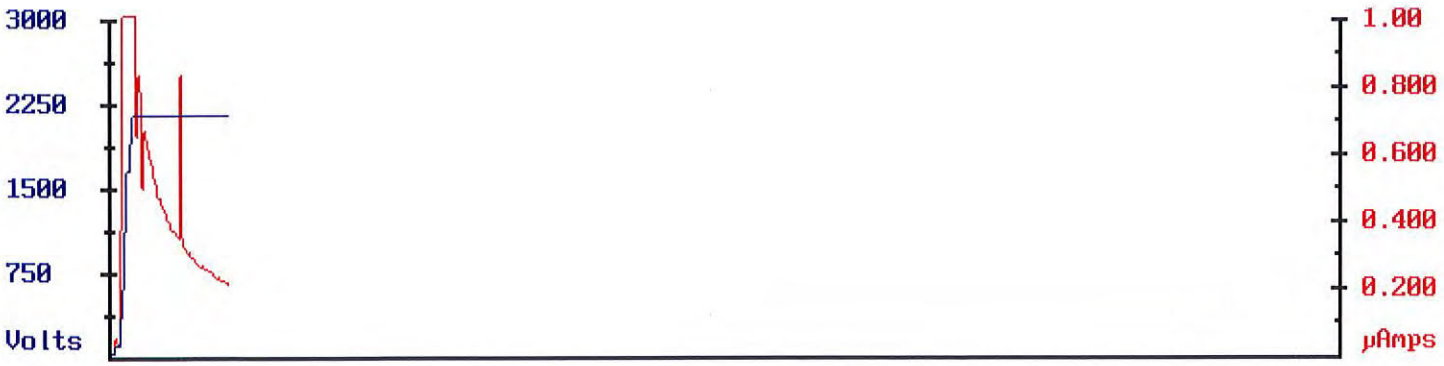
	IR	DA/PI	DC Hipot
Test Voltage (V)	590		
Leakage I (µA)	0.050		
IR (MΩ)	11800		
Corr 30.0°C (MΩ)			

Folder Name:	FLOW TECHN		
Record Name:	242863 B	Test Date/Time:	19-MAY-2016 08:47:11 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

DC Tests Results

	IR	DA/PI	DC Hipot
Test Voltage (V)			2130
Leakage I (µA)			0.204
IR (MΩ)			10441
Corr 30.0°C (MΩ)			



Folder Name:	FLOW TECHN		
Record Name:	242863 B	Test Date/Time:	19-MAY-2016 08:58:08 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

RLC Tests Results

HGG	Lead 1:	Lead 2:	Lead 3:	Unbal(%)
DC Resistance	14.8934 m	14.8381 m	14.6253 m	1.1
Temp Cor Res	14.8934 m	14.8381 m	14.6253 m	
Temp (°C)	25.0			
Impedance/Ang	0.142/ 83.7	0.142/ 83.8	0.142/ 83.9	0.2/0.1
Inductance mH	0.374	0.375	0.376	0.3
Z D/Q	0.111/ 9.003	0.109/ 9.173	0.107/ 9.347	
Frequency Hz	60.0			
Capacitance nF	102.7			
Cap D/Q	0.023/ 44.0			

JOLIET

TEST RESULTS MOTORS • REPAIR

MOTOR DATA

H.P.	295	MFR.	ABS
VOLTS	460	AMPS	465
TYPE		FRAME	PUMP
RPM	595	JOB NO.	242863C

CUSTOMER
FLOW TECHNICS
#3
s/n 58886

DATE 5/19/16

P/I CURRENT / TIME TEST WITH _____ VOLTS D.C.

TIME (MIN.)	LEAKAGE CURRENT uA	MEGOHMS E/I
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Notes:

HiPot Test
***Ground RTD's and/or Heaters 1st**

2 x Motor Volts _____
\+ 1000
X 1.7
X .60
Test Volts 2130

HEATER RES
1 _____
1 _____

RTD RES
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Lead Condition
Repair: ☐ O.K.: ☐

HiPot
0. 30 sec.
1. Min. 0.138uA

Phase Balance
Volt 100 A 78 B 78 C 78 Amps
Res.
1-2 _____ 2-3 _____ 3-1 _____

Craftsman
1. Bill Atkinson
2. _____

Meg. Voltage 590

Motor Temp. _____ F°
Relative Humidity
1. _____ %

Megohms 10.17G ohms

Joliet Instruments ID#
DX15
JRT76
JDS97

Leakage at 1 Minute
1. _____

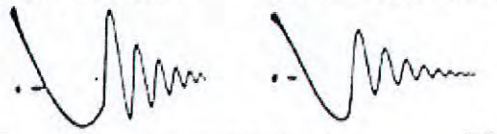
Leakage at 10 Minutes
1. _____

P.I. _____

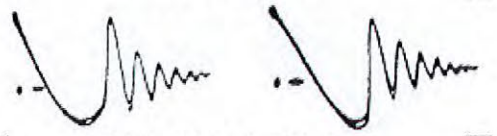
SURGE TESTER

Check the box that best shows the patterns corresponding with the motor being tested
2110 A.C. Volts
Check what type of connection, if known.
Waveshapes for typical winding faults.

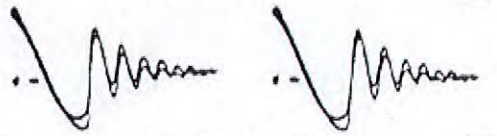
☐ Wye Connected Delta Conneced ☐



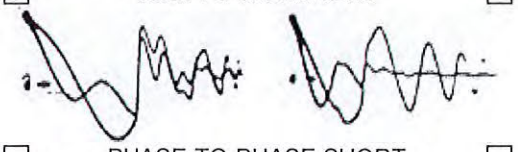
☒ GOOD WINDING ☒



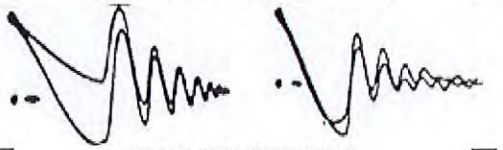
☐ TURN-TO-TURN SHORT ☐



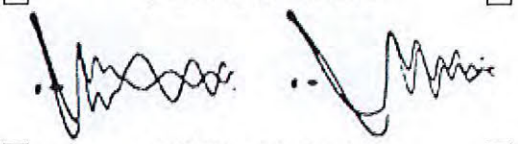
☐ COIL-TO-COILSHORT ☐



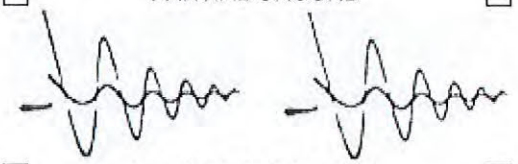
☐ PHASE-TO-PHASE SHORT ☐



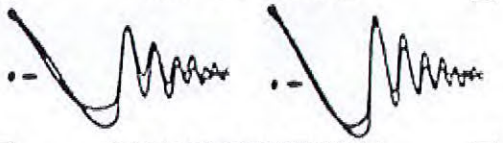
☐ OPEN CONNECTION ☐



☐ PARTIAL GROUND ☐



☐ COMPLETE GROUND ☐



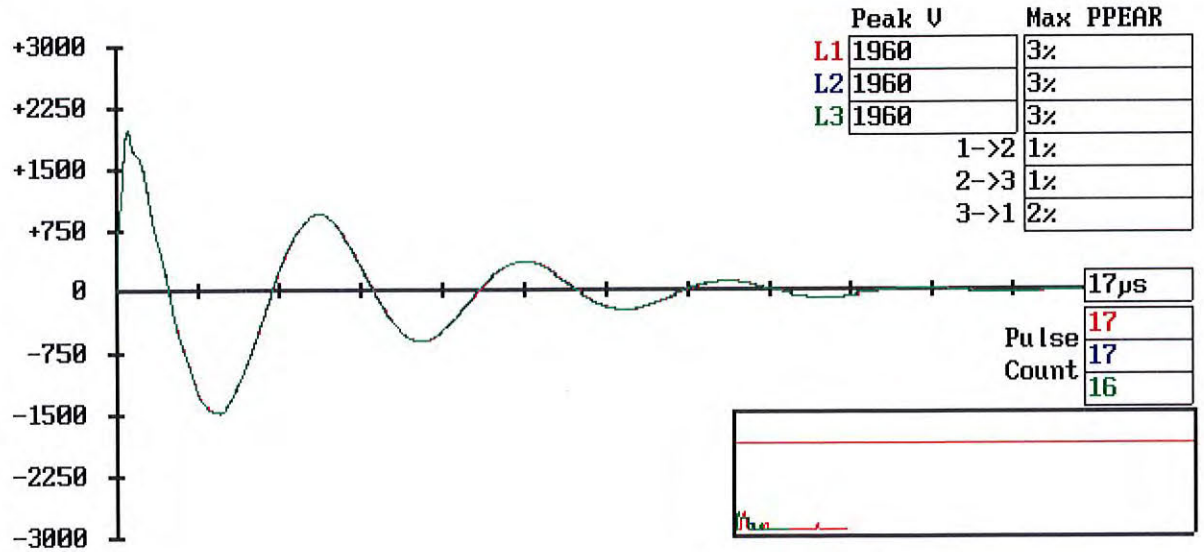
☐ REVERSE CONNECTION ☐

FORM 9.37B Rev. 07

Folder Name:	FLOW TECHN		
Record Name:	242863 C	Test Date/Time:	19-MAY-2016 09:59:30 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

3 Phase Surge Test Results



	Peak V	Max PPEAR
L1	1960	3%
L2	1960	3%
L3	1960	3%
1->2		1%
2->3		1%
3->1		2%

17µs

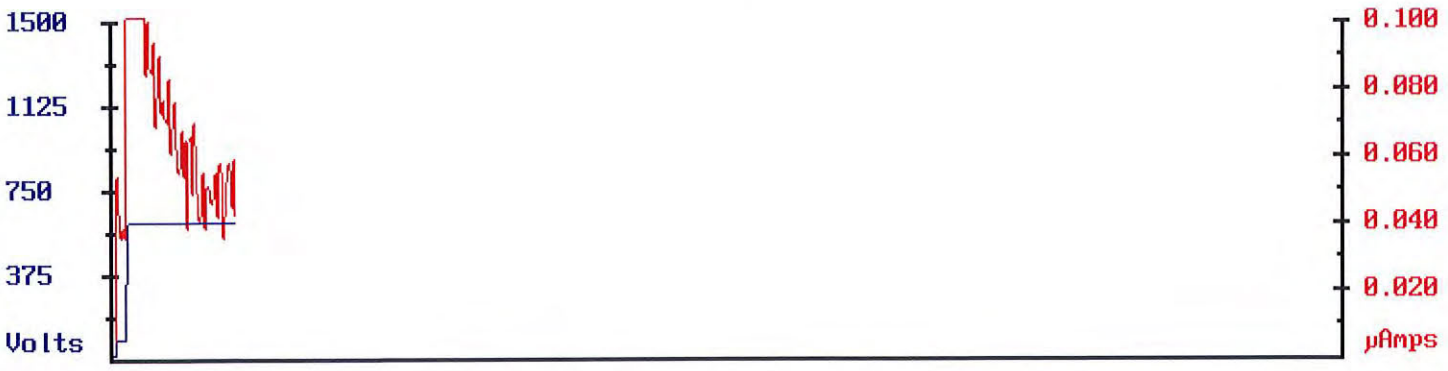
Pulse Count	
	17
	17
	16

Folder Name:	FLOW TECHN		
Record Name:	242863 C	Test Date/Time:	19-MAY-2016 09:56:40 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

DC Tests Results

	IR	DA/PI	DC Hipot
Test Voltage (V)	590		
Leakage I (µA)	0.058		
IR (MΩ)	10172		
Corr 30.0°C (MΩ)			

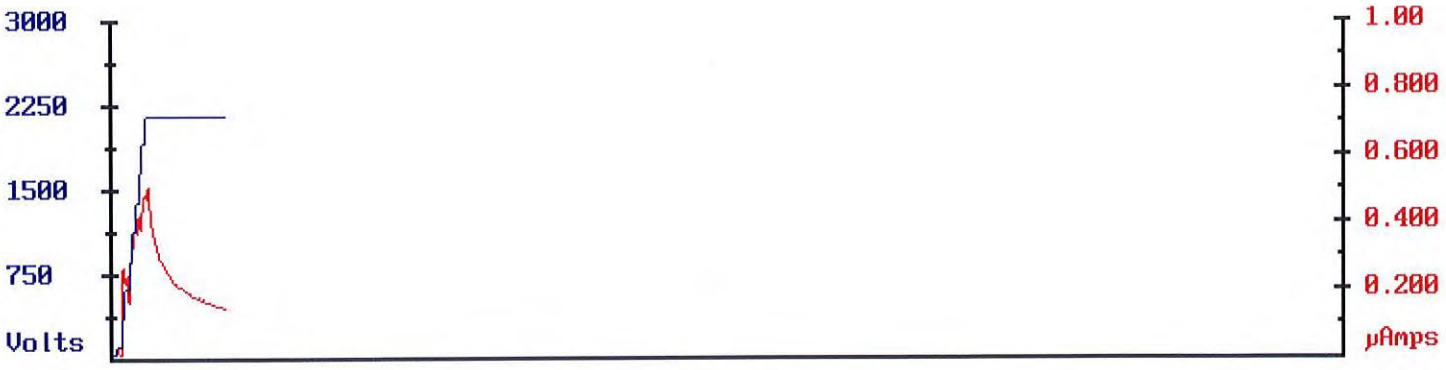


Folder Name:	FLOW TECHN		
Record Name:	242863 C	Test Date/Time:	19-MAY-2016 09:58:08 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

DC Tests Results

	IR	DA/PI	DC Hipot
Test Voltage (V)			2130
Leakage I (µA)			0.142
IR (MΩ)			15000
Corr 30.0°C (MΩ)			



[redacted]

Folder Name:	FLOW TECHN		
Record Name:	242863 C	Test Date/Time:	19-MAY-2016 10:02:09 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

RLC Tests Results

HGG	Lead 1:	Lead 2:	Lead 3:	Unbal(%)
DC Resistance	13.8834 m	14.0134 m	14.0165 m	0.6
Temp Cor Res	13.8834 m	14.0134 m	14.0165 m	
Temp (°C)	25.0			
Impedance/Ang	0.142/ 84.0	0.142/ 84.0	0.141/ 83.9	0.3/0.1
Inductance mH	0.373	0.373	0.371	0.4
Z D/Q	0.105/ 9.541	0.105/ 9.521	0.107/ 9.316	
Frequency Hz	60.0			
Capacitance nF	100.8			
Cap D/Q	0.020/ 50.1			

FLOW-TECHNICS, INC.

Reassembly Report

For

U.S. Army Corps of Engineers
Rice Lake Habitat
Banner, IL

Submitted by:
FLOW – TECHNICS, INC.
Frankfort, IL.
PHONE: 815-277-2600
FAX: 815-534-5311

Revised 9/29/2016

Introduction

Three VUPX 1001 Submersible Pumps were completed on September 19, 2016 by Flow-Technics, Inc. The reassembly and testing of all three pumps were completed on the following dates.

- Pump #1, serial number 58884, completed Thursday, September 1, 2016
- Pump #2, serial number 58885, completed Wednesday, August 31, 2016
- Pump #3, serial number 58886, completed Tuesday, August 30, 2016
- All 3 pumps were tested Wednesday, September 7, 2016

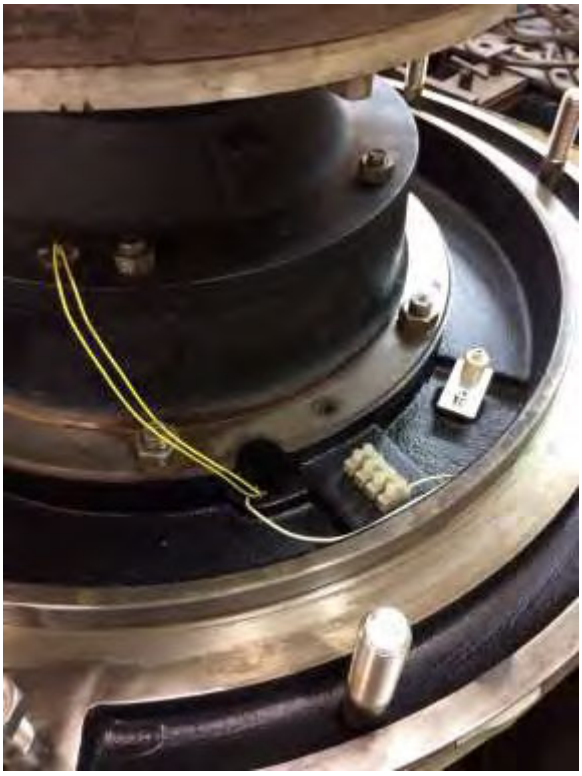
Reassembly

The lower bearing was installed.



Next, the rotor assembly was installed into the bearing housing.

The new lower probes and bearing sensor were then installed.



The stator was installed next.

Then the motor upper bearing sensors, terminal block and inner cable seals were installed.

Followed by the installation of the upper mechanical seal.

The oil chamber was installed next.

Next the lower seal was installed.

Pressure Tests were completed on all three pumps.

Pump #1 s/n 58884

Start of ½ hour test.

End of test holding 7 psi.

Pump #2 s/n 58885

Start of ½ hour test.

End of test holding 7 psi.

Pump #3 s/n 58886

Start of ½ hour test.

End of test holding 7 psi.

The propeller o-ring and key were installed.

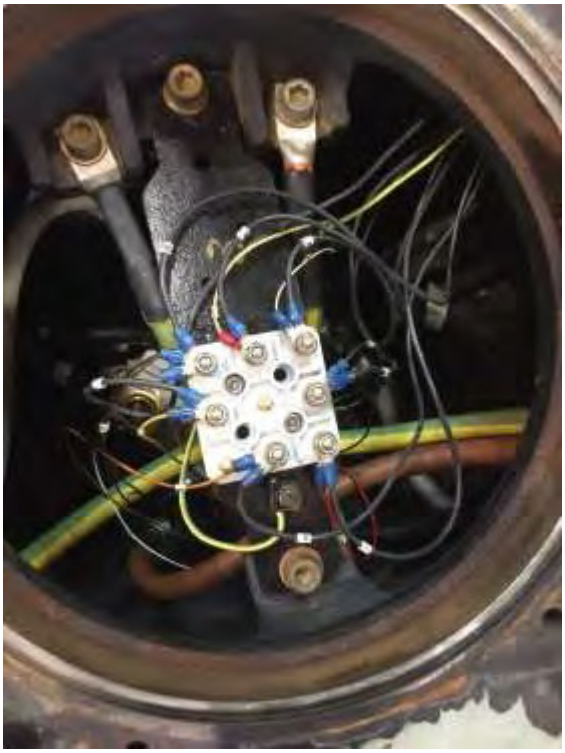
Next the discharge flow ring and propeller were installed.

Followed by the installation of the wear ring, propeller nut, and the propeller cap.

Next installed was the suction bell.

The cable assembly was attached to the lid and then installed onto the pump.

The power and control cable terminations were completed next.



Pump assembly completed.

All three units were reassembled in the same manner.

On Monday, September 19, 2016 the pumps were skidded and ready for pickup for the following day.

The following pages are the test data for all three pumps.

Sulzer VUPX 1001 Submersible Pumps
U.S. Army Corps. Of Engineers
Location: Rice Lake

Pump #1 S/N 58884 **Date: 9/1/2016**

MEG Windings:	T1 - > 550 @ 1,000V	T2 - > 550 @ 1,000V	T3 - > 550 @ 1,000V
Motor Resistance:	T1-T2 0.1 ohms	T1-T3 0.1 ohms	T2-T3 0.1 ohms
Motor Thermals:	0.2 ohms at motor	0.7 ohms at cable end	
Upper Bearing:	0.1 ohms at motor	0.7 ohms at cable end	
Lower Bearing:	0.1 ohms at motor	0.7 ohms at cable end	
Connection Chamber Probe:	>550m @ 1,000V		
Motor Housing Probe:	>550m @ 1,000V		
Oil Chamber Probe:	>550m @ 1,000V		

Pump #2 S/N 58885 **Date: 8/31/2016**

MEG Windings:	T1 - > 550 @ 1,000V	T2 - > 550 @ 1,000V	T3 - > 550 @ 1,000V
Motor Resistance:	T1-T2 0.1 ohms	T1-T3 0.1 ohms	T2-T3 0.1 ohms
Motor Thermals:	0.2 ohms at motor	0.7 ohms at cable end	
Upper Bearing:	0.1 ohms at motor	0.7 ohms at cable end	
Lower Bearing:	0.2 ohms at motor	0.9 ohms at cable end	
Connection Chamber Probe:	>550m @ 1,000V		
Motor Housing Probe:	>550m @ 1,000V		
Oil Chamber Probe:	>550m @ 1,000V		

Pump #3 S/N 58886 **Date: 8/30/2016**

MEG Windings:	T1 - > 550 @ 1,000V	T2 - > 550 @ 1,000V	T3 - > 550 @ 1,000V
Motor Resistance:	T1-T2 0.1 ohms	T1-T3 0.1 ohms	T2-T3 0.1 ohms
Motor Thermals:	0.1 ohms at motor	0.7 ohms at cable end	
Upper Bearing:	0.1 ohms at motor	0.7 ohms at cable end	
Lower Bearing:	0.2 ohms at motor	0.8 ohms at cable end	
Connection Chamber Probe:	>550m @ 1,000V		
Motor Housing Probe:	>550m @ 1,000V		
Oil Chamber Probe:	>550m @ 1,000V		

Joliet Equipment Corporation
1 Doris Avenue
Joliet, IL. 60433 USA

Phone: (815) 727-6624
Fax: (815) 727-6603

Date: 9/7/16

Service Report

Customer:	Flow-Technics Inc.	Job #:	242863
Contact:	Mike Wayman	P.O. #:	
Address:	181 Ontario Street		
	Frankfort, IL 60423		
Phone #:	815-277-2600		
Fax #:	815-534-5311		

Workscope: (Nameplate Data)

Rice Lake No Load Tests and VIBE checks

Description of Services:

#1 VIBE Test – Spike .028 in/sec @ 44660cpm /.061 @ 603.15cpm (Last)
Run volts NL 473.4 – 474.3 – 472.4
Amps NL 344.7 – 345.0 – 347.4 Data "9"

#2 VIBE Test – Spike .040 in/sec @ 44378.5cpm /.020@ 606cpm (First)
Run volts NL 471.2 – 471.6 – 472.5
Amps NL 337.7 – 340.2 – 338.5 Data "7"

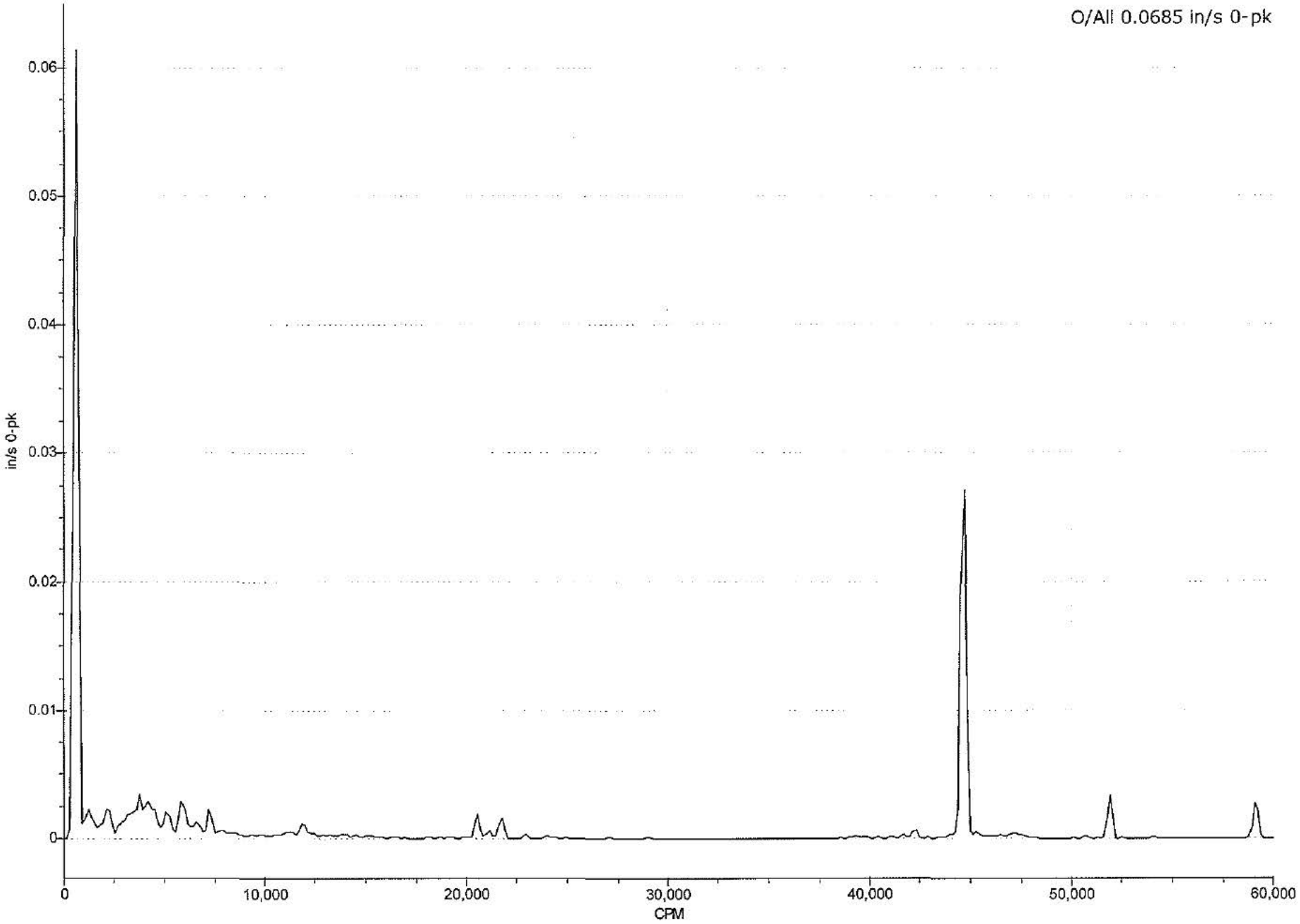
#3 VIBE Test – Spike .089 in/sec @ 44538cpm /.037 @ 604.47 (Second)
Run volts NL 477.6 – 478.2 – 479.0
Amps NL 348.3 – 351.3 – 349.7 Data "8"

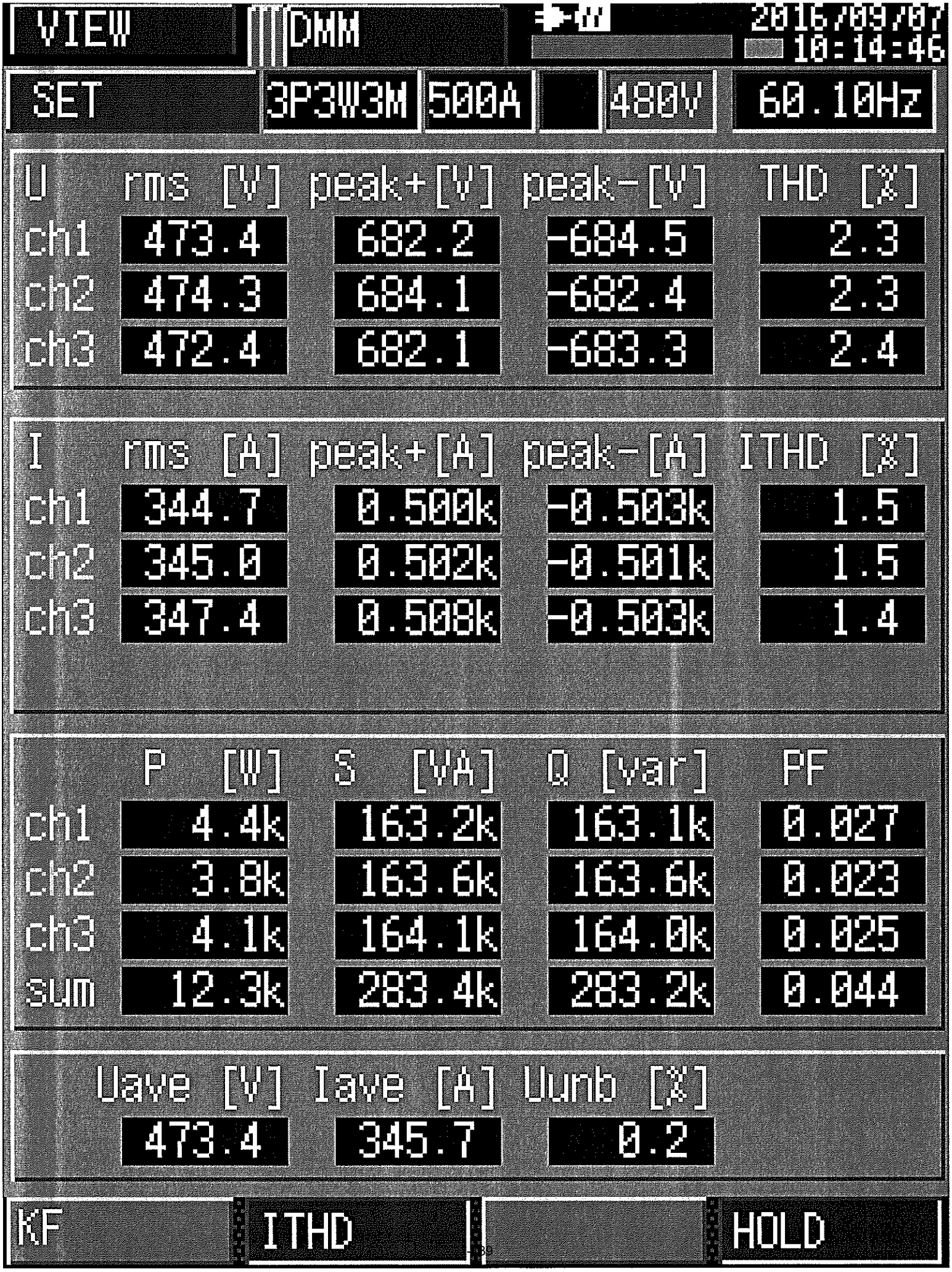
All Services Completed: Jim Gillingham *Job Site Foreman*

Customer Representative: Mike Wayman *Signature*

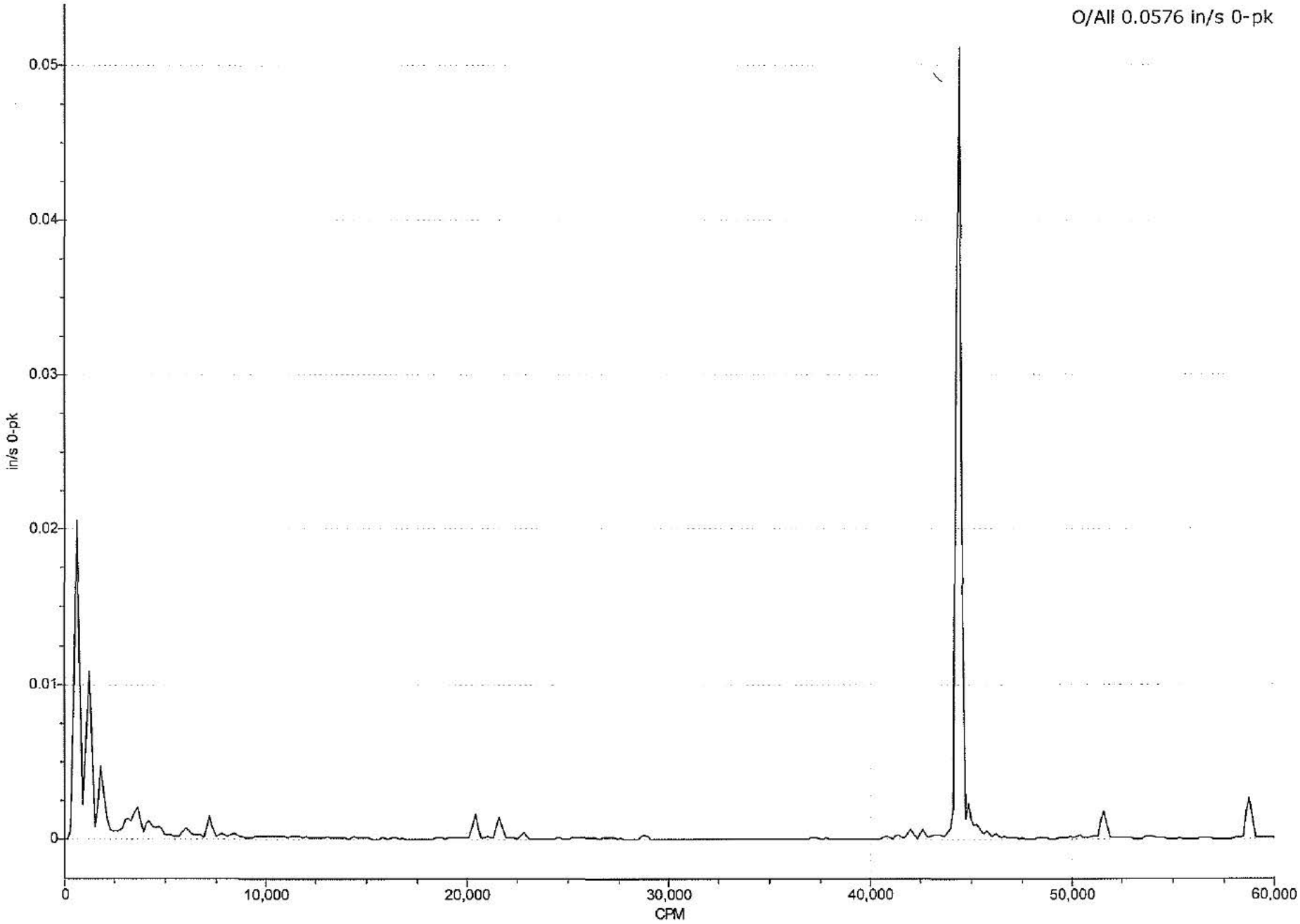
Mike Wayman *Printed*

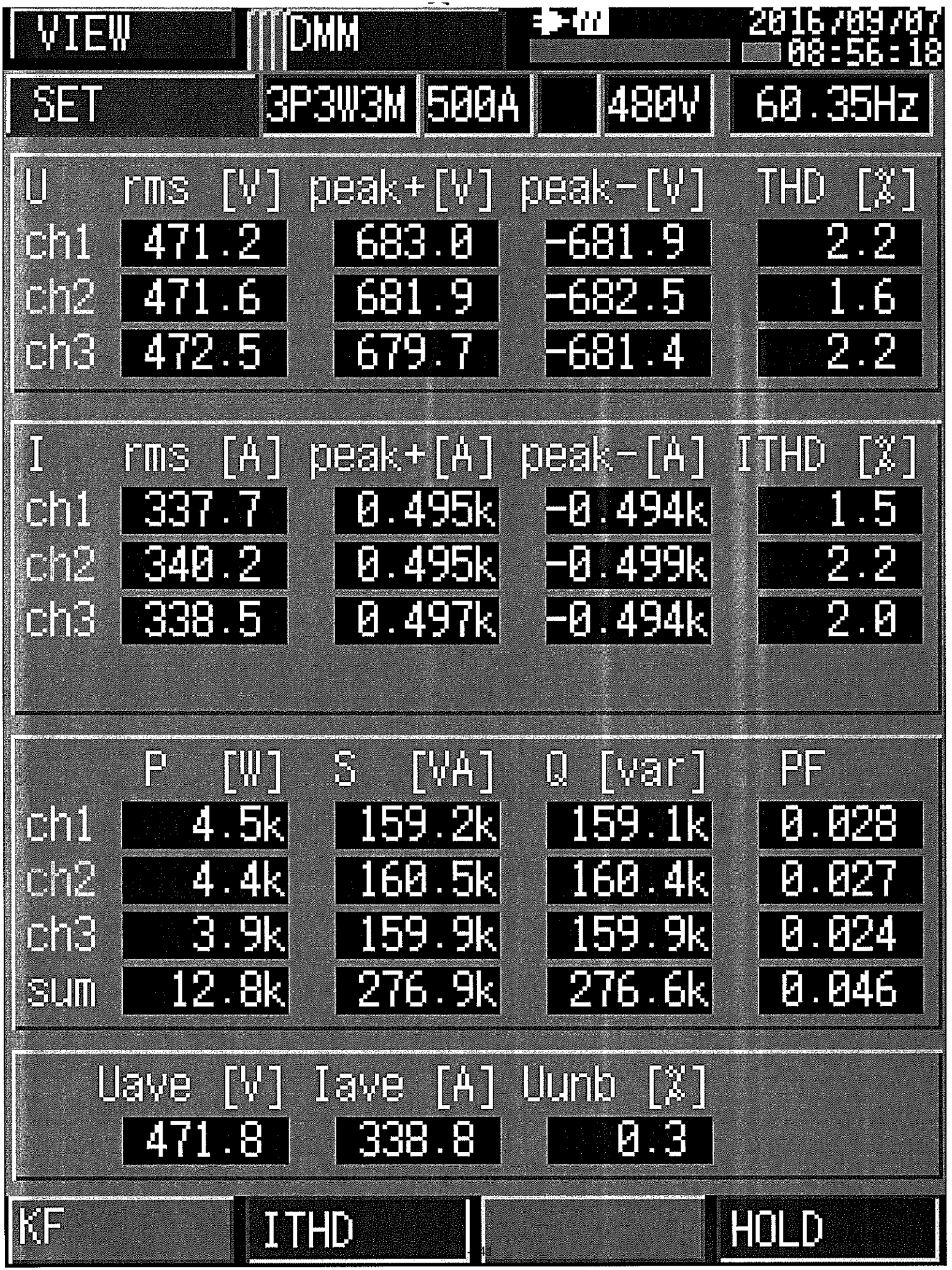
Pump 1 - Motor Top - Horizontal - Vel Spec/Wfm 60000 CPM
9/7/2016 10:14:28 AM



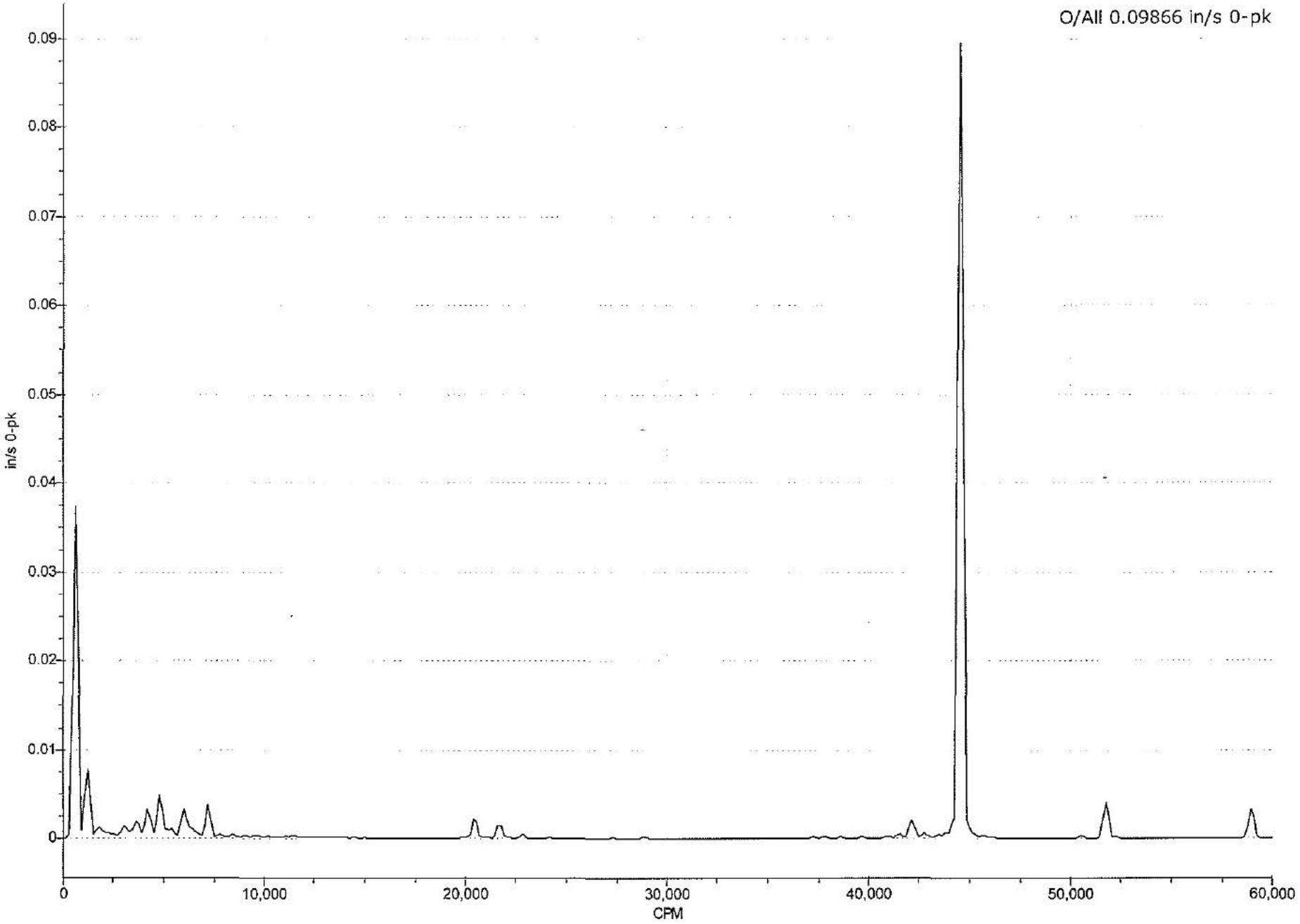

VIEW
DMM
2016/09/07
10:14:46
SET
3P3W3M
500A
480V
60.10Hz
U rms [V] peak+[V] peak-[V] THD [%]
ch1 473.4 682.2 -684.5 2.3
ch2 474.3 684.1 -682.4 2.3
ch3 472.4 682.1 -683.3 2.4
I rms [A] peak+[A] peak-[A] ITHD [%]
ch1 344.7 0.500k -0.503k 1.5
ch2 345.0 0.502k -0.501k 1.5
ch3 347.4 0.508k -0.503k 1.4
P [W] S [VA] Q [var] PF
ch1 4.4k 163.2k 163.1k 0.027
ch2 3.8k 163.6k 163.6k 0.023
ch3 4.1k 164.1k 164.0k 0.025
sum 12.3k 283.4k 283.2k 0.044
Uave [V] Iave [A] Uunb [%]
473.4 345.7 0.2
KF
ITHD
HOLD

Pump 2 - Motor Top - Horizontal - Vel Spec/Wfm 60000 CPM
9/7/2016 8:47:13 AM




VIEW
DMM
2016/09/07
08:56:18
SET
3P3W3M
500A
480V
60.35Hz
U rms [V] peak+[V] peak-[V] THD [%]
ch1 471.2 683.0 -681.9 2.2
ch2 471.6 681.9 -682.5 1.6
ch3 472.5 679.7 -681.4 2.2
I rms [A] peak+[A] peak-[A] ITHD [%]
ch1 337.7 0.495k -0.494k 1.5
ch2 340.2 0.495k -0.499k 2.2
ch3 338.5 0.497k -0.494k 2.0
P [W] S [VA] Q [var] PF
ch1 4.5k 159.2k 159.1k 0.028
ch2 4.4k 160.5k 160.4k 0.027
ch3 3.9k 159.9k 159.9k 0.024
sum 12.8k 276.9k 276.6k 0.046
Uave [V] Iave [A] Uunb [%]
471.8 338.8 0.3
KF
ITHD
HOLD

Pump 3 - Motor Top - Horizontal - Vel Spec/Wfm 60000 CPM
9/7/2016 9:23:54 AM



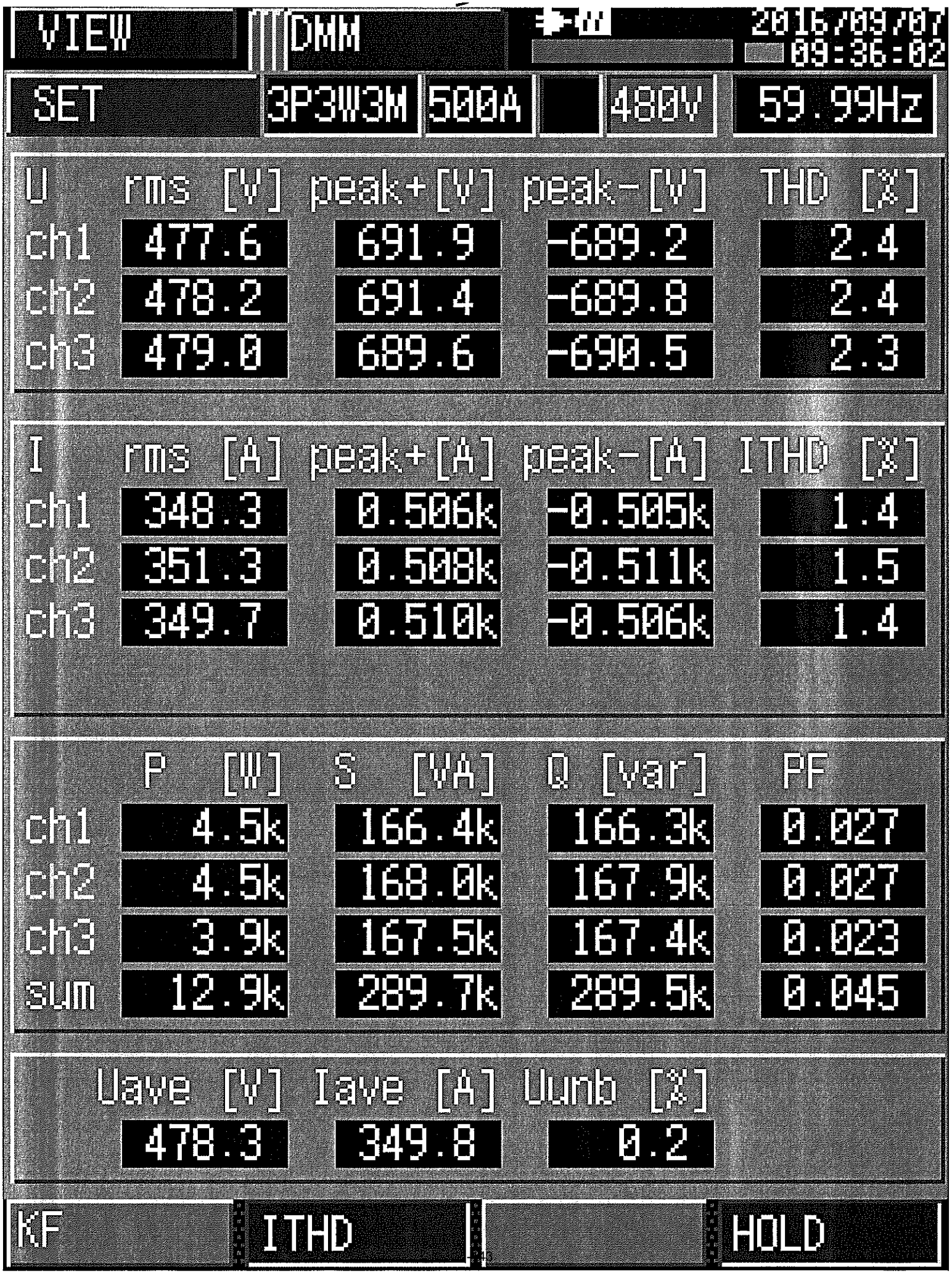
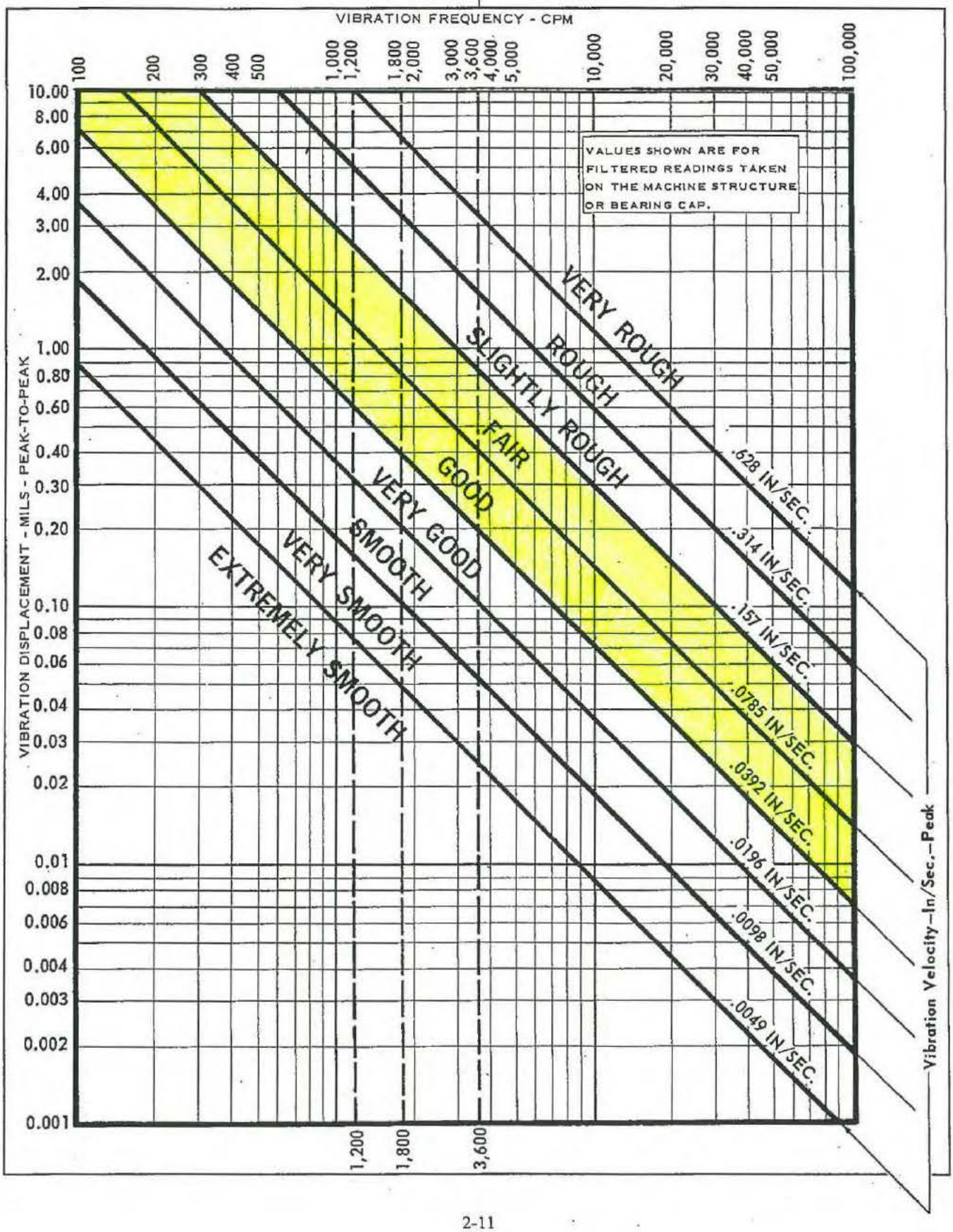

VIEW
DMM
2016/09/07
09:36:02
SET
3P3W3M
500A
480V
59.99Hz
U rms [V] peak+[V] peak-[V] THD [%]
ch1 477.6 691.9 -689.2 2.4
ch2 478.2 691.4 -689.8 2.4
ch3 479.0 689.6 -690.5 2.3
I rms [A] peak+[A] peak-[A] ITHD [%]
ch1 348.3 0.506k -0.505k 1.4
ch2 351.3 0.508k -0.511k 1.5
ch3 349.7 0.510k -0.506k 1.4
P [W] S [VA] Q [var] PF
ch1 4.5k 166.4k 166.3k 0.027
ch2 4.5k 168.0k 167.9k 0.027
ch3 3.9k 167.5k 167.4k 0.023
sum 12.9k 289.7k 289.5k 0.045
Uave [V] Iave [A] Uunb [%]
478.3 349.8 0.2
KF
ITHD
HOLD

Figure 2-12
Displacement/velocity severity chart.



Information Provided by Phase

Phase measurements are essential in vibration analysis to diagnose specific machinery problems. Comparative phase measurements are used as follows:

• Balancing—Phase is used to determine the type of unbalance, static or dynamic, and to calculate the amount and angular location of correcting weights. It is also used to evaluate effects of temperature, load, etc.

• Misalignment— Comparative phase measurements reveal the type of misalignment (angular or offset) and the location.

• Looseness— Phase is used to detect relative movement in machine components that is due to poor grouting, broken or cracked foundations, etc.

• Modal Studies— Comparative phase readings can reveal mode shapes in all types of machine structures.

Phase information is obtained using a stroboscopic light triggered by the vibration signal, a phase reference pickup, or in some cases, an oscilloscope. Details on phase measurement are covered in Chapter 5.

Assessing Vibration Severity
(How Much Vibration is Too Much?)

Because vibration amplitude is a measure of the severity of the trouble in a machine, your next question should be: How much vibration is too much? To answer this question, it is important to bear in mind that the objective is to use vibration checks to detect trouble in its early stages and schedule an appropriate correction procedure. The real goal is to get a fair warning of impending trouble, not to determine how much vibration a machine can withstand before it fails.

There are no realistic figures for selecting a vibration limit which, if exceeded, will result in immediate machinery failure. The events surrounding the development of a mechanical failure are too complex to set any reliable limits. On the other hand, you must have some general indication of machinery condition that can be evaluated on the basis of vibration amplitude. This is possible through the use of general guidelines that have been developed by experience over many years.

General Vibration Severity Charts

The vibration severity chart in Figure 2-12 is one example of a general guide to machinery condition. On this chart, the horizontal axis is scaled in terms of vibration frequency and the vertical axis in terms of displacement. The area between the diagonal lines represent levels of vibration severity, from EXTREMELY SMOOTH to VERY ROUGH.

If you measure a displacement amplitude of 0.30 mils peak-to-peak at a frequency of 3600 CPM, by cross-referencing these two values on the chart, you will find that the machine is operating in the GOOD range. The chart clearly shows that the severity of a machine's vibration depends on both the amount of displacement and the frequency of vibration. As the frequency of vibration increases, the amount of displacement decreases for a given machine condition (e.g. GOOD).

The same chart is much simpler to use with vibration velocity. Notice that each of the lines dividing the areas of severity are labeled with a figure for vibration velocity. The SLIGHTLY ROUGH areas, for example, begins at 0.157 in/sec and ends at 0.314 in/sec. Therefore, if you measure a velocity of 0.20 in/sec, *regardless of the frequency,* the chart indicates the machine is running SLIGHTLY ROUGH.

The severity chart in Figure 2-13 works much the same way, but uses velocity and acceleration parameters, and covers a higher CPM range. The frequency range, 18,000 to 600,000CPM, is plotted along the horizontal axis, and peak acceleration along the vertical axis. You must associate a given acceleration reading with a filtered frequency in order to determine the severity condition of a machine. But notice that you can refer to the diagonal lines, those representing velocity, to determine the condition solely on the basis of vibration velocity.

FLOW-TECHNICS, INC.

As per the preceding report and test documents all three (3) VUPX 1001 Submersible Pumps were tested and are acceptable for shipment. All three (3) pump motors were tested and are electrically acceptable for shipment.

Michael E. Carney, Project Manager

Michael Wayman, Service Technican

FLOW-TECHNICS, INC.

Evaluation Report

For

U.S. Army Corps of Engineers
Rice Lake Habitat
Banner, IL

Submitted by:
FLOW – TECHNICS, INC.
Frankfort, IL.
PHONE: 815-277-2600
FAX: 815-534-5311

2/23/2018

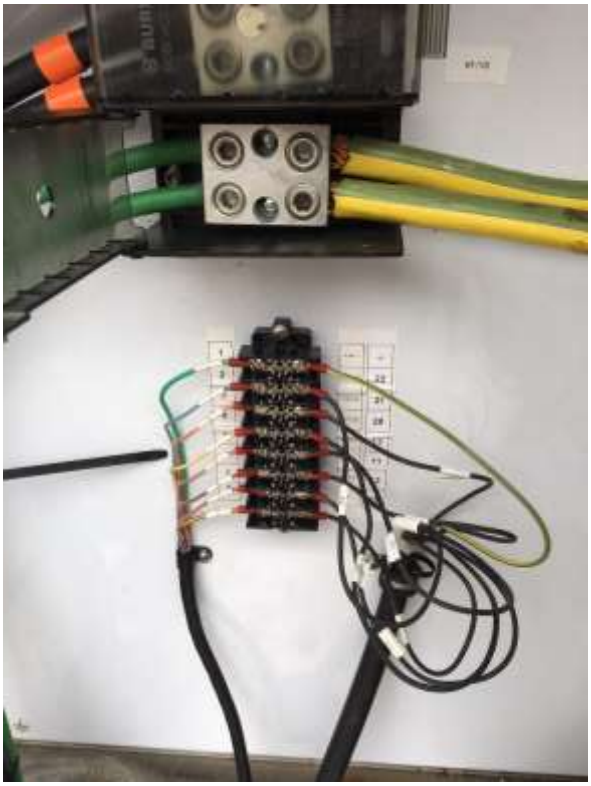
Pre-Service Survey

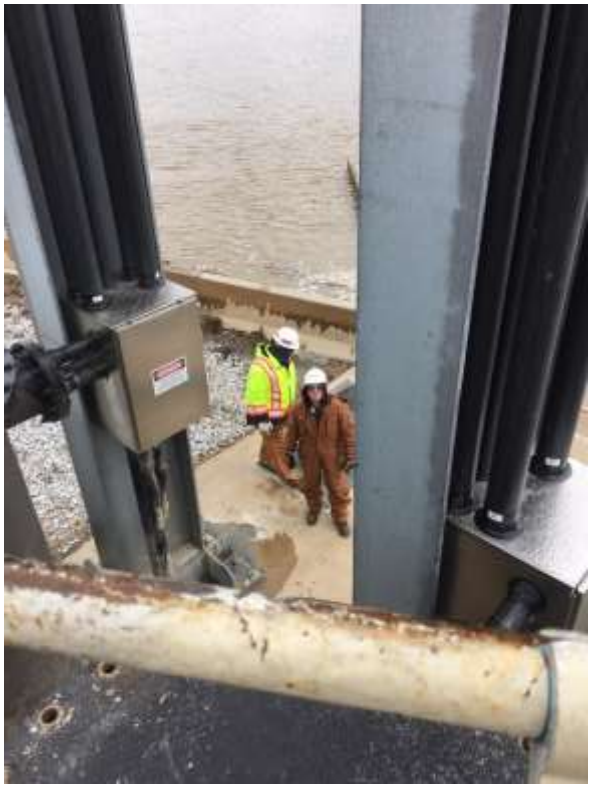
On Wednesday, February 21, 2018, Flow-Technics' Service Technicians located to Rice Lake Wildlife Habitat in Banner, Illinois to document the site conditions of the property, junction box electrical connections and electrical conductors within the pumps discharge tube.

Evaluation

- All power leads to stator are megging grounded.
- Power lines from junction box back to building are megging 200+ @ 1000V.
- Connection chamber probe meggs at 200+ @ 200V.
- Stator Housing probe megs 10 megs @ 200V.
- Seal Chamber probe megs 100 megs @ 200V.

Pump cables were pulled and showed no visible signs of damage. The pump was pulled out of the tube and no obstruction was seen in the propeller area. The pump was set by the road due to rising river level. The connection chamber was opened and looked good.





On Thursday, February 22, 2018 the pump was prepared for transport to the evaluation facility.

The pump was delivered to the evaluation facility on Thursday, February 22, 2018 and will be torn down and evaluated the week of February 26, 2018 upon the approval of the Army Corp. of Engineers.

FLOW-TECHNICS, INC.

Evaluation Report

For

U.S. Army Corps of Engineers
Rice Lake Habitat
Banner, IL

Submitted by:
FLOW – TECHNICS, INC.
Frankfort, IL.
PHONE: 815-277-2600
FAX: 815-534-5311

Rev. 3/23/2018

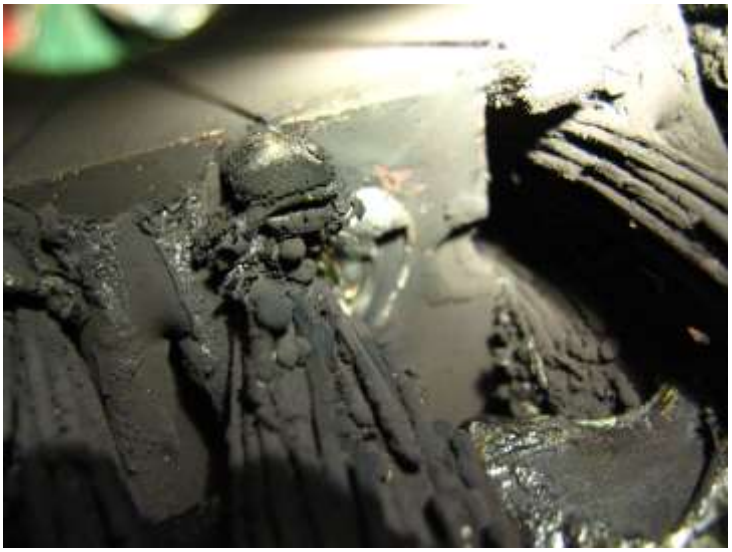
Evaluation:

On Monday, February 26, 2018, Flow-Technics' Service Technicians located to the evaluation site to begin the evaluation/tear down of Pump #2, VUPX 1001 serial number 58885.

Motor cover and cables were removed. Cables checked good. Stator megs grounded. Pulled stator off of pump and found stator blown on the lower end. The stator did not short out to the rotor.

The stator was brought to Joliet Equipment for inspection. It was found that there was apparent winding failure.

The pump stator failed to ground at the end of a slot. This type of failure is typically due to either a failure in the insulation or moisture related. The winding does not appear to have been overloaded or single phased.



Conclusion:

Based on the evaluation and inspection of the pump/motor it is concluded that the pump requires twelve (12) new one hole lug compression connectors as the stator leads were cut to remove the stator and they need to be re-terminated (see attached datasheet). Also, the stator needs to be reconditioned which includes rewinding of stator, VPI and dip overcoat winding and paint. The total cost for recommended repairs/parts is $ 19,224.00 (see chart for part listing).

Part Number	Description	Qty.	Unit Price	Ext. Price	
G6139813	One hole lug compression connector, 1 AWG	12	$9.50	$114.00	Non-warranty
Outsource	Stator Recondition	1	$16,250.00	$16,250.00	Non-warranty
Shop Labor	To Reassemble Pump	1	$2,860.00	$2,860.00	Non-warranty
			TOTAL:	**$19,224.00**	

FLOW-TECHNICS, INC.

Repair Report

For

U.S. Army Corps of Engineers
Rice Lake Habitat
Banner, IL

Submitted by:
FLOW – TECHNICS, INC.
Frankfort, IL.
PHONE: 815-277-2600
FAX: 815-534-5311

Rev. 6/25/2018

Repair/Testing:

On April 26, 2018 the stator was repaired/replaced as needed and tested. (See attached reports from Joliet Equipment).

On June 11, 2018, the Service Technicians relocated to repair shop to begin repairs.

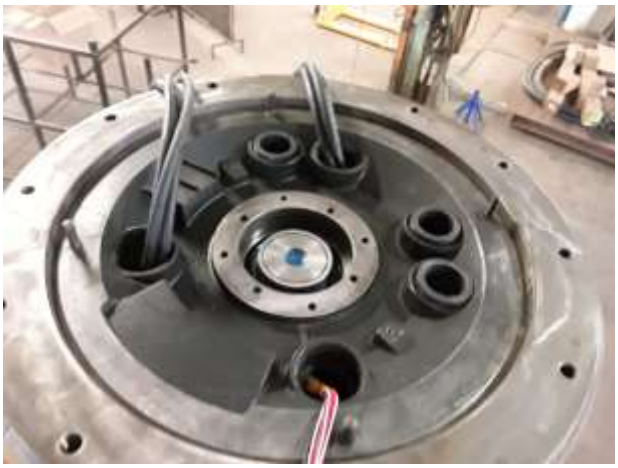
Rotor prior to cleaning and rotor after cleaning.

Bearing frame after cleaning.

New stator in housing and lower sensor wiring.

Lowering stator onto rotor and then assembled onto pump.

On June 12, 2018 the pump was completed.
Cleaned upper bearing housing installed.



Upper bearing installed and greased followed by upper bearing cap installed.

Cable seal grommets and terminal block installed and wired.

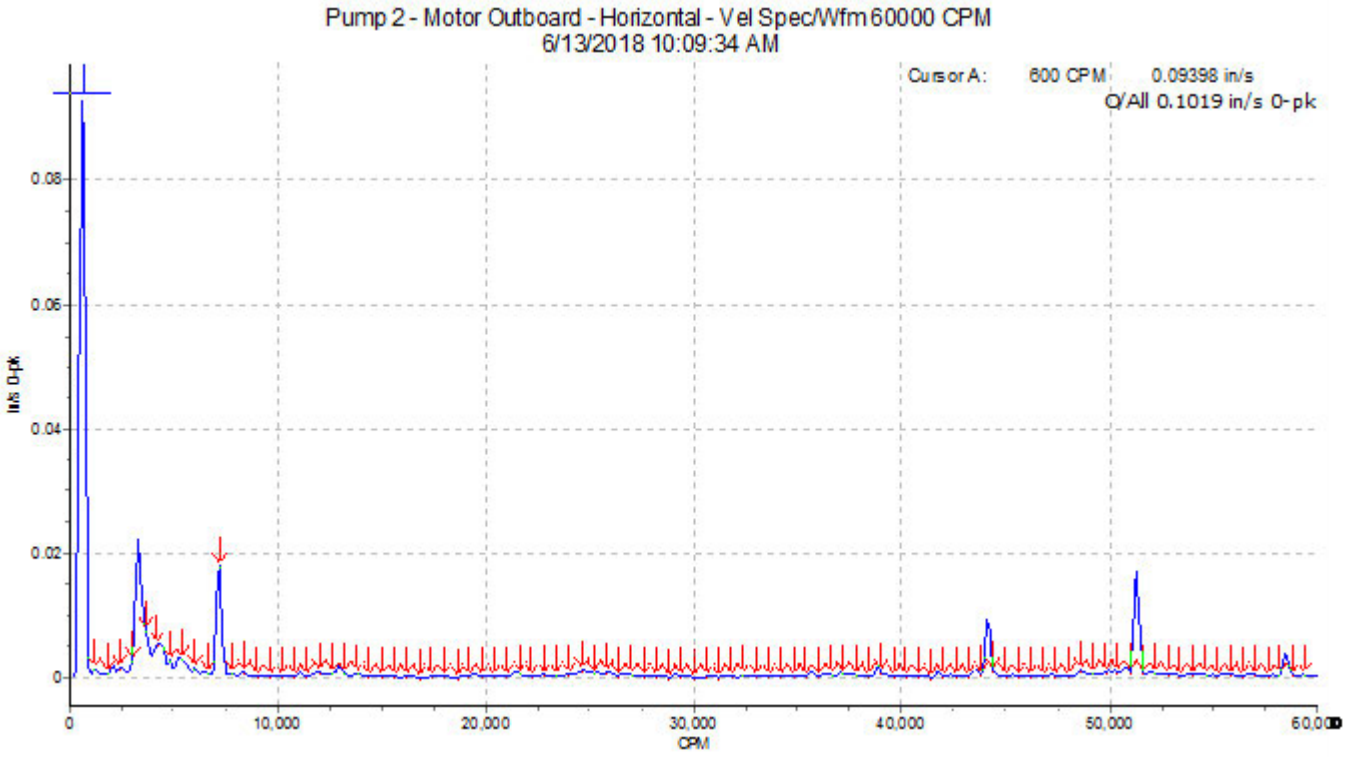
Installed upper cord cap assembly.

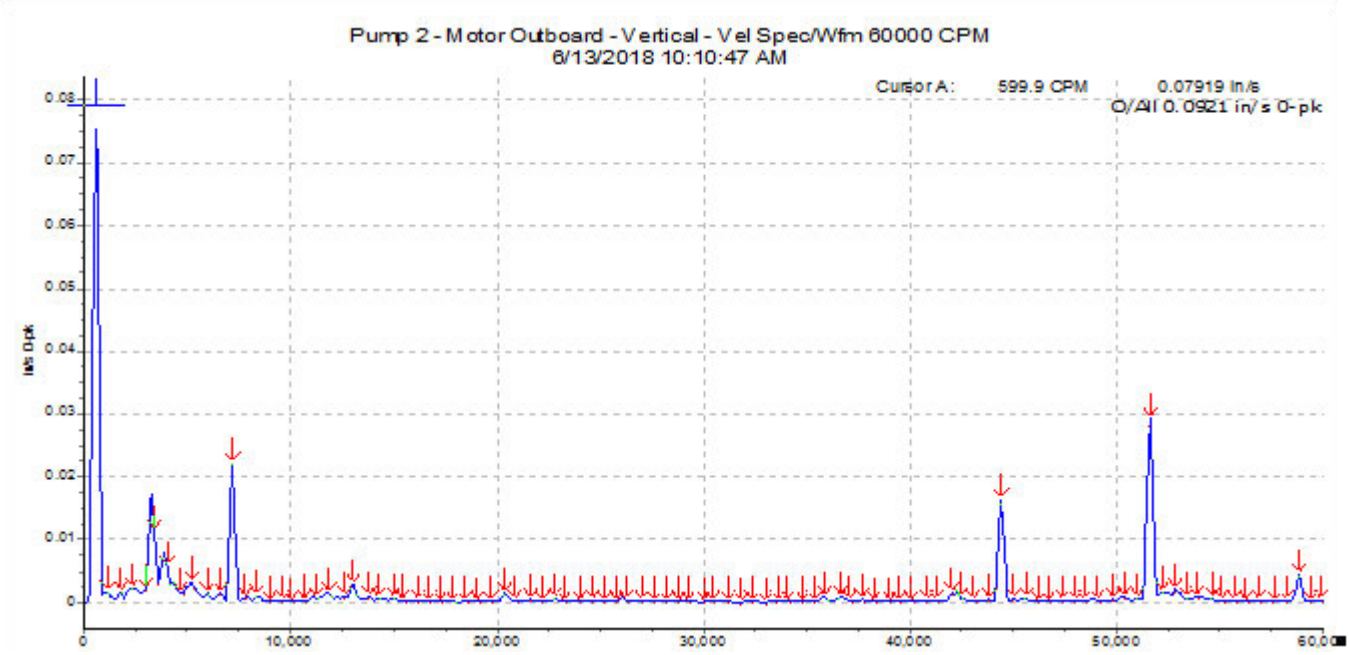
Cables wired and pump loaded onto truck to transport to testing facility.

On June 13, 2018 the pump was transported to Joliet Equipment (testing facility) where the pump was tested while observed by the U.S. Army Corp. of Engineers.

The pumps were tested. The following are vibration readings and a picture of the Hioki amperage and voltage readings. Also, pump was megger tested at 1000V after the run test the readings were 2000megs. Tested control cable, all probes; connection chamber, seal housing and stator housing, all 500+ meg ohms. Upper bearing and motor klixons .5 ohms. Lower bearing .6 ohms. All readings acceptable. Pump is ready to be installed and is schedule for delivery to site on Tuesday, June 19, 2018.

Rice Lake – Pump #2 – Vibration Readings





Motor Electrical Readings

JOLIET EQUIPMENT CORP.

TEST RESULTS

MOTORS • REPAIR

MOTOR DATA

H.P. 295 MFR. ABS
VOLTS 460 AMPS
TYPE FRAME
RPM 595 JOB NO. 243345

CUSTOMER Flow Tech

DATE 4-26-18

P/I CURRENT / TIME TEST WITH _____ VOLTS D.C.

TIME (MIN.)	LEAKAGE CURRENT uA	MEGOHMS E/I
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Notes:

HiPot Test

*Ground RTD's and/or Heaters 1st

2 x Motor Volts _____
\+ 1000
X 1.7
X .60
Test Volts 3420

HEATER RES
1 _____
1 _____

RTD RES
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Lead Condition
Repair: ☐ O.K.: ☒

HiPot
0. 30 sec.
1. Min.

Phase Balance
Volt 120 A 230 B 230 C 230 Amps
Res.
1-2 _____ 2-3 _____ 3-1 _____

Craftsman
1. Bill
2. _____

Meg. Voltage _____

Motor Temp. _____ F°
Relative Humidity
1. _____ %

Megohms _____

Joliet Instruments ID#

DX 15
JRT 54-57

Leakage at 1 Minute
1. _____

Leakage at 10 Minutes
1. _____

P.I. _____

SURGE TESTER

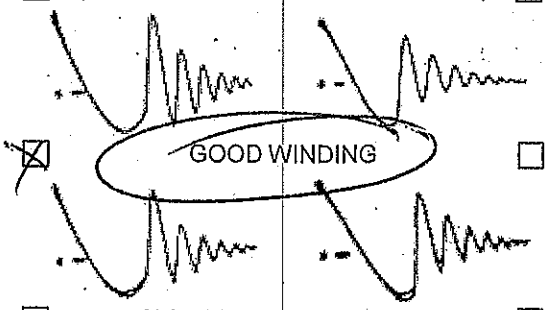
Check the box that best shows the patterns corresponding with the motor being tested

1990 A.C. Volts

Check what type of connection, if known.

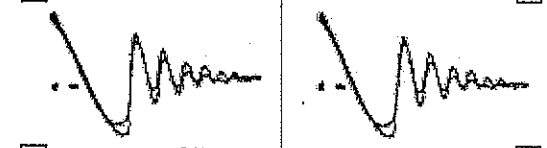
Waveshapes for typical winding faults.

☐ Wye Connected ☐ Delta Conneced

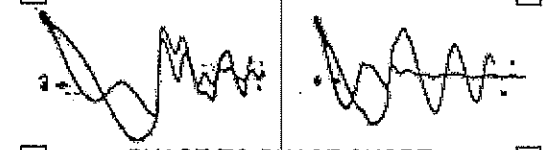


☒ GOOD WINDING ☐

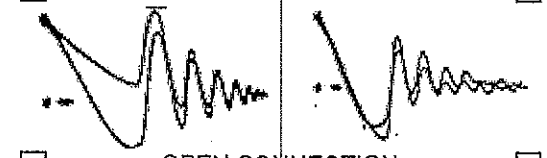
☐ TURN-TO-TURN SHORT ☐



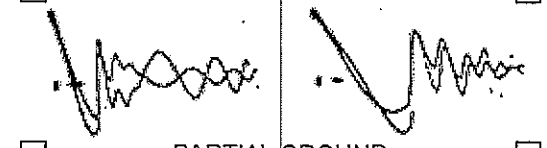
☐ COIL-TO-COILSHORT ☐



☐ PHASE-TO-PHASE SHORT ☐

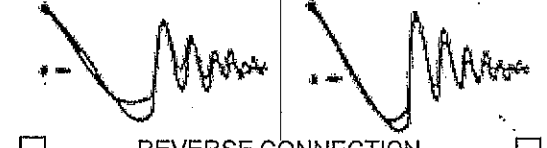


☐ OPEN CONNECTION ☐



☐ PARTIAL GROUND ☐

☐ COMPLETE GROUND ☐



☐ REVERSE CONNECTION ☐

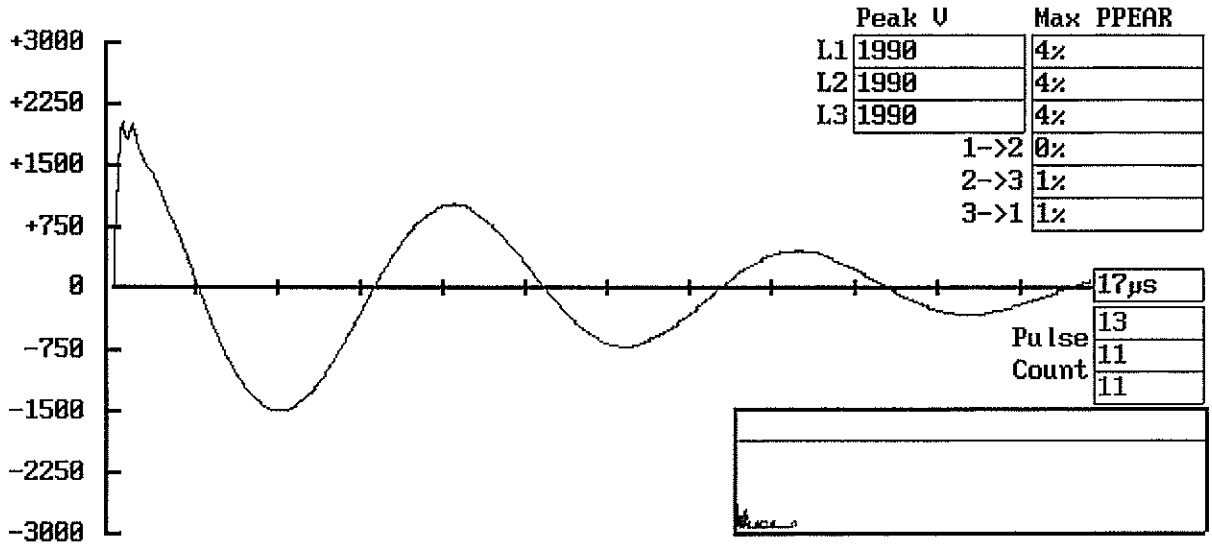
FORM 9.37B Rev. 07

[redacted]

Folder Name:	FLO TECH		
Record Name:	243345	Test Date/Time:	26-APR-2018 10:58:21 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

3 Phase Surge Test Results



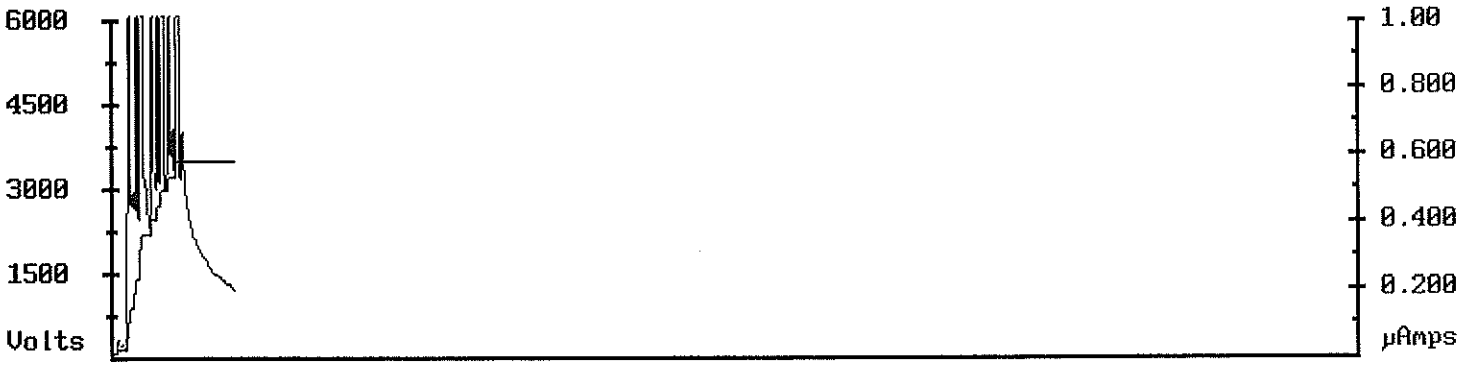
[redacted]

Folder Name:	FLO TECH		
Record Name:	243345	Test Date/Time:	26-APR-2018 11:02:25 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

DC Tests Results

	IR	DA/PI	DC Hipot
Test Voltage (V)			3420
Leakage I (µA)			0.194
IR (MΩ)			17629
Corr 86.0°F (MΩ)			



[redacted]

Folder Name:	FLO TECH		
Record Name:	243345	Test Date/Time:	26-APR-2018 11:05:39 AM
Tester Type:	DX15kV	Tester SN:	12268
Job Number:		Tested By:	
Notes:			

NamePlate Information			
SN:		Mfr:	
HP/kW:		Voltage:	

RLC Tests Results

HGO	Lead 1:	Lead 2:	Lead 3:	Unbal(%)
DC Resistance	49.5906 m	50.0995 m	50.1572 m	0.7
Temp Cor Res	49.5906 m	50.0995 m	50.1572 m	
Temp (°F)	77.0			
Impedance/Ang	0.551/ 85.9	0.554/ 85.9	0.554/ 85.9	0.3/0.0
Inductance mH	1.458	1.466	1.465	0.3
Z D/Q	0.071/14.112	0.072/13.943	0.071/14.064	
Frequency Hz	60.0			
Capacitance nF	110.5			
Cap D/Q	0.022/ 44.5			

FLOW-TECHNICS, INC.

Installation (Item 2) and Testing (Item 3) Report

For

U.S. Army Corps of Engineers
Rice Lake Habitat
Banner, IL

Submitted by:
FLOW – TECHNICS, INC.
Frankfort, IL.
PHONE: 815-277-2600
FAX: 815-534-5311

6/27/2018

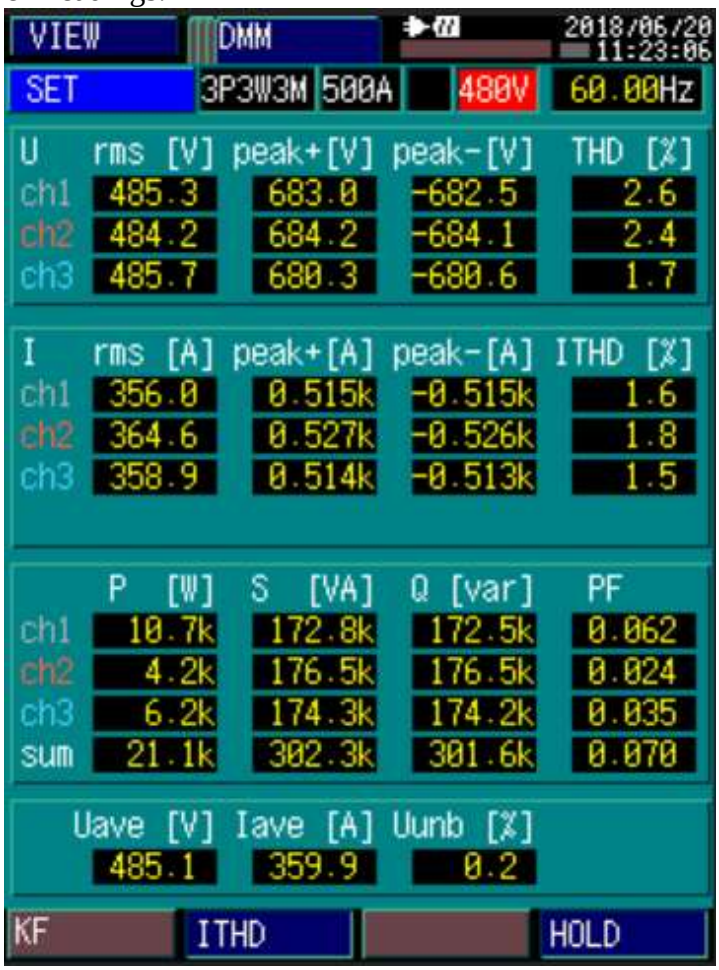
Delivery:

On June 19, 2018 pump was loaded onto flatbed for delivery to Banner, IL.

Pump offloaded and transferred to pump deck.

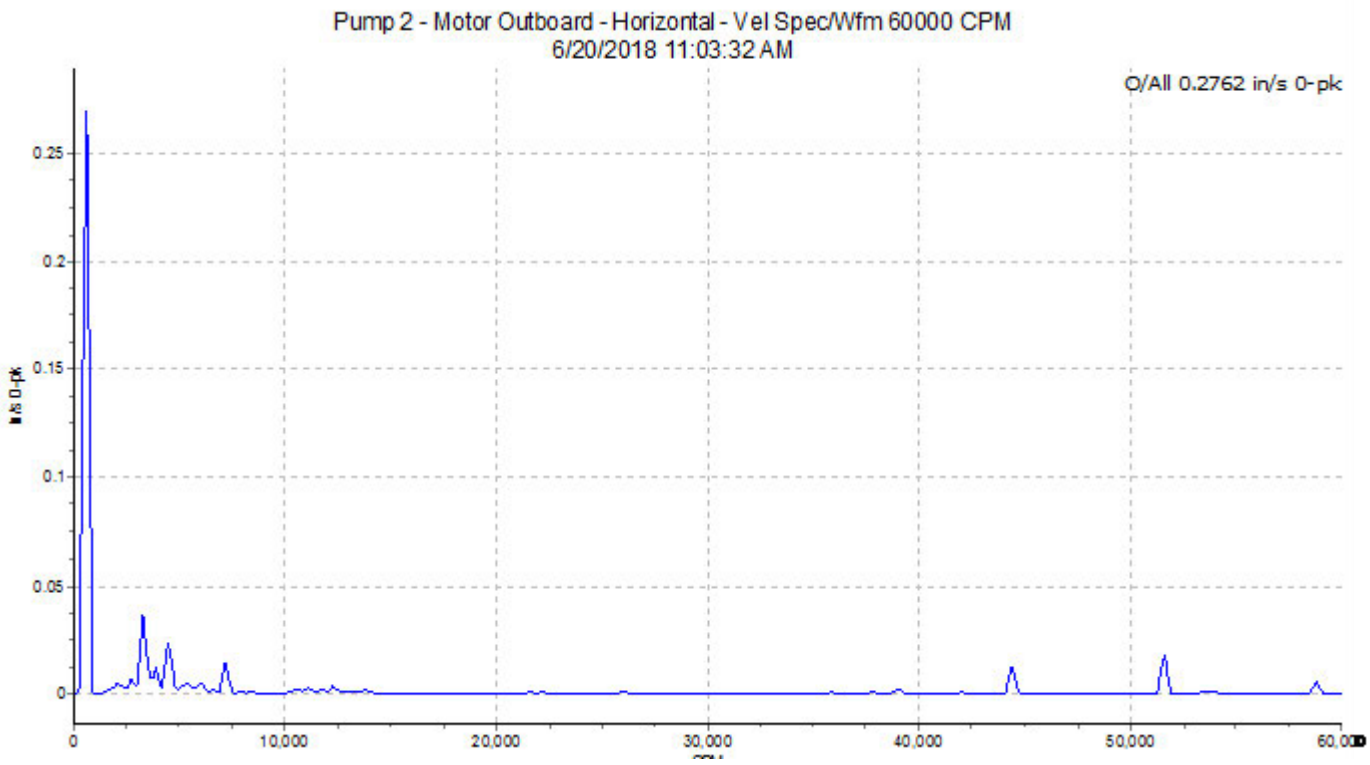
On June 20, 2018 pump was wired for dry test and installed.

Dry Test Power Readings:



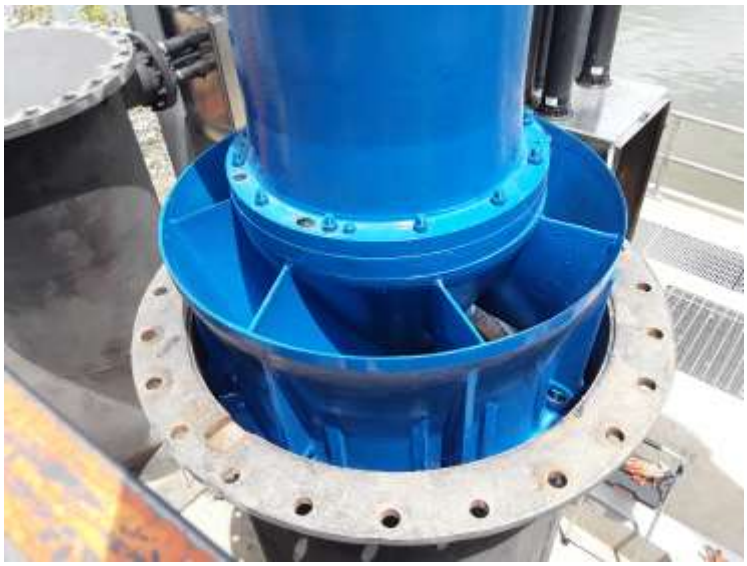
Dry Test Noise Reading:

Dry Test Vibe Reading:



Installation:

Pump set into tube.

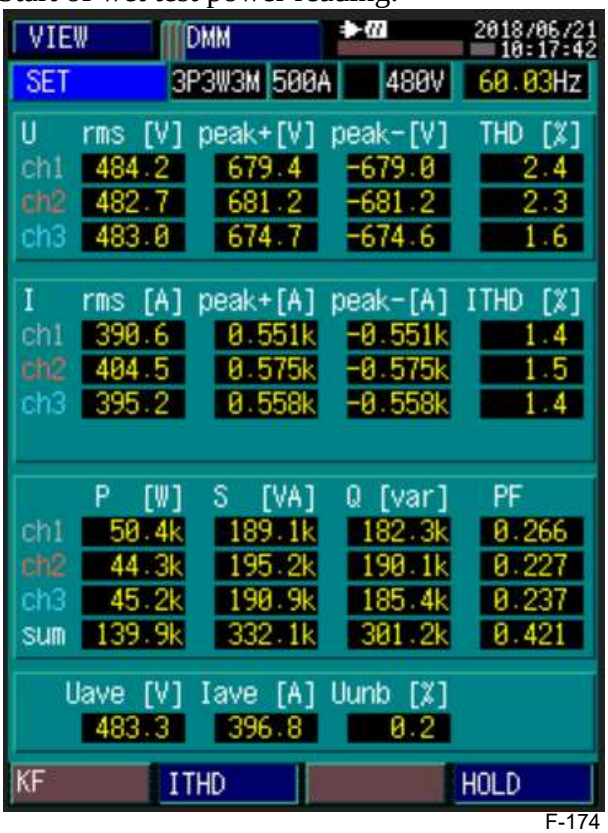


Pump and cables were installed and also the tube cover.

Testing:

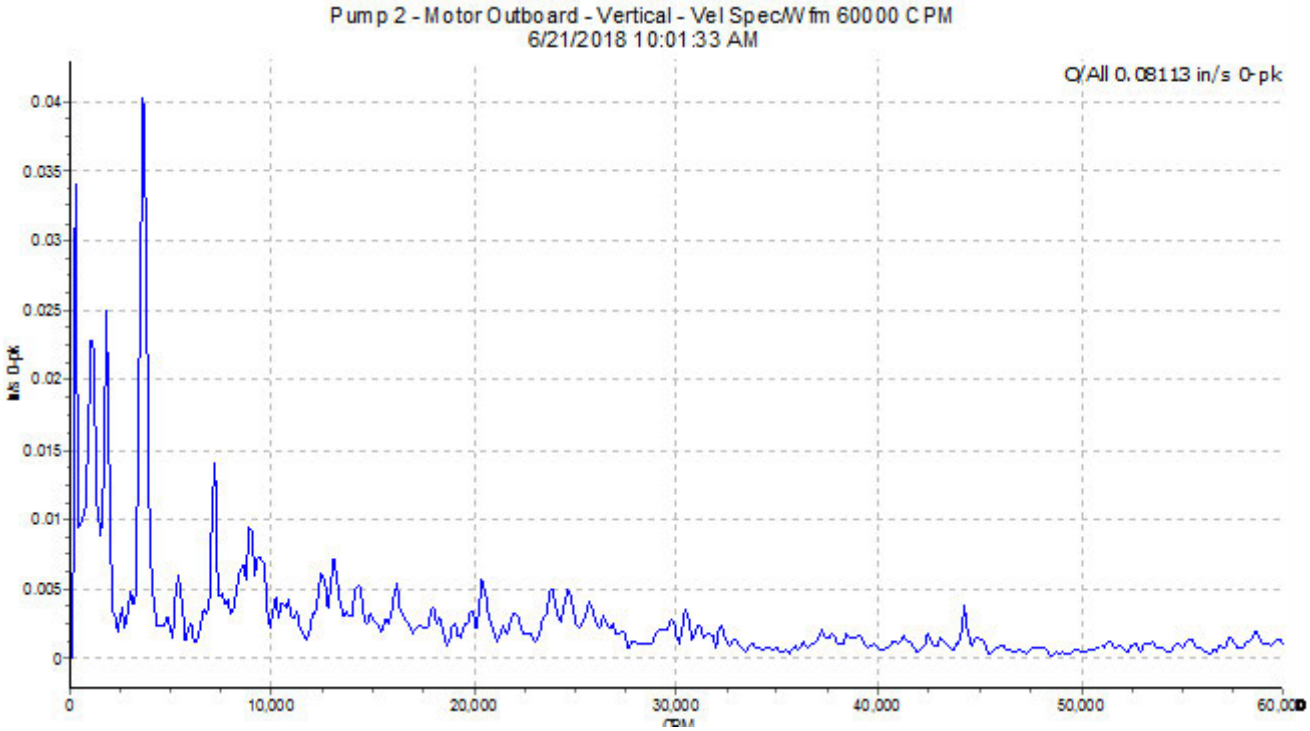
On June 21, 2018 wet test was performed.

Start of wet test power reading:

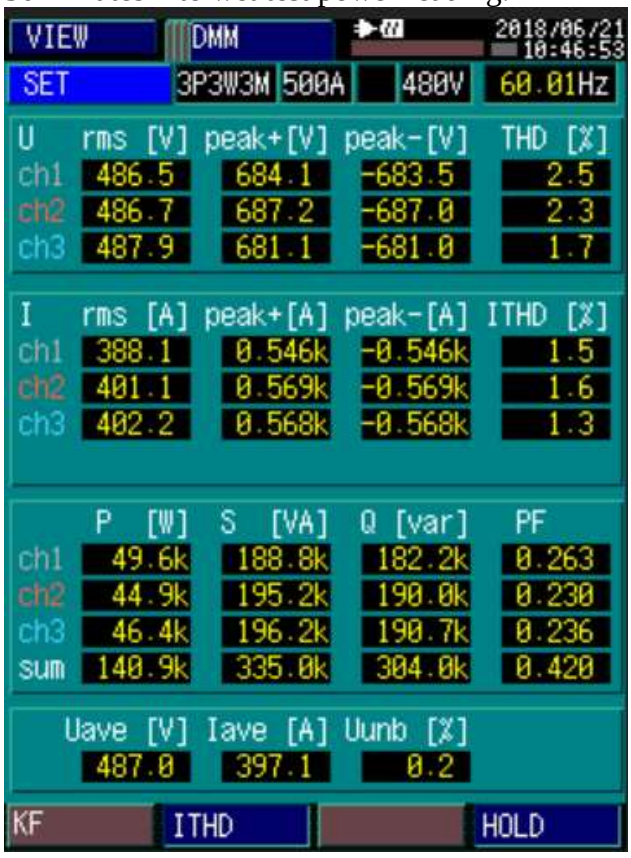


Start of wet test noise reading:

Start of wet test vibe reading:

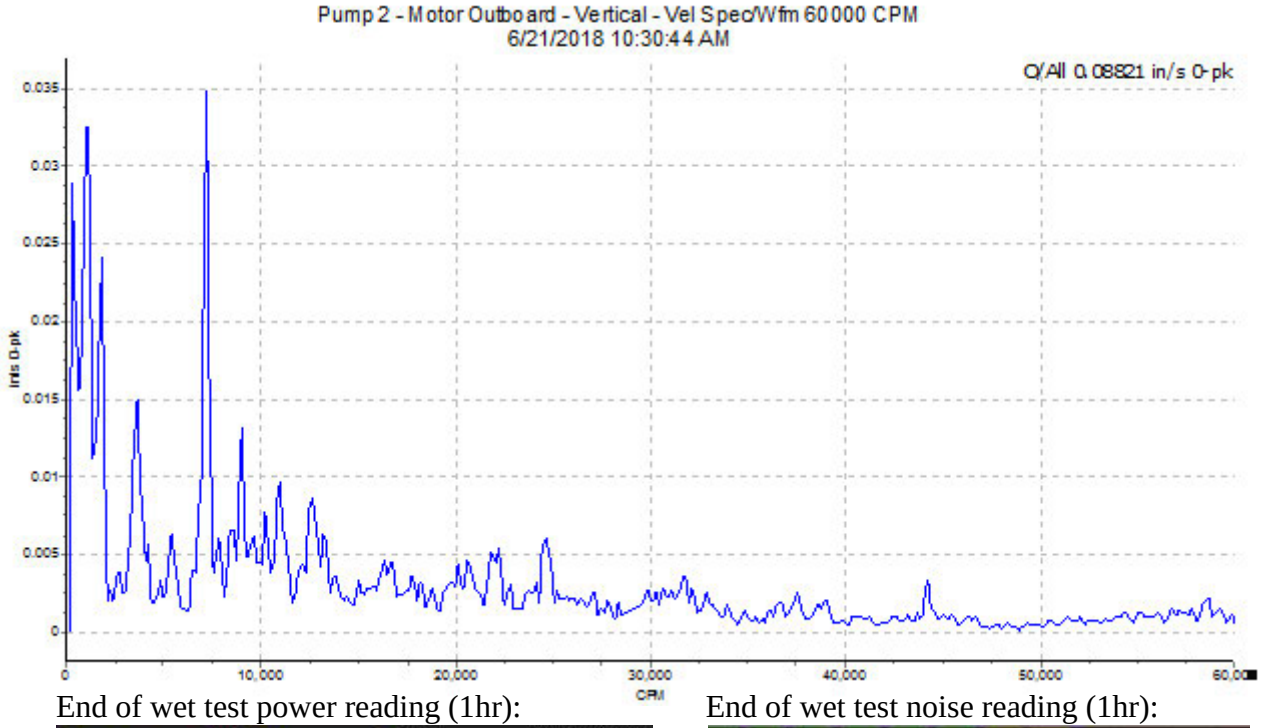


30 minutes into wet test power reading:

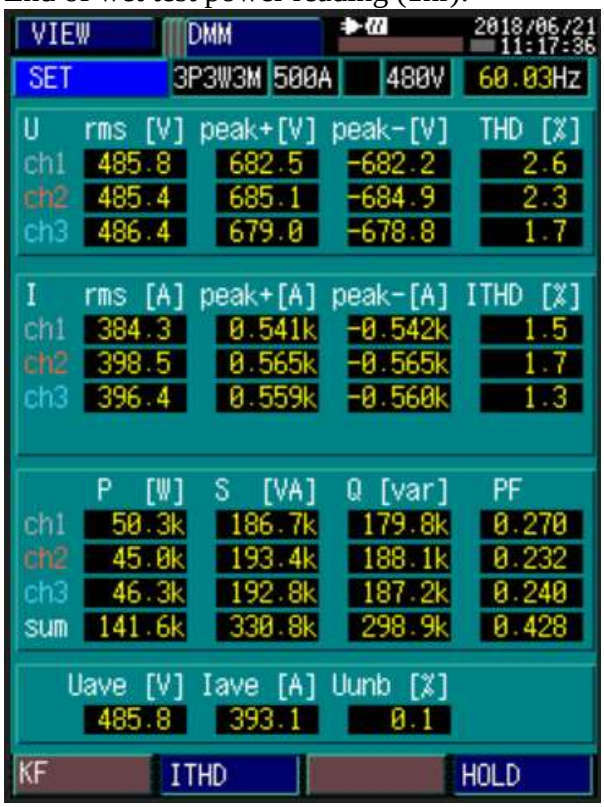


30 minutes into wet test noise reading:

30 minutes into wet test vibe reading:

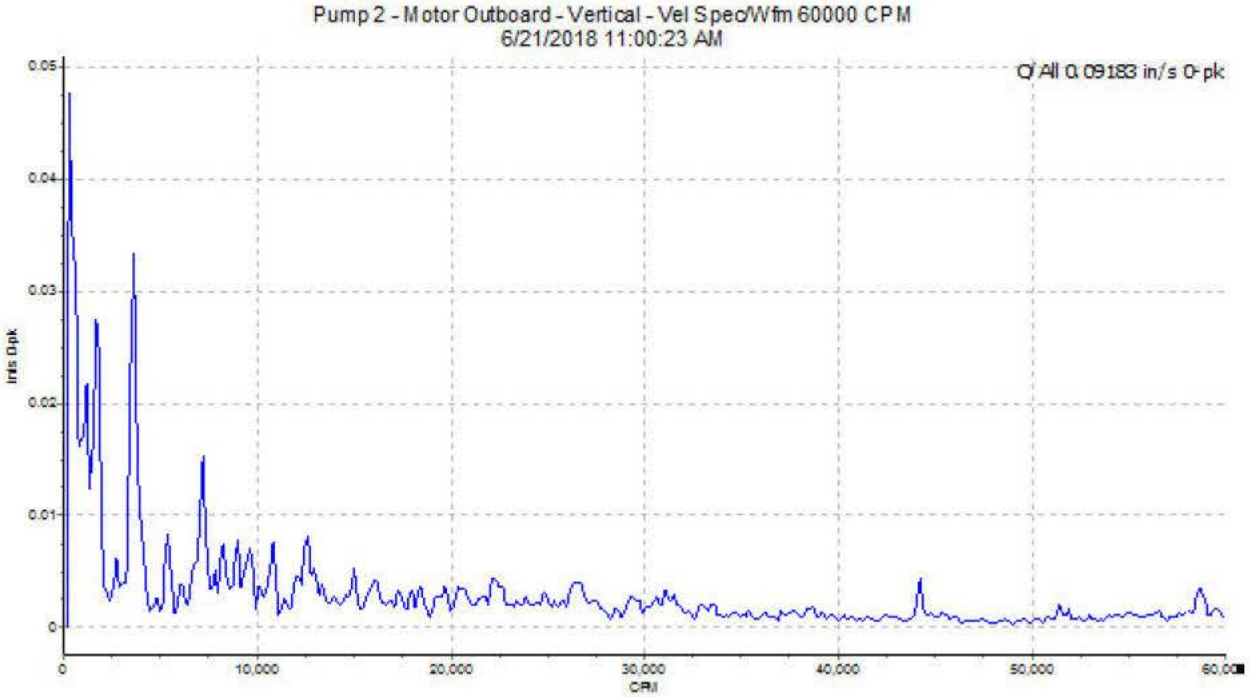


End of wet test power reading (1hr):



End of wet test noise reading (1hr):

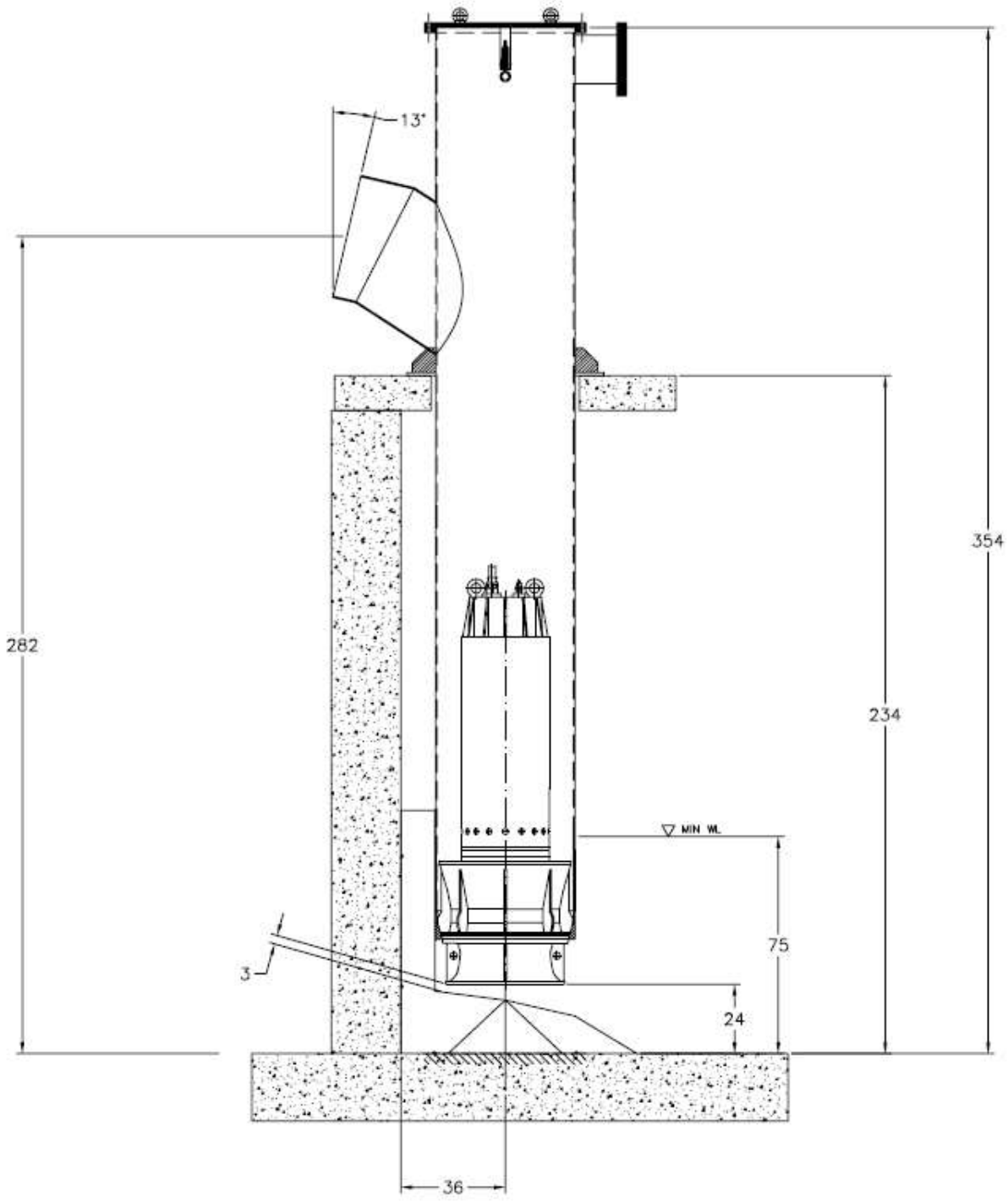
End of wet test vibe reading (1hr):



On June 25, 2018 flow testing was performed by the U.S. Army Corp. of Engineers. See below for location of flow sensor.

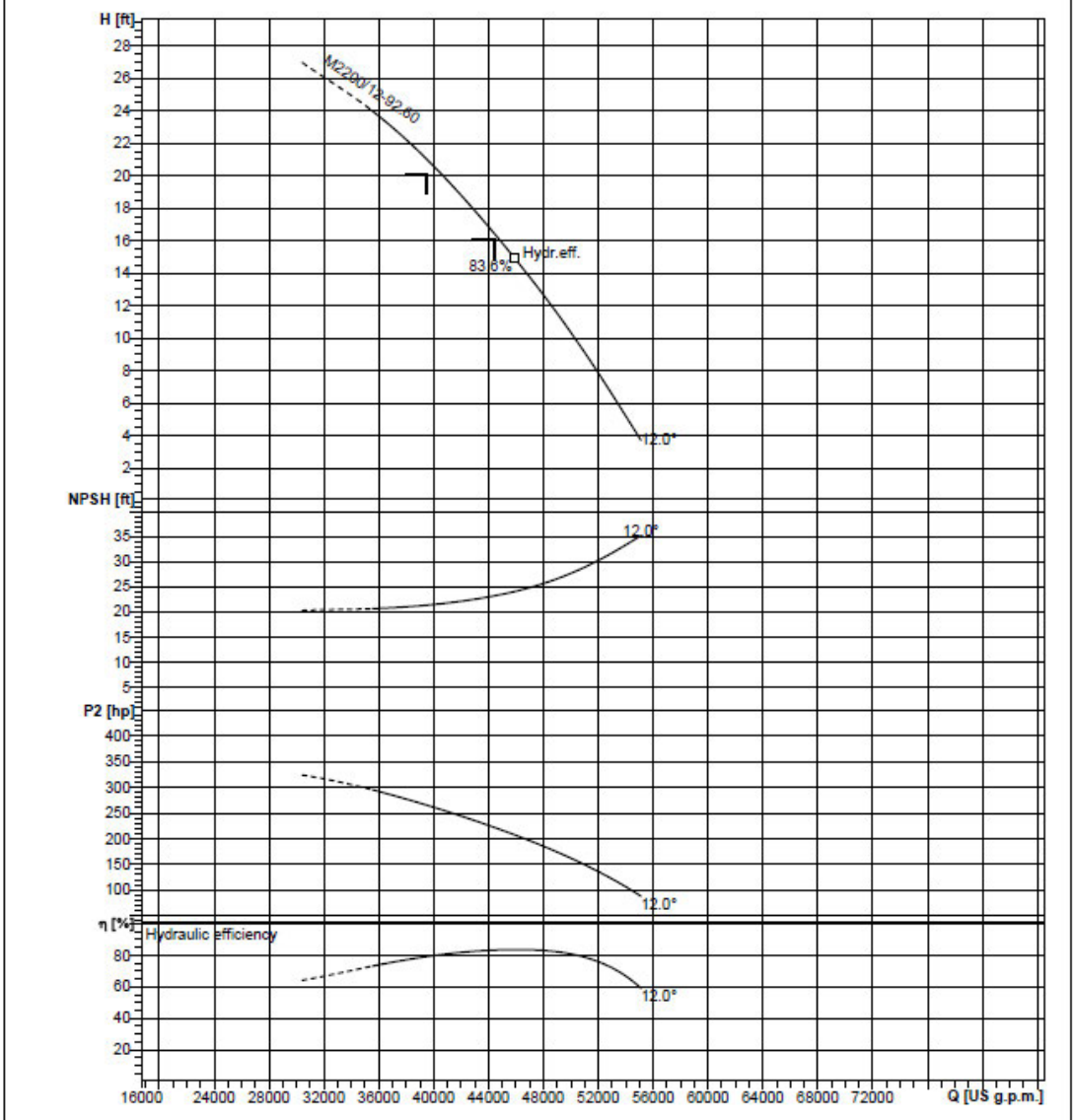
River level was 14.5” above pump deck. Discharge creek water level was 43.5” below discharge structure top wall.

Tube drawing:



U.S. Army Corp. of Engineers took flow readings for 5 minutes. Their readings averaged out to be 62,506.875 gpm.

abs	**Pump performance curves** VUPX 1001 60 HZ			Curve number Reference curve VUP 1001
			Discharge DN1200	Frequency 60 Hz
Density 62.43 lb/ft³	Viscosity 0.0000169 ft²/s	Testnorm Hydraulic Institute	Rated speed 595 rpm	Date 2012-03-15
Flow 44612 US g.p.m.	Head 16.3 ft	Rated power 220 hp	Hydraulic efficiency 83.4 %	NPSH 23.3 ft



Impeller size 34.8 inch	N° of vanes 3	Impeller Propeller	Solid size 6 7/8"	Revision 2010-02-16

ABSEL PRO 1.7.2 / 2006-12-21

OPERATION AND MAINTENANCE MANUAL

RICE LAKE STATE FISH AND WILDLIFE AREA
UPPER MISSISSIPPI RIVER RESTORATION
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
FULTON COUNTY, ILLINOIS

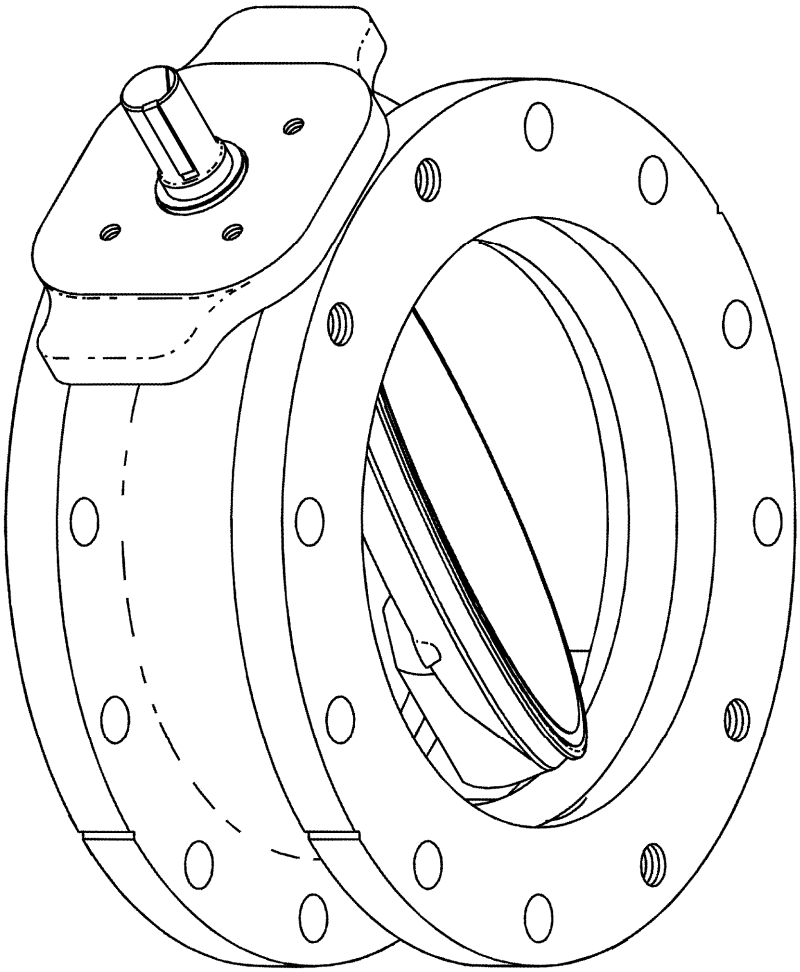
SEPTEMBER 2021

APPENDIX G

PUMP STATION BUTTERFLY VALVES
EQUIPMENT DATA

DeZURIK 3-20" BAW AWWA BUTTERFLY VALVES

WITH TRANSFER MOLDED SEAT



Instruction **D10386**

August 2013

Instructions

These instructions provide installation, operation and maintenance information for BAW Butterfly Valves. They are for use by personnel who are responsible for installation, operation and maintenance of BAW Butterfly Valves.

Safety Messages

All safety messages in the instructions are flagged with an exclamation symbol and the word Caution, Warning or Danger. These messages indicate procedures that must be followed exactly to avoid equipment damage, personal injury or death. Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death.

Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death. If a safety label becomes difficult to see or read, or if a label has been removed, please contact DeZURIK for replacement label(s).

WARNING!

Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials. Handle valves, which have been removed from service with suitable protection for any potential pipeline material in the valve.

Inspection

Your BAW Butterfly Valve has been packaged to provide protection during shipment, however, it can be damaged in transport. Carefully inspect the unit for damage upon arrival and file a claim with the carrier if damage is apparent.

Parts

Recommended spare parts are listed on the assembly drawing. These parts should be stocked to minimize downtime.

Order parts from your local DeZURIK sales representative, or directly from DeZURIK. When ordering parts, please include the 7-digit part number and 4-digit revision number (example: **9999999R000**) located on the data plate attached to the valve assembly. Also include the part name, the assembly drawing number, the balloon number and the quantity stated on the assembly drawing.

DeZURIK Service

DeZURIK service personnel are available to install, maintain and repair all DeZURIK products. DeZURIK also offers customized training programs and consultation services.

For more information, contact your local DeZURIK sales representative or visit our website at www.dezurik.com.

Table of Contents

Description

The 3-20" BAW AWWA Butterfly Valve is a resilient seated bi-directional valve that meets all class 150 requirements of ANSI/AWWA standard C504. Flanged and mechanical joints are offered. Pressure and temperature ratings are shown on the valve data plate

Handling

Lifting the valve improperly may damage it. Do not fasten lifting devices to the actuator, disc or through the seat opening in the body. Lift the valve with slings, chains or cables fastened around the valve body, or fastened to bolts or rods through bolt holes in the flanges.

Maintenance

This valve is assembled using standard SAE fasteners. To service this valve, you should have a full set of combination wrenches, flat tipped screwdrivers, Allen wrenches, a torque wrench, sockets, chisels, a hooked tool for removing the packing and a dead blow hammer.

Lubrication

The valve is lubricated at the factory, and does not require routine lubrication. When installing valve or if maintenance is required, refer to the appropriate sections for lubrication requirements and use an NSF 61 approved lubricant (such as Dow Corning 111 or Phoenix 505).

Refer to the actuator instructions for actuator lubrication requirements.

Fusion/Powder Coated Valves

CAUTION!

Valves with fusion/powder coated exterior paint require flat washers to be installed under the flange nuts when installing the valve to the pipeline flange to prevent the paint from cracking or chipping.

Installation

Mount the actuator on the valve before installation. For a DeZURIK actuator, see actuator instructions.

For other actuators:

- On valves with non-adjustable packing, the actuator interface must include a retaining plate for the packing.
- On valves with adjustable packing, the actuator interface must provide clearance for the packing gland and access for packing adjustment. Dimensional requirements are shown on the installation drawing for the valve.

Lifting the valve improperly may damage it. Do not fasten lifting devices to the actuator, disc or through the seat opening in the body. Lift the valve with slings, chains or cables fastened around the valve body, or fastened to bolts or rods through bolt holes in the flanges.

Refer to the installation drawing for dimensions and to identify components.

Requirements

CAUTION!

PVC pipe that does not meet AWWA standards may damage the valve. If PVC pipe is used with mechanical joint valves, the pipe O.D. must comply with AWWA C905-97, Table 2 "PVC PIPE WITH CAST IRON PIPE EQUIVALENT O.D.'S."

- Flanged connections require mating flanges that comply with ASME/ ANSI B16.1 Class 125 or Class 150. Flange gaskets are also required.
- Mechanical joints must comply with ANSI/AWWA C111/A21.11.
- To reduce the effects of downstream disturbances, install the valve at least the distance of eight pipe diameters downstream from the closest elbow or pump.
- If possible, install the valve with the shaft horizontal to provide self-cleaning action.

Installation *(Continued)*

Installing Valves using Class 200 PVC

When installing valves with mechanical joint ends on Class 200 (DR 14 or higher) PVC pipe, call DeZURIK customer service if you have any problems or questions with this procedure

1. Chamfer the ID of the pipe as shown in Table A to provide clearance for the valve disc.

Table A: Chamfer Requirements

Valve Size	Pipe Pressure Class	Pipe Dimension Ratio	Chamfer Seat Side	Chamfer Opposite Seat	Min. Chamfer Dia. (in)	Chamfer Angle
4	200	14	No	No	N/A	N/A
6	200	14				
8	200	14				
10	200	14	Yes	No	9.62"	30°
12	200	14	Yes	No	11.75"	30°
14	200	21	Yes	No	13.75"	30°
	235	18	Yes	No	13.88"	30°
	305	14	Yes	Yes	14.00"	30°
16	165	25	No	No	N/A	N/A
	200	21				
	235	18	Yes	No	15.68"	30°
	305	14	Yes	Yes	15.88"	30°
18	165	25	No	No	" N/A	N/A
	200	21				
	235	18	Yes	No	17.38"	30°
	305	14	Yes	Yes	17.50"	30°
20	165	25	Yes	Yes	41.50"	20°
	200	21	Yes	No	19.56"	30°
	305	18	Yes	No	19.56"	30°

*Call DeZURIK customer service if you have any questions on this procedure.

2. Cycle the valve for three full open–close cycles to ensure disc fully clears the pipe.

Installation *(Continued)*

Installing All Valves

1. Thoroughly clean the pipeline, valve and flanges of all debris, which could damage the seat, disc or bearings.
2. Open the valve, clean the seat and sealing edge of the disc, then apply a paint-like coating of an NSF 61 approved lubricant (such as Dow Corning 111 or Phoenix 505) to the seat.
3. Close the valve and tighten the bolts evenly in a crisscross pattern.

   Note: Ensure the pipeline, valve and flanges are properly aligned. Do not use the valve to force the pipeline into position.

Due to varying conditions during shipment, storage, handling and installation, it is recommended that each valve be tested while the valve is accessible in the pipeline.

Operation

Turning the valve shaft clockwise closes the valve. The valve is fully closed when the disc is centered on the seat; valve is fully open when the disc is 90° counterclockwise from the closed position.

Disc Position Indicator

The indicator notch on top of the valve shaft corresponds with the seat side of the disc. The location of the indicator notch is shown in Figure 1.

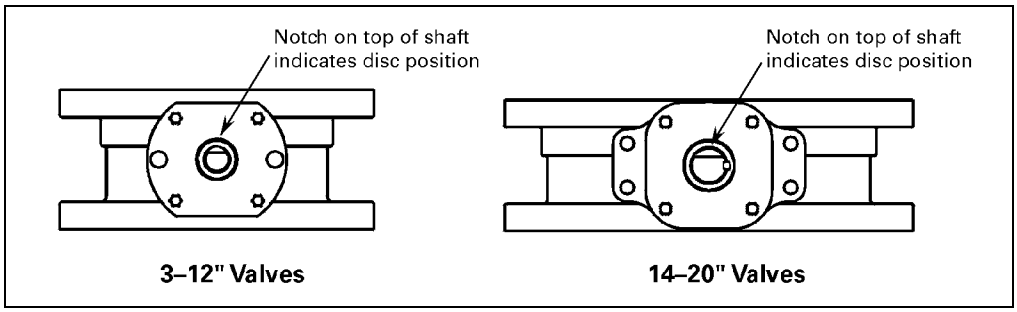


Figure 1—Disc Indicator Location

Position Stops

The valve actuator is connected to the valve shaft and positions the disc at the open, closed or intermediate positions. Installed DeZURIK actuators come with the position stops pre-adjusted. For other actuators, refer to actuator instructions to adjust the position stops.

Drawings

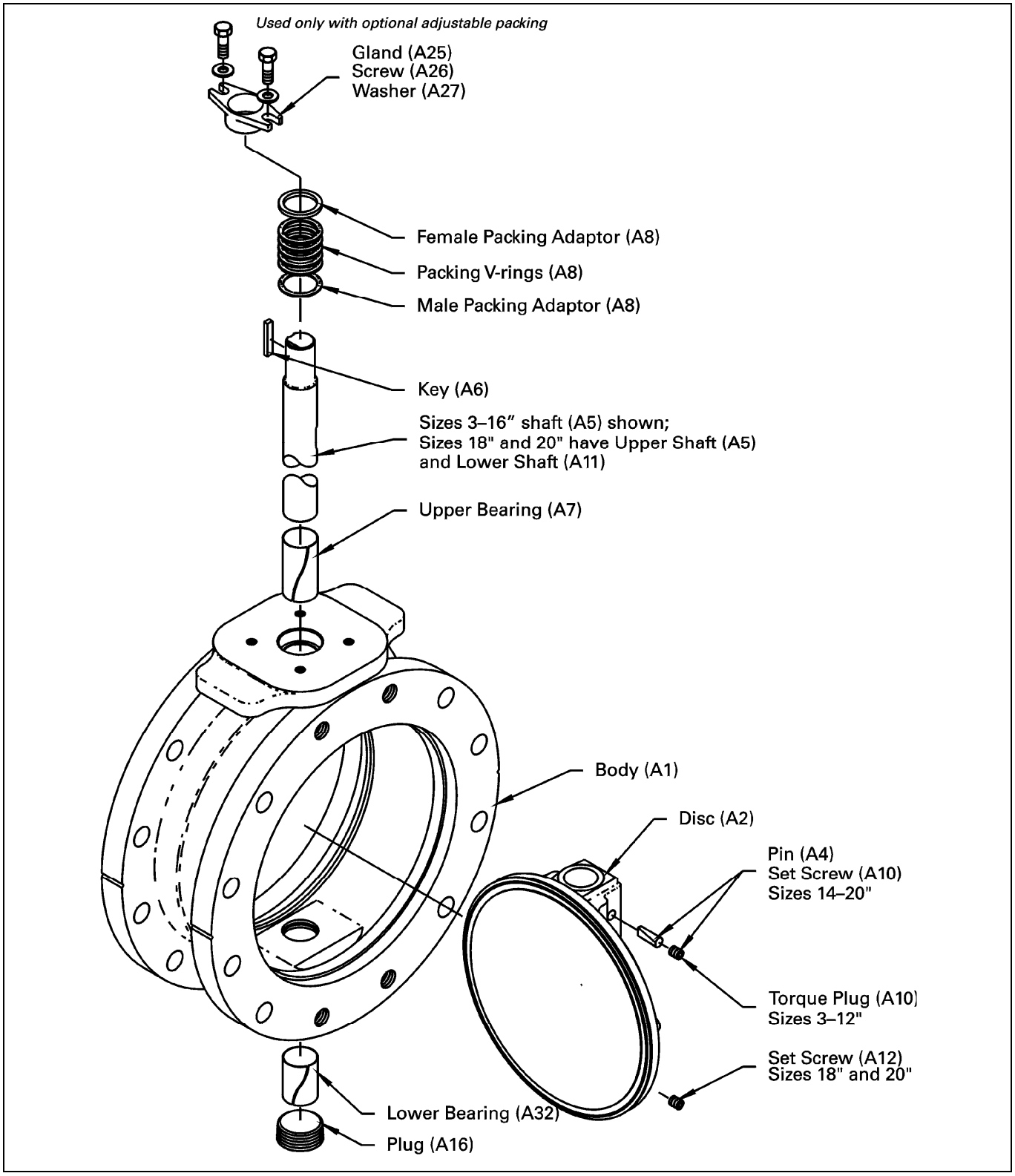


Figure 2—Disassembled 3–20" BAW AWWA Butterfly Valve

Drawings *(Continued)*

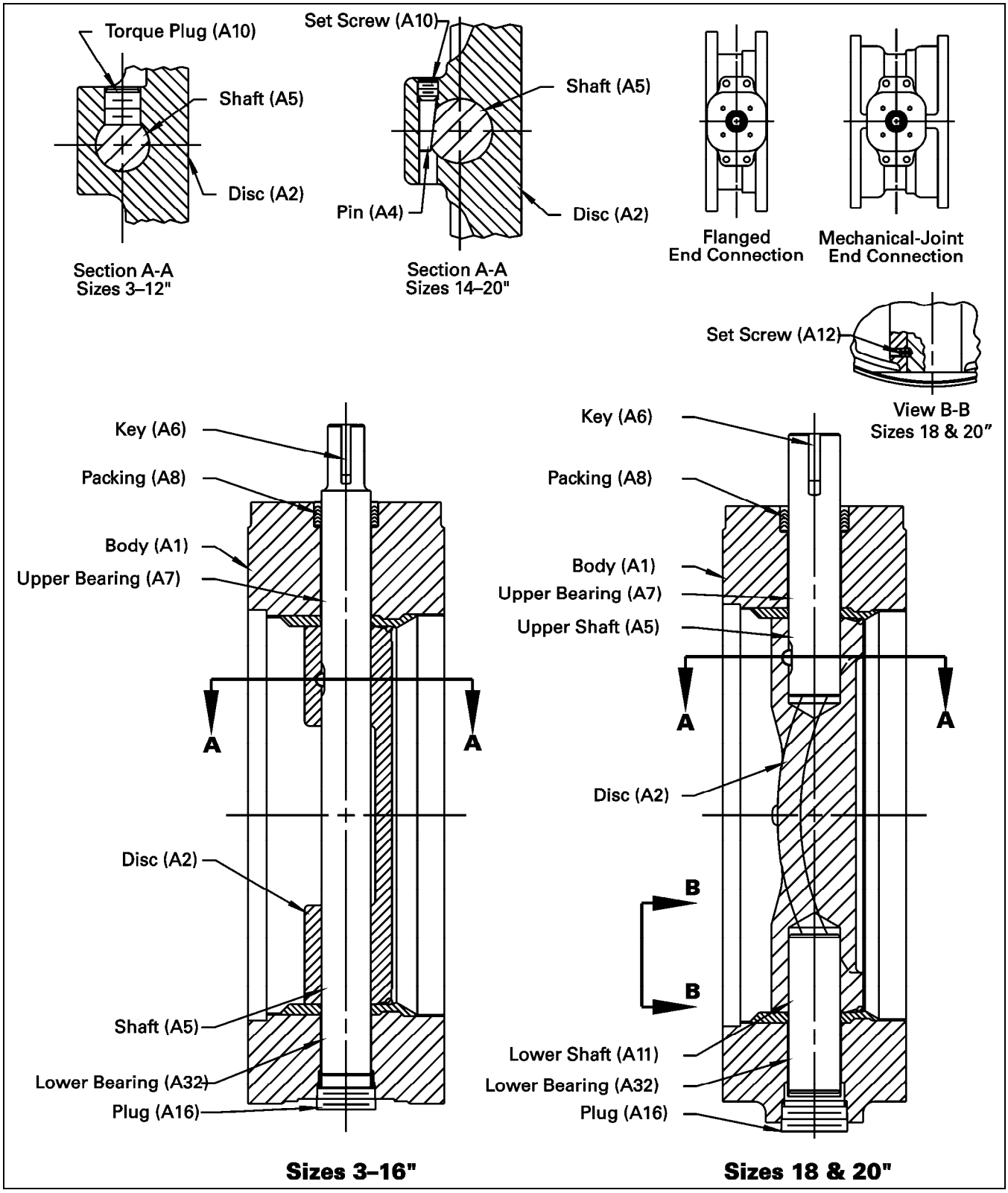


Figure 3—Assembled 3–20" BAW AWWA Butterfly Valve

Adjusting Packing

See Figure 2 to identify parts.

Valves without Packing Gland

WARNING!

Removing the valve while the pipeline is under pressure can cause personal injury or equipment damage. Relieve pipeline pressure before removing the valve.

1. Relieve the pressure in the pipeline and close the valve.

WARNING!

Accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic or electrical power to prevent accidental operation of the actuator.
3. Remove the actuator (and adapter, if included) from the valve.
4. Slide spacers down the valve shaft so that they protrude 1/32–1/16" above the body.

   Note: Spacers can be Garlock style 7857/260 rock hard rubber; Grade A, D or E Bronze; or 316 stainless steel.
5. Replace the actuator on the valve.
6. If packing continues to leak, replace the packing.

Valves with Packing Gland

If the packing leaks on valves with a packing gland, tighten the packing gland nuts just enough to stop the leak; over-tightening will cause excessive operating torques and premature packing wear. If the leak cannot be stopped by tightening the packing nuts, replace the packing.

Replacing Packing

Valves without Packing Gland

WARNING!

Removing the valve while the pipeline is under pressure can cause personal injury or equipment damage. Relieve pipeline pressure before removing the valve.

1. Relieve the pressure in the pipeline and close the valve.

WARNING!

Accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic, or electrical power to prevent accidental operation of the actuator.
3. Remove the actuator (and adaptor if included) from the valve
4. Remove all of the packing rings (A8) from the packing chamber with a hooked tool.
5. Apply a paint-like coat of an NSF 61 approved lubricant (such as Dow Corning 111 or Phoenix 505) to the inside and outside diameters of the new packing, then install the new packing one ring at a time.

   Note: Start each chevron ring into the packing chamber at a slight angle and push each ring carefully into position so that the sealing lips do not bend mover. Push the packing firmly into place. Do not use a sharp or pointed tool.
6. Replace the actuator adaptor (if included) and the actuator on the valve.

Valves with Packing Gland

WARNING!

Removing the valve while the pipeline is under pressure can cause personal injury or equipment damage. Relieve pipeline pressure before removing the valve.

1. Relieve the pressure in the pipeline and close the valve.

WARNING!

Accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic, or electrical power to prevent accidental operation of the actuator.

Replacing Packing *(Continued)*

3. Remove the actuator (and adaptor if included) from the valve.

4. Remove the two screws (A26) and the gland (A25).
5. Pull all of the packing rings (A8) from the packing chamber with a hooked tool.
6. Apply a paint-like coat of an NSF 61 approved lubricant (such as Dow Corning 111 or Phoenix 505) to the inside and outside diameters of the new packing, then install the new packing one ring at a time.

   Note: Start each chevron ring into the packing chamber at a slight angle and push each ring carefully into position so that the sealing lips do not bend over. Push the packing firmly into place. Do not use a sharp or pointed tool.
7. Replace the gland (A25), the two screws (A26) and washers (A27).
8. Tighten the screws in a criss-cross pattern until finger-tight, plus ½ turn.
9. Replace the actuator adaptor (if included) and the actuator on the valve.
10. Pressurize the valve and check for leaks.
11. If packing leaks, tighten the two adjustment screws (A26) on the packing gland. Tighten the screws evenly and gently, just enough to stop the leakage. Over-tightening will cause excessive operating torque and will decrease the life of the packing.
12. If the actuator is a powered actuator, reconnect power to the actuator.

Removing Valve

Lifting the valve improperly may damage it. Do not fasten lifting devices to the actuator, disc or through the seat opening in the body. Lift the valve with slings, chains or cables fastened around the valve body or fastened to bolts or rods through bolt holes in the flanges.

WARNING!

Removing the valve while the pipeline is under pressure can cause personal injury or equipment damage. Relieve pipeline pressure before removing the valve.

1. Relieve pipeline pressure and drain the section near the valve and close the valve.

WARNING!

Accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic or electrical power to the actuator.
3. Support the valve assembly, remove the flange bolts or mechanical joint connections then remove the valve from the pipeline.

Disassembling Valve

Before disassembly, remove the valve from the pipe line, open the valve and remove actuator (and adapter, if included) from the valve. See the "REMOVING VALVE" section. See Figures 1 and 2 for component identification.

Removing the Disc/Shaft from Body

1. If the valve has packing gland, remove the two screws (A26), and the gland (A25).
2. Remove the plug (A16) from the bottom of the valve.
3. Remove the disc-to-shaft assembly:
   - On sizes 3–12", remove the torque plug (A10).
   - On sizes 14–20", remove the set screw (A10) and drive out the pin (A4) from the side opposite the set screw with a hammer and punch. Do not damage the shaft with the punch.
   - On sizes 18 and 20", also remove the lower set screw (A12).
4. Remove the shaft from the valve body:
   - On sizes 3–16", push the bottom end of the shaft (A5) and carefully remove the shaft from the top of the body.
   - On sizes 18 and 20", turn a threaded fastener into the threaded hole on the lower shaft (A11). Using the threaded fastener, carefully remove the shaft from the body.
5. Remove the disc (A2) from the side of the body opposite seating side.

Reassembling Valve

1. Block the body (A1) in a horizontal position with the seat facing down.

   Note: Provide clearance for the disc above and below the seat opening.
2. Apply a paint-like coating of an NSF 61 approved lubricant (such as Dow Corning 111 or Phoenix 505) to the two flat pads near the holes for the shaft.
3. Holding the disc (A2) in a vertical "OPEN" position, with the shaft connection toward the top of the body, insert the disc into the seat opening in the body and align the shaft holes in the disc with the shaft holes in the body.
4. Insert the shaft into the body and disc:
   - On sizes 3–16", insert the shaft (A5) into the top of the body, through the disc and into the bottom of the body. Insert the shaft carefully so that the body bearings (A7 and A32) are not damaged or moved out of position.
   - On sizes 18 and 20", insert the upper shaft (A5) through the top of the body and into the top of the disc. Insert the shaft carefully so that the upper body bearing (A7) is not damaged or moved out of position. Align and center the flat on the shaft with the tapped hole in the disc. Insert the lower shaft (A11) though the bottom of the body and into the bottom of the disc. Insert the shaft carefully so that the lower body bearing (A32) is not damaged or moved out of position. Align and center the hole in the lower shaft with the tapped hole in the disc.

Reassembling Valve *(Continued)*

5. Connect the disc to the shaft:

   - On sizes 3–12", align and center the flat on the shaft with the tapped hole in the disc. See Figure 4. On sizes 3–6", apply one bead of Loctite 242 along half the depth of the threads tapped hole; on sizes 8–12", apply two beads, on opposite sides. Apply one bead to the threads of the torque plug (A10) and screw the torque plug into the disc and tighten to the torque shown in Table B.

Table B Plug Torque

Valve Size	Torque, Ft. Lbs.
3	13+/-2
4	20 +/-2
6	60+/-5
8	85+/-5
10	130+/-5
12	190+/-5

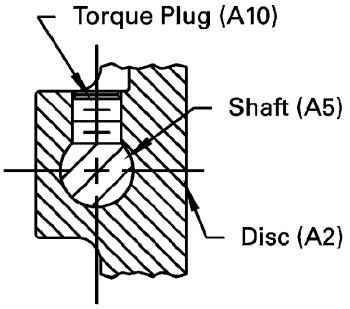


Figure 4 - Disc-to-Shaft Connection on 3–12"

   - On sizes 14–16", align and center the flat on the shaft with the tapped hole in the disc. Insert the pin (A4) into the mating hole in the disc (A2) so that the flat on the pin is centered on the flat on the shaft. Tap the pin firmly into position with a hammer and punch until the hammer bounces back when the pin is struck. Apply one bead of Loctite242 to the threads of set screw (A10) and one bead along half the depth of the threads in the tapped hole above the pin. Tighten the set screw to 75±5 ft. lbs. See Figure 5.

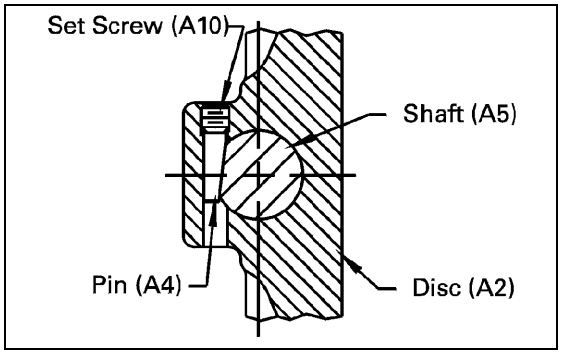


Figure 5—Disc-to-Shaft Connection on 14–20"

Reassembling Valve *(Continued)*

- On sizes 18 and 20", align and center the flat on the shaft with the tapped hole in the disc. Insert the pin (A4) into the mating hole in the disc (A2) so that the flat on the pin is centered on the flat on the shaft. Tap the pin firmly into position with a hammer and punch until the hammer bounces back when the pin is struck. Apply one bead of Loctite 242 to the threads of the set screw (A10) and one bead along half the depth of the threads in the tapped hole above the pin. Tighten the set screw to 125±5 ft. lbs. See Figure 5. Apply one bead of Loctite 242 to the threads of set screw (A12) and one bead along half the depth of the threads in the threaded hole near the bottom of the disc (A2). Thread the set screw into the disc and into the blind hole in the lower shaft (A11) and tighten to 13±2 ft. lbs. See Figure 6.

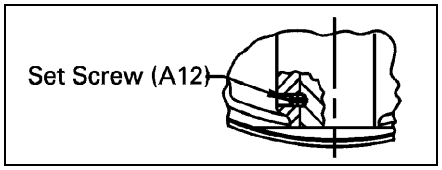


Figure 6—Lower Set Screw Detail 18" & 20"

6. Apply PTFE pipe sealant to the threads of plug (A16) and tighten the plug securely in the threaded hole in the bottom of the body.
7. If the valve has a packing gland, mount the gland (A25) with the two screws (A26) and washers(A27). Tighten the screws evenly and finger-tight, plus 1/2 turn.
8. Mount the actuator (and adapter, if included) to the valve.

Replacing Bearings

1. To replace bearing, disassemble the valve as instructed in the "disassembling valve" section.
2. Remove the bearings from the upper and lower journals in the valve body.

   Note: If PFTE or Darcon bearings are used, fabricate a sleeve the same size as the bearing OD; insert the sleeve into the bearing, and push the bearing out of the journal.
3. Thoroughly clean the journals before inserting new bearings.
4. Form new bearings into cylindrical shape and insert bearings into the journals until they stop against the rubber seat ring or are 1/8" away from the body opening.

   Note: For 3-8" valves, warm the bearing to 350°F (177°C) before forming into the cylindrical shape to avoid crimping the bearing material.
5. For PFTE or Darcon bearings, apply a layer of Loctite to the outside surface of bearing, then use sleeve to push it into the journal until its stops against the body step.
6. Reassemble the valve as described in the "reassembling valve" section.

Troubleshooting

Condition	Possible Cause	Corrective Action
Packing leaks.	Packing is loose.	Adjust packing See "Packing Adjustment."
	Packing is worn.	Replace Packing. See "Packing Replacement."
Valve leaks when closed.	Closed position stop is set incorrectly.	Adjust closed position stop
	Seat is worn or Damaged.	Replace valve.
	Sealing edge of disc is worn or damaged.	Replace disc.
Valve does not fully close.	Object is wedged between seat and disc.	Fully open valve to remove object.
	Closed position stop is not set correctly.	Adjust closed position stop.
Valve does not fully open.	Open position stop is not adjusted correctly.	Adjust open position stop.
Opening and/or closing torque is excessive.	Bearings, shaft, disc and/or seat are dirty or worn.	Clean or replace dirty or worn component(s).
	Shaft is bent.	Replace shaft.
	Packing gland screws are over-tightened.	Loosen screws and replace packing if needed.

Guarantee

Products, auxiliaries and parts thereof of DeZURIK, Inc. manufacture are warranted to the original purchaser for a period of twenty-four (24) months from date of shipment from factory, against defective workmanship and material, but only if properly installed, operated and serviced in accordance with DeZURIK, Inc. recommendations. Repair or replacement, at our option, for items of DeZURIK, Inc. manufacture will be made free of charge, (FOB) our facility with removal, transportation and installation at your cost, if proved to be defective within such time, and this is your sole remedy with respect to such products. Equipment or parts manufactured by others but furnished by DeZURIK, Inc. will be repaired or replaced, but only to the extent provided in and honored by the original manufacturers warranty to DeZURIK, Inc., in each case subject to the limitations contained therein. No claim for transportation, labor or special or consequential damages or any other loss, cost or damage shall be allowed. You shall be solely responsible for determining suitability for use and in no event shall DeZURIK, Inc. be liable in this respect. DeZURIK, Inc. does not guarantee resistance to corrosion, erosion, abrasion or other sources of failure, nor does DeZURIK, Inc. guarantee a minimum length of service. Your failure to give written notice to us of any alleged defect under this warranty within twenty (20) days of its discovery, or attempts by someone other than DeZURIK, Inc. or its authorized representatives to remedy the alleged defects therein, or failure to return product or parts for repair or replacement as herein provided, or failure to install and operate said products and parts according to instructions furnished by DeZURIK, Inc., or misuse, modification, abuse or alteration of such product, accident, fire, flood or other Act of God, or failure to pay entire contract price when due shall be a waiver by you of all rights under this warranty.

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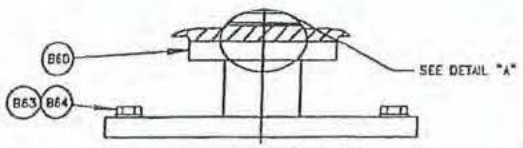
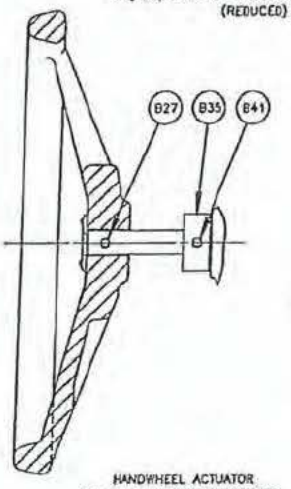
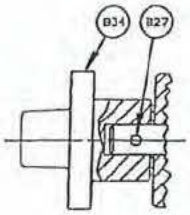
Part List



VIEW SHOWING ADAPTOR FAB FOR
24, 28, 30 & 36 VALVES W/ADJUSTABLE PACKING
(REDUCED)



HANDWHEEL ACTUATOR
12, 16 & 20 INCH HANDWHEEL



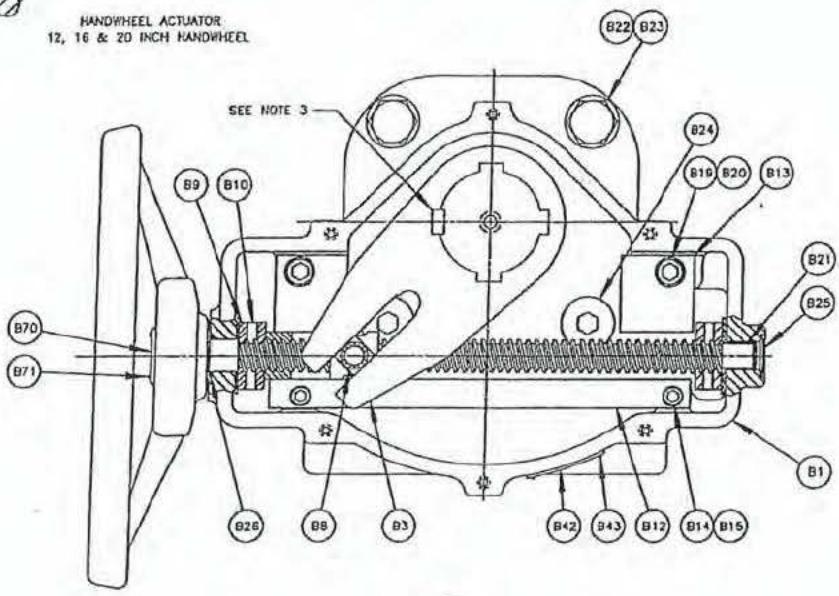
M_-3-N & M_-7-N
NUT ACTUATORS

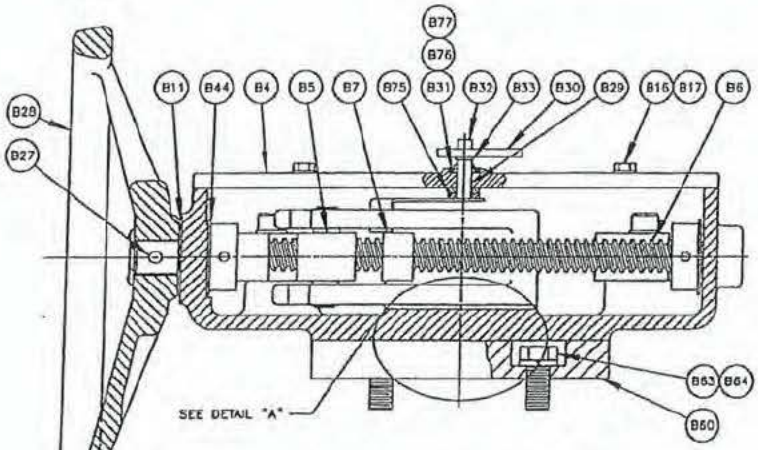
NO	PART NAME	QTY
B60	ADAPTOR (28, 30 & 36 VALVES W/O ADJ PKG OR 24, 28, 30 & 36 VALVES W/ADJ PACKING OR M_-7 ACTUATOR ON 3-12 VALVES)	1
B61	O-RING (28, 30 & 36 VALVES)	1
B63	SCREW (24, 28, 30 & 36 VALVES W/ADJ PKG OR M_-7 ACTUATOR ON 3-12 VALVES)	4
B64	LOCKWASHER (24, 28, 30 & 36 VALVES W/ADJ PKG OR M_-7 ACTUATOR ON 3-12 VALVES)	4
B65	BEARING (28, 30 & 36 VALVES)	1
B70	OPEN TAG (24, 30 & 36 HANDWHEELS ONLY)	1
B71	DRIVE SCREW (24, 30 & 36 HANDWHEELS ONLY)	2
B75	WASHER NYLON (MS-3 ACTUATOR)	2
B75	WASHER NYLON (MS-7 ACTUATOR)	1
B76	WASHER FIBER (MS-_ ACTUATOR)	1
B77	NUT PUSH-ON (MS-_ ACTUATOR)	1

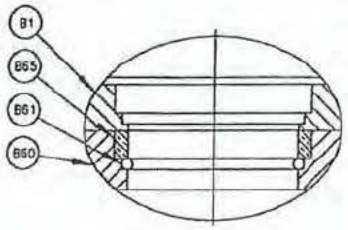
NOTE:

1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE. ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.
2. RECOMMENDED SPARE PARTS ARE ITEMS NO B2, B5, B11, B18, B21, B26, B31, B44, B61, B65, B75, B76 AND B77.
3. KEY, ITEM A6 OR A16 IS STOCKED WITH VALVE ASSEMBLY.

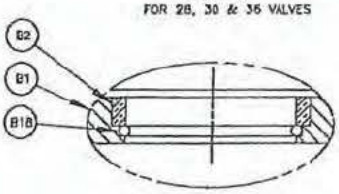
NO	PART NAME	QTY
B1	HOUSING	1
B2	BEARING (EXCEPT 28, 30 & 36 VALVES)	1
B3	YOKE	1
B4	COVER	1
B5	YOKE NUT ASSEMBLY	1
B6	SHAFT	1
B7	STOP NUT	2
B8	BEARING (YOKE NUT ASSEMBLY)	2
B9	COLLAR	2
B10	PIN	4
B11	THRUST WASHER (M_-3 ACTUATOR)	3
B11	THRUST WASHER (M_-7 ACTUATOR)	2
B12	YOKE GUIDE	1
B13	GUIDE BLOCK (28, 30 & 36 VALVES OR 3-24 VALVES WITH 450 FT/LB ACTR)	2
B14	SCREW	2
B15	LOCKWASHER	2
B16	SCREW (M_-3 ACTUATOR)	4
B16	SCREW (M_-7 ACTUATOR)	6
B17	WASHER (M_-3 ACTUATOR)	4
B17	WASHER (M_-7 ACTUATOR)	6
B18	O-RING (EXCEPT 28, 30 & 36 VALVES)	1
B19	SCREW (28, 30 & 36 VALVES OR 3-24 VALVES WITH 450 FT/LB ACTR)	2
B20	LOCKWASHER (28, 30 & 36 VALVES OR 3-24 VALVES WITH 450 FT/LB ACTR)	2
B21	BEARING	1
B22	SCREW (M_-3 ACTUATOR)	4
B22	SCREW (M_-7 ACTUATOR)	2
B23	LOCKWASHER (M_-3 ACTUATOR)	4
B23	LOCKWASHER (M_-7 ACTUATOR)	2
B24	SCREW (M_-7 ACTUATOR ONLY)	2
B25	EXPANSION PLUG	1
B26	O-RING	1
B27	PIN	1
B28	HANDWHEEL	1
B29	POINTER DRIVER (MS-_ ACTUATOR)	1
B30	POINTER (MS-_ ACTUATOR)	1
B31	SEAL (MS-_ ACTUATOR)	1
B32	SCREW (MS-_ ACTUATOR)	1
B33	LOCKWASHER (MS-_ ACTUATOR)	1
B34	WRENCHING SQUARE	1
B35	COLLAR (HDWHL)	1
B41	PIN (HDWHL)	1
B42	DATA PLATE	1
B43	DRIVE SCREW	2
B44	THRUST WASHER (M_-7 ACTUATOR)	1
B58		
B59		



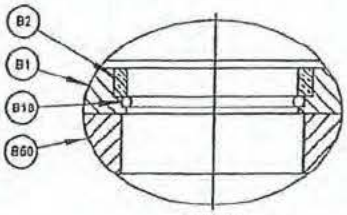




DETAIL "A"
FOR 28, 30 & 36 VALVES



DETAIL "A"
FOR 3 – 24 VALVES



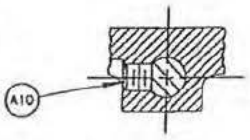
DETAIL "A"
FOR M_-7 ACTR ON 3-12 VALVES

DeZURIK
Sartell, MN USA 56377
www.dezurik.com

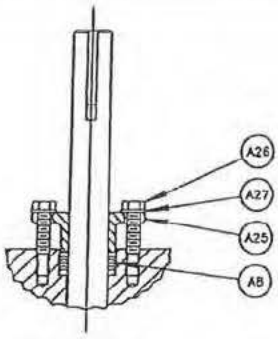
M_-3 & M_-7 MANUAL ACTUATOR ASSEMBLY
FOR USE WITH AWWA BUTTERFLY VALVES

DOCT. CODE	DRAWN	APPROVED	
C1	SN	DT	A40104
	CHECKED TNB	DATE 05-07-92	

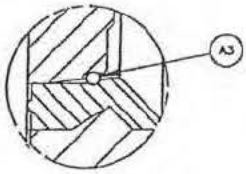
NO	PART NAME	QTY
A1	BODY	1
A2	DISC	1
A3	SEAT RING	1
A4		
A5	SHAFT	1
A6	KEY	1
A7	BEARING (UPPER JOURNAL)	1
A8	PACKING	–
A9	WASHER (TFE PACKING ONLY)	1
A10	TORQUE PLUG	1
A11		
A12		
A13	SPACER (SEE NOTE 3)	–
A14		
A15		
A16	PLUG	1
A25	GLAND	1
A26	SCREW	2
A27	WASHER	2
A32	BEARING (LOWER JOURNAL)	1
A40	VALVE CLASSIFICATION PLATE (WHEN REQ'D)	1
A41	DRIVE SCREW (USED WITH A40)	2
A42	SARTELL VALVES NAME PLATE (WHEN REQ'D)	1
A43	DRIVE SCREW	2



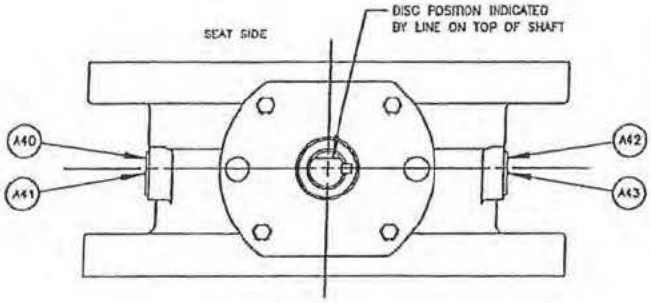
SECTION A-A



DETAIL "B"
ADJUSTABLE PACKING
(OPTIONAL)

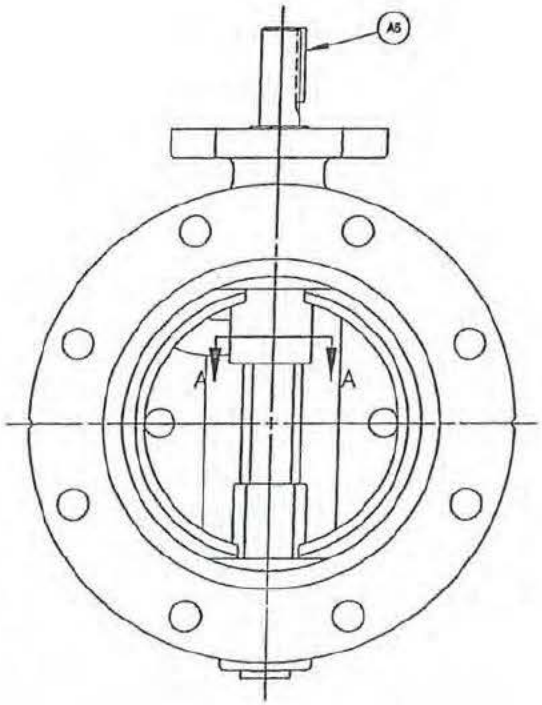


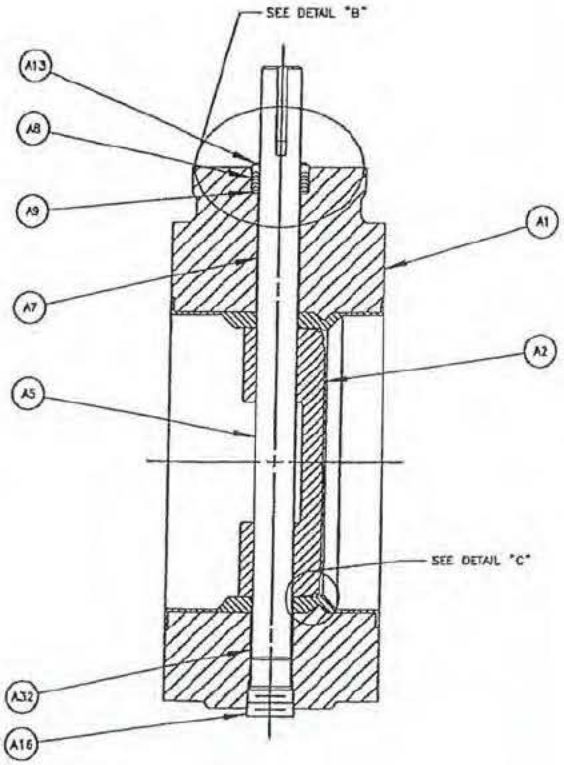
ENLARGED
DETAIL "C"



NOTE:

1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE. ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.
2. RECOMMENDED SPARE PARTS ARE ITEMS NO A7, A8 AND A32.
3. WHEN ITEM A13 IS ORDERED AS A SPARE PART, A QUANTITY OF 3 WILL BE SUPPLIED.





DeZURIK
Sartell, MN USA 56377
www.dezurik.com

BAW BUTTERFLY VALVES SIZE 3 – 12
FLANGED VALVE ASSEMBLY WITH TFE PACKING

DOCT. CODE	DRAWN	APPROVED	
	BMP	DP	J52967
C1	CHECKED DP	DATE 07/30/02	