FORT WASHINGTON WAY
PUMP STATION IOM

PUMPS 1, 2, 3, 4 & SUMP PUMP

February 14, 2020

EQUIP. TAG	MODEL	DESCRIPTION	MOTOR		MATERIAL
P-1	K200-316	KRT - S	156XE	20 HP	G
P-2, P-3, P-4	K500-634	KRT – K	1308XN	174 HP	G
SUMP	F 80-217	KRT – S	24XE	2 HP	G

OWNER
Ohio Department of Transportation
District 8
505 S. State Route 741
Lebanon, Ohio 45036

CONTRACTOR
Mosser Construction Inc.
122 S Wilson Ave.
Fremont, OH 43420

MANUFACTURER
KSB, Inc.
4415 Sarellen Road
Richmond, VA 23231

REPRESENTED BY
Baker & Associates, Inc
ATTN: Doug Borkosky
1284 SOM Center Rd #215
Cleveland, OH 44124

Customer PO #: 9006-003

KSB Inc. Order #: 98465

REPRESENTATIVE CONTACT INFO:

BAKER & ASSOCIATES
1284 SOM Center Rd., #215
Cleveland, Ohio 44124
Ph: 440-461-4577
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FORT WASHINGTON WAY PS
Pumps 1-4 & Sump Pump

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SECTION 1: GENERAL PROJECT INFORMATION

Baker & Associates

1284 SOM Center Road, #215
Cleveland, Ohio 44124

PH (614) 361-3673 * Fax (614) 573-7626

July 15, 2019

Mosser Construction
Attn: Mr. Nick Steyer
122 South Wilson Avenue, Drawer D
Fremont, Ohio 43420

Re: ODOT Fort Washington Way Stormwater Pump Station -- Pumps

Thank you for considering KSB for the ODOT Design Build proposal for the Second Street Stormwater Station.

We are pleased to offer the following pumps for the Project:

Position	Qty	Duty	KSB Selection	HP
P-1	1	Low Flow Pump	KRT K200-316/156XEG-S	20
P-2, P-3, P-4	3	Stormwater Pumps	KRT K500-634/1308XNG-K	174
SUMP	1	Sump Pump	KRT F80-217/24XEG-S IE3	2

P-1 Low Flow Pump
KSB MODEL KRT K200-316/156XEG-S

Qty	Description
1	8” Submersible pump equipped with a 460Volt/3 phase/60Hz/20 hp 1161 RPM motor, 12” non-clog impeller, moisture sensor, thermal sensors in stator, cast iron casing wear ring, slurry seal, standard submersible motor (no cooling jacket).
1	**65’** feet Submersible Power & Control Cable
1	Pump Safe Control Relay “A” (for moisture sensor and motor thermal sensors))
1	Certified Performance Curve, Factory Test (non-witnessed) Level 1U
1	Lifting Bails
1	50’ Stainless steel lifting chain
1	Day Equipment Commissioning Services
1	Day Training Services
1	Standard Warranty (7-yr Prorated)

P-2, P-3, & P-4 -- Stormwater Pumps

KSB MODEL KRT K500-634/1308XNG-K

Qty	Description
3	20” Submersible pump equipped with a 460Volt/3 phase/60Hz/174hp 890 RPM motor, 20” non-clog impeller, moisture sensor, thermal sensors in stator, cast iron casing wear ring, slurry seal.
3	65’ feet Submersible Power Cables (2) & Associated Control Cable (1)
3	Pump Safe Control Relay “A” (for moisture sensor and motor thermal sensors)
3	Certified Performance Curve & Factory Test (non-witnessed) Level 1U
3	Pump Guide Bar Adaptor Claw (if needed)
3	Base Elbow –20”x20”
3	Upper Guide Rail Bracket Assembly – 24” Riser
6	Intermediate Guide Rail Bracket Assembly (max 15’ spacing) – 24” Riser
3	Lifting Bails
3	50’ Stainless steel lifting chain
3	Day Equipment Commissioning Services
1	Day Training Services
1	Standard Warranty (7-yr Prorated)

Sump Pump
KSB MODEL KRT K80-217/24XG-S IE3

Qty	Description
1	3” Submersible pump equipped with a 460Volt/3 phase/60Hz/2hp 1759 RPM motor, 7.0” vortex impeller, moisture sensor, thermal sensors in stator.
1	50’ feet Submersible Power & Control Cable
1	Pump Safe Control Relay “A” (for moisture sensor and motor thermal sensors)
1	Certified Performance Curve
1	Pump Guide Bar Adaptor Claw
1	Base Elbow –3”x3”
1	Upper Guide Rail Bracket Assembly – 3” Riser
2	Intermediate Guide Rail Bracket Assembly (max 15’ spacing) – 3” Riser
1	Lifting Bails
1	Day Equipment Commissioning Services
1	Standard Warranty (7-yr Prorated)

EXCEPTIONS:

This quotation is based on the limited information provided by ODOT and Mosser Construction. The reality is that KSB is offering similar duty pumps but the final scope required depends on obtaining additional information about the piping, accessories, and electrical supply.

Notes on Pricing:

- We do not supply junction boxes, disconnects, surge protection, kellum grips, piping, valves, guide rails, pressure gauges, spare parts, labor or any other equipment or installation services not specifically indicated above.

- NOTE: P-1/P-2/P-3/P-4 require 3" diameter guide rails. Sump pump requires 2" diameter guide rails.

- Freight is included. Terms of payment: Net 30 Days

- Lead times include 4 weeks for submittal drawings. Delivery is 29-31 weeks for the 20" pumps (P-2/P-3/P-4) after approval. Delivery is 16-18 weeks for P-1 and the Sump Pump.

Attached with this document is a PDF file with Data Sheet, Pump Curve, Pump Drawing, and Motor Data Sheet for each pump.

Baker & Associates and KSB appreciate the need for an equipment supplier to be active and engaged in a Design-Build project. Our effort to propose an alternate to the existing pumps and to expend the technical effort to research the capabilities of the existing gear is evidence of such willingness. We would appreciate the opportunity to be a part of a successful project.

We hope this information is helpful to you. Should you have any questions or require additional information, please feel free to call or e-mail me.

Sincerely,
BAKER & ASSOCIATES

Douglas D. Borkosky, P.E.

Seven Year Submersible Pump Warranty and Ten Year Guide Cable Warranty for Permanent Municipal Installations

KSB, Inc. ("KSB") warrants to the Original End Purchaser ("OEP") that KSB's submersible pumps of the type named above (the "Pump(s)") when used for sewage collection systems or for intermittent duty cycle pumping will be free from defects in workmanship and materials for a period of seven (7) years on a pro-rated basis from date of initial shipment ("Pro-rated Term"). In addition to the Pump warranty, KSB warrants to OEP that the Guide Cable sold with the Pump will be free from defects in workmanship and materials for a period of ten (10) years from date of initial shipment. Pumps and Guide Cables covered by this warranty are "Equipment." Warranties hereunder are expressly conditioned upon Pumps (i) pumping abrasive-free, non-corrosive liquids used in permanent municipal installations; (ii) being operated according to KSB specifications; and (iii) monitoring equipment incorporated in the Pump is correctly connected and in use.

OEP's claim(s) of alleged defects in workmanship or materials during the Term of the warranty must be delivered in writing to KSB within ninety (90) days of discovery. KSB's obligation under this warranty expressly is limited to, at KSB, sole discretion, repair or replacement of defective part(s), provided that (i) the terms of payment for Equipment have been complied with and (ii) the Pump(s) with cable(s) attached or faulty part(s) thereof have been returned freight prepaid to KSB or to an authorized KSB Service Facility as directed by KSB and (iii) KSB has acknowledged in writing that the defect has been caused by faulty workmanship or defective material. Normal wear and tear are specifically excluded from warranty coverage. KSB Grinder Pumps are specifically excluded from this warranty. The warranty shall be void if the Pump(s) or its part(s) have not been used and maintained in accordance with the printed instructions of KSB, or have been damaged wholly or in part by misuse, accident, neglect, faulty electrical system, or any other cause beyond the control of KSB.

Unless otherwise specified by KSB, the pro-rated warranty period shall be computed from the original shipping date to the date the Pump(s) and/or part(s) are returned to KSB or its authorized repair facility, or, if authorized repairs are made on site, the warranty period shall be computed to the date notice of defects is received by KSB.

Pump(s) or part(s) repaired or replaced will be returned at the cost of OEP. Repairs or replacement parts are warranted free from defects in workmanship and materials for the longer of the un-expired term of this warranty or ninety (90) days from the date KSB ships such repaired or replaced items, and all other terms and conditions of this warranty shall apply. OEP agrees to provide documentation and data in support of its warranty claim(s) as requested by KSB. Prior to shipment by KSB, OEP shall remit its portion in the repair or replacement cost as detailed below.

As requested by KSB, OEP shall provide electrical system schematics (including bills of material) to support any warranty claims. This documentation will be required for warranty claims for pumps of 20 horsepower and larger.

In accordance with the table below, KSB will bear the pro-rated cost for warrantied repairs or replacements as follows:

TABLE OF KSB'S PRO-RATED COSTS FOR WARRANTIED REPAIR OR REPLACEMENT OF PUMPS AND PARTS

Item	Categories	I	II	III	IV
A. Pumps	Months after Shipment	0-18	19-39	40-59	60 - 84
	KSB Share of Cost	100%	50%	25%	10%
B. Guide Cables	Months after Shipment	0-120		-	-
	KSB Share of Cost	100%		-	-

KSB WILL NOT BE RESPONSIBLE FOR TRAVEL EXPENSES, RENTED EQUIPMENT, OUTSIDE CONTRACTORS' FEES, UNAUTHORIZED REPAIR(S), REPAIRS NEEDED DUE TO MISUSE, ACCIDENT, NEGLECT, FAULTY ELECTRICAL SYSTEM, OR OTHER CAUSE OUTSIDE OF KSB'S CONTROL SHOP EXPENSES OR FOR PUMPS PURCHASED OR USED WITHOUT KSB SUPPLIED POWER CABLE(S).

THE WARRANTIES MADE HEREIN BY KSB ARE IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. KSB. DISCLAIMS ANY AND ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. KSB ASSUMES NO LIABILITY FOR LOSS OF USE, LOSS OF PROFIT, OR ANY DIRECT, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND.

NOTWITHSTANDING ANYTHING HEREIN TO THE CONTRARY, IN NO EVENT SHALL KSB'S LIABILITY TO PURCHASER EXCEED THE FEES PAID OR TO BE PAID FOR PARTS OR REPAIRS UNDER A WARRANTY OR PURPORTED WARRANTY CLAIM THAT GIVES RISE TO ANY SUCH ALLEGED LIABILITY.

No sales agent or sales representative or any other person is authorized to modify, extend, or enlarge this Warranty. Any modification, extension, or enlargement of this Warranty shall not bind KSB.

SECTION 2: DATA SHEETS & GENERAL FEATURES

SECTION 2A

P-1	KRT K 200-316/156XEG-S

Data sheet

Pump type **KRT K 200-316/156XEG-S**

Operating data

Flow	2000	US g.p.m.	Fluid			
Head	30	ft	Density of fluid	62.3	lb/ft³	
Operating speed	1165	rpm	Viscosity	1.08E-5	ft²/s	
Shaft power	18.5	hp	Temperature	68	°F	
Efficiency	82.4	%				
Required pump NPSH	12	ft				
Head H(Q=0)	52.7	ft				
Application range	Head		Flow			
From	38.1	ft	1200	US g.p.m.		
To	13	ft	3420	US g.p.m.		

Design

Make	KSB		Impeller type	Multi channel impeller	
Design	Submersible pump			Closed	
Series	KRT K		Impeller size	(299) 12	inch
Frame size	200-316			Max. (305) 12	inch
Stages	1			Min. (265) 10	inch
Curve number	K42104s/4		Free passage	4 inch	inch
			Weight	833.33	lb
Type of bearings	Antifriction				
Nos. of bearings	1 / 1				
Lubrication	Grease lubrication. lubricated for lifetime				
Suction port	Pressure rating		--		
	Flange size	DN0	---		
	Flange size	DN1	8"		
	Norm		--		
Discharge port	Pressure rating		CLASS 125		
	Flange size	DN2	8 inch		
	Flange size	DN3	8 inch		
	Norm		ASME/ANSI B16.1		

Suction port: pump (DN1)
Discharge port: discharge elbow (DN3)

Materials

Pump casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Discharge cover	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Shaft	Stainless steel EN-1.4021+QT800 (A 276 Type 420)
Bearing bracket	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bolts. nuts	Stainless steel A4 (EN-1.4571) (A 276 Type 316)
Shaft protection sleeve	---
Casing wear ring	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller wear ring	---
O-Rings	Nitrile rubber (NBR)

Data sheet

Pump type **KRT K 200-316/156XEG-S**

Shaft seal

Type of seal	Double mechanical seal
Arrangement:	Tandem
Seal on medium side	With protected spring
Mechanical seal. pump-side	Silicon carbide / Silicon carbide
Mechanical seal. bearing-side	Carbon / Silicon carbide

Monitoring

Thermal winding protection	By temperature sensitive switches
Explosion proof protection	By PTC (Explosion proof models only)
Motor housing monitoring	By conductive moisture sensor electrode
Mechanical seal leakage detection	---
Bearing temperature monitoring	---

Coating

Preparatory treatment	SSPC near white SP 10
Blasting method	Steel grit blasting
Primer	Zinc phosphate or Zinc dust
Dry film thickness primer	> 1 1/2 mils (35 microns)
Top coat	2-component epoxy resin
Solids content	> 82 %
Dry film thickness top coat	> 6 mils (150 microns)
Color	Ultramarine Blue

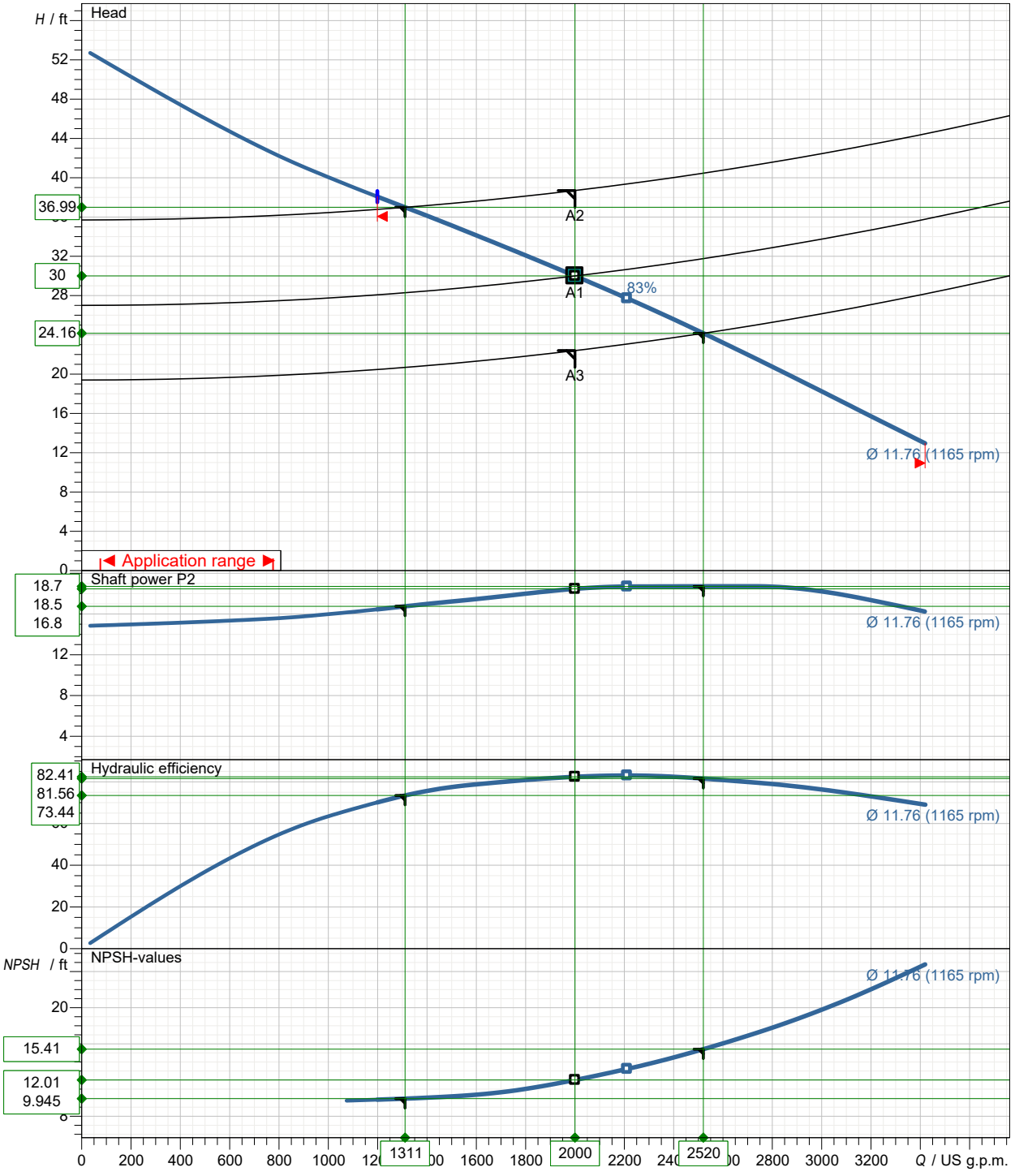
Installation

INSTALLATION	
Type of installation: automatic connection to a permanently installed discharge elbow	Wet well installation designed for
Discharge elbow size (DN2/DN3):	8 inch / 8 inch
Flange to suit:	ASME/ANSI B16.1, CLASS 125
Claw:	Bolted to the pump
Guide system:	Double guide bars, by contractor
Guide bar dimension:	3" diameter pipes
Installation depth:	33 ft (10 m)
Lifting device:	stainless steel lifting chain
Length of lifting device:	33 ft (10 m)
Lifting loops:	Every 8 ft (2.5 m)
Installation accessories: fasteners, claw, bracket, lifting chain, but without guide bars	Discharge elbow, 8 inch / 8 inch
Materials:	
Discharge elbow:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Claw:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bracket:	Stainless steel EN-1.4571 (A 276 Type 316 Ti)
Lifting device:	Stainless steel EN-1.4404 (A 276 Type 316L)

INSTALLATION

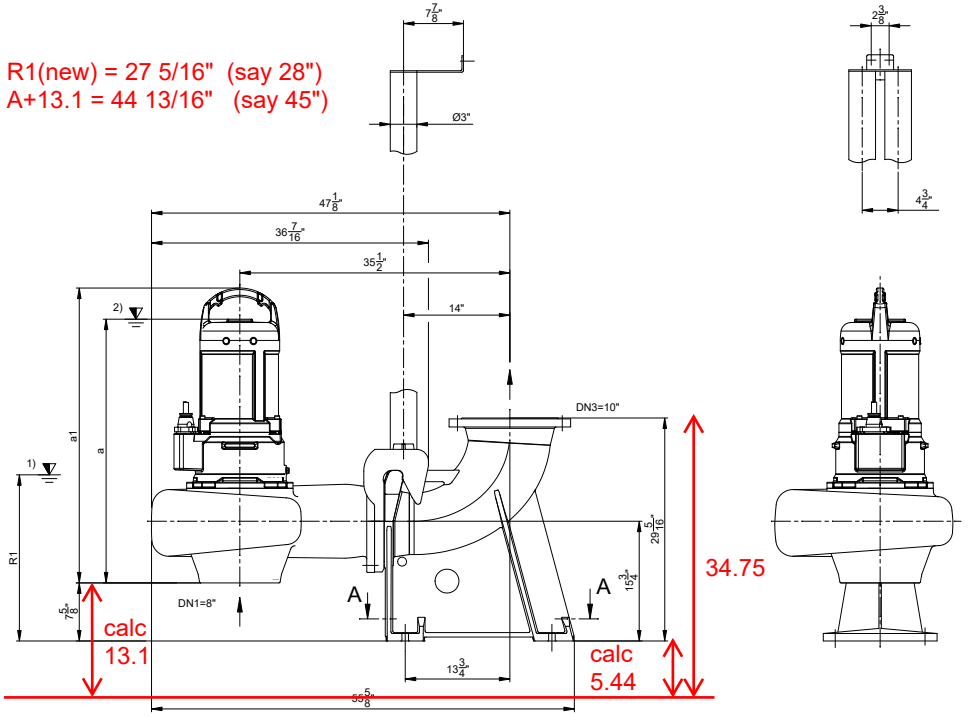
Performance curve

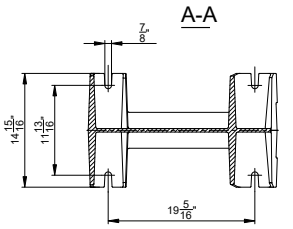
Pump type **KRT K 200-316/156XEG-S**

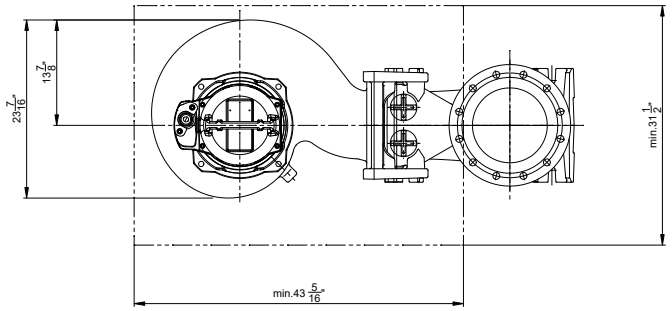


Impeller type	Multi channel impeller, Closed			Curve number	K42104s/4
Free passage	4 inch		Density of fluid 62.322 lb/ft³	Frequency	60 Hz
Impeller size	12 inch	(299)	Viscosity 1.082E-5 ft²/s	Speed	1165 1/min

R1(new) = 27 5/16" (say 28")
A+13.1 = 44 13/16" (say 45")







Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	a 50 Hz mm	a 60 Hz mm	a 60 Hz inch	a1 50 Hz mm	a1 60 Hz mm	a1 60 Hz inch	Gewicht / Weight / Poids G kg	G lbs
K	76 KA13	827	827	32 9/16	931	931	36 5/8	342	755
	116 KA13							349	770
	156 KA16	881	881	34 11/16	985	985	38 3/4	378	834
	186 KA16							393	867

Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	R1 U...X...Y...W...- Motor/Engine/Moteur mm	R1 U...X...Y...W...- Motor/Engine/Moteur inch	R1 Z...- Motor/Engine/Moteur mm	R1 Z...- Motor/Engine/Moteur inch
K	76 KA13	555	21 7/8	655	25 13/16
	116 KA13				
	156 KA16				
	186 KA16				

NUR FÜR ANFRAGE/ANGEBOT
technische Änderungen vorbehalten

FOR INQUIRY/OFFER ONLY
technical modifications reserved

SEULEMENT POUR LES DEMANDES/LES OFFRES
sous réserve de modifications technique

1)Tiefster Ausschaltpunkt bei Automatikbetrieb
1)Lowest shut-off point for automatic operation
1)Point d'arrêt le plus bas en service automatique

2)Mindestüberdeckung bei Dauerbetrieb
2)Minimum submergence for continuous operation
2)Recouvrement minimal pour service continu

AS-BUILT
2020-02-18

ERWEITERUNGSKRÜMMER
EXTENSION ELBOW
COUDE DIVERGENT

Maßstab/Scale/Echelle 1:10				stationäre Aufstellung stationary installation installation stationnaire
CAD A 2				Baureihe-Größe/Type-Size KRT 200-316
KSB	0	2018-04-13	emmrpat	KSB Auftrags-Nr./KSB Order No./N° commande KSB
	Änderung/Revision Modification	Datum/Date	Name/Nom	----------
KSB SE & Co. KGaA Turmstraße 92-100 D-06110 Halle (Saale)	CAD-BEZEICHNUNG			Zeichnungs-Nr./Drawing No./N° Plan
	SCHUTZVERMERK DIN 34-1-D			

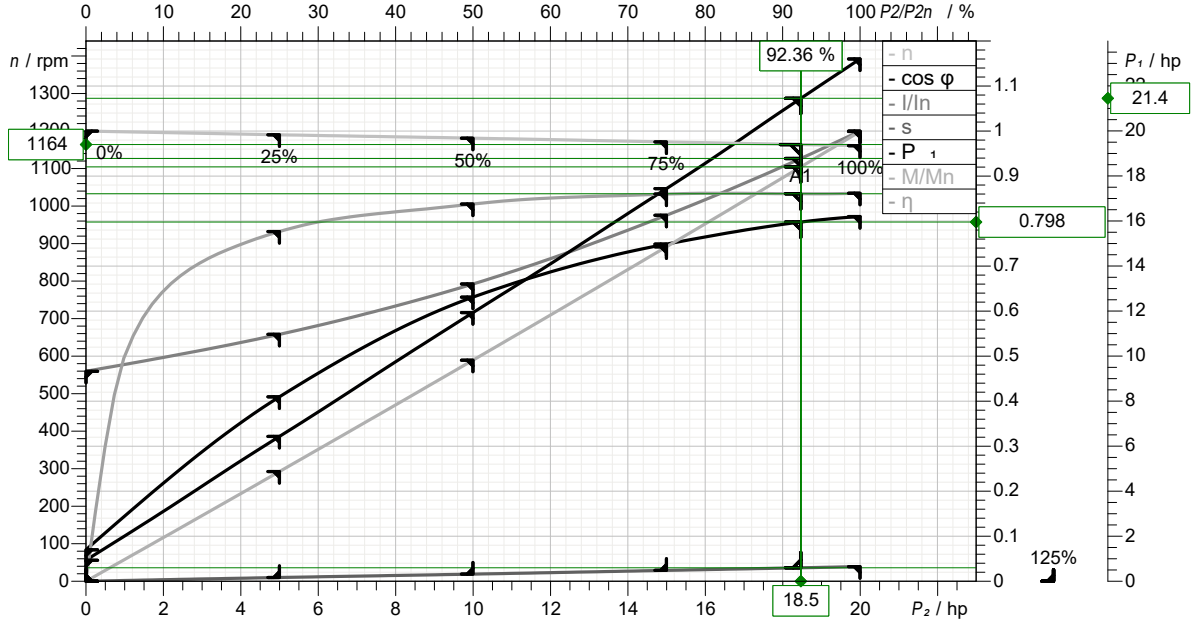
Data sheet: Motor data

Motor type 156XEG

Motor manufacturer	KSB SE & Co. KGaA	Rated voltage	460	V
Design acc. standard	-	Rated frequency	60	Hz
Service factor	1.14	Rated HP (D.O.L) or VFD	20	hp
Degree of protection	IP68	Rated current	26.8	A
Insulation class		Nominal speed	1161	rpm
Starting mode	Direct starting	NEMA code letter	H	
No. starts / h	10	Starting to rated current	6.3	
Coolant temperature	< / = 104 °F (40 °C)	Starting current	168.8	A
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)			
Explosion protection	Class I, Div. 1, Groups C,D, T3			
Pump type	KRT K 200-316/156XEG-S			

Load	P1 kW	P2 hp	eta %	cos phi	I A
4/4	17.30	20.0	86.2	0.81	26.8
3/4	13.01	15.0	85.9	0.75	21.8
2/4	8.90	10.0	83.7	0.63	17.7
1/4	4.80	5.0	77.6	0.41	14.7

Main cable	1 x AWG 11-7+15-5	Diameter	92.46 US g.p.m....101.27 US g.p.m
Control cable	---	Diameter	
Cable. outer sheath	Waterproof synthetic rubber compound		
Cable length	80 ft (25 m)		



KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961
KSB Pumps Inc, 5885 Kennedy Road, Mississauga, Ontario L4Z 2G3 (Canada), Phone: (0905) 568-9200, Fax: (0905) 568-9120

KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

Waste Water

Submersible Motor Pump

Amarex KRT

Main applications

- Waste water management
- Service water supply systems
- Disposal
- Waste water treatment plants
- Sludge disposal

Fluids handled

- Sewage containing feces
- Activated sludge
- Digested sludge
- Raw sludge
- Fluids containing gas
- Industrial waste water

Operating data

SEE DATASHEETS FOR PROJECT SPECIFIC VALUES

Operating properties

Characteristic		Value
Flow rate	Q [US.gpm]	≤ 45000
	Q [l/s]	≤ 2800
Head	H [ft]	≤ 330
	H [m]	≤ 100
Fluid temperature	T [°F]	≤ +140
	T [°C]	≤ +60
Motor rating	P_2 [hp]	≤ 1140
	P_2 [kW]	≤ 850

Design details

P-1

Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

Drive

- Three-phase asynchronous squirrel-cage motor
- Motors integrated in explosion-proof pump sets are supplied in Explosionproof Class I Division 1, Groups C&D, T3.

Shaft seal

Standard bearings:

- Two bi-directional mechanical seals in tandem arrangement, with liquid reservoir

Reinforced bearings:

- Two bi-directional mechanical seals in tandem arrangement, with leakage chamber

Impeller type

- Various application-oriented impeller types

Bearings

Standard bearings:

- Grease-packed bearings sealed for life
- Maintenance-free

Reinforced bearings:

Drive end:

- Grease-packed bearings sealed for life
- Maintenance-free

Pump end:

- Grease-packed bearings
- Can be re-lubricated

Designation

Example: ~~Amarex KRT K 150-503/155 4 UN G-D IE3~~ Amarex KRT K200-317/156XEG-S

Designation key

Code		Description	
Amarex KRT		Type series	
K		Impeller type (⇨ Page 4)	
		S/S-max	Impeller with cutter
		F/F-max	Free-flow impeller
		E/E-max	Closed single-channel impeller
		D	Open, diagonal single-vane impeller
		K/K-max	Closed multi-channel impeller
~~150~~	200	Nominal discharge nozzle diameter [mm]	
~~503~~	317	Maximum nominal impeller diameter [mm]	
~~155~~	15	Motor size	
~~4~~	6	Number of motor poles	
~~UN~~		Motor version	
		UN/UE	Non-explosion-proof, for fluid temperatures of up to 40 °C
		WN/WE	Non-explosion-proof, for fluid temperatures of up to 60 °C
	XE	XN/XE	Explosion-proof FM APPROVED or NSF explosion-proof Class I, Division I, Groups C & D, T3, for fluid temperatures of up to 40 °C
		ZN/ZE	Explosion-proof FM APPROVED or NSF Explosion-proof Class I, Division I, Groups C & D, T3, for fluid temperatures of up to 40 °C
G		Material variant	
		G	Standard variant, gray cast iron
		G1	Like G, impeller made of duplex stainless steel
		G2	Like G, impeller made of white cast iron
		GH	Like G, impeller and discharge cover made of white cast iron
		H	Wetted components made of white cast iron
		C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, bolts/screws made of A4
		C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462
~~D~~		Installation type (⇨ Page 34)	
		D	Stationary dry installation, vertical (S1 duty)
	S	H	Stationary dry installation, horizontal (S1 duty)
		K	Stationary wet installation (S1 duty with motor outside the fluid possible) with guide cable arrangement or guide rail arrangement
		S	Stationary wet installation (S1 duty with submerged motor) with guide cable arrangement or guide rail arrangement
		P	Wet installation of transportable model (S1 duty with submerged motor)
~~IE3~~		Motor efficiency classification[1]	
		[2]	No efficiency classification
		~~IE2~~	~~High Efficiency~~
		~~IE3~~	~~Premium Efficiency~~

1) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.
2) Blank

Materials

Overview of available materials

Part No.	Description	Material variant						
		G	G1	G2	GH	H	C1	C2
Pump set								
101	Pump casing	EN-GJL-250				EN-GJN-HB555	1.4517	
135	Wear plate[3]	EN-GJL-250		-				
163	Discharge cover	EN-GJL-250			EN-GJN-HB555		1.4517	
210	Shaft	1.4021 (⇨ Page 8)					1.4021/1.4462/C45+N (⇨ Page 8)	
230	Impeller[4]	EN-GJL-250	1.4517	EN-GJN-HB555			1.4517	
350	Bearing housing	EN-GJL-250					1.4517/EN-GJL-250	
412	O-ring	Nitrile butadiene rubber NBR						Viton (FKM)
433.01	Mechanical seal (drive end)	Carbon/SiC						
433.02	Mechanical seal (pump end)	SiC/SiC						
502	Casing wear ring[5]	EN-GJL-250			VG 434			
66-2	Cooling jacket	1.4571			-			
811	Motor housing	EN-GJL-250					1.4517	
824	Power cable	(⇨ Page 12)						
900	Screws/bolts	A4[6]						1.4462
Installation parts								
572	Guide cable suspension bracket	1.4571 to DN 200; EN-GJL-250 from size K200-500						1.4571
59-24	Guide cable	1.4401						1.4401/ Tefzel
72-1	Flanged elbow	EN-GJL-250				EN-GJN-HB555	1.4517	
732	Claw	EN-GJL-250 or EN-GJS-400-15/EN-GJS-500-7					1.4517	
885	Lifting chain/rope	Lifting chain: 1.4404 Lifting rope: polyamide/polypropylene					Lifting rope: polypropylene	
892	Foot plate / feet	1.0038 + Z					1.4571	1.4517/ 1.4462
894	Mounting bracket	1.4571 to DN 200; 1.0038 + Z from size K200-502						1.4571

Comparison of materials

EN	ASTM
EN-GJL-250	A 48 Class 35 B
EN-GJS-400-15	A 536 Class 60-40-18
EN-GJN-HB555	A 532 Class II Type B (15 % Cr-Mo)
1.4517	A 890 CD4MCuN
1.4021	A 276 Type 410

EN	ASTM
1.4401	A 276 Type 316 L
1.4462	A 182 F51
VG 434	-
1.4571	A 276 Type 316 Ti
C45+N	A 576 Gr. 1045
NBR	NBR
FKM	FKM

Description of materials

Gray cast iron EN-GJL-250 (lamellar graphite cast iron):
Lamellar graphite cast iron to EN 1561 is the most widely used cast material for handling municipal sewage, waste water and sludges as well as stormwater and surface water. It is suitable for neutral fluids which are only slightly aggressive and cause little wear. The pH should be ≥ 6.5, the sand content ≤ 0.5 g/l.

Duplex stainless steel (1.4517 or technically equivalent material)

This type of cast steel is resistant to cavitation, has excellent strength values and is used for high circumferential speeds. An excellent resistance to pitting corrosion makes ferritic-austenitic stainless steel a popular choice for pumping acidic waste water with a high chloride content as well as seawater and brackish water. Thanks to its good chemical resistance, e.g. against waste water containing phosphorus and sulphuric acid, this material is used in a wide range of applications in the chemical industry and process engineering. Pumps made of duplex stainless steel have a very long service life, even when handling brines, chemical waste water (pH 1 - 12), gray water and landfill leachate.

Wear-resistant white cast iron (EN-GJN-HB555 [XCR14] or technically equivalent material)

3) For D impeller
4) D impeller: EN-GJL-250, with hardened edges
5) For E impeller and K impeller
6) Equivalent to 1.4571

Wear-resistant white cast iron is suitable for handling highly abrasive fluids containing sand, ash or iron ore sinter, for example. It has a Rockwell hardness (HRC) of 54 as a minimum, which is higher than that of hardened chrome steel. Owing to its hardness, the chromium-molybdenum alloy cast iron features a notably higher wear resistance than EN-GJL-250 gray cast iron and other cast materials. A pH ≥ 6.5 should be observed.

Product benefits

- Absolutely water-tight resin-sealed cable entries prevent any water from entering the motor – even in the event of a damaged connection cable.
- Reliable operation ensured by moisture sensors signaling any ingress of moisture into the motor
- Reliable operation ensured by sensors monitoring the motor temperature and preventing overheating
- Non-clogging low-maintenance design with large free passages reduces clogging risk and, consequently, maintenance work.
- Optimum hydraulic and energy efficiency by high-efficiency motors and variable hydraulic systems

Material variants C1 and C2:

- Long service life due to corrosion-resistant wetted components made of stainless steel

Acceptance tests and warranty

Functional test

- Every pump undergoes functional testing to KSB standard ZN 56535.
- Operating data is guaranteed to DIN EN ISO 9906/2/2B or Hydraulic Institute Level A/B.

Acceptance tests

- Acceptance testing to ISO/DIN or comparable standards is available against a surcharge.
- Acceptance tests to Hydraulic Institute available on request.

Warranty

- Quality is assured by means of an audited and certified quality assurance system to DIN EN ISO 9001.

Selection information

- The indicated heads and performance data apply to material variant G, for fluids handled with a density $\rho = 1$ kg/dm³ and a kinematic viscosity $v \leqq 20$ mm²/s.
- For hydraulic acceptance tests of material variants other than "G" reduce the documented efficiencies by 2 percentage points.

Impeller type

- S, F, E and D impellers can only be supplied with the documented impeller diameters. Indicate the pump set designation and the impeller diameter in the purchase order.
- K impellers are trimmed to the duty point. Indicate the H / Q data or the impeller diameter in the purchase order. In the hydraulic selection program, the impeller diameter is automatically computed based on the H / Q data and added to the designation of the pump set.

Pump input power

- Adjust the power input to the density of the fluid handled:
  P_2 (required) = ρ [kg/dm³] (fluid handled) × P_2 (documented)
- Select the operating point with the largest power input within an operating range. Select a motor size providing a power reserve to compensate for the tolerances in the system characteristic / pump characteristic.

Recommended motor power reserve[7)]

P_2		Reserve	
[hp]	[kW]	Mains operation	With frequency inverter
≤ 40	≤ 30	10 %	15 %
> 40	> 30	5 %	10 %

- For installation types K and D (with cooling jacket) an additional power reserve of 2 hp [1.5 kW] must always be added for the cooling circuit.
- The motors are suitable for operation on a frequency inverter.
- The service factor for all motors equals 1.15.

In the case of waste water, too low a flow velocity in the discharge line will lead to clogging and increased wear. The flow velocity in the vertical riser must not fall below 2 m/s (6.56 ft/s).

In the case of waste water, too low a circumferential speed of the impeller will lead to clogging of the hydraulic system (operation on frequency inverter). A minimum circumferential speed (measured at the outside diameter of the impeller) of 12 m/s (39.4 ft/s) must be observed.[8)]

7) If larger power reserves are stipulated by local regulations, these larger reserves must be provided.
8) For F impellers, a circumferential speed below 12 m/s (39.4 ft/s) is permissible.

Overview of product features / selection tables

Overview of product features

Material variants G, G1, G2, GH

Feature	Motors						
2 poles	**3 2 E ... 26 2 E**	-	**55 2 E ... 75 2 E**	-	-	-	-
4 poles	**2 4 E ... 22 4 E**	**30 4 E ... 37 4 E**	**45 4 E ... 75 4 E**	**35 4 N ... 110 4 N**	**130 4 N ... 175 4 N**	**200 4 N ... 350 4 N**	-
6 poles	**7 6 E ... 18 6 E**	**22 6 E ... 30 6 E**	**31 6 E ... 55 6 E**	**32 6 N ... 100 6 N**	**120 6 N ... 165 6 N**	**190 6 N ... 480 6 N**	**530 6 N ... 850 6 N**
8 poles	-	**11 8 E ... 22 8 E**	**30 8 E ... 45 8 E**	**26 8 N ... 75 8 N**	**90 8 N ... 130 8 N**	**150 8 N ... 400 8 N**	**460 8 N ... 760 8 N**
10 poles	-	-	-	-	**40 10 N ... 90 10 N**	**110 10 N ... 350 10 N**	**390 10 N ... 660 10 N**
12 poles	-	-	-	-	-	**105 12 N ... 300 12 N**	**340 12 N ... 560 12 N**
Suction flange	[9]						
Shaft material							
Shaft	A 276 Type 420						
~~Shaft protecting sleeve~~	-			~~A 276 Type 420~~[10]	~~A 276 Type 420~~		
Bearing assembly	Grease-packed rolling element bearings sealed for life		~~Grease-packed rolling element bearings sealed for life~~[11]	~~Pump end: re-greasable rolling element bearings drive end: grease-packed rolling element bearings sealed for life~~			
Explosion protection							
~~Versions U, W~~	~~Non-explosion-proof~~						
Versions X, Z	FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3						-
Motor							
Starting method	DOL, soft starter, frequency inverter or star-delta			~~DOL, soft starter, frequency inverter~~			
Voltage	460 V[12]						~~460 V~~[13]
Cooling	Cooled by surrounding fluid[14]	~~Cooled by surrounding fluid~~		~~Cooled by surrounding fluid or via cooling jacket~~			
Immersion depth	100 ft [30 m] max.						
Power cable							
Type	~~See table "Overview of power cables"~~						
Length	65 ft ~~30~~ ft [10 m][15]						
Cable entry	Absolutely watertight						
Sealing elements							
Elastomer seals	Nitrile butadiene rubber NBR[16]						

9) Drilled to ANSI B16.1 Class 125 on request, not available for all sizes.
10) For maximum nominal impeller diameters 400 mm / 401 mm / 402 mm / 403 mm: without shaft protecting sleeve
11) For D impeller: re-greasable rolling element bearings at the pump end, grease-packed rolling element bearings sealed for life at the drive end
12) Optional: 200 V, 230 V, 380 V, 575 V
13) Optional: 380 V, 575 V
14) Optional: air cooling for motors 11 2E ... 26 2E; 7 4E ... 22 4E; 7 6E ... 18 6E;
15) Optional: up to 164 ft [50 m]
16) Optional: Viton = fluorocarbon rubber FPM

Feature	Motors						
2 poles	**3 2 E ... 26 2 E**	**-**	**55 2 E ... 75 2 E**	**-**	**-**	**-**	**-**
4 poles	**2 4 E ... 22 4 E**	**30 4 E ... 37 4 E**	**45 4 E ... 75 4 E**	**35 4 N ... 110 4 N**	**130 4 N ... 175 4 N**	**200 4 N ... 350 4 N**	**-**
6 poles	**7 6 E ... 18 6 E**	**22 6 E ... 30 6 E**	**31 6 E ... 55 6 E**	**32 6 N ... 100 6 N**	**120 6 N ... 165 6 N**	**190 6 N ... 480 6 N**	**530 6 N ... 850 6 N**
8 poles	**-**	**11 8 E ... 22 8 E**	**30 8 E ... 45 8 E**	**26 8 N ... 75 8 N**	**90 8 N ... 130 8 N**	**150 8 N ... 400 8 N**	**460 8 N ... 760 8 N**
10 poles	**-**	**-**	**-**	**-**	**40 10 N ... 90 10 N**	**110 10 N ... 350 10 N**	**390 10 N ... 660 10 N**
12 poles	**-**	**-**	**-**	**-**	**-**	**105 12 N ... 300 12 N**	**340 12 N ... 560 12 N**
Shaft seal	Bellows-type mechanical seal[17] with slurry cover						Mechanical seal with covered spring
Monitoring equipment							
~~Winding temperature, versions U, W; installation types S, P~~	~~Temperature switch (bimetal) in the winding~~						
Winding temperature, versions X, Z; installation types S, P	Temperature switch (bimetal) in the winding, plus PTC for explosion protection[18]	~~Temperature switch (bimetal) in the winding, plus PTC for explosion protection~~					-
~~Winding temperature; installation types D, H, K~~	~~PTC~~			~~PTC~~			
~~Coolant temperature; installation types D, K~~	-			~~PTC~~			
Bearing temperature	-		-[19]	~~Pt100 at pump end~~[20]			~~Pt100 at the pump end and drive end~~
Leakage inside the motor	Leakage sensor in the motor space						
Mechanical seal leakage	-			~~Float switch in leakage area~~			
~~Vibration sensor~~	-			-[21]			
Coating	Environmentally friendly KSB standard coating, color RAL 5002[22]						
Maximum fluid temperature and ambient temperature							
~~Version U~~	~~104 °F [40 °C]~~						
Version X	104 °F [40 °C]						-
~~Versions W, Z~~	~~140 °F [60 °C]~~						-
Tests/inspections							
Hydraulic system	KSB standard (ZN 56525)[23]						
General	KSB standard (ZN 56525)						
Installation type							

17) Optional: mechanical seal with covered spring
18) Motors 3 2E 2 4E, 3 4E: temperature switch (bimetal) in the winding, plus temperature switch (bimetal) for explosion protection
19) Optional: Pt100 at the pump end
20) Optional: Pt100 at pump end
21) Optional: internal vibration sensor
22) Optional: 250 µm two-component epoxy coating
23) Optional: S, D, E, F impellers to ISO 9906/A, K impellers to ISO 9906//1/2/A

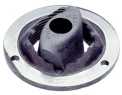
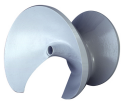
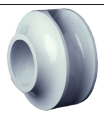
Feature	Motors						
2 poles	3 2 E ... 26 2 E	-	55 2 E ... 75 2 E	-	-	-	-
4 poles	2 4 E ... 22 4 E	30 4 E ... 37 4 E	45 4 E ... 75 4 E	35 4 N ... 110 4 N	130 4 N ... 175 4 N	200 4 N ... 350 4 N	-
6 poles	7 6 E ... 18 6 E	22 6 E ... 30 6 E	31 6 E ... 55 6 E	32 6 N ... 100 6 N	120 6 N ... 165 6 N	190 6 N ... 480 6 N	530 6 N ... 850 6 N
8 poles	-	11 8 E ... 22 8 E	30 8 E ... 45 8 E	26 8 N ... 75 8 N	90 8 N ... 130 8 N	150 8 N ... 400 8 N	460 8 N ... 760 8 N
10 poles	-	-	-	-	40 10 N ... 90 10 N	110 10 N ... 350 10 N	390 10 N ... 660 10 N
12 poles	-	-	-	-	-	105 12 N ... 300 12 N	340 12 N ... 560 12 N
Stationary, with guide cable arrangement	Installation depth 15 ft [4.5 m][24]						
Stationary, with guide rail arrangement	45 ft Installation depth 15 ft [4.5 m][25]						
Transportable	Up to size 300-401 (except sizes 200-502/503, 200-632)					-	
Stationary, dry	-			With cooling jacket			

Material variants H, C1, C2

Feature	Motors					
2 poles	3 2 E ... 7 2 E	-	55 2 E ... 75 2 E	-	-	-
4 poles	2 4 E ... 5 4 E	30 4 E ... 37 4 E	45 4 E ... 75 4 E	35 4 N ... 110 4 N	130 4 N ... 175 4 N	200 4 N ... 350 4 N
6 poles	-	22 6 E ... 30 6 E	31 6 E ... 55 6 E	32 6 N ... 100 6 N	120 6 N ... 165 6 N	190 6 N ... 480 6 N
8 poles	-	11 8 E ... 22 8 E	30 8 E ... 45 8 E	26 8 N ... 75 8 N	90 8 N ... 130 8 N	150 8 N ... 480 8 N
10 poles	-	-	-	-	40 10 N ... 90 10 N	110 10 N ... 350 10 N
12 poles	-	-	-	-	-	105 12 N ... 300 12 N
Suction flange	[26]					
Shaft material for material variant H						
Shaft	A 276 Type 420			A 276 Type 420[27]	A 276 Type 420	
Shaft protecting sleeve	-	-	-	A 276 Type 420[10]	A 276 Type 420	
Shaft material for material variants C1, C2						
Shaft	A 182 F51 / A 576 Gr. 1045			A 276 Type 420		
Shaft protecting sleeve	-	-	-	A 182 F51	A 182 F51	
Bearing assembly	Grease-packed rolling element bearings sealed for life			Pump end: re-greasable rolling element bearings drive end: grease-packed rolling element bearings sealed for life		
Explosion protection						
Versions U, W	Non-explosion-proof					
Versions X, Z	FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3					-
Motor						

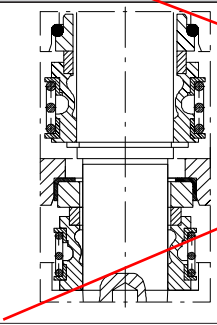
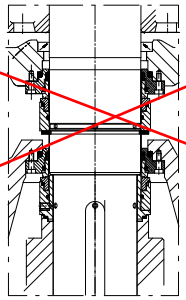
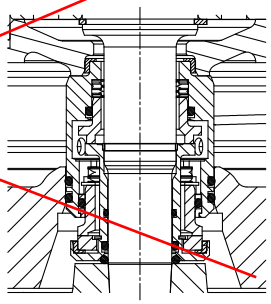
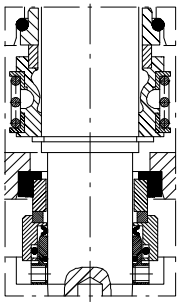
24) Optional: up to 98 ft [30 m], from size K200-502 up to 49 ft [15 m]
25) Optional: up to 98 ft [30 m]
26) Drilled to ANSI B16.1 Class 125 on request, not available for all sizes.
27) For maximum nominal impeller diameters 400 mm / 401 mm / 402 mm / 403 mm: A 182 F51

Impellers

	Impeller with cutter (impeller type S/S-max)
	Free-flow impeller (impeller type F/F-max)
	Closed single-channel impeller (impeller type E/E-max)
	Open, diagonal single-vane impeller (impeller type D)
	Closed multi-channel impeller (impeller type K/K-max)

Shaft seal

Available shaft seal types per bearing bracket

Standard design		Standard variant[47)]	
Mechanical seal with elastomer bellows (NBR, optional Viton)[48)]	Stationary cartridge seal with spring outside of fluid	Cartridge seal[49)50)51)]	Product-side mechanical seal with covered spring[50)51)]
			

47) A surcharge and longer delivery times apply to standard variants.
48) For all types of waste water
49) Only possible in combination with motor generation "E" for maximum nominal impeller diameters 315
50) For very abrasive fluids or fluids containing metallic particles (e.g. shavings from drilling)
51) Standard for material variants H and C2 (optional for material variants G, G1, G2, GH and C1)

Mass moments of inertia per motor

2-pole

Motor	Motor type	J
		[kgm²]
3 2 E	1	0,002
4 2 E	1	0,005
5 2 E	1	0,006
7 2 E	1	0,011
11 2 E	2	0,012
15 2 E	2	0,022
18 2 E	2	0,034
22 2 E	2	0,044
26 2 E	2	0,044
55 2 E	3	0,190
65 2 E	3	0,220
75 2 E	3	0,250

4-pole

Motor	Motor type	J
		[kgm²]
2 4 E	1	0,003
3 4 E	1	0,004
4 4 E	1	0,011
5 4 E	1	0,011
7 4 E	2	0,022
11 4 E	2	0,032
15 4 E	2	0,054
18 4 E	2	0,064
22 4 E	2	0,074
30 4 E	3	0,136
37 4 E	3	0,176
45 4 E	3	0,263
55 4 E	3	0,323
65 4 E	3	0,380
75 4 E	3	0,450
35 4 N	4	0,25
50 4 N	4	0,28
65 4 N	4	0,33
80 4 N	4	0,46
95 4 N	4	0,55
110 4 N	4	0,63
130 4 N	4	1,26
155 4 N	4	1,43
175 4 N	4	1,57
200 4 N	4	3,78
250 4 N	4	4,13
300 4 N	4	4,82
350 4 N	4	5,51

6-pole

Motor	Motor type	J
		[kgm²]
7 6 E	2	0,032
11 6 E	2	0,042
15 6 E	2	0,094
18 6 E	2	0,114
22 6 E	3	0,186
30 6 E	3	0,216
31 6 E	3	0,463
37 6 E	3	0,463
45 6 E	3	0,550
55 6 E	3	0,650
32 6 N	4	0,37
40 6 N	4	0,45
50 6 N	4	0,54
60 6 N	4	0,66
80 6 N	4	0,80
100 6 N	4	0,94
120 6 N	4	1,98
140 6 N	4	2,25
165 6 N	4	2,55
190 6 N	4	7,30
225 6 N	4	8,57
260 6 N	4	9,84
320 6 N	4	14,32
360 6 N	4	15,89
400 6 N	4	17,58
440 6 N	4	19,15
480 6 N	4	20,71
530 6 N	4	32,54
580 6 N	4	37,34
630 6 N	4	42,06
690 6 N	4	46,82
770 6 N	4	51,58
850 6 N	4	56,34

8-pole

Motor	Motor type	J
		[kgm²]
11 8 E	3	0,186
15 8 E	3	0,186
18 8 E	3	0,226
22 8 E	3	0,276
30 8 E	3	0,463
37 8 E	3	0,550
45 8 E	3	0,650
26 8 N	4	0,40
35 8 N	4	0,50
50 8 N	4	0,66
65 8 N	4	0,80
75 8 N	4	0,94
90 8 N	4	1,98
110 8 N	4	2,25
130 8 N	4	2,55
150 8 N	4	7,30
185 8 N	4	8,57
220 8 N	4	9,84
260 8 N	4	13,27
300 8 N	4	15,88
350 8 N	4	19,13
400 8 N	4	20,70
460 8 N	4	32,54
530 8 N	4	37,30
580 8 N	4	42,06
630 8 N	4	46,82
690 8 N	4	51,58
760 8 N	4	56,34

Installation types

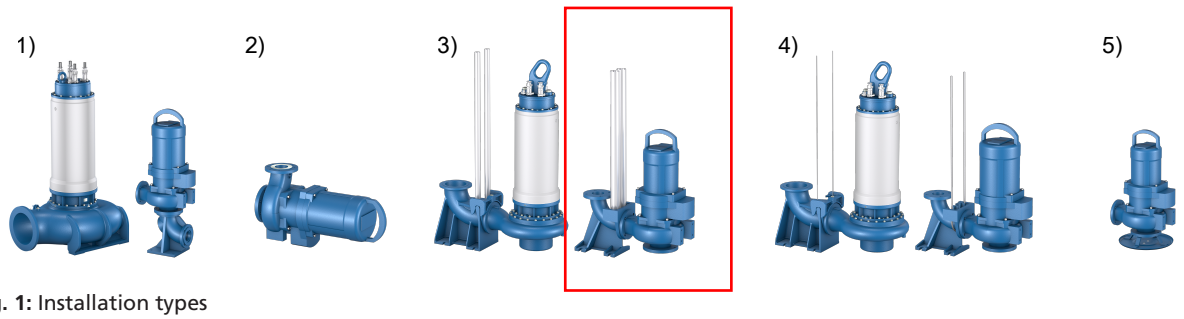


Fig. 1: Installation types

1	Installation type D: stationary dry installation, vertical (S1 duty)
2	Installation type H: stationary dry installation, horizontal (S1 duty)
3	Installation type K: wet installation (S1 duty with motor outside of the fluid possible) with guide rail arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide rail arrangement
4	Installation type K: stationary wet installation (S1 duty with motor outside of the fluid possible) with guide cable arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide cable arrangement
5	Installation type P: wet installation of transportable model (S1 duty with submerged motor)

Pump sets of installation types D, H and K
are suitable for continuous operation with the motor outside the fluid. Cooling is effected by means of air convection. Versions with a cooling jacket have an additional internal cooling circuit.

Pump sets of installation types P and S
are designed for continuously submerged operation. The motor is cooled by the fluid handled on the motor surface. Operation with the motor outside the fluid handled is possible for short periods.

Scope of supply

Stationary dry installation - vertical (installation type D)

- Pump set complete with connection cables
- Base elbow with inspection hole[54)] and fastening elements
- Optional: intake elbow with inspection hole

Stationary dry installation - horizontal (installation type H)

- Pump set complete with connection cables
- Foundation rails
- Suction-side flanged spacer with inspection hole[55)] (optional)

Stationary wet installation (installation types K and S)

- Pump set complete with connection cables
- Claw with sealing elements and mounting elements
- Lifting rope, lifting chain or lifting bail (optional)
- Mounting bracket with mounting elements
- Base elbow and mounting elements
- Guide cable / guide rail
  (guide rails are not included in KSB's scope of supply)

Transportable model for wet installation (installation type P)

- Pump set complete with connection cables
- Foot plate or pump stool with mounting elements

54) For nominal discharge nozzle diameter ≥ DN100
55) For nominal discharge nozzle diameter ≥ DN100

Amarex KRT, motor type 2

Correlation of motor and motor type: (⇨ Page 23)

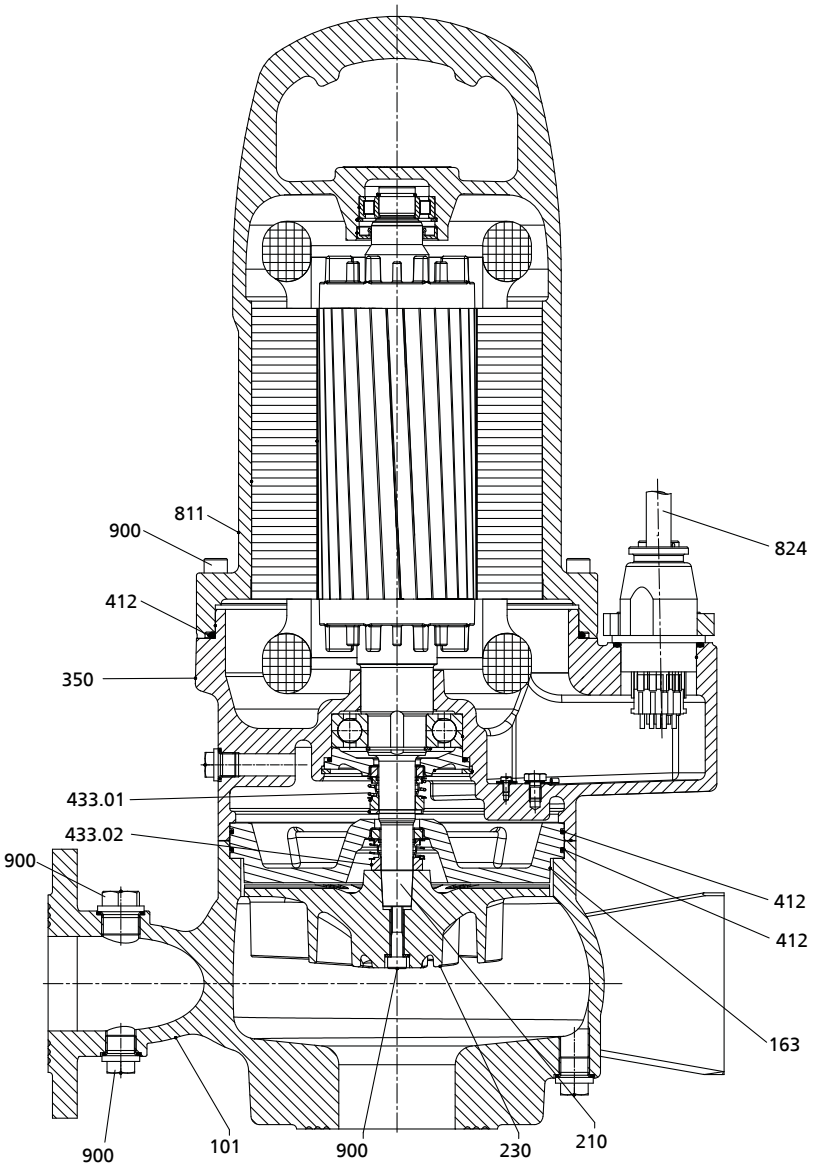


Fig. 3: General assembly drawing, example: Amarex KRT F 65-215

List of components

Part No.	Description	Part No.	Description
101	Pump casing	412	O-ring
163	Discharge cover	433.01/.02	Mechanical seal
210	Shaft	811	Motor housing
230	Impeller	824	Power cable
350	Bearing housing	900	Screw

SECTION 2B

P-2, P-3, P-4	KRT K 500-634/1308XNG-K

Data sheet

Pump type **KRT K 500-634/1308XNG-K**

Operating data

Flow	15000	US g.p.m.	Fluid			
Head	30	ft	Density of fluid	62.3	lb/ft³	
Operating speed	891.2	rpm	Viscosity	1.08E-5	ft²/s	
Shaft power	149	hp	Temperature	68	°F	
Efficiency	76.3	%				
Required pump NPSH	18.6	ft				
Head H(Q=0)	61.2	ft				
Application range	Head		Flow			
From	54.9	ft	7680	US g.p.m.		
To	7.52	ft	19200	US g.p.m.		

Design

Make	KSB	Impeller type	Stdd		
Design	Submersible pump		Closed		
Series	KRT K	Impeller size	(512)	20	inch
Frame size	500-634		Max. (638)	25	inch
Stages	1		Min. (503)	20	inch
Curve number	K43590	Free passage		5 1/4 inch	inch
		Weight		6838.6	lb

Type of bearings	Antifriction		
Nos. of bearings	2 / 1		
Lubrication	Grease lubrication. regreasing without dismantling of pump		
Suction port	Pressure rating		--
	Flange size	DN0	---
	Flange size	DN1	20"
	Norm		--
Discharge port	Pressure rating		CLASS 125
	Flange size	DN2	20 inch
	Flange size	DN3	20 inch
	Norm		ASME/ANSI B16.1

Suction port: pump (DN1)
Discharge port: discharge elbow (DN3)

Materials

Pump casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Discharge cover	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Shaft	Stainless steel EN-1.4021+QT800 (A 276 Type 420)
Bearing bracket	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bolts. nuts	Stainless steel A4 (EN-1.4571) (A 276 Type 316)
Shaft protection sleeve	Stainless steel EN-1.4021+QT800 (A 276 Type 420)
Casing wear ring	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller wear ring	---
O-Rings	Nitrile rubber (NBR)

Cooling Jacket

Data sheet

Pump type **KRT K 500-634/1308XNG-K**

Shaft seal

Type of seal	Double mechanical seal
Arrangement:	Tandem
Seal on medium side	with elastomer bellows
Mechanical seal. pump-side	Silicon carbide / Silicon carbide
Mechanical seal. bearing-side	Carbon / Silicon carbide

Monitoring

Thermal winding protection	By temperature sensitive switches or PTC
Explosion proof protection	---
Motor housing monitoring	By conductive moisture sensor electrode
Mechanical seal leakage detection	By float switch
Bearing temperature monitoring	By PT 100 RTD

Coating

Preparatory treatment	SSPC near white SP 10
Blasting method	Steel grit blasting
Primer	Zinc phosphate or Zinc dust
Dry film thickness primer	> 1 1/2 mils (35 microns)
Top coat	2-component epoxy resin
Solids content	> 82 %
Dry film thickness top coat	> 6 mils (150 microns)
Color	Ultramarine Blue

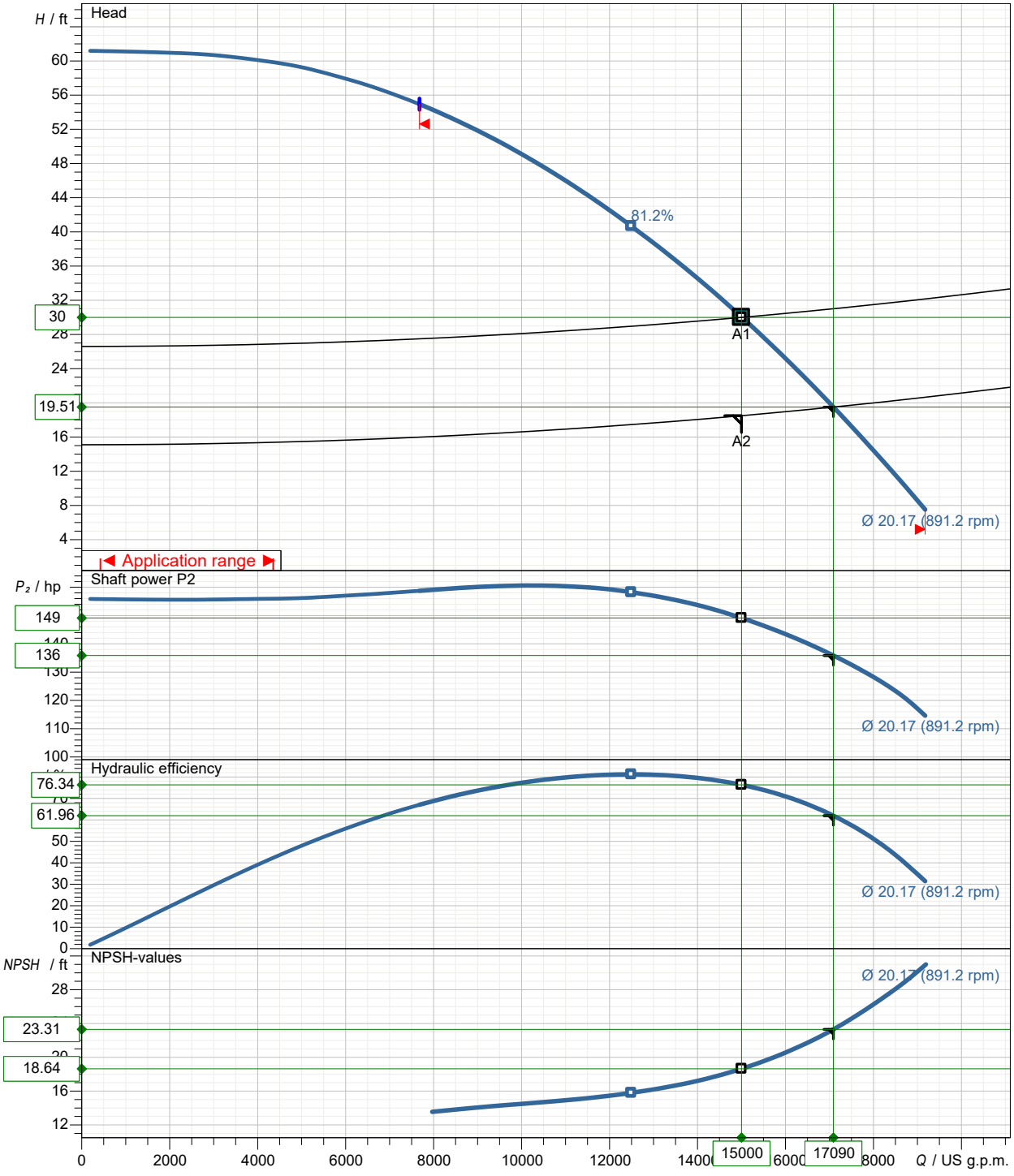
Installation

INSTALLATION	
Type of installation: automatic connection to a permanently installed discharge elbow	Wet well installation designed for
Discharge elbow size (DN2/DN3):	20 inch / 20 inch
Flange to suit:	ASME/ANSI B16.1, CLASS 125
Claw:	Bolted to the pump
Installation depth:	33 ft (10 m)
Guide system:	Double guide bars, by contractor
Guide bar dimension:	3" diameter pipes
Lift rigging:	stainless steel lifting chain
Length of lifting device:	33 ft (10 m)
Lifting loops:	Every 8 ft (2.5 m)
Installation accessories: fasteners, claw, bracket, lifting chain, but without guide bars	Discharge elbow, 20 inch / 20 inch
Materials:	
Discharge elbow:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Claw:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bracket:	Stainless steel EN-1.4571 (A 276 Type 316 Ti)
Lifting device:	Stainless steel EN-1.4404 (A 276 Type 316L)

INSTALLATION

Performance curve

Pump type **KRT K 500-634/1308XNG-K**



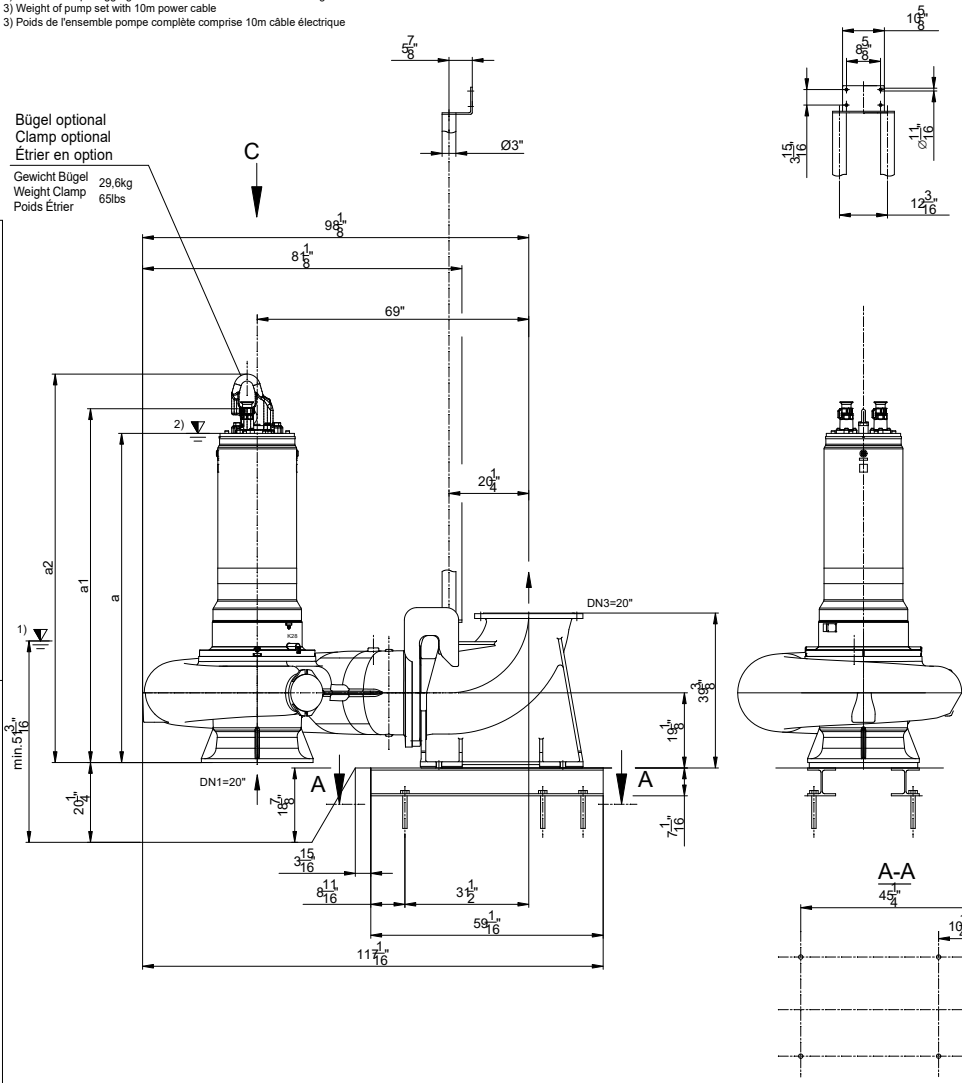
Impeller type	Stdd	, Closed			Curve number	K43590
Free passage	5 inch		Density of fluid	62.322 lb/ft³	Frequency	60 Hz
Impeller size	20 inch	(512)	Viscosity	1.082E-5 ft²/s	Speed	891.2 1/min

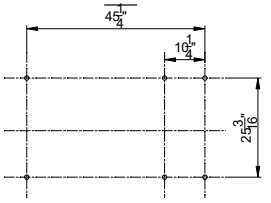
1)Tiefster Ausschaltpunkt bei Automatikbetrieb
1)Lowest shut-off point for automatic operation
1)Point d'arrêt le plus bas en service automatique

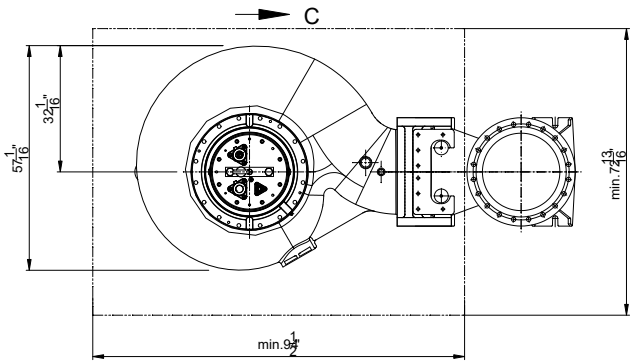
2)Mindestüberdeckung bei Dauerbetrieb für Variante S
2)Minimum submergence for continuous operation for variant S
2)Recouvrement minimal pour service continu pour variante S

3) Gewicht Pumpenaggregat mit 10m elektrischer Anschlussleitung
3) Weight of pump set with 10m power cable
3) Poids de l'ensemble pompe complète comprise 10m câble électrique

Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	50 Hz	60 Hz	a mm	a inch	a1 mm	a1 inch	a2 mm	a2 inch	Gewicht / Weight / Poids 3) Type S Material version/variant G kg	Type S G lbs	Type K Material version/variant G kg	Type K G lbs
K	165 6 K28	X	-	2126	83 11/16	2285	90	2510	98 13/16	3042	6712	3162	6977
	90 8 K28	X	X							2852	6293	2972	6557
	110 8 K28	X	X							2922	6447	3042	6712
	130 8 K28	X	X							2982	6579	3102	6844
	40 10 K28	X	-							2792	6160	2912	6425
	60 10 K28	X	X							2832	6249	2952	6513
	75 10 K28	X	X							2902	6403	3022	6668
	90 10 K28	-	X							2972	6557	3092	6822







mit Fundamentschienen
with foundation rails
avec glissieres de fondement

NUR FÜR ANFRAGE/ANGEBOT
technische Änderungen vorbehalten
FOR INQUIRY/OFFER ONLY
technical modifications reserved
SEULEMENT POUR LES DEMANDES/LES OFFRES
sous réserve de modifications technique

Maßstab/Scale/Echelle 1:20				stationäre Aufstellung stationary installation installation stationaire
CAD A 2				
KSB	1	2018-06-20	emmrpat	Baureihe-Größe/Type-Size KRT K 500-634 / K28
	0	2018-04-13	emmrpat	KSB Auftrags-Nr./KSB Order No./N° commande KSB ----------
	Änderung/Revision Modification	Datum/Date	Name/Nom	
KSB SE & Co. KGaA Turmstraße 92-100 D-06110 Halle (Saale)	CAD-BEZEICHNUNG			Zeichnungs-Nr./Drawing No./N° Plan
	SCHUTZVERMERK DIN 34-1-D			

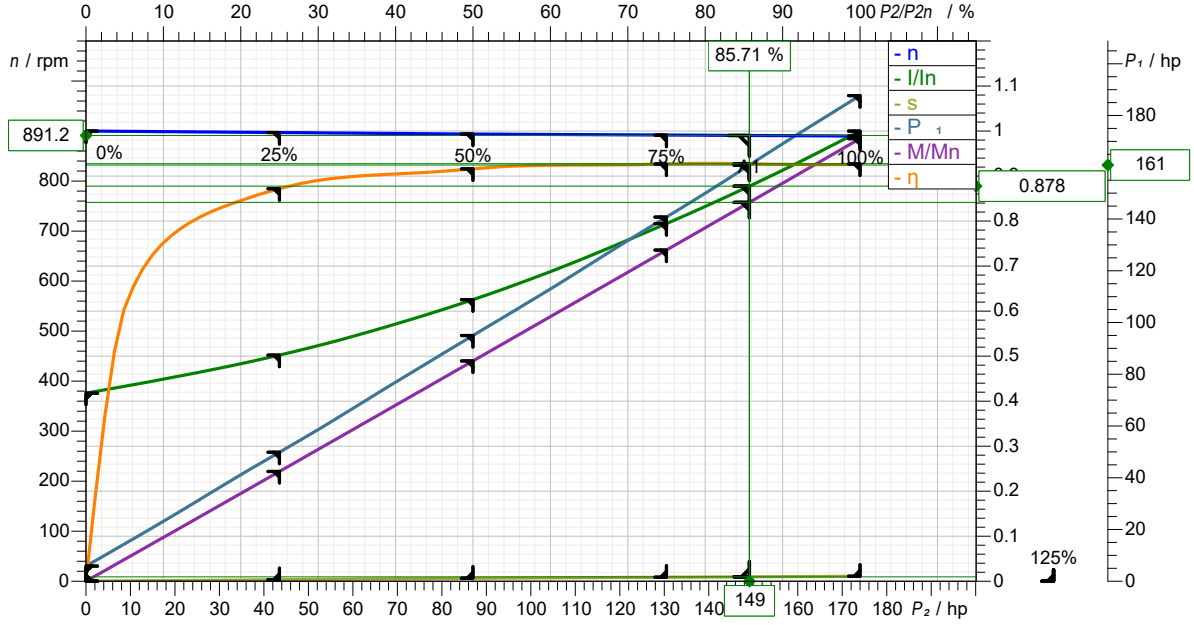
Data sheet: Motor data

Motor type 1308XNG K / D

Motor manufacturer	KSB SE & Co. KGaA	Rated voltage	460	V
Design acc. standard	-	Rated frequency	60	Hz
Service factor	1.14	Rated HP (D.O.L) or VFD	174	hp
Degree of protection	IP68	Rated current	219	A
Insulation class	H	Nominal speed	890	rpm
Starting mode	Direct starting	NEMA code letter	G	
No. starts / h	10	Starting to rated current	5.6	
Coolant temperature	< / = 104 °F (40 °C)	Starting current	1226.4	A
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)			
Explosion protection	Class I, Div. 1, Groups C,D, T3			
Pump type	KRT K 500-634/1308XNG-K			

Load	P1 kW	P2 hp	eta %	cos phi	I A
4/4	139.97	174.0	92.7	0.8	219.0
3/4	104.97	130.5	92.7	0.76	174.0
2/4	70.83	87.0	91.6	0.65	137.0
1/4	37.20	43.5	87.2	0.42	110.0

Main cable	2 x AWG 1/0-4	Diameter	153.66 US g.p.m....162.47 US g.p
Control cable	1 x AWG 15-10	Diameter	70.01 US g.p.m....74.41 US g.p.m
Cable. outer sheath	Waterproof synthetic rubber compound		
Cable length	80 ft (25 m)		



KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961
KSB Pumps Inc, 5885 Kennedy Road, Mississauga, Ontario L4Z 2G3 (Canada), Phone: (0905) 568-9200, Fax: (0905) 568-9120

KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

Waste Water

Submersible Motor Pump

Amarex KRT

Main applications

- Waste water management
- Service water supply systems
- Disposal
- Waste water treatment plants
- Sludge disposal

Fluids handled

- Sewage containing feces
- Activated sludge
- Digested sludge
- Raw sludge
- Fluids containing gas
- Industrial waste water

Operating data

SEE DATASHEETS FOR PROJECT SPECIFIC VALUES

Operating properties

Characteristic		Value
Flow rate	Q [US.gpm]	≤ 45000
	Q [l/s]	≤ 2800
Head	H [ft]	≤ 330
	H [m]	≤ 100
Fluid temperature	T [°F]	≤ +140
	T [°C]	≤ +60
Motor rating	P_2 [hp]	≤ 1140
	P_2 [kW]	≤ 850

Design details P-2, P-3 & P-4

Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

Drive

- Three-phase asynchronous squirrel-cage motor
- Motors integrated in explosion-proof pump sets are supplied in Explosionproof Class I Division 1, Groups C&D, T3.

Shaft seal

Standard bearings:

- Two bi-directional mechanical seals in tandem arrangement, with liquid reservoir

Reinforced bearings:

- Two bi-directional mechanical seals in tandem arrangement, with leakage chamber

Impeller type

- Various application-oriented impeller types

Bearings

Standard bearings:

- Grease-packed bearings sealed for life
- Maintenance-free

Reinforced bearings:

Drive end:

- Grease-packed bearings sealed for life
- Maintenance-free

Pump end:

- Grease-packed bearings
- Can be re-lubricated

Designation

Example: ~~Amarex KRT K 150-503/155 4 UN G-D IE3~~ Amarex KRT K500-634/1308XNG-K

Designation key

Code		Description	
Amarex KRT		Type series	
K		Impeller type (⇨ Page 4)	
		S/S-max	Impeller with cutter
		F/F-max	Free-flow impeller
		E/E-max	Closed single-channel impeller
		D	Open, diagonal single-vane impeller
		K/K-max	Closed multi-channel impeller
~~150~~	500	Nominal discharge nozzle diameter [mm]	
~~503~~	634	Maximum nominal impeller diameter [mm]	
~~155~~	130	Motor size	
~~4~~	8	Number of motor poles	
~~UN~~		Motor version	
		UN/UE	Non-explosion-proof, for fluid temperatures of up to 40 °C
		WN/WE	Non-explosion-proof, for fluid temperatures of up to 60 °C
	XN	XN/XE	Explosion-proof FM APPROVED or CSA explosion-proof Class I, Division I, Groups C & D, T3, for fluid temperatures of up to 40 °C
		ZN/ZE	Explosion-proof FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3, for fluid temperatures of up to 40 °C
G		Material variant	
		G	Standard variant, gray cast iron
		G1	Like G, impeller made of duplex stainless steel
		G2	Like G, impeller made of white cast iron
		GH	Like G, impeller and discharge cover made of white cast iron
		H	Wetted components made of white cast iron
		C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, bolts/screws made of A4
		C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462
~~D~~		Installation type (⇨ Page 34)	
		D	Stationary dry installation, vertical (S1 duty)
	K	H	Stationary dry installation, horizontal (S1 duty)
		K	Stationary wet installation (S1 duty with motor outside the fluid possible) with guide cable arrangement or guide rail arrangement
		S	Stationary wet installation (S1 duty with submerged motor) with guide cable arrangement or guide rail arrangement
		P	Wet installation of transportable model (S1 duty with submerged motor)
~~IE3~~		Motor efficiency classification[1]	
		[2]	No efficiency classification
		~~IE2~~	~~High Efficiency~~
		~~IE3~~	~~Premium Efficiency~~

1) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.
2) Blank

Materials

Overview of available materials

Part No.	Description	Material variant						
		G	G1	G2	GH	H	C1	C2
Pump set								
101	Pump casing	EN-GJL-250				EN-GJN-HB555	1.4517	
135	Wear plate[3]	EN-GJL-250		-				
163	Discharge cover	EN-GJL-250			EN-GJN-HB555		1.4517	
210	Shaft	1.4021 (⇨ Page 8)					1.4021/1.4462/C45+N (⇨ Page 8)	
230	Impeller[4]	EN-GJL-250	1.4517	EN-GJN-HB555			1.4517	
350	Bearing housing	EN-GJL-250					1.4517/EN-GJL-250	
412	O-ring	Nitrile butadiene rubber NBR						Viton (FKM)
433.01	Mechanical seal (drive end)	Carbon/SiC						
433.02	Mechanical seal (pump end)	SiC/SiC						
502	Casing wear ring[5]	EN-GJL-250			VG 434			
66-2	Cooling jacket	1.4571			-			
811	Motor housing	EN-GJL-250					1.4517	
824	Power cable	(⇨ Page 12)						
900	Screws/bolts	A4[6]						1.4462
Installation parts								
572	Guide cable suspension bracket	1.4571 to DN 200; EN-GJL-250 from size K200-500						1.4571
59-24	Guide cable	1.4401						1.4401/ Tefzel
72-1	Flanged elbow	EN-GJL-250				EN-GJN-HB555	1.4517	
732	Claw	EN-GJL-250 or EN-GJS-400-15/EN-GJS-500-7					1.4517	
885	Lifting chain/rope	Lifting chain: 1.4404 Lifting rope: polyamide/polypropylene					Lifting rope: polypropylene	
892	Foot plate / feet	1.0038 + Z					1.4571	1.4517/ 1.4462
894	Mounting bracket	1.4571 to DN 200; 1.0038 + Z from size K200-502						1.4571

Comparison of materials

EN	ASTM
EN-GJL-250	A 48 Class 35 B
EN-GJS-400-15	A 536 Class 60-40-18
EN-GJN-HB555	A 532 Class II Type B (15 % Cr-Mo)
1.4517	A 890 CD4MCuN
1.4021	A 276 Type 410

EN	ASTM
1.4401	A 276 Type 316 L
1.4462	A 182 F51
VG 434	-
1.4571	A 276 Type 316 Ti
C45+N	A 576 Gr. 1045
NBR	NBR
FKM	FKM

Description of materials

Gray cast iron EN-GJL-250 (lamellar graphite cast iron):
Lamellar graphite cast iron to EN 1561 is the most widely used cast material for handling municipal sewage, waste water and sludges as well as stormwater and surface water. It is suitable for neutral fluids which are only slightly aggressive and cause little wear. The pH should be ≥ 6.5, the sand content ≤ 0.5 g/l.

Duplex stainless steel (1.4517 or technically equivalent material)

This type of cast steel is resistant to cavitation, has excellent strength values and is used for high circumferential speeds. An excellent resistance to pitting corrosion makes ferritic-austenitic stainless steel a popular choice for pumping acidic waste water with a high chloride content as well as seawater and brackish water. Thanks to its good chemical resistance, e.g. against waste water containing phosphorus and sulphuric acid, this material is used in a wide range of applications in the chemical industry and process engineering. Pumps made of duplex stainless steel have a very long service life, even when handling brines, chemical waste water (pH 1 - 12), gray water and landfill leachate.

Wear-resistant white cast iron (EN-GJN-HB555 [XCR14] or technically equivalent material)

3) For D impeller
4) D impeller: EN-GJL-250, with hardened edges
5) For E impeller and K impeller
6) Equivalent to 1.4571

Wear-resistant white cast iron is suitable for handling highly abrasive fluids containing sand, ash or iron ore sinter, for example. It has a Rockwell hardness (HRC) of 54 as a minimum, which is higher than that of hardened chrome steel. Owing to its hardness, the chromium-molybdenum alloy cast iron features a notably higher wear resistance than EN-GJL-250 gray cast iron and other cast materials. A pH ≥ 6.5 should be observed.

Product benefits

- Absolutely water-tight resin-sealed cable entries prevent any water from entering the motor – even in the event of a damaged connection cable.
- Reliable operation ensured by moisture sensors signaling any ingress of moisture into the motor
- Reliable operation ensured by sensors monitoring the motor temperature and preventing overheating
- Non-clogging low-maintenance design with large free passages reduces clogging risk and, consequently, maintenance work.
- Optimum hydraulic and energy efficiency by high-efficiency motors and variable hydraulic systems

Material variants C1 and C2:

- Long service life due to corrosion-resistant wetted components made of stainless steel

Acceptance tests and warranty

Functional test

- Every pump undergoes functional testing to KSB standard ZN 56535.
- Operating data is guaranteed to DIN EN ISO 9906/2/2B or Hydraulic Institute Level A/B.

Acceptance tests

- Acceptance testing to ISO/DIN or comparable standards is available against a surcharge.
- Acceptance tests to Hydraulic Institute available on request.

Warranty

- Quality is assured by means of an audited and certified quality assurance system to DIN EN ISO 9001.

Selection information

- The indicated heads and performance data apply to material variant G, for fluids handled with a density $\rho = 1$ kg/dm³ and a kinematic viscosity $v \leqq 20$ mm²/s.
- For hydraulic acceptance tests of material variants other than "G" reduce the documented efficiencies by 2 percentage points.

Impeller type

- S, F, E and D impellers can only be supplied with the documented impeller diameters. Indicate the pump set designation and the impeller diameter in the purchase order.
- K impellers are trimmed to the duty point. Indicate the H / Q data or the impeller diameter in the purchase order. In the hydraulic selection program, the impeller diameter is automatically computed based on the H / Q data and added to the designation of the pump set.

Pump input power

- Adjust the power input to the density of the fluid handled:
  P_2 (required) = ρ [kg/dm³] (fluid handled) × P_2 (documented)
- Select the operating point with the largest power input within an operating range. Select a motor size providing a power reserve to compensate for the tolerances in the system characteristic / pump characteristic.

Recommended motor power reserve[7)]

P_2		Reserve	
[hp]	[kW]	Mains operation	With frequency inverter
≤ 40	≤ 30	10 %	15 %
> 40	> 30	5 %	10 %

- For installation types K and D (with cooling jacket) an additional power reserve of 2 hp [1.5 kW] must always be added for the cooling circuit.
- The motors are suitable for operation on a frequency inverter.
- The service factor for all motors equals 1.15.

In the case of waste water, too low a flow velocity in the discharge line will lead to clogging and increased wear. The flow velocity in the vertical riser must not fall below 2 m/s (6.56 ft/s).

In the case of waste water, too low a circumferential speed of the impeller will lead to clogging of the hydraulic system (operation on frequency inverter). A minimum circumferential speed (measured at the outside diameter of the impeller) of 12 m/s (39.4 ft/s) must be observed.[8)]

7) If larger power reserves are stipulated by local regulations, these larger reserves must be provided.
8) For F impellers, a circumferential speed below 12 m/s (39.4 ft/s) is permissible.

Overview of product features

Material variants G, G1, G2, GH

Feature	Motors						
2 poles	**3 2 E ... 26 2 E**	-	**55 2 E ... 75 2 E**	-	-	-	-
4 poles	**2 4 E ... 22 4 E**	**30 4 E ... 37 4 E**	**45 4 E ... 75 4 E**	**35 4 N ... 110 4 N**	**130 4 N ... 175 4 N**	**200 4 N ... 350 4 N**	-
6 poles	**7 6 E ... 18 6 E**	**22 6 E ... 30 6 E**	**31 6 E ... 55 6 E**	**32 6 N ... 100 6 N**	**120 6 N ... 165 6 N**	**190 6 N ... 480 6 N**	**530 6 N ... 850 6 N**
8 poles	-	**11 8 E ... 22 8 E**	**30 8 E ... 45 8 E**	**26 8 N ... 75 8 N**	**90 8 N .. 130 8 N**	**150 8 N ... 400 8 N**	**460 8 N ... 760 8 N**
10 poles	-	-	-	-	**40 10 N ... 90 10 N**	**110 10 N ... 350 10 N**	**390 10 N ... 660 10 N**
12 poles	-	-	-	-	-	**105 12 N ... 300 12 N**	**340 12 N ... 560 12 N**
Suction flange	[9]						
Shaft material							
Shaft	A 276 Type 420						
Shaft protecting sleeve	-			~~A 276 Type 420~~[10]	A 276 Type 420		
Bearing assembly	~~Grease-packed rolling element bearings sealed for life~~	~~Grease-packed rolling element bearings sealed for life~~[11]		Pump end: re-greasable rolling element bearings drive end: grease-packed rolling element bearings sealed for life			
Explosion protection							
~~Versions U, W~~	~~Non-explosion-proof~~						
Versions X, Z	FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3						-
Motor							
Starting method	~~DOL, soft starter, frequency inverter or star delta~~			DOL, soft starter, frequency inverter			
Voltage	460 V[12]						~~460 V~~[13]
Cooling	~~Cooled by surrounding fluid~~[14]	~~Cooled by surrounding fluid~~		Cooled by surrounding fluid or via cooling jacket			
Immersion depth	100 ft [30 m] max.						
Power cable							
Type	~~See table "Overview of power cables"~~						
Length	65 ft ~~30~~ ft [10 m][15]						
Cable entry	Absolutely watertight						
Sealing elements							
Elastomer seals	Nitrile butadiene rubber NBR[16]						

9) Drilled to ANSI B16.1 Class 125 on request, not available for all sizes.
10) For maximum nominal impeller diameters 400 mm / 401 mm / 402 mm / 403 mm: without shaft protecting sleeve
11) For D impeller: re-greasable rolling element bearings at the pump end, grease-packed rolling element bearings sealed for life at the drive end
12) Optional: 200 V, 230 V, 380 V, 575 V
13) Optional: 380 V, 575 V
14) Optional: air cooling for motors 11 2E ... 26 2E; 7 4E ... 22 4E; 7 6E ... 18 6E;
15) Optional: up to 164 ft [50 m]
16) Optional: Viton = fluorocarbon rubber FPM

Feature	Motors						
2 poles	**3 2 E ... 26 2 E**	**-**	**55 2 E ... 75 2 E**	**-**	**-**	**-**	**-**
4 poles	**2 4 E ... 22 4 E**	**30 4 E ... 37 4 E**	**45 4 E ... 75 4 E**	**35 4 N ... 110 4 N**	**130 4 N ... 175 4 N**	**200 4 N ... 350 4 N**	**-**
6 poles	**7 6 E ... 18 6 E**	**22 6 E ... 30 6 E**	**31 6 E ... 55 6 E**	**32 6 N ... 100 6 N**	**120 6 N ... 165 6 N**	**190 6 N ... 480 6 N**	**530 6 N ... 850 6 N**
8 poles	**-**	**11 8 E ... 22 8 E**	**30 8 E ... 45 8 E**	**26 8 N ... 75 8 N**	**90 8 N ... 130 8 N**	**150 8 N ... 400 8 N**	**460 8 N ... 760 8 N**
10 poles	**-**	**-**	**-**	**-**	**40 10 N ... 90 10 N**	**110 10 N ... 350 10 N**	**390 10 N ... 660 10 N**
12 poles	**-**	**-**	**-**	**-**	**-**	**105 12 N ... 300 12 N**	**340 12 N ... 560 12 N**
Shaft seal	Bellows-type mechanical seal[17] with slurry cover						Mechanical seal with covered spring
Monitoring equipment							
~~Winding temperature, versions U, W; installation types S, P~~	~~Temperature switch (bimetal) in the winding~~						
Winding temperature, versions X, Z; installation types S, P	~~Temperature switch (bimetal) in the winding, plus PTC for explosion protection[18]~~	Temperature switch (bimetal) in the winding, plus PTC for explosion protection					-
Winding temperature; installation types D, H, K	~~PTC~~	-		PTC			
Coolant temperature; installation types D, K	-			PTC			
Bearing temperature	-	-[19]		Pt100 at pump end[20]			~~Pt100 at the pump end and drive end~~
Leakage inside the motor	Leakage sensor in the motor space						
Mechanical seal leakage	-			Float switch in leakage area			
Vibration sensor	-			-[21]			
Coating	Environmentally friendly KSB standard coating, color RAL 5002[22]						
Maximum fluid temperature and ambient temperature							
~~Version U~~	~~104 °F [40 °C]~~						
Version X	104 °F [40 °C]						-
~~Versions W, Z~~	~~140 °F [60 °C]~~						-
Tests/inspections							
Hydraulic system	KSB standard (ZN 56525)[23]						
General	KSB standard (ZN 56525)						
Installation type							

17) Optional: mechanical seal with covered spring
18) Motors 3 2E 2 4E, 3 4E: temperature switch (bimetal) in the winding, plus temperature switch (bimetal) for explosion protection
19) Optional: Pt100 at the pump end
20) Optional: Pt100 at pump end
21) Optional: internal vibration sensor
22) Optional: 250 µm two-component epoxy coating
23) Optional: S, D, E, F impellers to ISO 9906/A, K impellers to ISO 9906//1/2/A

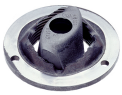
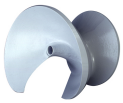
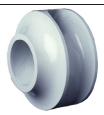
Feature	Motors						
2 poles	3 2 E ... 26 2 E	-	55 2 E ... 75 2 E	-	-	-	-
4 poles	2 4 E ... 22 4 E	30 4 E ... 37 4 E	45 4 E ... 75 4 E	35 4 N ... 110 4 N	130 4 N ... 175 4 N	200 4 N ... 350 4 N	-
6 poles	7 6 E ... 18 6 E	22 6 E ... 30 6 E	31 6 E ... 55 6 E	32 6 N ... 100 6 N	120 6 N ... 165 6 N	190 6 N ... 480 6 N	530 6 N ... 850 6 N
8 poles	-	11 8 E ... 22 8 E	30 8 E ... 45 8 E	26 8 N ... 75 8 N	90 8 N ... 130 8 N	150 8 N ... 400 8 N	460 8 N ... 760 8 N
10 poles	-	-	-	-	40 10 N ... 90 10 N	110 10 N ... 350 10 N	390 10 N ... 660 10 N
12 poles	-	-	-	-	-	105 12 N ... 300 12 N	340 12 N ... 560 12 N
Stationary, with guide cable arrangement	Installation depth 15 ft [4.5 m][24]						
Stationary, with guide rail arrangement	45 ft Installation depth 15 ft [4.5 m][25]						
Transportable	Up to size 300-401 (except sizes 200-502/503, 200-632)					-	
Stationary, dry	-			With cooling jacket			

Material variants H, C1, C2

Feature	Motors					
2 poles	3 2 E ... 7 2 E	-	55 2 E ... 75 2 E	-	-	-
4 poles	2 4 E ... 5 4 E	30 4 E ... 37 4 E	45 4 E ... 75 4 E	35 4 N ... 110 4 N	130 4 N ... 175 4 N	200 4 N ... 350 4 N
6 poles	-	22 6 E ... 30 6 E	31 6 E ... 55 6 E	32 6 N ... 100 6 N	120 6 N ... 165 6 N	190 6 N ... 480 6 N
8 poles	-	11 8 E ... 22 8 E	30 8 E ... 45 8 E	26 8 N ... 75 8 N	90 8 N ... 130 8 N	150 8 N ... 480 8 N
10 poles	-	-	-	-	40 10 N ... 90 10 N	110 10 N ... 350 10 N
12 poles	-	-	-	-	-	105 12 N ... 300 12 N
Suction flange	[26]					
Shaft material for material variant H						
Shaft	A 276 Type 420			A 276 Type 420[27]	A 276 Type 420	
Shaft protecting sleeve	-	-	-	A 276 Type 420[10]	A 276 Type 420	
Shaft material for material variants C1, C2						
Shaft	A 182 F51 / A 576 Gr. 1045			A 276 Type 420		
Shaft protecting sleeve	-	-	-	A 182 F51	A 182 F51	
Bearing assembly	Grease-packed rolling element bearings sealed for life			Pump end: re-greasable rolling element bearings drive end: grease-packed rolling element bearings sealed for life		
Explosion protection						
Versions U, W	Non-explosion-proof					
Versions X, Z	FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3					-
Motor						

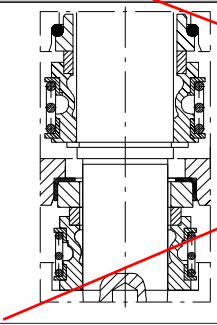
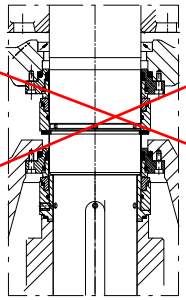
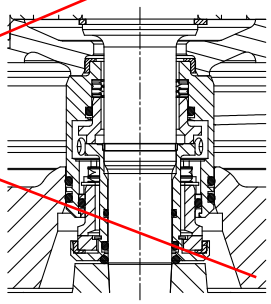
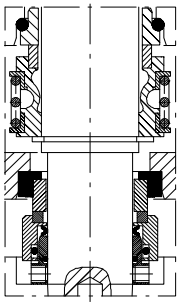
24) Optional: up to 98 ft [30 m], from size K200-502 up to 49 ft [15 m]
25) Optional: up to 98 ft [30 m]
26) Drilled to ANSI B16.1 Class 125 on request, not available for all sizes.
27) For maximum nominal impeller diameters 400 mm / 401 mm / 402 mm / 403 mm: A 182 F51

Impellers

	Impeller with cutter (impeller type S/S-max)
	Free-flow impeller (impeller type F/F-max)
	Closed single-channel impeller (impeller type E/E-max)
	Open, diagonal single-vane impeller (impeller type D)
	Closed multi-channel impeller (impeller type K/K-max)

Shaft seal

Available shaft seal types per bearing bracket

Standard design		Standard variant[47)]	
Mechanical seal with elastomer bellows (NBR, optional Viton)[48)]	Stationary cartridge seal with spring outside of fluid	Cartridge seal[49)50)51)]	Product-side mechanical seal with covered spring[50)51)]
			

47) A surcharge and longer delivery times apply to standard variants.
48) For all types of waste water
49) Only possible in combination with motor generation "E" for maximum nominal impeller diameters 315
50) For very abrasive fluids or fluids containing metallic particles (e.g. shavings from drilling)
51) Standard for material variants H and C2 (optional for material variants G, G1, G2, GH and C1)

Mass moments of inertia per motor

2-pole

Motor	Motor type	J [kgm²]
3 2 E	1	0,002
4 2 E	1	0,005
5 2 E	1	0,006
7 2 E	1	0,011
11 2 E	2	0,012
15 2 E	2	0,022
18 2 E	2	0,034
22 2 E	2	0,044
26 2 E	2	0,044
55 2 E	3	0,190
65 2 E	3	0,220
75 2 E	3	0,250

4-pole

Motor	Motor type	J [kgm²]
2 4 E	1	0,003
3 4 E	1	0,004
4 4 E	1	0,011
5 4 E	1	0,011
7 4 E	2	0,022
11 4 E	2	0,032
15 4 E	2	0,054
18 4 E	2	0,064
22 4 E	2	0,074
30 4 E	3	0,136
37 4 E	3	0,176
45 4 E	3	0,263
55 4 E	3	0,323
65 4 E	3	0,380
75 4 E	3	0,450
35 4 N	4	0,25
50 4 N	4	0,28
65 4 N	4	0,33
80 4 N	4	0,46
95 4 N	4	0,55
110 4 N	4	0,63
130 4 N	4	1,26
155 4 N	4	1,43
175 4 N	4	1,57
200 4 N	4	3,78
250 4 N	4	4,13
300 4 N	4	4,82
350 4 N	4	5,51

6-pole

Motor	Motor type	J [kgm²]
7 6 E	2	0,032
11 6 E	2	0,042
15 6 E	2	0,094
18 6 E	2	0,114
22 6 E	3	0,186
30 6 E	3	0,216
31 6 E	3	0,463
37 6 E	3	0,463
45 6 E	3	0,550
55 6 E	3	0,650
32 6 N	4	0,37
40 6 N	4	0,45
50 6 N	4	0,54
60 6 N	4	0,66
80 6 N	4	0,80
100 6 N	4	0,94
120 6 N	4	1,98
140 6 N	4	2,25
165 6 N	4	2,55
190 6 N	4	7,30
225 6 N	4	8,57
260 6 N	4	9,84
320 6 N	4	14,32
360 6 N	4	15,89
400 6 N	4	17,58
440 6 N	4	19,15
480 6 N	4	20,71
530 6 N	4	32,54
580 6 N	4	37,34
630 6 N	4	42,06
690 6 N	4	46,82
770 6 N	4	51,58
850 6 N	4	56,34

8-pole

Motor	Motor type	J [kgm²]
11 8 E	3	0,186
15 8 E	3	0,186
18 8 E	3	0,226
22 8 E	3	0,276
30 8 E	3	0,463
37 8 E	3	0,550
45 8 E	3	0,650
26 8 N	4	0,40
35 8 N	4	0,50
50 8 N	4	0,66
65 8 N	4	0,80
75 8 N	4	0,94
90 8 N	4	1,98
110 8 N	4	2,25
130 8 N	4	2,55
150 8 N	4	7,30
185 8 N	4	8,57
220 8 N	4	9,84
260 8 N	4	13,27
300 8 N	4	15,88
350 8 N	4	19,13
400 8 N	4	20,70
460 8 N	4	32,54
530 8 N	4	37,30
580 8 N	4	42,06
630 8 N	4	46,82
690 8 N	4	51,58
760 8 N	4	56,34

Installation types

Fig. 1: Installation types

1	Installation type D: stationary dry installation, vertical (S1 duty)
2	Installation type H: stationary dry installation, horizontal (S1 duty)
3	Installation type K: wet installation (S1 duty with motor outside of the fluid possible) with guide rail arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide rail arrangement
4	Installation type K: stationary wet installation (S1 duty with motor outside of the fluid possible) with guide cable arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide cable arrangement
5	Installation type P: wet installation of transportable model (S1 duty with submerged motor)

Pump sets of installation types D, H and K
are suitable for continuous operation with the motor outside the fluid. Cooling is effected by means of air convection. Versions with a cooling jacket have an additional internal cooling circuit.

Pump sets of installation types P and S
are designed for continuously submerged operation. The motor is cooled by the fluid handled on the motor surface. Operation with the motor outside the fluid handled is possible for short periods.

Scope of supply

Stationary dry installation - vertical (installation type D)

- Pump set complete with connection cables
- Base elbow with inspection hole[54)] and fastening elements
- Optional: intake elbow with inspection hole

Stationary dry installation - horizontal (installation type H)

- Pump set complete with connection cables
- Foundation rails
- Suction-side flanged spacer with inspection hole[55)] (optional)

Stationary wet installation (installation types K and S)

- Pump set complete with connection cables
- Claw with sealing elements and mounting elements
- Lifting rope, lifting chain or lifting bail (optional)
- Mounting bracket with mounting elements
- Base elbow and mounting elements
- Guide cable / guide rail
  (guide rails are not included in KSB's scope of supply)

Transportable model for wet installation (installation type P)

- Pump set complete with connection cables
- Foot plate or pump stool with mounting elements

54) For nominal discharge nozzle diameter ≥ DN100
55) For nominal discharge nozzle diameter ≥ DN100

Amarex KRT, motor type 4, installation types K and D

Correlation of motor and motor type: (⇨ Page 23)

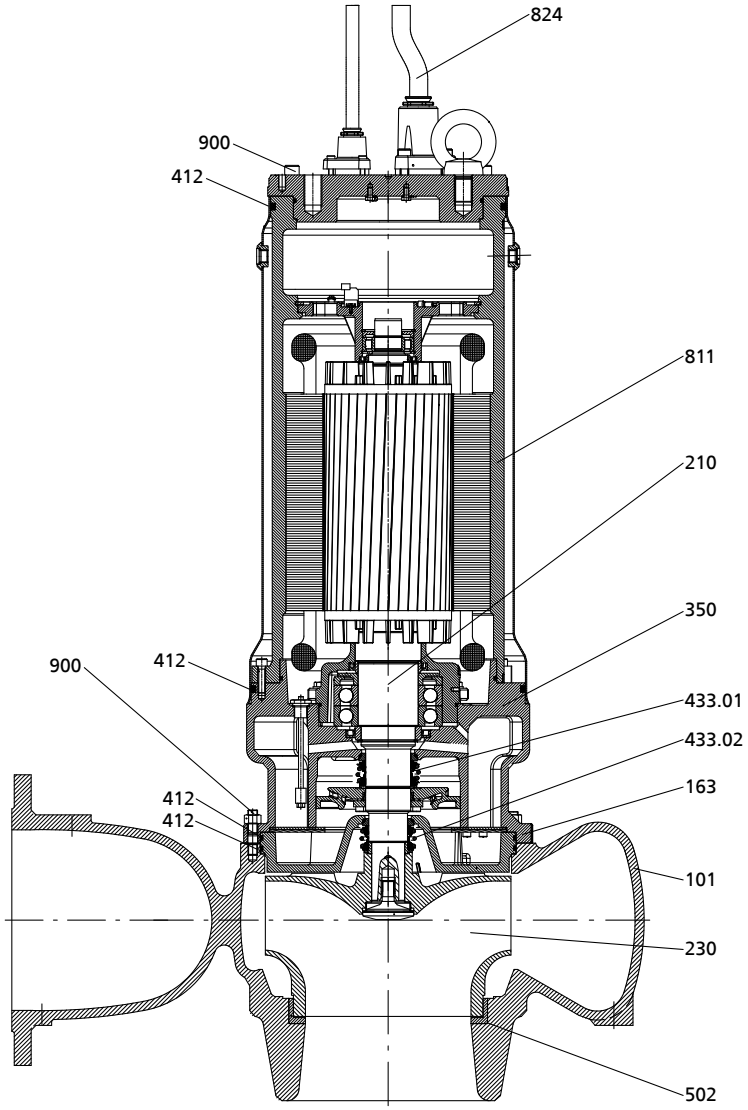


Fig. 6: General assembly drawing, example: Amarex KRT K 150-403 / 130 4 XNG-K with cooling jacket

List of components

Part No.	Description	Part No.	Description
101	Pump casing	433.01/.02	Mechanical seal
163	Discharge cover	502	Casing wear ring
210	Shaft	811	Motor housing
230	Impeller	824	Power cable
350	Bearing housing	900	Bolt/screw
412	O-ring		

SECTION 2C

Sump Pump	KRT F 80-217/24XEG-S

Data sheet

Pump type KRT F 80-217/24XEG-S IE3

Operating data

Flow	53.3	US g.p.m.	Fluid		
Head	31.5	ft	Density of fluid	62.3	lb/ft³
Operating speed	1759	rpm	Viscosity	1.08E-5	ft²/s
Shaft power	1.52	hp	Temperature	68	°F
Efficiency	28.1	%			
Required pump NPSH	5	ft			
Head H(Q=0)	34.2	ft			
Application range	Head		Flow		
From	33.9	ft	4.81	US g.p.m.	
To	11.9	ft	181	US g.p.m.	

Design

Make	KSB		Impeller type	Vortex impeller	
Design	Submersible pump			Open	
Series	KRT F		Impeller size	(180) 7	inch
Frame size	80-217			Max. (200) 8	inch
Stages	1			Min. (120) 5	inch
Curve number	K43504/0		Free passage	3 1/8 inch	inch
			Weight		lb
Type of bearings	Antifriction				
Nos. of bearings	1 / 1				
Lubrication	Grease lubrication. lubricated for lifetime				
Suction port	Pressure rating		--		
	Flange size	DN0	---		
	Flange size	DN1	4"		
	Norm		--		
Discharge port	Pressure rating		CLASS 125		
	Flange size	DN2	3 inch		
	Flange size	DN3	3 inch		
	Norm		ASME/ANSI B16.1		

Suction port: pump (DN1)
Discharge port: discharge elbow (DN3)

Materials

Pump casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Discharge cover	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Shaft	Stainless steel EN-1.4021+QT800 (A 276 Type 420)
Bearing bracket	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bolts. nuts	Stainless steel A4 (EN-1.4571) (A 276 Type 316)
Shaft protection sleeve	---
Casing wear ring	
Impeller wear ring	
O-Rings	Nitrile rubber (NBR)

Data sheet

Pump type **KRT F 80-217/24XEG-S IE3**

Shaft seal

Type of seal	Double mechanical seal
Arrangement:	Tandem
Seal on medium side	with elastomer bellows
Mechanical seal. pump-side	Silicon carbide / Silicon carbide
Mechanical seal. bearing-side	Carbon / Silicon carbide

Monitoring

Thermal winding protection	By temperature sensitive switches
Explosion proof protection	By temperature sensitive switches
Motor housing monitoring	By conductive moisture sensor electrode
Mechanical seal leakage detection	---
Bearing temperature monitoring	---

Coating

Preparatory treatment	SSPC near white SP 10
Blasting method	Steel grit blasting
Primer	Zinc phosphate or Zinc dust
Dry film thickness primer	> 1 1/2 mils (35 microns)
Top coat	2-component epoxy resin
Solids content	> 82 %
Dry film thickness top coat	> 6 mils (150 microns)
Color	Ultramarine Blue

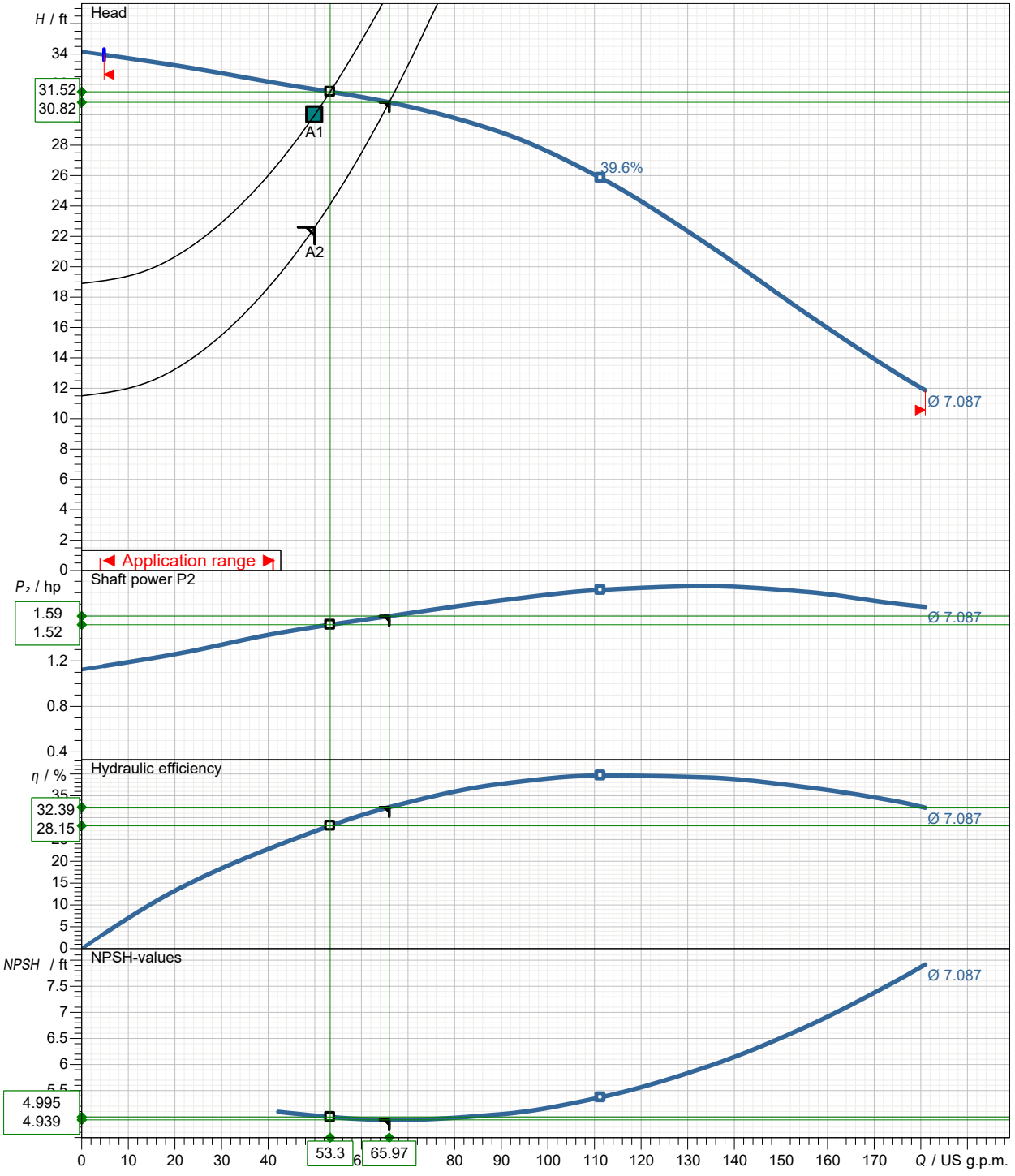
Installation

INSTALLATION	
Type of installation:	Wet well installation designed for automatic connection to a permanently installed discharge elbow
Discharge elbow size (DN2/DN3):	3 inch / 3 inch
Flange to suit:	ASME/ANSI B16.1, CLASS 125
Claw:	Bolted to the pump
Guide system:	Double guide bars, by contractor
Guide bar dimension:	2" diameter pipes
Installation depth:	33 ft (10 m)
Lifting device:	
Length of lifting device:	33 ft (10 m)
Lifting loops:	Every 8 ft (2.5 m)
Installation accessories:	Discharge elbow, 3 inch / 3 inch fasteners, claw, bracket, lifting chain, but without guide bars
Materials:	
Discharge elbow:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Claw:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bracket:	Stainless steel EN-1.4571 (A 276 Type 316 Ti)
Lifting device:	

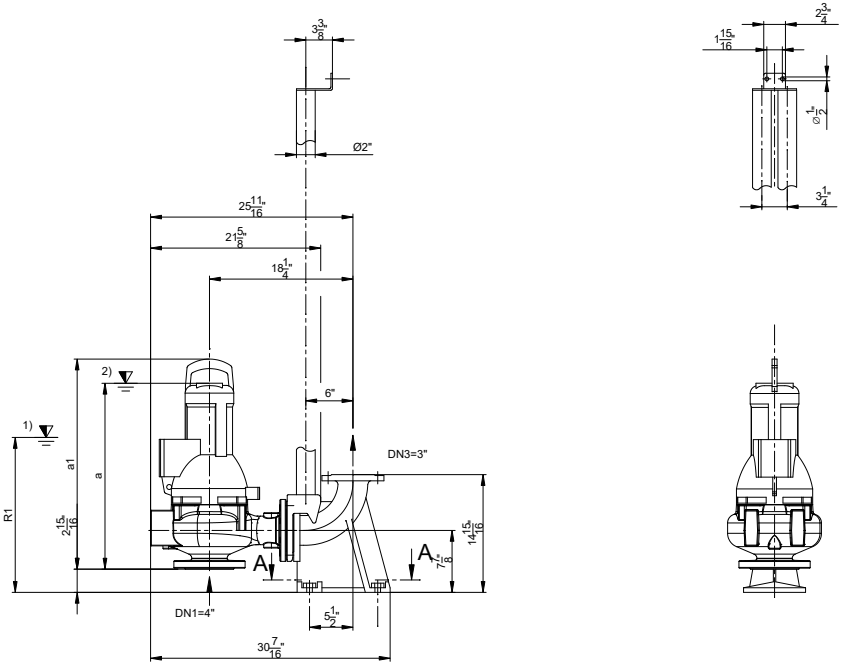
INSTALLATION

Performance curve

Pump type **KRT F 80-217/24XEG-S IE3**

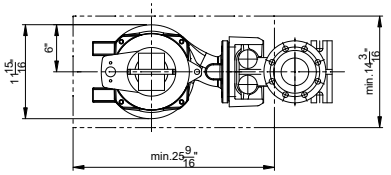


Impeller type	Vortex impeller , Open			Curve number	K43504/0
Free passage	3 inch	Density of fluid	62.322 lb/ft³	Frequency	60 Hz
Impeller size	7 inch (180)	Viscosity	1.082E-5 ft²/s	Speed	1759 1/min

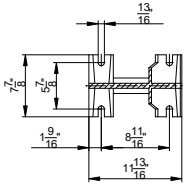


Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	a			a1			Gewicht / Weight / Poids					
		50 Hz	60 Hz		50 Hz	60 Hz		G		H		C1, C2	
		mm	mm	inch	mm	mm	inch	kg	lbs	kg	lbs	kg	lbs
F	32 KA09							98	216	--	--	--	--
	24 KA09	---	600	23 5/8	---	678	26 11/16	98	216	--	--	--	--
	34 KA09							100	221	--	--	--	--

Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	R1			
		U...X...Y...W...- Motor/Engine/Moteur		Z...- Motor/Engine/Moteur	
		mm	inch	mm	inch
F	32 KA09				
	24 KA09	500	19 11/16	500	19 11/16
	34 KA09				



A-A



1)Tiefster Ausschaltpunkt bei Automatikbetrieb
1)Lowest shut-off point for automatic operation
1)Point d'arrêt le plus bas en service automatique

2)Mindestüberdeckung bei Dauerbetrieb
2)Minimum submergence for continuous operation
2)Recouvrement minimal pour service continu

NUR FÜR ANFRAGE/ANGEBOT
technische Änderungen vorbehalten
FOR INQUIRY/OFFER ONLY
technical modifications reserved
SEULEMENT POUR LES DEMANDES/LES OFFRES
sous réserve de modifications technique

Maßstab/Scale/Echelle 1:10				stationäre Aufstellung stationary installation installation stationnaire
CAD A 2				
KSB				Baureihe-Größe/Type-Size KRT F 80-217
	0	2018-04-13	emmrpat	KSB Auftrags-Nr./KSB Order No./N° commande KSB ----------
	Änderung/Revision Modification	Datum/Date	Name/Nom	
KSB SE & Co. KGaA Turmstraße 92-100 D-06110 Halle (Saale)	CAD-BEZEICHNUNG			Zeichnungs-Nr./Drawing No./N° Plan
	SCHUTZVERMERK DIN 34-1-D			

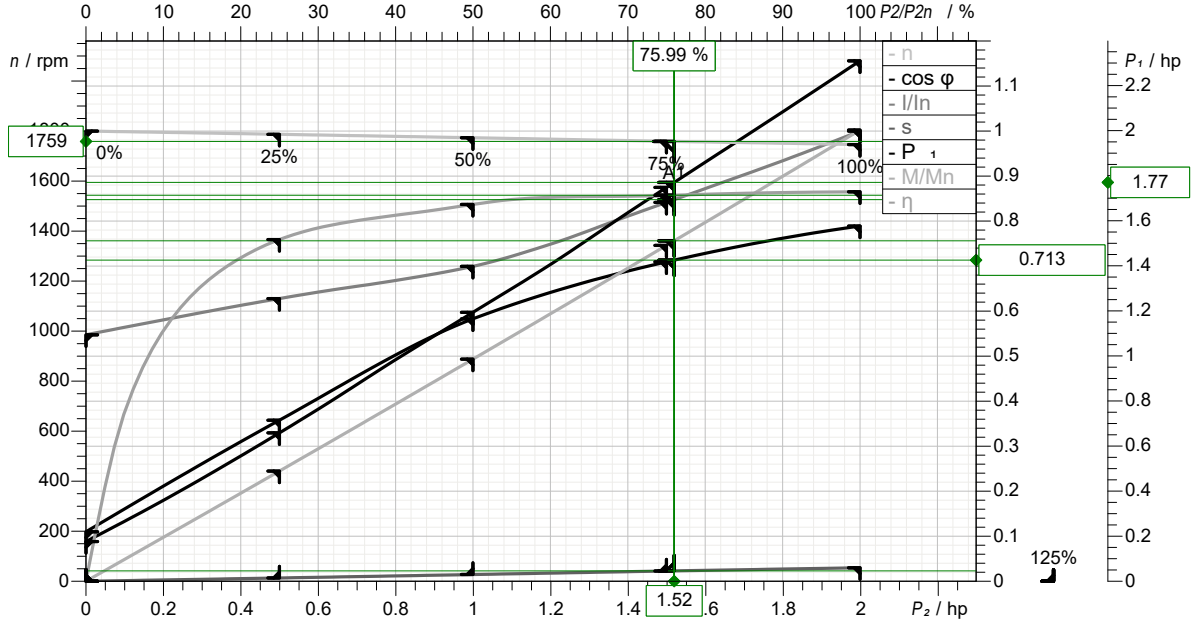
Data sheet: Motor data

Motor type 24XEG IE3

Motor manufacturer	KSB SE & Co. KGaA	Rated voltage	460	V
Design acc. standard	IE3	Rated frequency	60	Hz
Service factor	1.14	Rated HP (D.O.L) or VFD	2	hp
Degree of protection	IP68	Rated current	2.74	A
Insulation class		Nominal speed	1746	rpm
Starting mode	Direct starting	NEMA code letter	K	
No. starts / h	30	Starting to rated current	7.9	
Coolant temperature	< / = 104 °F (40 °C)	Starting current	21.6	A
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)			
Explosion protection	Class I, Div. 1, Groups C,D, T3			
Pump type	KRT F 80-217/24XEG-S IE3			

Load	P1 kW	P2 hp	eta %	cos phi	I A
4/4	1.72	2.0	86.5	0.79	2.7
3/4	1.31	1.5	85.5	0.71	2.3
2/4	0.90	1.0	83.2	0.58	1.9
1/4	0.49	0.5	76.3	0.36	1.7

Main cable	1 x AWG 15-8	Diameter	62.96 US g.p.m....67.36 US g.p.m
Control cable	---	Diameter	
Cable. outer sheath	Waterproof synthetic rubber compound		
Cable length	50 ft (15 m)		



KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961
KSB Pumps Inc, 5885 Kennedy Road, Mississauga, Ontario L4Z 2G3 (Canada), Phone: (0905) 568-9200, Fax: (0905) 568-9120

KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

Waste Water

Submersible Motor Pump

Amarex KRT

Main applications

- Waste water management
- Service water supply systems
- Disposal
- Waste water treatment plants
- Sludge disposal

Fluids handled

- Sewage containing feces
- Activated sludge
- Digested sludge
- Raw sludge
- Fluids containing gas
- Industrial waste water

Operating data

SEE DATASHEETS FOR PROJECT SPECIFIC VALUES

Operating properties

Characteristic		Value
Flow rate	Q [US.gpm]	≤ 45000
	Q [l/s]	≤ 2800
Head	H [ft]	≤ 330
	H [m]	≤ 100
Fluid temperature	T [°F]	≤ +140
	T [°C]	≤ +60
Motor rating	P_2 [hp]	≤ 1140
	P_2 [kW]	≤ 850

Design details

SUMP

Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

Drive

- Three-phase asynchronous squirrel-cage motor
- Motors integrated in explosion-proof pump sets are supplied in Explosionproof Class I Division 1, Groups C&D, T3.

Shaft seal

Standard bearings:

- Two bi-directional mechanical seals in tandem arrangement, with liquid reservoir

Reinforced bearings:

- Two bi-directional mechanical seals in tandem arrangement, with leakage chamber

Impeller type

- Various application-oriented impeller types

Bearings

Standard bearings:

- Grease-packed bearings sealed for life
- Maintenance-free

Reinforced bearings:

Drive end:

- Grease-packed bearings sealed for life
- Maintenance-free

Pump end:

- Grease-packed bearings
- Can be re-lubricated

Designation

Example: ~~Amarex KRT K 150-503/155 4 UN G-D IE3~~ Amarex KRT F80-217/124XEG-S IE3

Designation key

Code		Description	
Amarex KRT		Type series	
~~K~~		Impeller type (⇨ Page 4)	
		S/S-max	Impeller with cutter
	F	F/F-max	Free-flow impeller
		E/E-max	Closed single-channel impeller
		D	Open, diagonal single-vane impeller
		K/K-max	Closed multi-channel impeller
~~150~~	80	Nominal discharge nozzle diameter [mm]	
~~503~~	217	Maximum nominal impeller diameter [mm]	
~~155~~	2	Motor size	
~~4~~	4	Number of motor poles	
~~UN~~		Motor version	
		UN/UE	Non-explosion-proof, for fluid temperatures of up to 40 °C
		WN/WE	Non-explosion-proof, for fluid temperatures of up to 60 °C
	XE	XN/XE	Explosion-proof FM APPROVED or CSA explosion-proof Class I, Division I, Groups C & D, T3, for fluid temperatures of up to 40 °C
		ZN/ZE	Explosion-proof FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3, for fluid temperatures of up to 40 °C
G		Material variant	
		G	Standard variant, gray cast iron
		G1	Like G, impeller made of duplex stainless steel
		G2	Like G, impeller made of white cast iron
		GH	Like G, impeller and discharge cover made of white cast iron
		H	Wetted components made of white cast iron
		C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, bolts/screws made of A4
		C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462
~~D~~		Installation type (⇨ Page 34)	
		D	Stationary dry installation, vertical (S1 duty)
	S	H	Stationary dry installation, horizontal (S1 duty)
		K	Stationary wet installation (S1 duty with motor outside the fluid possible) with guide cable arrangement or guide rail arrangement
		S	Stationary wet installation (S1 duty with submerged motor) with guide cable arrangement or guide rail arrangement
		P	Wet installation of transportable model (S1 duty with submerged motor)
~~IE3~~		Motor efficiency classification[1]	
		[2]	~~No efficiency classification~~
		~~IE2~~	~~High Efficiency~~
		IE3	Premium Efficiency

1) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.
2) Blank

Materials

Overview of available materials

Part No.	Description	Material variant						
		G	G1	G2	GH	H	C1	C2
Pump set								
101	Pump casing	EN-GJL-250				EN-GJN-HB555	1.4517	
135	Wear plate[3]	EN-GJL-250		-				
163	Discharge cover	EN-GJL-250			EN-GJN-HB555		1.4517	
210	Shaft	1.4021 (⇨ Page 8)					1.4021/1.4462/C45+N (⇨ Page 8)	
230	Impeller[4]	EN-GJL-250	1.4517	EN-GJN-HB555			1.4517	
350	Bearing housing	EN-GJL-250					1.4517/EN-GJL-250	
412	O-ring	Nitrile butadiene rubber NBR						Viton (FKM)
433.01	Mechanical seal (drive end)	Carbon/SiC						
433.02	Mechanical seal (pump end)	SiC/SiC						
502	Casing wear ring[5]	EN-GJL-250			VG 434			
66-2	Cooling jacket	1.4571			-			
811	Motor housing	EN-GJL-250					1.4517	
824	Power cable	(⇨ Page 12)						
900	Screws/bolts	A4[6]						1.4462
Installation parts								
572	Guide cable suspension bracket	1.4571 to DN 200; EN-GJL-250 from size K200-500						1.4571
59-24	Guide cable	1.4401						1.4401/ Tefzel
72-1	Flanged elbow	EN-GJL-250				EN-GJN-HB555	1.4517	
732	Claw	EN-GJL-250 or EN-GJS-400-15/EN-GJS-500-7					1.4517	
885	Lifting chain/rope	Lifting chain: 1.4404 Lifting rope: polyamide/polypropylene					Lifting rope: polypropylene	
892	Foot plate / feet	1.0038 + Z					1.4571	1.4517/ 1.4462
894	Mounting bracket	1.4571 to DN 200; 1.0038 + Z from size K200-502						1.4571

Comparison of materials

EN	ASTM
EN-GJL-250	A 48 Class 35 B
EN-GJS-400-15	A 536 Class 60-40-18
EN-GJN-HB555	A 532 Class II Type B (15 % Cr-Mo)
1.4517	A 890 CD4MCuN
1.4021	A 276 Type 410

EN	ASTM
1.4401	A 276 Type 316 L
1.4462	A 182 F51
VG 434	-
1.4571	A 276 Type 316 Ti
C45+N	A 576 Gr. 1045
NBR	NBR
FKM	FKM

Description of materials

Gray cast iron EN-GJL-250 (lamellar graphite cast iron):
Lamellar graphite cast iron to EN 1561 is the most widely used cast material for handling municipal sewage, waste water and sludges as well as stormwater and surface water. It is suitable for neutral fluids which are only slightly aggressive and cause little wear. The pH should be ≥ 6.5, the sand content ≤ 0.5 g/l.

Duplex stainless steel (1.4517 or technically equivalent material)

This type of cast steel is resistant to cavitation, has excellent strength values and is used for high circumferential speeds. An excellent resistance to pitting corrosion makes ferritic-austenitic stainless steel a popular choice for pumping acidic waste water with a high chloride content as well as seawater and brackish water. Thanks to its good chemical resistance, e.g. against waste water containing phosphorus and sulphuric acid, this material is used in a wide range of applications in the chemical industry and process engineering. Pumps made of duplex stainless steel have a very long service life, even when handling brines, chemical waste water (pH 1 - 12), gray water and landfill leachate.

Wear-resistant white cast iron (EN-GJN-HB555 [XCR14] or technically equivalent material)

3) For D impeller
4) D impeller: EN-GJL-250, with hardened edges
5) For E impeller and K impeller
6) Equivalent to 1.4571

Wear-resistant white cast iron is suitable for handling highly abrasive fluids containing sand, ash or iron ore sinter, for example. It has a Rockwell hardness (HRC) of 54 as a minimum, which is higher than that of hardened chrome steel. Owing to its hardness, the chromium-molybdenum alloy cast iron features a notably higher wear resistance than EN-GJL-250 gray cast iron and other cast materials. A pH ≥ 6.5 should be observed.

Product benefits

- Absolutely water-tight resin-sealed cable entries prevent any water from entering the motor – even in the event of a damaged connection cable.
- Reliable operation ensured by moisture sensors signaling any ingress of moisture into the motor
- Reliable operation ensured by sensors monitoring the motor temperature and preventing overheating
- Non-clogging low-maintenance design with large free passages reduces clogging risk and, consequently, maintenance work.
- Optimum hydraulic and energy efficiency by high-efficiency motors and variable hydraulic systems

Material variants C1 and C2:

- Long service life due to corrosion-resistant wetted components made of stainless steel

Acceptance tests and warranty

Functional test

- Every pump undergoes functional testing to KSB standard ZN 56535.
- Operating data is guaranteed to DIN EN ISO 9906/2/2B or Hydraulic Institute Level A/B.

Acceptance tests

- Acceptance testing to ISO/DIN or comparable standards is available against a surcharge.
- Acceptance tests to Hydraulic Institute available on request.

Warranty

- Quality is assured by means of an audited and certified quality assurance system to DIN EN ISO 9001.

Selection information

- The indicated heads and performance data apply to material variant G, for fluids handled with a density $\rho = 1$ kg/dm³ and a kinematic viscosity $v \leqq 20$ mm²/s.
- For hydraulic acceptance tests of material variants other than "G" reduce the documented efficiencies by 2 percentage points.

Impeller type

- S, F, E and D impellers can only be supplied with the documented impeller diameters. Indicate the pump set designation and the impeller diameter in the purchase order.
- K impellers are trimmed to the duty point. Indicate the H / Q data or the impeller diameter in the purchase order. In the hydraulic selection program, the impeller diameter is automatically computed based on the H / Q data and added to the designation of the pump set.

Pump input power

- Adjust the power input to the density of the fluid handled:
  P_2 (required) = ρ [kg/dm³] (fluid handled) × P_2 (documented)
- Select the operating point with the largest power input within an operating range. Select a motor size providing a power reserve to compensate for the tolerances in the system characteristic / pump characteristic.

Recommended motor power reserve[7)]

P_2		Reserve	
[hp]	[kW]	Mains operation	With frequency inverter
≤ 40	≤ 30	10 %	15 %
> 40	> 30	5 %	10 %

- For installation types K and D (with cooling jacket) an additional power reserve of 2 hp [1.5 kW] must always be added for the cooling circuit.
- The motors are suitable for operation on a frequency inverter.
- The service factor for all motors equals 1.15.

In the case of waste water, too low a flow velocity in the discharge line will lead to clogging and increased wear. The flow velocity in the vertical riser must not fall below 2 m/s (6.56 ft/s).

In the case of waste water, too low a circumferential speed of the impeller will lead to clogging of the hydraulic system (operation on frequency inverter). A minimum circumferential speed (measured at the outside diameter of the impeller) of 12 m/s (39.4 ft/s) must be observed.[8)]

7) If larger power reserves are stipulated by local regulations, these larger reserves must be provided.
8) For F impellers, a circumferential speed below 12 m/s (39.4 ft/s) is permissible.

Overview of product features

Material variants G, G1, G2, GH

Feature	Motors						
2 poles	**3 2 E ... 26 2 E**	**-**	**55 2 E ... 75 2 E**	**-**	**-**	**-**	**-**
4 poles	**2 4 E ... 22 4 E**	**30 4 E ... 37 4 E**	**45 4 E ... 75 4 E**	**35 4 N ... 110 4 N**	**130 4 N ... 175 4 N**	**200 4 N ... 350 4 N**	**-**
6 poles	**7 6 E ... 18 6 E**	**22 6 E ... 30 6 E**	**31 6 E ... 55 6 E**	**32 6 N ... 100 6 N**	**120 6 N ... 165 6 N**	**190 6 N ... 480 6 N**	**530 6 N ... 850 6 N**
8 poles	**-**	**11 8 E ... 22 8 E**	**30 8 E ... 45 8 E**	**26 8 N ... 75 8 N**	**90 8 N ... 130 8 N**	**150 8 N ... 400 8 N**	**460 8 N ... 760 8 N**
10 poles	**-**	**-**	**-**	**-**	**40 10 N ... 90 10 N**	**110 10 N ... 350 10 N**	**390 10 N ... 660 10 N**
12 poles	**-**	**-**	**-**	**-**	**-**	**105 12 N ... 300 12 N**	**340 12 N ... 560 12 N**
Suction flange	9)						
Shaft material							
Shaft	A 276 Type 420						
~~Shaft protecting sleeve~~	~~-~~			~~A 276 Type 420~~[10]	~~A 276 Type 420~~		
Bearing assembly	Grease-packed rolling element bearings sealed for life		~~Grease-packed rolling element bearings sealed for life~~[11]	~~Pump end: re-greasable rolling element bearings drive end: grease-packed rolling element bearings sealed for life~~			
Explosion protection							
~~Versions U, W~~	~~Non-explosion-proof~~						
Versions X, Z	FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3						-
Motor							
Starting method	DOL, soft starter, frequency inverter or star-delta			~~DOL, soft starter, frequency inverter~~			
Voltage	460 V[12]						~~460 V~~[13]
Cooling	Cooled by surrounding fluid[14]	~~Cooled by surrounding fluid~~		~~Cooled by surrounding fluid or via cooling jacket~~			
Immersion depth	100 ft [30 m] max.						
Power cable							
Type	~~See table "Overview of power cables"~~						
Length	50 ft ~~30~~ ft [10 m][15]						
Cable entry	Absolutely watertight						
Sealing elements							
Elastomer seals	Nitrile butadiene rubber NBR[16]						

9) Drilled to ANSI B16.1 Class 125 on request, not available for all sizes.
10) For maximum nominal impeller diameters 400 mm / 401 mm / 402 mm / 403 mm: without shaft protecting sleeve
11) For D impeller: re-greasable rolling element bearings at the pump end, grease-packed rolling element bearings sealed for life at the drive end
12) Optional: 200 V, 230 V, 380 V, 575 V
13) Optional: 380 V, 575 V
14) Optional: air cooling for motors 11 2E ... 26 2E; 7 4E ... 22 4E; 7 6E ... 18 6E;
15) Optional: up to 164 ft [50 m]
16) Optional: Viton = fluorocarbon rubber FPM

Feature	Motors						
2 poles	**3 2 E ... 26 2 E**	**-**	**55 2 E ... 75 2 E**	**-**	**-**	**-**	**-**
4 poles	**2 4 E ... 22 4 E**	**30 4 E ... 37 4 E**	**45 4 E ... 75 4 E**	**35 4 N ... 110 4 N**	**130 4 N ... 175 4 N**	**200 4 N ... 350 4 N**	**-**
6 poles	**7 6 E ... 18 6 E**	**22 6 E ... 30 6 E**	**31 6 E ... 55 6 E**	**32 6 N ... 100 6 N**	**120 6 N ... 165 6 N**	**190 6 N ... 480 6 N**	**530 6 N ... 850 6 N**
8 poles	**-**	**11 8 E ... 22 8 E**	**30 8 E ... 45 8 E**	**26 8 N ... 75 8 N**	**90 8 N ... 130 8 N**	**150 8 N ... 400 8 N**	**460 8 N ... 760 8 N**
10 poles	**-**	**-**	**-**	**-**	**40 10 N ... 90 10 N**	**110 10 N ... 350 10 N**	**390 10 N ... 660 10 N**
12 poles	**-**	**-**	**-**	**-**	**-**	**105 12 N ... 300 12 N**	**340 12 N ... 560 12 N**
Shaft seal	Bellows-type mechanical seal[17]						Mechanical seal with covered spring
Monitoring equipment							
~~Winding temperature, versions U, W; installation types S, P~~	~~Temperature switch (bimetal) in the winding~~						
Winding temperature, versions X, Z; installation types S, P	Temperature switch (bimetal) in the winding, plus PTC for explosion protection[18]	~~Temperature switch (bimetal) in the winding, plus PTC for explosion protection~~					-
~~Winding temperature; installation types D, H, K~~	~~PTC~~			~~PTC~~			
~~Coolant temperature; installation types D, K~~	-			~~PTC~~			
Bearing temperature	-		-[19]	~~Pt100 at pump end~~[20]			~~Pt100 at the pump end and drive end~~
Leakage inside the motor	Leakage sensor in the motor space						
Mechanical seal leakage	-			~~Float switch in leakage area~~			
~~Vibration sensor~~	-			-[21]			
Coating	Environmentally friendly KSB standard coating, color RAL 5002[22]						
Maximum fluid temperature and ambient temperature							
~~Version U~~	~~104 °F [40 °C]~~						
Version X	104 °F [40 °C]						-
~~Versions W, Z~~	~~140 °F [60 °C]~~						-
Tests/inspections							
Hydraulic system	KSB standard (ZN 56525)[23]						
General	KSB standard (ZN 56525)						
Installation type							

17) Optional: mechanical seal with covered spring
18) Motors 3 2E 2 4E, 3 4E: temperature switch (bimetal) in the winding, plus temperature switch (bimetal) for explosion protection
19) Optional: Pt100 at the pump end
20) Optional: Pt100 at pump end
21) Optional: internal vibration sensor
22) Optional: 250 µm two-component epoxy coating
23) Optional: S, D, E, F impellers to ISO 9906/A, K impellers to ISO 9906//1/2/A

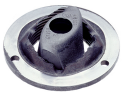
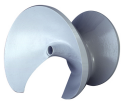
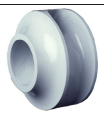
Feature	Motors						
2 poles	3 2 E ... 26 2 E	-	55 2 E ... 75 2 E	-	-	-	-
4 poles	2 4 E ... 22 4 E	30 4 E ... 37 4 E	45 4 E ... 75 4 E	35 4 N ... 110 4 N	130 4 N ... 175 4 N	200 4 N ... 350 4 N	-
6 poles	7 6 E ... 18 6 E	22 6 E ... 30 6 E	31 6 E ... 55 6 E	32 6 N ... 100 6 N	120 6 N ... 165 6 N	190 6 N ... 480 6 N	530 6 N ... 850 6 N
8 poles	-	11 8 E ... 22 8 E	30 8 E ... 45 8 E	26 8 N ... 75 8 N	90 8 N ... 130 8 N	150 8 N ... 400 8 N	460 8 N ... 760 8 N
10 poles	-	-	-	-	40 10 N ... 90 10 N	110 10 N ... 350 10 N	390 10 N ... 660 10 N
12 poles	-	-	-	-	-	105 12 N ... 300 12 N	340 12 N ... 560 12 N
Stationary, with guide cable arrangement	Installation depth 15 ft [4.5 m][24]						
Stationary, with guide rail arrangement	28 ft Installation depth 15 ft [4.5 m][25]						
Transportable	Up to size 300-401 (except sizes 200-502/503, 200-632)					-	
Stationary, dry	-			With cooling jacket			

Material variants H, C1, C2

Feature	Motors					
2 poles	3 2 E ... 7 2 E	-	55 2 E ... 75 2 E	-	-	-
4 poles	2 4 E ... 5 4 E	30 4 E ... 37 4 E	45 4 E ... 75 4 E	35 4 N ... 110 4 N	130 4 N ... 175 4 N	200 4 N ... 350 4 N
6 poles	-	22 6 E ... 30 6 E	31 6 E ... 55 6 E	32 6 N ... 100 6 N	120 6 N ... 165 6 N	190 6 N ... 480 6 N
8 poles	-	11 8 E ... 22 8 E	30 8 E ... 45 8 E	26 8 N ... 75 8 N	90 8 N ... 130 8 N	150 8 N ... 480 8 N
10 poles	-	-	-	-	40 10 N ... 90 10 N	110 10 N ... 350 10 N
12 poles	-	-	-	-	-	105 12 N ... 300 12 N
Suction flange	[26]					
Shaft material for material variant H						
Shaft	A 276 Type 420			A 276 Type 420[27]	A 276 Type 420	
Shaft protecting sleeve	-	-	-	A 276 Type 420[10]	A 276 Type 420	
Shaft material for material variants C1, C2						
Shaft	A 182 F51 / A 576 Gr. 1045			A 276 Type 420		
Shaft protecting sleeve	-	-	-	A 182 F51	A 182 F51	
Bearing assembly	Grease-packed rolling element bearings sealed for life			Pump end: re-greasable rolling element bearings drive end: grease-packed rolling element bearings sealed for life		
Explosion protection						
Versions U, W	Non-explosion-proof					
Versions X, Z	FM APPROVED or CSA Explosion-proof Class I, Division I, Groups C & D, T3					-
Motor						

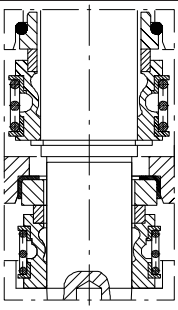
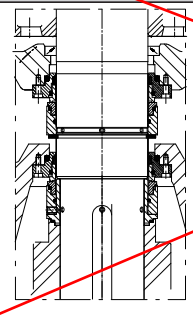
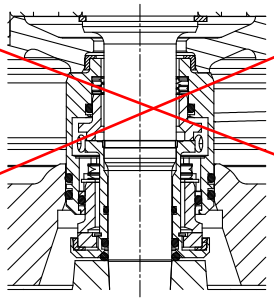
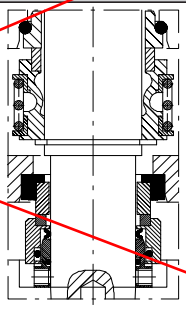
24) Optional: up to 98 ft [30 m], from size K200-502 up to 49 ft [15 m]
25) Optional: up to 98 ft [30 m]
26) Drilled to ANSI B16.1 Class 125 on request, not available for all sizes.
27) For maximum nominal impeller diameters 400 mm / 401 mm / 402 mm / 403 mm: A 182 F51

Impellers

	Impeller with cutter (impeller type S/S-max)
	Free-flow impeller (impeller type F/F-max)
	Closed single-channel impeller (impeller type E/E-max)
	Open, diagonal single-vane impeller (impeller type D)
	Closed multi-channel impeller (impeller type K/K-max)

Shaft seal

Available shaft seal types per bearing bracket

Standard design		Standard variant[47]	
Mechanical seal with elastomer bellows (NBR, optional Viton)[48]	Stationary cartridge seal with spring outside of fluid	Cartridge seal[49][50][51]	Product-side mechanical seal with covered spring[50][51]
			

47) A surcharge and longer delivery times apply to standard variants.
48) For all types of waste water
49) Only possible in combination with motor generation "E" for maximum nominal impeller diameters 315
50) For very abrasive fluids or fluids containing metallic particles (e.g. shavings from drilling)
51) Standard for material variants H and C2 (optional for material variants G, G1, G2, GH and C1)

Mass moments of inertia per motor

2-pole

Motor	Motor type	J [kgm²]
3 2 E	1	0,002
4 2 E	1	0,005
5 2 E	1	0,006
7 2 E	1	0,011
11 2 E	2	0,012
15 2 E	2	0,022
18 2 E	2	0,034
22 2 E	2	0,044
26 2 E	2	0,044
55 2 E	3	0,190
65 2 E	3	0,220
75 2 E	3	0,250

4-pole

Motor	Motor type	J [kgm²]
2 4 E	1	0,003
3 4 E	1	0,004
4 4 E	1	0,011
5 4 E	1	0,011
7 4 E	2	0,022
11 4 E	2	0,032
15 4 E	2	0,054
18 4 E	2	0,064
22 4 E	2	0,074
30 4 E	3	0,136
37 4 E	3	0,176
45 4 E	3	0,263
55 4 E	3	0,323
65 4 E	3	0,380
75 4 E	3	0,450
35 4 N	4	0,25
50 4 N	4	0,28
65 4 N	4	0,33
80 4 N	4	0,46
95 4 N	4	0,55
110 4 N	4	0,63
130 4 N	4	1,26
155 4 N	4	1,43
175 4 N	4	1,57
200 4 N	4	3,78
250 4 N	4	4,13
300 4 N	4	4,82
350 4 N	4	5,51

6-pole

Motor	Motor type	J [kgm²]
7 6 E	2	0,032
11 6 E	2	0,042
15 6 E	2	0,094
18 6 E	2	0,114
22 6 E	3	0,186
30 6 E	3	0,216
31 6 E	3	0,463
37 6 E	3	0,463
45 6 E	3	0,550
55 6 E	3	0,650
32 6 N	4	0,37
40 6 N	4	0,45
50 6 N	4	0,54
60 6 N	4	0,66
80 6 N	4	0,80
100 6 N	4	0,94
120 6 N	4	1,98
140 6 N	4	2,25
165 6 N	4	2,55
190 6 N	4	7,30
225 6 N	4	8,57
260 6 N	4	9,84
320 6 N	4	14,32
360 6 N	4	15,89
400 6 N	4	17,58
440 6 N	4	19,15
480 6 N	4	20,71
530 6 N	4	32,54
580 6 N	4	37,34
630 6 N	4	42,06
690 6 N	4	46,82
770 6 N	4	51,58
850 6 N	4	56,34

8-pole

Motor	Motor type	J [kgm²]
11 8 E	3	0,186
15 8 E	3	0,186
18 8 E	3	0,226
22 8 E	3	0,276
30 8 E	3	0,463
37 8 E	3	0,550
45 8 E	3	0,650
26 8 N	4	0,40
35 8 N	4	0,50
50 8 N	4	0,66
65 8 N	4	0,80
75 8 N	4	0,94
90 8 N	4	1,98
110 8 N	4	2,25
130 8 N	4	2,55
150 8 N	4	7,30
185 8 N	4	8,57
220 8 N	4	9,84
260 8 N	4	13,27
300 8 N	4	15,88
350 8 N	4	19,13
400 8 N	4	20,70
460 8 N	4	32,54
530 8 N	4	37,30
580 8 N	4	42,06
630 8 N	4	46,82
690 8 N	4	51,58
760 8 N	4	56,34

Installation types

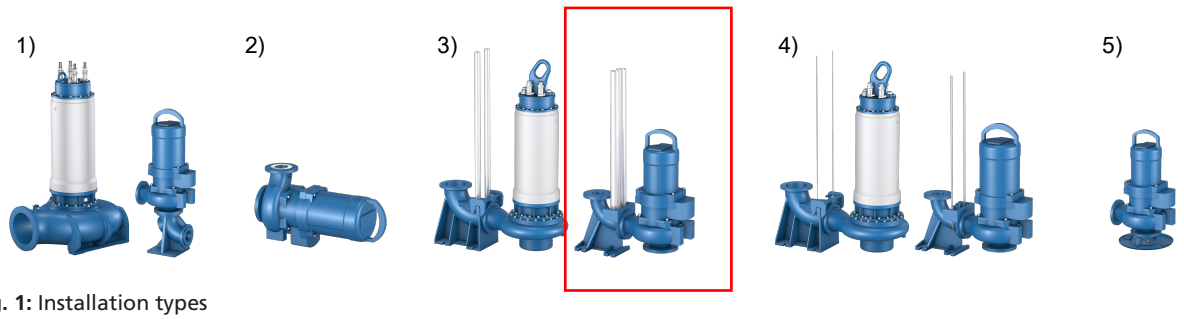


Fig. 1: Installation types

1	Installation type D: stationary dry installation, vertical (S1 duty)
2	Installation type H: stationary dry installation, horizontal (S1 duty)
3	Installation type K: wet installation (S1 duty with motor outside of the fluid possible) with guide rail arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide rail arrangement
4	Installation type K: stationary wet installation (S1 duty with motor outside of the fluid possible) with guide cable arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide cable arrangement
5	Installation type P: wet installation of transportable model (S1 duty with submerged motor)

Pump sets of installation types D, H and K
are suitable for continuous operation with the motor outside the fluid. Cooling is effected by means of air convection. Versions with a cooling jacket have an additional internal cooling circuit.

Pump sets of installation types P and S
are designed for continuously submerged operation. The motor is cooled by the fluid handled on the motor surface. Operation with the motor outside the fluid handled is possible for short periods.

Scope of supply

Stationary dry installation - vertical (installation type D)

- Pump set complete with connection cables
- Base elbow with inspection hole[54)] and fastening elements
- Optional: intake elbow with inspection hole

Stationary dry installation - horizontal (installation type H)

- Pump set complete with connection cables
- Foundation rails
- Suction-side flanged spacer with inspection hole[55)] (optional)

Stationary wet installation (installation types K and S)

- Pump set complete with connection cables
- Claw with sealing elements and mounting elements
- Lifting rope, lifting chain or lifting bail (optional)
- Mounting bracket with mounting elements
- Base elbow and mounting elements
- Guide cable / guide rail
  (guide rails are not included in KSB's scope of supply)

Transportable model for wet installation (installation type P)

- Pump set complete with connection cables
- Foot plate or pump stool with mounting elements

54) For nominal discharge nozzle diameter ≥ DN100
55) For nominal discharge nozzle diameter ≥ DN100

General assembly drawings with list of components

Amarex KRT, motor type 1

Correlation of motor and motor type: (⇨ Page 23)

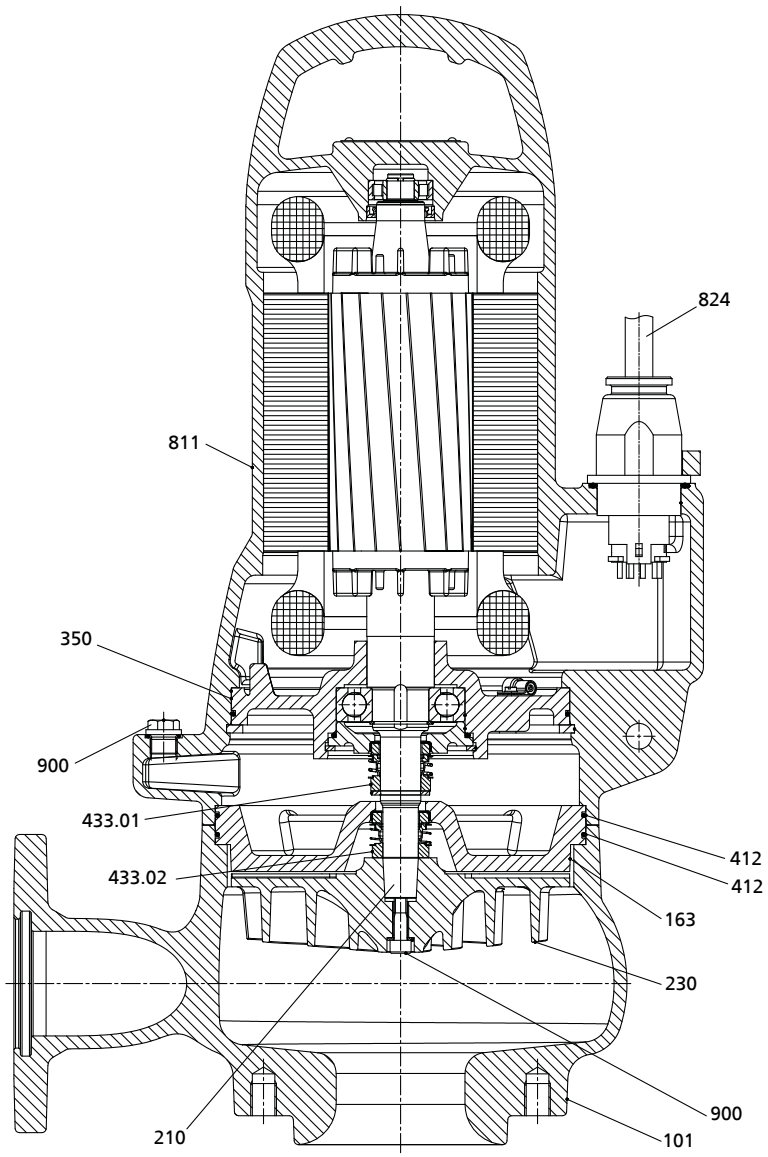


Fig. 2: General assembly drawing, example: Amarex KRT F65-215

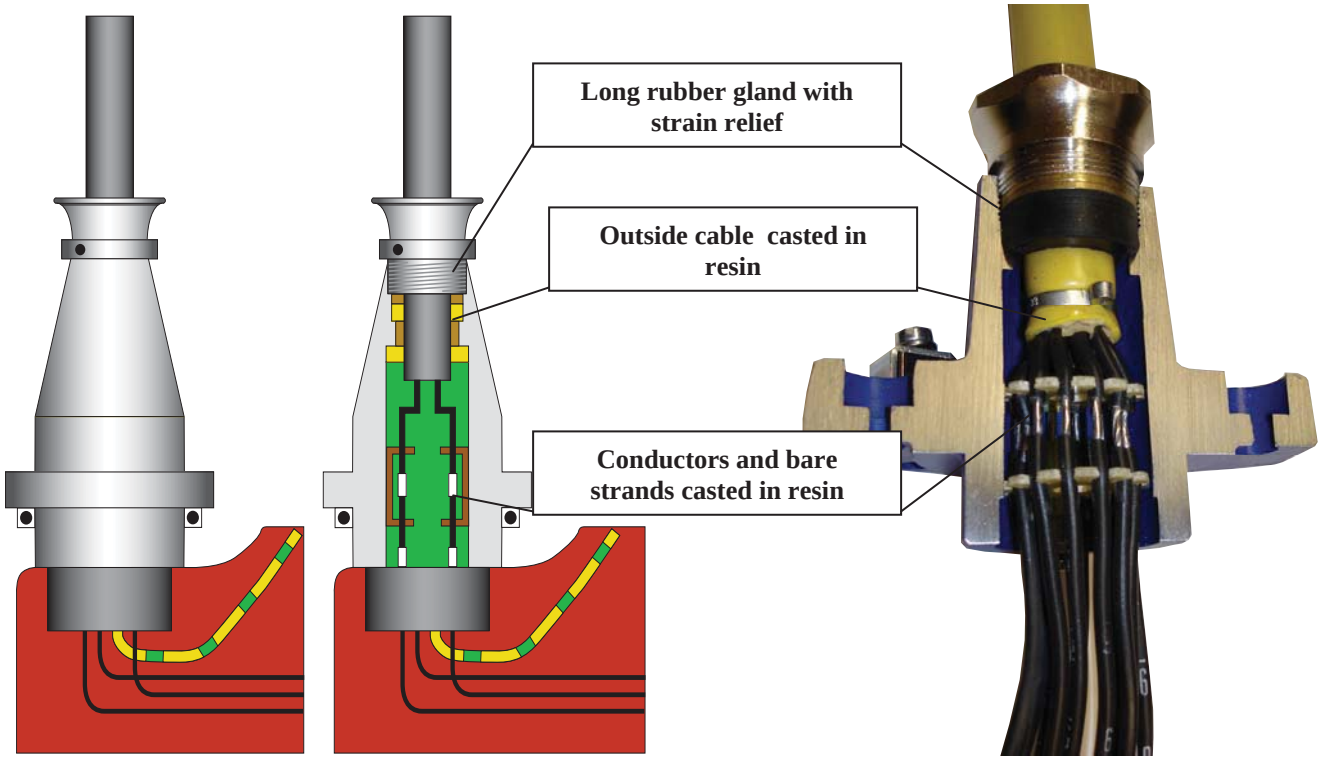
List of components

Part No.	Description	Part No.	Description
101	Pump casing	412	O-ring
163	Discharge cover	433.01/.02	Mechanical seal
210	Shaft	811	Motor housing
230	Impeller	824	Power cable
350	Bearing housing	900	Screw

SECTION 3: ADDITIONAL FEATURES

CABLE ENTRY

LEAKPROOF TRIPLE SEALED CABLE ENTRY



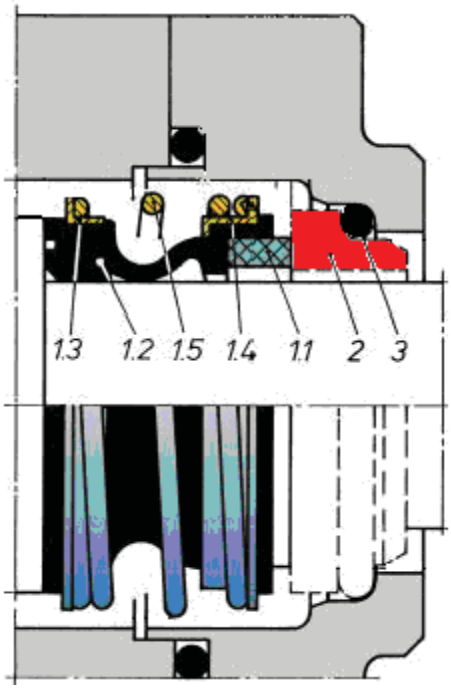
Typical Specification - “The power cable shall be suitable for the submersible application and sized in accordance with NEC requirements. The cable entry shall consist of a grommet compressed by two stainless steel washers with strain relief being supplied as part of the entry design. The entire end of the cable shall be sealed inside the cable entry housing through the use of a non-shrink epoxy resin. Further, a monolithic solder dam formed on a bare stripped section shall seal each individual cable lead. This solder dam shall be further protected through the use of a monolithic shield. This cable entry design shall then insure that no entry of moisture is possible into the high-voltage motor terminal area even if the cable is damaged or severed below water level to a submerged depth of up to 100 feet.”

KRT PAINTING DATA SHEET

LUBERPOX-High-Solid-Coating IV20

1.	Typical uses and characteristics:	Two component epoxy coating with a very high volume solid content, providing low solvent emission and high coverage. Suitable as one coat or topcoat system for pumps, tanks, vessels and pipes of steel or cast iron. The cured coating is resistant against a wide range of chemicals, water and waste water.
2.	Dry Film Thickness	Primer: 1.5 to 2 mils (35 to 50 microns) Top coat: 6 mils (150 microns)
3.	Color	RAL 5002 Ultramarine Blue
4.	Physical & Application Data:	Per attached sheet LUBERPOX-High-Solid-Coating Art.No. IV20

MECHANICAL SEALS (MG1 SERIES)



- **Single Seal**
- **Unbalanced**
- **Independent of direction of rotation**
- **Elastomer bellows**

Mechanical seals of the MG series are among the most commonly used. The bellows are not subjected to any torsional stress and its ingenious design incorporates several functions, as seal face carrier, secondary sealing element and drive collar. The seal face is driven through the spring and "L"-rings. There are no bonded joints and all the face materials are interchangeable without having to modify any dimensions. Highly recommended for duties with media containing solids, e.g. in waste water and sewage applications. The MG1 can be used as a double seal in tandem.

Double Mechanical Seal in Tandem Arrangement

Part No.	Description	Material Pump-side (433.02)	Material Motor-side (433.01)
1.1	Seal Face	Silicon Carbide	Carbon
1.2	Bellows	Nitrile-butadiene-rubber (NBR)	Nitrile-butadiene-rubber (NBR)
1.3	"L"-ring (spring collar)	CrNiMo-stainless steel	CrNiMo- stainless steel
1.4	"L"-ring (spring collar)	CrNiMo- stainless steel	CrNiMo- stainless steel
1.5	Spring	CrNiMo- stainless steel	CrNiMo- stainless steel
2	Seat	Silicon Carbide	Silicon Carbide
3	O-ring	Nitrile-butadiene-rubber (NBR)	Nitrile-butadiene-rubber (NBR)

KSB Incorporated
Water & Wastewater Division

August 21, 2011

To: To whom it may concern

From: Jed Pratt, Vice President – Water & Wastewater Division

Re: NON SPARKING, KRT GUIDE CABLE AND GUIDE RAIL SYSTEMS

The KSB Submersible Wastewater Pump Motors having a designation (X) or (Z) are approved for installations in Class I, Division 1, Group C and D, hazardous locations. This approval covers both the motor and KSB guide system. The materials of the guide rail or guide cable system which are in motion with respect to one another (cast iron guide claws and stainless steel guide cables or guide rails), are non-sparking. Guide system components that consist of two rubbing stainless steel parts are also permitted.

Respectfully submitted,
KSB, Inc.

Jed Pratt
Vice President, Water & Wastewater Division

cc: legal file

KSB Inc. 4415 Sarellen Road, Richmond, Virginia 23231
Tel: (804) 222-1818, FAX (804) 226-6961

HALLIDAY PRODUCTS, INC.
ORLANDO, FL
http://www.hallidayproducts.com

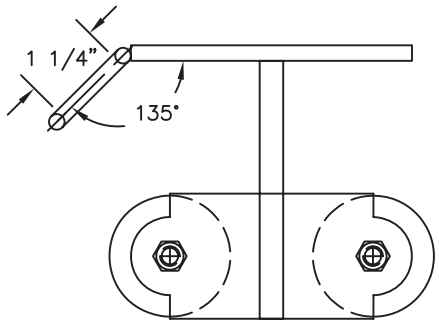
HALLIDAY PRODUCTS

MODEL NO. U G
QUANTITY: 3
ORDER NO. Q
DATE: 8/1/2019
LOCATION/TAG: P-2, P-3, P-4

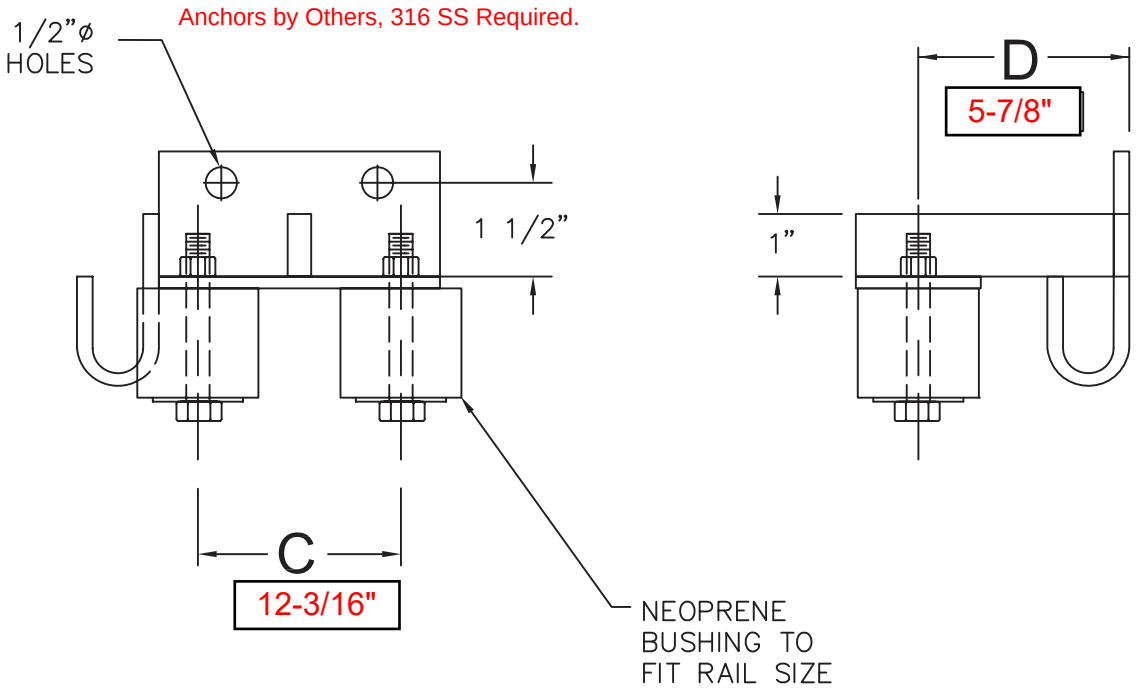
SERIES U-G UPPER GUIDE RAIL BRACKET

ALL WELDED CONSTRUCTION
NEOPRENE BUSHING FOR QUIET OPERATION

BRACKET MATERIAL:
[ ] T-304 S.STL.
[X] T-316 S.STL.



A
3 " PIPE RAIL SIZE



Fort Washington Way PS
KRT K 500-634/1308XNG-K

NOTE:
"B" DIM. NOT USED

HALLIDAY PRODUCTS, INC.
ORLANDO, FL
http://www.hallidayproducts.com

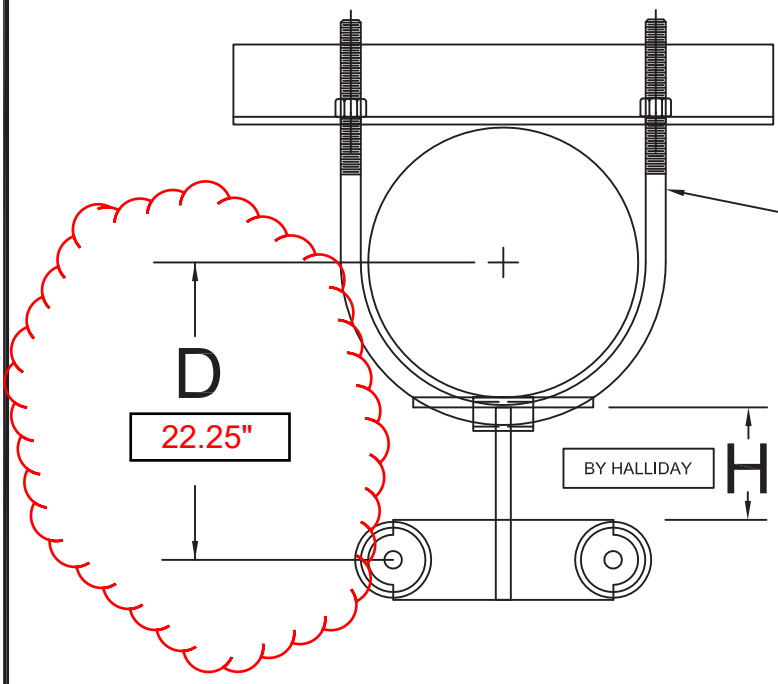
HALLIDAY PRODUCTS

MODEL NO. U–H
QUANTITY: 6
ORDER NO. Q
DATE: 8/1/2019
LOCATION/TAG: P-2, P-3, P-4

SERIES U-H INTERMEDIATE GUIDE RAIL BRACKET

BRACKET MATERIAL:
- [ ] T-304 S.STL.
- [X] T-316 S.STL.

U BOLT SUPPLIED
- [X] YES
- [ ] NO

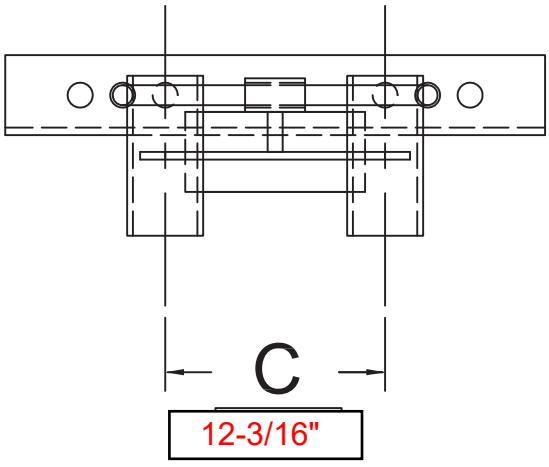


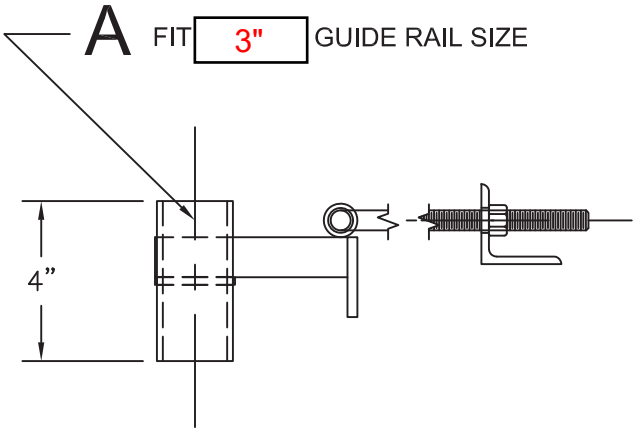
U BOLT TO FIT 24" DISCHARGE PIPE

- [ ] COMBO

NOTE:
1) COMBO = HOLES FOR (2) ADDITIONAL "U" BOLT SIZES

ALL WELDED CONSTRUCTION





A FIT 3" GUIDE RAIL SIZE

Fort Washington Way PS
KRT K 500-634/1308XNG-K

PART MAY HAVE UNUSED HOLES

HALLIDAY PRODUCTS, INC.
ORLANDO, FL
http://www.hallidayproducts.com

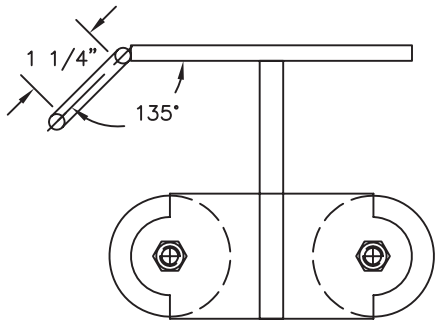
HALLIDAY PRODUCTS

MODEL NO. U G
QUANTITY: 1
ORDER NO. Q
DATE: 8/1/2019
LOCATION/TAG: SUMP PUMP

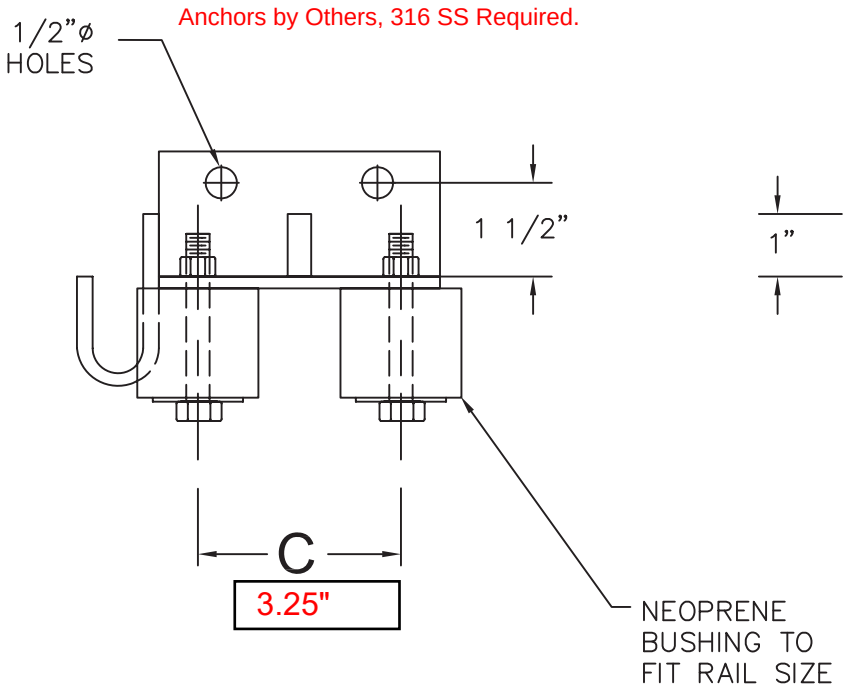
SERIES U-G UPPER GUIDE RAIL BRACKET

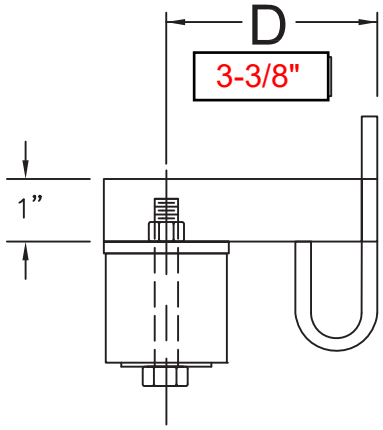
ALL WELDED CONSTRUCTION
NEOPRENE BUSHING FOR QUIET OPERATION

BRACKET MATERIAL:
- [ ] T-304 S.STL.
- [x] T-316 S.STL.



A
2 " PIPE RAIL SIZE





Fort Washington Way PS
KRT K 80-217/24XEG-S

NOTE:
"B" DIM. NOT USED

HALLIDAY PRODUCTS, INC.
ORLANDO, FL
http://www.hallidayproducts.com

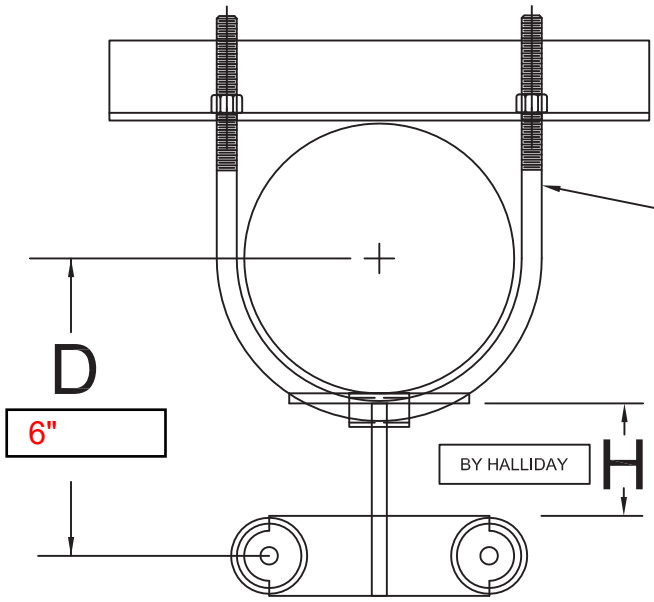
HALLIDAY PRODUCTS

MODEL NO. U–H
QUANTITY: 2
ORDER NO. Q
DATE: 8/1/2019
LOCATION/TAG: SUMP PUMP

SERIES U-H INTERMEDIATE GUIDE RAIL BRACKET

BRACKET MATERIAL:
- [ ] T-304 S.STL.
- [X] T-316 S.STL.

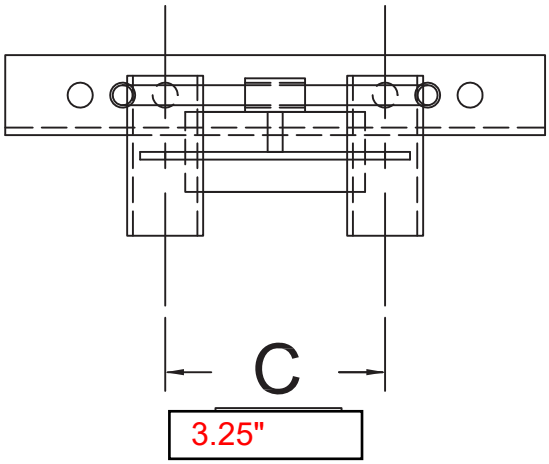
U BOLT SUPPLIED
- [X] YES
- [ ] NO



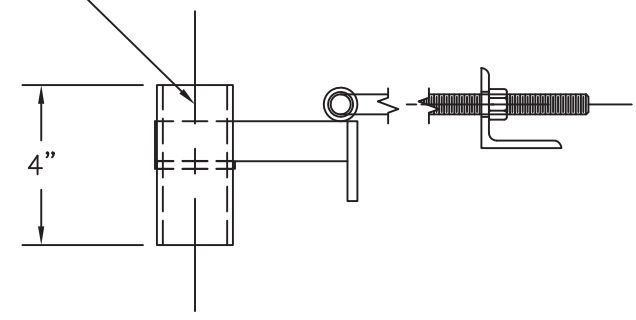
B
U BOLT TO FIT 3" DISCHARGE PIPE
[ ] COMBO

NOTE:
1) COMBO = HOLES FOR (2) ADDITIONAL "U" BOLT SIZES

ALL WELDED CONSTRUCTION

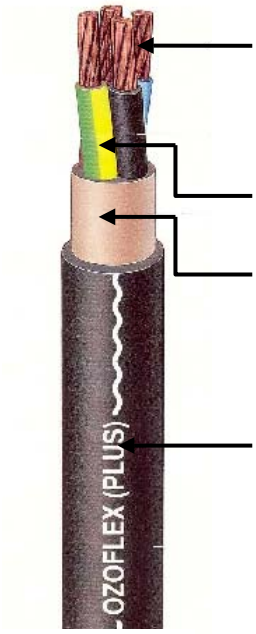


A FIT 2" GUIDE RAIL SIZE



Fort Washington Way PS
KRT K 80-217/24XEG-S

PART MAY HAVE UNUSED HOLES



Technical data

Copper conductor, finely stranded
class 5 to
DIN VDE 0295

EPR insulation

Rubber inner sheath

Special outer rubber sheath of synthetic india rubber
colour: black

Permissible temperature at conductor

Permissible temp. in case of short-circuit (up to 5 s)

Burning behaviour according to
DIN EN 50265-2-1

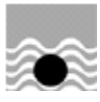
UV, ozone and weather resistant

Oil-resistant acc. to
DIN VDE 0473-811-2-1,
Section 10

flexible

Temp. during trans-port and handling:
-25 to + 80°C

0,6/1kV: with green-yellow core



Application with water/ no drinking water

Short description

OZOFLEX(PLUS) rubber-sheathed cables S1BN8-F are designed to be used for KSB standard pumps, as well as for explosion proof versions. They are intended for the mobile connection of KSB submersible motor pumps up to a cross section of 35 mm².

Due to the many different and variable compositions of waste water, the cables must be installed in easily accessible places where they can be inspected without difficulty.

When aggressive water or water of certain other compositions is involved, the chemical resistance of the cable must be checked in each individual case.

These cables can be used indoors, outdoors, in explosive atmospheres, in locations exposed to fire hazards, in industrial and agricultural plants.

In addition, the general regulations of DIN VDE 0298-300 (HD 516) apply.

Structure based on
DIN VDE 0828-16

VDE-REG.NR. 7586

~~Energieleitungen~~
Power cables

~~Flexible Leitungen mit vernetzter Elastomer Isolierung:~~
~~Wasserbeständige Leitungen~~

Flexible cables with cross linked elastomeric insulation:
Water resistant cables

OZOFLEX(PLUS) S1BN8-F

0,6/1 kV

PRYSMIAN Kabel und Systeme GmbH
Alt-Moabit 91D
D-10559 Berlin

PKS OEM / SL
Dokument: 07DS331_62.doc
Ausgabe 6.2 / 05.2011

Energieleitungen
Power cables

Technische Angaben

Markenname	**OZOFLEX(PLUS)**
Bauartkurzzeichen	**S1BN8-F**
Norm	Prysmian Produktspezifikation in Anlehnung an DIN VDE 0282 Teil 16
Approbationen	VDE-Gutachten mit Fertigungsüberwachung
Verwendung	OZOFLEX(PLUS)-Gummischlauchleitungen S1BN8-F sind bestimmt für den Anschluss von elektrischen Betriebsmitteln im Schmutzwasser bei mittleren mechanischen Beanspruchungen. Wegen der unterschiedlichen und auch häufig wechselnden Zusammensetzung des Schmutzwassers dürfen die Leitungen nur in leicht zugänglichen und kontrollierbaren Bereichen eingesetzt werden (Einbautiefen von ca. 10 m, wie sie üblicherweise in Schmutzwasserbecken anzutreffen sind). Diese Leitungen sind auch in Betriebs-, Kühl-, Oberflächen-, Regen- und Mischwasser sowie im Grundwasser und Meerwasser einsetzbar, wobei die Anforderungen an die Zugänglichkeit und Kontrollierbarkeit verringert werden können. In diesem Fall bestehen keine Bedenken, die Leitungen in Tiefen bis 500 m einzusetzen. (Definition der Wasserarten nach DIN 4045 und DIN 4046). Bei aggressivem Wasser oder Wasser mit besonderer Zusammensetzung ist die Beständigkeit der Leitung im Einzelfall zu überprüfen. Diese Leitungen sind verwendbar in Innenräumen, im Freien, in explosionsgefährdeten Bereichen nach DIN VDE 0165, in feuergefährdeten Betriebsstätten, auf Baustellen nach DIN VDE 0100 Teil 704, im Tagebau und in Steinbrüchen nach DIN VDE 0168, in der Industrie, in gewerblichen und landwirtschaftlichen Betrieben. Sie dürfen auch fest verlegt werden, z.B. auf Putz oder auf Baggern und Hebezeugen. Die verwendeten Isolier- und Mantelwerkstoffe gestatten eine Grenztemperatur am Leiter von 90 °C. Aufgrund dieser Eigenschaft, die durch ein Gutachten des VDE-Prüf- und Zertifizierungsinstitutes bestätigt ist, dürfen diese Leitungen in Abstimmung mit der Physikalisch-Technischen Bundesanstalt PTB auch für Ex-geschützte Pumpen verwendet werden. Darüber hinaus gelten die allgemeinen Festlegungen in DIN VDE 0298-300

Technical Details

Trademark	**OZOFLEX(PLUS)**
Type Designation	**S1BN8-F**
Standard	Prysmian Product Specification, based on DIN VDE 0282 part 16
Approval	VDE Certificate of Conformity with Factory surveillance
Application	OZOFLEX(PLUS) rubber-sheathed cables S1BN8-F are intended for connection of electrical equipment in contaminated water and for medium mechanical stresses. Owing to the various (and frequently changing) substances of which the contaminated water is made up, the cables may be used only in easily accessible areas that can be inspected (installation depth of approximately 10 m, as customarily encountered in sewage water tanks). These cables are also suitable for use in process water, cooling water, mine surface water, rainwater and combined waste water. They also can be used in groundwater and seawater; it is possible to impose less stringent specifications in terms of accessibility and inspection. In such cases the cables can be used at depths up to 500 m. (The water types are defined in accordance with DIN 4045 and DIN 4046). If the water concerned is aggressive or composed of special substances, the cable's resistance properties should be examined. These cables can be used indoors, outdoors, in explosion-hazard areas to DIN VDE 0165, in fire-hazard locations, on construction sites in accordance with DIN VDE 0100 Part 704, in open-cast mining and in quarries in accordance with DIN VDE 0168, in industry and in agriculture. They can also be permanently installed, e.g. on plaster, on excavators or on hoisting gear. The insulating and sheath materials used allow a maximum temperature at the conductor of 90 °C. By virtue of this characteristic, which is verified by a report from the VDE Test and Certification Institute, these cables may be used according to the specifications of the Federal Testing Laboratories (PTB) for explosion-protected pumps. In other respects the specifications of DIN VDE 0298 part 300 apply.

PRYSMIAN Kabel und Systeme GmbH
Alt-Moabit 91D
D-10559 Berlin

Energieleitungen
Power cables

	Aufbaumerkmale	Design features
Leiter Conductor	Kupfer, feindrähtig, verzinnt, Klasse 5 nach DIN VDE 0295 / IEC 60228	Copper, finely stranded, tinned, class 5 in accordance with DIN VDE 0295 / IEC 60228
Isolierung Insulation	Vulkanisierte Gummimischung, Werkstoffbasis HEPR	Vulcanized rubber compound, basis HEPR
Aderkennzeichnung Core identifikation	bis 5 Adern: farbig nach DIN VDE 0293-308 ab 6 Adern: hell mit schwarzen Ziffern	up to 5 cores: coloured in accordance with DIN VDE 0293-308 from 6 cores: light with black numerals
Innenmantel Inner sheath	bei mehradrigen Leitungen mit Mantelwanddicke > 2,4 mm und vieladrigen Leitungen: Vulkanisierte Gummimischung, Werkstoffbasis EPR, Mantelfarbe: hell	for multicore cables with wall thickness of sheath > 2,4 mm: Colour of sheath: light
Außenmantel Outer sheath	Vulkanisierte Gummimischung, Werkstoffbasis CPE, Mantelfarbe: schwarz	Vulcanized rubber compound, basis CPE, Colour of sheath: black
Kennzeichnung Marking	~~~~~~~ **OZOFLEX(PLUS) S1BN8-F 4G10 VDE-REG-NR** ~~~~~~~~	

Elektrische Eigenschaften Electrical characteristics	Nennspannung (Wechselspannung)	Rated AC voltage	U_0/U 0,6/1 kV
	Höchste, dauernd zulässige Betriebsspannung der Anlagen oder Netze bei - Wechselstrom bzw. Drehstrom Leiter-Erde / Leiter-Leiter - Gleichstrom Leiter-Erde / Leiter-Leiter	Maximum permissible operation voltage of plant and power system - Single-phase and three-phase AC operation Line-Earth / Line-Line - DC operation Line-Earth / Line-Line	 0,7/1,2 kV 0,9/1,8 k V
	Prüfwechselspannung (Prüfdauer)	AC test voltage (test duration)	3 kV (15 min)
	Strombelastbarkeit Die Angaben gelten bei Dauerbetrieb mit Gleichstrom bzw. mit Wechsel- oder Drehstrom mit 50 bis 60 Hz bei 30 °C Umgebungstemperatur, an Flächen liegend, zwei oder drei Adern belastet, bei vieladrigen Leitungen alle Adern belastet	Current-carrying capacity The values are valid for permanent operation with DC or AC with 50 up to 60 Hz at 30 °C ambient temperature, touching a surface, two or three cores loaded, multi-core cables all cores loaded	

Thermische Eigenschaften Thermal characteristics	Höchste zulässige Betriebstemperatur am Leiter	Maximum permissible operating temperature at conductor	90 °C
	Höchste zulässige Kurzschlußtemperatur am Leiter	Maximum permissible short circuit temperature at conductor	250 °C (max. 5 s)
	Höchste zulässige Wassertemperatur. (Bei höheren Wassertemperaturen ist mit einer Verringerung der Gebrauchsdauer der Leitungen zu rechnen)	Maximum permissible water temperature. (At higher water temperatures, a shortened cable service life is to be expected)	40 °C
	Tiefste zulässige Temperaturen - bewegt - nicht bewegt	Minimum permissible temperatures - when in motion - when stationary	 -25 °C -40 °C

Mechanische Eigenschaften Mechanical characteristics	Zugbelastbarkeit	Permissible pulling force	max. 15 N/mm²
	Mindestbiegeradien siehe Auswahldaten	Minimum permissible bending radii see selection data	

Beständigkeit gegen äußere Einflüsse Stability against external influences	Ölbeständigkeit	Oil resistance	DIN EN 60811-2-1 IEC 60811-2-1
	Flammausbreitung, einzelne Leitung	Flame propagation, single cable	DIN EN 60332-1-2 IEC 60332-1-2
	Wasserbeständigkeit, Prüfung nach ...	Water resistance, test according to ...	DIN VDE 0282-16

PRYSMIAN Kabel und Systeme GmbH
Alt-Moabit 91D
D-10559 Berlin

Energieleitungen
Power cables

Aderanzahl und Leiternenn-querschnitt Number of cores and nominal cross-sectional area	Bestell-Nr. Order no.	Leiter-durch-messer Con-ductor dia-meter	Leitungsaußen-durchmesser Outer diameter of cable		Biegeradius Bending radius		Gewicht netto Weight of cable net 1000 m	Strom-belast-barkeit Current-carrying capacity	Zuläs-siger Kurz-schluß-strom Permis-sible short-circuit current	Zuläs-sige Zug-kraft Permis-sible pulling force
					fest verlegt fixed installed	bei Beweg-ung free moving				
mm²		ca. mm	min. mm	max. mm	min. mm	min. mm	ca. kg	30°C A	(1 s) kA	max. N
OZOFLEX(PLUS) S1BN8-F 4G…										
Aderfarben: grün-gelb, braun, schwarz, grau Color of cores: **green-yellow, brown, black, grey**										
4G4	5DH8 006	2,4	12,4	13,4	54	67	269	41	0,57	240
4G6	5DH8 007	2,9	14,3	15,3	61	77	377	53	0,86	360
4G10	5DH8 008	3,9	18,2	19,6	78	98	628	74	1,43	600
4G16	5DH8 009	5,7	22,5	23,9	96	120	995	99	2,29	960
4G25	5DH8 010	6,8	26,8	28,8	115	144	1494	131	3,58	1500
4G35	5DH8 011	8,0	30,3	32,3	129	162	1983	162	5,01	2100
4G50	5DH8 012	9,4	34,9	36,9	150	187	2661	202	7,15	3000
4G70	5DH8 013	11,0	38,7	41,7	167	209	3726	250	10,01	4200
4G95	5DH8 014	12,8	44,1	47,1	188	236	4796	301	13,59	5700
4G120	5DH8 015	14,5	48,6	52,6	210	263	5935	352	17,16	7200
OZOFLEX(PLUS) S1BN8-F 5G…										
Aderfarben: grün-gelb, blau, braun, schwarz, grau Color of cores: **green-yellow, blue, brown, black, grey**										
5G1,5	5DH8 021	1,5	10,2	11,8	35	47	181	23	0,21	113
OZOFLEX(PLUS) S1BN8-F …G1,5										
Aderfarben: grün-gelb, weitere Adern hell, mit schwarzen Ziffern Color of cores: **green-yellow, other cores light, with black numerals**										
7G1,5	5DH8 001	1,5	13,2	14,4	58	72	276	15,0	0,21	158
8G1,5	5DH8 002	1,5	14,3	15,3	61	77	310	13,8	0,21	180
10G1,5	5DH8 003	1,5	15,9	16,9	68	85	357	12,7	0,21	225
12G1,5	5DH8 004	1,5	16,6	17,6	70	88	415	12,0	0,21	270
OZOFLEX(PLUS) S1BN8-F …G2,5										
Aderfarben: grün-gelb, weitere Adern hell, mit schwarzen Ziffern Color of cores: **green-yellow, other cores light, with black numerals**										
12G2,5	5DH8 005	1,9	18,5	19,5	78	98	542	15,6	0,36	450
OZOFLEX(PLUS) S1BN8-F 7G…+5X1,5 ST										
Aderfarben: grün-gelb, weitere Adern schwarz, mit weißen Ziffern Color of cores: **green-yellow, other cores black, with white numerals**										
Adern 1,5 mm²: blau mit weißen Ziffern / Cores 1,5 mm²: blue with white numerals										
7G4+5X1,5ST	5DH8 018	2,4/1,5	21,0	23,0	92	115	719	27	0,57/0,21	420
7G6+5X1,5ST	5DH8 019	2,9/1,5	23,8	26,8	107	134	913	35	0,86/0,21	630
7G10+5X1,5ST	5DH8 020	3,9/1,5	24,5	27,5	110	138	1242	48	1,43/0,21	1050

Bei abweichender Umgebungstemperatur sind die Belastbarkeitswerte mit folgenden Faktoren umzurechnen:
For other ambient temperatures, the current-carrying capacities must be converted with the following factors:

°C	10	15	20	25	**30**	35	40	45	50	55	60	65	70	75	80
f	1,15	1,12	1,08	1,04	**1,00**	0,96	0,91	0,87	0,82	0,76	0,71	0,65	0,58	0,50	0,41

Zulässige Kurzschlußströme I_{thz} für andere Ausschaltzeiten t_k bis zu 5 s erhält man mit
Permissible short-circuit currents I_{thz} for other break times t_k up to 5 s are calculated using the formula

$$I_{thz} = I_{thr}\sqrt{\frac{1s}{t_k}}$$

PRYSMIAN Kabel und Systeme GmbH
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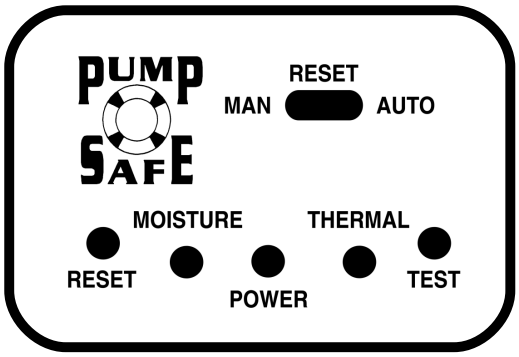
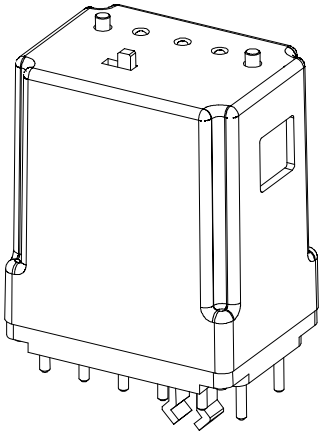
D-10559 Berlin

PKS OEM / SL
Dokument: 07DS331_62.doc
Ausgabe 6.2 / 05.2011

SECTION 4: PumpSafe™ RELAY AND FIELD WIRING DIAGRAM



Monitoring Module



PumpSafe™ Monitoring Modules for KSB Submersible Pumps

Module Types (by sensor types and pump leads)	
Model	**Description**
A	Bi-Metal (21 & 22) or PTC Thermistor (10 & 11) and Moisture Sensor (9 & Pump Ground)
~~B~~	~~Bi-Metal (21 & 22) or PTC Thermistor (10 & 11) and Float Switch (3 & 4)~~
~~D~~	~~Bearing PT-100 (15 & 16) optional (16 & 17) and Float Switch (3 & 4).~~

Overview

KSB submersible pump motors have varying combinations of over-temperature and moisture intrusion protection. The alternatives employed by the KSB factory are motor specific. The alternatives include bi-metal or thermistors for winding thermal protection, a PT-100 platinum resistance temperature detector for bearing temperature monitoring, either a conductive sensor electrode or float switch or both for moisture detection. The appropriate module(s) should be specified accordingly.

There are three different models designated as A, B, and D. These models each incorporate an RS-485 communication bus over which the device broadcasts current status and archival data. Each model is optionally available in a Modbus version (-M option) in which the RS-485 bus is used to communicate to a Serial Modbus Master.

PumpSafe™ Model A

All PumpSafe™ models have two independent channels for monitoring various pump sensors. The Model A monitors Channel 1 and faults when the resistance is sensed to be less than 6K ohms—the value corresponding to moisture having entered the motor housing. Upon falling below this value, an internal timer starts and counts to 15 seconds at which time a counter is advanced by one count. When the counter reaches three, the "Moisture Sensor" LED changes from Green to Amber and the Channel 1 relay toggles indicating an alarm condition. (The counter is reset if no count is received for a 24 hour period.)

In case that the indication of moisture is intermittent, the LED continues to flash Amber after the fault condition has disappeared. This allows maintenance personnel to be aware that an alarm has occurred.

Cycling power to the PumpSafe or pressing the Reset button returns the LED to its Green (normal) condition. (If the fault condition is still present, the Seal Failure alarm will return in 45 seconds.)

WARNING: Wait 45 seconds before starting the pump.

Channel 0 faults when resistance in the monitored circuit exceeds 4K ohms. This is typically used for

monitoring a PTC thermistor set or a set of bimetals switches embedded in the pump motor windings.

When the 4K ohm set point is exceeded, there is a delay of nominally 3 seconds after which the contacts toggle and the LED changes from Green to Red. NOTE: For temperature monitoring, the N.C. contacts are in reality the N.O. relay contacts held closed electrically. This is to provide fail safe operation in the event of a failed or accidentally unplugged PumpSafe module. As a consequence, there is a period of a few milliseconds where the N.O. contact is closed on power-up.

NOTE: On both channels, time delays may appear to vary slightly with sensor resistance due to hardware and digital filtering of the signals.

See "Common Features" for additional information.

PumpSafe™ Model B

Both channels of the Model B PumpSafe™ are set to fault when the circuit resistance exceeds 4K ohms and therefore behave in the same manner as Channel 0 of the Model A. Typical applications are Channel 0 monitoring a N.C. thermal switch while Channel 1 is monitoring a PTC thermistor. Other N.C. pump sensors such as bi-metallic switches, thermistors or float switches can also be monitored.

See "Common Features" for additional information.

PumpSafe™ Model D (presently no Model C)

The Model D is also primarily designed for monitoring temperature with Channel 1 configured to alarm when the circuit resistance is greater than 4K ohms, allowing it to monitor either a N.C. thermal switch or a PTC-type thermistor. Channel 0 is configured to monitor a PT100 RTD and is preset for 157 ohms, corresponding to 150°C. Functionally both channels operate in the same manner as Channel 0 of the Model A version.

Common Features

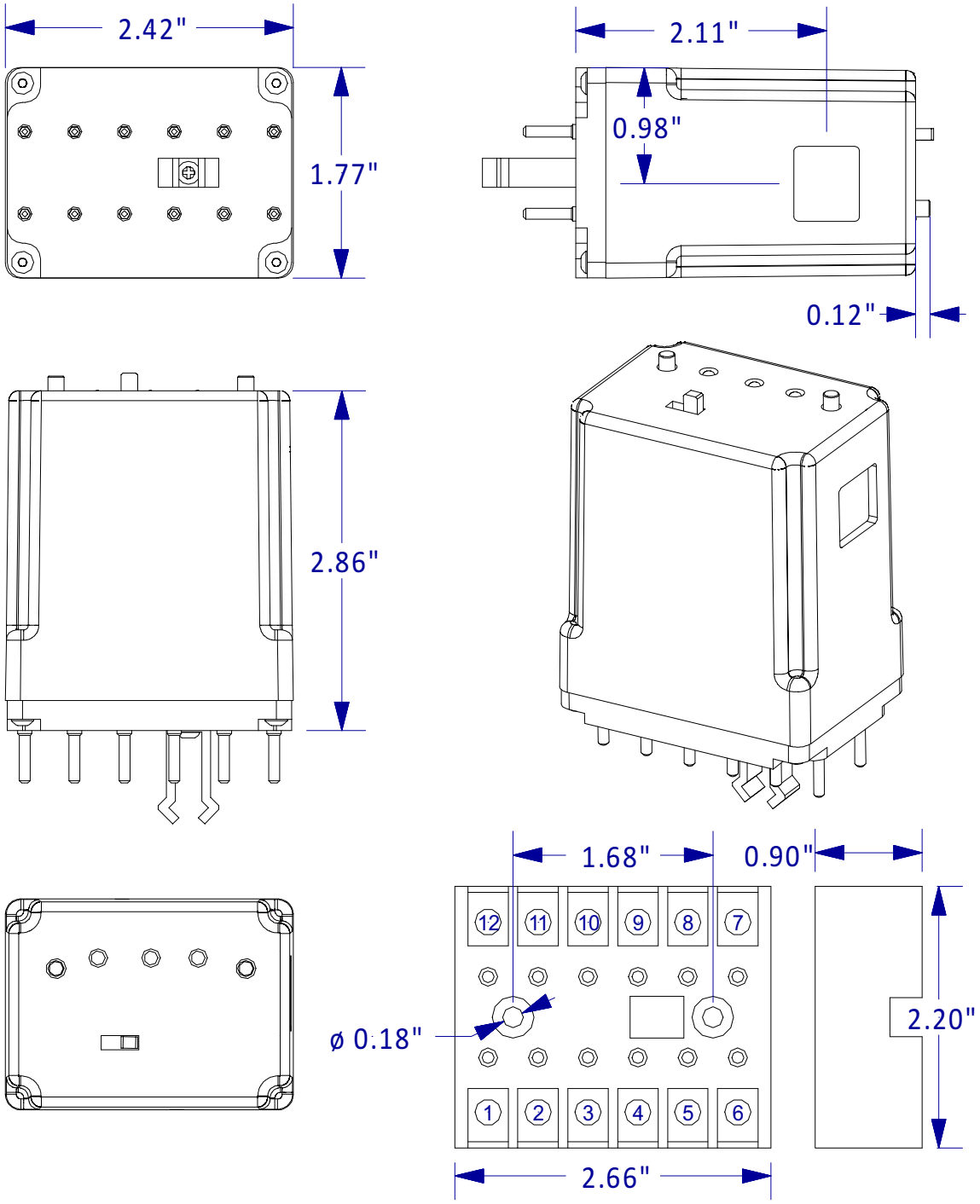
Auto/Manual Reset Switch	Channels that monitor temperature can be set for Manual or Auto reset after experiencing an alarm condition. (Seal failures automatically reset when the alarm condition is removed although the LED continues to flash until reset.) It is recommended that Manual reset be used except in those cases where the control logic "locks out" an automatic restart of the pump.
Reset Push Button	This push button is used to reset the high temperature contacts when the PumpSafe™ is in the Manual Reset mode. It also resets the flashing LEDs that signify that an alarm condition has occurred.
Test Push Button	The Test button simulates an alarm condition in both channels for three seconds or until released. It should be noted that in many cases this will cause the pump to stop because of the simulated high temp condition.
Modbus Host (Slave) (Available as an option. Specify -M when ordering.)	All PumpSafe™ relays are provided with a female RJ-11 connector configured as an RS485 port. On standard models, this port is used to broadcast ASCII encoded data for reporting status and archival data to a monitoring host. On Modbus models, this port is used to communicate to a Serial Modbus Master. It can be used both to monitor status and to control certain aspects of the PumpSafe™ device.
Special Configurations	Special configurations are available with short lead-times. Consult the factory for special requirements.

Technical Data

Operation Principle:	Current sensing
Environment:	-40 to 55°C (-40 to 131°F)
Supply Voltage (Nominal):	24 to 240 VAC, 50-60 Hz 24-48 VDC
Relay Contact Rating:	NEMA B300 Pilot Duty, 1/6th HP, 3A @240VAC; Form C
Maximum Sensor Voltage:	10 VDC +/- 2%
Values of Operation:	Alarm conditions Model A Channel 0 R > 4K ohms Channel 1 R < 6K ohms Alarm conditions Model B Channel 0 R > 4K ohms Channel 1 R > 4K ohms Alarm conditions Model D Channel 0 R > 157 ohms Channel 1 R > 4K ohms Green LED On = Supply Voltage present Green LED Off = No Supply Voltage present
Moisture / Leakage	
Contact:	N.O. contact closes on Alarm condition; N.C. contact used for interlocking when moisture / leakage is a fault condition.
Reset:	Reset is automatic after removal of alarm condition; however LED continues to blink until Reset button is pushed or the unit is reset via the Modbus.
LED Indicators:	Green LED On = No moisture inside motor housing or no liquid inside leakage chamber Amber LED On = Moisture inside motor housing or liquid inside leakage chamber Amber LED Blinking = Latched Moisture / Leakage alarm
THERMAL (Temperature)	
Contact:	N.O. contact closed on Alarm condition; N.C. contact used for interlocking
Reset:	**Automatic Reset** mode. Reset occurs upon closure of thermal switch in stator, however LED continues to flash until power is removed or the Reset button is pressed or the unit is reset via the Modbus. **Manual Reset** mode. High Temperature relay remains “locked out” until power is removed or the Reset button is pressed or the unit is reset via the Modbus.
LED Indicators:	Red LED On = High temperature indicate Red LED Off = Normal temperature Red LED Blinking = High temperature has occurred in the past but the condition has been automatically cleared
Power Consumption	24 VAC - 50/60 1.7 VA 120 VAC – 50/60 1.9 VA

	240 VAC – 50/60 2.4 VA 24 VDC 1.4 Watts
Part Number	PumpSafe Model A-M ~~PumpSafe Model B-M~~ ~~PumpSafe Model D-M~~ Suggested socket – 27390
Approvals	UL – File E222351

Mechanical



Wiring Diagrams

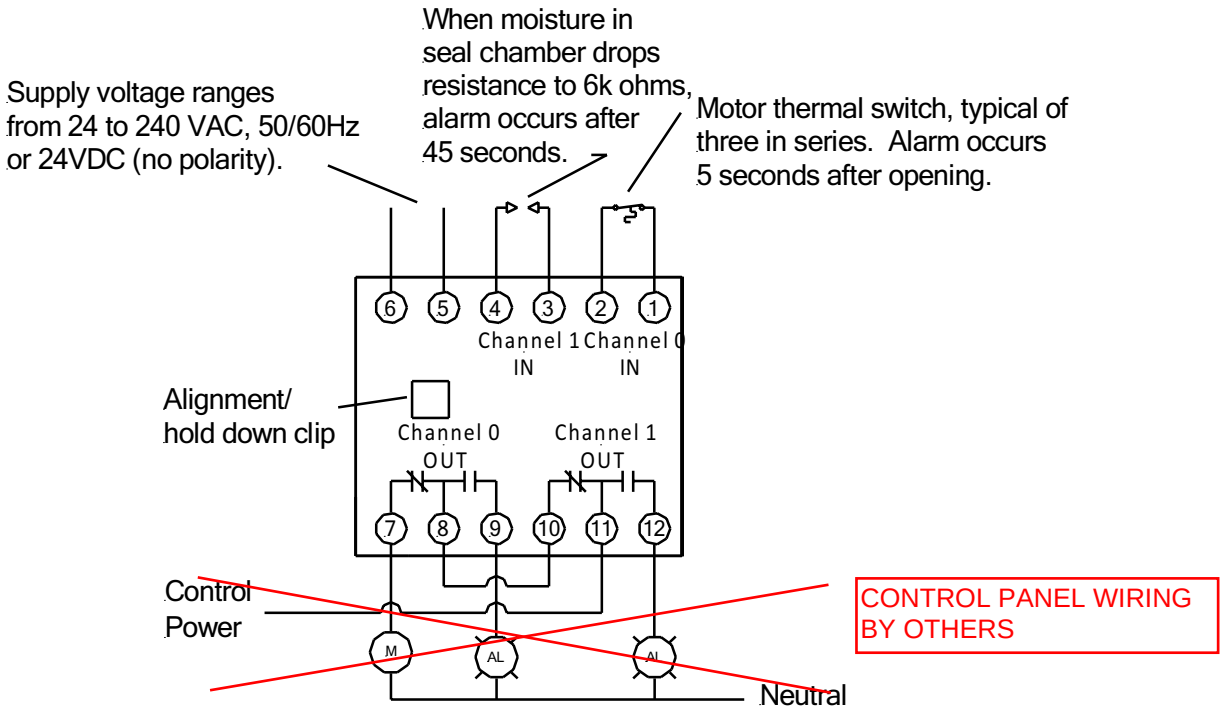


Figure 1 Typical Wiring for Model A PumpSafe When Moisture is a Pump Shut Down Condition

NOTE FOR ALL MODELS:

Pins #4 and #2 in **ALL MODELS** are connected internally to the PumpSafe internal Ground signal. Care must be taken to avoid a grounding conflict. If communication over the Modbus is used, then either pin #4 or pin #2 should be connected to panel ground for proper RS-485 signal referencing. In all standard configurations, this would typically be done at pin #4.

Case Marking / Model Identification

Cases are marked with the appropriate Model (A, B or D) and the communication option. If MODBUS is not marked then the default option is Broadcast.

SUMP PUMP KRT K80-217/24XEG-S

9.3 Wiring diagrams

9.3.1 Wiring diagrams for installation types P and S

9.3.1.1 Wiring diagram for one power cable 8G1.5 (AWG 15-8)

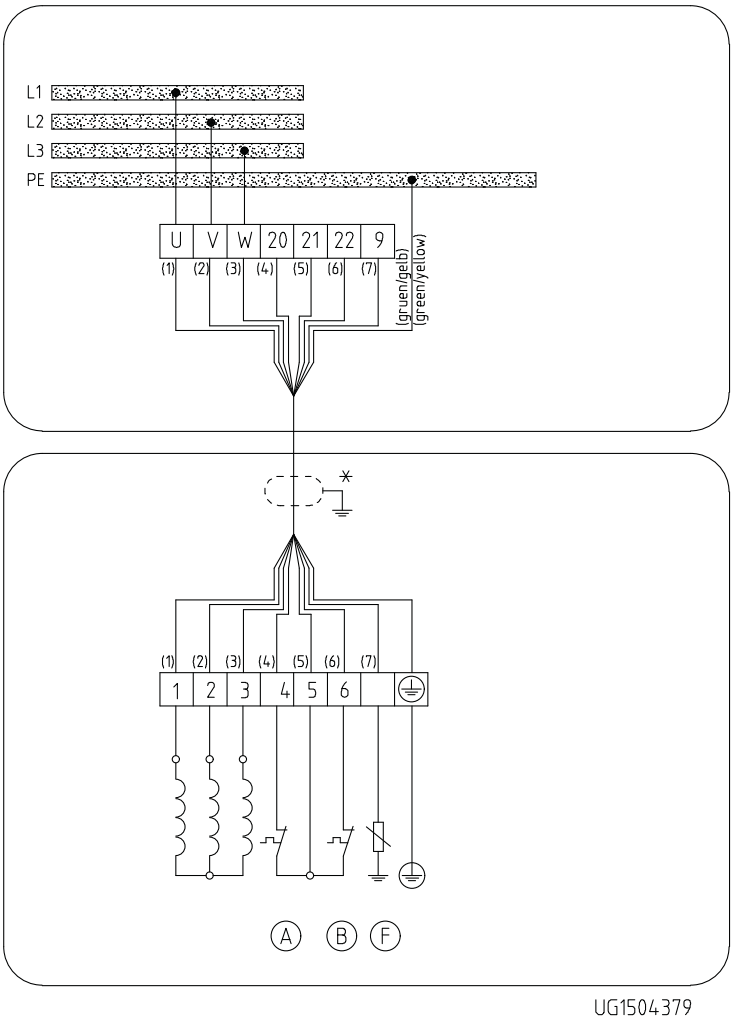


Fig. 55: Wiring diagram for pump sets of installation types P or S with one power cable 8G1.5

Ⓐ	Motor temperature 1
Ⓑ	Motor temperature 2
Ⓕ	Leakage inside the motor
*	Shielded cable optional

P-1 KRT K200-317/156XEG-S

9.3.1.3 Wiring diagram for one power cable 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5 (AWG 11 - 7 + 15 - 5, AWG 9 - 7 + 15 - 5 or AWG 7 - 7 + 15 - 5)

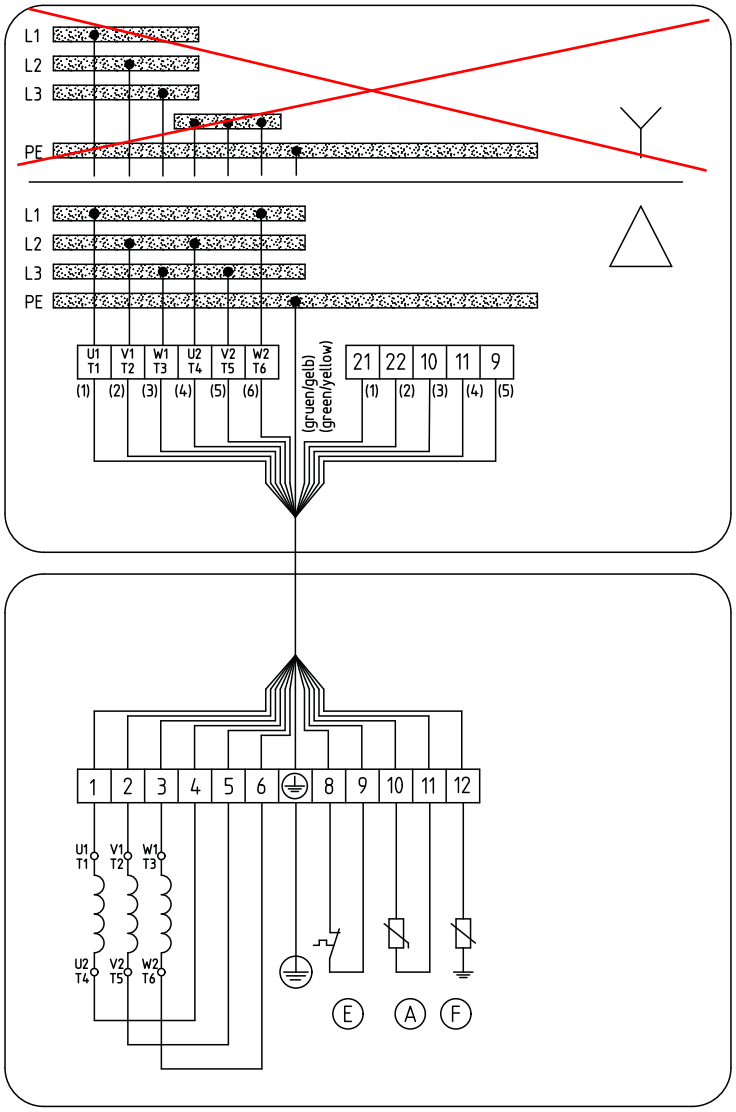


Fig. 57: Wiring diagram for pump sets of installation types P or S with one power cable 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5

Ⓐ	Motor temperature (PTC thermistor)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor
*	Shielded cable optional

9.3 Wiring diagrams

9.3.1 Wiring diagram for the power cables

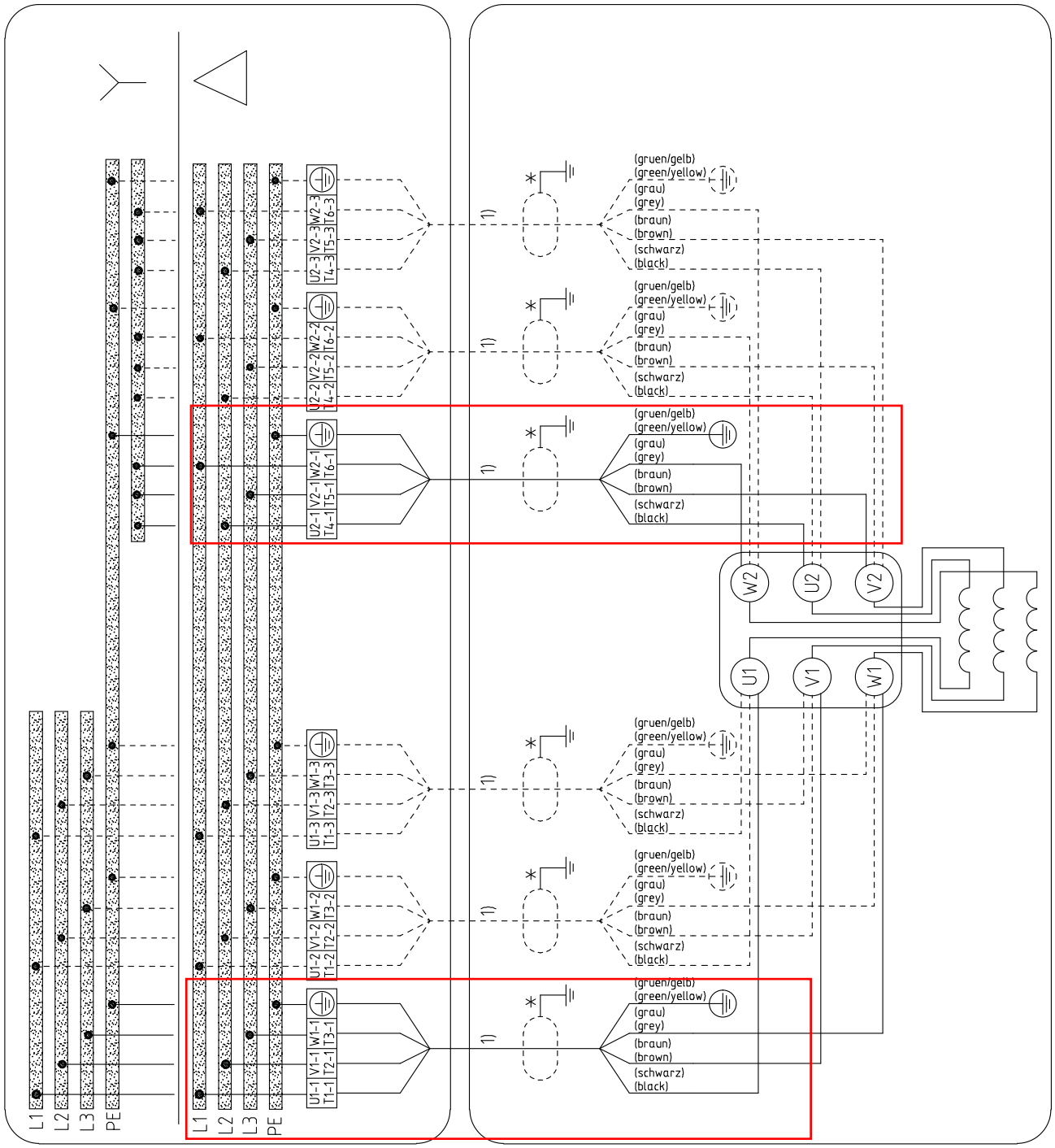


Fig. 80: Wiring diagram for the power cables

* Shielded cable optional
[1)] Up to 3 parallel cable pairs possible

9.3.2 Wiring diagrams for the sensors

9.3.2.1 Pump sets with cooling system, installation types D and K

Standard pump set, installation types D and K

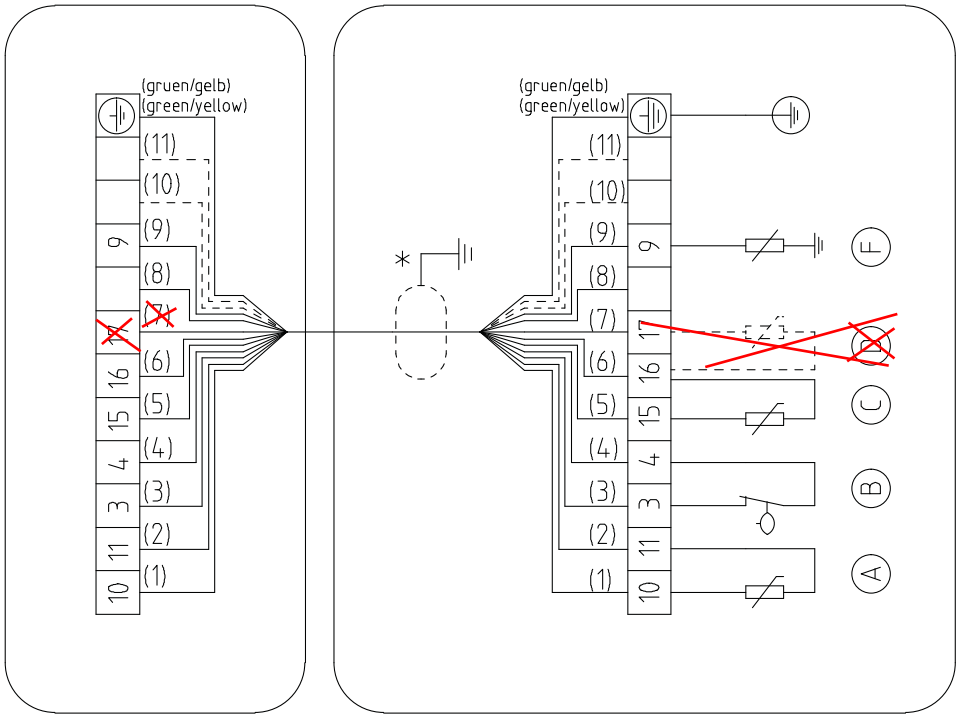


Fig. 81: Sensor wiring diagram for standard pump sets, installation types D and K

*	Shielded cables optional
Ⓐ	Motor temperature (PTC)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
~~Ⓓ~~	~~Bearing temperature (upper bearing, optional)~~
Ⓕ	Leakage inside the motor

SECTION 5: INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS

SECTION 5A

P-1 & SUMP PUMP IOM

KRT K 200-316/156XEG-S
KRT F 80-217/24XEG-S

Submersible Motor Pump

P-1	KRT K200-317/156XEG-S
Sump Pump (SP)	KRT F80-217/24XEG-S

Amarex KRT

Sizes DN 40 to DN 300; 60 Hz
Motor sizes
2 Poles: 3 2.E to 75 2.E
4 Poles: 2 4.E to 75 4.E
6 Poles: 7 6.E to 55 6.E
8 Poles: 11 8.E to 45 8.E

Installation/Operating Manual

Mat. No.: 01654473

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Installation/Operating Manual Amarex KRT

Original operating manual

Subject to technical modification without prior notice.

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Glossary

Back pull-out unit

Pump without pump casing; partly completed machinery

Certificate of decontamination

If a product is to be returned to the manufacturer, the customer declares in a certificate of decontamination that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

Close-coupled design

Motor directly fitted to the pump via a flange or a drive lantern

Discharge line

The pipeline which is connected to the discharge nozzle

Hydraulic system

The part of the pump in which the kinetic energy is converted into pressure energy

Noise characteristics

The noise characteristics are indicated as surface sound pressure level in dB(A).

Pump set

Complete pump set consisting of pump, drive, additional components and accessories

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

1 General

1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover (for details, refer to the table below).

Table 1: Variants covered by this manual

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH	H	C1	C2
40-252	F, K, S	F, K, S	F, K	F, K	F, K	F, K	F, K	F, K
50-215	F	F	F	F	F	F	F	F
50-216	F, S	F, S	F	F	F	F	F	F
65-215	F	F	F	F	F	F	F	F
65-216	E	E	-	-	-	-	-	-
65-217	F	F	F	F	F	-	-	-
80-216	E, F	E, F	F	F	F	F	F	F
SP 80-217	F	F	F	F	F	-	-	-
80-252	F	F	F	F	F	F	F	F
80-253	E, F, K	E, F, K	F, K	F, K	F, K	F, K	F, K	F, K
80-315	D	D	D	-	-	-	-	-
80-317	D	D	D	-	-	-	-	-
100-215	F	F	F	F	F	-	-	-
100-253	D, E, K	D, E, K	D, K	K	K	K	K	K
100-254	F, K	F, K	F, K	F, K	F, K	F, K	F, K	F, K
100-255	E	E	-	-	-	-	-	-
100-315	D	D	D	-	-	-	-	-
100-316	D, F, K	D, F, K	D, F, K	F, K	F, K	F, K	F, K	F, K
100-317	E	E	-	-	-	-	-	-
100-400	K	K	K	-	K	-	K	K
100-401	E, F, K	E, F, K	F, K	-	F, K	F, K	F, K	F, K
150-253	D	D	D	-	-	-	-	-
150-315	D, F, K	D, F, K	D, F, K	F, K	F, K	F, K	F, K	F, K
150-317	E, K	E, K	K	K	K	K	K	K
150-400	D, K	D, K	D, K	K	K	K	K	K
150-401	D, E, F, K	D, E, F, K	D, F, K	K	F, K	F, K	F, K	F, K
150-403	K	K	K	K	K	K	K	K
151-401	K	K	K	-	K	K	K	K
151-403	K	K	K	K	K	K	K	K
200-315	D, K	D, K	D, K	K	K	K	K	K
200-316	K	K	K	K	K	K	K	K
P-1 200-317	K	K	K	K	K	-	-	-
200-318	K	K	K	K	K	-	-	-
200-330	K	K	K	K	K	K	K	K
200-400	D	D	D	-	-	-	-	-
200-401	E, K	E, K	K	K	K	K	K	K
200-402	K	K	K	K	K	K	K	K
200-403	K	K	K	K	K	K	K	K
250-400	D, K	D, K	D, K	K	K	K	K	K
250-401	K	K	K	K	K	K	K	K
250-403	K	K	K	K	K	K	K	K

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH	H	C1	C2
300-400	D, K	D, K	D, K	K	K	K	K	K
300-401	K	K	K	K	K	K	K	K
300-403	K	K	K	K	K	K	K	K

The manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number clearly identify the pump set and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest KSB Service center to maintain the right to claim under warranty.

Observe the noise characteristics, indicated as surface sound pressure level. (⇨ Section 4.7, Page 22)

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance.

1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇨ Section 2.4, Page 12)

1.4 Other applicable documents

Table 2: Overview of other applicable documents

Document	Contents
Data sheet	Technical data of the pump set
General arrangement drawing/ outline drawing	Mating dimensions, installation dimensions and weights of the pump set
Hydraulic characteristic curve	Characteristic curves showing head, flow rate, efficiency and power input
General assembly drawing[1)]	Sectional drawing of the pump set with part numbers
Sub-supplier product literature[1)]	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists[1)]	Description of spare parts
Supplementary operating manual[1)]	E.g. for special accessories

For accessories and/or integrated machinery components observe the product literature of the corresponding manufacturer.

1.5 Symbols

Table 3: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action

1) If agreed to be included in the scope of supply

Symbol	Description
⇨	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

2 Safety

DANGER

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 Key to safety symbols/markings

Table 4: Definition of safety symbols/markings

Symbol	Description
DANGER	**DANGER** This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	**General hazard** In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	**Electrical hazard** In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	**Machine damage** In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

2.2 General

This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.

The safety information in all sections of this manual must be complied with.

The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.

The contents of this operating manual must be available to the specialist personnel at the site at all times.

Information attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:

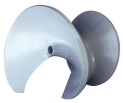
- Arrow indicating the direction of rotation
- Markings for connections
- Name plate

The operator is responsible for ensuring compliance with all local regulations which are not taken into account.

2.3 Intended use

- The pump (set) must only be operated within the operating limits which are described in the other applicable documents.
- Only operate pump sets which are in perfect technical condition.
- Do not operate partially assembled pump sets.
- Only use the pump (set) to handle the fluids described in the data sheet or product literature of the pump variant.
- Never operate the pump set without the fluid to be handled.

- Observe the limits for continuous duty specified in the data sheet or product literature (Q_{min} and Q_{max}) (to prevent damage such as shaft fracture, bearing failure, mechanical seal damage, etc).
- When untreated waste water is handled, the duty points in continuous operation lie within 0.7 to 1.2 × $Q_{opt}$to minimize the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates (< 0.7 x Q_{opt}).
- Observe the minimum flow rates and maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pump set (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.
- Only use the respective impeller types in combination with the fluids described below.

	Impeller with cutter (impeller type S/S-max)
	Free-flow impeller (impeller type F/F-max) **SP**
	Closed single-channel impeller (impeller type E/E-max)
	Open, diagonal single-vane impeller (impeller type D)
	Closed multi-channel impeller (impeller type K/K-max) **P-1**

- Use in the Amajet system
  See Amajet installation/operating manual for installation types.
  The following sizes are approved for use in the Amajet system:
  - F 100-254
  - D 100-253
  - F 150-315
  - D 100-316
  - D 150-253
  - D 150-315

Prevention of foreseeable misuse

- Observe the minimum flow velocities required to fully open the swing check valves to prevent the reduction of pressure and risk of clogging.
  (Contact the manufacturer for the required minimum flow velocities/loss coefficients.)
- Never exceed the permissible operating limits (pressure, temperature, etc.) specified in the data sheet or product literature.
- Observe all safety information and instructions in this manual.

2.4 Personnel qualification and personnel training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by sufficiently trained specialist personnel training and instructing the personnel who will carry out the respective tasks. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

2.5 Consequences and risks caused by non-compliance with these operating instructions

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

2.6 Safety awareness

In addition to the safety information contained in this manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

2.7 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.8 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorized by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation is performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energized).
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇨ Section 6.3, Page 56)
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇨ Section 6.1, Page 50)

2.9 Unauthorized modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this manual.

The warranty relating to the operating reliability and safety of the pump (set) supplied is only valid if the equipment is used in accordance with its intended use.

2.10 Explosion protection

Special conditions apply to the operation of explosion-proof pumps.

- The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.
- The limits stated in the data sheet and on the name plate must not be exceeded under any circumstances.
- Correct monitoring of the motor temperature is imperative to ensure explosion protection.
- Observe the wiring diagrams.
- Never operate an explosion-proof pump set without temperature monitoring.
- Modifications or alteration of the pump set could affect explosion protection and are only permitted after consultation with the manufacturer.
- Only original spare parts and accessories authorized by the manufacturer must be used for explosion-proof pumps.

3 Transport/Temporary Storage/Disposal

3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the distributor and the insurance company about the damage in writing immediately.

3.2 Transport

DANGER

Improper transport

Danger to life from falling parts!

Damage to the pump set!

- Use the attachment point provided for attaching the lifting accessory.
- Never suspend the pump set by its power cable.
- Use the lifting chain/rope included in the scope of supply exclusively for lowering or lifting the pump set into/out of the pump sump.
- Securely attach the lifting chain/rope to the pump and crane.
- Use tested, marked and approved lifting accessories only.
- Observe the regional transport regulations.
- Observe the documentation of the lifting accessory manufacturer.
- The load-carrying capacity of the lifting accessories must exceed the weight indicated on the name plate of the pump set to be lifted. Take into account any additional system components to be lifted.

To transport the pump set suspend it from the lifting tackle as shown.

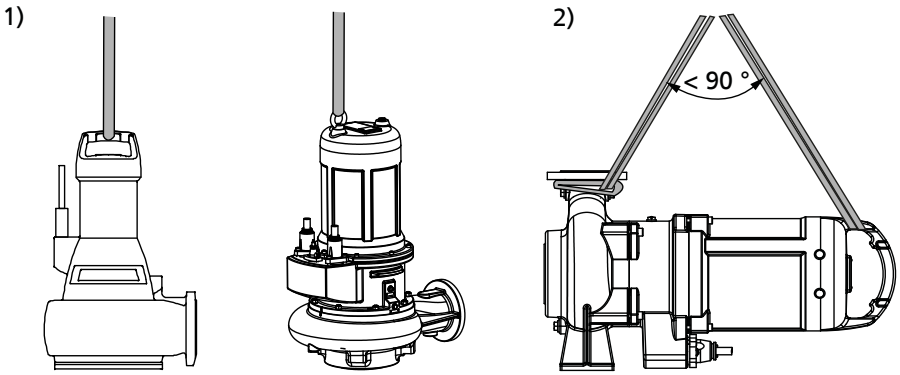


Fig. 1: Transporting the pump set 1) vertical installation 2) horizontal installation

Placing down the pump set

WARNING

Incorrect positioning/placing down

Personal injury and damage to property!

- Position the pump set vertically with the motor on top.
- Use appropriate means to secure the pump set against tilting and tipping over.
- Refer to the weights given in the data sheet/on the name plate.

⚠ WARNING

Improper placing of pump sets in a vertical/horizontal position

Personal injury and damage to property!

- Use appropriate means to secure the pump set against tilting or tipping over.
- Use two sets of lifting equipment when handling large pump sets if possible (using the attachment point provided on the motor and the discharge nozzle).
- Secure power cables against falling down.
- Use additional supports for the transport holder to secure it against tilting.
- Maintain adequate safety distance during lifting operations.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Placing the pump set on unsecured and uneven surfaces

Personal injury and damage to property!

- Always place the pump set on a solid and level surface with the pump set in a vertical position and the motor on top.
- Only place the pump set on a surface of sufficient load-carrying capacity.
- Use appropriate means to secure the pump set against tilting or tipping over.

It may be necessary to place the pump set down in a horizontal position during maintenance or installation.

3.3 Storage/Preservation

If commissioning is to take place some time after delivery, we recommend that the following measures be taken:

CAUTION

Improper storage

Damage to the power cables!

- Support the power cables at the cable entry to prevent permanent deformation.
- Only remove the protective caps from the power cables at the time of installation.

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of the pump (set)!

- For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.

CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

Table 5: Ambient conditions for storage

Ambient conditions	Value
Relative humidity	5 % to 85 % (non-condensing)
Ambient temperature	-4 °F to 158 °F [- 20 °C to + 70 °C]

- Store the pump set under dry and vibration-free conditions, if possible in its original packaging.

1. Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative.
2. Spray the preservative through the suction and discharge nozzles.
   It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).

NOTE

Observe the manufacturer's instructions for application/removal of the preservative.

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇨ Section 7.3, Page 68)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralized, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
   Always indicate any safety measures and decontamination measures taken.
   (⇨ Section 10, Page 118)

NOTE

If required, a blank certificate of decontamination can be downloaded from the KSB web site at: www.ksb.com/certificate_of_decontamination

3.5 Disposal

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Dismantle the pump (set).
   Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
   - Metals
   - Plastics
   - Electronic waste
   - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

4 Description of the Pump (Set)

4.1 General description

Pump for handling untreated waste water containing long fibers and solid substances, liquids containing air/gas, and raw sludge, activated sludge and digested sludge.

4.2 Designation

P-1 KRT K200-317/156XEG-S

~~Example: Amarex KRT F 50 - 215 / 32XEC1 - S IE3~~

Table 6: Designation key

Code	Description	
Amarex KRT	Type series	
~~F~~ K	Impeller type	
~~50~~ 200	Nominal discharge nozzle diameter [mm]	
~~215~~ 317	Maximum nominal impeller diameter [mm]	
~~3~~ 15	Motor size	
~~2~~ 6	Number of motor poles	
XE	Motor version	
	~~UE~~	~~Not explosion-proof, for fluid temperatures of up to 104 °F [40 °C]~~
	~~WE~~	~~Not explosion-proof, for fluid temperatures of up to 140 °F [60 °C]~~
	XE	Explosion-proof, for fluid temperatures of up to 104 °F [40 °C]
	~~ZE~~	~~Explosion-proof, for fluid temperatures of up to 140 °F [60 °C]~~
~~C1~~ G	Material variant	
	G	Standard design, gray cast iron
	~~G1~~	Like G with impeller made of duplex stainless steel
	G2	Like G with impeller made of white cast iron
	GH	Like G with impeller and discharge cover made of white cast iron
	H	Like G with impeller, discharge cover and pump casing made of white cast iron
	C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, screws/bolts made of A4
	C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462
S	Type of installation	
~~IE3~~	Motor efficiency classification[2)]	
	[3)]	No efficiency classification
	~~IE3~~	~~Premium Efficiency~~

2) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.

3) Blank

4 Description of the Pump (Set)

4.1 General description

Pump for handling untreated waste water containing long fibers and solid substances, liquids containing air/gas, and raw sludge, activated sludge and digested sludge.

4.2 Designation

SUMP PUMP KRT K80-217/24XEG-S

~~Example: Amarex KRT F 50 215 / 32XEC1 S IE3~~

Table 6: Designation key

Code	Description	
Amarex KRT	Type series	
F	Impeller type	
~~50~~ 80	Nominal discharge nozzle diameter [mm]	
~~215~~ 217	Maximum nominal impeller diameter [mm]	
~~3~~ 2	Motor size	
~~2~~ 4	Number of motor poles	
XE	Motor version	
	~~UE~~	~~Not explosion-proof, for fluid temperatures of up to 104 °F [40 °C]~~
	~~WE~~	~~Not explosion-proof, for fluid temperatures of up to 140 °F [60 °C]~~
	XE	Explosion-proof, for fluid temperatures of up to 104 °F [40 °C]
	~~ZE~~	~~Explosion-proof, for fluid temperatures of up to 140 °F [60 °C]~~
~~C1~~ G	Material variant	
	G	Standard design, gray cast iron
	~~G1~~	Like G with impeller made of duplex stainless steel
	G2	Like G with impeller made of white cast iron
	GH	Like G with impeller and discharge cover made of white cast iron
	H	Like G with impeller, discharge cover and pump casing made of white cast iron
	C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, screws/bolts made of A4
	C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462
S	Type of installation	
IE3	Motor efficiency classification[2)]	
	[3)]	No efficiency classification
	IE3	Premium Efficiency

2) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.

3) Blank

4.3 Name plate

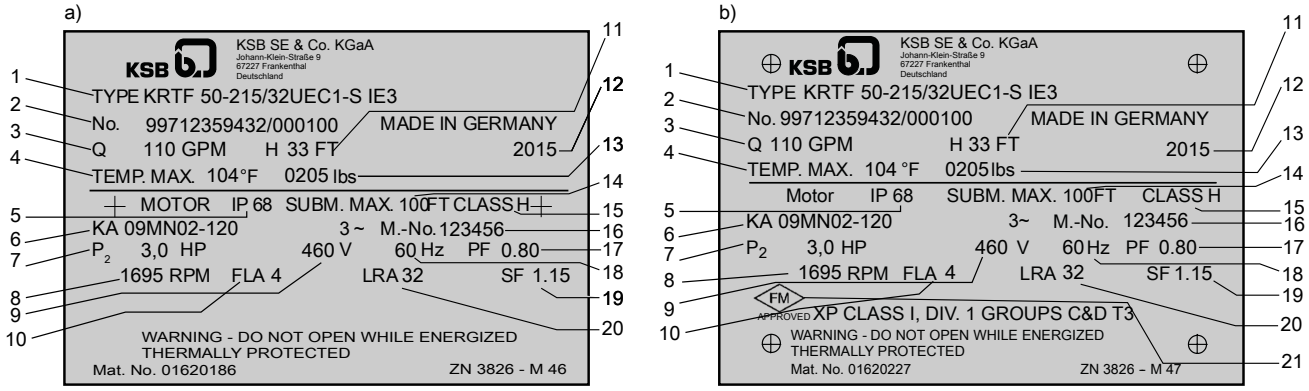


Fig. 2: Name plate (example) a) for non-explosionproof model, b) for explosion-proof model

1	Designation	2	KSB order number
3	Flow rate	4	Maximum fluid temperature and ambient temperature
5	Enclosure	6	Motor type
7	Rated power	8	Rated speed
9	Rated voltage	10	Rated current
11	Head	12	Year of construction
13	Total weight	14	Maximum submergence
15	Thermal class of winding insulation	16	Motor number
17	Power factor at rated operating point	18	Rated frequency
19	Service factor	20	Starting current
21	Explosion protection marking		

4.4 Design details

Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

Impeller type

- Various application-oriented impeller types

Shaft seal

Standard bearings:

- Two bi-directional mechanical seals in tandem arrangement, with leakage chamber

Reinforced bearings: (⇨ Section 9.2.7, Page 94)

- Two bi-directional mechanical seals in tandem arrangement, with leakage chamber

Bearings

Standard bearings:

- Grease-packed bearings sealed for life
- Maintenance-free

Reinforced bearings: (⇨ Section 9.2.7, Page 94)

Drive end:

- Grease-packed bearings sealed for life
- Maintenance-free

Pump end:

- Grease-packed bearings
- Can be re-lubricated

Drive

- Three-phase asynchronous squirrel-cage motor
- Motors integrated in explosion-proof pump sets are supplied in Explosionproof Class I Division 1, Groups C&D, T3.

P-1 = Bare Pump to be mounted on existing claw, but Type #3 - Type S Below

4.5 Installation types

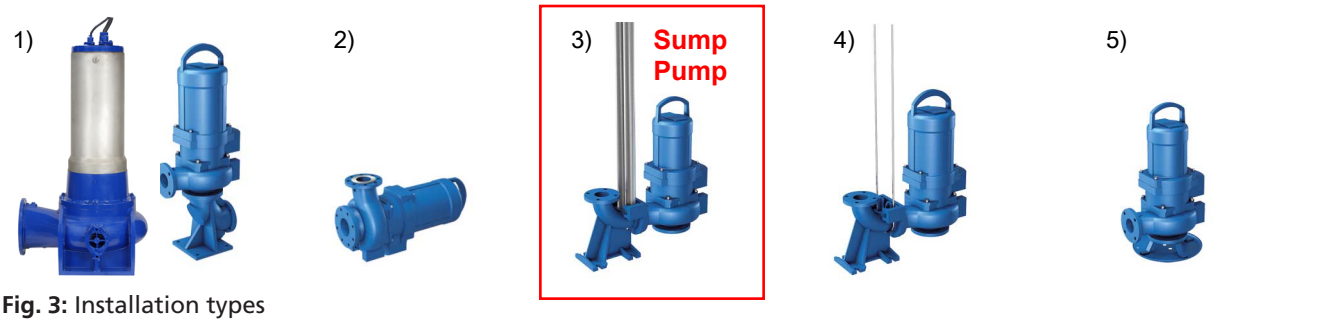


Fig. 3: Installation types

1	Installation type D: stationary dry installation, vertical (S1 duty)
2	Installation type H: stationary dry installation, horizontal (S1 duty)
3	Installation type K: wet installation (S1 duty with motor outside of the fluid possible) with guide rail arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide rail arrangement
4	Installation type K: stationary wet installation (S1 duty with motor outside of the fluid possible) with guide cable arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide cable arrangement
5	Installation type P: wet installation of transportable model (S1 duty with submerged motor)

~~**Pump sets of installation types D, H and K**~~
~~are suitable for continuous operation with the motor outside the fluid. Cooling is effected by means of air convection.~~
~~Versions with a cooling jacket have an additional internal cooling circuit.~~

Pump sets of installation types P and S
are designed for continuously submerged operation. The motor is cooled by the fluid handled on the motor surface. Operation with the motor outside the fluid handled is possible for short periods.

4.6 Configuration and function

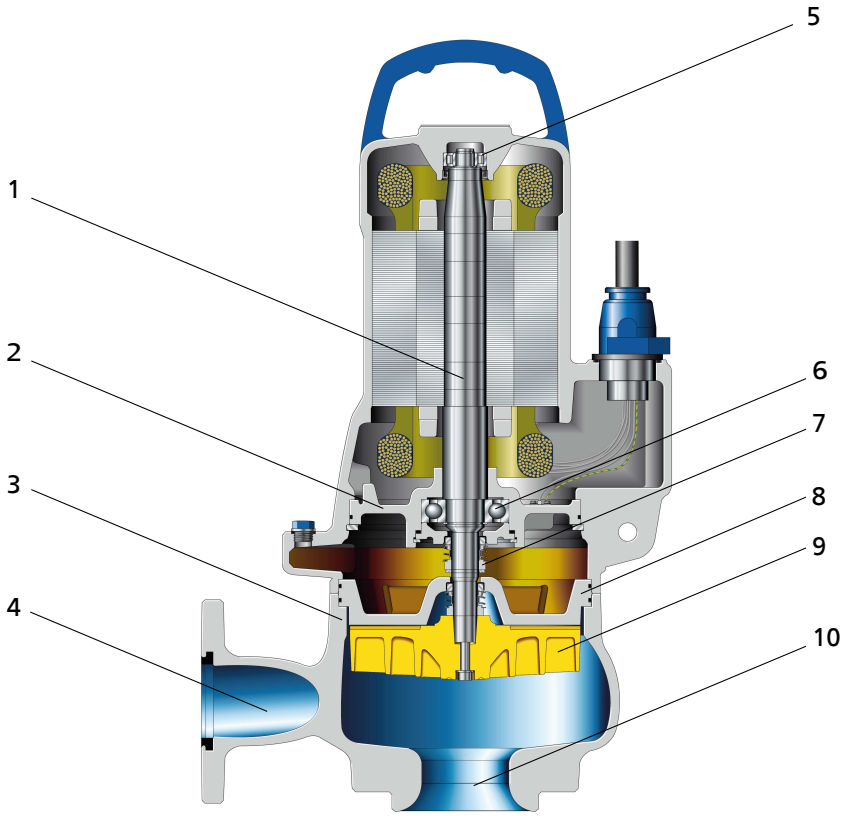


Fig. 4: Sectional drawing

1	Shaft	2	Bearing housing
3	Pump casing	4	Discharge nozzle
5	Bearing, motor end	6	Bearing, pump end
7	Shaft seal	8	Discharge cover
9	Impeller	10	Suction nozzle

Design The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system sits on the extended motor shaft. The shaft runs in common bearings.

Function The fluid enters the pump axially via a suction nozzle (10) and is accelerated outward in a cylindrical flow by the rotating impeller (9). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (4), where it leaves the pump. At the rear side of the impeller, the shaft (1) enters the hydraulic system via the discharge cover (8). The shaft passage through the discharge cover is sealed with a shaft seal (7). The shaft runs in rolling element bearings (5 and 6) which are supported by a bearing housing (2).

Sealing The pump is sealed by two bi-directional mechanical seals in tandem arrangement. A lubricant chamber in-between the seals ensures cooling and lubrication of the mechanical seals.

4.7 Noise characteristics

Table 7: Surface sound pressure level (L_{pA} [4) 5)]) depending on speed (n) and rated power (P_2)

P_2		L_{pA}		
		n = 3500 rpm	n = 1750 rpm	n = 1160 rpm
[kW]	[hp]	[dB]	[dB]	[dB]
2,2	3,0	-	58,5	57,5
3,7	5,0	68.5	62	59
5,5	7,4	70	63,5	63
6,5	8,7	71	-	63,5
7,5	10,0	71,5	65	-
8,5	11,4	72	66	-
10,0	13,4	72,5	67	-

4.8 Scope of supply

Depending on the model, the following items are included in the scope of supply:

Stationary model for wet installation (installation types S and K)

- Pump set complete with connection cables
- Claw with sealing and mounting elements
- Lifting rope / lifting chain
- Mounting bracket with mounting elements
- Base elbow and mounting elements
- Guide cable / guide rail
  (guide rails are not included in KSB's scope of supply)

SEE DETAILED SCOPE IN SUBMITTAL

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

Transportable model for wet installation (installation type P)

- Pump set complete with connection cables
- Foot plate or pump stool with mounting elements
- Lifting rope / lifting chain

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

Stationary model for dry installation (installation types D and H)

Depending on the model, the following items are included in the scope of supply:

- Pump set complete with connection cables
- Foundation rails (for horizontal installation)
- Suction-side flanged spacer with inspection hole[6)] (optional)
- Suction elbow (for vertical installation)

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

4) Measured at a distance of 1 m from the pump outline (as per DIN 45635 Parts 1 and 24)
5) For installation types D and H only
6) For nominal discharge nozzle diameter ≥ DN100

4.9 Dimensions and weights

For dimensions and weights refer to the general arrangement drawing/outline drawing or data sheet of the pump set.

5 Installation at Site

5.1 Safety regulations

DANGER

Improper installation

Damage to the pump set!

- Observe the information given in the data sheet and on the name plate of the pump set.

DANGER

Risk of falling when working at great heights

Danger to life by falling from great heights!

- Do not step onto the pump (set) during installation work or dismantling work.
- Pay attention to safety equipment, such as railings, covers, barriers, etc.
- Observe the applicable local occupational safety regulations and accident prevention regulations.

DANGER

Persons in the tank during pump operation

Electric shock!

Risk of personal injury!

Danger of death from drowning!

- Never start up the pump set when there are persons in the tank.

WARNING

Hands, other body parts or foreign objects in the impeller or intake area

Risk of personal injury! Damage to the submersible motor pump!

- Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.
- Check that the impeller can rotate freely.

WARNING

Impermissible solid objects (tools, screws/bolts or similar) in the pump sump/inlet tank during pump start-up

Personal injury and damage to property!

- Check the pump sump/inlet tank for impermissible solid objects before flooding, and remove, if necessary.

5.2 Checks to be carried out prior to installation

5.2.1 Checking the operating data

Before installing the pump set, verify that the name plate data matches the data given in the purchase order and the system data.

5.2.2 Preparing the place of installation

Place of installation for stationary models

⚠ WARNING

Installation on mounting surfaces which are unsecured and cannot support the load

Personal injury and damage to property!

- Observe the required compressive strength class C25/30 of the concrete in exposure class XC1 as per EN 206-1.
- The mounting surface must have set and must be completely horizontal and even.
- Observe the weights indicated.

Resonances

Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

Place of installation for transportable models

⚠ WARNING

Incorrect positioning/placing down

Personal injury and damage to property!

- Position the pump set vertically with the motor on top.
- Use appropriate means to secure the pump set against tilting and tipping over.
- Refer to the weights given in the data sheet/on the name plate.

Resonances

Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

5.2.3 Checking the lubricant level

The lubricant chambers have been filled with an environmentally-friendly, non-toxic lubricant at the factory.

Visual inspection for signs of oil leakage

1. If no oil leakage is visible in the area of the pump casing, impeller and transport holder, the lubricant chamber is filled properly.
2. If oil leakage is visible in the area of the pump casing, impeller and transport holder, top up the lubricant chamber.

Filling in the lubricant

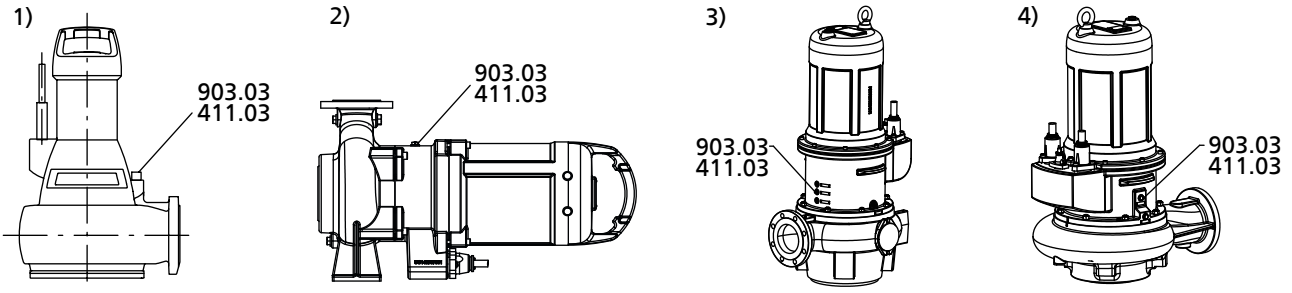


Fig. 5: Filling in the lubricant

Table 8: Filling in the lubricant

Motor	Impeller type	Variant			
		1	2	3	4
3 2.E - 7 2.E	E, F, K, S	✗	-	-	-
11 2.E - 26 2.E	E, F, K, S	-	✗	-	-
55 2.E - 75 2.E	D	-	-	✗	-
SP 2 4.E - 5 4.E	E, F, K, S	✗	-	-	-
7 4.E - 37 4.E	D, E, F, K, S	-	✗	-	-
45 4.E - 75 4.E	D	-	-	✗	-
45 4.E - 75 4.E	E, F, K	-	-	-	✗
P-1 7 6.E - 30 6.E	D, E, F, K, S	-	✗	-	-
31 6.E - 55 6.E	D	-	-	✗	-
31 6.E - 55 6.E	E, F, K	-	-	-	✗
11 8.E - 22 8.E	D, E, F, K	-	✗	-	-
30 8.E - 45 8.E	D	-	-	✗	-
30 8.E - 45 8.E	E, F, K	-	-	-	✗

1. Position the pump set as shown.
2. Undo and remove screw plug 903.03 and joint ring 411.03.
3. Fill lubricant through the lubricant filler opening until the lubricant level reaches the opening.
4. Fit screw plug 903.03 together with a new joint ring 411.03.

5.2.4 Checking the direction of rotation

DANGER

Pump set running dry

Explosion hazard!

- ▷ Check the direction or rotation of explosion-proof pump sets outside potentially explosive atmospheres.

WARNING

Hands and/or foreign objects in the pump casing

Risk of injuries, damage to the pump!

- ▷ Never insert your hands or any other objects into the pump.
- ▷ Check that the inside of the pump is free from any foreign objects.
- ▷ Take suitable precautions (e.g. wear safety goggles).

WARNING

Improper positioning of pump set when checking the direction of rotation

Personal injury and damage to property!

- ▷ Use appropriate means to secure the pump set against tilting or tipping over.

	**CAUTION** **Pump set running dry** Increased vibrations! Damage to mechanical seals and bearings! ▷ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

✓ The pump set is connected to the power supply.

1. Start the pump set and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.
   Impeller rotation must be anti-clockwise (seen from the pump mouth end). On some pump casings, the direction of rotation is marked by an arrow.

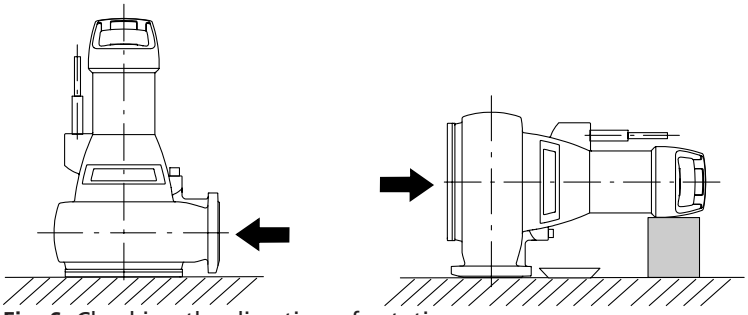


Fig. 6: Checking the direction of rotation

3. If the impeller is running in the wrong direction of rotation, check the electrical connection of the pump and the control system, if applicable.
4. Disconnect the pump set from the power supply and make sure it cannot be started unintentionally.

5.3 Installing the pump set

Always refer to and comply with the general arrangement drawing/outline drawing when installing the pump set.

5.3.1 Stationary wet installation

5.3.1.1 Fastening the flanged elbow

Fastening the flanged elbow with chemical anchors

Depending on the pump size, the flanged elbow is fastened with chemical anchors.

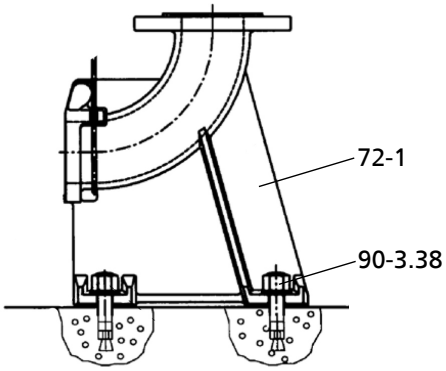


Fig. 7: Fastening the flanged elbow

1. Position base elbow 72-1 at the bottom of the tank/well.
2. Fit chemical anchors 90-3.38.
3. Bolt base elbow 72-1 to the floor using chemical anchors 90-3.38.

Chemical anchor dimensions

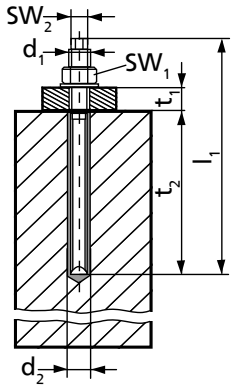


Fig. 8: Dimensions

Table 9: Chemical anchor dimensions [″]

Size ($d_1 \times l_1$)	d_2 [″]	t_1 [″]	t_2 [″]	SW_1 [7)] [″]	SW_2 [7)] [″]	M_{d1} [ft lb]
$^3/_8 \times 5\ ^1/_8$″	$^7/_{16}$	$^7/_8$	$3\ ^9/_{16}$	$^{11}/_{16}$	$^1/_4$	14,75
$^7/_{16} \times 6\ ^5/_{16}$″	$^9/_{16}$	1	$4\ ^5/_{16}$	$^3/_4$	$^5/_{16}$	29,50
$^5/_8 \times 7\ ^1/_2$″	$^{11}/_{16}$	$1\ ^3/_8$	$4\ ^{15}/_{16}$	$^{15}/_{16}$	$^7/_{16}$	44,25

Table 10: Chemical anchor dimensions [mm]

Size ($d_1 \times l_1$)	d_2 [mm]	t_1 [mm]	t_2 [mm]	SW_1 [7)] [mm]	SW_2 [7)] [mm]	M_{d1} [Nm]
M10 × 130	12	22	90	17	6	20
M12 × 160	14	25	110	19	8	40
M16 × 190	18	35	125	24	12	60

Table 11: Curing times of mortar cartridge

Floor temperature		Curing time
[°F]	[°C]	[min]
23 to 32	-5 to 0	240
32 to 50	0 to +10	45
50 to 68	+10 to +20	20
> 68	> +20	10

7) SW = Width across flats

5.3.1.2 Connecting the piping

DANGER

Impermissible loads acting on the flange of the base elbow

Danger to life from leakage of hot, toxic, corrosive or flammable fluids!

- ▷ Do not use the pump as an anchorage point for the piping.
- ▷ Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains.
- ▷ Observe the permissible flange loads.
- ▷ Take appropriate measures to compensate thermal expansion of the piping.

NOTE

When the pump set is used for draining low-level building areas, fit a swing check valve into the discharge line to avoid backflow from the sewer system.

CAUTION

Critical speed

Increased vibrations!

Damage to mechanical seals and bearings!

- ▷ In the case of longer riser pipes, fit a swing check valve to prevent the pump from excessively running in reverse after it is switched off.
  Choose the position of the swing check valve to allow proper venting.

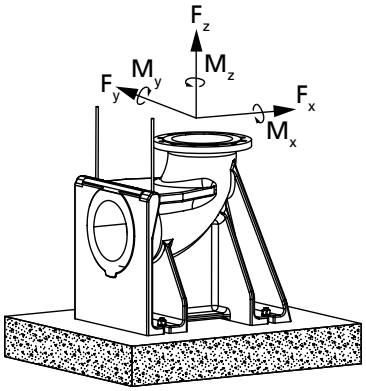


Fig. 9: Permissible flange loads

Table 12: Permissible flange loads

DN	Forces								Moments							
	F_y		F_z		F_x		ΣF		M_y		M_z		M_x		ΣM	
	[lbf]	[N]	[lbf]	[N]	[lbf]	[N]	[lbf]	[N]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]
50	303	1350	371	1650	337	1500	584	2600	738	1000	848	1150	1033	1400	1512	2050
65	303	1350	371	1650	337	1500	584	2600	738	1000	848	1150	1033	1400	1512	2050
80	461	2050	562	2500	506	2250	888	3950	848	1150	959	1300	1180	1600	1733	2350
100	607	2700	753	3350	674	3000	1180	5250	922	1250	1670	1450	1291	1750	1918	2600
150	910	4050	1124	5000	1012	4500	1765	7850	1292	1750	1513	2050	1845	2500	2694	3650
200	1214	5400	1506	6700	1349	6000	2369	10450	1697	2300	1956	2650	2399	3250	3542	4800
250	1517	6750	1877	8350	1675	7450	2934	13050	2323	3150	2692	3650	3282	4450	4831	6550
300	1810	8050	2248	10000	2012	8950	3518	15650	3172	4300	3651	4950	4462	6050	6565	8900

~~5.3.1.3 Fitting the guide cable arrangement~~

~~The pump set is guided into the sump or tank along two parallel, tightly stretched guide cables made of stainless steel. It attaches itself automatically to the base elbow which has been fitted to the floor.~~

NOTE

Should site conditions/piping layout, etc. require the guide cable to run off the vertical, do not exceed a maximum angle of 5° to ensure reliable fitting and guiding of the pump set.

Fitting the mounting bracket

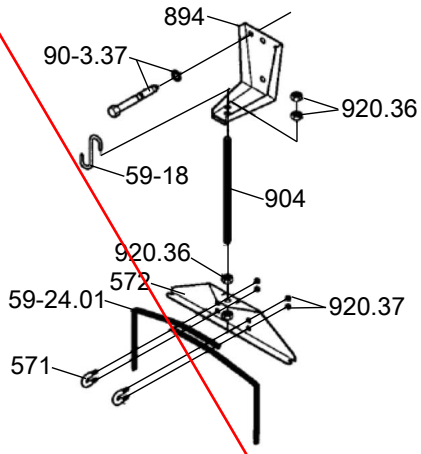


Fig. 10: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 7.4 lbf ft [10 Nm].
2. Insert clamping pieces 571 through the holes of suspension bracket 572 and fasten with nuts 920.37.
3. Fasten fully threaded stud 904 with the pre-assembled clamping arrangement to the mounting bracket with nut 920.36.
   Tighten nut 920.36 allowing sufficient play for subsequently tensioning the guide cable.

Inserting the guide cable

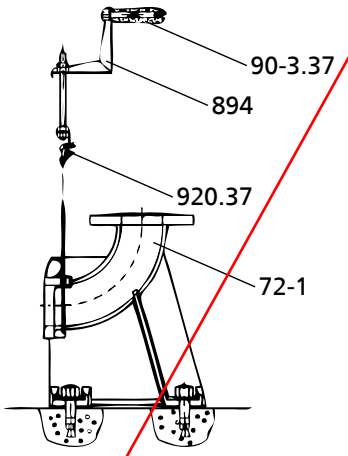


Fig. 11: Inserting the guide cable

1. Lift clamping piece 571 and insert one end of the guide cable.
2. Run cable 59-24.01 around base elbow 72-1 and back again to guide cable suspension bracket 572 and insert it into clamping piece 571.
3. Manually tension cable 59-24.01 and secure it by means of hexagon nuts 920.37.
4. Pull the cable taut by tightening hexagon nuts 920.36 on the upper side of the mounting bracket to a torque M_A=10.3 lbf ft [14 Nm] and a cable tensioning force P = 1349 lbf [6000 N].
5. Secure the nuts with a second hexagon nut.

6. The loose cable ends at guide cable suspension bracket 572 can either be twisted into a ring or the end can be cut off.
   After length adjustment tape the ends to avoid fraying.
7. Attach hook 59-18 to mounting bracket 894 for attaching the lifting chain / lifting rope at a later stage.

5.3.1.4 Fitting the guide rail arrangement

The pump set is guided into the sump or tank along two vertical guide rails. It attaches itself automatically to the base elbow which has been fitted to the floor.

NOTE

The guide rails are not included in KSB's scope of supply.
Select guide rail materials which are suitable for the fluid handled or as specified by the operator.

Observe the following dimensions for the guide rails:

Table 13: Guide rail dimensions

Size of hydraulic system	Outside diameter		Wall thickness[8)]			
			Min.		Max.	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]
DN 40 to DN 150	2,36	60	0,079	2	0,197	5
DN 200 to DN 700	3,5	89	0,118	3	0,236	6

Fitting the mounting bracket

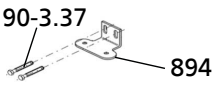


Fig. 12: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 7.4 lbf ft [10 Nm].
   (See outline drawing.)

Fitting the guide rails

CAUTION

Improper installation of guide rails

Damage to the guide rail arrangement!

- ▷ Always adjust the guide rails so that they are in a perfectly vertical position.

8) To DIN 2440/2442/2462 or equivalent standards

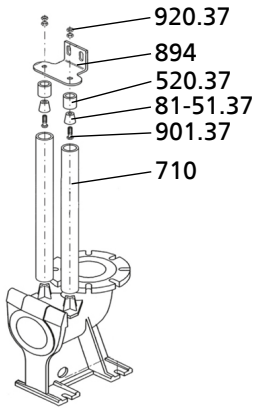


Fig. 13: Fitting the guide rails

1. Place rails 710 onto the conical bosses provided on base elbow 72-1 and position them vertically.
2. Mark the length of rails 710 (up to the lower edge of the mounting bracket), taking into account the adjusting range of the slotted holes in mounting bracket 894.
3. Shorten rails 710 with a 90° cut to the pipe axis. Debur the rails inside and outside.
4. Insert mounting bracket 894 with elastic sleeves 520.37 into guide rails 710 until the mounting bracket rests on the rail ends.
5. Tighten nuts 920.37.
   This pulls clamping sleeves 81-51.37 upwards and expands sleeves 520.37 against the inside pipe diameter.
6. Lock nuts 920.37 with a second nut each and secure them with Loctite 243.

NOTE

For installation depths of more than 19.7 ft [6 m], the scope of supply may include brackets as a middle support for the guide rails. The mounting brackets also serve as spacers between the two guide rails.

Fitting the middle support

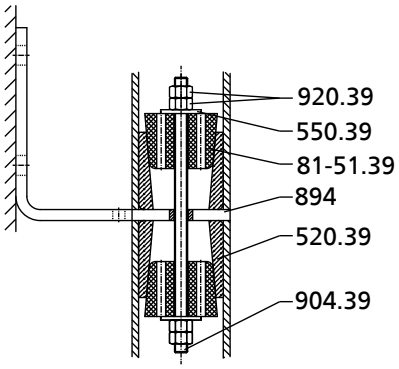


Fig. 14: Fitting the middle support

1. Measure the inside diameter of the guide rails.
2. Expand elastic sleeves 520.39 with clamping sleeves 81-51.39 to the inside diameter of the guide rails by tightening nuts 920.39.
3. Slide the guide rails onto the sleeves and check whether there is a tight fit between the guide rails and the sleeves.
4. Secure the screwed connection of the pipeline by tightening the locknuts.

5.3.1.5 Preparing the pump set

Fitting the claw

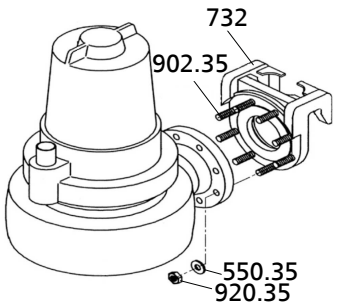


Fig. 15: Fitting the claw

1. Fasten claw 732 to the discharge flange with studs 902.35, discs 550.35 and nuts 920.35.
   Observe the tightening torques.
2. Fit profile joint 410 in the groove of the claw.
   This will seal the base elbow/pump connection.

Attaching the chain / lifting rope

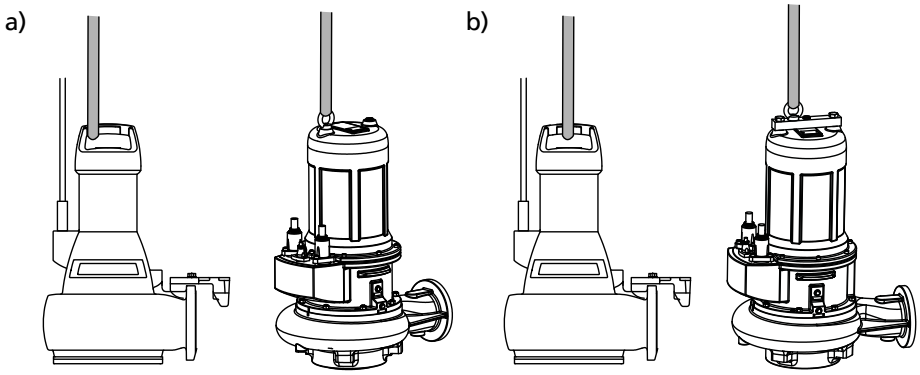


Fig. 16: Attaching the chain / lifting rope for stationary wet installation a) with guide cable arrangement b) with guide rail arrangement

1. Attach the chain or lifting rope to the pump set as illustrated.
   This attachment point achieves a forward inclination of the pump set towards the discharge nozzle, which allows the pump claw to hook onto the base elbow.

5.3.1.6 Installing the pump set

NOTE

Make sure the pump set with the pre-assembled claw can easily be guided over the mounting bracket, threaded onto the guide cables and lowered down. If required, alter the position of the crane during installation.

1. Guide the pump set over the suspension bracket/mounting bracket, thread it onto the guide cables/rails and slowly lower it down.
   The pump set attaches itself to base elbow 72-1.
2. Attach the lifting chain/rope to hook 59-18 at the mounting bracket.

5.4 Electrical system

5.4.1 Information for planning the control system

For the electrical connection of the pump set observe the wiring diagrams.
(⇨ Section 9.3, Page 102)

NOTE

When laying a cable between the control system and the pump set's connection point, make sure the number of cores for the sensors is sufficient. A minimum cross-section of AWG 15 [1.5 mm²] is required.

The motors can be connected to electrical low-voltage grids with rated voltages and voltage tolerances to IEC 60038. The permissible tolerances must be observed.

5.4.1.1 Starting method

The pump set is wired for DOL starting. Star-delta starting is technically possible. This excludes:

- Pump sets with one power cable 8G1.5
- Pump sets with two power cables 4G16 and 8G1.5

For reducing the starting current autotransformers or soft starters can be used. For selecting suitable devices observe the rated current of the motor.
At least three times the rated current is required for reliable start-up. The run-up time must not exceed 4 seconds.

After start-up of the pump, a soft starter must always be bypassed.

5.4.1.2 Overload protection

1. Protect the pump set against overloading by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.
2. Set the overload protection device to the rated current specified on the name plate.

5.4.1.3 Level control

DANGER

Pump set running dry

Explosion hazard!

▷ Never allow an explosion-proof pump set to run dry.

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

▷ Never allow the fluid level to drop below the specified minimum.

Automatic operation of the pump set in a tank requires the use of level control equipment.
Observe the minimum fluid level.

5.4.1.4 Operation on a frequency inverter

The pump set is suitable for operation on a frequency inverter as per IEC 60034-17.

DANGER

Operation outside the permitted frequency range

Explosion hazard!

▷ Never operate an explosion-proof pump set outside the specified range.

DANGER

Incorrect selection and setting of the frequency inverter

Explosion hazard!

▷ Observe the following information on selecting and setting a frequency inverter.

Selection

When selecting a frequency inverter, check the following details:

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the rated current
- Only voltage intermediate-circuit inverters (VSI) with pulse width modulation (PWM) and carrier frequencies between 1 and 16 kHz are suitable.

Setting

Observe the following instructions for setting a frequency inverter:

- Set the current limit to max. 1.2 times the rated current. The rated current is indicated on the name plate.

Start-up

Observe the following instructions for starting up a frequency inverter:

- Ensure short start ramps (maximum 5 seconds).
- Only start speed-controlled operation after 2 minutes at the earliest.
  Pump start-up with long start ramps and low frequency may cause clogging.

Operation

Observe the following limits when operating the pump set on a frequency inverter:

- Only utilize up to 95 % of the motor rating P_2 indicated on the name plate.
- Frequency range 30 to 60 Hz

Electromagnetic compatibility

Operation on a frequency inverter produces interference emissions whose level varies depending on the inverter used (type, interference suppression, make). To prevent the drive system, consisting of a submersible motor and a frequency inverter, from exceeding any given limits always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a submersible motor pump with shielded power cables.

Interference immunity

The submersible motor pump generally meets interference immunity requirements. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the power cables in the plant. No modifications are required on the power/control cable of the submersible motor pump. Suitable analyzing devices must be selected. This applies in particular to the leakage sensor inside the motor.

5.4.1.5 Sensors

DANGER

Operating an incompletely connected pump set

Explosion hazard!

Damage to the pump set!

▷ Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.

CAUTION

Incorrect connection

Damage to the sensors!

- ▷ Observe the limits stated in the following sections of this manual when connecting the sensors.

The pump set features sensors that avoid hazards and damage to the pump set.

NOTE

Reliable and safe operation of the pump within the scope of our warranty is only possible if the sensor signals are properly analyzed as stipulated in this manual.

All sensors are located inside the pump set and are connected to the power cable. For information on wiring and core identification please refer to the wiring diagrams.
The individual sensors and the limit values to be set are described in the following sections.

5.4.1.5.1 Motor temperature

Pump sets of installation types P or S with 8-core power cable

DANGER

Insufficient cooling

Explosion hazard!

Winding damage!

- ▷ Never operate a pump set without operational temperature monitoring equipment.

The pump set features double monitoring of the winding temperature. The temperature switches for motor temperature 1 (terminals 20 and 21, max. 250 V~/2 A) serve as temperature control devices which open when the winding temperature is too high. Tripping must result in the pump set cutting out. Automatic re-starting is permitted.

If the temperature switches at terminals 21 and 22 are not used, the conductor for terminal 22 must be insulated or connected to a dummy terminal.

WARNING

Incorrect electrical installation

Electric shock!

- ▷ Adequately insulate conductor 22.

For an explosion-proof pump set (motor version XE or ZE) use the temperature switches for motor temperature 2 (terminals 21 and 22, maximum 250 V~/2 A) in addition to the above. Tripping must result in the pump set cutting out. After the pump set has been tripped by these temperature switches, it must not re-start automatically.

Pump sets of installation types P or S with 12-core power cable or several power cables

DANGER

Insufficient cooling

Explosion hazard!

Winding damage!

- ▹ Never operate a pump set without operational temperature monitoring.
- ▹ For explosion-proof pump sets use a thermistor tripping unit with manual reset.

CAUTION

Incorrect wiring

Winding damage!

- ▹ Never rely on the PTC thermistors alone for temperature monitoring.

The pump set features double monitoring of the winding temperature.
Two bimetal switches (terminals 21 and 22, max. 250 V AC/2 A) serve as temperature control devices which open when the winding temperature is too high. Opening of the contacts must result in the pump set cutting out. Automatic re-starting is permitted.
For explosion-proof pump sets, the three additional, series-connected PTC thermistors with terminals 10 and 11 must be used. Use a thermistor tripping unit with manual reset for this purpose.

Pump sets of installation types D, H or K

DANGER

Insufficient cooling

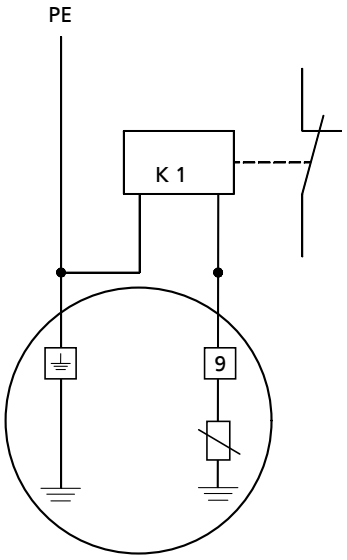
Explosion hazard!

Winding damage!

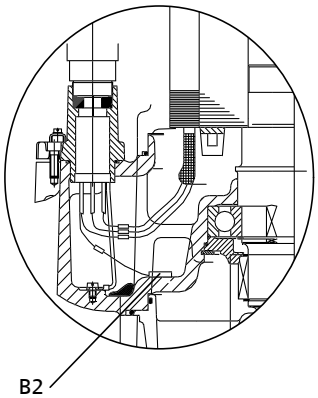
- ▹ Never operate a pump set without operational temperature monitoring.
- ▹ For explosion-proof pump sets use a thermistor tripping unit with manual reset.

The motor is monitored by three series-connected PTC thermistors with terminals 10 and 11. Tripping must result in the pump set cutting out. Automatic re-start is not permitted.
On explosion-proof pump sets, the thermistors must be connected to a thermistor tripping unit with manual reset.

5.4.1.5.2 Leakage inside the motor



Wiring of the electrode relay



Position of the electrode in the motor housing

An electrode fitted inside the motor monitors the winding space (B2) for leakage. This electrode must be connected to an electrode relay (core marked 9). Tripping of the electrode relay must result in the pump set cutting out.

The electrode relay (K1) must meet the following requirements:

- Sensor circuit 10 to 30 V AC
- Tripping current 0.5 to 3 mA
  (equivalent to a tripping resistance of 3 to 60 kΩ)

5.4.1.5.3 Bearing temperature

As an option, the pump set can be supplied with temperature monitoring in the area of the lower bearing assembly.
Check in the data sheet whether the pump set is equipped with bearing temperature monitoring.

The bearing temperature sensor is a Pt100 resistance thermometer. It has to be connected to a temperature control device with a Pt100 input and 2 separate outputs for two different switching points (sensor circuit maximum 6 V/2 mA).

Set the following limits:

- Alert at 230 °F [110 °C]
- Cut-out of the pump set at 266 °F [130 °C]

5.4.2 Electrical connection

DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

- ▷ Always have the electrical connections installed by a trained electrician.
- ▷ Observe IEC 60364 regulations as well as any locally applicable regulations.

WARNING

Incorrect connection to the mains

Damage to the mains network, short circuit!

- ▷ Observe the technical specifications of the local energy supply companies.

CAUTION

Improper routing of power cables

Damage to the power cables!

- Never move the power cables at temperatures below -13 °F [-25 °C].
- Never kink or crush the power cables.
- Never lift the pump set by the power cables.
- Adjust the length of the power cables to the site requirements.

CAUTION

Motor overload

Damage to the motor!

- Protect the motor by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.

For the electrical connection of the pump set observe the wiring diagrams (⇨ Section 9.3, Page 102) in the Annex and the information for planning the control system .

The pump set is supplied complete with connection cables. Always use all cables provided and connect all marked cores of the control cable.

DANGER

Incorrect connection

Explosion hazard!

- The connection point of the cable ends must be located outside hazardous areas or in an area approved for electrical equipment.

DANGER

Operating an incompletely connected pump set

Explosion hazard!

Damage to the pump set!

- Never start up a pump set with an incompletely connected power cable or non-operational monitoring devices.

DANGER

Connection of damaged power cables

Danger of death from electric shock!

- Check the power cables for damage before connecting them.
- Never connect damaged power cables.
- Replace damaged power cables.

CAUTION

Flow-induced motion

Damage to the power cable!

- Run the power cable upwards without slack.

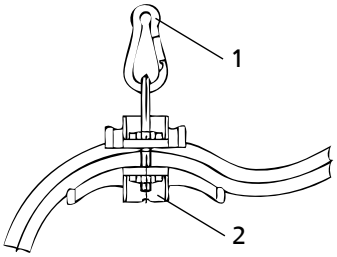


Fig. 22: Fastening the power cables

1. Run the power cables directly upwards without slack, and fasten them.
2. Only remove the protective caps from the power cables immediately before connecting the cables.
3. If necessary, adjust the length of the power cables to the site requirements.
4. After shortening the cables, correctly re-affix the markings of the individual cores at the cable ends.

5.4.2.1 Potential equalization

Wet installation (installation types K, P, S)

The pump set does not have an external PE connection (risk of corrosion).

DANGER

Incorrect connection

Explosion hazard!

- Explosion-proof pump sets installed in a tank must never be retrofitted with an external potential equalization connection!

DANGER

Touching the pump set during operation

Electric shock!

- Make sure that the pump set cannot be touched during operation.

Dry installation (installation types D and H)

Pump sets for dry installation are provided with an external potential equalization connection. Potential equalization shall be provided for in compliance with IEC 60204.

Connecting the potential equalization conductor

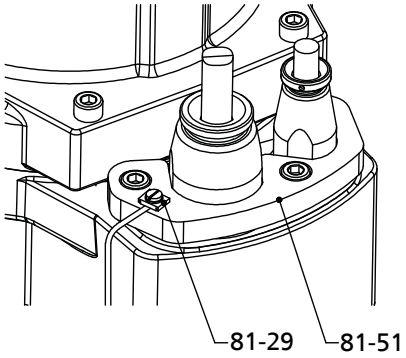


Fig. 23: Connecting the potential equalization conductor

81-29	Connection terminal
81-51	Clamping element

1. Connect the potential equalization conductor to terminal 81-29 provided on clamping element 81-51.

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/start-up

6.1.1 Prerequisites for commissioning/start-up

Before commissioning/starting up the pump set, make sure that the following conditions are met:

- The pump set has been properly connected to the electric power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.
- All auxiliary connections required are connected and operational.
- The lubricant has been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the pump (set) to service have been carried out. (⇨ Section 6.4, Page 56)

DANGER

Persons in the tank during pump operation

Electric shock!

Risk of personal injury!

Danger of death from drowning!

▷ Never start up the pump set when there are persons in the tank.

DANGER

Exceeding the operating limits

Pump casing could burst/leak!

Pressurized hot or toxic fluid could escape!

Flying parts!

▷ Maintain an adequate safety distance from pump sets which are in operation.

6.1.2 Priming and venting the pump set (dry installation only - installation types D and H)

DANGER

Shaft seal failure caused by insufficient lubrication

Hot or toxic fluid could escape!

Damage to the pump!

▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.

1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off element in the suction line.
3. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc).

6.1.3 Commissioning/start-up

Wet installation (installation types K, P, S)

CAUTION

Re-starting while motor is still running down

Damage to the pump set!

- ▷ Do not re-start the pump set before it has come to a standstill.
- ▷ Never start the pump set while the pump is running in reverse.

✓ The fluid level is sufficiently high.

CAUTION

Start-up against a closed shut-off element

Increased vibrations!

Damage to mechanical seals and bearings!

- ▷ Never start up the pump set against a closed shut-off element.

1. Fully open the discharge line shut-off element, if any.
2. Start up the pump set.

Dry installation (installation types D and H)

DANGER

Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed.

Leakage of hot or toxic fluids!

- ▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.
- ▷ Only start up the pump set with the discharge side gate valve slightly or fully open.

DANGER

Excessive temperatures due to insufficient lubrication of shaft seal or excessive gas content in the fluid handled

Damage to the pump set!

- ▷ Never operate the pump set without liquid fill.
- ▷ Prime the pump as per operating instructions.
- ▷ Always operate the pump within the permissible operating range.

WARNING

Hot surface

Risk of burns

- ▷ Never touch a pump set which is in operation.

WARNING

Very high noise emission during operation

Personal injury!

- ▷ Minimize exposure in the vicinity of the pump set.
- ▷ For required work near running pump sets use appropriate ear protection.

⚠ WARNING

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

Risk of personal injury!

- ▹ Switch off the pump (set) immediately.
- ▹ Eliminate the causes before returning the pump set to service.

✓ Pump, suction line and inlet tank (if fitted) have been vented and primed with the fluid to be handled.

✓ The priming lines and venting lines have been closed.

CAUTION

Start-up against open discharge line

Motor overload!

- ▹ Make sure the motor has sufficient power reserves.
- ▹ Use a soft starter.
- ▹ Use speed control.

1. Fully open the shut-off element in the suction head/suction lift line.
2. Slightly open the shut-off element in the discharge line.
3. Start up the motor.
4. Immediately after the pump has reached full rotational speed, slowly open the shut-off element in the discharge line and adjust it to comply with the duty point.

6.1.4 Shutdown (dry installation only – installation types D and H)

✓ The shut-off element in the suction line is and remains open.

1. Switch off the motor.
2. Immediately after having switched off the motor, close the shut-off element in the discharge line.

NOTE

If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close any auxiliary lines.

CAUTION

Danger of freezing!

Damage to the pump set!

- ▹ Drain the pump set or protect it against freezing.

6.2 Operating limits

DANGER

Non-compliance with operating limits

Damage to the pump set!

- Comply with the operating data indicated in the data sheet.
- Avoid operation against a closed shut-off element.
- Never operate the pump set at ambient or fluid temperatures exceeding those specified in the data sheet or on the name plate.
- Never operate the pump set outside the limits specified below.

6.2.1 Frequency of starts

CAUTION

Excessive frequency of starts

Damage to the motor!

- Never exceed the specified frequency of starts.

To prevent high temperature increases in the motor and excessive loads on the motor, sealing elements and bearings, the switching frequency shall not exceed the following number of starts per hour.

Table 20: Frequency of starts

Motor rating		Maximum frequency of starts
[kW]	[hp]	[Starts/hour]
≤ 7,5	≤ 10,0	30
> 7,5	> 10,0	10

These values apply to mains start-up (DOL or with star-delta contactor, autotransformer, soft starter). These limits do not apply to operation on a frequency inverter.

6.2.2 Operation on the power supply mains

DANGER

Non-compliance with permissible supply voltage tolerances

Explosion hazard!

- Never operate an explosion-proof pump (set) outside the specified range.

The maximum permissible deviation in supply voltage is ±10 % of the rated voltage. The voltage difference between the individual phases must not exceed 1 %.

6.2.3 Operation on a frequency inverter

DANGER

Operation outside the permitted frequency range

Explosion hazard!

- Never operate an explosion-proof pump set outside the specified range.

CAUTION

Pumping solids-laden fluids at reduced speed

Increased wear and clogging!

- Never operate the pump set with flow velocities below approx. 25 $^{in.}/_{s}$ [0.7 $^{m}/_{s}$] in horizontal pipes and approx. 45 $^{in.}/_{s}$ [1.2 $^{m}/_{s}$] in vertical pipes.

Frequency inverter operation of the pump set is permitted in the frequency range from 30 to 60 Hz.

6.2.4 Fluid handled

6.2.4.1 Temperature of the fluid handled

The pump set is designed for transporting liquids. The pump set is not operational under freezing conditions.

CAUTION

Danger of freezing!

Damage to the pump set!

- Drain the pump set or protect it against freezing.

Refer to the maximum permissible fluid temperature and ambient temperature indicated on the name plate and/or in the data sheet.

6.2.4.2 Minimum level of fluid handled (for installation types K, P and S only)

DANGER

Pump set running dry

Explosion hazard!

- Never allow an explosion-proof pump set to run dry.

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

- Never allow the fluid level to drop below the specified minimum.

Installation types P and S

The pump set is designed for continuously **submerged** operation. This condition has to be fulfilled for the motor to be cooled sufficiently.

Ready for operation

The pump set is ready for operation as soon as the motor is fully submerged.

The pump can be operated at a lower fluid level for short periods.
If the motor is not sufficiently cooled, an internal temperature monitoring device will trip the pump set and automatically re-start it after the motor has cooled down. The fluid level must not drop below the specified minimum (dimension B). Exact dimensions see general arrangement drawing/outline drawing.
(⇨ Section 1.4, Page 8)

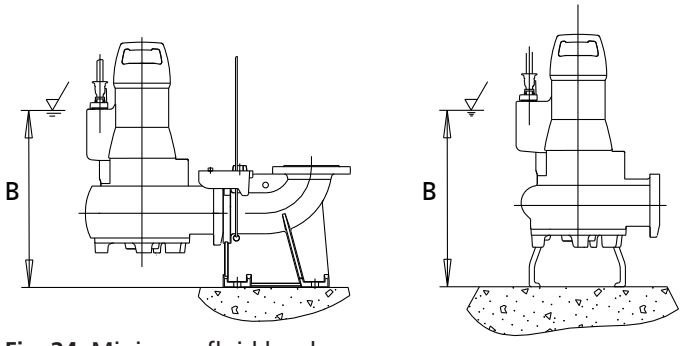


Fig. 24: Minimum fluid level

NOTE

Compliance with dimension B does not guarantee trouble-free operation of the pump set.
Depending on the pump's duty point, higher fluid levels may be required. Observe the NPSH values indicated in the characteristic curve (see hydraulic characteristic curves).

Installation type K

Pump sets of installation type K are suitable for continuous operation with the motor outside the fluid.

Ready for operation

The pump set is ready for operation when the minimum fluid level has been reached (dimension B). Exact dimensions see general arrangement drawing/outline drawing.

Use in the Amajet system

Slurp mode

For pumps with F impeller, slurp mode (partly involving air intake) is permissible for a period of up to 60 seconds.
For pumps with D impeller, slurp mode is impermissible! Make sure that the pump set switches off in time.

6.2.4.3 Density of the fluid handled

The power input of the pump changes in proportion to the density of the fluid handled.

CAUTION

Impermissibly high density of fluid handled.

Motor overload!

- ▷ Observe the information on fluid density in the data sheet.
- ▷ Make sure the motor has sufficient power reserves.

6.2.4.4 Abrasive fluids

Do not exceed the maximum permissible solids content specified in the data sheet. When the pump handles fluids containing abrasive substances, increased wear of the hydraulic system and the shaft seal is to be expected. In this case, halve the intervals commonly recommended for servicing and maintenance.

6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

The pump set remains installed

⚠ WARNING

Unintentional starting of pump set

Risk of injury by moving components and shock currents!

- ▹ Make sure that the pump set cannot be started up unintentionally.
- ▹ Always make sure the electrical connections are disconnected before carrying out work on the pump set.

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Risk of personal injury!

- ▹ Observe all relevant laws.
- ▹ When draining the fluid take appropriate measures to protect persons and the environment.
- ▹ Decontaminate pumps which handle fluids posing a health hazard.

CAUTION

Danger of frost/freezing

Damage to the pump set!

- ▹ If there is any danger of frost/freezing, remove the pump set from the fluid handled and clean, preserve and store it.

✓ Make sure sufficient fluid is available for the operation check run of the pump set.

1. For prolonged shutdown periods, start up the pump set regularly once every three months for approximately one minute.
   This will prevent the formation of deposits within the pump and the pump intake area.

The pump (set) is removed from the pipe and stored

✓ The pump has been properly drained

✓ The safety instructions for dismantling the pump have been observed.

1. Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative.
2. Spray the preservative through the suction nozzle and discharge nozzle.
   It is advisable to then close the pump nozzles (e.g. with plastic caps).
3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil and grease, food-approved if required) to protect them against corrosion.
   Observe the additional instructions on preservation.

6.4 Returning to service

For returning the pump set to service, observe the items on commissioning/start-up. (⇨ Section 6.1, Page 50)

Refer to and comply with the operating limits. (⇨ Section 6.2, Page 53)

For returning the pump set to service after storage also follow the instructions for maintenance/inspection. (⇨ Section 7.2, Page 59)

⚠ WARNING

Failure to re-install or re-activate protective equipment/devices

Risk of personal injury from moving parts or escaping fluid!

- ▷ As soon as the work is completed, re-install and/or re-activate any safety-relevant devices and protective devices.

NOTE

On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.

7 Servicing/Maintenance

7.1 Safety regulations

The operator ensures that all maintenance, all inspections and all installation work is performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.

DANGER

Sparks produced during maintenance work

Explosion hazard!

- Observe the safety regulations in force at the place of installation.
- Never open a pump set that is connected to the power supply.
- Always perform maintenance work on pump sets outside potentially explosive atmospheres.

DANGER

Risk of falling when working at great heights

Danger to life by falling from great heights!

- Do not step onto the pump (set) during installation work or dismantling work.
- Pay attention to safety equipment, such as railings, covers, barriers, etc.
- Observe the applicable local occupational safety regulations and accident prevention regulations.

WARNING

Unintentional starting of pump set

Risk of injury by moving components and shock currents!

- Make sure that the pump set cannot be started up unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

WARNING

Hands, other body parts or foreign objects in the impeller or intake area

Risk of personal injury! Damage to the submersible motor pump!

- Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.
- Check that the impeller can rotate freely.

WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Risk of personal injury!

- Observe all relevant laws.
- When draining the fluid take appropriate measures to protect persons and the environment.
- Decontaminate pumps which handle fluids posing a health hazard.

⚠ WARNING

Hot surface

Risk of personal injury!

- ▷ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Insufficient stability

Risk of crushing hands and feet!

- ▷ During assembly/dismantling, secure the pump (set)/pump parts against tilting or tipping over.

NOTE

Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump (set) with a minimum of maintenance expenditure and work.

NOTE

All maintenance work, service work and installation work can be carried out by KSB Service or authorized workshops. Find your contact in the attached "Addresses" booklet or on the Internet at "www.ksb.com/contact".

Never use force when dismantling and reassembling the pump set.

7.2 Maintenance/inspection

KSB recommends the following regular maintenance schedule:

Table 21: Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
Every 4000 operating hours[11)]	Measuring the insulation resistance	(⇨ Section 7.2.2.3, Page 61)
	Checking the power cables	(⇨ Section 7.2.2.2, Page 60)
	Visual inspection of the lifting chain/lifting rope	(⇨ Section 7.2.2.1, Page 60)
Every 10,000 operating hours[12)]	Checking the sensors	(⇨ Section 7.2.2.4, Page 61)
	Changing the lubricant	(⇨ Section 7.2.3.1.4, Page 65)
Every 5 years	General overhaul	-

11) At least once per year
12) At least every three years

7.2.1 Supervision of operation (for installation types D and H only)

DANGER

Formation of a potentially explosive atmosphere inside the pump

Explosion hazard!

- ▷ The pump internals in contact with the fluid handled, including the seal chamber and auxiliary systems, must be filled with the fluid handled at all times.
- ▷ Provide sufficient inlet pressure.
- ▷ Provide an appropriate monitoring system.

CAUTION

Increased wear due to dry running

Damage to the pump set!

- ▷ Never operate the pump set without liquid fill.
- ▷ Never close the shut-off element in the suction line and/or supply line during pump operation.

CAUTION

Impermissibly high temperature of fluid handled

Damage to the pump!

- ▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).
- ▷ Observe the temperature limits in the data sheet and in the section on operating limits.

While the system is in operation, observe and check the following:

- The pump set must run quietly and free from vibrations at all times.
- Monitor the correct functioning of any auxiliary connections.
- Monitor the stand-by pump.
  To make sure that stand-by pumps are ready for operation, start them up once a week.

7.2.2 Inspection work

7.2.2.1 Checking the lifting chain/rope

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Inspect the lifting chain/rope as well as their fasteners for any visible damage.
2. Replace any damaged components by original spare parts.

7.2.2.2 Checking the power cables

Visual inspection

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Inspect the power cables for visible damage.
2. Replace any damaged components by original spare parts.

Checking the ground conductor

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Measure the resistance between the ground conductor and chassis ground.
   The electrical resistance must be lower than 1 Ω.
2. Replace any damaged components by original spare parts.

DANGER

Defective ground conductor

Electric shock!

▹ Never switch on a pump set with a defective ground conductor.

7.2.2.3 Measuring the insulation resistance

Measure the insulation resistance of the motor winding during annual maintenance work.

✓ The pump set has been disconnected in the control cabinet.

✓ Use an insulation resistance measuring device.

✓ The maximum measuring voltage is 500 V (maximum permissible voltage 1000 V).

1. Measure the winding to chassis ground.
   To do so, connect all winding ends together.
2. Measure the winding temperature sensor to chassis ground.
   To do so, connect all core ends of the winding temperature sensors together and connect all winding ends to chassis ground.

⇨ The insulation resistance of the core ends to chassis ground must not be lower than 1 MΩ.
If the resistance measured is lower, power cable and motor resistance must be measured separately. Disconnect the power cable from the motor for this purpose.

NOTE

If the insulation resistance of the power cable is lower than 1 MΩ, the power cable is defective and must be replaced.

NOTE

If the insulation resistances measured on the motor are too low, the winding insulation is defective. The pump set must not be returned to service in this case.

7.2.2.4 Checking the sensors

CAUTION

Excessive test voltage

Damage to the sensors!

▹ Use a commercially available ohmmeter to measure the resistance.

The tests described below measure the resistance at the core ends of the power cable. The actual function of the sensors is not tested.

Temperature sensors in the motor winding

Table 22: Resistance measurement

Measurement between terminals ...	Resistance
	[Ω]
20 and 21[13)]	< 1
21 and 22	< 1
10 and 11[13)]	100-1000

13) If any

If the specified tolerances are exceeded, disconnect the connection cable at the pump set and repeat the check inside the motor.
If the tolerances are exceeded here, too, the motor part must be opened and overhauled. The temperature sensors are fitted in the stator winding and cannot be replaced.

Leakage sensor in the motor

Table 23: Resistance measurement of the leakage sensor in the motor

Measurement between terminals ...	Resistance
	[kΩ]
9 and ground conductor (PE)	> 60

Lower resistance values would suggest water ingress into the motor. In this case the motor section must be opened and serviced.

Bearing temperature sensor

Table 24: Resistance measurement of the bearing temperature sensors

Measurement between terminals ...	Resistance
	[Ω]
15 and 16	100 to 120

7.2.2.5 Visual inspection through the inspection hole (for inspection types D and H only and for pump sets with nominal diameters ≥100)

If there are problems with clogging, the inside of the casing and/or the impeller can be checked via the inspection hole.

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- Wear safety clothing and a protective mask if required.
- Observe all legal regulations on the disposal of fluids posing a health hazard.

⚠ WARNING

Hands and/or foreign objects in the pump casing

Risk of injuries, damage to the pump!

- Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.
- Never insert your hands or any other objects into the pump, if the pump set has not been disconnected from the power supply and secured against unintentional start-up.

If a problem has occurred which requires visual inspection, observe the following instructions:

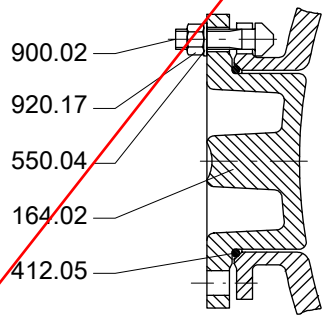


Fig. 25: Inspection hole in the casing

Opening the inspection hole

- Close the shut-off element on the suction side.
- Switch off the drive and make sure it cannot be re-started unintentionally.
- Close the shut-off element on the discharge side.
- Open the drain plug (auxiliary connection 6B).
- Collect and dispose of any liquid residues.
- Loosen nuts 920.17 at the inspection hole and remove inspection cover 164.02.
- Perform a visual inspection with a lamp or similar.

Closing the inspection hole

- Fit new O-ring 412.05.
- Fit inspection cover 164.02.
- Place discs 550.04 and nuts 920.17 on screws 900.02 and tighten.
- Observe the instructions on commissioning/start-up.

7.2.3 Lubrication and lubricant change

7.2.3.1 Lubricating the mechanical seal

The mechanical seal is supplied with lubricant from the lubricant chamber.

7.2.3.1.1 Intervals

Replace the lubricant every 10,000 operating hours but at least every 3 years.

7.2.3.1.2 Lubricant quality

The lubricant chamber is filled at the factory with environmentally friendly, non-toxic lubricant of medicinal quality (unless otherwise specified by the customer).
The following lubricants can be used to lubricate the mechanical seals:

Table 25: Lubricant quality

Description	Properties	
Paraffin oil or white oil. Alternative: motor oil grades SAE 10W to SAE 20W	Kinematic viscosity at 104 °F [40 °C]	< 0.065 ft/s² [< 20 mm/s²]
	Flash point (to Cleveland)	> 320 °F [> 160 °C]
	Solidification point (pour point)	< -5 °F [< -15 °C]

Recommended lubricants:

- Merkur WOP 40 PB, made by SASOL
- Merkur white oil Pharma 40, made by DEA
- Thin-bodied paraffin oil No. 7174, made by Merck
- Equivalent brands of medical quality, non-toxic
- Water-glycol mixture

⚠ WARNING

Contamination of fluid handled by lubricant

Hazard to persons and the environment!

▷ Using machine oil is only permitted if the oil is disposed of properly.

7.2.3.1.3 Lubricant quantity

Size	Impeller type	Lubricant quantity depending on the motor											
		3 2.E 2 4.E 3 4.E SP		4 2.E 5 2.E 7 2.E 4 4.E 5 4.E		11 2.E 15 2.E 18 2.E 22 2.E 26 2.E		7 4.E 11 4.E 15 4.E 18 4.E 22 4.E 7 6.E 11 6.E 15 6.E 18 6.E		30 4.E 37 4.E 22 6.E 30 6.E 11 8.E 15 8.E 18 8.E 22 8.E		55 2.E 65 2.E 75 2.E 45 4.E 55 4.E 65 4.E 75 4.E 31 6.E 37 6.E 45 6.E 55 6.E 30 8.E 37 8.E 45 8.E	
		[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]
40-252	F, K, S	-	-	2,7	2,9	2,6	2,8	2,6	2,8	-	-	-	-
50-215	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
50-216	F, S	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
65-215	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
65-216	E	3,1	3,3	3,1	3,3	3,1	3,3	3,1	3,3	-	-	-	-
65-217	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
80-216	E	3,1	3,3	3,1	3,3	3,1	3,3	3,1	3,3	-	-	-	-
80-216	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
SP 80-217	F	1,9	2,0	~~1,9~~	~~2,0~~	~~2,0~~	~~2,1~~	~~2,0~~	~~2,1~~	-	-	-	-
80-252	F	-	-	2,7	2,9	2,6	2,8	2,6	2,8	-	-	-	-
80-253	E, F, K	-	-	2,4	2,5	2,5	2,7	2,5	2,7	-	-	-	-
80-315	D	-	-	-	-	-	-	4,5	4,8	-	-	1,4	1,5
80-317	D	-	-	-	-	-	-	4,1	4,3	-	-	-	-
100-215	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
100-253	D	-	-	-	-	-	-	2,5	2,7	-	-	-	-
100-253	E, K	-	-	2,4	2,5	2,5	2,7	2,5	2,7	-	-	-	-
100-254	F, K	-	-	2,7	2,9	2,6	2,8	2,6	2,8	-	-	-	-
100-255	E	-	-	2,4	2,5	2,5	2,7	2,5	2,7	-	-	-	-
100-315	D	-	-	-	-	-	-	4,5	4,8	4,9	5,2	1,4	1,5
100-316	D	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
100-316	F, K	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
100-317	E	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
100-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
100-401	E, F, K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
150-253	D	-	-	-	-	-	-	2,5	2,7	-	-	-	-
150-315	D	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
150-315	F, K	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
150-317	E, K	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
150-400	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
150-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
150-401	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
150-401	E, F, K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
150-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
151-401	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
151-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0

Size	Impeller type	Lubricant quantity depending on the motor											
		3 2.E 2 4.E 3 4.E		4 2.E 5 2.E 7 2.E 4 4.E 5 4.E		11 2.E 15 2.E 18 2.E 22 2.E 26 2.E		7 4.E 11 4.E 15 4.E 18 4.E 22 4.E 7 6.E 11 6.E 15 6.E 18 6.E P-1		30 4.E 37 4.E 22 6.E 30 6.E 11 8.E 15 8.E 18 8.E 22 8.E		55 2.E 65 2.E 75 2.E 45 4.E 55 4.E 65 4.E 75 4.E 31 6.E 37 6.E 45 6.E 55 6.E 30 8.E 37 8.E 45 8.E	
		[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]
200-315	D	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
200-315	K	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
200-316	K	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
P-1 200-317	K	-	-	-	-	-	-	4,5	4,8	~~4,9~~	~~5,2~~	-	-
200-318	K	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
200-330	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-400	D	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-401	E, K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-402	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
250-400	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
250-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
250-401	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
250-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
300-400	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
300-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
300-401	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
300-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0

7.2.3.1.4 Changing the lubricant

⚠ WARNING

Lubricants posing a health hazard and/or hot lubricants

Hazard to persons and the environment!

- ▷ When draining the lubricant take appropriate measures to protect persons and the environment.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Collect and dispose of any lubricants.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

⚠ WARNING

Excess pressure in the lubricant chamber

Liquid spurting out when the lubricant chamber is opened at operating temperature!

- ▷ Open the screw plug of the lubricant chamber very carefully.

Draining the lubricant

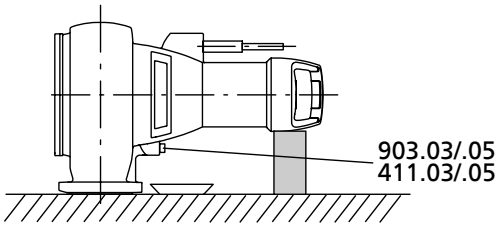


Fig. 26: Draining the lubricant

1. Position the pump set as shown.
2. Place a suitable container under the screw plug.
3. Undo screw plug 903.03/.05 with joint ring 411.03/.05 and drain off the lubricant.

Filling in the lubricant

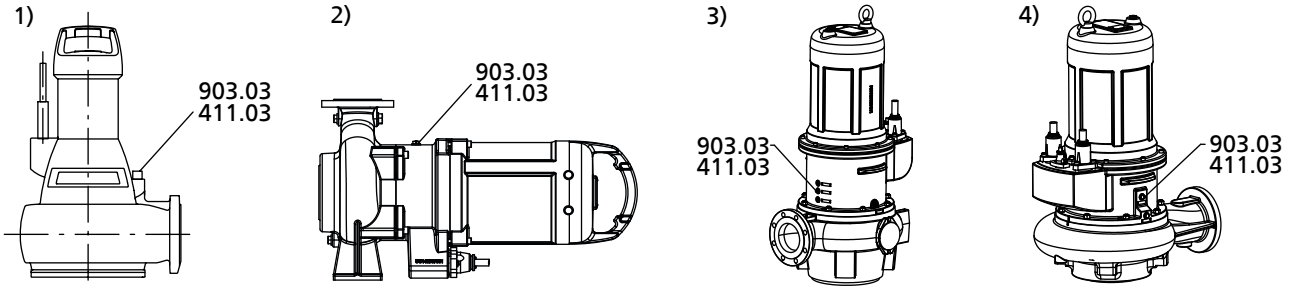


Fig. 27: Filling in the lubricant

Table 26: Filling in the lubricant

	Motor	Impeller type	Variant			
			1	2	3	4
	3 2.E - 7 2.E	E, F, K, S	✘	-	-	-
	11 2.E - 26 2.E	E, F, K, S	-	✘	-	-
	55 2.E - 75 2.E	D	-	-	✘	-
SP	2 4.E - 5 4.E	E, F, K, S	✘	-	-	-
	7 4.E - 37 4.E	D, E, F, K, S	-	✘	-	-
	45 4.E - 75 4.E	D	-	-	✘	-
	45 4.E - 75 4.E	E, F, K	-	-	-	✘
P-1	7 6.E - 30 6.E	D, E, F, K, S	-	✘	-	-
	31 6.E - 55 6.E	D	-	-	✘	-
	31 6.E - 55 6.E	E, F, K	-	-	-	✘
	11 8.E - 22 8.E	D, E, F, K	-	✘	-	-
	30 8.E - 45 8.E	D	-	-	✘	-
	30 8.E - 45 8.E	E, F, K	-	-	-	✘

1. Position the pump set as shown.
2. Undo and remove screw plug 903.03 and joint ring 411.03.
3. Fill lubricant through the lubricant filler opening until the lubricant level reaches the opening.
4. Fit screw plug 903.03 together with a new joint ring 411.03.

7.2.3.2 Lubricating the rolling element bearings

The pump set is equipped with grease-lubricated, maintenance-free rolling element bearings.

7.2.3.3 Lubricating the rolling element bearings

The rolling element bearings of the pump set are grease-packed and maintenance-free, with the exception described below.

On pump sets with reinforced bearings the pump-end rolling element bearings can be relubricated; they must be relubricated as part of the maintenance work.

7.2.3.3.1 Grease quality

The following greases can be used to lubricate the rolling element bearings:

Grease quality

- Lithium soap grease suitable for high temperatures

Recommended commercially available brands

- ESSO UNIREX N3
- FAG ARCANOL L40
- TEXACO HYTEX EP3/DEA Pragon

7.2.3.3.2 Grease quantity

Use 60 g of grease to lubricate the rolling element bearings.

7.2.3.3.3 Re-lubrication

Pump sets with reinforced bearings

An encapsulated water-tight lubricating nipple allows re-lubrication of the angular contact ball bearings without opening the pump.

DANGER

Dry running

Explosion hazard!

▷ Re-lubricate explosion-proof pump sets outside potentially explosive atmospheres.

WARNING

Hands inside the pump casing

Risk of injuries, damage to the pump!

▷ Never insert your hands or any other objects into the pump if the pump has not been de-energized and secured against unintentional start-up.

CAUTION

Incomplete re-lubrication

Bearing damage!

▷ Always re-lubricate the bearings with the pump set in operation.

✓ The pump set has been positioned on a level surface.

✓ The pump set is secured against tipping over.

1. Remove screw plug 903.46 and joint ring 411.46.
2. Connect the pump set to the power supply.

CAUTION

Pump set running dry

Increased vibrations!

Damage to mechanical seals and bearings!

▷ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

3. Start up the pump set.

4. Fill in grease via lubricating nipple 636.02.
5. Disconnect the pump set from the power supply again and make sure it cannot be started unintentionally.
6. Close screw plug 903.46 with joint ring 411.46 again.

7.3 Drainage/cleaning

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Always flush the pump if it has been used for handling noxious, explosive, hot or other hazardous fluids.
2. Always flush and clean the pump before transporting it to the workshop. Always complete and enclose a certificate of decontamination when returning the pump set. (⇨ Section 10, Page 118)

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of personal injury!

- ▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.

⚠ WARNING

Hot surface

Risk of personal injury!

- ▷ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Observe the general safety instructions and information.

For dismantling and reassembly observe the general assembly drawing.

In the event of damage you can always contact our service staff.

DANGER

Insufficient preparation of work on the pump (set)

Risk of personal injury!

- ▷ Properly shut down the pump set.
- ▷ Close the shut-off elements in the suction line and discharge line.
- ▷ Drain the pump and release the pump pressure.
- ▷ Shut off any auxiliary feed lines.
- ▷ Allow the pump set to cool down to ambient temperature.

WARNING

Components with sharp edges

Risk of cutting or shearing injuries!

- ▷ Always use appropriate caution for installation and dismantling work.
- ▷ Wear work gloves.

7.4.2 Preparing the pump set

7.4.2.1 Preparing the pump set (for installation types K, P and S only)

- ✓ The pump set has been removed from the pump sump.
- ✓ The pump set has been cleaned. (⇨ Section 7.3, Page 68)
- ✓ The lubricant has been drained.

1. De-energize the pump set and secure it against unintentional start-up.
2. Drain the leakage chamber and leave it open for the duration of the disassembly.

7.4.2.2 Preparing the pump set (for installation types D and H only)

7.4.2.2.1 Separating the pump from the piping

- ✓ The pump set has been switched off properly.
- ✓ The shut-off elements in the suction line and discharge line have been closed.
- ✓ Any auxiliary connections have been closed.
- ✓ The pump has been drained and the pump pressure has been released.

1. Disconnect any auxiliary feed lines.
2. Remove the discharge nozzle and suction nozzle from the piping.

NOTE

After the pump set has been removed from the piping, the suction casing should be cleaned with water. Suitable protective clothing is recommended.

7.4.2.2.2 Removing the pump set from the piping

⚠ WARNING

Pump set tilting

Risk of squashing hands and feet!

▹ Suspend or support the pump set.

✓ The pump set has been disconnected from the piping.
(⇨ Section 7.4.2.2.1, Page 69)

1. Suspend the pump set as specified for transport.
2. Depending on the type of installation, loosen the fastening bolts at the pump foot or at the soleplate.
3. Place the pump set in a horizontal position.

7.4.2.2.3 Removing the back pull-out unit

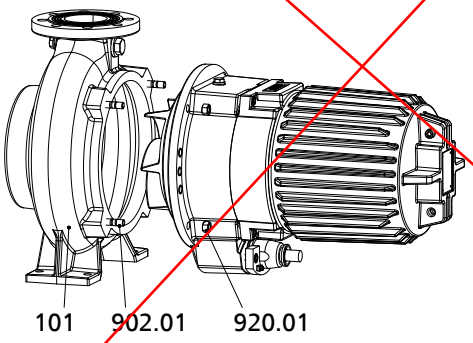


Fig. 28: Removing the back pull-out unit

1. Undo screwed connections 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
2. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over or rolling off.

7.4.3 Dismantling the pump section

Dismantle the pump section in accordance with the relevant general assembly drawing.

7.4.3.1 Removing the impeller

1. Remove pump casing 101.
2. Undo and remove impeller fastening screw 914.10.
The impeller/shaft connection is a tapered fit.
3. For dismantling of the impeller, a jacking thread is provided at the impeller hub. Screw in the forcing screw and remove the impeller.

NOTE

The forcing screw is not included in the scope of supply. It can be ordered separately from KSB.

Table 27: Forcing screws for pulling off the impeller

Size	Impeller type	Forcing screw	
		Thread	Code
40-252	F, K, S	M16	ADS 8
50-215	F	M10	ADS 0

Size	Impeller type	Forcing screw	
		Thread	Code
50-216	F	M10	ADS 6
50-216	S	M10	ADS 0
65-215	F	M10	ADS 6
65-216	E	M12	ADS 7
65-217	F	M10	ADS 6
80-216	E	M12	ADS 7
80-216	F	M10	ADS 6
SP 80-217	F	M10	ADS 6
80-252	F	M16	ADS 8
80-253	E, F, K	M20	ADS 2
80-315	D	M24	ADS 5
80-317	D	M20	ADS 2
100-215	F	M10	ADS 6
100-253	D, E, K	M16	ADS 3
100-254	F, K	M16	ADS 8
100-255	E	M20	ADS 2
100-315	D	M24	ADS 5
100-316	D	M20	ADS 2
100-316	F, K	M20	ADS 4
100-317	E	M20	ADS 2
100-400	K	M24	ADS 9
100-401	E, F, K	M24	ADS 9
150-253	D	M16	ADS 3
150-315	D	M20	ADS 4
150-315	F, K	M20	ADS 2
150-317	E, K	M20	ADS 2
150-400	D	M24	ADS 5
150-400	K	M24	ADS 9
150-401	D	M24	ADS 5
150-401	E, F, K	M24	ADS 9
150-403	K	M24	ADS 9
151-401	K	M24	ADS 9
151-403	K	M24	ADS 9
200-315	D	M20	ADS 4
200-315	K	M20	ADS 2
200-316	K	M20	ADS 2
P-1 200-317	K	M20	ADS 2
200-318	K	M20	ADS 2
200-330	K	M24	ADS 9
200-400	D	M24	ADS 5
200-401	E, K	M24	ADS 9
200-402	K	M24	ADS 9
200-403	K	M24	ADS 9
250-400	D	M24	ADS 5
250-400	K	M24	ADS 9
250-401	K	M24	ADS 9
250-403	K	M24	ADS 9
300-400	D	M24	ADS 5

Size	Impeller type	Forcing screw	
		Thread	Code
300-400	K	M24	ADS 9
300-401	K	M24	ADS 9
300-403	K	M24	ADS 9

7.4.3.2 Removing the mechanical seal

Remove the mechanical seal in accordance with the general arrangement drawings.

7.4.3.2.1 Removing the pump-end mechanical seal

✓ The back pull-out unit and the impeller have been removed as described above.

1. Pull the rotating assembly of mechanical seal 433.02 off shaft 210.
2. Remove discharge cover 163 from motor housing 811 or bearing bracket 350.
3. Press the stationary seat of mechanical seal 433.02 out of discharge cover 163.

7.4.3.2.2 Removing the drive-end mechanical seal

✓ The back pull-out unit and the impeller have been removed as described above.

1. Remove taper lock ring 515 or circlip 932.03.
2. Pull the rotating assembly of mechanical seal 433.01 off shaft 210.

7.4.3.2.3 Removing the double cartridge seal

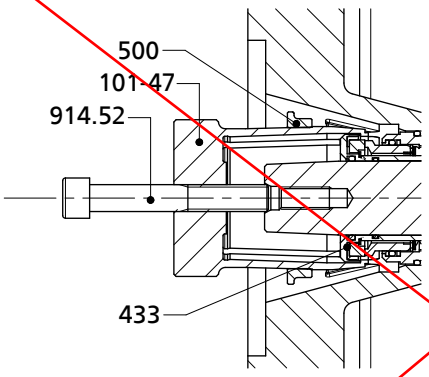


Fig. 29: Removing the double cartridge seal

✓ The back pull-out unit and impeller have been removed.

1. Fix discharge cover 163 to bearing housing 350 using suitable bolts/screws and washers.
2. Remove O-ring 412.58 from the shaft.
3. Slide puller 101-47 over the shoulder of mechanical seal 433 and lock with ring 500.
4. Press forcing screw 914.52 against shaft 210 and pull mechanical seal 433 out of discharge cover 163.

7.4.3.3 Removing the wear plate

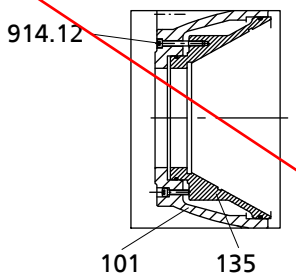


Fig. 30: Removing the wear plate

✓ The back pull-out unit has been separated from the pump casing.

✓ The inside of the casing has been cleaned.

✓ The wear plate needs to be replaced as a result of visual inspection.

1. Undo hexagon socket head cap screws 914.12.
2. Remove wear plate 135 and O-rings 412.34.

7.4.4 Dismantling the motor section

NOTE

Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.

NOTE

The motors of explosion-proof pump sets are supplied in "flameproof enclosure" type of protection. Any work on the motor section which could affect explosion protection, such as re-winding and repair work involving machining, must be inspected by an approved expert or performed by the motor manufacturer. No modifications must be made to the internal configuration of the motor space. Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions.

When dismantling the motor section and the connection cable make sure that the cores/terminals are clearly marked for future reassembly.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Components with sharp edges

Risk of cutting or shearing injuries!

- ▷ Always use appropriate caution for installation and dismantling work.
- ▷ Wear work gloves.

CAUTION

Improper reassembly

Damage to the pump!

- ▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.
- ▷ Use original spare parts only.

NOTE

Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Refer to the flamepath positions specified in the Annex.

Sequence

Always reassemble the pump set in accordance with the corresponding general assembly drawing.

Sealing elements

- O-rings
  - Check O-rings for any damage and replace by new O-rings, if required.
  - Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.
- Assembly adhesives
  - Avoid the use of assembly adhesives, if possible.

Tightening torques

When reassembling the pump set, tighten all screws/bolts as indicated.
In addition, secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).

7.5.2 Reassembling the pump section

7.5.2.1 Installing the mechanical seal

Observe the following to ensure trouble-free operation of the mechanical seal:

- Only remove the protective wrapping of the seal faces immediately before assembly takes place.
- Make sure the surface of the shaft is absolutely clean and undamaged.
- Immediately before installing the mechanical seal, wet the contact faces with a drop of oil.
- For easier installation of bellows-type mechanical seals, wet the inside diameter of the bellows with soapy water (not oil).
- To prevent any damage to the rubber bellows, place a thin foil (of approximately 0.1 to 0.3 mm thickness) around the free shaft stub.
  Slip the rotating assembly over the foil into its installation position.
  Then remove the foil.

✓ The shaft and rolling element bearings have been properly fitted in the motor.

1. Guide drive-end mechanical seal 433.01 onto shaft 210. Secure it with taper lock ring 515.
2. Insert O-rings 412.04 and 412.15 into discharge cover 163.
3. Guide discharge cover 163 into bearing housing 350 or motor housing 811 as far as it will go.
4. Guide the pump-end mechanical seal 433.02 onto shaft 210.

For special mechanical seals with covered spring, tighten the socket head cap screw at the rotating assembly before fitting the impeller. Observe installation dimension "A". (⇨ Section 9.5.2, Page 116)

Table 28: Installation dimension "A" for mechanical seal with covered springs (HJ)

Size	Impeller type	Installation dimension "A" (⇨ Section 9.5.2, Page 116)	
		[mm]	[inch]
100-400	K	48,3	1,902
100-401	E, F, K	48,3	1,902
150-400	D, K	48,3	1,902
150-401	D, E, F, K	48,3	1,902
150-403	K	48,3	1,902
151-401	K	48,3	1,902
151-403	K	48,3	1,902
200-330	K	48,3	1,902
200-400	D	48,3	1,902
200-401	E, K	48,3	1,902
200-402	K	48,3	1,902
200-403	K	48,3	1,902
250-400	D, K	48,3	1,902
250-401	K	48,3	1,902
250-403	K	48,3	1,902
300-400	D, K	48,3	1,902
300-401	K	48,3	1,902
300-403	K	48,3	1,902

NOTE

The puller/ mounting device for the KSB double cartridge seal is not included in the scope of supply. It can be ordered separately from KSB.

7.5.2.2 Installing the double cartridge seal

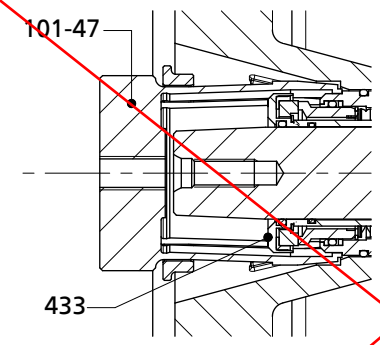


Fig. 31: Installing the double cartridge seal

✓ Install the mechanical seal as shown in the installation drawing.

✓ The back pull-out unit of the pump has been placed in a clean and level assembly area.

✓ The 4STQ double cartridge seal is fully assembled and undamaged.

1. Insert circlip 932.59 in the shaft groove and make sure that circlip 932.59 is positioned correctly in the shaft groove. When fitting the circlip take care to prevent damage to the shaft.

Size	Impeller type	Reference dimension "K"	
		[mm]	[inch]
100-316	D, F, K	41+/- 0,5	1,614+/-0.02
100-317	E	41+/- 0,5	1,614+/-0.02
150-253	D	41+/- 0,5	1,614+/-0.02
150-315	D, F, K	41+/- 0,5	1,614+/-0.02
150-317	E, K	41+/- 0,5	1,614+/-0.02
200-315	D, K	41+/- 0,5	1,614+/-0.02
200-316	K	41+/- 0,5	1,614+/-0.02
200-317	K	41+/- 0,5	1,614+/-0.02
200-318	K	41+/- 0,5	1,614+/-0.02

7.5.2.3 Fitting the impeller

NOTE

For bearing brackets with tapered fit make sure that the tapered fit of impeller and shaft is undamaged and assembled free from grease.

✓ The shaft and rolling element bearings have been properly installed.

✓ The mechanical seals have been properly installed.

1. Slide impeller 230 onto the shaft end.
2. Apply Loctite 243 as thread-locking agent to the thread of the impeller screw.
3. Screw in impeller screw 914.10 and disc 550.23, if any. Tighten with a torque wrench. Observe the tightening torques.

Table 30: Tightening torques for impeller screws

Size	Impeller type	Thread	Tightening torque	
			[Nm]	[ft lbf]
40-252	F, K, S	M16	150	110,6
50-215	F	M8	26	19,2
50-216	F, S	M8	26	19,2
65-215	F	M8	26	19,2
65-216	E	M10	35	25,8
65-217	F	M8	26	19,2
80-216	E	M10	35	25,8
80-216	F	M8	26	19,2
SP 80-217	F	M8	26	19,2
80-252	F	M16	150	110,6
80-253	E, F, K	M20	290	213,9
80-315	D	M20	290	213,9
80-317	D	M20	290	213,9
100-215	F	M8	26	19,2
100-253	D	M16	150	110,6
100-253	E, K	M10	35	25,8
100-254	F, K	M16	150	110,6
100-255	E	M20	290	213,9
100-315	D	M20	290	213,9
100-316	D, F, K	M20	290	213,9
100-317	E	M20	290	213,9
100-400	K	M20	290	213,9

Size	Impeller type	Thread	Tightening torque	
			[Nm]	[ft lbf]
100-401	E, F, K	M20	290	213,9
150-253	D	M10	35	25,8
150-315	D, F, K	M20	290	213,9
150-317	E, K	M20	290	213,9
150-400	D, K	M20	290	213,9
150-401	D, E, F, K	M20	290	213,9
150-403	K	M20	290	213,9
151-401	K	M20	290	213,9
151-403	K	M20	290	213,9
200-315	D, K	M20	290	213,9
200-316	K	M20	290	213,9
P-1 200-317	K	M20	290	213,9
200-318	K	M20	290	213,9
200-330	K	M20	290	213,9
200-400	D	M20	290	213,9
200-401	E, K	M20	290	213,9
200-402	K	M20	290	213,9
200-403	K	M20	290	213,9
250-400	D, K	M20	290	213,9
250-401	K	M20	290	213,9
250-403	K	M20	290	213,9
300-400	D, K	M20	290	213,9
300-401	K	M20	290	213,9
300-403	K	M20	290	213,9

7.5.2.3.1 Fitting the cutter

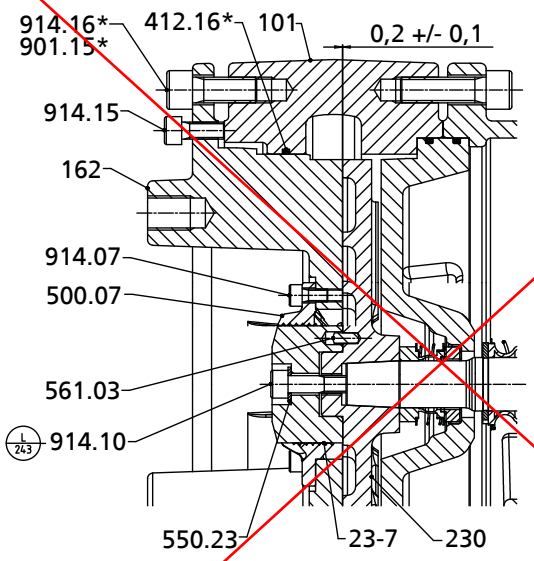


Fig. 33: Fitting the cutter

✓ Pump-end mechanical seal 433.02 has been installed.

1. Slide impeller 230 onto the tapered shaft end.
2. Insert grooved pin 561.03 into the impeller. Place impeller body 23-7 onto the centering hub.
3. Screw in hexagon socket head cap screw 914.10 and use a torque wrench to tighten the screw to a torque of 26 Nm.

4. Adjust the clearance between impeller 230 and wear plate 135 by tightening and loosening screws 914.12 and 914.24.
   ⇨ Screw 914.24 presses the wear plate in the direction of the impeller.
   ⇨ The clearance equals 0.4 $^{+0.2}$ mm (measured on the suction side from the outer surface of the impeller vane to the wear plate).
5. Insert the complete back pull-out unit into the pump casing.
6. Evenly tighten bolted/screwed connection 920.01 and 902.01 and/or 914.74 between pump casing and bearing housing.

7.5.3 Reassembling the motor section

NOTE

Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Only use original spare parts made by KSB for explosion-proof pumps. Observe the flamepath positions specified in the Annex. Secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).

DANGER

Wrong screws/bolts

Explosion hazard!

- Always use the original screws/bolts for assembling an explosion-proof pump set.
- Never use screws/bolts of different dimensions or of a lower property class.

7.5.4 Leak testing

After reassembly, the mechanical seal area/lubricant chamber must be tested for leakage. The leak test is performed at the lubricant filler opening.

Observe the following values for leak testing:

- **Test medium:** compressed air
- **Test pressure:** 11.6 psi [0.8 bar] maximum
- **Test duration:** 2 minutes

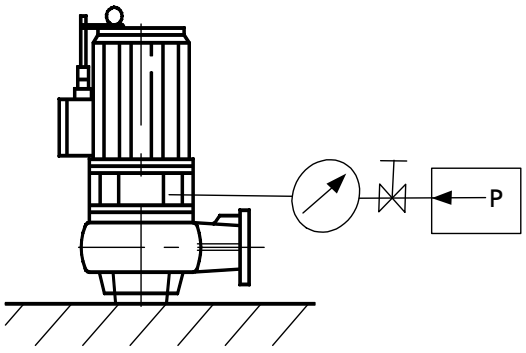


Fig. 37: Screwing in the testing device

1. Unscrew and remove the screw plug and joint ring of the lubricant chamber.
2. Screw the testing device tightly into the lubricant filler opening.
3. Carry out the leak test with the values specified above.
   The pressure must not drop during the test period.
   If the pressure does drop, check the seals and screwed connections.
   Repeat the leak test.
4. If the leak test has been successful, fill in the lubricant.

7.5.5 Checking the connection of motor/power supply

Check the power cables after reassembly. (⇨ Section 7.2.2, Page 60)

7.6 Tightening torques

Table 31: Tightening torques [lbf ft] depending on thread, material and property class

Thread	Material				
	A4-50	A4-70	A4-70	1.4462	8.8
	Property class Rp 0.2 $^{N}/_{mm^2}$				
	210	250	450	450	640
M5	-	-	2,95	2,95	4,43
M6	-	-	5,16	5,16	7,38
M8	-	-	12,54	12,54	18,44
M10	-	-	25,81	25,81	36,88
M12	-	-	44,25	44,25	62,69
M14	-	-	66,34	66,34	95,88
M16	-	-	110,63	110,63	154,88
M20	-	-	213,89	213,89	301,66

Table 32: Tightening torques [Nm] depending on thread, material and property class

Thread	Material				
	A4-50	A4-70	A4-70	1.4462	8.8
	Property class Rp 0.2 $^{N}/_{mm^2}$				
	210	250	450	450	640
M5	-	-	4,00	4,00	6,00
M6	-	-	7,00	7,00	10,00
M8	-	-	17,00	17,00	25,00
M10	-	-	35,00	35,00	50,00
M12	-	-	60,00	60,00	85,00
M14	-	-	90,00	90,00	130,00
M16	-	-	150,00	150,00	210,00
M20	-	-	290,00	290,00	410,00

7.7 Spare parts stock

7.7.1 Ordering spare parts

Always quote the following data when ordering replacement parts or spare parts:

- Order number
- Order item number
- Type series
- Size
- Year of construction
- Motor number

Refer to the name plate for all data.

Also supply the following data:

- Part No. and description (⇨ Section 9.1, Page 85)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

8 Trouble-shooting

A Pump is running but does not deliver

B Pump delivers insufficient flow rate

C Excessive current/power input

D Insufficient discharge head

E Vibrations and noise during pump operation

Table 34: Trouble-shooting

A	B	C	D	E	Possible cause	Remedy
-	✗	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point.
-	✗	-	-	-	Gate valve in the discharge line is not fully open.	Fully open the gate valve.
-	-	✗	-	✗	Pump is running in off-design conditions (part load/overload).	Check the pump's operating data.
✗	-	-	-	-	Pump and/or piping are not vented.	Vent by lifting the pump off the base elbow and lowering it again.
✗	-	-	-	-	Pump intake clogged by deposits	Clean the intake, pump components and lift check valve.
-	✗	-	✗	✗	Inlet pipe or impeller clogged	Remove deposits in the pump and/or piping.
-	-	✗	-	✗	Dirt/fibers in the clearance between the casing wall and impeller; sluggish rotor.	Check whether the impeller can be easily rotated. Clean the impeller, if required.
-	✗	✗	✗	✗	Wear of internal parts	Replace worn parts by new ones.
✗	✗	-	✗	-	Defective riser (pipe and sealing elements)	Replace defective riser pipes. Replace sealing elements.
-	✗	-	✗	✗	Impermissible air or gas content in the fluid handled	Contact KSB.
-	-	-	-	✗	System-induced vibrations	Contact KSB.
-	✗	✗	✗	✗	Wrong direction of rotation	Check the electrical connection of the motor and the control system, if any.
-	-	✗	-	-	Wrong supply voltage	Check the mains power supply. Check the cable connections.
✗	-	-	-	-	Motor is not running because of lack of voltage.	Check the electrical installation. Contact the energy supplier.
✗	-	✗	-	-	Motor winding or power cable are defective.	Replace by new original KSB parts or contact KSB.
-	✗	-	✗	-	In case of star-delta configuration: motor running in star configuration only	Check star-delta contactor.
-	-		-	✗	Defective rolling element bearing(s)	Contact KSB.
-	✗	-	-	-	Water level lowered too much during operation	Check level control equipment.
✗	-	-	-	-	Temperature control device monitoring the winding has tripped the pump as a result of excessive winding temperatures.	The motor will restart automatically once it has cooled down.
✗	-	-	-	-	Temperature limiter (explosion protection) has tripped the pump as a result of the permissible winding temperature being exceeded.	Have cause determined and eliminated by qualified and trained personnel.
✗	-	-	-	-	Motor has been tripped by leakage monitor.	Have cause determined and eliminated by qualified and trained personnel.

SUMP PUMP KRT K80-217/24XEG-S

9 Related Documents

9.1 General assembly drawings with list of components

9.1.1 Amarex KRT, motor type 1

Sizes:
40-252
50-215
50-216
65-215
65-216
65-217
65-253
80-215
80-216
80-217
80-252
80-253
80-255
100-215
100-253
100-254
100-255
150-253

Motors:
3 2
4 2
5 2
7 2
2 4
3 4
4 4
5 4

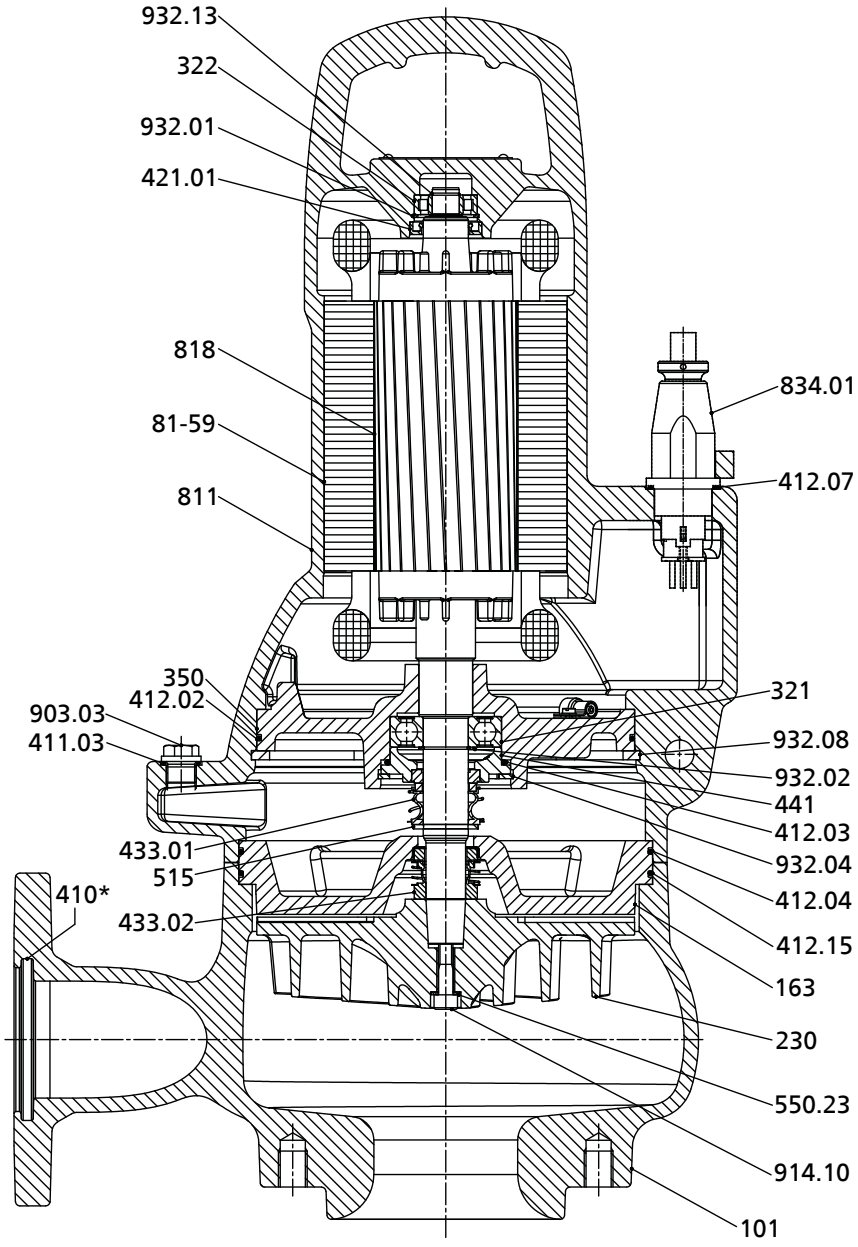


Fig. 38: General assembly drawing Amarex KRT, motor type 1

*: On specific designs only

Table 35: List of components

Part No.	Description	Part No.	Description
101	Pump casing	441	Shaft seal housing
163	Discharge cover	515	Taper lock ring
230	Impeller	550.23	Disc
321	Radial ball bearing	81-59	Stator
322	Radial roller bearing	811	Motor housing
350	Bearing housing	818	Rotor

Part No.	Description	Part No.	Description
410	Profile joint	834.01	Cable gland
411.03	Joint ring	903.03	Screw plug
412.02/.03/.04/.07/.15	O-ring	914.10	Hexagon socket head cap screw
421.01	Lip seal	932.01/.02/.04/.08/.13	Circlip
433.01/.02	Mechanical seal		

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9.1.2 Amarex KRT, motor type 2

Sizes:
40-252
50-215
50-216
65-215
65-216
65-217
65-253
80-215
80-216
80-217
80-252
80-253
80-255
80-315
80-316
80-317
100-215
100-253
100-254
100-255
150-253
150-315
150-317
200-315
200-316
200-317
200-318

Motors:
11 2
15 2
18 2
22 2
26 2
7 4
11 4
15 4
18 4
22 4
7 6
11 6
15 6
18 6

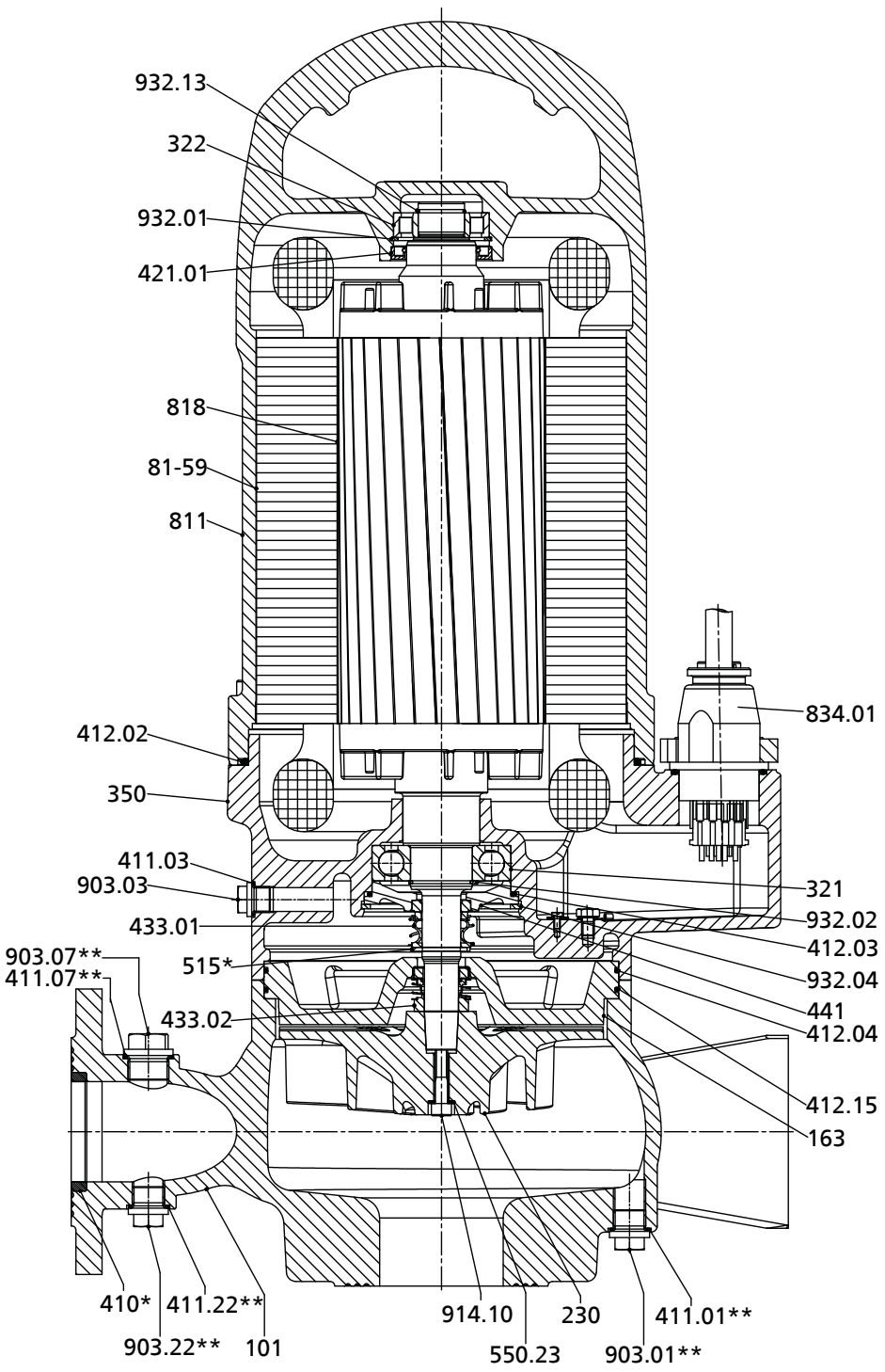

Fig. 39: General assembly drawing Amarex KRT, motor type 2

*: On specific designs only

** Only for installation types K, D and H

NOTE: CROSS SECTION SHOWS "F" IMPELLER. P-1 USES "K" IMPELLER

Table 36: List of components

Part No.	Description	Part No.	Description
101	Pump casing	441	Shaft seal housing
163	Discharge cover	515	Taper lock ring
230	Impeller	550.23	Disc
321	Radial ball bearing	81-59	Stator

Part No.	Description	Part No.	Description
322	Radial roller bearing	811	Motor housing
350	Bearing housing	818	Rotor
410	Profile joint	834.01	Cable gland
411.01/.03/.07/.22	Joint ring	903.01/.03/.07/.22	Screw plug
412.02/.03/.04/.15	O-ring	914.10	Hexagon socket head cap screw
421.01	Lip seal	932.01/.02/.04/.13	Circlip
433.01/.02	Mechanical seal		

9.1.3 Amarex KRT, motor type 3

Sizes:
100-315
100-316
100-317
100-400
100-401
150-315
150-317
150-400
150-401
150-403
151-403
200-315
200-316
200-317
200-318
200-330
200-400
200-401
200-402
250-400
250-401
250-403
300-400
300-401
300-403

Motors:
55 2
65 2
75 2
30 4
37 4
45 4
55 4
65 4
75 4
22 6
30 6
31 6
37 6
45 6
55 6
11 8
15 8
18 8
22 8
30 8
37 8
45 8

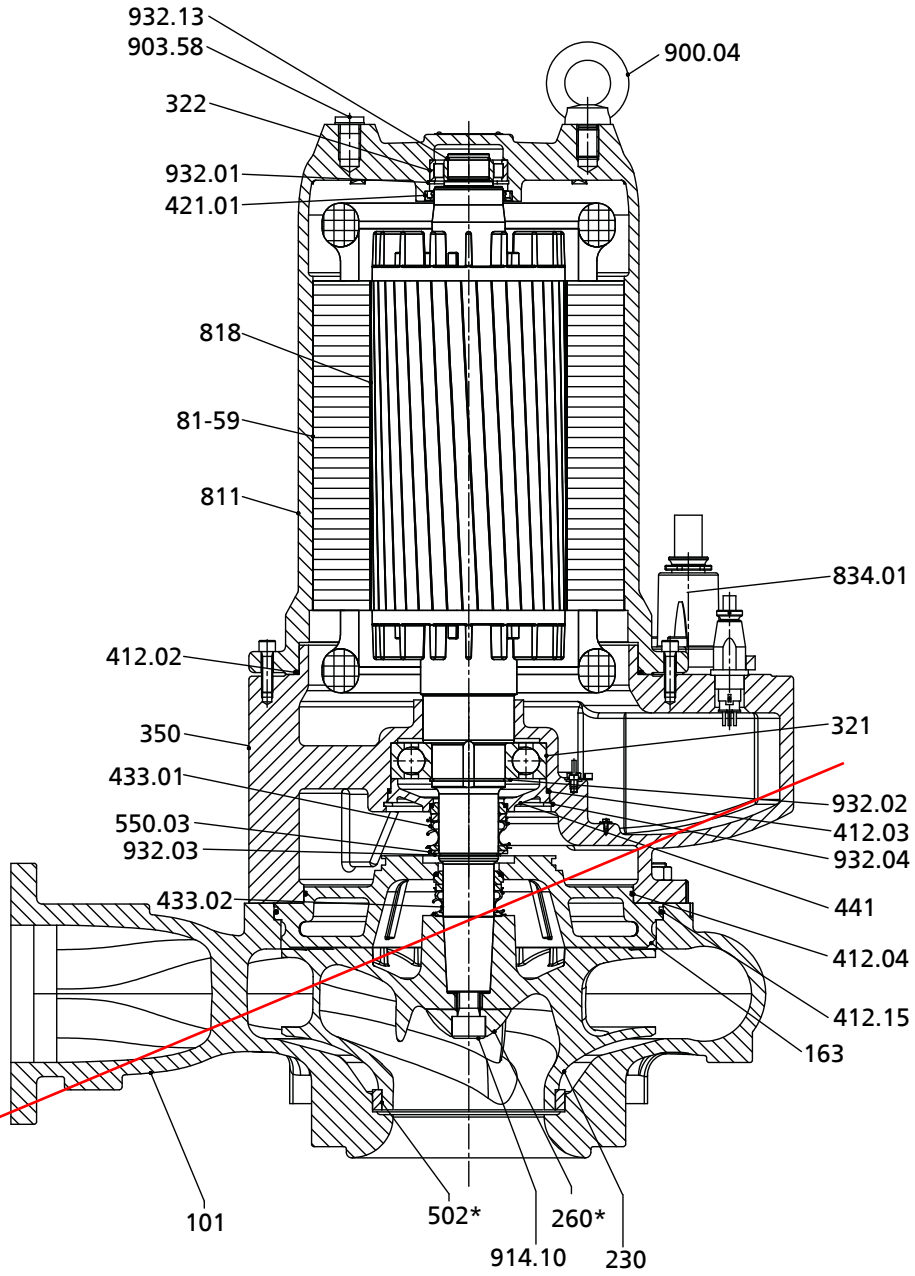

Fig. 40: General assembly drawing Amarex KRT, motor type 3

* On specific designs only

Table 37: List of components

Part No.	Description	Part No.	Description
101	Pump casing	502	Casing wear ring
163	Discharge cover	550.03	Disc
230	Impeller	81-59	Stator
260	Impeller hub cap	811	Motor housing
321	Radial ball bearing	818	Rotor
322	Radial roller bearing	834.01	Cable gland
350	Bearing housing	900.04	Bolt/screw
412.02/.03/.04/.15	O-ring	903.58	Screw plug

9.2.8 Attachment elements

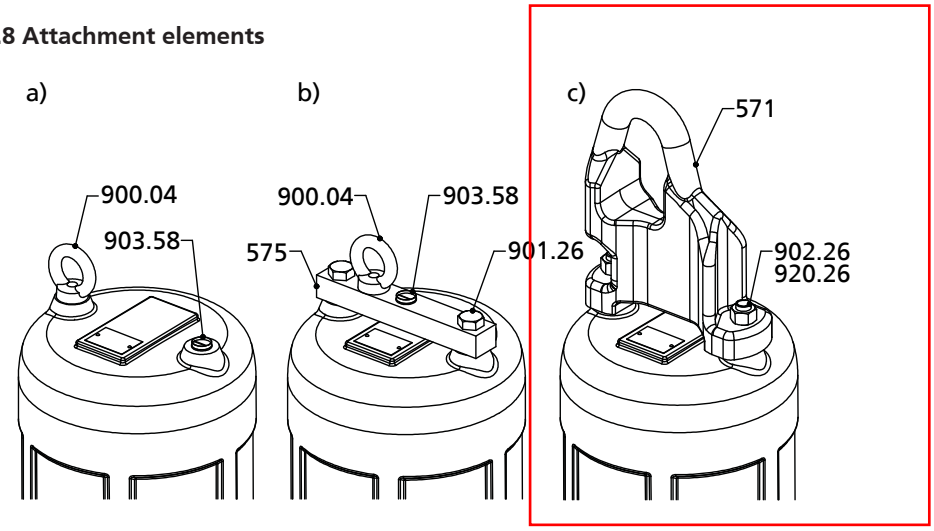

Fig. 48: Attachment elements a) bolt for guide cable arrangement b) bolt for guide rail arrangement c) bail

Table 47: Attachment elements

Part No.	Description	Part No.	Description
571	Bail	902.26	Stud
575	Strip	903.58	Screw plug
900.04	Bolt/screw	920.26	Nut
901.26	Hexagon head bolt		

9.2.9 Electrode for leakage monitoring

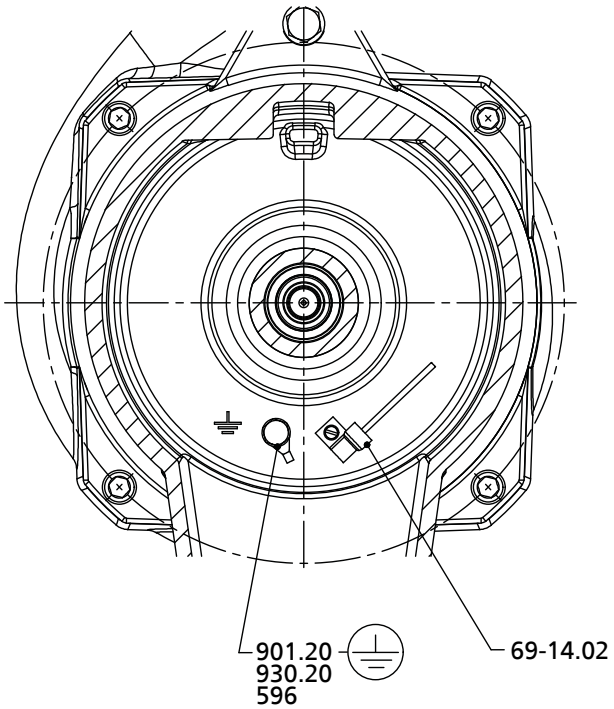

Fig. 49: Electrode for leakage monitoring

Table 48: Electrode for leakage monitoring

Part No.	Description	Part No.	Description
596	Wire	901.20	Hexagon head bolt
69-14.02	Leakage sensor	930.20	Safety device

9.2.10 Electrode for leakage monitoring and motor temperature sensor

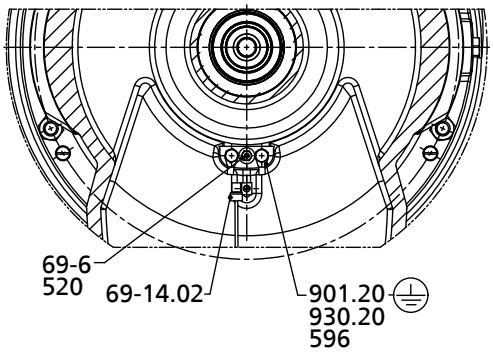

Fig. 50: Electrode for leakage monitoring and motor temperature sensor

Table 49: Electrode for leakage monitoring and motor temperature sensor

Part No.	Description	Part No.	Description
520	Sleeve	69-14.02	Leakage sensor
596	Wire	901.20	Hexagon head bolt
69-6	Temperature sensor	930.20	Safety device

9.2.11 Motor and fastening elements for the cable glands

SP

9.2.11.1 Amarex KRT, motor type 1

Sizes:
40-252
50-215
50-216
65-215
65-216
65-217
65-253
80-215
80-216
80-217
80-252
80-253
80-255
100-215
100-253
100-254
100-255
150-253

Motors:
3 2
4 2
5 2
7 2
2 4
3 4
4 4
5 4

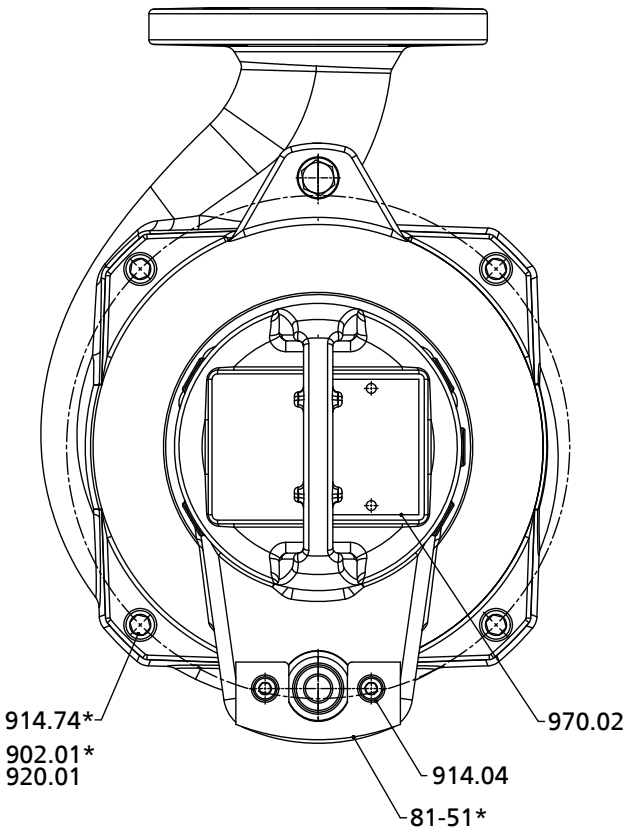

Fig. 51: Motor and fastening elements for the cable glands Amarex KRT, motor type 1
*: On specific designs only

Table 50: List of components

Part No.	Description	Part No.	Description
81-51*	Clamping element	920.01*	Nut
902.01*	Stud	970.02	Label/plate
914.04/.74*	Hexagon socket head cap screw		

P-1

9.2.11.2 Amarex KRT, motor type 2

Sizes:
40-252
50-215
50-216
65-215
65-216
65-217
65-253
80-215
80-216
80-217
80-252
80-253
80-255
80-315
80-316
80-317
100-215
100-253
100-254
100-255
150-253
150-315
150-317
200-315
200-316
200-317
200-318

Motors:
11 2
15 2
18 2
22 2
26 2
7 4
11 4
15 4
18 4
22 4
7 6
11 6
15 6
18 6

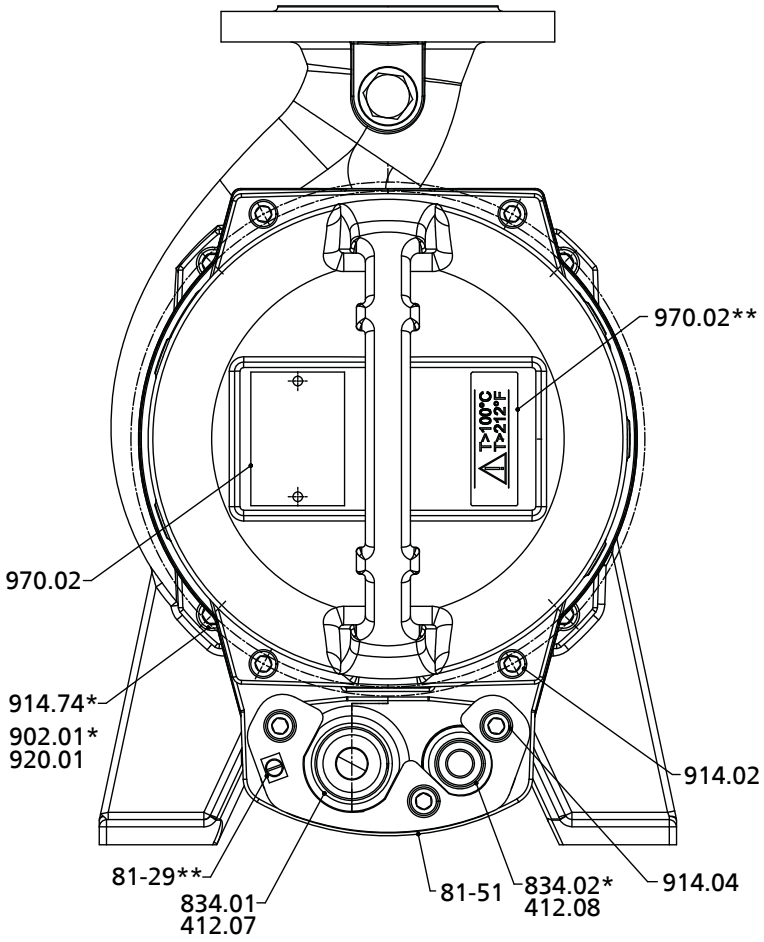

Fig. 52: Motor and fastening elements for the cable glands Amarex KRT, motor type 2

*: On specific designs only

** Only for installation types K, D and H

Table 51: List of components

Part No.	Description	Part No.	Description
412.07/.08*	O-ring	902.01*	Stud
81-29**	Terminal	914.02/.04/.74*	Hexagon socket head cap screw
81-51	Clamping element	920.01*	Nut
834.01/.02*	Cable gland	970.02/.20**	Label/plate

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9.3 Wiring diagrams

9.3.1 Wiring diagrams for installation types P and S

9.3.1.1 Wiring diagram for one power cable 8G1.5 (AWG 15-8)

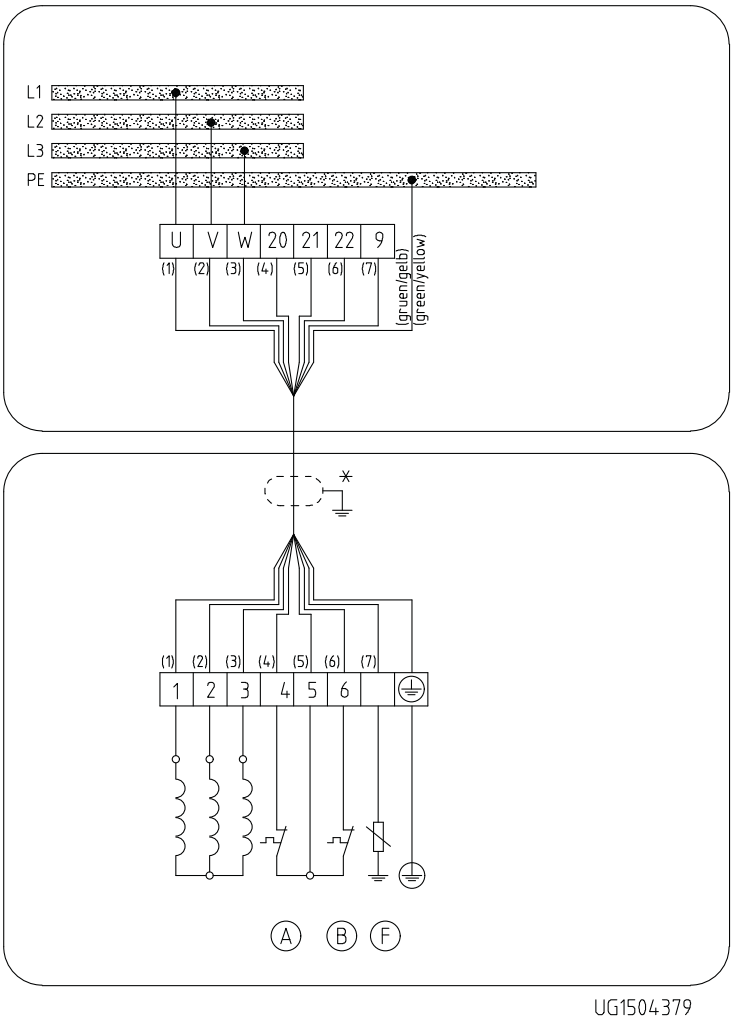

Fig. 55: Wiring diagram for pump sets of installation types P or S with one power cable 8G1.5

Ⓐ	Motor temperature 1
Ⓑ	Motor temperature 2
Ⓕ	Leakage inside the motor
*	Shielded cable optional

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9.3.1.3 Wiring diagram for one power cable 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5 (AWG 11 - 7 + 15 - 5, AWG 9 - 7 + 15 - 5 or AWG 7 - 7 + 15 - 5)

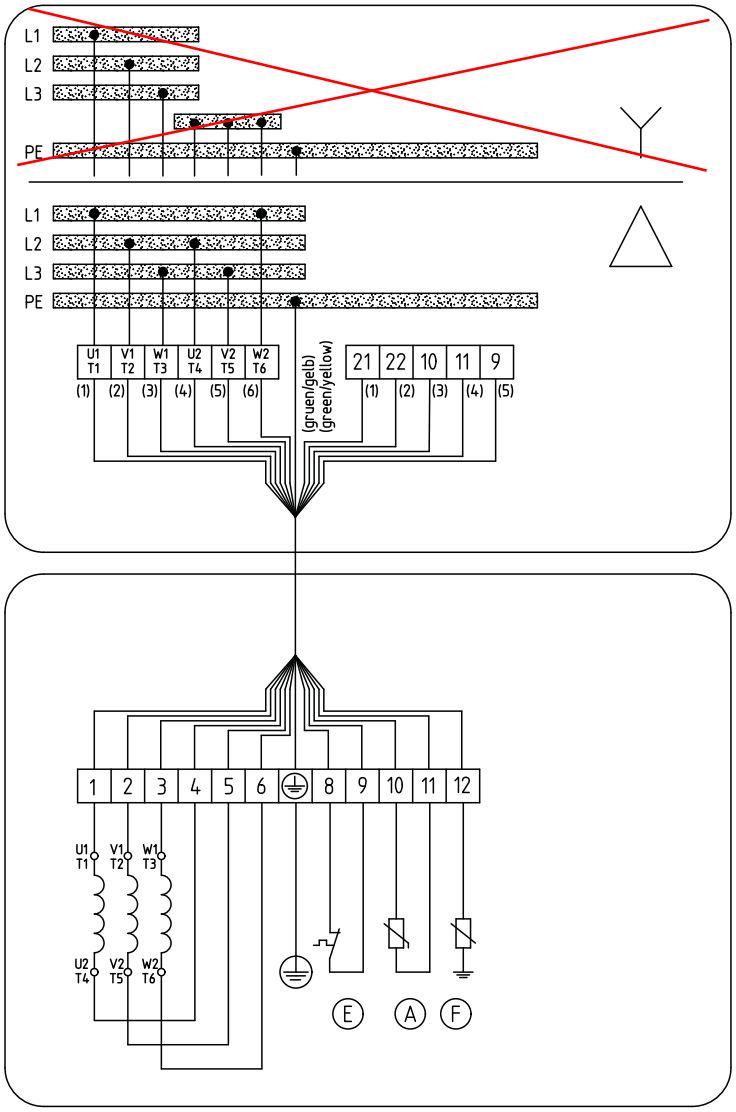

Fig. 57: Wiring diagram for pump sets of installation types P or S with one power cable 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5

Ⓐ	Motor temperature (PTC thermistor)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor
*	Shielded cable optional

9.4 Flamepaths on explosion-proof motors

9.4.1 Amarex KRT, motor type 1

Motors:

3 2
4 2
5 2
~~**7 2**~~
2 4
3 4
4 4
5 4

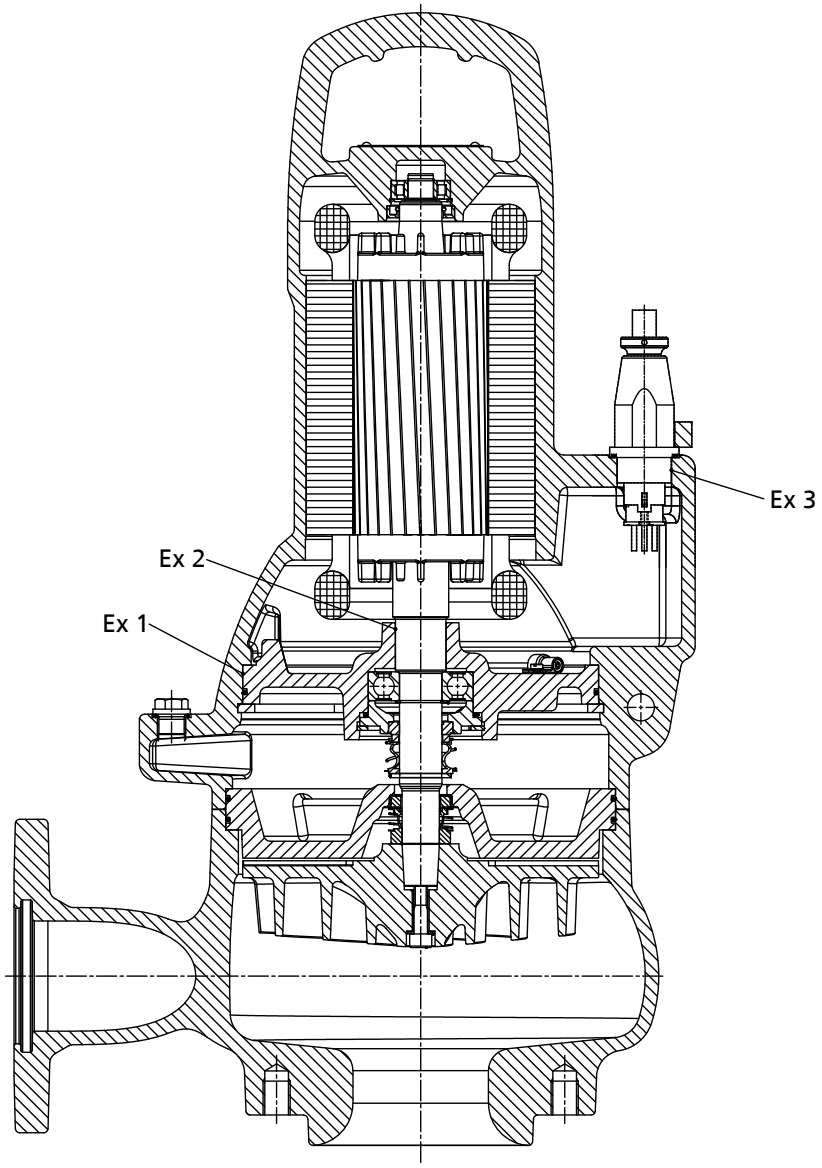

Fig. 66: Flamepaths Amarex KRT, motor type 1

9.4.2 Amarex KRT, motor type 2

Motors:
11 2
15 2
18 2
22 2
26 2
7 4
11 4
15 4
18 4
22 4
7 6
11 6
15 6
18 6

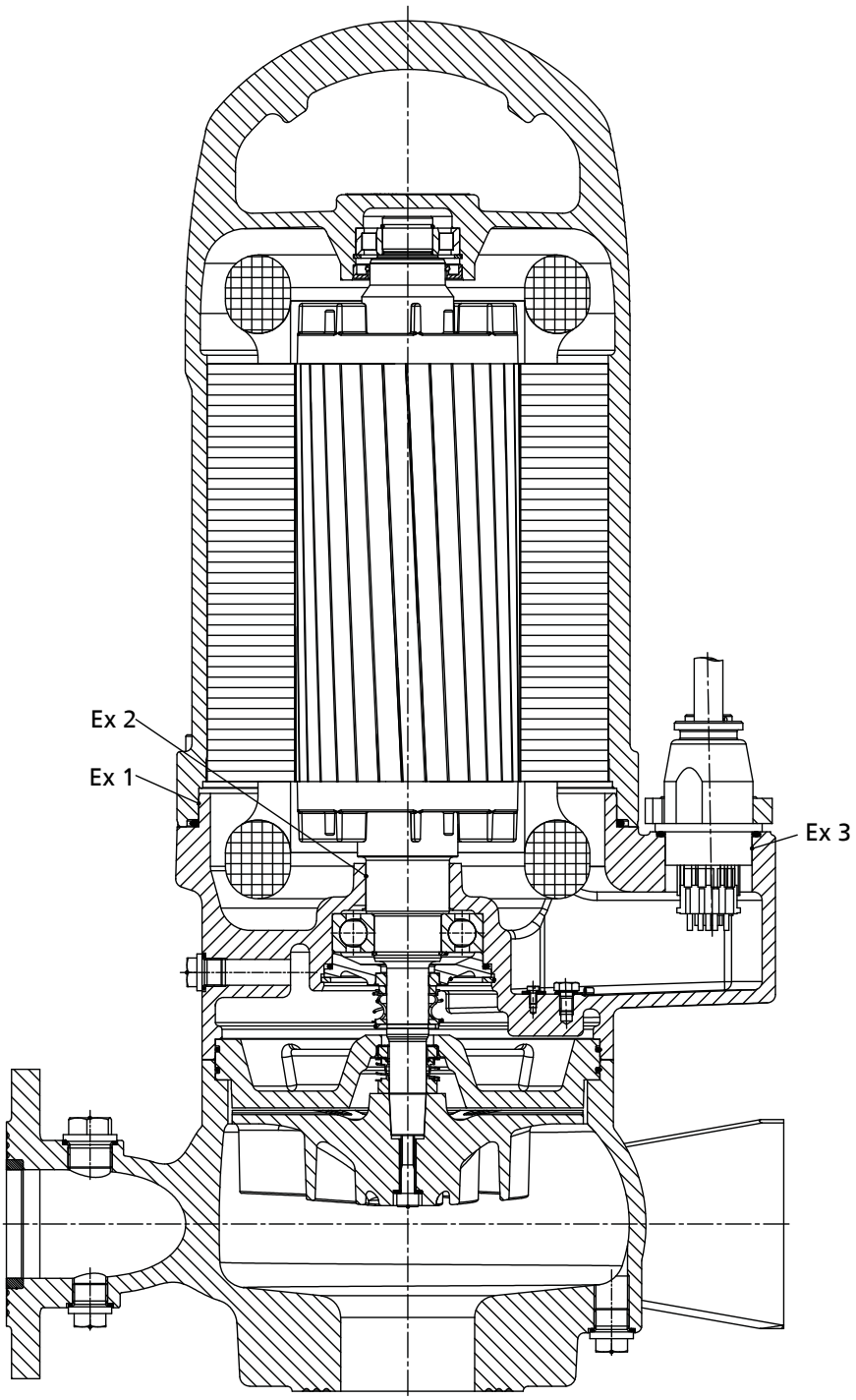

Fig. 67: Flamepaths Amarex KRT, motor type 2

9.5 Sectional drawings of the mechanical seal

SP

9.5.1 Bellows-type mechanical seal

Mechanical seal for material variants G, G1, G2, GH, C1

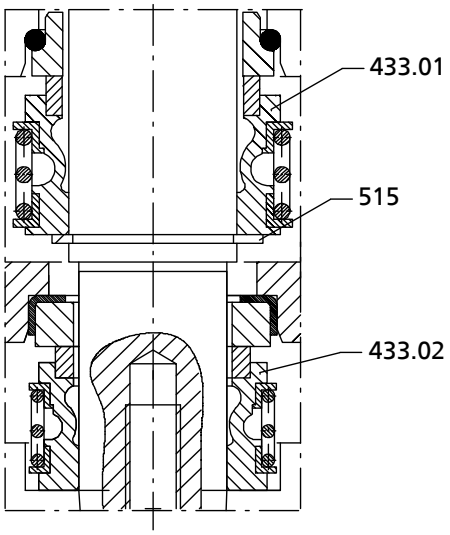

Fig. 69: Sectional drawing of bellows-type mechanical seal

Table 54: Bellows-type mechanical seal

Part No.	Description	Part No.	Description
433.01/.02	Mechanical seal	515	Taper lock ring

9.5.2 Mechanical seal with covered springs (HJ)

P-1

Mechanical seal for material variants H, C2[15)]

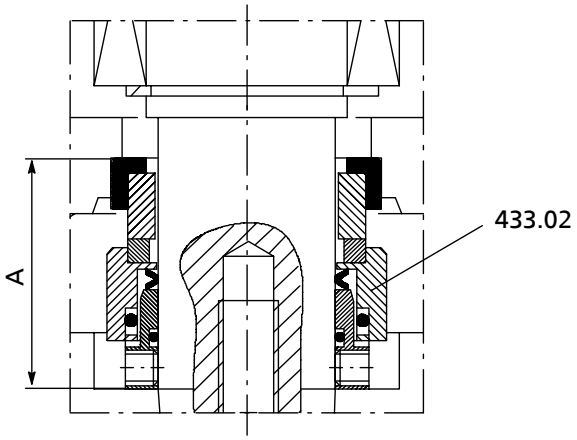

Fig. 70: Sectional drawing of mechanical seal with covered springs (HJ)

Table 55: Mechanical seal with covered springs (HJ)

Part No.	Description	Part No.	Description
433.02	Mechanical seal		

15) Optional for material variants G, G1, G2, GH, C1

10 Certificate of Decontamination

Type: .....

Order number/

order item number[18]: .....

Delivery date: .....

Field of application: .....

Fluid handled[18]: .....

Please check where applicable[18]:

☐ Radioactive

☐ Explosive

☐ Corrosive

☐ Toxic

☐ Harmful

☐ Bio-hazardous

☐ Highly flammable

☐ Safe

Reason for return[18]: .....

Comments: .....

.....

The product/accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch/ placing at your disposal.

We herewith declare that this product is free from any hazardous chemicals as well as from biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

☐ No special safety precautions are required for further handling.

☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....	.....	.....
Place, date and signature	Address	Company stamp

18) Required fields

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2553.821/05-EN-US (01654473)

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www.ksb.com

SECTION 5B

P-2, P-3, P-4 IOM

KRT K 500-634/1308XNG-K

Submersible Motor Pump

P-2, P-3, P-4 KRT K500-634/1308XNG-K

Amarex KRT

Sizes DN 100 to DN 700; 60 Hz
4-pole: 35 4_N to 350 4_N
6-pole: 32 6_N to 480 6_N
8-pole: 26 8_N to 400 8_N
10-pole: 40 10 _N to 350 10_N
12-pole: 195 12_N to 300 12_N

Installation/Operating Manual

Mat. No.: 01426370

KSB

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Installation/Operating Manual Amarex KRT

Original operating manual

Subject to technical modification without prior notice.

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Glossary

Back pull-out unit

Pump without pump casing; partly completed machinery

Certificate of decontamination

If a product is to be returned to the manufacturer, the customer declares in a certificate of decontamination that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

Close-coupled design

Motor directly fitted to the pump via a flange or a drive lantern

Discharge line

The pipeline which is connected to the discharge nozzle

Flamepath

The surface of motor housing components which form flameproof joints when an explosion-proof motor is installed.

Hydraulic system

The part of the pump in which the kinetic energy is converted into pressure energy

Pump set

Complete pump set consisting of pump, drive, additional components and accessories

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

1 General

1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover (for details, refer to the table below).

Table 1: Variants covered by this manual

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH[1)]	H[1)]	C1[1)]	C2[1)]
100-400	K	K	K	-	-	-	K	K
100-401	E, F, K	E, F, K	F, K	F	F, K	F, K	F, K	F, K
150-400	K	K	-	-	-	-	-	-
150-401	E, F, K	E, F, K	F, K	F	F, K	F, K	F, K	F, K
150-403	K	K	K	-	K	K	K	K
150-503	K	K	K	-	-	-	-	-
151-403	K	K	K	-	K	K	K	K
151-401	K	K	K	-	K	K	K	K
200-330	K	K	K	-	K	K	K	K
200-401	E, K	E, K	K	-	K	K	K	K
200-402	K	K	K	-	K	K	K	K
200-403	K	K	K	-	K	K	K	K
200-501	K	K	K	-	-	-	K	K
200-502	K	K	K	-	-	K	K	K
200-503	K	K	K	-	-	-	-	-
200-631	K	K	K	-	-	-	K	K
250-400	K	K	K	-	K	K	K	K
250-401	K	K	K	-	K	K	K	K
250-403	K	K	K	-	K	K	K	K
250-632	K	K	K	-	-	-	-	-
250-900	K	K	K	-	-	-	-	-
300-400	K	K	K	-	K	K	K	K
300-401	K	K	K	-	K	K	K	K
300-403	K	K	K	-	K	K	K	K
300-420	K	K	K	-	K	-	K	K
300-500	K	K	K	-	K	-	K	K
300-503	K	K	K	-	-	-	K	K
300-505	K	K	K	-	-	-	-	-
350-420	K	K	K	-	K	-	K	K
350-500	K	K	K	-	K	-	K	K
350-501	K	K	-	-	-	-	-	-
350-503	K	K	-	-	-	-	-	-
350-632	K	K	K	-	-	-	K	K
350-633	K	K	K	-	-	-	-	-
350-636	K	K	K	-	-	-	K	K
350-710	K	K	K	-	-	-	K	K
350-713	K	K	K	-	-	-	-	-
400-500	K	K	K	-	-	-	K	K
400-632	K	K	K	-	-	-	-	-
400-900	K	K	K	-	-	-	-	-

1) Not for pump sets with cooling system

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH[1)]	H[1)]	C1[1)]	C2[1)]
401-710	K	K	K	-	-	-	-	-
401-713	K	K	K	-	-	-	-	-
500-632	K	K	K	-	-	-	K	K
500-634	K	K	K	-	-	-	K	K
500-640	K	K	K	-	-	-	K	K
501-710	K	K	K	-	-	-	-	-
501-900	K	K	K	-	-	-	-	-
600-520	K	K	K	-	-	-	K	K
600-710	K	K	K	-	-	-	K	K
700-901	K	K	K	-	-	-	-	-
700-902	K	K	K	-	-	-	K	K

The manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number clearly identify the pump set and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest KSB Service center to maintain the right to claim under warranty.

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance.

1.3 Target group

This supplementary operating manual is aimed at the target group of trained and qualified specialist technical personnel.

1.4 Other applicable documents

Table 2: Overview of other applicable documents

Document	Contents
Data sheet	Technical data of the pump set
General arrangement drawing/ outline drawing	Mating dimensions, installation dimensions and weights of the pump set
Hydraulic characteristic curve	Characteristic curves showing head, flow rate, efficiency and power input
General assembly drawing[2)]	Sectional drawing of the pump set with part numbers
Sub-supplier product literature[2)]	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists[2)]	Description of spare parts
Supplementary operating manual[2)]	E.g. for special accessories

For accessories and/or integrated machinery components observe the product literature of the corresponding manufacturer.

2) If agreed to be included in the scope of supply

1.5 Symbols

Table 3: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇨	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

2 Safety

DANGER

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 Key to safety symbols/markings

Table 4: Definition of safety symbols/markings

Symbol	Description
DANGER	**DANGER** This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	**General hazard** In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	**Electrical hazard** In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	**Machine damage** In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

2.2 General

This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.

The safety information in all sections of this manual must be complied with.

The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.

The contents of this operating manual must be available to the specialist personnel at the site at all times.

Information attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:

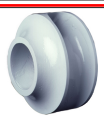
- Arrow indicating the direction of rotation
- Markings for connections
- Name plate

The operator is responsible for ensuring compliance with all local regulations which are not taken into account.

2.3 Intended use

- The pump set must only be operated within the operating limits described in the other applicable documents.
- Only operate pump sets which are in perfect technical condition.
- Do not operate partially assembled pump sets.
- Only use the pump set to handle the fluids described in the data sheet or product literature of the pump variant.
- Never operate the pump set without the fluid to be handled.

- Observe the limits for continuous duty specified in the data sheet or product literature (Q_{min} and Q_{max}) (to prevent damage such as shaft fracture, bearing failure, mechanical seal damage, etc).
- When untreated waste water is handled, the duty points in continuous operation lie within 0.7 to 1.2 × $Q_{opt}$to minimize the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates (< 0.7 x Q_{opt}).
- Observe the minimum flow rates and maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pump set (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.
- Only use the respective impeller types in combination with the fluids described below.

	Free-flow impeller (impeller type F/F-max)
	Closed single-channel impeller (impeller type E/E-max)
	Closed multi-channel impeller (impeller type K/K-max)

Prevention of foreseeable misuse

- Observe the minimum flow velocities required to fully open the swing check valves to prevent the reduction of pressure and risk of clogging.
  (Contact the manufacturer for the required minimum flow velocities/loss coefficients.)
- Never exceed the permissible operating limits (pressure, temperature, etc.) specified in the data sheet or product literature.
- Observe all safety information and instructions in this manual.

2.4 Personnel qualification and personnel training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by sufficiently trained specialist personnel training and instructing the personnel who will carry out the respective tasks. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

2.5 Consequences and risks caused by non-compliance with these operating instructions

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:

- Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
- Failure of important product functions
- Failure of prescribed maintenance and servicing practices
- Hazard to the environment due to leakage of hazardous substances

2.6 Safety awareness

In addition to the safety information contained in this manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

2.7 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.8 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorized by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation is performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energized).
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇨ Section 6.3, Page 59)
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇨ Section 6.1, Page 54)

2.9 Unauthorized modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this manual.

The warranty relating to the operating reliability and safety of the pump (set) supplied is only valid if the equipment is used in accordance with its intended use.

2.10 Explosion protection

Special conditions apply to the operation of explosion-proof pumps.

- The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.
- The limits stated in the data sheet and on the name plate must not be exceeded under any circumstances.
- Correct monitoring of the motor temperature is imperative to ensure explosion protection.
- Observe the wiring diagrams.
- Never operate an explosion-proof pump set without temperature monitoring.
- Modifications or alteration of the pump set could affect explosion protection and are only permitted after consultation with the manufacturer.
- Only original spare parts and accessories authorized by the manufacturer must be used for explosion-proof pumps.

3 Transport/Temporary Storage/Disposal

3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the distributor and the insurance company about the damage in writing immediately.

3.2 Transport

⚠ DANGER

Improper transport

Danger to life from falling parts!

Damage to the pump set!

- ▷ Attach any lifting accessories to the attachment point (pump handle) provided.
- ▷ Use the eyebolts for vertical loads only. For lateral loads the eyebolts must be replaced by permissible lifting tackle for this direction of load.
- ▷ Never suspend the pump set by its power cable.
- ▷ Use the supplied lifting chain/rope exclusively to lower the pump set into or pull it out of the pump sump.
- ▷ Securely attach the lifting rope/chain to the pump and crane.
- ▷ Use tested, marked and approved lifting accessories only.
- ▷ Observe the regional transport regulations.
- ▷ Observe the documentation of the lifting accessory manufacturer.
- ▷ The load-carrying capacity of the lifting accessories must exceed the weight indicated on the name plate of the pump set to be lifted. Take into account any additional system components to be lifted.

⚠ WARNING

Improper placing of pump sets in a vertical/horizontal position

Personal injury and damage to property!

- ▷ Use appropriate means to secure the pump set against tilting or tipping over.
- ▷ Use two sets of lifting equipment when handling large pump sets if possible (using the attachment point provided on the motor and the discharge nozzle).
- ▷ Secure power cables against falling down.
- ▷ Use additional supports for the transport holder to secure it against tilting.
- ▷ Maintain adequate safety distance during lifting operations.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

To transport the pump set suspend it from the lifting tackle as shown.

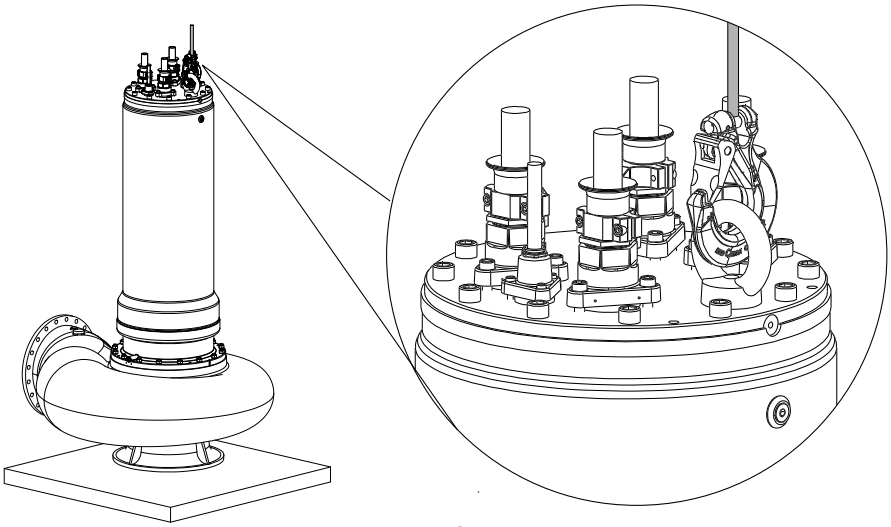


Fig. 1: Transporting the pump set with lifting accessories

3.2.1 Setting the pump set down in a horizontal position

⚠ WARNING

Placing the pump set on unsecured and uneven surfaces

Personal injury and damage to property!

- Always place the pump set on a solid and level surface with the pump set in a vertical position and the motor on top.
- Only place the pump set on a surface of sufficient load-carrying capacity.
- Use appropriate means to secure the pump set against tilting or tipping over.

It may be necessary to place the pump set down in a horizontal position during maintenance or installation.

Pump sets with cooling system (installation types D and K)

CAUTION

Improper transport / Improper positioning of pump sets with cooling system

Damage to the cooling system!

- Never place the pump set on the cooling jacket or fasten it by the cooling system.

Pump sets equipped with a cooling system are delivered with a support foot as a transport lock.

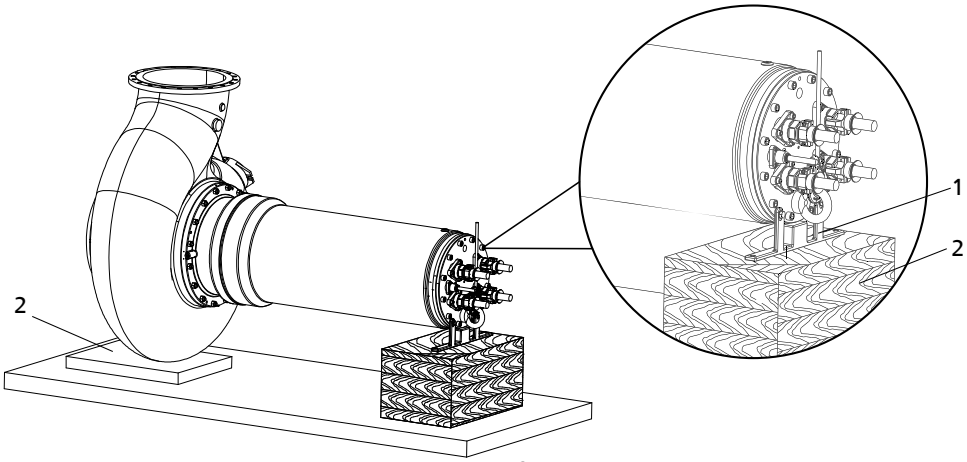


Fig. 2: Setting down a pump set with support foot

1	Support foot	2	Wooden support

For setting down the pump set, observe the following points:

- Support foot (1)
  - Fit the support foot (1) of the pump prior to setting the pump set down in a horizontal position.
  - Set the pump set down on the support foot (1) and pump casing.
- Wooden support (2)
  - Use wooden supports (2) to prevent any damage to the coating of the pump set.

Pump sets without cooling system (installation types P and S)

For setting down the pump set, observe the following points:

- Set the pump set down on its pump casing as well as directly on the edge of the motor housing cover.
- Use wooden supports to prevent any damage to the coating of the pump set.

3.2.2 Placing the pump set in a vertical position

To change the pump from a horizontal to a vertical position, attach lifting equipment to the attachment point provided.
When the pump is pulled upright, the pump casing will act as a pivot. Place wooden supports under the pivot points.

3.3 Storage/preservation

If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump set storage:

CAUTION

Improper storage

Damage to the power cables!

- ▷ Support the power cables at the cable entry to prevent permanent deformation.
- ▷ Only remove the protective caps from the power cables at the time of installation.

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of the pump (set)!

- ▷ For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.

CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

- ▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

Table 5: Ambient conditions for storage

Ambient condition	Value
Relative humidity	5 % to 85 % (non-condensing)
Ambient temperature	-4 °F to 158 °F [-20 °C to +70 °C]

- Store the pump set under dry and vibration-free conditions, if possible in its original packaging.

1. Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative.
2. Spray the preservative through the suction and discharge nozzles.
   It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).

NOTE

Observe the manufacturer's instructions for application/removal of the preservative.

3. Rotate the impeller by hand once every three months.

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇨ Section 7.3, Page 77)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralized, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
   Always indicate any safety measures and decontamination measures taken.
   (⇨ Section 10, Page 122)

NOTE

If required, a blank certificate of decontamination can be downloaded from the KSB web site at: www.ksb.com/certificate_of_decontamination

3.5 Disposal

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Dismantle the pump (set).
   Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
   - Metals
   - Plastics
   - Electronic waste
   - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

4 Description of the Pump (Set)

4.1 General description

Pump for handling untreated waste water containing long fibers and solid substances, liquids containing air/gas, and raw sludge, activated sludge and digested sludge.

4.2 Designation

KRT K500-634/1308XNG-K

Example: ~~Amarex KRT K 150-403/80 4 UN G-S IE3~~

Table 6: Designation key

Code	Description	
Amarex KRT	Type series	
K	Impeller type	
	~~F/F-max~~	~~Free-flow impeller~~
	~~E/E-max~~	~~Closed single-channel impeller~~
	K/K-max	Closed multi-channel impeller
~~150~~ 500	Nominal discharge nozzle diameter [mm]	
~~403~~ 634	Maximum nominal impeller diameter [mm]	
~~80~~ 130	Motor size	
~~4~~ 8	Number of motor poles	
~~UN~~ XN	Motor version	
	~~U/UN/UE~~	~~Not explosion-proof, for fluid temperatures of up to 104 °F [40 °C]~~
	~~W/WN/WE~~	~~Not explosion-proof, for fluid temperatures of~~ up to ~~140 °F [60 °C]~~
	X/XN/XE	Explosion-proof, for fluid temperatures of up to 104 °F [40 °C]
	~~Z/ZN/ZE~~	~~Explosion-proof, for fluid temperatures of up to 140 °F [60 °C]~~
G	Material variant	
	G	Standard design, gray cast iron
	~~G1~~	Like G, impeller made of duplex stainless steel
	G2	Like G, impeller made of white cast iron
	GH	Like G, impeller and discharge cover made of white cast iron
	H	Wetted components made of white cast iron
	C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, screws/ bolts made of A4/A 276 Type 316 Ti
	C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462/A 182 F51
~~S~~ K	Type of installation	
	~~D~~	~~Stationary dry installation, vertical (S1 duty)~~
	K	Stationary wet installation (S1 duty with motor outside of the fluid possible) with guide cable or guide rail arrangement
	~~S~~	~~Stationary wet installation (S1 duty with submerged motor) with guide cable or guide rail arrangement~~
	~~P~~	~~Transportable wet installation (S1 duty with submerged motor)~~

Code	Description	
IE3	Motor efficiency classification to IEC 60034-30[3]	
	[4]	No efficiency classification
	IE2	High Efficiency (IE = International Efficiency)
	IE3	Premium Efficiency (IE = International Efficiency)

4.3 Name plate

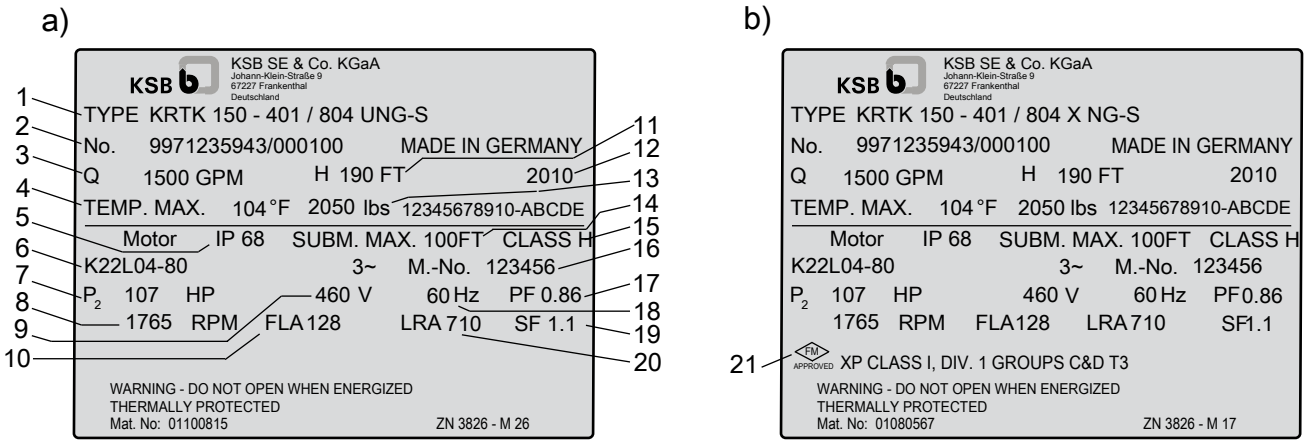


Fig. 3: Name plate (example) a) Standard pump set b) Explosion-proof pump set

1	Designation	2	KSB order number
3	Flow rate	4	Maximum fluid and ambient temperature
5	Enclosure	6	Motor type
7	Rated power	8	Rated speed
9	Rated voltage	10	Rated current
11	Head	12	Year of construction
13	Total weight	14	Maximum submergence
15	Thermal class of winding insulation	16	Motor number
17	Power factor at rated operating point	18	Rated frequency
19	Mode of operation	20	Starting current
21	Explosion protection marking		

4.4 Design details

Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

Impeller type

- Various application-oriented impeller types

Shaft seal

- Two bi-directional mechanical seals in tandem arrangement, with liquid reservoir
- Leakage chamber

3) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.

4) Blank

Standard bearings

Motor-end bearing:

- Grease-packed bearings sealed for life
- Maintenance-free

Pump-end bearings:

- Can be re-lubricated

Drive

- Three-phase asynchronous squirrel-cage motor
- Motors integrated in explosion-proof pump sets are supplied in Explosionproof Class I Division 1, Groups C&D, T3.

4.5 Types of installation

Four design variants are available, depending on the installation type:

- **Installation type D**
  Stationary dry installation with cooling system
- **Installation type K**
  Stationary wet installation with cooling system
- **Installation type P**
  Transportable model for wet installation without cooling system
- **Installation type S**
  Stationary wet installation without cooling system

Pump sets of installation types P and S
are designed for continuously submerged operation. The motor is cooled by the fluid handled on the motor surface. Operation with the motor outside the fluid handled is possible for short periods.

Pump sets of installation types D and K
are suitable for continuous operation with the motor outside the fluid. The motor is cooled by the integrated cooling system.

4.6 Configuration and function

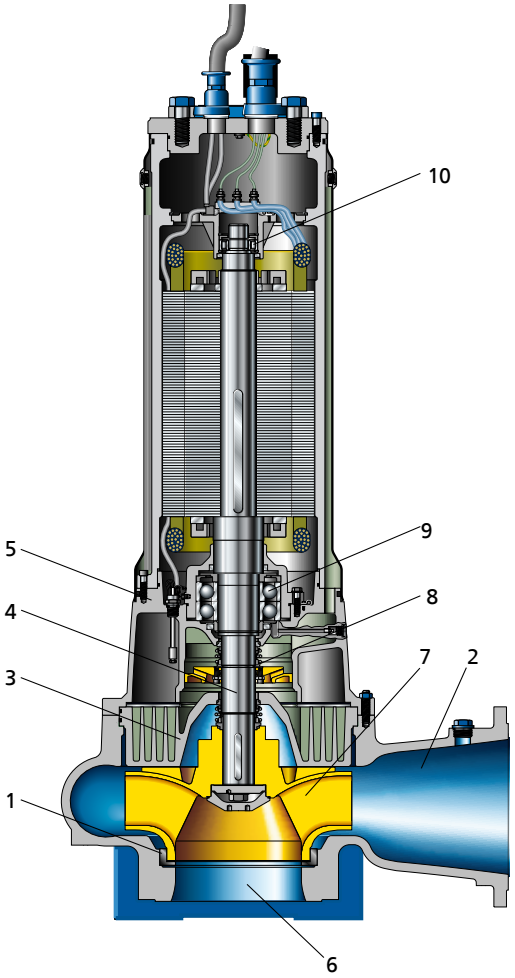


Fig. 4: Sectional drawing

1	Casing wear ring	2	Discharge nozzle
3	Discharge cover	4	Shaft
5	Bearing bracket	6	Suction nozzle
7	Impeller	8	Shaft seal
9	Bearing, pump-end	10	Bearing, motor-end

Design The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system sits on the extended motor shaft. The shaft runs in common bearings.

Function The fluid enters the pump axially via the suction nozzle (6) and is accelerated outward by the rotating impeller (7). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (2), where it leaves the pump. The casing wear ring (1) prevents any fluid from flowing back from the casing into the suction nozzle. At the rear side of the impeller, the shaft (4) enters the casing via the discharge cover (3). The shaft passage through the cover is sealed to atmosphere with a shaft seal (8). The shaft runs in rolling element bearings (9 and 10), which are supported by a bearing bracket (5) connected to the pump casing and/or discharge cover.

Sealing The pump is sealed by two bi-directional mechanical seals in tandem arrangement. A lubricant chamber in-between the seals ensures cooling and lubrication of the mechanical seals.

Cooling system Pump sets of installation types K and D feature an integrated motor cooling system. The heat generated by the motor is transferred via the discharge cover to the fluid handled by internal circulation. The coolant serves as anti-corrosive and antifreeze agent, and as a lubricant for the mechanical seals.

4.7 Noise characteristics (only for dry installation – installation type D)

Table 7: Surface sound pressure level L_{pA} [5)]

Rated power P_2		1500 1/min	1000/750 rpm	600/500 rpm
[hp]	[kW]	[dB]	[dB]	[dB]
32	24	-	68	-
43	32	71	70	-
54/56	40/42	72	71	70
67/74/80	50/55/60	73	72	71
100	75	74	73	72
121	90	75	74	73
134/148	100/110	76	-	74
161/168/174	120/125/130	78	77	75
188/195	140/145	79	78	-
201/215/221	150/160/165	80	79	77
228/235/241	170/175/180	81	80	78
261/268/282	195/200/210	82	81	79
295/308/315	220/230/235	83	82	80
322/335	240/250	84	-	81
362/375	270/280	-	-	82
382/389	285/290	85	83	-
416/436	310/325	-	84	83
456/483	340/360	-	85	84
536/590	400/440	-	85	-

4.8 Scope of supply

Depending on the model, the following items are included in the scope of supply:

Stationary wet installation (installation types K and S)

- Pump set complete with connection cables
- Claw with sealing and mounting elements
- Lifting rope, lifting chain or lifting bail (optional)
- Mounting bracket with mounting elements
- Base elbow with inspection hole[6)] and fastening elements
- Guide cable / guide rail
  (guide rails are not included in KSB's scope of supply)

SEE DETAILED SCOPE IN SUBMITTAL

Stationary dry installation (installation type D)

- Pump set complete with connection cables
- Base elbow with inspection hole[7)] and fastening elements
- Optional: intake elbow with inspection hole

Transportable model for wet installation (installation type P)

- Pump set complete with connection cables
- Foot plate or pump stool with mounting elements
- Lifting rope, lifting chain or lifting bail (optional)

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

5) Measured at a distance of 3.28 ft (1 m) from the pump outline
6) For nominal discharge nozzle diameter ≥ DN100
7) For nominal discharge nozzle diameter ≥ DN100

4.9 Dimensions and weights

For dimensions and weights refer to the general arrangement drawing/outline drawing or data sheet of the pump set.

5 Installation at Site

5.1 Safety regulations

DANGER

Improper installation in potentially explosive atmospheres

Damage to the pump set!

- Comply with the applicable local explosion protection regulations.
- Observe the information given in the data sheet and on the pump/motor name plates.

DANGER

Risk of falling when working at great heights

Danger to life by falling from great heights!

- Do not step onto the pump (set) during installation work or dismantling work.
- Pay attention to safety equipment, such as railings, covers, barriers, etc.
- Observe the applicable local occupational safety regulations and accident prevention regulations.

DANGER

Persons in the tank during pump operation

Electric shock!

Risk of personal injury!

Danger of death from drowning!

- Never start up the pump set when there are persons in the tank.

WARNING

Hands, other body parts or foreign objects in the impeller or intake area

Risk of personal injury! Damage to the submersible motor pump!

- Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.
- Check that the impeller can rotate freely.

WARNING

Impermissible solid objects (tools, screws/bolts or similar) in the pump sump/inlet tank during pump start-up

Personal injury and damage to property!

- Check the pump sump/inlet tank for impermissible solid objects before flooding, and remove, if necessary.

5.2 Checks to be carried out prior to installation

5.2.1 Preparing the place of installation

Place of installation for stationary models

⚠ WARNING

Installation on mounting surfaces which are unsecured and cannot support the load

Personal injury and damage to property!

- Use a concrete with a minimum compressive strength of 3000 psi [Class C25/30 in exposure class XC1 to EN 206-1].
- The mounting surface must have set and must be completely horizontal and even.
- Observe the weights indicated.

Resonances Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

Place of installation for transportable models

⚠ WARNING

Incorrect positioning/placing down

Personal injury and damage to property!

- Position the pump set vertically with the motor on top.
- Use appropriate means to secure the pump set against tilting and tipping over.
- Refer to the weights given in the data sheet/on the name plate.

Resonances Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

5.2.2 Removing the transport lock (installation types K and D)

Pump sets equipped with a cooling system are fitted with a support foot for transport to prevent in-transit damage to the cooling jacket.

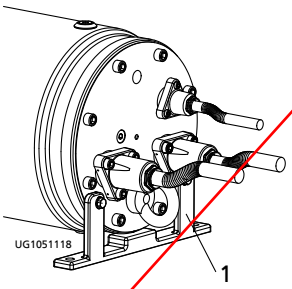


Fig. 5: Transport lock

1	Support foot

Remove the support foot (1) prior to commissioning and keep it for future servicing, temporary storage or decommissioning of the pump.

5.2.3 Checking the lubricant level (installation types S and P)

Check the lubricant level of pump sets without cooling system.

The lubricant chambers have been filled with an environmentally-friendly, non-toxic lubricant at the factory.

Visual inspection for signs of oil leakage

1. If no oil leakage is visible in the area of the pump casing or impeller, the lubricant chamber is filled properly.
2. If oil leakage is visible in the area of the pump casing or impeller, top up the lubricant chamber.

WARNING

Incorrect positioning/placing down

Personal injury and damage to property!

- ▹ Position the pump set vertically with the motor on top.
- ▹ Use appropriate means to secure the pump set against tilting and tipping over.
- ▹ Refer to the weights given in the data sheet/on the name plate.

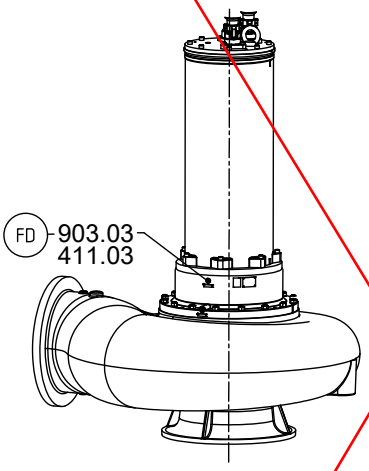


Fig. 6: Checking the lubricant level

✓ Signs of oil leakage have been detected.

1. Place the pump set in a vertical position. (⇨ Section 3.2.2, Page 16)
2. Secure the pump set against tipping over.
3. Unscrew and remove screw plug 903.03 with joint ring 411.03.
4. Check the lubricant level.
   - ⇨ If the lubricant level reaches the opening, fit and tighten screw plug 903.03 with joint ring 411.03 again.
   - ⇨ If the lubricant level is below the opening, top up the lubricant. (⇨ Section 7.2.3.1.4, Page 73)
5. Fit and tighten screw plug 903.03 with a new joint ring 411.03.

Table 8: Key to the symbols and codes

Symbol	Description
FD	Always apply a **liquid sealing agent** (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

NOTE

If more than 1.59 quart [1.5 l] of lubricant are required for topping up, this suggests a defect of the mechanical seals.

5.2.4 Checking the coolant level (installation types D and K)

Check the coolant level of pump sets with cooling system.

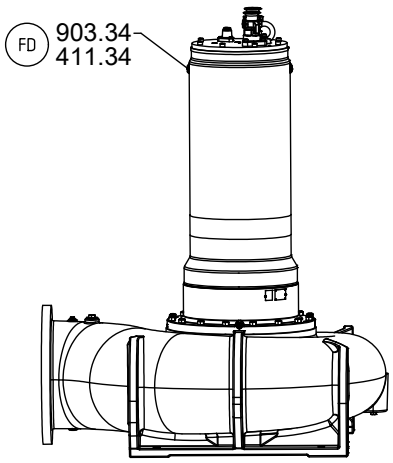


Fig. 7: Coolant filler opening

✓ The pump set has been set down in a vertical position.

1. Position the pump set as shown.
2. Undo and remove screw plug 903.34 and joint ring 411.34.
3. Insert a paper test strip through the filler opening and read off the coolant level from the paper.
   ⇨ The fluid level should not be more than 1.18 inch [3 cm] below the edge of the filler opening.
4. If the coolant level is lower, top up clear water through the filler opening until it overflows.
5. Close screw plug 903.34 with joint ring 411.34.

NOTE

If more than 2.12 quart [2 l] are required for topping up the coolant, this suggests a defect in the cooling system.

5.2.5 Checking the direction of rotation

⚠ DANGER

Pump set running dry

Explosion hazard!

- ▷ Check the direction or rotation of explosion-proof pump sets outside potentially explosive atmospheres.

⚠ WARNING

Hands and/or foreign objects in the pump casing

Risk of injuries, damage to the pump!

- ▷ Never insert your hands or any other objects into the pump.
- ▷ Check that the inside of the pump is free from any foreign objects.
- ▷ Take suitable precautions (e.g. wear safety goggles).

⚠ WARNING

Improper positioning of pump set when checking the direction of rotation

Personal injury and damage to property!

- ▹ Use appropriate means to secure the pump set against tilting or tipping over.

CAUTION

Pump set running dry

Increased vibrations!

Damage to mechanical seals and bearings!

- ▹ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

✓ The pump set is connected to the power supply.

1. Start the pump set and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.
   - ⇨ **Pump sets for wet installation (installation types K, S, P):** Impeller rotation must be anti-clockwise (seen from the pump mouth end). On some pump casings, the direction of rotation is marked by an arrow.
   - ⇨ **Pump sets for dry installation (installation type D):** Viewed through the inspection hole of the pump set, impeller movement must be to the left (on some pumps, the direction of rotation is marked by an arrow).

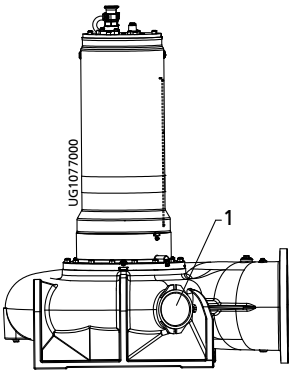


Fig. 8: Inspection hole

1	Inspection hole

3. If the impeller is running in the wrong direction of rotation, check the electrical connection of the pump and the control system, if necessary.
4. Disconnect the pump set from the power supply and make sure it cannot be started unintentionally.

5.3 Installing the pump set

Always refer to and comply with the general arrangement drawing/outline drawing when installing the pump set.

5.3.1 Stationary wet installation

5.3.1.1 Fastening the base elbow

Depending on the pump size, the base elbow is either fastened with chemical anchors and/or foundation rails.

Fastening the base elbow with chemical anchors

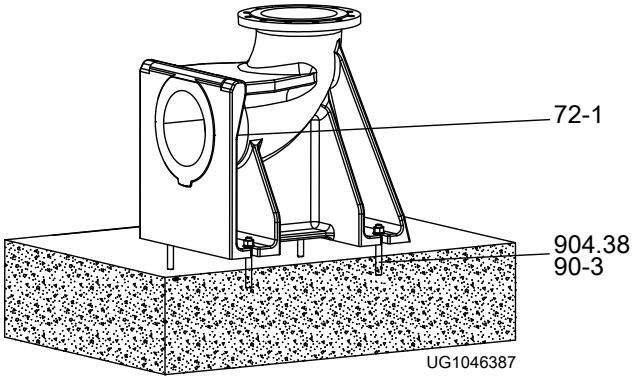


Fig. 9: Fastening the base elbow with chemical anchors

1. Position base elbow 72-1 at the bottom of the tank/well.
2. Insert chemical anchors 904.38.
3. Bolt base elbow 72-1 to the floor using chemical anchors 904.38.

Fastening the base elbow with foundation rails and chemical anchors

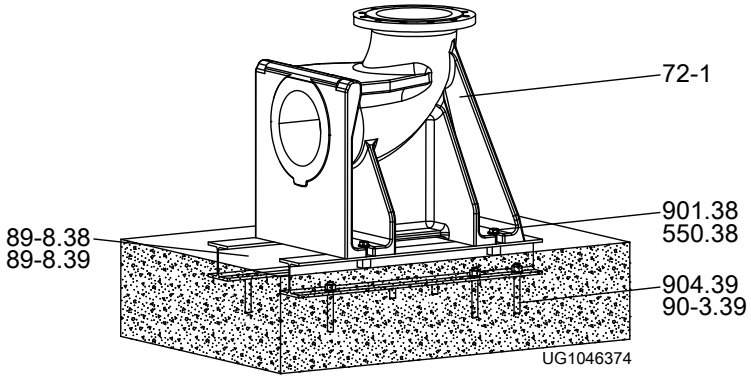


Fig. 10: Fastening the base elbow with foundation rails and chemical anchors

1. Position base elbow 72-1 with foundation rails 89-8.38/.39 at the bottom of the tank/well.
2. Insert chemical anchors 904.38.
3. Use chemical anchors 904.38 to bolt base elbow 72-1 with foundation rails 89-8.38/.39 to the floor.
4. Set the foundation rails in concrete.

Chemical anchor dimensions

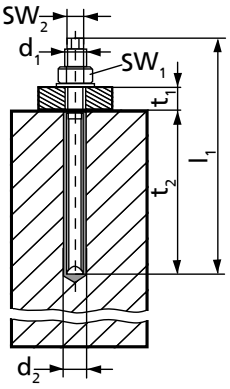


Fig. 11: Dimensions

Table 9: Chemical anchor dimensions [″]

Size ($d_1 \times l_1$)	d_2 [″]	t_1 [″]	t_2 [″]	SW_1[8] [″]	SW_2[8] [″]	M_{d1} [ft lb]
$^3/_8 \times 5\ ^1/_8$″	$^7/_{16}$	$^7/_8$	3 $^9/_{16}$	$^{11}/_{16}$	$^1/_4$	14,75
$^7/_{16} \times 6\ ^5/_{16}$″	$^9/_{16}$	1	4 $^5/_{16}$	$^3/_4$	$^5/_{16}$	29,50
$^5/_8 \times 7\ ^1/_2$″	$^{11}/_{16}$	1 $^3/_8$	4 $^{15}/_{16}$	$^{15}/_{16}$	$^7/_{16}$	44,25
$^{13}/_{16} \times 10\ ^1/_4$″	1	2 $^9/_{16}$	6 $^{11}/_{16}$	1 $^3/_{16}$	$^9/_{16}$	88,50
$^{15}/_{16} \times 11\ ^{13}/_{16}$″[9]	1 $^1/_8$	2 $^9/_{16}$	8 $^1/_4$	1 $^7/_{16}$	$^{11}/_{16}$	132,76
1 $^3/_{16} \times 14\ ^{15}/_{16}$″[9]	1 $^3/_8$	2 $^9/_{16}$	11	1 $^{13}/_{16}$	-	295,02

Table 10: Chemical anchor dimensions [mm]

Size ($d_1 \times l_1$)	d_2 [mm]	t_1 [mm]	t_2 [mm]	SW_1[8] [mm]	SW_2[8] [mm]	M_{d1} [Nm]
M10 × 130	12	22	90	17	6	20
M12 × 160	14	25	110	19	8	40
M16 × 190	18	35	125	24	12	60
M20 × 260	25	65	170	30	14	120
M24 × 300[9]	28	65	210	36	17	180
M30 × 380[9]	35	65	280	46	-	400

Table 11: Curing times of mortar cartridge

Floor temperature		Curing time
[°F]	[°C]	[min]
23 to 32	-5 to 0	240
32 to 50	0 to +10	45
50 to 68	+10 to +20	20
> 68	> +20	10

5.3.1.2 Connecting the piping

DANGER

Impermissible loads acting on the flange of the base elbow

Danger to life from leakage of hot, toxic, corrosive or flammable fluids!

- Do not use the pump as an anchorage point for the piping.
- Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains.
- Observe the permissible flange loads.
- Take appropriate measures to compensate thermal expansion of the piping.

NOTE

When the pump set is used for draining low-level building areas, fit a swing check valve into the discharge line to avoid backflow from the sewer system.

8) SW = Width across flats
9) Mounting accessories of the respective manufacturer are required.

CAUTION

Critical speed

Increased vibrations!

Damage to mechanical seals and bearings!

- In the case of longer riser pipes, fit a swing check valve to prevent the pump from excessively running in reverse after it is switched off.
  Choose the position of the swing check valve to allow proper venting.

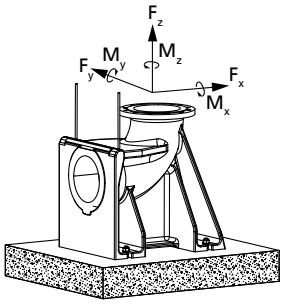


Fig. 12: Permissible flange loads

Table 12: Permissible flange loads

Nominal flange diameter	Forces [lbf]				Moments [lbf ft]			
	F_x	F_y	F_z	$\sum F$	M_x	M_y	M_z	$\sum M$
100	374	607	753	1180	1291	922	1070	2600
150	1012	910	1124	1765	1844	1291	1512	3650
200	1349	1214	1506	2349	2397	1696	1955	4800
250	1675	1517	1877	2934	3282	2323	2692	6550
300	2012	1810	2248	3518	4462	3172	3651	8900
350	2349	2113	2619	4103	5716	4057	4684	11400
400	2686	2417	2990	4687	7155	5089	5864	14300
500	3361	3024	3732	5856	10658	7560	8704	21300
600	4035	3631	4474	7025	14900	10621	12244	29900
700	4676	4294	5058	8228	18956	12687	15490	37300

Table 13: Permissible flange loads

Nominal flange diameter	Forces [N]				Moments [Nm]			
	F_x	F_y	F_z	$\sum F$	M_x	M_y	M_z	$\sum M$
100	3000	2700	3350	5250	1750	1250	1450	2600
150	4500	4050	5000	7850	2500	1750	2050	3650
200	6000	5400	6700	10450	3250	2300	2650	4800
250	7450	6750	8350	13050	4450	3150	3650	6550
300	8950	8050	10000	15650	6050	4300	4950	8900
350	10450	9400	11650	18250	7750	5500	6350	11400
400	11950	10750	13300	20850	9700	6900	7950	14300
500	14950	13450	16600	26050	14450	10250	11800	21300
600	17950	16150	19900	31250	20200	14400	16600	29900
700	20800	19100	22500	36600	25700	17200	21000	37300

5.3.1.3 Fitting the guide cable arrangement

The pump set is guided into the sump or tank along two parallel, tightly stretched guide cables made of stainless steel. It attaches itself automatically to the base elbow which has been fitted to the floor.

Size	Tightening torque M_A		Guide cable tension	
	[lbf ft]	[Nm]	[lbf]	[N]
250-900	22,1	30	2248	10000
300-400	22,1	30	2248	10000
300-401	22,1	30	2248	10000
300-403	22,1	30	2248	10000
300-420	22,1	30	2248	10000
300-500	22,1	30	2248	10000
300-503	22,1	30	2248	10000
300-505	22,1	30	2248	10000
350-420	15,5[10)]	21[10)]	3372	15000
350-500	15,5[10)]	21[10)]	3372	15000
350-501	15,5[10)]	21[10)]	3372	15000
350-503	15,5[10)]	21[10)]	3372	15000
350-632	15,5[10)]	21[10)]	3372	15000
350-633	15,5[10)]	21[10)]	3372	15000
350-636	15,5[10)]	21[10)]	3372	15000
350-710	15,5[10)]	21[10)]	3372	15000
350-713	15,5[10)]	21[10)]	3372	15000
400-500	15,5[10)]	21[10)]	3372	15000
400-632	15,5[10)]	21[10)]	3372	15000
400-900	15,5[10)]	21[10)]	3372	15000
401-710	15,5[10)]	21[10)]	3372	15000
401-713	15,5[10)]	21[10)]	3372	15000
500-634	15,5[10)]	21[10)]	3372	15000
500-640	15,5[10)]	21[10)]	3372	15000
500-641	15,5[10)]	21[10)]	3372	15000
501-710	15,5[10)]	21[10)]	3372	15000
501-900	15,5[10)]	21[10)]	3372	15000
600-520	15,5[10)]	21[10)]	3372	15000
600-710	15,5[10)]	21[10)]	3372	15000
700-901	15,5[10)]	21[10)]	3372	15000
700-902	15,5[10)]	21[10)]	3372	15000

5.3.1.4 Fitting the guide rail arrangement

The pump set is guided into the sump or tank along two vertical guide rails. It attaches itself automatically to the base elbow which has been fitted to the floor.

NOTE

The guide rails are not included in KSB's scope of supply.
Select guide rail materials which are suitable for the fluid handled or as specified by the operator.

Observe the following dimensions for the guide rails:

10) 2 tensioning bolts, indicated per bolt
11) To DIN 2440/2442/2462 or equivalent standards

Table 18: Guide rail dimensions

Size of hydraulic system	Outside diameter		Wall thickness[11)]			
			Min.		Max.	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]
DN 40 to DN 150	2,36	60	0,079	2	0,197	5
DN 200 to DN 700	3,5	89	0,118	3	0,236	6

Fitting the mounting bracket

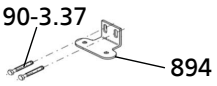


Fig. 17: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 7.4 lbf ft [10 Nm].
   (See outline drawing.)

Fitting the guide rails

CAUTION

Improper installation of guide rails

Damage to the guide rail arrangement!

- ▷ Always adjust the guide rails so that they are in a perfectly vertical position.

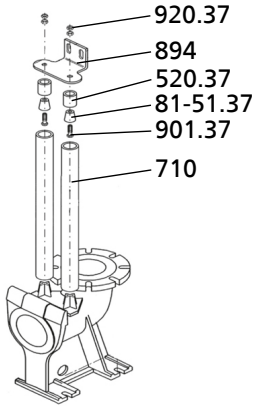


Fig. 18: Fitting the guide rails

1. Place rails 710 onto the conical bosses provided on base elbow 72-1 and position them vertically.
2. Mark the length of rails 710 (up to the lower edge of the mounting bracket), taking into account the adjusting range of the slotted holes in mounting bracket 894.
3. Shorten rails 710 with a 90° cut to the pipe axis. Debur the rails inside and outside.
4. Insert mounting bracket 894 with elastic sleeves 520.37 into guide rails 710 until the mounting bracket rests on the rail ends.
5. Tighten nuts 920.37.
   This pulls clamping sleeves 81-51.37 upwards and expands sleeves 520.37 against the inside pipe diameter.
6. Lock nuts 920.37 with a second nut each and secure them with Loctite 243.

NOTE

For installation depths of more than 19.7 ft [6 m], the scope of supply may include brackets as a middle support for the guide rails. The mounting brackets also serve as spacers between the two guide rails.

Fitting the middle support

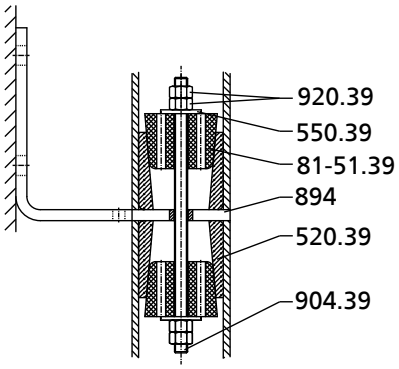


Fig. 19: Fitting the middle support

1. Measure the inside diameter of the guide rails.
2. Expand elastic sleeves 520.39 with clamping sleeves 81-51.39 to the inside diameter of the guide rails by tightening nuts 920.39.
3. Slide the guide rails onto the sleeves and check whether there is a tight fit between the guide rails and the sleeves.
4. Secure the screwed connection of the pipeline by tightening the locknuts.

5.3.1.5 Preparing the pump set

Fitting the claw

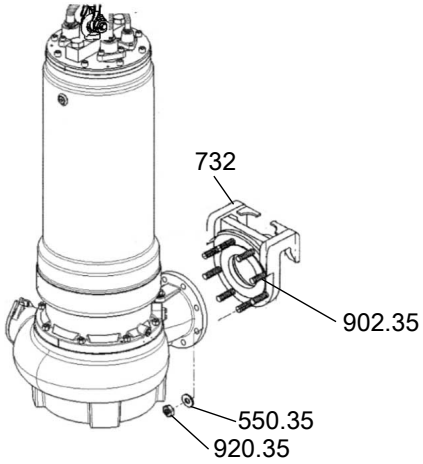


Fig. 20: Fitting the claw

1. Fasten claw 732 to the discharge flange with studs 902.35, discs 550.35 and nuts 920.35.
   Observe the tightening torques.
2. Fit profile joint 410 or round cord 99-6 into the groove of the claw.
   This will seal the base elbow/pump connection.

Attaching the lifting chain/rope

Stationary wet installation

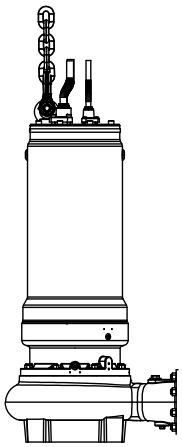


Fig. 21: Attaching the lifting chain/rope – stationary wet installation

1. Attach the lifting chain or rope to the eyebolt opposite the discharge nozzle or to the bail of the pump set.
   This attachment point achieves a forward inclination of the pump set towards the discharge nozzle, which allows the pump claw to hook onto the base elbow.

Connecting the piping

The discharge nozzles can be connected to rigid or flexible pipes.

Installing the pump set

1. Lift the completely assembled pump set with a chain/rope and position it vertically in its prepared place of installation.

5.4 Electrical system

5.4.1 Information for planning the control system

For the electrical connection of the pump set observe the wiring diagram.
The pump set is supplied with power cables; it is wired for DOL starting. Star-delta starting is also possible.

NOTE

When laying a cable between the control system and the pump set's connection point, make sure to have a sufficient number of cores for the sensors. A minimum cross-section of AWG 15 [1.5 mm²] is required.

The motors can be connected to electrical low-voltage grids with rated voltages and voltage tolerances to IEC 60038. The permissible tolerances must be observed.

5.4.1.1 Overload protection

1. Protect the pump set against overloading by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.
2. Set the overload protection device to the rated current specified on the name plate.

5.4.1.2 Level control

DANGER

Pump set running dry

Explosion hazard!

- ▷ Never allow an explosion-proof pump set to run dry.

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

- ▷ Never allow the fluid level to drop below the specified minimum.

Automatic operation of the pump set in a tank requires the use of level control equipment.
Observe the minimum fluid level.

5.4.1.3 Frequency inverter operation

The pump set is suitable for operation on a frequency inverter as per IEC 60034-17.

DANGER

Operation outside the permitted frequency range

Explosion hazard!

- ▷ Never operate an explosion-proof pump set outside the specified range.

DANGER

Incorrect selection and setting of the frequency inverter

Explosion hazard!

▷ Observe the following information on selecting and setting a frequency inverter.

Selection

When selecting a frequency inverter, check the following details:

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the rated current

Start-up

Observe the following instructions for starting up a frequency inverter:

- Ensure short start ramps (maximum 5 seconds).
- Only start speed-controlled operation after 2 minutes at the earliest.
  Pump start-up with long start ramps and low frequency may cause clogging.

Operation

Observe the following limits when operating the pump set on a frequency inverter:

- Only utilize up to 95 % of the motor rating P_2 indicated on the name plate.
- Frequency range 30 to 60 Hz

Electromagnetic compatibility

Operation on a frequency inverter produces interference emissions whose level varies depending on the inverter used (type, interference suppression, make). To prevent the drive system, consisting of a submersible motor and a frequency inverter, from exceeding any given limits always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a submersible motor pump with shielded power cables.

Interference immunity

The submersible motor pump generally meets interference immunity requirements. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the power cables in the plant. No modifications are required on the power/control cable of the submersible motor pump. Suitable analyzing devices must be selected. To monitor the leakage sensor inside the motor using a special relay available from KSB is recommended.

5.4.1.4 Sensors

DANGER

Operating an incompletely connected pump set

Explosion hazard!

Damage to the pump set!

▷ Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.

CAUTION

Incorrect connection

Damage to the sensors!

▷ Observe the limits stated in the following sections of this manual when connecting the sensors.

The pump set features sensors that avoid hazards and damage to the pump set.

NOTE

Reliable and safe operation of the pump within the scope of our warranty is only possible if the sensor signals are properly analyzed as stipulated in this manual.

All sensors are located inside the pump set and are connected to the power cable.
For information on wiring and core identification please refer to the wiring diagrams.
The individual sensors and the limit values to be set are described in the following sections.

5.4.1.4.1 Motor temperature

DANGER

Insufficient cooling

Explosion hazard!

Winding damage!

- ▷ Never operate a pump set without operational temperature monitoring.
- ▷ For explosion-proof pump sets use a thermistor tripping unit with manual reset.

Pump sets with cooling system (installation types D and K):

Four series-connected thermistors (PTC) with terminals 10 and 11 monitor the winding and cooling liquid temperature. Use a thermistor tripping unit with manual reset. For explosion-proof pump sets use a thermistor tripping unit which is approved for monitoring the temperature of explosion-proof motors in "flameproof enclosure" Ex d type of protection.

Pump sets without cooling system (installation types P and S):

The pump set features double monitoring of the winding temperature.
Two bimetal switches (terminals 21 and 22, max. 250 V AC/2 A) serve as temperature control devices which open when the winding temperature is too high. Opening of the contacts must result in the pump set cutting out. Automatic re-starting is permitted.
For explosion-proof pump sets, the three additional, series-connected (PTC) thermistors with terminals 10 and 11 must be used. They must be combined with a thermistor tripping unit with manual reset.

Resistance thermometer (Pt100)

As an option, in addition to the above, the motor can be fitted with resistance thermometers (Pt100) in the winding. These can be used for reading the motor temperature (sensor circuit maximum 6 V/2 mA).

CAUTION

Temperature monitoring equipment not properly connected

Winding damage!

- ▷ Never use the resistance thermometers as a sole means of monitoring the motor temperature.

5.4.1.4.2 Leakage inside the motor

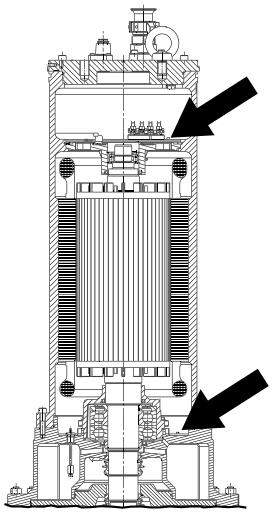
DANGER

Incorrect monitoring of leakage electrode

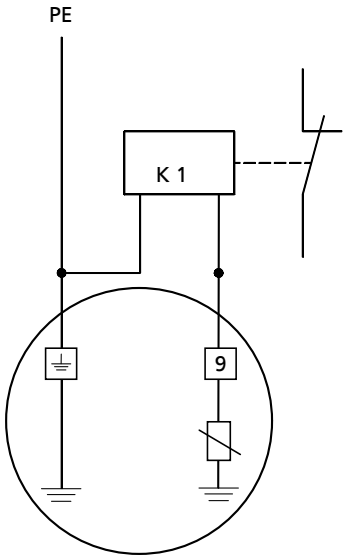
Explosion hazard!

Danger of death from electric shock!

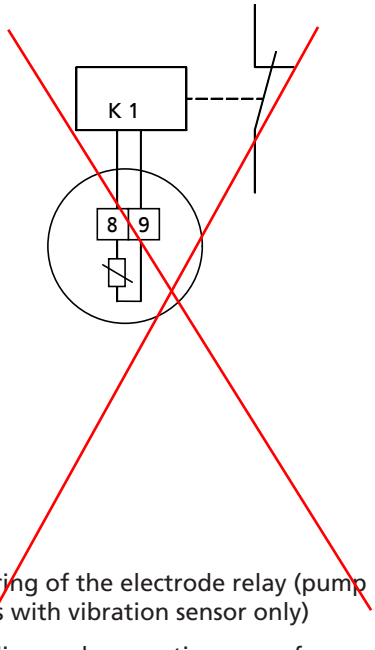
- ▷ Voltages must be < 30 V AC and tripping currents < 0.5 mA.



Position of the electrodes in the motor housing



Wiring of the electrode relay (standard)



Wiring of the electrode relay (pump sets with vibration sensor only)

Electrodes fitted inside the motor monitor the winding and connection space for leakage. Both electrodes are connected in parallel (core identification 9). They must be connected to an electrode relay. Tripping of the electrode relay must result in the pump set cutting out.

The electrode relay (K1) must meet the following requirements:

- Sensor circuit 10 to 30 V AC
- Tripping current ≤ 0.5 mA

Pump sets with vibration sensors

A different wiring system is used for the electrodes of pump sets with vibration sensors.

5.4.1.4.3 Mechanical seal leakage

EQUIPPED BUT NOT MONITORED

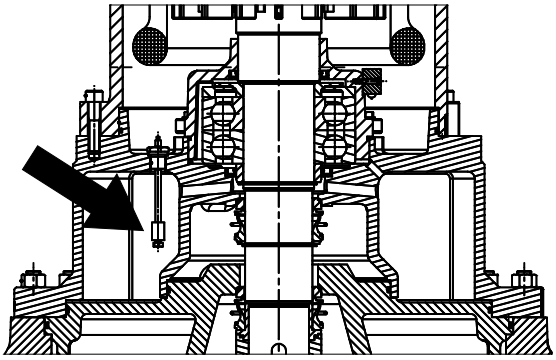


Fig. 31: Float switch

The chamber for mechanical seal leakage is equipped with a float switch (core identification 3 and 4). The contact (maximum 250 V~/2 A) opens when leakage is detected in the leakage chamber. Opening of the contact shall trigger an alarm signal.

5.4.1.4.4 Bearing temperature

EQUIPPED BUT NOT MONITORED

The lower (impeller-end) bearing of the pump set is equipped with a bearing temperature sensor. This sensor is a Pt100 resistance thermometer (core identification 15 and 16). Connect the sensor to a temperature control device with a Pt100 input and 2 separate outputs for two different switching points (sensor circuit maximum 6 V/2 mA).

Set the following limits:

- Alert at 226 °F [130 °C]
- Cut-out of the pump set at 302 °F [150 °C]

As an option, the upper (drive-end) bearing can also be equipped with a temperature sensor (core identification 16 and 17). Its connection and settings are identical with the above. Check in the data sheet whether the pump set features temperature monitoring of the upper bearing.

5.4.1.4.5 Vibrations

As an option, the pump set can be supplied with a vibration sensor in the area of the upper bearing. The sensor is matched to KSB's diagnosis systems.

The vibration sensor measures the root-mean-square value of the radial vibration velocity at the upper bearing. The sensor has an integrated signal converter with a standardized output (4 to 20 mA). This allows simple integration into existing PLC systems or process control systems.

Table 24: Technical data of the sensor

Characteristic	Value
Measuring range	4 - 20 mA at 0 - 0.79 in/s RMS [0 - 20 mm/s]
Measuring error	< 5 %
Long-term stability	+/- 1 % in 10 years
Max. shock load	1.1 lb [500 g]
Frequency range	2 Hz - 1000 Hz
Resonant frequency	18 kHz
Output impedance	200 Ohm max.
Voltage supply	18 - 30 V (smoothed)
Working resistance	50 - 100 Ohm

Connecting the vibration sensor

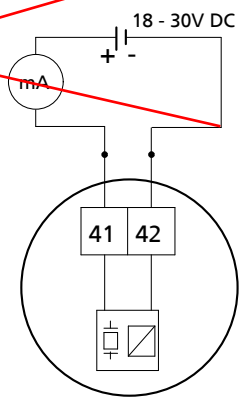


Fig. 32: Connecting the vibration sensor

We recommend the following settings for vibration monitoring with the (optional) vibration sensor fitted at the factory:

- Alert triggered at v_{eff}= 0.43 in/s [11 mm/s] (impeller type E: v_{eff}= 0.55 in/s [14 mm/s])
  - This vibration limit requires remedial action.
  - In general, pump operation may continue until the causes of the change in vibration level have been detected and remedies have been determined.
- Cut-out at v_{eff} = 0.55 in/s [14 mm/s] (impeller type E: v_{eff}= 0.66 in/s [17 mm/s])
  - If this vibration velocity is exceeded, continued pump set operation may result in damage.
  - Suitable action to reduce vibrations should be taken immediately, or the pump set should be switched off.

5.4.2 Electrical connection

DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

- Always have the electrical connections installed by a trained electrician.
- Observe IEC 60364 regulations as well as any locally applicable regulations.

WARNING

Incorrect connection to the mains

Damage to the mains network, short circuit!

- Observe the technical specifications of the local energy supply companies.

CAUTION

Improper routing of power cables

Damage to the power cables!

- Never move the power cables at temperatures below -13 °F [-25 °C].
- Never kink or crush the power cables.
- Never lift the pump set by the power cables.
- Adjust the length of the power cables to the site requirements.

CAUTION

Motor overload

Damage to the motor!

- Protect the motor by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.

For the electrical connection of the pump set observe the wiring diagrams (⇨ Section 9.3, Page 109) in the Annex and the information for planning the control system (⇨ Section 5.4.1, Page 46) .

The pump set is supplied complete with connection cables. Always use all cables provided and connect all marked cores of the control cable.

DANGER

Incorrect connection

Explosion hazard!

- The connection point of the cable ends must be located outside hazardous areas or in an area approved for electrical equipment.

DANGER

Operating an incompletely connected pump set

Explosion hazard!

Damage to the pump set!

- Never start up a pump set with an incompletely connected power cable or non-operational monitoring devices.

DANGER

Connection of damaged power cables

Danger of death from electric shock!

- Check the power cables for damage before connecting them.
- Never connect damaged power cables.
- Replace damaged power cables.

CAUTION

Flow-induced motion

Damage to the power cable!

- Run the power cable upwards without slack.

1. Run the power cables directly upwards without slack, and fasten them.
2. Only remove the protective caps from the power cables immediately before connecting the cables.
3. If necessary, adjust the length of the power cables to the site requirements.
4. After shortening the cables, correctly re-affix the markings of the individual cores at the cable ends.

5.4.2.1 Potential equalization

Wet installation (installation types K, P, S)

The pump set does not have an external PE connection (risk of corrosion).

DANGER

Touching the pump set during operation

Electric shock!

- Make sure that the pump set cannot be touched during operation.

Dry installation (installation type D)

Pump sets for dry installation are provided with an external potential equalization connection. Potential equalization shall be provided for in compliance with IEC 60204.

DANGER

Incorrect connection

Danger of death from electric shock!

- Never operate the pump set without connecting the PE conductor.

Connecting the potential equalization conductor

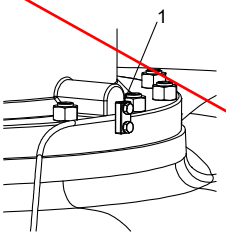


Fig. 33: Connecting the potential equalization conductor

1	Potential equalization conductor

1. Connect the potential equalization conductor to terminal 81-51 provided on the outside of bearing housing 350.
2. Fasten the conductor with hexagon head bolts 901.30 and spring washers 932.30.

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/start-up

6.1.1 Prerequisites for commissioning/start-up

Before commissioning/starting up the pump set, make sure that the following conditions are met:

- The pump set has been properly connected to the electric power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.
- All auxiliary connections required are connected and operational.
- The lubricant has been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the pump (set) to service have been carried out. (⇨ Section 6.4, Page 60)

DANGER

Persons in the tank during pump operation

Electric shock!

Risk of personal injury!

Danger of death from drowning!

▷ Never start up the pump set when there are persons in the tank.

DANGER

Exceeding the operating limits

Pump casing could burst/leak!

Pressurized hot or toxic fluid could escape!

Flying parts!

▷ Maintain an adequate safety distance from pump sets which are in operation.

6.1.2 Priming and venting the pump set (dry installation only - installation type D)

DANGER

Shaft seal failure caused by insufficient lubrication

Hot or toxic fluid could escape!

Damage to the pump!

▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.

1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off element in the suction line.
3. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc).

6.1.3 Start-up

Wet installation (installation types K, P, S)

CAUTION

Re-starting while motor is still running down

Damage to the pump set!

- ▷ Do not re-start the pump set before it has come to a standstill.
- ▷ Never start the pump set while the pump is running in reverse.

✓ The fluid level is sufficiently high.

CAUTION

Start-up against a closed shut-off element

Increased vibrations!

Damage to mechanical seals and bearings!

- ▷ Never start up the pump set against a closed shut-off element.

1. Fully open the discharge line shut-off element, if any.
2. Start up the pump set.

Dry installation (installation type D)

DANGER

Non-compliance with the permissible pressure limits and temperature limits due to pump being operated with the suction and discharge lines closed.

Explosion hazard!

Leakage of hot or toxic fluids!

- ▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.
- ▷ Only start up the pump set against a slightly open discharge-side shut-off element.

DANGER

Excessive temperatures due to insufficient lubrication of shaft seal or excessive gas content in the fluid handled

Damage to the pump set!

- ▷ Never operate the pump set without liquid fill.
- ▷ Prime the pump as per operating instructions.
- ▷ Always operate the pump within the permissible operating range.

WARNING

Hot surface

Risk of burns

- ▷ Never touch a pump set which is in operation.

⚠ WARNING

Very high noise emission during operation

Personal injury!

- ▹ Minimize exposure in the vicinity of the pump set.
- ▹ For required work near running pump sets use appropriate ear protection.

⚠ WARNING

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

Risk of personal injury!

- ▹ Switch off the pump (set) immediately.
- ▹ Eliminate the causes before returning the pump set to service.

✓ The pump, suction line and inlet tank, if any, have been vented and primed with the fluid to be handled.

✓ The priming and venting lines have been closed.

CAUTION

Start-up against open discharge line

Motor overload!

- ▹ Make sure the motor has sufficient power reserves.
- ▹ Use a soft starter.
- ▹ Use speed control.

1. Fully open the shut-off element in the suction head/suction lift line.
2. Slightly open the shut-off element in the discharge line.
3. Start up the motor.
4. Immediately after the pump has reached full rotational speed, slowly open the shut-off element in the discharge line and adjust it to comply with the duty point.

6.1.4 Shutdown (dry installation only - installation type D)

✓ The shut-off element in the suction line is and remains open.

1. Switch off the motor.
2. Immediately after having switched off the motor, close the shut-off element in the discharge line.

NOTE

If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close any auxiliary lines.

CAUTION

Danger of freezing!

Damage to the pump set!

- ▹ Drain the pump set or protect it against freezing.

6.2 Operating limits

DANGER

Non-compliance with operating limits

Damage to the pump set!

- Comply with the operating data indicated in the data sheet.
- Avoid operation against a closed shut-off element.
- Never operate the pump set at ambient or fluid temperatures exceeding those specified in the data sheet or on the name plate.
- Never operate the pump set outside the limits specified below.

6.2.1 Frequency of starts

CAUTION

Excessive frequency of starts

Damage to the motor!

- Never exceed the specified frequency of starts.

To prevent high temperature increases in the motor and excessive loads on the motor, sealing elements and bearings, the frequency of starts shall not exceed 6 starts per hour.

These values apply to mains start-up (DOL or with star-delta contactor, autotransformer, soft starter). These limits do not apply to operation on a frequency inverter.

CAUTION

Re-starting while motor is still running down

Damage to the pump set!

- Do not re-start the pump set before it has come to a standstill.
- Never start the pump set while the pump is running in reverse.

6.2.2 Operation on the power supply mains

DANGER

Non-compliance with permissible supply voltage tolerances

Explosion hazard!

- Never operate an explosion-proof pump (set) outside the specified range.

The maximum permissible deviation in supply voltage is ±10 % of the rated voltage. The voltage difference between the individual phases must not exceed 1 %.

6.2.3 Frequency inverter operation

DANGER

Operation outside the permitted frequency range

Explosion hazard!

- Never operate an explosion-proof pump set outside the specified range.

CAUTION

Pumping solids-laden fluids at reduced speed

Increased wear and clogging!

- Never operate the pump set with flow velocities below approx. 25 $^{in.}/_{s}$ [0.7 $^{m}/_{s}$] in horizontal pipes and approx. 45 $^{in.}/_{s}$ [1.2 $^{m}/_{s}$] in vertical pipes.

Frequency inverter operation of the pump set is permitted in the frequency range from 30 to 60 Hz.

6.2.4 Fluid handled

6.2.4.1 Temperature of the fluid handled

The pump set is designed for transporting liquids. The pump set is not operational under freezing conditions.

CAUTION

Danger of freezing!

Damage to the pump set!

- Drain the pump set or protect it against freezing.

Refer to the maximum permissible fluid temperature and ambient temperature indicated on the name plate and/or in the data sheet.

6.2.4.2 Minimum level of fluid handled

DANGER

Pump set running dry

Explosion hazard!

- Never allow an explosion-proof pump set to run dry.

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

- Never allow the fluid level to drop below the specified minimum.

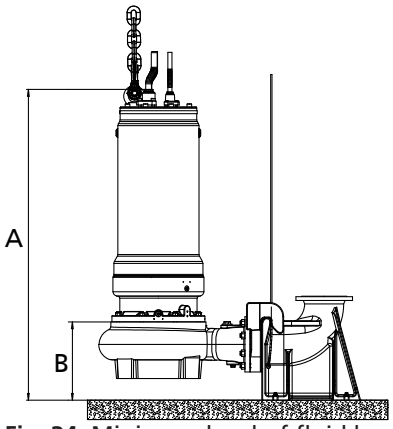


Fig. 34: Minimum level of fluid handled

Pump sets without cooling system (installation types P and S)

Pump sets without cooling system are designed for continuously **submerged** operation. This condition has to be fulfilled for the motor to be cooled sufficiently.

Ready for operation The pump set is ready for operation as soon as the motor is fully submerged (dimension A). Exact dimensions see general arrangement drawing/outline drawing.

The pump can be operated at a lower fluid level for short periods. If the motor is not sufficiently cooled, an internal temperature monitoring device will trip the pump set and automatically re-start it after the motor has cooled down. The fluid level must not drop below the specified minimum (dimension B). Exact dimensions see general arrangement drawing/outline drawing.

→ **Pump sets with cooling system (installation type K)**

Pump sets with cooling system are suitable for continuous operation with the motor **outside the fluid**.

Ready for operation The pump set is ready for operation when the minimum fluid level has been reached (dimension B). Exact dimensions see general arrangement drawing/outline drawing.

NOTE

Compliance with dimension B does not guarantee trouble-free operation of the pump set.
Depending on the pump's duty point, higher fluid levels may be required. Observe the NPSH values indicated in the characteristic curve (see hydraulic characteristic curves).

6.2.4.3 Density of the fluid handled

The power input of the pump changes in proportion to the density of the fluid handled.

CAUTION

Impermissibly high density of fluid handled.

Motor overload!

- ▷ Observe the information on fluid density in the data sheet.
- ▷ Make sure the motor has sufficient power reserves.

6.2.4.4 Abrasive fluids

Do not exceed the maximum permissible solids content specified in the data sheet. When the pump handles fluids containing abrasive substances, increased wear of the hydraulic system and the shaft seal is to be expected. In this case, halve the intervals commonly recommended for servicing and maintenance.

6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

The pump set remains installed

⚠ WARNING

Unintentional starting of pump set

Risk of injury by moving components and shock currents!

- ▷ Make sure that the pump set cannot be started up unintentionally.
- ▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Risk of personal injury!

- ▹ Observe all relevant laws.
- ▹ When draining the fluid take appropriate measures to protect persons and the environment.
- ▹ Decontaminate pumps which handle fluids posing a health hazard.

CAUTION

Danger of frost/freezing

Damage to the pump set!

- ▹ If there is any danger of frost/freezing, remove the pump set from the fluid handled and clean, preserve and store it.

✓ Make sure sufficient fluid is available for the operation check run of the pump set.

1. For prolonged shutdown periods, start up the pump set regularly once every three months for approximately one minute.
   This will prevent the formation of deposits within the pump and the pump intake area.

The pump (set) is removed from the pipe and stored

✓ All safety regulations are observed. (⇨ Section 7.1, Page 61)

1. Clean the pump set.
2. Preserve the pump set.
3. Observe the instructions given in (⇨ Section 3.2, Page 14) .

6.4 Returning to service

For returning the pump set to service, observe the items on commissioning/start-up. (⇨ Section 6.1, Page 54)

Refer to and comply with the operating limits. (⇨ Section 6.2, Page 57)

For returning the pump set to service after storage also follow the instructions for maintenance/inspection.

⚠ WARNING

Failure to re-install or re-activate protective equipment/devices

Risk of personal injury from moving parts or escaping fluid!

- ▹ As soon as the work is completed, re-install and/or re-activate any safety-relevant devices and protective devices.

NOTE

On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.

7 Servicing/Maintenance

7.1 Safety regulations

The operator ensures that all maintenance, all inspections and all installation work is performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.

DANGER

Sparks produced during maintenance work

Explosion hazard!

- Observe the safety regulations in force at the place of installation.
- Never open a pump set that is connected to the power supply.
- Always perform maintenance work on pump sets outside potentially explosive atmospheres.

DANGER

Risk of falling when working at great heights

Danger to life by falling from great heights!

- Do not step onto the pump (set) during installation work or dismantling work.
- Pay attention to safety equipment, such as railings, covers, barriers, etc.
- Observe the applicable local occupational safety regulations and accident prevention regulations.

WARNING

Unintentional starting of pump set

Risk of injury by moving components and shock currents!

- Make sure that the pump set cannot be started up unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

WARNING

Hands, other body parts or foreign objects in the impeller or intake area

Risk of personal injury! Damage to the submersible motor pump!

- Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.
- Check that the impeller can rotate freely.

WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Risk of personal injury!

- Observe all relevant laws.
- When draining the fluid take appropriate measures to protect persons and the environment.
- Decontaminate pumps which handle fluids posing a health hazard.

⚠ WARNING

Hot surface

Risk of personal injury!

- ▷ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Insufficient stability

Risk of crushing hands and feet!

- ▷ During assembly/dismantling, secure the pump (set)/pump parts against tilting or tipping over.

NOTE

Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump (set) with a minimum of maintenance expenditure and work.

NOTE

All maintenance work, service work and installation work can be carried out by KSB Service or authorized workshops. Find your contact in the attached "Addresses" booklet or on the Internet at "www.ksb.com/contact".

Never use force when dismantling and reassembling the pump set.

7.2 Servicing/inspection

KSB recommends the following regular maintenance schedule:

Table 25: Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
Every 4000 operating hours[13)]	Insulation resistance measurement	(⇨ Section 7.2.1.3, Page 63)
	Checking the connection cables	(⇨ Section 7.2.1.2, Page 63)
	Visual inspection of the lifting chain/lifting rope	(⇨ Section 7.2.1.1, Page 63)

13) At least once a year

Maintenance interval	Maintenance work	For details see ...
Every 8000 operating hours[14)]	Checking the sensors	(⇨ Section 7.2.1.4, Page 64)
	Checking the mechanical seal leakage	(⇨ Section 7.2.1.5, Page 65)
	Changing the lubricant or checking the coolant.	(⇨ Section 7.2.3.1.4, Page 73) (⇨ Section 7.2.2, Page 67)
	Lubricating the bearings	(⇨ Section 7.2.3.2, Page 74)
Every 5 years	General overhaul (including coolant change on installation types K and D).	(⇨ Section 7.2.2.3, Page 69)

NOTE

Apply liquid sealant to all screw plugs.

7.2.1 Inspection work

7.2.1.1 Checking the lifting chain/rope

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Inspect the lifting chain/rope as well as their fasteners for any visible damage.
2. Replace any damaged components by original spare parts.

7.2.1.2 Checking the power cables

Visual inspection

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Inspect the power cables for visible damage.
2. Replace any damaged components by original spare parts.

Checking the ground conductor

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Measure the resistance between the ground conductor and chassis ground.
   The electrical resistance must be lower than 1 Ω.
2. Replace any damaged components by original spare parts.

⚠ DANGER

Defective ground conductor

Electric shock!

▷ Never switch on a pump set with a defective ground conductor.

7.2.1.3 Measuring the insulation resistance

Measure the insulation resistance of the motor winding during annual maintenance work.

✓ The pump set has been disconnected in the control cabinet.

✓ Use an insulation resistance measuring device.

✓ The maximum measuring voltage is 500 V (maximum permissible voltage 1000 V).

1. Measure the winding to chassis ground.
   To do so, connect all winding ends together.
2. Measure the winding temperature sensor to chassis ground.
   To do so, connect all core ends of the winding temperature sensors together and connect all winding ends to chassis ground.

14) At least every two years

⇨ The insulation resistance of the core ends to chassis ground must not be lower than 1 MΩ.
If the resistance measured is lower, power cable and motor resistance must be measured separately. Disconnect the power cable from the motor for this purpose.

NOTE

If the insulation resistance of the power cable is lower than 1 MΩ, the power cable is defective and must be replaced.

NOTE

If the insulation resistances measured on the motor are too low, the winding insulation is defective. The pump set must not be returned to service in this case.

7.2.1.4 Checking the sensors

CAUTION

Excessive test voltage

Damage to the sensors!

▹ Use a commercially available ohmmeter to measure the resistance.

The tests described below measure the resistance at the core ends of the control cable. The actual sensor function is not tested.

Temperature sensors in the motor winding

Table 26: Resistance measurement

Measurement between terminals ...	Resistance
	[Ω]
21 and 22[15)]	< 1
10 and 11	200 to 1000
31 and 32[16)]	100 to 120
33 and 34[16)]	100 to 120
35 and 36[16)]	100 to 120

If the specified tolerances are exceeded, disconnect the connection cable at the pump set and repeat the check inside the motor.
If the tolerances are exceeded here, too, the motor part must be opened and overhauled. The temperature sensors are fitted in the stator winding and cannot be replaced.

If the sensors are defective, use the back-up sensors provided at the same place in the stator winding.

Leakage sensors in the motor

Table 27: Resistance measurement of the leakage sensor in the motor

Measurement between terminals ...	Resistance
	[kΩ]
9 and ground conductor (PE)	> 60
8 and 9[17)]	> 60

Lower resistance values would suggest water ingress into the motor. In this case the motor section must be opened and overhauled.

15) Only for pump sets without cooling system, installation type S
16) Optional
17) Only for pump sets with vibration sensor

Float switch (mechanical seal leakage)

Table 28: Resistance measurement of the float switch

Measurement between terminals ...	Resistance
	[Ω]
3 and 4	< 1

If the readings suggest an open switch, check for mechanical seal leakage.

Bearing temperature sensor

Table 29: Resistance measurement of the bearing temperature sensors

Measurement between terminals ...	Resistance
	[Ω]
15 and 16	100 to 120
16 and 17[18)]	100 to 120

Vibration sensor

Table 30: Current measurement at the vibration sensor

Measurement between terminals ...	Current value
41 and 42	Constant 4 mA during standstill

Functional test
Connect the vibration sensor. Measure the current in the measuring circuit with a suitable ammeter.

7.2.1.5 Checking the mechanical seal leakage

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

⚠ WARNING

Excess pressure inside the pump set

Risk of personal injury when opening the pump set!

- ▷ Be careful when opening the inner chambers.

NOTE

Slight wear of the mechanical seal is unavoidable. This will be aggravated by abrasive substances contained in the fluid handled.

18) Optional

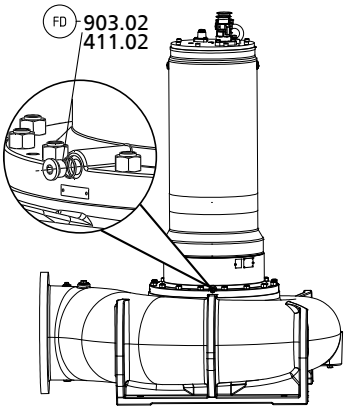


Fig. 35: Checking the mechanical seal leakage

✓ The pump set has been placed in vertical position.

1. Place a suitable container under screw plug 903.02.
2. Remove screw plug 903.02 and joint ring 411.02.
3. Drain the leakage.

NOTE

If more than 5.3 quart [5 liters] of leakage should escape we recommend to replace the mechanical seals.

4. Close screw plug 903.02, fitting joint ring 411.02 and applying liquid sealant.

7.2.1.6 Visual inspection of the pump set through the inspection hole (dry installation only - installation type D)

In the event of clogging the inside of the pump casing and the impeller can be checked via the inspection hole.

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

⚠ WARNING

Hands inside the pump casing

Risk of injuries, damage to the pump!

- ▷ Never insert your hands or any other objects into the pump if the pump has not been de-energized and secured against unintentional start-up.

If there is a problem which requires visual inspection, observe the following instructions:

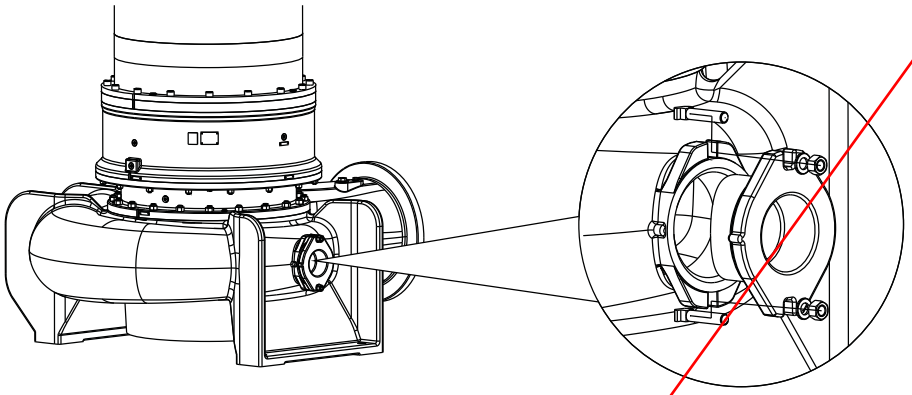


Fig. 36: Inspection hole at the casing

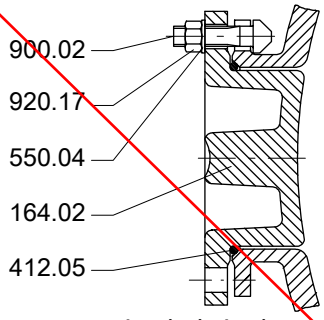


Fig. 37: Inspection hole in the casing

Opening the inspection hole

- Close the shut-off element on the suction side.
- Switch off the drive and make sure it cannot be re-started unintentionally.
- Close the shut-off element on the discharge side.
- Open the drain plug (auxiliary connection 6B). (⇨ Section 5.3.2.2.2, Page 44)
- Collect and dispose of any liquid residues.
- Loosen nuts 920.17 at the inspection hole and remove inspection cover 164.02.
- Perform a visual inspection with a lamp or similar.

Closing the inspection hole

- Fit new O-ring 412.05.
- Fit inspection cover 164.02.
- Place discs 550.04 and nuts 920.17 on screws 900.02 and tighten.
- Observe the instructions on commissioning/start-up.

7.2.2 Coolant (pump sets with cooling system only - installation types D and K)

The pump set's cooling system is filled with an environmentally friendly propylene glycol/water mixture. The coolant additive prevents corrosion in the cooling system and provides frost protection down to -4 °F [-20°C]. The coolant also lubricates the mechanical seals.

7.2.2.1 Coolant quality

	**CAUTION**
	Incorrect coolant mixture Corrosion of the cooling system ▷ Always use the exact coolant mixture.

1.2-propylene glycol/water mixture with corrosion inhibitors for frost protection down to -4 °F [-20 °C]
(e.g. Tyfocor L[19] /water mixture, mixing ratio 38:62)

7.2.2.2 Coolant quantity

Table 31: Coolant quantity [quart and liter]

Size	Impeller type	Motor											
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8		95 4 110 4 80 6 100 6 75 8		130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10		200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12		320 6 360 6 260 8 300 8 230 10 195 12		400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12	
		[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]
100-400	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
100-401	F, K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
150-400	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
150-401	E, F, K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
150-403	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
150-503	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
151-401	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
151-403	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
200-330	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
200-401	E, K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
200-402	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
200-403	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
200-501	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
200-502	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
200-503	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
200-631	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
250-400	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
250-401	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
250-403	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
250-632	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
250-900	K	-	-	-	-	-	-	-	-	132,1	125	142,7	135
300-400	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
300-401	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
300-403	K	29,6	28	31,7	30	63,4	60	-	-	-	-	-	-
300-420	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
300-500	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
300-503	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
300-505	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
350-420	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
350-500	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
350-501	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
350-503	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-

19) Manufacturer: Metalsol Chemie, Magdeburg, Germany

Size	Impeller type	Motor											
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8		95 4 110 4 80 6 100 6 75 8		130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10		200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12		320 6 360 6 260 8 300 8 230 10 195 12		400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12	
		[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]
350-632	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
350-633	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
350-636	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
350-710	K	-	-	-	-	-	-	95,1	90	116,2	110	126,8	120
350-713	K	-	-	-	-	-	-	95,1	90	116,2	110	126,8	120
400-500	K	42,3	40	44,4	42	79,3	75	84,5	80	-	-	-	-
400-632	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
400-900	K	-	-	-	-	-	-	-	-	132,1	125	142,7	135
401-710	K	-	-	-	-	-	-	95,1	90	116,2	110	126,8	120
401-713	K	-	-	-	-	-	-	95,1	90	116,2	110	126,8	120
500-634	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
500-640	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
500-641	K	-	-	-	-	95,1	90	95,1	90	116,2	110	126,8	120
501-710	K	-	-	-	-	-	-	-	-	116,2	110	126,8	120
501-900	K	-	-	-	-	-	-	-	-	132,1	125	142,7	135
600-520	K	-	-	-	-	95,1	90	95,1	90	-	-	-	-
600-710	K	-	-	-	-	-	-	95,1	90	116,2	110	126,8	120
700-901	K	-	-	-	-	-	-	-	-	132,1	125	142,7	135
700-902	K	-	-	-	-	-	-	-	-	132,1	125	142,7	135

7.2.2.3 Changing the coolant

⚠ WARNING

Coolants and supplies which pose a health hazard or are hot

Hazard to persons and the environment!

- ▷ When draining the fluid take appropriate measures to protect persons and the environment.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

⚠ WARNING

Cooling liquid spurting out due to excess pressure in the cooling liquid chamber at operating temperature!

Risk of injuries by parts flying off and escaping cooling liquid!

- ▷ Open the screw plug of the cooling liquid chamber very carefully.

Draining the coolant

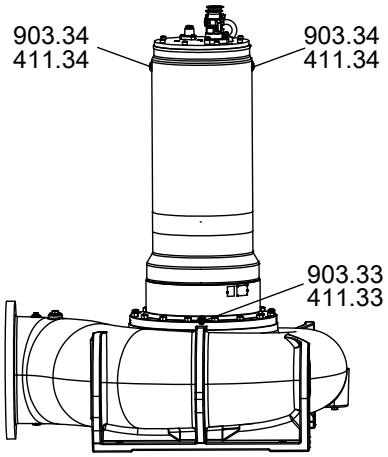


Fig. 38: Coolant filler openings

✓ The pump set has been placed in a vertical position.

1. Place a suitable container under screw plug 903.33. (Coolant quantity (⇨ Section 7.2.2.2, Page 68))
2. Unscrew both screw plugs 903.34 with joint rings 411.34 at the coolant filler openings (opposed by 180°).
3. Undo screw plug 903.33 with joint ring 411.33 and drain off the coolant.

NOTE

The drain plug is not located at the lowest point of the cooling system. To fully drain all coolant, proceed as follows:

4. **Option 1:** Insert a suction pump through the coolant filler opening and pump off the remaining coolant.
   Option 2: Place the pump set in horizontal position to fully drain the cooling system.

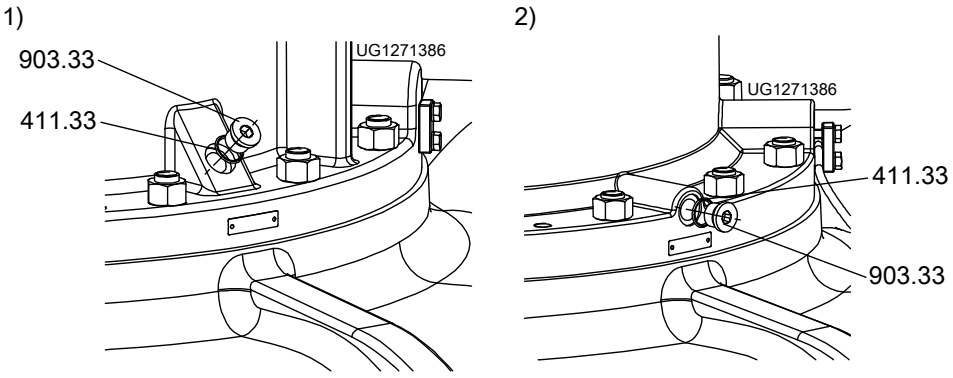


Fig. 39: Coolant draining options

NOTE

The coolant is bright and transparent in appearance. A slight discoloration, caused by the running–in process of new mechanical seals or small amounts of leakage from the fluid pumped, has no detrimental effect. However, if the coolant is severely contaminated by the fluid handled, this suggests a defect at the mechanical seals.

Topping up the coolant

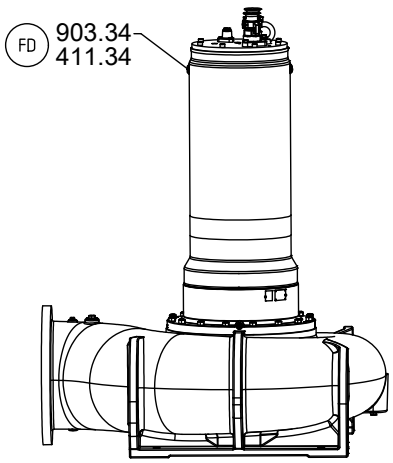


Fig. 40: Topping up the coolant

✓ The pump set has been placed in a vertical position.

1. Close screw plugs 903.33 with joint ring 411.33.
2. Fill coolant through the filler opening (screw plug 903.34) until it overflows.
3. Pump off 1 liter of coolant with a suction pump or drain it via screw plug 903.33.
   ⇨ The coolant level must be approximately 3 cm below the filler opening.
4. Close screw plug 903.34 again, fitting a new joint ring 411.34.

Table 32: Key to the symbols and codes

Symbol	Description
FD	Always apply a **liquid sealing agent** (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

7.2.3 Lubrication and lubricant change

7.2.3.1 Lubricating the mechanical seal (pump sets without cooling system only - installation types S and P)

7.2.3.1.1 Intervals

Replace the lubricant every 8000 operating hours but at least every 2 years.

7.2.3.1.2 Lubricant quality

The lubricant chamber is filled at the factory with environmentally friendly, non-toxic lubricant of medicinal quality (unless otherwise specified by the customer).
The following lubricants can be used to lubricate the mechanical seals:

Table 33: Lubricant quality

Description	Properties	
Paraffin oil or white oil. Alternative: motor oil grades SAE 10W to SAE 20W	Kinematic viscosity at 104 °F [40 °C]	< 0.065 ft/s² [< 20 mm/s²]
	Flash point (to Cleveland)	> 320 °F [> 160 °C]
	Solidification point (pour point)	< -5 °F [< -15 °C]

Recommended lubricants:

- Merkur WOP 40 PB, made by SASOL
- Merkur white oil Pharma 40, made by DEA
- Thin-bodied paraffin oil No. 7174, made by Merck
- Equivalent brands of medical quality, non-toxic
- Water-glycol mixture

Draining the lubricant

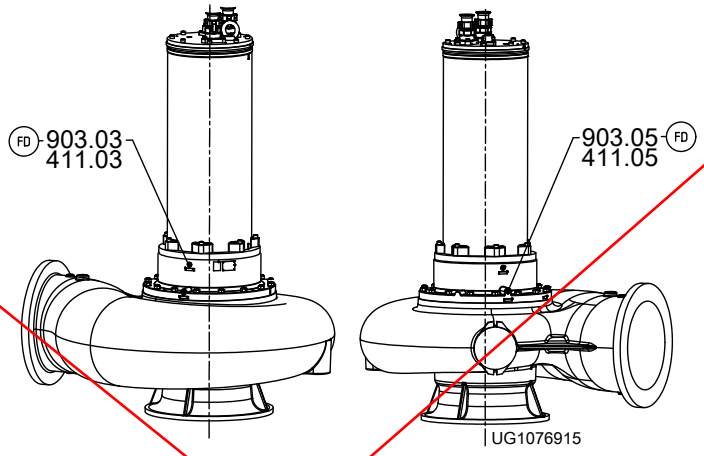


Fig. 41: Draining and re-filling the lubricant

✓ The pump set has been placed in a vertical position.

1. Place a suitable container under screw plug 903.05.
2. Unscrew and remove screw plug 903.03 with joint ring 411.03.
3. Undo screw plugs 903.05 with joint ring 411.05 and drain off the lubricant.

Topping up the lubricant

✓ The pump set has been placed in a vertical position.

1. Position the pump set as shown.
2. Close screw plugs 903.05 with joint ring 411.05.
3. Pour lubricant into lubricant filler opening 903.03 until the lubricant reservoir overflows.
4. Fit screw plug 903.03 together with a new joint ring 411.03.

Table 35: Key to the symbols and codes

Symbol	Description
FD	Always apply a **liquid sealing agent** (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

7.2.3.2 Lubricating the rolling element bearings

The upper (radial) rolling element bearing of the pump set is grease-packed and maintenance-free. The lower bearings can be re-lubricated; they need to be re-lubricated as part of the maintenance work.

7.2.3.2.1 Grease quality

CAUTION

Mix of different grease types

Damage to the pump set!

- ▷ Make sure to use the right type of grease.
- ▷ Never mix different types of grease.

The following greases can be used to lubricate the rolling element bearings:

Table 36: Lubricant characteristics

Type	Base oil	Thickener	NLGI grade (DIN 51518)	Worked penetration at 77 °F [25 °C], 0.1 mm (DIN 51818)	Drop point (ISO 2176)	Application temperature range [°C]	Viscosity at 104 °F [40 °C] (DIN 51562)
A	Mineral oil	Lithium complex soap	2 or 3	220 to 295	> 527 °F [>275 °C]	-4 °F to 320 °F [-20 °C to +160 °C]	≤120
B	Ester oil	Polyurea	2	265 to 295	>482 °F [>250 °C]	-40 °F to +356 °F [-40 °C to +180 °C]	100

The re-lubrication and maintenance intervals apply to the grease type originally used by the manufacturer:

- Type A
  - Multis Complex EP2, made by TOTAL
- Type B
  - Klüberquiet BQH 72-102, made by Klüber Lubrication München KG

7.2.3.2.2 Grease quantity for re-lubrication

NOTE

Always use grease type B for motors in stainless steel design (..NC.. motors).

Table 37: Grease quantity

Motor	35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	130 4 155 4...-S 155 4...-P 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10	155 4...-K 155 4...-D	200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 10	320 6 360 6 260 8 300 8 230 10 195 12	400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12
Grease quantity	~~2.5 oz [70 g]~~	~~3.2 oz [90 g]~~	3.9 oz [110 g]	~~3.9 oz [110 g]~~	~~5.6 oz [160 g]~~	~~6.3 oz [180 g]~~	~~6.3 oz [180 g]~~
Grease type[20]	~~Type A~~	~~Type A~~	Type A	~~Type B~~	~~Type B~~	~~Type B~~	~~Type B~~

7.2.3.2.3 Re-lubrication

Lubricating nipple

An encapsulated water-tight lubricating nipple allows re-lubrication of the angular contact ball bearings without opening the pump.

DANGER

Dry running

Explosion hazard!

▷ Re-lubricate explosion-proof pump sets outside potentially explosive atmospheres.

20) Also see the section on grease quality.

	**⚠ WARNING** **Hands inside the pump casing** Risk of injuries, damage to the pump! ▷ Never insert your hands or any other objects into the pump if the pump has not been de-energized and secured against unintentional start-up.

	**CAUTION** **Incomplete re-lubrication** Bearing damage! ▷ Always re-lubricate the bearings with the pump set in operation.

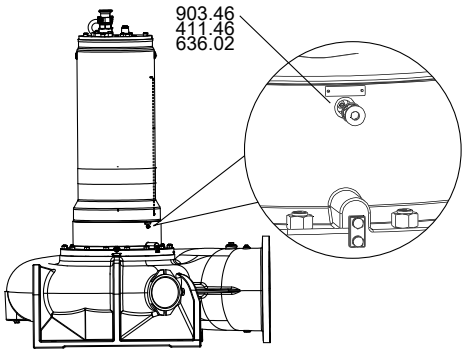


Fig. 42: Lubricating nipple

✓ The pump set has been positioned on a level surface.

✓ The pump set is secured against tipping over.

1. Remove screw plug 903.46 and joint ring 411.46.
2. Connect the pump set to the power supply.

	**CAUTION** **Pump set running dry** Increased vibrations! Damage to mechanical seals and bearings! ▷ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

3. Start up the pump set.
4. Fill in grease via lubricating nipple 636.02.
5. Disconnect the pump set from the power supply again and make sure it cannot be started unintentionally.
6. Close screw plug 903.46 with joint ring 411.46 again.

7.3 Drainage/cleaning

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▹ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▹ Wear safety clothing and a protective mask if required.
- ▹ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Always flush the pump if it has been used for handling noxious, explosive, hot or other hazardous fluids.
2. Always flush and clean the pump before transporting it to the workshop. Always complete and enclose a certificate of decontamination when returning the pump set. (⇨ Section 10, Page 122)

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of personal injury!

- ▹ Always have repair work and maintenance work performed by specially trained, qualified personnel.

⚠ WARNING

Hot surface

Risk of personal injury!

- ▹ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▹ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Observe the general safety instructions and information.

For dismantling and reassembly observe the general assembly drawing.

In the event of damage you can always contact our service staff.

⚠ DANGER

Insufficient preparation of work on the pump (set)

Risk of personal injury!

- ▹ Properly shut down the pump set.
- ▹ Close the shut-off elements in the suction line and discharge line.
- ▹ Drain the pump and release the pump pressure.
- ▹ Shut off any auxiliary feed lines.
- ▹ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Components with sharp edges

Risk of cutting or shearing injuries!

- ▹ Always use appropriate caution for installation and dismantling work.
- ▹ Wear work gloves.

7.4.2 Preparing the pump set

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 77) have been observed/ carried out.

1. Interrupt the power supply and secure the pump against unintentional start-up.
2. On pump sets without cooling system (installation types S and P) drain the lubricant.
3. On pump sets with cooling system (installation types D and K) drain the cooling liquid.
4. Drain the leakage chamber and leave it open for the duration of the disassembly.

7.4.3 Dismantling the pump section

Dismantle the pump section in accordance with the relevant general assembly drawing.

7.4.3.1 Removing the back pull-out unit

1. Undo screwed connections 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
2. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over or rolling off.

7.4.3.2 Removing the impeller

The procedures for removing the impeller differ depending on the hydraulic system and motor.

Table 38: Impeller fastening elements

Size	Impeller type	Tapered fit		Cylindrical fit					
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10	200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12	320 6 360 6 260 8 300 8 230 10 195 12	400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12
100-400	K	M20	M20	-	-	-	-	-	-
100-401	F	M20	M20	-	-	-	-	-	-
100-401	K	M20	M20	-	-	-	-	-	-
150-400	K	M20	M20	-	-	M85 × 2	-	-	-
150-401	F	M20	M20	-	-	-	-	-	-

Size	Impeller type	Tapered fit		Cylindrical fit					
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10	200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12	320 6 360 6 260 8 300 8 230 10 195 12	400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12
150-401	E	M20	M20	-	-	M85 × 2	-	-	-
150-401	K	M20	M20	-	-	M85 × 2	-	-	-
150-403	K	M20	M20	-	-	M85 × 2	-	-	-
151-403	K	M20	M20	-	-	M85 × 2	-	-	-
150-503	K	-	-	M85 × 2	M85 × 2	M85 × 2	M100 × 2	-	-
200-330	K	M20	M20	-	-	M85 × 2	-	-	-
200-401	E	M20	M20	-	-	M85 × 2[21)]	-	-	-
200-401	K	M20	M20	-	-	M85 × 2	-	-	-
200-402	K	M20	M20	-	-	M85 × 2	-	-	-
200-403	K	M20	M20	-	-	M85 × 2	-	-	-
200-501	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
200-502	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
200-503	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
200-631	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
250-400	K	M20	M20	-	-	M85 × 2	-	-	-
250-401	K	M20	M20	-	-	M85 × 2	-	-	-
250-403	K	M20	M20	-	-	M85 × 2	-	-	-
250-632	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
250-900	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
300-400	K	M20	M20	-	-	M85 × 2	-	-	-
300-401	K	M20	M20	-	-	-	-	-	-
300-403	K	M20	M20	-	-	M42 × 1.5	-	-	-
300-420	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
300-500	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
300-505	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
350-420	K	-	-	M85 × 2	M85 × 2	M85 × 2	M100 × 2	-	-
350-500	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
350-501	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
350-503	K	-	-	M85 × 2	M85 × 2	M85 × 2	M100 × 2	-	-
350-632	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
350-633	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
350-636	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
350-710	K	-	-	-	-	-	-	-	-
350-713	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
400-500	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-

21) For impeller diameter 373 mm M75 × 2

Size	Impeller type	Tapered fit		Cylindrical fit					
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10	200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12	320 6 360 6 260 8 300 8 230 10 195 12	400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12
400-630	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
400-632	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
400-900	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
401-710	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
401-713	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
500-632	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	M100 × 2	M100 × 2
500-634	K	-	-	-	-	M125 × 2	~~M125 × 2~~	~~M125 × 2~~	~~M125 × 2~~
500-640	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	M100 × 2	M100 × 2
501-710	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
501-900	K	-	-	-	-	M160 × 3	M160 × 3	M160 × 3	M160 × 3
600-520	K	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
700-901	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
700-902	K	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2

NOTE

Pull off the impeller using a special impeller removal tool or forcing screw.

NOTE

The special impeller removal tool and forcing screw are not included in the scope of supply. They can be ordered separately from KSB.

Table 39: Special impeller fitting and removal tool

Size	Impeller type	Tapered fit		Cylindrical fit					
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10	200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12	320 6 360 6 260 8 300 8 230 10 195 12	400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12
100-400	K	M24	ADS5	-	-	-	-	-	-
100-401	F	M24	ADS5	-	-	-	-	-	-
100-401	K	M24	ADS5	-	-	-	-	-	-
150-400	K	M24	ADS5	-	-	AV3	-	-	-
150-401	F	M24	ADS5	-	-	-	-	-	-
150-401	E	M24	ADS5	-	-	AV3	-	-	-
150-401	K	M24	ADS5	-	-	AV3	-	-	-
150-403	K	M24	ADS5	-	-	AV3	-	-	-
150-503	K	-	-	AV3	AV3	AV3	AV5	-	-
151-403	K	M24	ADS5	-	-	AV3	-	-	-
200-330	K	M24	ADS5	-	-	AV3	-	-	-
200-401	E	M24	ADS5	-	-	AV3	-	-	-
200-401	K	M24	ADS5	-	-	AV3	-	-	-
200-402	K	M24	ADS5	-	-	AV3	-	-	-
200-403	K	M24	ADS5	-	-	AV3	-	-	-
200-501	K	-	-	AV5	AV5	AV5	AV5	-	-
200-502	K	-	-	AV5	AV5	AV5	AV5	-	-
200-503	K	-	-	AV5	AV5	AV5	AV5	-	-
200-631	K	-	-	-	-	AV4	AV4	AV4	AV4
250-400	K	M24	ADS5	-	-	AV3	-	-	-
250-401	K	M24	ADS5	-	-	AV3	-	-	-
250-403	K	M24	ADS5	-	-	AV3	-	-	-
250-632	K	-	-	-	-	AV4	AV4	AV4	AV4
250-900	K	-	-	-	-	AV4	AV4	AV4	AV4
300-400	K	M24	ADS5	-	-	AV3	-	-	-
300-401	K	M24	ADS5	-	-	-	-	-	-
300-403	K	M24	ADS5	-	-	ADS6	-	-	-
300-420	K	-	-	AV5	AV5	AV5	AV5	-	-
300-500	K	-	-	-	-	AV4	AV4	AV4	AV4
300-505	K	-	-	AV5	AV5	AV5	AV5	-	-
350-420	K	-	-	AV3	AV3	AV3	AV5	-	-
350-500	K	-	-	-	-	AV4	AV4	AV4	AV4
350-501	K	-	-	-	-	AV4	AV4	AV4	AV4
350-503	K	-	-	AV3	AV3	AV3	AV5	-	-
350-632	K	-	-	-	-	AV4	AV4	AV4	AV4
350-633	K	-	-	-	-	AV4	AV4	AV4	AV4

Size	Impeller type	Tapered fit		Cylindrical fit					
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10	200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12	320 6 360 6 260 8 300 8 230 10 195 12	400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12
350-636	K	-	-	-	-	AV4	AV4	AV4	AV4
350-710	K	-	-	-	-	-	-	-	-
350-713	K	-	-	-	-	-	AV4	AV4	AV4
400-500	K	-	-	AV5	AV5	AV5	AV5	-	-
400-630	K	-	-	-	-	AV4	AV4	AV4	AV4
400-632	K	-	-	-	-	AV4	AV4	AV4	AV4
400-900	K	-	-	-	-	AV4	AV4	AV4	AV4
401-710	K	-	-	-	-	AV4	AV4	AV4	AV4
401-713	K	-	-	-	-	AV4	AV4	AV4	AV4
500-632	K	-	-	AV5	AV5	AV5	AV5	AV5	AV5
500-634	K	-	-	-	-	AV4	AV4	AV4	AV4
500-640	K	-	-	AV5	AV5	AV5	AV5	AV5	AV5
501-710	K	-	-	-	-	AV4	AV4	AV4	AV4
501-900	K	-	-	-	-	AV7	AV7	AV7	AV7
600-520	K	-	-	AV5	AV5	AV5	AV5	-	-
700-901	K	-	-	-	-	AV4	AV4	AV4	AV4
700-902	K	-	-	-	-	AV4	AV4	AV4	AV4

Impeller fastening elements M20

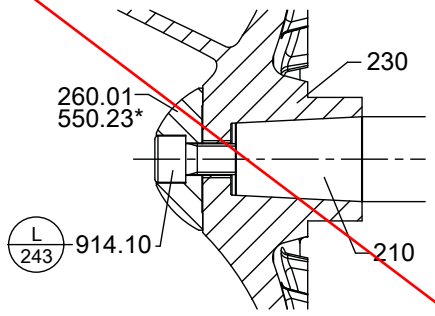


Fig. 43: Removing the impeller

*: On specific designs only

✓ The back pull-out unit has been placed in a horizontal position on wooden supports and secured against rolling off.

✓ The lubricant and any leakage have been drained.

1. Undo and remove hexagon socket head cap screw 914.10.
   ⇨ The impeller/shaft connection is a tapered fit.
2. Remove impeller hub cap 260.01 or disc 550.23.
   ⇨ For dismantling of the impeller, a jacking thread is provided at the impeller hub.

3. Screw in the forcing screw and remove impeller 230.

Impeller fastening elements M42 × 1.5

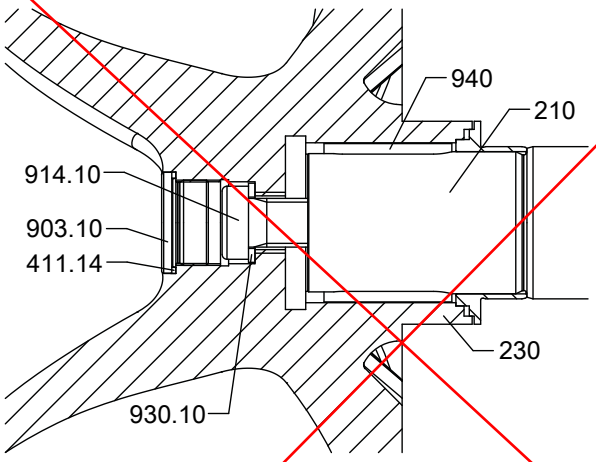


Fig. 44: Impeller fastening elements M42 × 1.5

1. Unscrew screw plug 903.10 (right-hand thread).
2. Remove joint ring 411.14.
3. Undo hexagon socket head cap screw 914.10. Remove it together with safety device 930.10.
   ⇨ For dismantling of the impeller, a jacking thread is provided at the impeller hub.
4. Screw in the forcing screw and remove impeller 230.
5. Remove keys 940.01.

Impeller fastening elements M85 × 2; M100 × 2; M125 × 2; M160 × 3

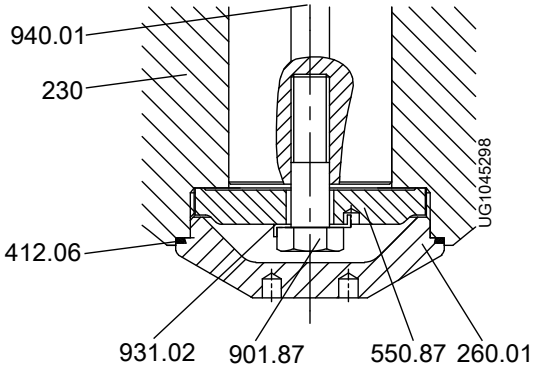


Fig. 45: Impeller fastening elements

1. Unscrew impeller hub cap 260.01 using a special wrench (right-hand thread).
2. Remove O-ring 412.06.
3. Bend open lock washer 931.02, undo hexagon head bolt 901.87 and remove them together with disc 550.87.
4. Pull off impeller 230 with a special impeller fitting and removal tool.

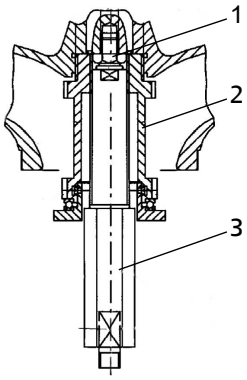


Fig. 46: Special impeller fitting and removal tool

5. Screw hexagon head bolt 1 into the shaft end to prevent any damage to the shaft thread.
6. Screw part 2 into the impeller.
7. Screw fully threaded stud 3 into part 2 and pull off the impeller.
8. Remove key 940.01.

Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)

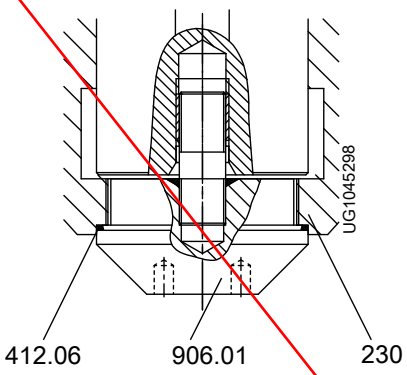


Fig. 47: Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)

1. Unscrew impeller screw 906.01 using a special wrench (right-hand thread).
2. Remove O-ring 412.06.
3. Pull off impeller 230 with a special impeller fitting and removal tool.

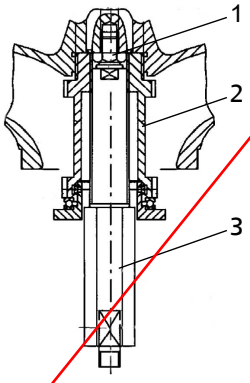


Fig. 48: Special impeller fitting and removal tool

4. Screw hexagon head bolt 1 into the shaft end to prevent any damage to the shaft thread.
5. Screw part 2 into the impeller.

6. Screw fully threaded stud 3 into part 2 and pull off the impeller.
7. Remove key 940.01.

Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)

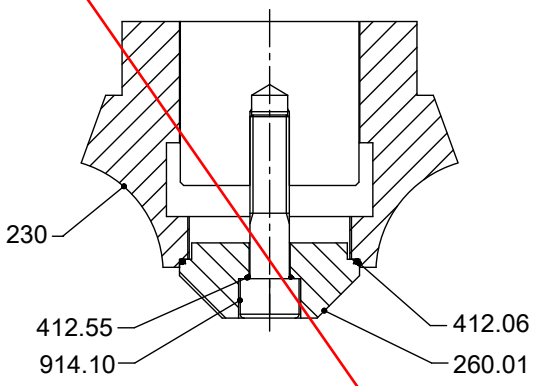


Fig. 49: Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)

1. Unscrew hexagon socket head cap screw 914.10 (right-hand thread).
2. Remove impeller hub cap 260.01 with O-ring 412.55 and O-ring 412.06.
3. Pull off impeller 230 with a special impeller fitting and removal tool.

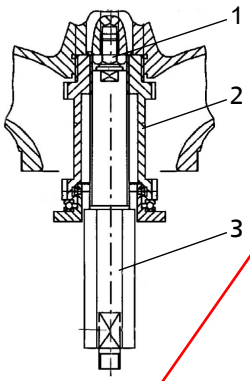


Fig. 50: Special impeller fitting and removal tool

4. Screw hexagon head bolt 1 into the shaft end to prevent any damage to the shaft thread.
5. Screw part 2 into the impeller.
6. Screw fully threaded stud 3 into part 2 and pull off the impeller.
7. Remove keys 940.01.

7.4.3.3 Removing the mechanical seal

Remove the mechanical seal in accordance with the general arrangement drawings. (⇨ Section 9.5, Page 119)

7.4.3.3.1 Removing the pump-end mechanical seal

✓ The back pull-out unit and the impeller have been removed as described above.

1. Pull the rotating assembly of mechanical seal 433.02 and spacer sleeve 525 off shaft 210.
2. Remove discharge cover 163 from bearing housing 350.
3. Press the stationary seat of mechanical seal 433.02 out of discharge cover 163.

7.4.3.3.2 Removing the drive-end mechanical seal

✓ The back pull-out unit, impeller and pump-end mechanical seal have been removed as described

1. Remove locking ring 515 or circlip 932.03 and support disc 550.05 or loosen grub screw 904.01.
2. Pull the rotating assembly of mechanical seal 433.01 off shaft 210.

7.4.3.4 Removing the cooling jacket

CAUTION

Removing the cooling jacket without using eyebolts

Damage to the cooling jacket!

▷ Always use eyebolts to pull off the cooling jacket.

1. Screw two eyebolts (G 1/2 and R 1/2, respectively) into the filler openings.
2. Attach hoisting tackle to the eyebolts.
3. Use the hoisting tackle to pull the cooling jacket upwards and remove it from the pump set.

7.4.4 Dismantling the motor section

NOTE

Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.

NOTE

The motors of explosion-proof pump sets are supplied in "flameproof enclosure" type of protection. Any work on the motor section which could affect explosion protection, such as re-winding and repair work involving machining, must be inspected by an approved expert or performed by the motor manufacturer. No modifications must be made to the internal configuration of the motor space. Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions.

When dismantling the motor section and the connection cable make sure that the cores/terminals are clearly marked for future reassembly.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Components with sharp edges

Risk of cutting or shearing injuries!

- ▷ Always use appropriate caution for installation and dismantling work.
- ▷ Wear work gloves.

CAUTION

Improper reassembly

Damage to the pump!

- ▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.
- ▷ Use original spare parts only.

NOTE

Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Refer to the flamepath positions specified in the Annex.

Sequence

Always reassemble the pump set in accordance with the corresponding general assembly drawing.

Sealing elements

- O-rings
  - Check O-rings for any damage and replace by new O-rings, if required.
  - Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.
- Assembly adhesives
  - Avoid the use of assembly adhesives, if possible.

Tightening torques

When reassembling the pump set, tighten all screws/bolts as indicated.
In addition, secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).

7.5.2 Reassembling the motor section

NOTE

Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Only use original spare parts made by KSB for explosion-proof pumps. Observe the flamepath positions specified in the Annex. Secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).

⚠ DANGER

Wrong screws/bolts

Explosion hazard!

- ▷ Always use the original screws/bolts for assembling an explosion-proof pump set.
- ▷ Never use screws/bolts of different dimensions or of a lower property class.

7.5.3 Reassembling the pump section

7.5.3.1 Fitting the mechanical seal

Observe the following to ensure trouble-free operation of the mechanical seal:

- Only remove the protective wrapping of the contact faces immediately before assembly takes place.
- Make sure the surface of the shaft is absolutely clean and undamaged.
- Immediately before installing the mechanical seal, wet the contact faces with a drop of oil.
- For easier installation of bellows-type mechanical seals, wet the inside diameter of the bellows with soapy water (not oil).
- To prevent any damage to the rubber bellows, place a thin foil (of approximately 0.0039 to 0.0118 inch [0.1 to 0.3 mm] thickness) around the free shaft stub. Slip the rotating assembly over the foil into its installation position. Then remove the foil.

✓ The shaft and rolling element bearings have been properly fitted in the motor.

1. Slide drive-end mechanical seal 433.01 with support disc 550.05 onto shaft 210 and secure with circlip 932.03, or slide drive-end mechanical seal 433.01 onto shaft 210 and secure with grub screws 904.01.
2. Insert O-rings 412.04/412.35 and 412.15/412.11 into discharge cover 163, and press them into bearing housing 350 as far as they will go.
3. Slide pump-end mechanical seal 433.02 with spacer sleeve 525.04 onto shaft 210.

7.5.3.2 Fitting the impeller

The procedures for fitting the impeller differ depending on the hydraulic system and motor. (⇨ Section 7.4.3.2, Page 78)

Impeller fastening elements M20

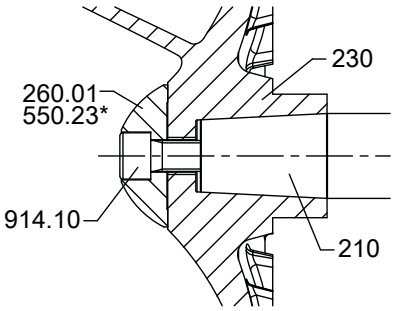


Fig. 51: Fitting the impeller

*: On specific designs only

	NOTE
	For bearing brackets with tapered fit make sure that the tapered fit of impeller and shaft is undamaged and assembled free from grease.

✓ The shaft and rolling element bearings have been properly installed.

✓ The mechanical seals have been properly installed.

1. Slide impeller 230 onto the shaft end.
2. Apply Loctite 243 as thread-locking agent to the thread of the impeller screw.
3. Screw in impeller screw 914.10 and disc 550.23, if any. Tighten with a torque wrench. Observe the tightening torques.

Impeller fastening elements M42 × 1.5

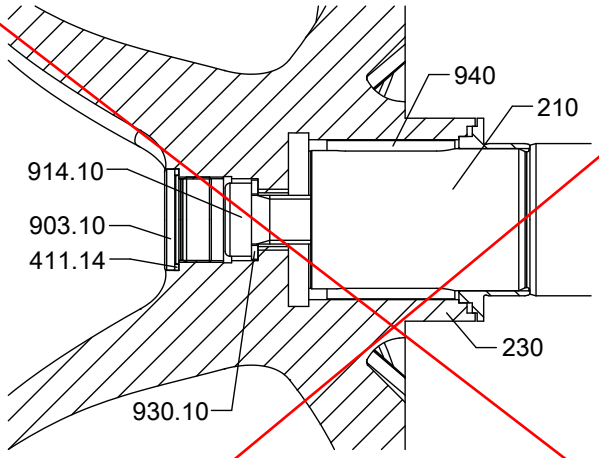


Fig. 52: Impeller fastening elements M42 × 1.5

1. Insert key 940.01.
2. Slide impeller 230 onto the shaft end.
3. Screw in hexagon socket head cap screw 914.10 including safety device 930.10 and tighten with a torque wrench. Observe the tightening torques.
4. Insert joint ring 411.14.
5. Screw in screw plug 903.10 (right-hand thread).

Impeller fastening elements M85 × 2, M125 × 2, M100 × 2, M160 × 3

✓ The back pull-out unit has been placed in a horizontal position on wooden supports. It has been secured against rolling off.

✓ The mechanical seals and keys have been properly installed.

1. Insert key 940.01.
2. Pull on impeller 230 with a special impeller fitting and removal tool.

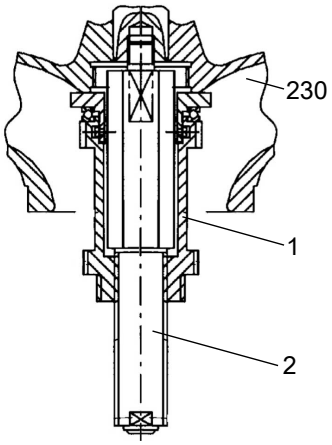


Fig. 53: Special impeller fitting and removal tool.

3. Screw part 2 of the special impeller fitting and removal tool into the shaft end of the pump set.
4. Screw part 1 to fully threaded stud part 2.

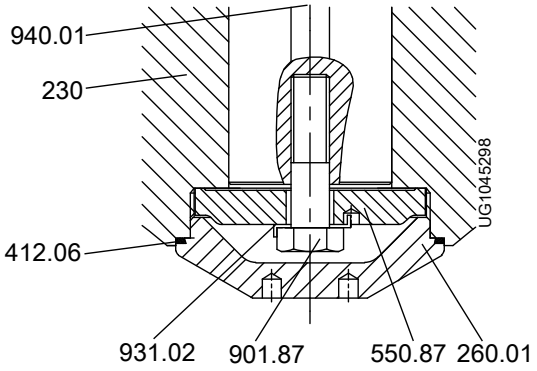


Fig. 54: Impeller fastening elements

5. Screw in hexagon head bolt 901.87 with disc 550.87. Bend over lock washer 931.02.
6. Insert O-ring 412.06.
7. Screw in impeller hub cap 260.01 using a special wrench (right-hand thread).

Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)

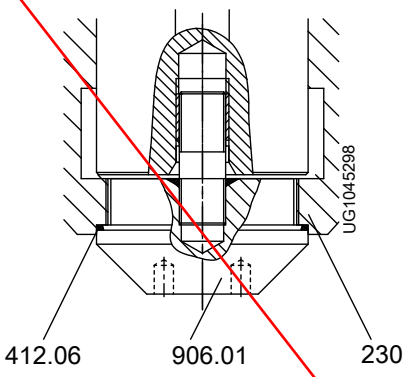


Fig. 55: Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)

1. Insert key 940.01.
2. Mount impeller 230 with a special impeller fitting and removal tool.

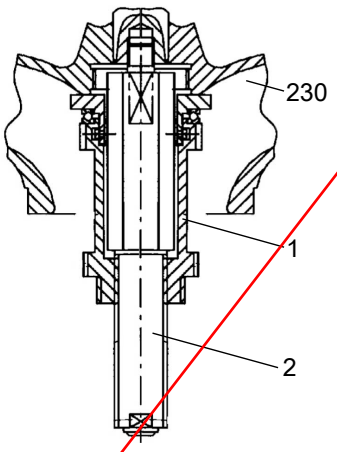


Fig. 56: Special impeller fitting and removal tool

3. Screw part 2 of the special impeller fitting and removal tool into the shaft end of the pump set.
4. Screw part 1 to fully threaded stud part 2.

5. Insert O-ring 412.06.
6. Screw in impeller screw 906.01 using a special wrench (right-hand thread).

Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)

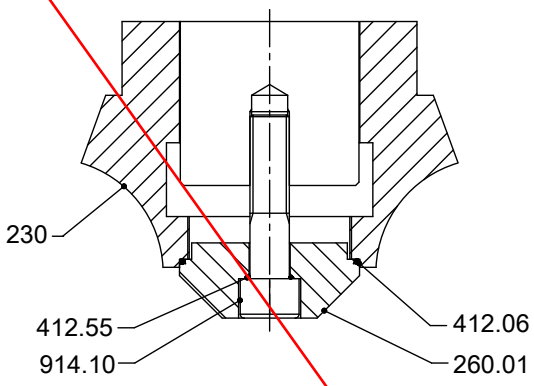


Fig. 57: Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)

1. Insert keys 940.01.
2. Fit impeller 230 using a special impeller fitting and removal tool.

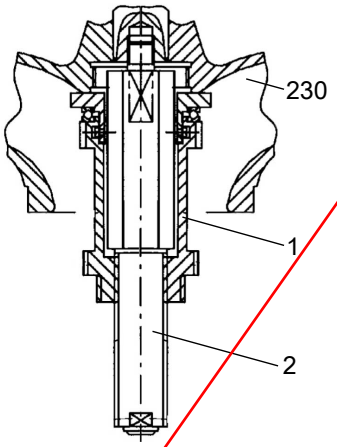


Fig. 58: Special impeller fitting and removal tool

3. Screw part 2 of the special impeller fitting and removal tool into the shaft end of the pump set.
4. Screw part 1 to fully threaded stud part 2.
5. Fit impeller hub cap 260.01 with O-ring 412.55 and O-ring 412.06.
6. Fasten hexagon socket head cap screw 914.10 (right-hand thread).

7.5.3.3 Installing the back pull-out unit

✓ The shaft, rolling element bearings, mechanical seal and impeller have been assembled properly.

1. Insert the complete back pull-out unit into the pump casing.
2. Evenly tighten screwed connection 920.01 between pump casing and bearing housing 350 or adapter 82-5, as applicable.

7.5.4 Leak testing

7.5.4.1 Testing the mechanical seal area for leakage

Observe the following values for leak testing:

- **Test medium**: compressed air
- **Test pressure**:15.4 psi [1 bar]
- **Test duration**: 5 minutes
- **Opening:**
  - Pump sets with cooling system (installation types K and D): coolant filler opening or coolant drainage opening

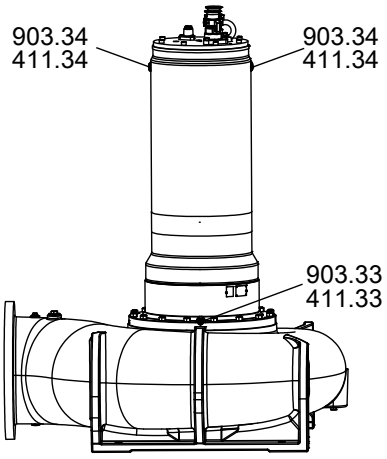
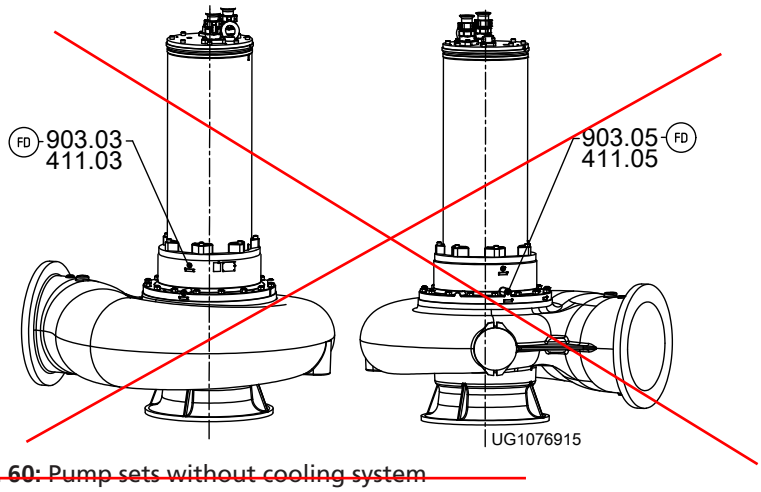


Fig. 59: Pump sets with cooling system



~~**Fig. 60:** Pump sets without cooling system~~

- ~~Pump sets without cooling system (installation types S and P)~~: lubricant filler opening or lubricant drainage opening

1. Remove the screw plug and joint ring of the lubricant reservoir or cooling system.
2. Screw the testing device tightly into the G½ plug thread.
3. Carry out the leak test with the values specified above.
   ⇨ The pressure must not drop during the test period.
   ⇨ If the pressure does drop, check the seals and screwed connections.
4. Repeat the leak test if required.
5. Remove the testing device.
6. After the leak test, top up coolant/lubricant.

7.5.4.2 Testing the motor for leakage

Observe the following values for leak testing:

- **Test medium**: nitrogen
- **Test pressure**: 12.3 psi [0.8 bar]
- **Test duration**: 2 minutes
- **Opening:** hole of screw plug 903.31

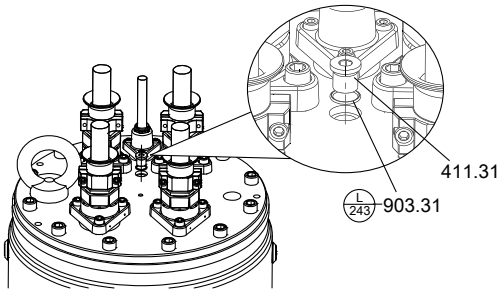


Fig. 61: Testing the motor for leakage

1. Undo and remove screw plug 903.31 and joint ring 411.31.
2. Screw the testing device tightly into the G½ plug thread.
3. Carry out the leak test with the values specified above.
   ⇨ The pressure must not drop during the test period.
   ⇨ If the pressure does drop, check the seals and screwed connections.
4. Repeat the leak test, if required.
5. Remove the testing device.

DANGER

Screw plug leaking or missing

Explosion hazard!

Damage to the motor!

- ▹ Never start up a pump set without screw plug 903.31.
- ▹ Apply a thread-locking agent (Loctite 243) to screw plug 903.31.

6. Apply a thread-locking agent (Loctite, type 243) to screw plug 903.31.
7. Close screw plug 903.31 again, fitting a new joint ring 411.31.

7.5.5 Checking the connection of motor/power supply

Check the power cables after reassembly. (⇨ Section 7.2.1, Page 63)

7.6 Tightening torques

Table 40: Tightening torques

Property class Rp 0.2 N/mm²	A4-50		A4-70				1.4462		8.8	
	210		250		450		450		640	
Thread	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]
M8	-	-	-	-	12,5	17	12,5	17		25
M10	-	-	-	-	26	35	26	35	37	50
M12	-	-	-	-	44	60	44	60	63	85
M14	-	-	-	-	66	90	66	90	96	130
M16	-	-	-	-	110	150	110	150	155	210
M20	-	-	-	-	215	290	215	290	302	410
M24	170	230		278	-	-		500	515	700
M30	340	460	-	-	-	-		1000	1035	1400

Property class Rp 0.2 N/mm²	A4-50		A4-70				1.4462		8.8	
	210		250		450		450		640	
Thread	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]
M42	960	1300	-	-	-	-		2750	2875	3900
M48	1440	1950	-	-	-	-		4200	4425	6000

7.7 Spare parts stock

7.7.1 Ordering spare parts

Always quote the following data when ordering replacement parts or spare parts:

- Order number
- Order item number
- Type series
- Size
- Year of construction
- Motor number

Refer to the name plate for all data.

Also supply the following data:

- Part No. and description (⇨ Section 9.1, Page 97)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

7.7.2 Recommended spare parts stock for 2 years' operation to DIN 24296

Table 41: Quantity of spare parts for recommended spare parts stock[22)]

Part No.	Description	Number of pump sets (including stand-by pump sets)						
		2	3	4	5	6 and 7	8 and 9	10 and more
80-1	Motor unit	-	-	-	1	1	2	30 %
834	Cable gland	1	1	2	2	2	3	40 %
818	Rotor	-	-	-	1	1	2	30 %
230	Impeller	1	1	1	2	2	3	30 %
502	Casing wear ring	2	2	2	3	3	4	50 %
433.01	Mechanical seal, motor end	2	3	4	5	6	7	90 %
433.02	Mechanical seal, pump end	2	3	4	5	6	7	90 %
321.01 / 322	Rolling element bearing, motor end	1	1	2	2	3	4	50 %
320 / 321.02	Rolling element bearing, pump end	1	1	2	2	3	4	50 %
99-9	Set of sealing elements for the motor	4	6	8	8	9	10	100 %
99-9	Set of sealing elements for the hydraulic system	4	6	8	8	9	10	100 %

22) For two years of continuous operation or 17,800 operating hours

8 Trouble-shooting

⚠ WARNING

Improper remedial work

Risk of personal injury!

- ▷ For any work performed in order to remedy faults observe the relevant information given in this operating manual and/or the product literature provided by the accessories manufacturers.

If problems occur that are not described in the following table, consultation with KSB's customer service is required.

A Pump is running but does not deliver

B Pump delivers insufficient flow rate

C Excessive current/power input

D Insufficient discharge head

E Vibrations and noise during pump operation

Table 42: Trouble-shooting

A	B	C	D	E	Possible cause	Remedy
-	✗	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point.
-	✗	-	-	-	Gate valve in the discharge line is not fully open.	Fully open the gate valve.
-	-	✗	-	✗	Pump is running in off-design conditions (low flow/overload).	Check the pump's operating data.
✗	-	-	-	-	Pump or piping are not completely vented.	**Dry installation:** Vent and/or prime the pump and piping; fit a vent valve if required.
						Wet installation: Vent by lifting the pump off the base elbow and lowering it again.
✗	✗	-	✗	✗	**Wet installation:** Pump intake clogged by deposits	Clean the intake, pump components and lift check valve.
					Dry installation: Inlet line clogged by deposits	Clean the intake or inlet line, pump components and lift check valve.
-	-	✗	-	✗	Dirt/fibers in the clearance between the casing wall and impeller; sluggish rotor.	Check whether the impeller can be easily rotated. Clean the impeller, if required.
-	✗	✗	✗	✗	Wear	Replace worn parts by new ones.
✗	✗	-	✗	-	Defective riser (pipe and sealing elements)	Replace defective riser pipes. Replace sealing elements.
-	✗	-	✗	✗	Impermissible air or gas content in the fluid handled	Contact KSB.
-	-	-	-	✗	System-induced vibrations	Contact KSB.
-	✗	✗	✗	✗	Wrong direction of rotation	Check the connection of the motor and control system, if any.
-	✗	-	✗	-	Wrong supply voltage	Check the mains power supply. Check the cable connections.
✗	-	-	-	-	No voltage	Check the electrical installation. Contact the energy supplier.
-	-	-	-	✗	Worn or defective rolling element bearings	Contact KSB.
-	✗	-	✗	-	In case of star-delta configuration: motor running in star configuration only	Check star-delta contactor.
✗	-	-	-	-	Defective motor winding	Contact KSB.
-	✗	-	-	-	**Wet installation:** Water level lowered too much during operation	Check level control equipment.

A	B	C	D	E	Possible cause	Remedy
-	✗	-	-	-	**Dry installation:** Suction lift is too high, NPSHavailable (positive suction head) is too low.	Check the inlet line for clogging, clean if necessary; fully open the shut-off element in the inlet line.
✗	-	-	-	-	**Pump sets without cooling system (installation types P and S):** The temperature control device for monitoring the winding has tripped due to excessive winding temperature.	The motor will restart automatically once it has cooled down.
✗	-	-	-	-	The thermistor tripping unit with manual reset for temperature limiter has tripped the pump as a result of the permissible winding temperature being exceeded.	Have caused determined and eliminated by qualified and trained personnel. **Pump sets with cooling system:** Check the coolant level.
✗	-	-	-	-	Motor has been tripped by leakage monitor.	Have cause determined and eliminated by qualified and trained personnel.
✗	-	-	-	-	Mechanical seal monitor has tripped.	Have cause determined and eliminated by qualified and trained personnel.
✗	-	-	-	-	Bearing temperature monitor has tripped.	Have cause determined and eliminated by qualified and trained personnel.

9 Related Documents

9.1 General assembly drawings with list of components

9.1.1 Pump sets with cooling system (installation types K and D):

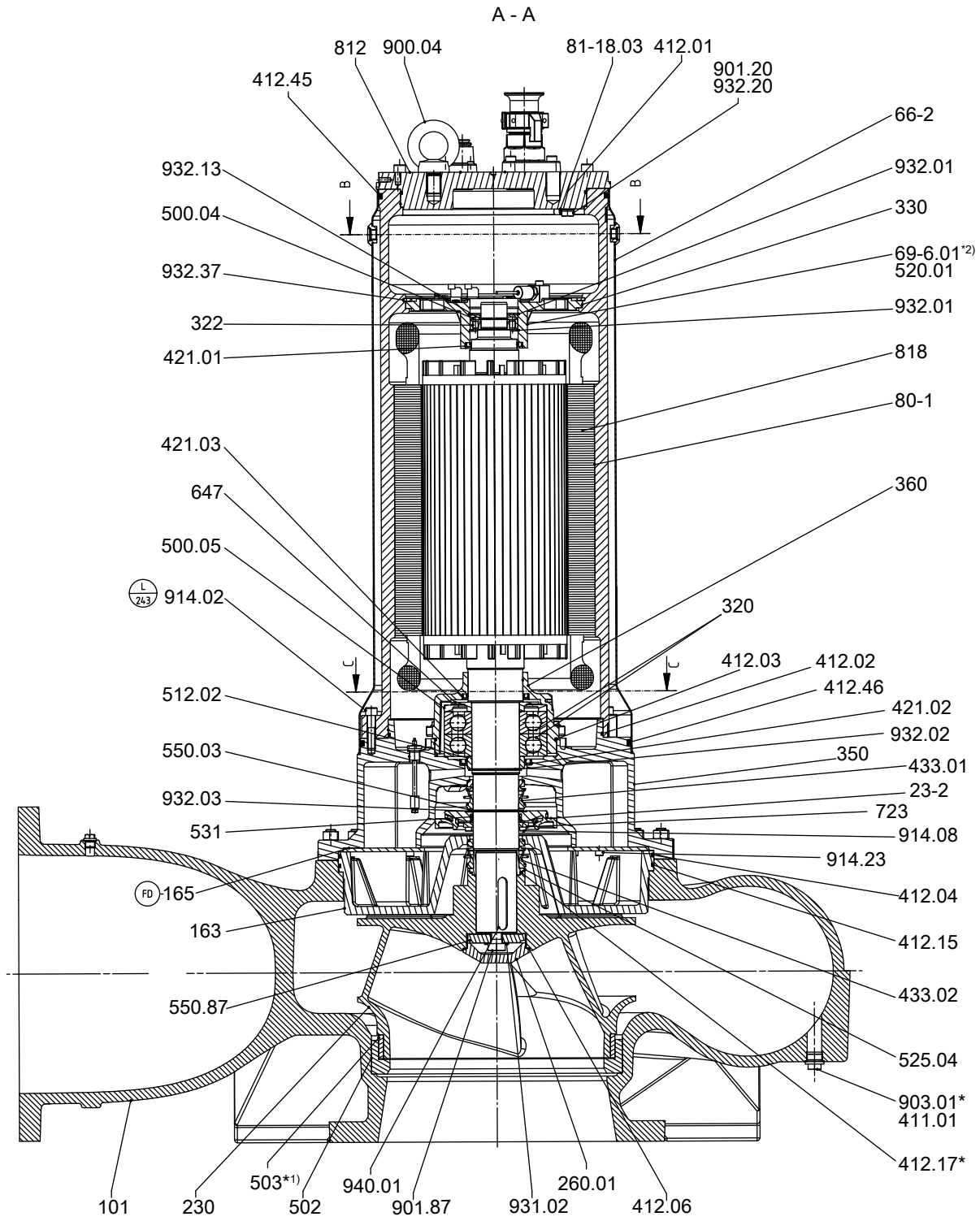


Fig. 62: General assembly drawing

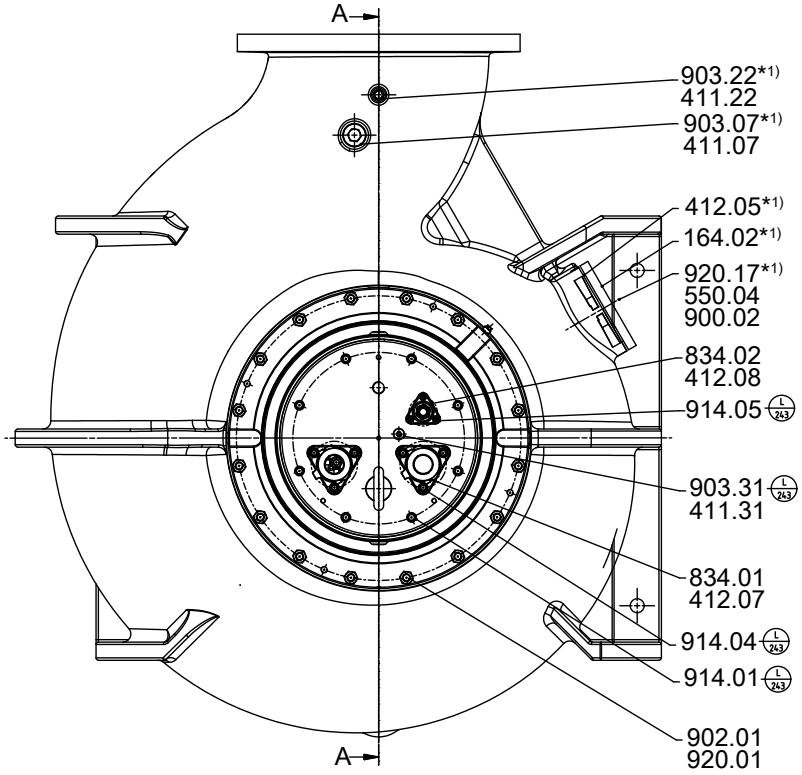


Fig. 63: Top view

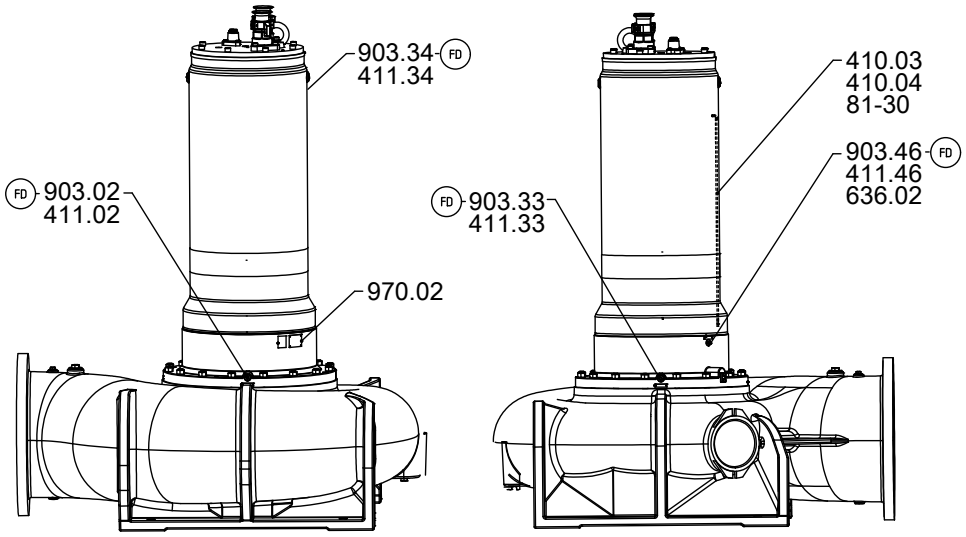


Fig. 64: Side views

*: For dry installation only

*1): If fitted

*2): Optional

Table 43: Key to the symbols and codes

Symbol	Description
L 243	Always secure screwed connections marked with this symbol with **Loctite 243**.
FD	Always apply a **liquid sealing agent** (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

Table 44: List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	502	Casing wear ring
66-2	Cooling jacket	503	Impeller wear ring
69-6.01	Temperature sensor	512.02	Wear ring
80-1	Motor unit	520.01	Sleeve
81-18.03	Cable terminal	525.04	Spacer sleeve
81-30	Guide rail	531	Locking sleeve
101	Pump casing	550.03/.04/.87	Disc
163	Discharge cover	636.02	Lubricating nipple
164.02	Inspection cover	647	Grease regulator
165	Cooling chamber cover	723	Flange
230	Impeller	812	Motor housing cover
260.01	Impeller hub cap	818	Rotor
320	Rolling element bearing	834.01/.02	Cable gland
322	Radial roller bearing	900.02/.04	Screw
330	Bearing bracket	901.20/.87	Hexagon head bolt
350	Bearing housing	902.01	Stud
360	Bearing cover	903.01/.02/.07/.22/.31/.33/.34/.46	Screw plug
410.03/.04	Profile seal	914.01/.02/.04/.05/.08/.23	Hexagon socket head cap screw
411.01/.02/.07/.22/.31/.33 .34/.46	Joint ring	920.01/.17	Nut
412.01/.02/.03/.04/.05/.06/.07/ .08/.15/.17/.45/.46	O-ring	931.02	Lock washer
421.01/.02/.03	Lip seal	932.01/.02/.03/.13/.20/.37	Circlip
433.01/.02	Mechanical seal	940.01	Key
500.04/.05	Ring	970.02	Label/plate

9.2 Detailed views

9.2.1 Sensors and terminals - pump set with cooling system

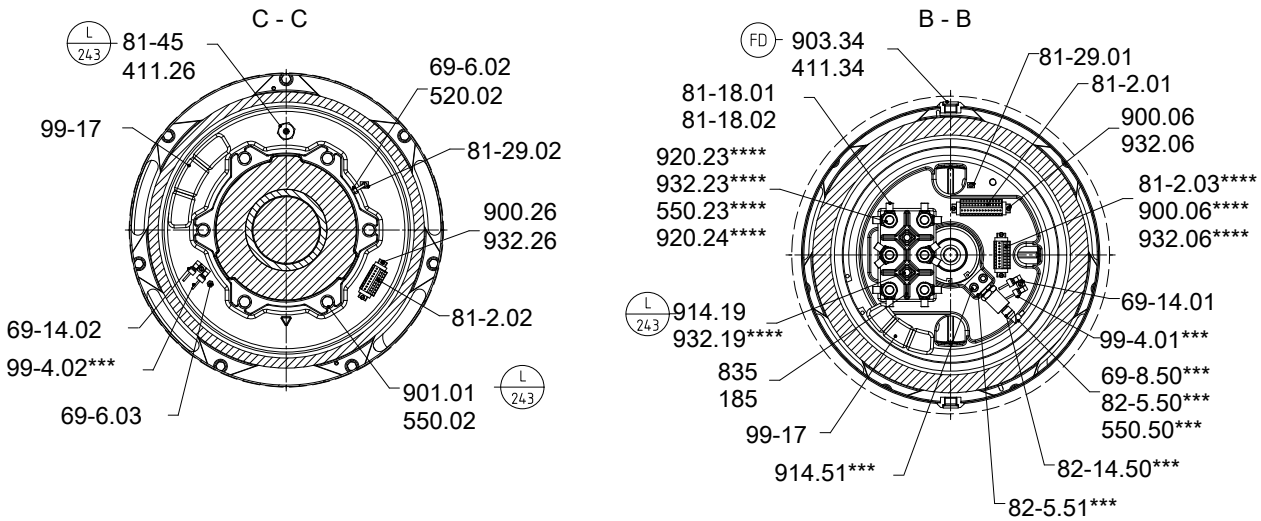


Fig. 68: Sensors and terminals - pump set with cooling system

***: Variants with vibration monitoring only

****: Specific sizes only

Table 47: Key to the symbols and codes

Symbol	Description
L 243	Always secure screwed connections marked with this symbol with **Loctite 243**.

Table 48: List of components

Part No.	Description	Part No.	Description
69-14.01/.02	Leakage monitor	185	Plate
69-6.02/.03	Temperature sensor	411.26/.34	Joint ring
69-8.50	Measurement transmitter	520.02	Sleeve
81-18.01/.02	Cable terminal	550.02/.23/.50	Disc
81-2.01/.02/.03	Plug	835	Terminal board
81-29.01/.02	Terminal	900.06/.26	Bolt/screw
81-45	Float switch	901.01	Hexagon head bolt
82-14.50	Cable with plug	903.34	Screw plug
82-5.50/.51	Adapter	914.19/.51	Hexagon socket head cap screw
99-17	Desiccant	920.23/.24	Nut
99-4.01/.02	Conversion kit	932.06/.19/.23/.26	Circlip

9.2.3 Bearings - pump set with cooling system

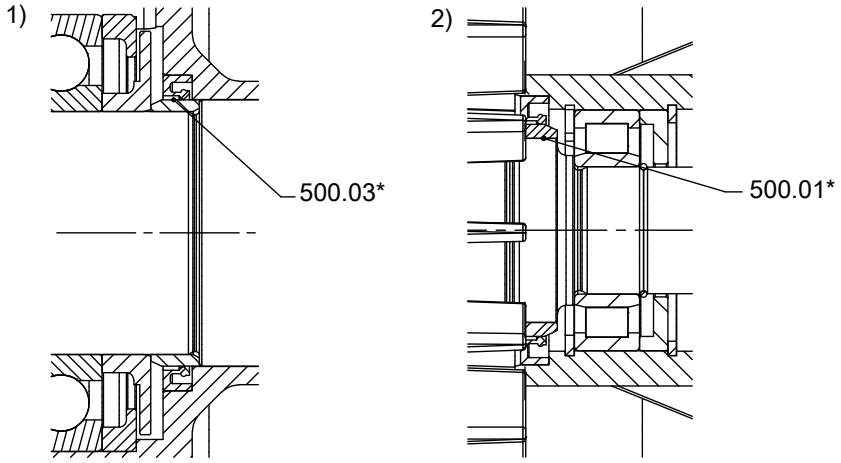


Fig. 70: Bearings - pump set with cooling system

1)	Motors: 65 4, 80 4, 50 6, 60 6, 35 8, 50 8
2)	Motors: 65 4, 80 4, 95 4, 110 4, 50 6, 60 6, 80 6, 100 6, 35 8, 50 8, 75 8

*: Additional

Table 51: List of components

Part No.	Description	Part No.	Description
500.01/.03	Ring		

9.2.4 Bearings - pump set without cooling system

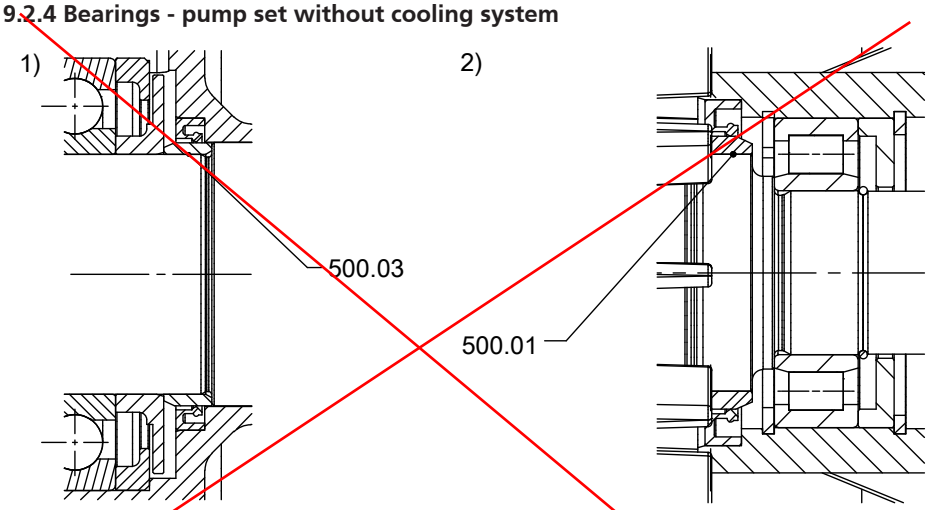


Fig. 71: Bearings - pump set without cooling system

1	Motors: 35 4...80 4, 32 6...60 6, 26 8...50 8
2	Motors: 35 4...110 4, 32 6...100 6, 26 8...75 8

*: Additional

Table 52: List of components

Part No.	Description	Part No.	Description
500.01/.03	Ring		

9.2.5 Bearing housing made of stainless steel

..NC..motors
and hydraulic systems
155 4 ...-K
155 4 ...-D

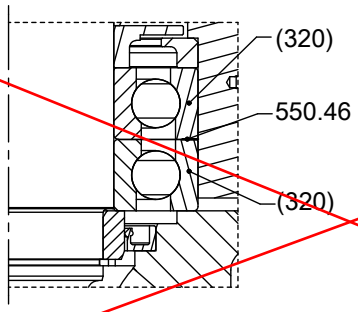


Fig. 72: Bearing housing made of stainless steel

Table 53: List of components

Part No.	Description	Part No.	Description
320	Rolling element bearing	550.46	Disc

9.2.6 Bearing bracket fastening

Motors:
35 4...175 4
32 6...165 6
26 8...130 8
40 10...90 10

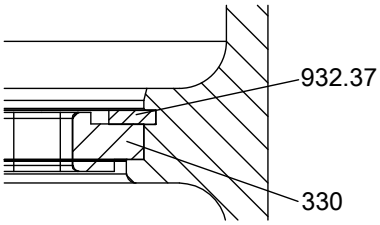


Fig. 73: Bearing bracket fastening

Table 54: List of components

Part No.	Description	Part No.	Description
330	Bearing bracket	932.37	Circlip

Motors:
200 4...350 4
190 6...480 6
150 8...400 8
110 10...350 10
105 12...300 12

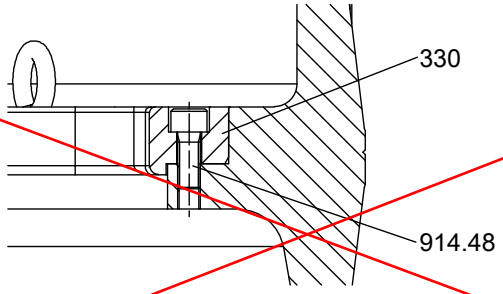


Fig. 74: Bearing bracket fastening

Table 55: List of components

Part No.	Description	Part No.	Description
330	Bearing bracket	914.48	Hexagon socket head cap screw

9.2.7 Special feature of hydraulic system - pump set with cooling system

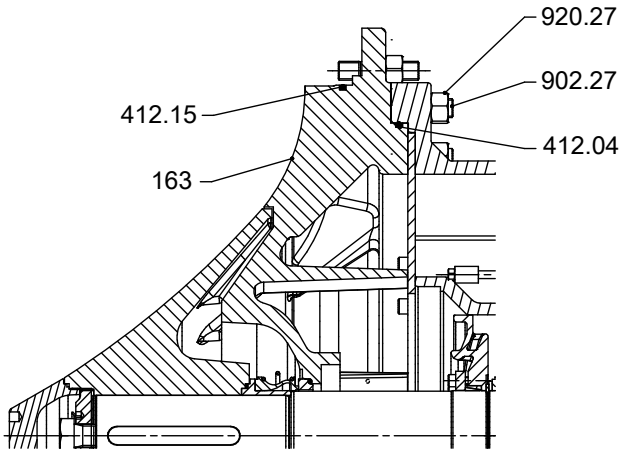


Fig. 75: Special feature of hydraulic system - pump set with cooling system

Table 56: List of components

Part No.	Description	Part No.	Description
163	Discharge cover	902.27	Stud
412.04/.15	O-ring	920.27	Nut

9.2.8 Special feature of hydraulic system - pump set without cooling system

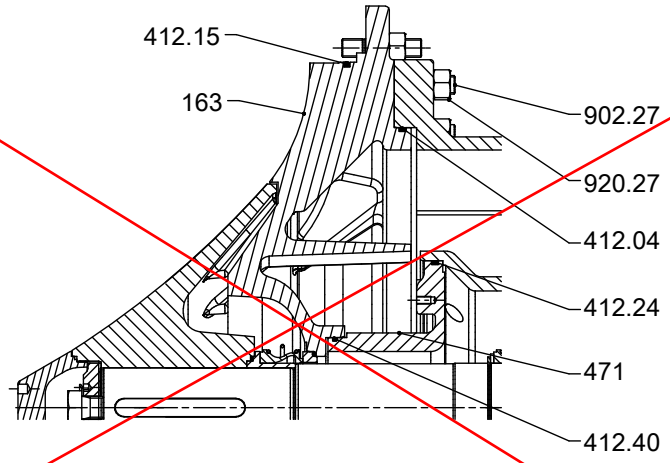


Fig. 76: Special feature of hydraulic system - pump set without cooling system

Table 57: List of components

Part No.	Description	Part No.	Description
163	Discharge cover	902.27	Stud
412.04/.15/.24/.40	O-ring	920.27	Nut
471	Seal cover		

9.2.9 Special feature of hydraulic system - K 350-710, K 350-713, K 401-710, K 401-713, K 501-710, K 600-710

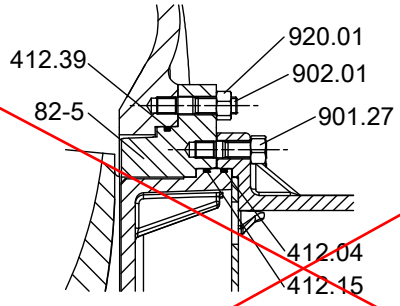


Fig. 77: Special feature of hydraulic system - K 350-710, K 350-713, K 401-710, K 401-713, K 501-710, K 600-710

Table 58: List of components

Part No.	Description	Part No.	Description
82-5	Adapter	902.01	Stud
412.04/.15/.39	O-ring	920.01	Nut
901.27	Hexagon head bolt		

9.2.10 Connection space of K35 motors

320 6...480 6
260 8...400 8
230 10...350 10
195 12...300 12

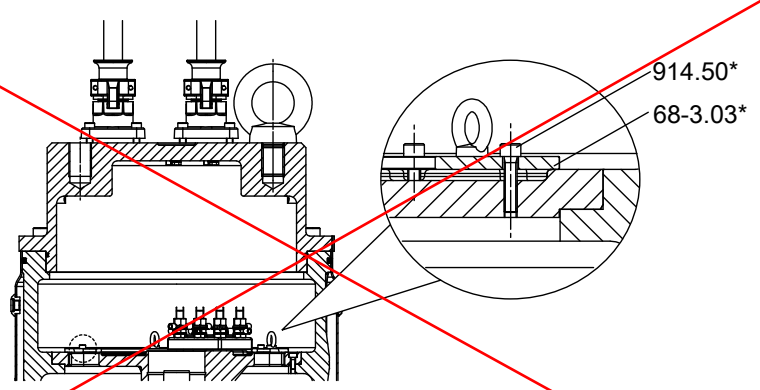


Fig. 78: Connection space of K35 motors

*: Explosion-proof variants only

Table 59: List of components

Part No.	Description	Part No.	Description
68-3.03	Cover plate	914.50	Hexagon socket head cap screw

9.2.11 Bail

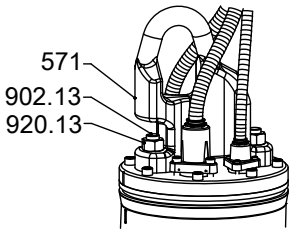


Fig. 79: Bail

Table 60: List of components

Part No.	Description	Part No.	Description
571	Bail	920.13	Nut
902.13	Stud		

9.3 Wiring diagrams

9.3.1 Wiring diagram for the power cables

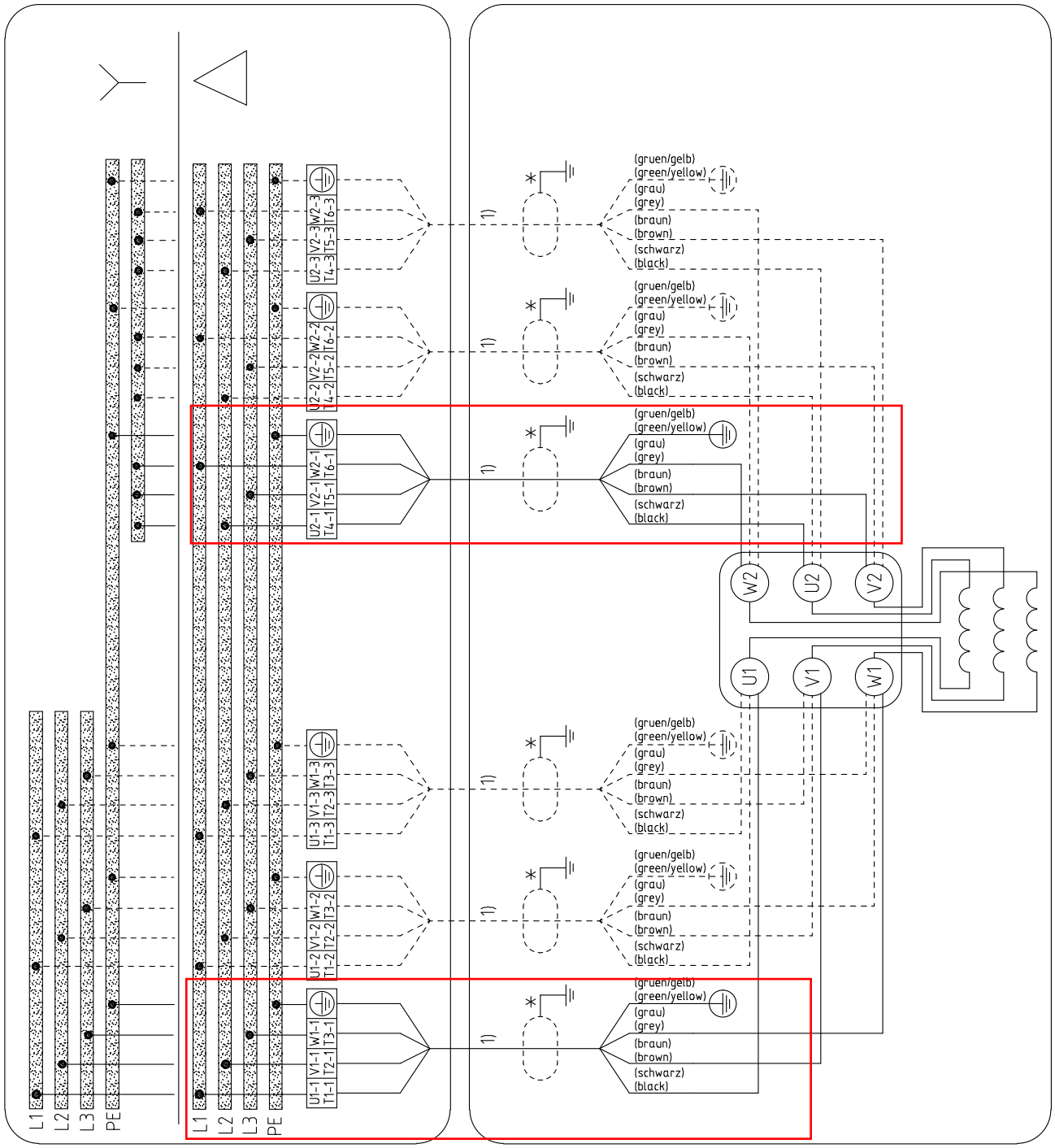


Fig. 80: Wiring diagram for the power cables

* Shielded cable optional
[1)] Up to 3 parallel cable pairs possible

9.3.2 Wiring diagrams for the sensors

9.3.2.1 Pump sets with cooling system, installation types D and K

Standard pump set, installation types D and K

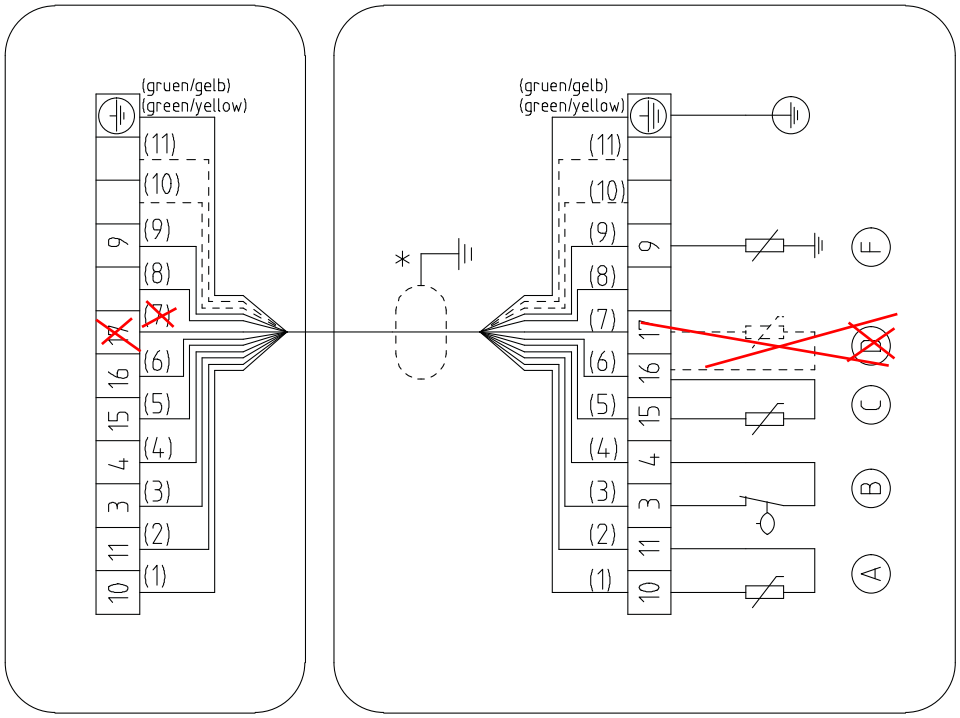


Fig. 81: Sensor wiring diagram for standard pump sets, installation types D and K

*	Shielded cables optional
Ⓐ	Motor temperature (PTC)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
~~Ⓓ~~	~~Bearing temperature (upper bearing, optional)~~
Ⓕ	Leakage inside the motor

9.4 Flamepaths on explosion-proof motors

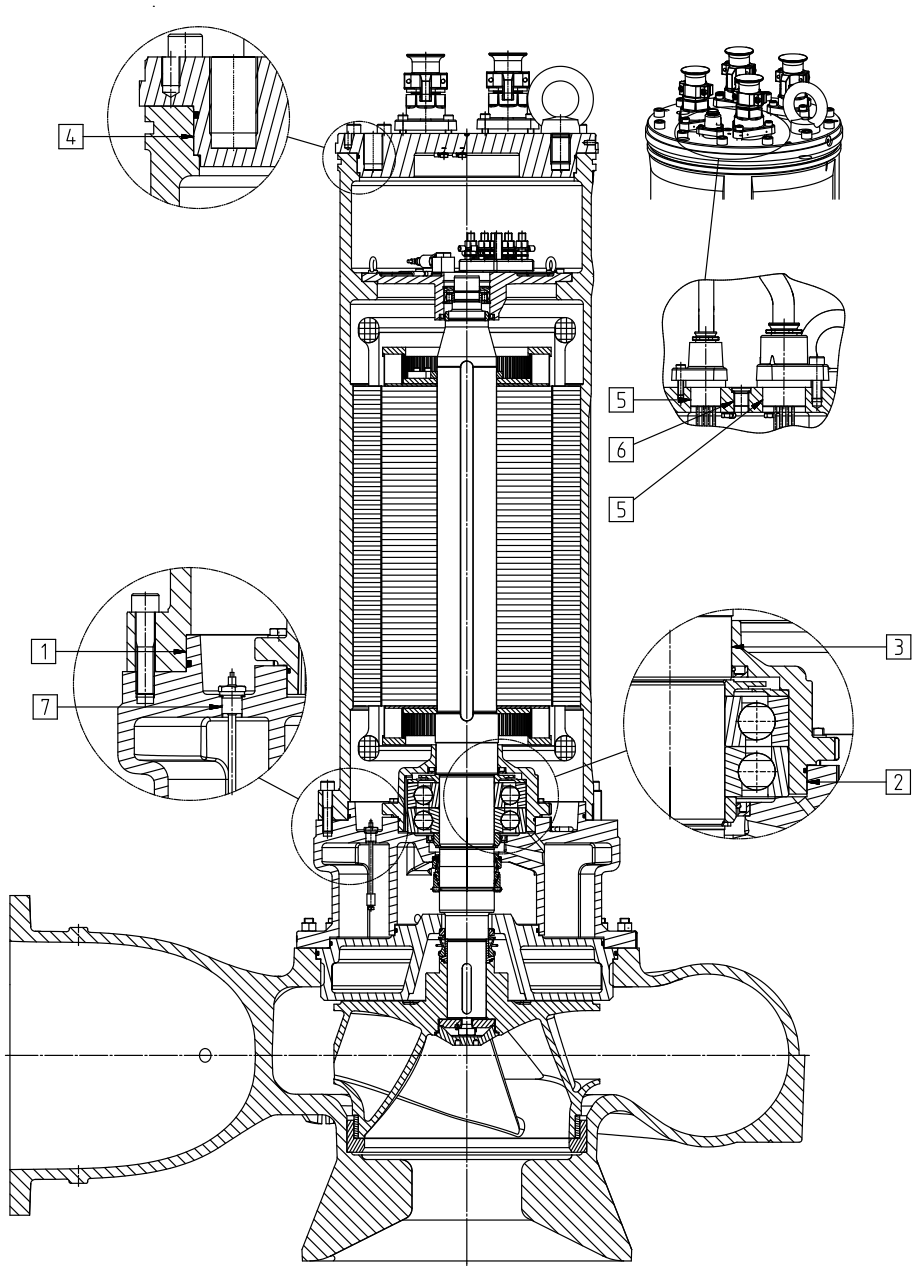


Fig. 89: Flamepaths on explosion-proof motors

1, 2, 3, 4, 5, 6, 7	Flamepaths

9.5 Sectional drawings of the mechanical seal

Motors:
35 4...110 4
32 6...100 6
26 8..75 8

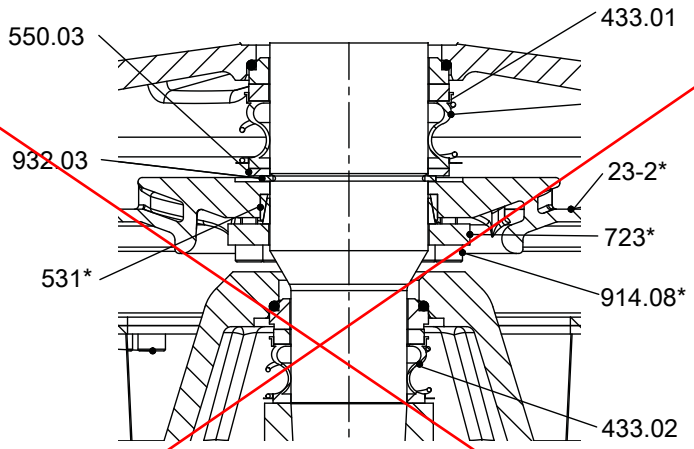


Fig. 90: Mechanical seal depending on the motor
*: Only for pump sets with cooling system

Table 61: List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	723	Flange
433.01/.02	Mechanical seal	914.08	Hexagon socket head cap screw
531	Locking sleeve	932.03	Circlip
550.03	Disc		

Motors:
130 4...175 4
120 6...165 6
90 8..130 8
40 10...90 10

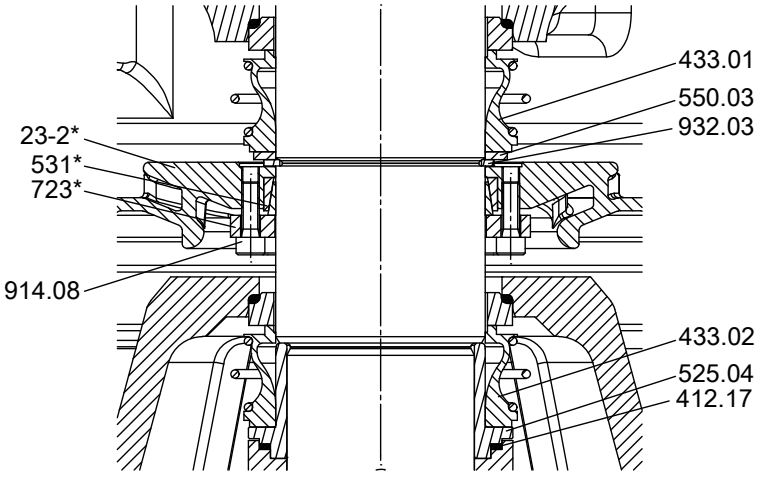


Fig. 91: Mechanical seal depending on the motor
*: Only for pump sets with cooling system

Table 62: List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	550.03	Disc
412.17	O-ring	723	Flange
433.01/.02	Mechanical seal	914.08	Hexagon socket head cap screw
525.04	Spacer sleeve	932.03	Circlip
531	Locking sleeve		

10 Certificate of Decontamination

Type: .....

Order number/

order item number[23]: .....

Delivery date: .....

Field of application: .....

Fluid handled[23]: .....

Please check where applicable[23]:

☐ Radioactive

☐ Explosive

☐ Corrosive

☐ Toxic

☐ Harmful

☐ Bio-hazardous

☐ Highly flammable

☐ Safe

Reason for return[23]: .....

Comments: .....

.....

The product/accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch/ placing at your disposal.

We herewith declare that this product is free from any hazardous chemicals as well as from biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

☐ No special safety precautions are required for further handling.

☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....	.....	.....
Place, date and signature	Address	Company stamp

23) Required fields

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2553.8049/03-EN-US (01426370)

KSB SE & Co. KGaA
Johann-Klein-Straße 9 • 67227 Frankenthal (Germany)
Tel. +49 6233 86-0
www.ksb.com

NORTH AMERICAN EQUIVALENTS

RECOMMENDED OILS FOR KRT PUMPS

CITGO Duoprime Oil 90
EXXON Marcol #87
Any Brand Vegetable Oil

RECOMMEND COOLANT

Brenntag industrial glycol (Product code: 83948)
Sierra Antifreeze/Coolant
Ratio: 60%-40%

RECOMMENDED OIL FOR MIXER GEAR BOX

MOBIL POLY 372

RECOMMENDED GREASES

PUMPS LOWER THAN 80 HP: SHELL ALVANIA EP-3, MOBILUX EP-3
PUMPS EQUAL OR GREATER THAN 80 HP: SHELL STAMINA GREASE RLS

RECOMMENDED O-RING LUBRICANT

DOW CORNING 55

RECOMMENDED PAINTS

BLUE EPOXY PAINT:
TNEMEC PART A F066B3159A/ RAL5002 ULTRA BL
TNEMEC PART B B066-066B/BA 1999110366

BLACK EPOXY PAINT
BENJAMIN MOORE & CO. COAL TAR EPOXY M47/M48

KRT & AMACAN COMPOUNDS

L/243=LOCTITE 243 (P/N : 24078)
FD=PERMATEX/HYLOMAR HPF (P/N : 25249)
GP=MARINE GRADE ANTI-SEIZE (P/N : 34395)
FK=3M RUBBER & GASKET ADHESIVE 1300

SECTION 6: AS-BUILT INFORMATION

CERTIFIED PUMP CURVES

PUMP P-1 – LOW FLOW

500926443/1000/1

MOTOR # 70368195

PROJECT: **FT WASHINGTON WAY**
PUMP: **KRT K200-316/156XEG-S**
TAG: LOW FLOW P-1

From Spec: Hydraulic Institute "1U"

		Positive	Negative
Flow Tolerance	(%)	**10**	**0**
Head Tolerance	(%)	**6**	**0**

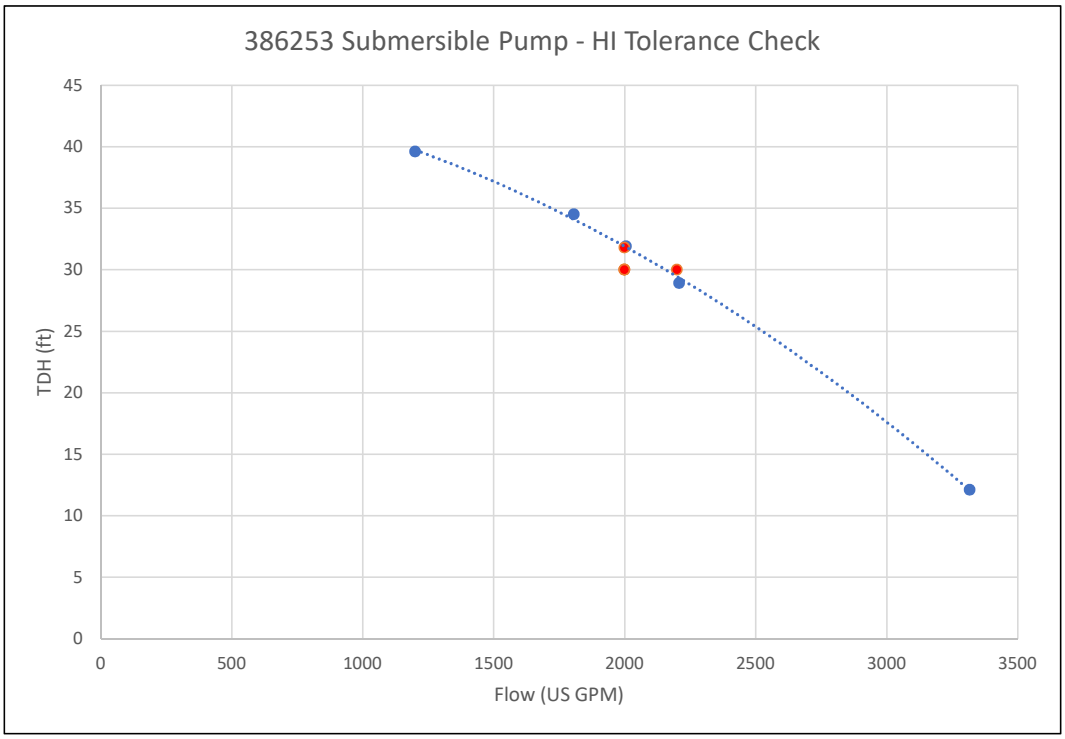
	Guar. Point	Tolerance		Values	
		+	-	+	-
Flow	2000	0.1	0	2200	2000
Head	30	0.06	0	31.8	30.0

Data

Flow	Head
1201.1	39.6
1807.3	34.5
2006.3	31.9
2208.3	28.9
3317.2	12.1

Tolerances

Flow	Head
2000	30
2000	31.8
2000	30.0
2200	30.0
2000	30



KSB SE & Co. KGaA
Engineered Pumps Division

Inspection Record

Ordered Data

client:	KSB Inc.	client reference:	97889
order no.:	500926443	curve no.	1000-1
pump type:	Amarex KRT (50Hz)/ 65-217F	no. of stages:	1
serial no.:	500926443-1000-1	KSB location:	LILLE
construction:	KRTK 200-316/156XEG-S	manufacturer:	KSB

Motor Data

manufacturer:		motor type:	156XEG
serial no.:	70368195	client motor:	
motor rated power:	14,914 kW	speed:	1161 rpm
voltage:	460 Volt	current:	26,799999 Ampere
cos ϕ:	0,81 -	frequency:	60 Hz

Guaranteed data (Design)

capacity Q_G	2005,42 gal/min (US)	head H:	30,16 feet
pump input power P_G:	18,64 hp (electric)	speed n:	1161 1/min
pump efficiency η_G:	81,8 %	density ρ:	998,23 kg/m³
NPSH_G:	0 m	kin. viskosity:	0,000001 m²/s
acceptance test class:	ISO 9906/HI 1 U	water temperature T:	20 °C

Measure Instructions

diam. press. gauge inlet:	200 mm	diam. press. gauge discharge:	215 mm
geod. height z_M1 inlet:	0 m	geod. height z_M2 discharge:	0,1 m
geod. height impeller z_D:	0 m	gravitational acceleration:	9,80665 m/s²

measured data

measured values	dimension	1	2	3	4	5			
capacity discharge Q	gal/min (US)	1201,1	1807,3	2006,3	2208,3	3317,2			
total head Hd	feet	39,6	34,5	31,9	28,9	12,1			
pump input power P2	hp (electric)	17,7	19,6	19,7	19,8	17,3			
pump efficiency η	%	67,6	80,4	81,9	81,2	58,5			
						test bench type		offen	

test record no.	test person	test bench name	date
20191003-065914	BLATON Cédric	KRT	15.10.2019

This report was created electronically and is valid without signature

KSB	KSB SE & Co. KGaA Engineered Pumps Division	Inspection Record

Ordered Data

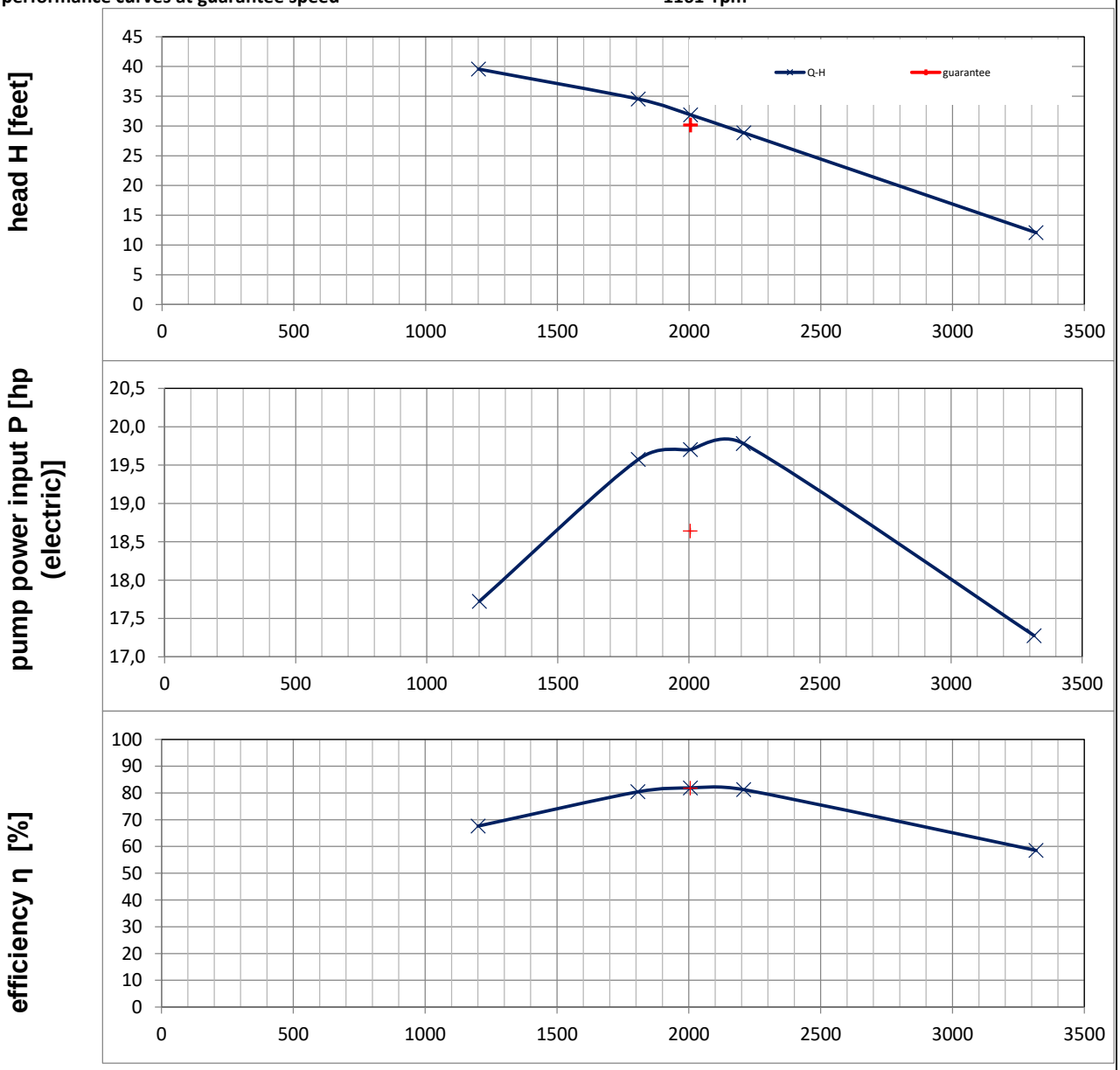
client:	KSB Inc.	client reference:	97889
order no.:	500926443	curve no.	1000-1
pump type:	Amarex KRT (50Hz)/ 65-217F	no. of stages:	1
serial no.:	500926443-1000-1	KSB location:	LILLE
construction:	KRTK 200-316/156XEG-S	manufacturer:	KSB

Guaranteed data (Design)

capacity Q_G	2005,42 gal/min (US)	head H:	30,16 feet
pump input power P_G:	18,64 hp (electric)	speed n:	1161 1/min
pump efficiency η_G:	81,8 %	density ρ:	998,23 kg/m³
NPSH_G:	0 m	kin. viskosity:	0,000001 m²/s
acceptance test class:	ISO 9906/HI 1 U	water temperature T:	20 °C

Calculated to garantee parameters

performance curves at guarantee speed **1161 rpm**



test record no.	test person	test bench name	date
20191003-065914	BLATON Cédric	KRT	15.10.2019

This report was created electronically and is valid without signature

PUMP P-2 – STORMWATER

9574145313/00010001

MOTOR # 395866

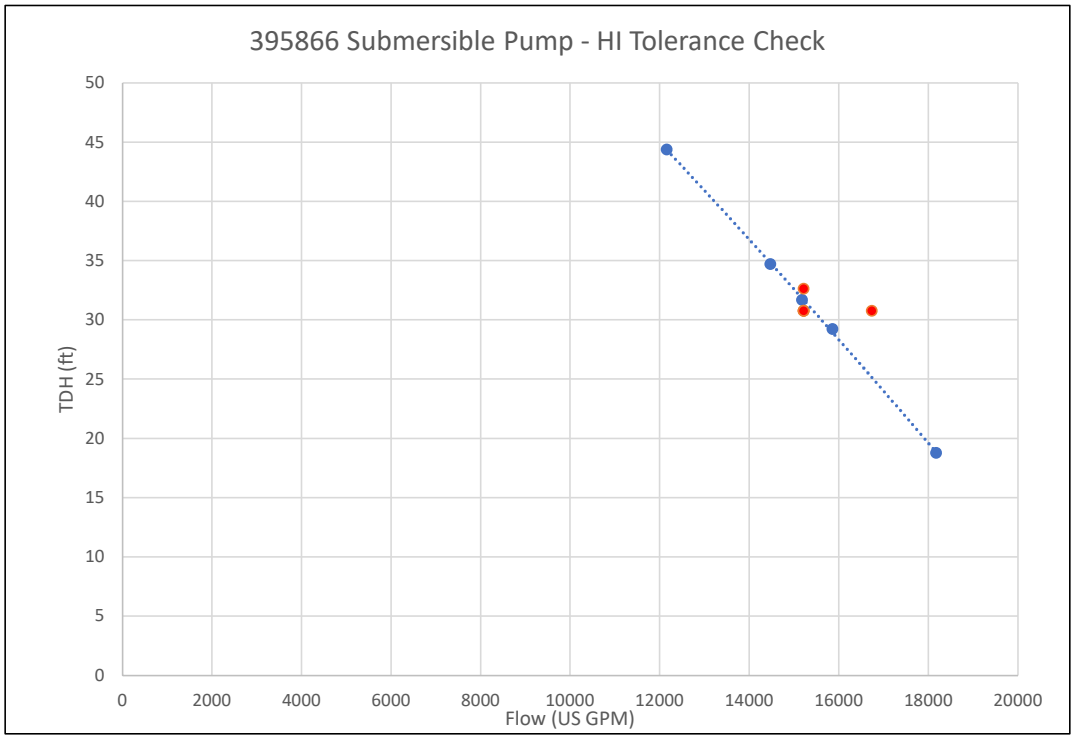
PROJECT: FT WASHINGTON WAY
PUMP: KRT K500-634/1308XNG-K
TAG: STORMWATER (P2-P4)
S/N:395866
From Spec: Hydraulic Institute "1U"

		Positive	Negative
Flow Tolerance	(%)	**10**	**0**
From Spec: Hydraulic Institute "1U"			

		Positive	Negative	Values	
		Tolerance			
Flow Tolerance	(%)	**10**	**0**		
Head Tolerance	(%)	**6**	**0**		

	Guar. Point	**+**	**-**	**+**	**-**
Flow	15216.06	0.1	0	16737.67	15216
Head	30.76	0.06	0	32.6	30.8

	Data		**Tolerances**	
	Flow	Head	Flow	Head
3	12161.66	44.36	15216.06	30.76
4	14472.14	34.68	15216.06	32.6
5	15184.33	31.66	15216.06	30.8
6	15860	29.2	16737.67	30.8
7	18176.17	18.77	15216	30.76



KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	9974145313_000100	*curve no.:*	
pump type:	KRT K 500-634 / 130 8 XNG-K	*manufacturer:*	KSB Halle
serial no.:	395866	*KSB location:*	HA
construction:	vertical	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	K28 L08-130	
serial no.:	395866		*client motor:*	VERTICAL	
motor rated power:	174	hp	*speed:*	890	r.p.m.
voltage:	460	Volt	*current:*	219	Ampere
cos φ:	0,8	-	*frequency:*	60	Hz

Guarantee Data

capacity	15216,06	gal/min	*head H:*	30,76	feet
pump input power P:	154,71	hp	*speed n:*	891	r.p.m.
pump efficiency η:	76,35	%	*density ρ:*	62,3	lb/ft³
NPSH:		feet	*kin. viscosity:*	0,0015	in²/s
acceptance test class	Hydr. Inst. cl. 1U		*fluid temperature T:*	68,00	°F

Measure Instructions

impeller trimming type AN 1528	Type A06	D1	521 mm	D2	473 mm
		D3	515 mm	D4	446 mm
		D6	280 mm	Alpha	16,03 °

measured data

measured values	dimension	1	2	3	4	5	6	7	8
speed n	r.p.m.	890,8	890,5	890,6	890,8	891,0	891,1	891,8	892,3
temperature T	°F	71,9	71,9	71,9	71,9	71,9	71,9	71,9	71,9
capacity Q	**gal/min**	**5000,33**	**8601,61**	**12161,66**	**14472,14**	**15184,33**	**15860,00**	**18176,17**	**19477,26**
motor input power Pel	hp	167,03	174,68	173,16	166,69	162,87	159,44	143,38	131,01
voltage U	V	461,0	459,0	461,1	461,0	461,8	461,1	460,5	460,3
current I1	A	196,73	204,66	202,57	196,08	191,74	188,95	173,66	162,37
current I2	A	197,88	205,67	203,51	197,13	192,56	189,85	174,50	163,12
current I3	A	198,65	206,45	204,24	197,89	193,48	190,54	175,33	163,92
cos phi	-	0,789	0,797	0,795	0,790	0,789	0,785	0,769	0,751
calculated values									
density ρ	lb/ft³	62,3	62,3	62,3	62,3	62,3	62,3	62,3	62,3
total head H	**feet**	**66,66**	**56,80**	**44,36**	**34,68**	**31,66**	**29,20**	**18,77**	**11,44**
motor efficiency η mot	%	92,76	92,75	92,75	92,76	92,76	92,76	92,70	92,58
cool. jack. eff. η cool	%	98,70	98,76	98,75	98,70	98,67	98,64	98,49	98,34
pump input power P2	**hp**	**152,92**	**160,00**	**158,60**	**152,61**	**149,07**	**145,89**	**130,90**	**119,28**
pump power P2 ρ ordered	hp	152,95	160,03	158,63	152,64	149,10	145,91	130,93	119,31
pump efficiency η	**%**	**54,98**	**77,02**	**85,79**	**82,96**	**81,33**	**80,07**	**65,74**	**47,12**
η total (pump+motor)	%	50,33	70,55	78,57	75,95	74,44	73,27	60,02	42,90

Remarks:
P+C: Birgit Bock

test record nr.	20200115-092355
test person	Bart
test bench name	Prüfstand P9
test bench type	open
*quality check *)*	
date	15.01.2020

\ DN 500 \ 9974145313_000100_395866

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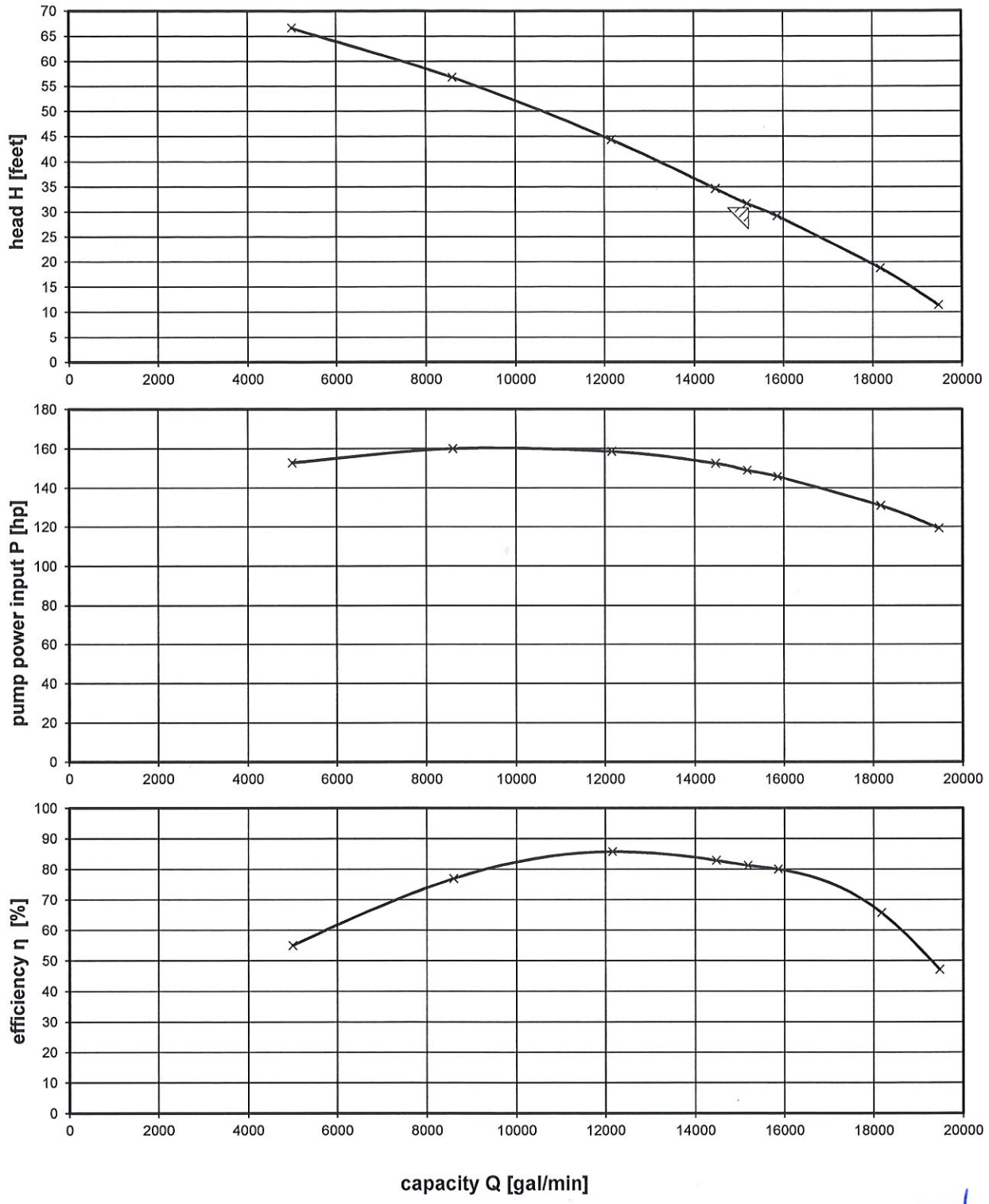
performance curves at operation speed from 890 to 892 r.p.m.



KSB	**performance curves**			client reference					
	\ DN 500 \ 9974145313_000100_395866			order nr.	9974145313_000100			date	15.01.2020
pump data	type	KRT K 500-634 / 130 8 X	D1 [mm]	D2 [mm]	D3 [mm]	D4 [mm]	D6 [mm]	Alpha [°]	
report nr.	manufactur.	KSB Halle	521	473	515	446	280	16,03	
20200115-092355	curve no.		Type A06						
motor data	type	K28 L08-130	frequency	P motor	speed n	voltage	current	cos φ	
client motor	manufactur.	KSB Halle	Hz	hp	r.p.m.	Volt	Ampere	–	
VERTICAL	serial no.	395866	60	174	890	460	219,0	0,80	
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet	hp	%	r.p.m.	feet	lb/ft³	°F	in²/s
Hydr. Inst. cl. 1U	15216,06	30,76	154,71	76,35	891		62,3	68,0	0,0015

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PUMP P-3 – STORMWATER

9574145313/00010003

MOTOR # 395868

PROJECT: FT WASHINGTON WAY
PUMP: KRT K500-634/1308XNG-K
TAG: STORMWATER (P2 -P4)
S/N:395868
From Spec: Hydraulic Institute "1U"

		Positive	Negative
Flow Tolerance	(%)	**10**	**0**
Head Tolerance	(%)	**6**	**0**

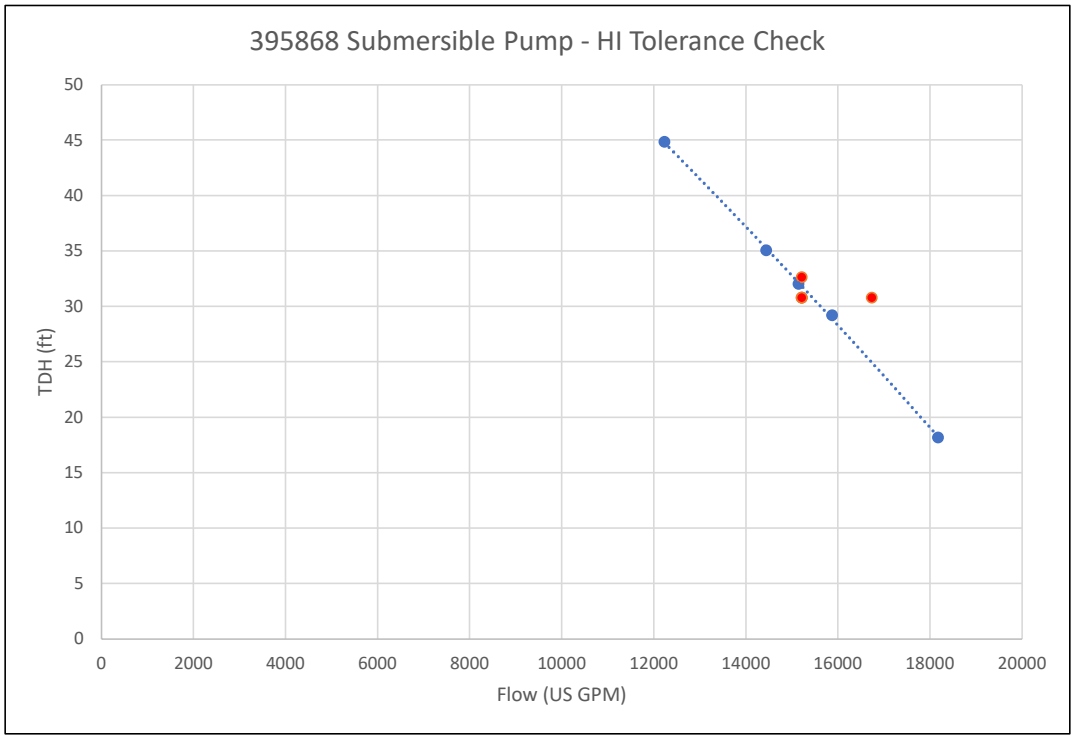
	Guar. Point	Tolerance		Values	
		+	-	+	-
Flow	15216.06	0.1	0	16737.67	15216
Head	30.76	0.06	0	32.6	30.8

Data

	Flow	Head
3	12233.52	44.82
4	14441.26	35.03
5	15147.05	32
6	15878.24	29.18
7	18177.2	18.16

Tolerances

Flow	Head
15216.06	30.76
15216.06	32.6
15216.06	30.8
16737.67	30.8
15216	30.76



KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	9974145313_000100	*curve no.:*	
pump type:	KRT K 500-634 / 130 8 XNG-K	*manufacturer:*	KSB Halle
serial no.:	395868	*KSB location:*	HA
construction:	vertical	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	K28 L08-130	
serial no.:	395868		*client motor:*	VERTICAL	
motor rated power:	174	hp	*speed:*	890	r.p.m.
voltage:	460	Volt	*current:*	219	Ampere
cos φ:	0,8	-	*frequency:*	60	Hz

Guarantee Data

capacity	15216,06	gal/min	*head H:*	30,76	feet
pump input power P:	154,71	hp	*speed n:*	891	r.p.m.
pump efficiency η:	76,35	%	*density ρ:*	62,3	lb/ft³
NPSH:		feet	*kin. viscosity:*	0,0015	in²/s
acceptance test class	Hydr. Inst. cl. 1U		*fluid temperature T:*	68,00	°F

Measure Instructions

impeller trimming type AN 1528	Type A06	D1	521	mm	D2	473	mm
		D3	515	mm	D4	446	mm
		D6	280	mm	Alpha	16,03	°

measured data

measured values	dimension	1	2	3	4	5	6	7	8
speed n	r.p.m.	890,7	890,6	890,5	890,8	890,9	891,1	891,8	892,3
temperature T	°F	72,0	72,0	72,0	72,0	72,0	72,0	72,0	72,0
capacity Q	**gal/min**	**4983,01**	**8590,50**	**12233,52**	**14441,26**	**15147,05**	**15878,24**	**18177,20**	**19503,94**
motor input power Pel	hp	168,22	172,55	175,85	167,32	163,12	159,55	143,15	132,60
voltage U	V	460,4	460,4	460,7	461,0	460,1	460,5	460,6	459,9
current I1	A	199,83	204,09	207,20	198,49	194,41	190,80	175,40	165,75
current I2	A	200,86	205,01	208,08	199,49	195,43	191,75	176,13	166,46
current I3	A	201,38	205,50	208,63	200,01	195,93	192,27	176,65	166,96
cos phi	-	0,784	0,788	0,791	0,784	0,782	0,779	0,760	0,746
calculated values									
density ρ	lb/ft³	62,3	62,3	62,3	62,3	62,3	62,3	62,3	62,3
total head H	**feet**	**67,03**	**56,22**	**44,82**	**35,03**	**32,00**	**29,18**	**18,16**	**11,44**
motor efficiency η mot	%	92,76	92,75	92,74	92,76	92,76	92,76	92,70	92,60
cool. jack. eff. η cool	%	98,71	98,74	98,77	98,70	98,67	98,64	98,48	98,36
pump input power P2	**hp**	**154,03**	**158,04**	**161,08**	**153,19**	**149,30**	**145,99**	**130,69**	**120,78**
pump power P2 ρ ordered	hp	154,06	158,07	161,11	153,23	149,34	146,02	130,71	120,80
pump efficiency η	**%**	**54,70**	**77,08**	**85,86**	**83,28**	**81,89**	**80,04**	**63,72**	**46,61**
η total (pump+motor)	%	50,08	70,60	78,64	76,25	74,95	73,23	58,17	42,46

Remarks:
P+C: Birgit Bock

\ DN 500 \ 9974145313_000100_395868

test record nr.	20200115-122644
test person	Bart
test bench name	Prüfstand P9
test bench type	open
*quality check *)*	
date	15.01.2020

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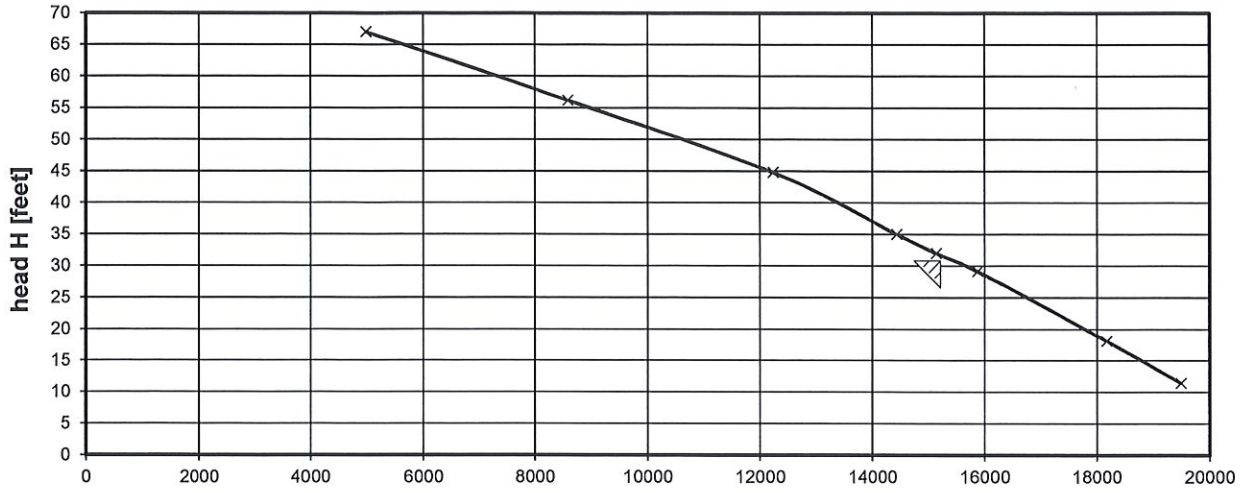
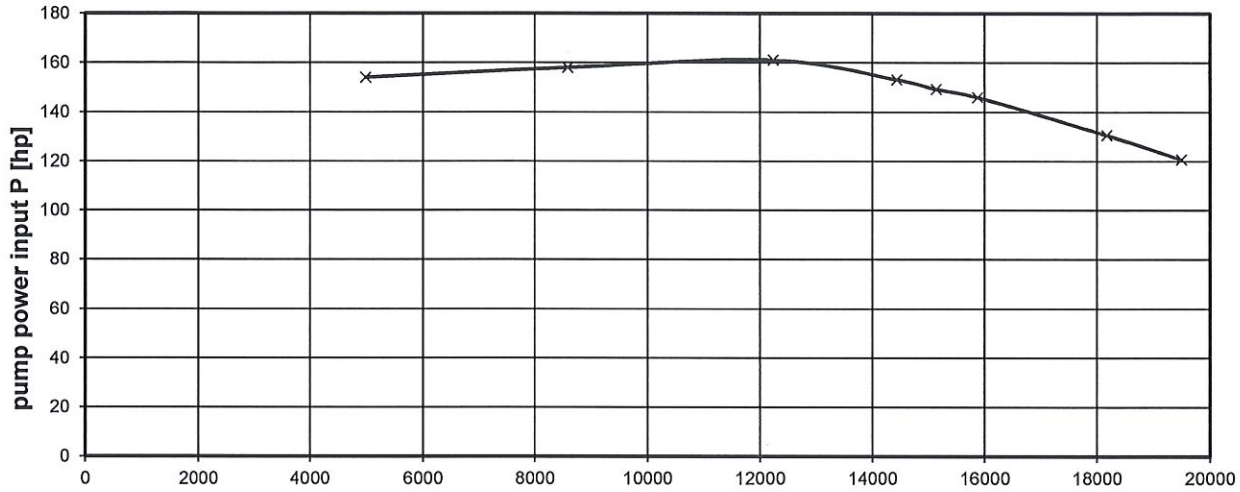
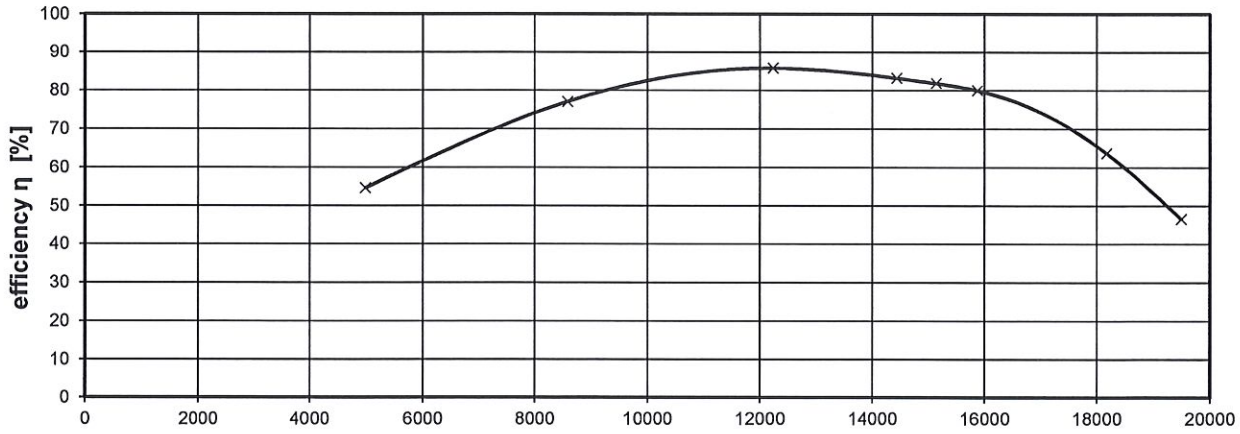
performance curves at operation speed from 890 to 892 r.p.m.







capacity Q [gal/min]

KSB

performance curves

\ DN 500 \ 9974145313_000100_395868

client reference

order nr. 9974145313_000100 date 15.01.2020

pump data	type	KRT K 500-634 / 130 8 X		D1 [mm]	D2 [mm]	D3 [mm]	D4 [mm]	D6 [mm]	Alpha [°]
report nr.	manufactur.	KSB Halle		521	473	515	446	280	16,03
20200115-122644	curve no.			Type A06					
motor data	type	K28 L08-130		frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur.	KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–
VERTICAL	serial no.	395868		60	174	890	460	219,0	0,80
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet	hp	%	r.p.m.	feet	lb/ft³	°F	in²/s
Hydr. Inst. cl. 1U	15216,06	30,76	154,71	76,35	891		62,3	68,0	0,0015

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PUMP P-4 – STORMWATER

9574145313/00010002

MOTOR # 395867

PROJECT: FT WASHINGTON WAY
PUMP: KRT K500-634/1308XNG-K
TAG: STORMWATER (P2 -P4)
S/N:395867
From Spec: Hydraulic Institute "1U"

		Positive	Negative
Flow Tolerance	(%)	**10**	**0**
Head Tolerance	(%)	**6**	**0**

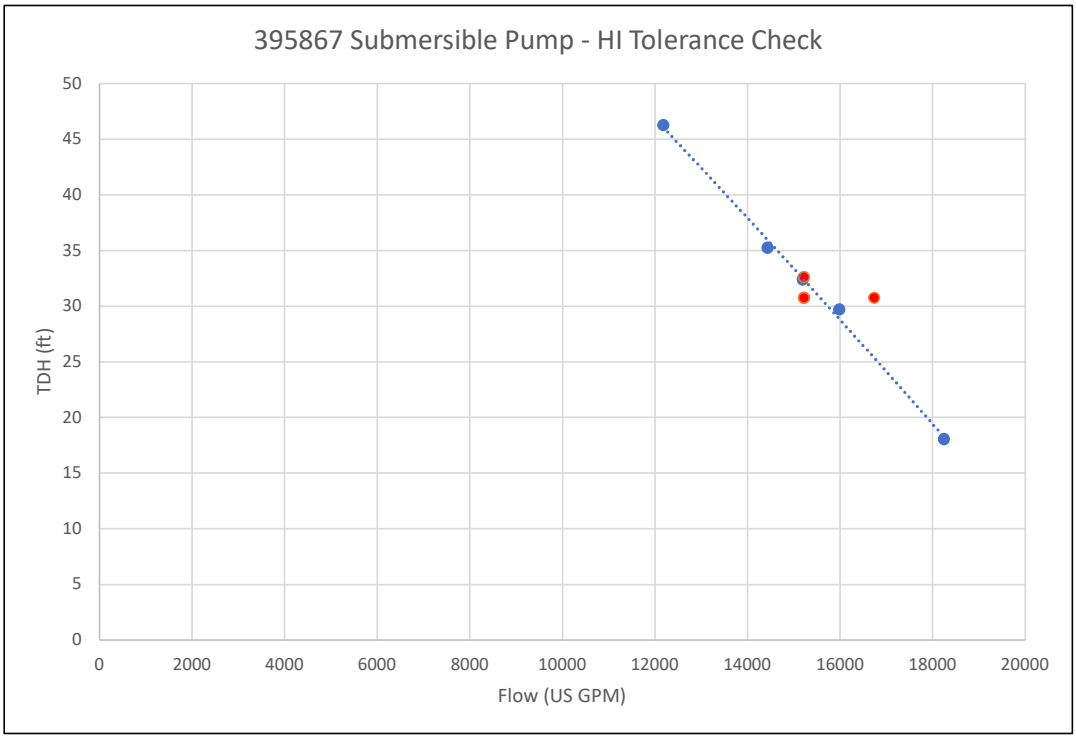
	Guar. Point	Tolerance		Values	
		+	-	+	-
Flow	15216.06	0.1	0	16737.67	15216
Head	30.76	0.06	0	32.6	30.8

Data

	Flow	Head
3	12180.86	46.26
4	14431.37	35.25
5	15189.53	32.38
6	15980.24	29.71
7	18244.41	18.05

Tolerances

Flow	Head
15216.06	30.76
15216.06	32.6
15216.06	30.8
16737.67	30.8
15216	30.76



KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	9974145313_000100	*curve no.:*	
pump type:	KRT K 500-634 / 130 8 XNG-K	*manufacturer:*	KSB Halle
serial no.:	395867	*KSB location:*	HA
construction:	vertical	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	K28 L08-130	
serial no.:	395867		*client motor:*	VERTICAL	
motor rated power:	174	hp	*speed:*	890	r.p.m.
voltage:	460	Volt	*current:*	219	Ampere
cos φ:	0,8	-	*frequency:*	60	Hz

Guarantee Data

capacity	15216,06	gal/min	*head H:*	30,76	feet
pump input power P:	154,71	hp	*speed n:*	891	r.p.m.
pump efficiency η:	76,35	%	*density ρ:*	62,3	lb/ft³
NPSH:		feet	*kin. viscosity:*	0,0015	in²/s
acceptance test class	Hydr. Inst. cl. 1U		*fluid temperature T:*	68,00	°F

Measure Instructions

impeller trimming type AN 1528	Type A06	D1	521 mm	D2	473 mm
		D3	515 mm	D4	446 mm
		D6	280 mm	Alpha	16,03 °

measured data

measured values	dimension	1	2	3	4	5	6	7	8
speed n	r.p.m.	890,7	890,5	890,4	890,7	890,9	891,0	891,9	892,2
temperature T	°F	71,8	71,9	71,8	71,8	71,8	71,8	71,8	71,8
capacity Q	**gal/min**	**5054,19**	**8585,29**	**12180,86**	**14431,37**	**15189,53**	**15980,24**	**18244,41**	**19471,34**
motor input power Pel	hp	168,41	174,59	177,88	168,46	164,97	160,66	140,43	134,69
voltage U	V	464,6	460,4	460,5	460,5	461,7	464,2	465,2	466,9
current I1	A	198,32	204,42	208,34	199,12	195,59	191,13	172,36	167,21
current I2	A	199,06	205,49	209,23	199,91	196,33	191,77	173,04	167,84
current I3	A	199,64	206,29	209,82	200,52	196,94	192,37	173,55	168,32
cos phi	-	0,784	0,795	0,795	0,788	0,784	0,777	0,752	0,740
calculated values									
density ρ	lb/ft³	62,3	62,3	62,3	62,3	62,3	62,3	62,3	62,3
total head H	**feet**	**66,90**	**56,69**	**46,26**	**35,25**	**32,38**	**29,71**	**18,05**	**12,66**
motor efficiency η mot	%	92,76	92,75	92,74	92,76	92,76	92,76	92,68	92,63
cool. jack. eff. η cool	%	98,71	98,76	98,78	98,71	98,69	98,65	98,46	98,39
pump input power P2	**hp**	**154,20**	**159,92**	**162,95**	**154,25**	**151,02**	**147,02**	**128,14**	**122,75**
pump power P2 ρ ordered	hp	154,23	159,95	162,98	154,28	151,05	147,05	128,16	122,77
pump efficiency η	**%**	**55,31**	**76,77**	**87,23**	**83,17**	**82,15**	**81,45**	**64,83**	**50,65**
η total (pump+motor)	%	50,65	70,32	79,91	76,16	75,20	74,54	59,16	46,16

Remarks:
P+C: Birgit Bock

\ DN 500 \ 9974145313_000100_395867

test record nr.	20200115-043014
test person	Schö
test bench name	Prüfstand P9
test bench type	open
*quality check *)*	
date	15.01.2020

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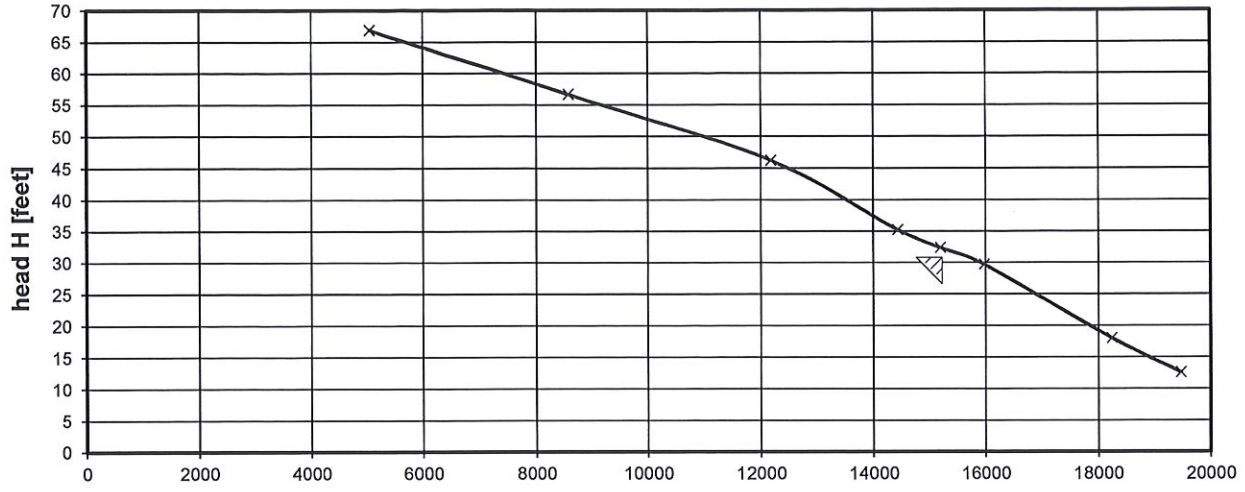
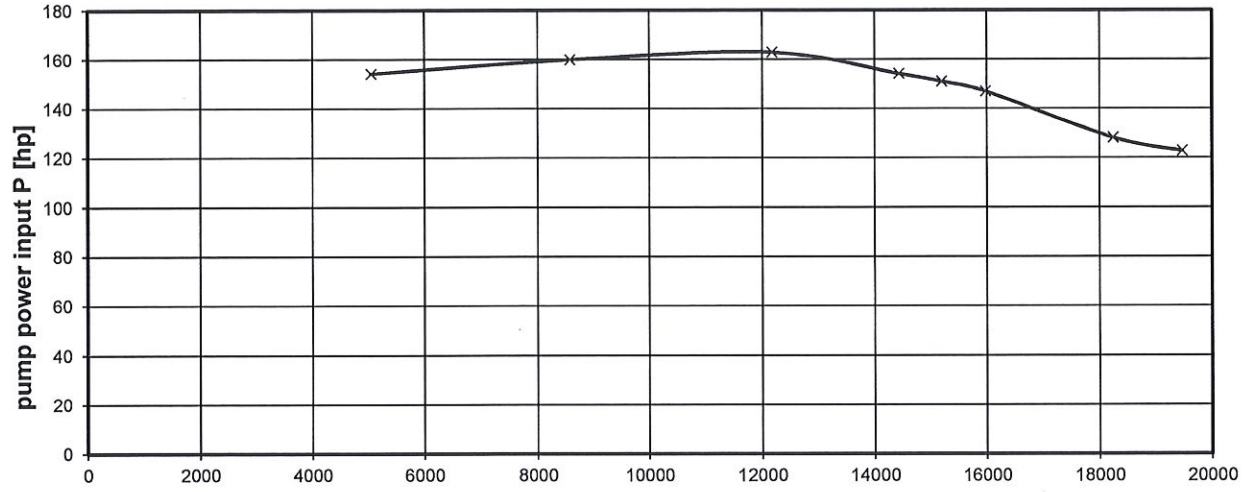
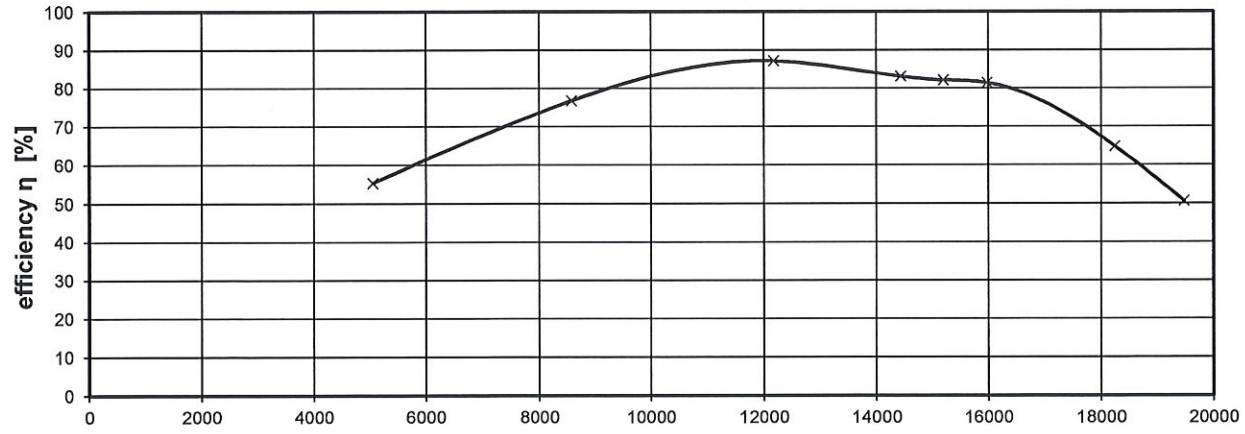
performance curves at operation speed from 890 to 892 r.p.m.







capacity Q [gal/min]

KSB	performance curves			client reference					
	\ DN 500 \ 9974145313_000100_395867			order nr. 9974145313_000100				date 15.01.2020	
pump data	type KRT K 500-634 / 130 8 X		D1 [mm]	D2 [mm]	D3 [mm]	D4 [mm]	D6 [mm]	Alpha [°]
report nr.	manufactur. KSB Halle		521	473	515	446	280	16,03
20200115-043014	curve no.		Type A06					
motor data	type K28 L08-130		frequency Hz	P motor hp	speed n r.p.m.	voltage Volt	current Ampere	cos φ –
client motor	manufactur. KSB Halle							
VERTICAL	serial no. 395867		60	174	890	460	219,0	0,80
ordered data	capacity Q gal/min	head H feet	P pump hp	η pump %	speed n r.p.m.	NPSH feet	density ρ lb/ft³	temp. hot °F	kin. visk in²/s
acceptance test class									
Hydr. Inst. cl. 1U	15216,06	30,76	154,71	76,35	891		62,3	68,0	0,0015

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SUMP PUMP

500926443/2000/1

MOTOR # 70368196

PROJECT: **FT WASHINGTON WAY**
PUMP: **KRT F80-217/24XEG-S IE3**
TAG: SUMP PUMP

From Spec: Hydraulic Institute "1-10 kW"

		Positive	Negative
Flow Tolerance	(%)	**10**	**10**
Head Tolerance	(%)	**8**	**8**

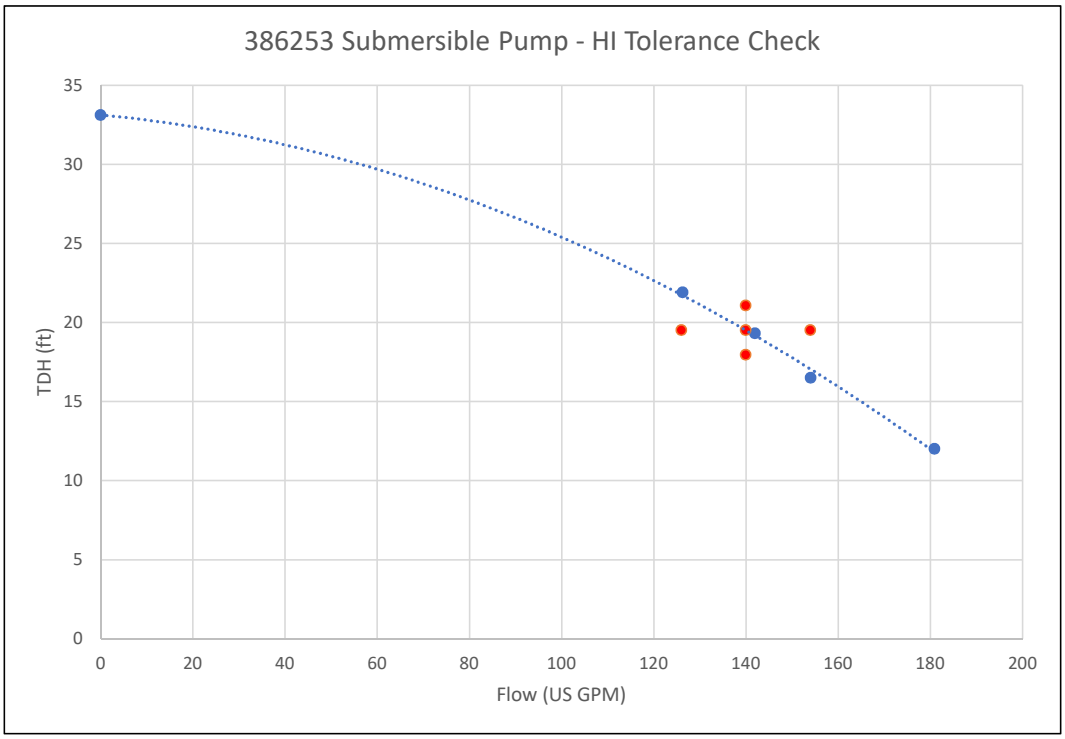
	Guar. Point	Tolerance		Values	
		+	-	+	-
Flow	140	0.1	0.1	154	126
Head	19.5	0.08	0.08	21.1	17.9

Data

Flow	Head
0	33.1
126.3	21.9
142	19.3
154.1	16.5
180.9	12

Tolerances

Flow	Head
140	19.5
140	21.1
140	17.9
154	19.5
126	19.5



KSB SE & Co. KGaA
Engineered Pumps Division

Inspection Record

Ordered Data

client:	KSB Inc.	client reference:	97889
order no.:	500926443	curve no.	2000-1
pump type:	Amarex KRT (50Hz)/80.217F	no. of stages:	1
serial no.:	500926443-2000-1	KSB location:	LILLE
construction:	KRTF 80-217/24XEG-S IE3	manufacturer:	KSB

Motor Data

manufacturer:		motor type:	24XEG
serial no.:	70368196	client motor:	
motor rated power:	2 hp (electric)	speed:	1746 rpm
voltage:	460 Volt	current:	2,74 Ampere
cos ϕ:	0,79 -	frequency:	60 Hz

Guaranteed data (Design)

capacity Q_G	141,48 gal/min (US)	head H:	19,92 feet
pump input power P_G:	1,85 hp (electric)	speed n:	1746 1/min
pump efficiency η_G:	38,5 %	density ρ:	998,23 kg/m³
NPSH_G:	0 m	kin. viskosity:	0,000001 m²/s
acceptance test class:	ISO 9906 P < 10 kW	water temperature T:	20 °C

Measure Instructions

diam. press. gauge inlet:	80 mm	diam. press. gauge discharge:	84,4 mm
geod. height z_M1 inlet:	0 m	geod. height z_M2 discharge:	0,1 m
geod. height impeller z_D:	0 m	gravitational acceleration:	9,80665 m/s²

measured data

measured values	dimension	1	2	3	4	5			
capacity discharge Q	gal/min (US)	-0,8	126,3	142,0	154,1	180,9			
total head Hd	feet	33,1	21,9	19,3	16,5	12,0			
pump input power P2	hp (electric)	1,4	1,9	1,9	1,7	1,7			
pump efficiency η	%	-0,5	37,4	36,8	36,8	32,0			
						test bench type		offen	

test record no.	test person	test bench name	date
20191003-215109	DESCAMPS Nicolas	KRT	03.10.2019

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KSB	KSB SE & Co. KGaA Engineered Pumps Division	Inspection Record

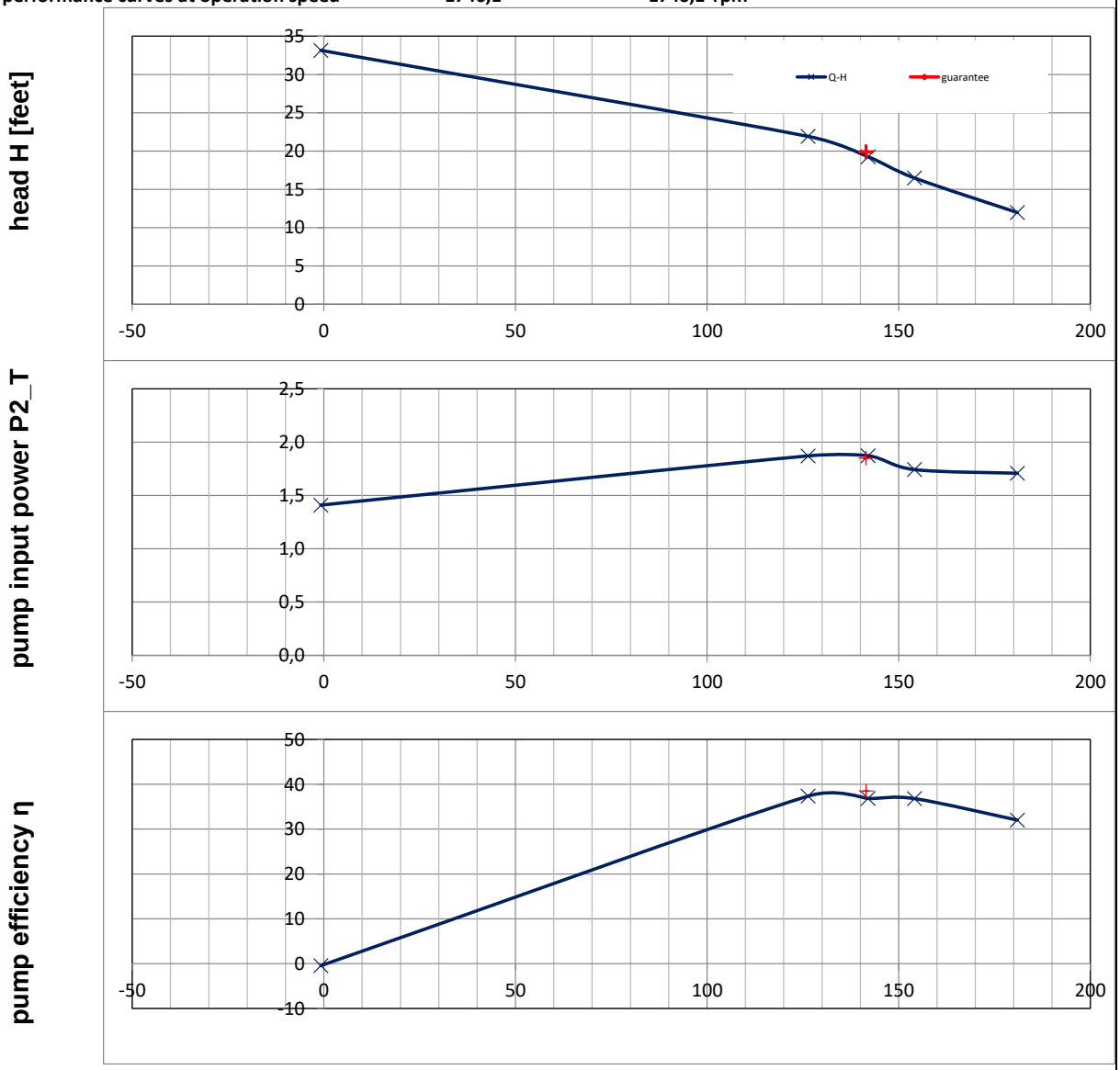
Ordered Data

client:	KSB Inc.	client reference:	97889	
order no.:	500926443	curve no.	2000-1	
pump type:	Amarex KRT (50Hz)/80.217F	no. of stages:		1
serial no.:	500926443-2000-1	KSB location:	LILLE	
construction:	KRTF 80-217/24XEG-S IE3	manufacturer:	KSB	

Guaranteed data (Design)

capacity Q_G	141,48 gal/min (US)	head H:	19,92 feet
pump input power P_G:	1,85 hp (electric)	speed n:	1746 1/min
pump efficiency η_G:	38,5 %	density ρ:	998,23 kg/m³
NPSH_G:	0 m	kin. viskosity:	0,000001 m²/s
acceptance test class:	ISO 9906 P < 10 kW	water temperature T:	20 °C

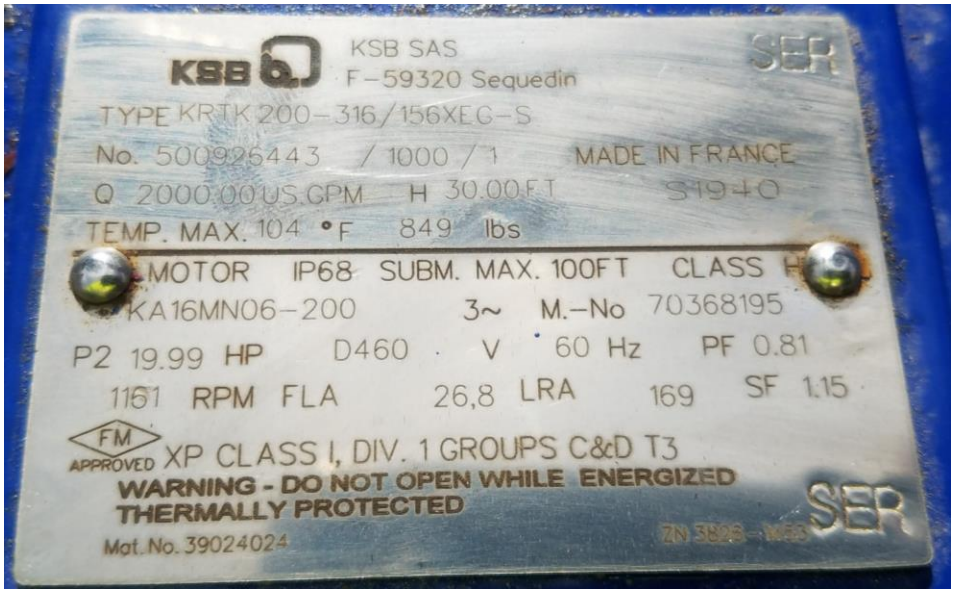
performance curves at operation speed **1746,1** **-** **1746,1** **rpm**



test record no.	test person	test bench name	date
20191003-215109	DESCAMPS Nicolas	KRT	03.10.2019

This report was created electronically and is valid without signature

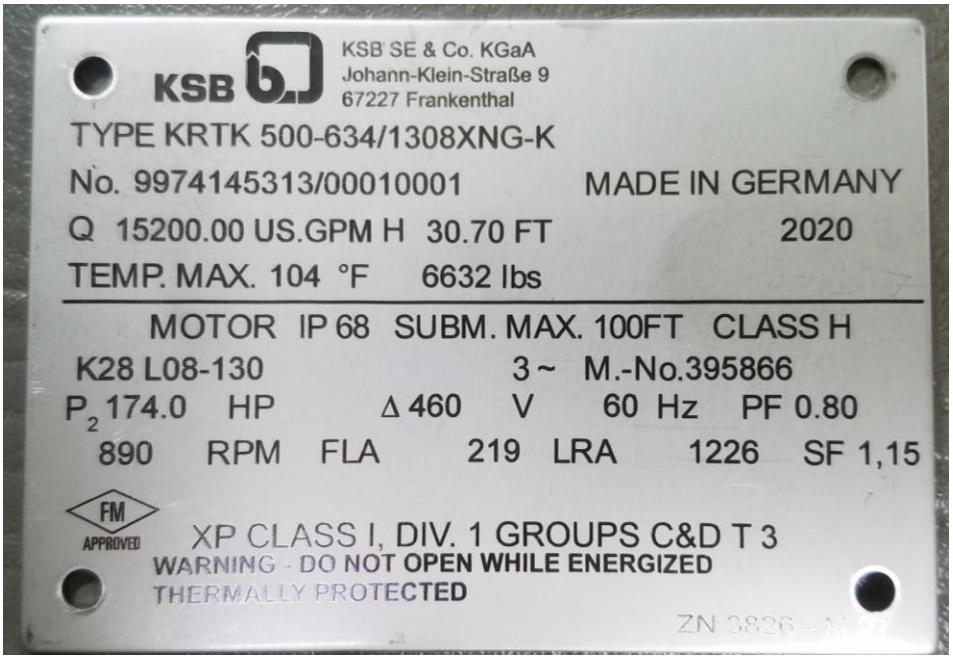
NAMEPLATE PHOTOS



P-1

Pump #: 500926443/1000/1

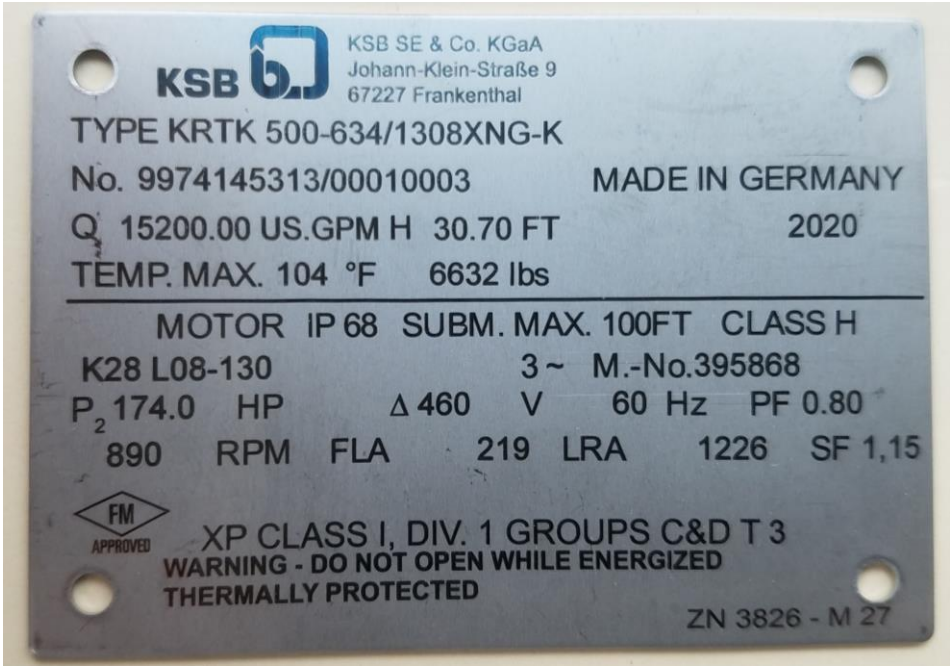
Motor #: 70368195



P-2

Pump #: 997414533/00010001

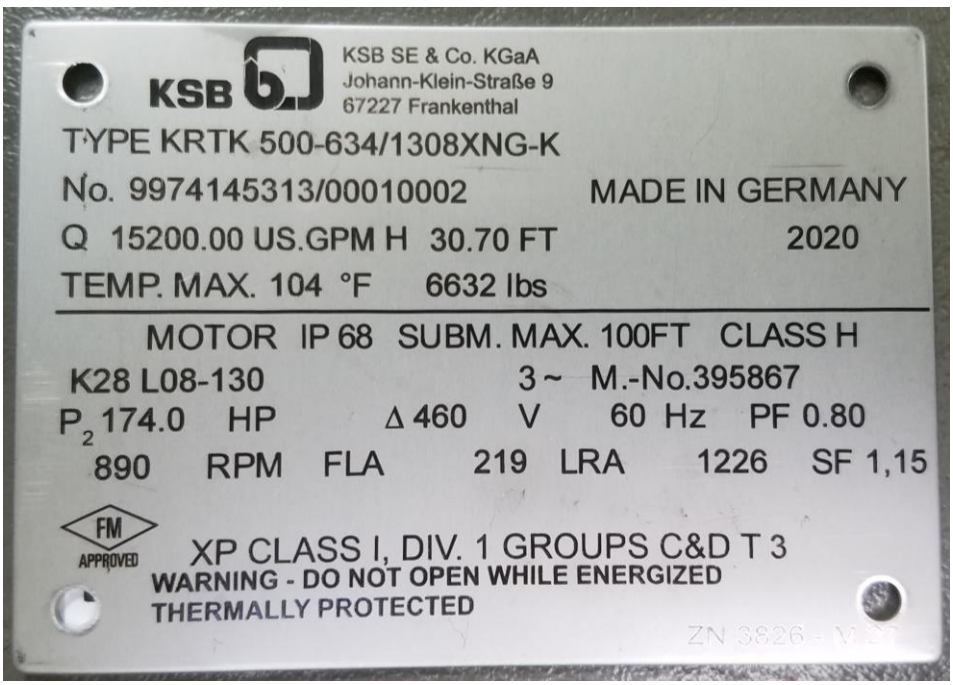
Motor #: 396866



P-3

Pump #: 997414533/00010003

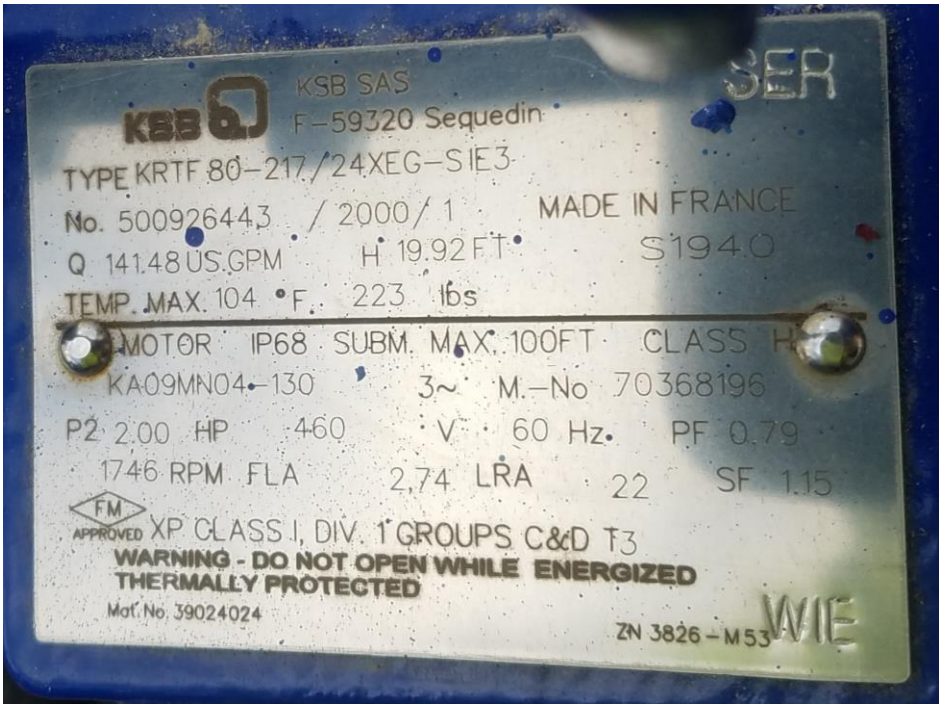
Motor #: 396868



P-4

Pump #: 997414533/00010002

Motor #: 396867



SUMP PUMP

Pump #: 500926443/2000/1

Motor #: 70368196

STARTUP REPORTS

Baker & Associates

1284 SOM Center Road, #215
Cleveland, Ohio 44124

PH (614) 361-3673 * Fax (614) 573-7626

February 14, 2020

Mosser Construction
Attn: Mr. Nick Steyer
122 South Wilson Avenue, Drawer D
Fremont, Ohio 43420

Re: ODOT Fort Washington Way Stormwater Pump Station – Pump Startup

Nick,

Yesterday I was on site to perform pump check-out/startup. Because this is a stormwater pump station and also a carefully staged design build project, it was not feasible for the pumps to be tested while I was on site. This is understandable and was fully expected.

The pump start-up forms for the project are attached. Because of the sequencing, there are some blanks. This is not uncommon for projects, so we typically note remaining recommended checks prior to placing the pumps into full operation. In this case, I chose to note these in this cover letter rather than repeating throughout the forms.

Prior to operation of the pumps we recommend:

1. Install PumpSafe monitoring relays provided on the project to monitor motor thermals and motor moisture sensor. (My understanding is that these are being installed with the controls replacement/upgrade.)

2. Verify all connections in the junction boxes are tight.

3. Provide appropriate cable management devices at the ceiling where the cables hang and pass over the pipes.

4. Install the remainder of the guide rails, cable hooks, and lifting cables (we realize you are waiting on delivery of the latter items).

5. Verify that the cable entries into the junction boxes are sealed to prevent corrosive gas entry and corrosion of terminals.

6. Verify rotation of the pumps.

7. If a run test is possible on water:

    a. Record voltage and current for all three legs as well as approximate wet well levels. (useful for future operational checks)
    b. Start each pump and then test pump safe (test button) and verify the controls stop the pumps. To be even more certain that the sensors are being monitored correctly while operating the pump (1) remove one of the thermal sensor leads at the control panel terminal strip – should alarm as thermal (after timer) and pump should stop and (2) jumper the two terminals for the moisture sensor – should alarm as moisture alarm and pump should stop.

In addition, we have two requests:

A. Please provide the dates on which each pump was placed into the wet well.
B. Please provide wiring diagrams and starter/soft start/overload information from the upgraded controls (for our record).

We know that the pumps are in expert hands with Doug/Allied. Please let us know if there are any other questions or concerns.

Sincerely,
BAKER & ASSOCIATES

Douglas D. Borkosky, P.E.

Attachments:
Startup Reports: 10 pp (2 pages per pump)
Wiring “Cheat Sheets” for Junction Box

P-1

KSB Warranty Department

Appendix 2: START UP FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Star-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020

Customer Name MOSSER CONSTRUCTION Owner Name OHIO DEPT. OF TRANS.

Station FORT WASHINGTON WAY City/State CINCINNATI, OHIO

Proof of Electrical Protection Form attached? Yes ☒ No ☐ If "no" state the reason _____

2. NAMEPLATE DATA

TYPE KRT K 200 - 316/156XEG-S

ORD. NO. 5009 26443 /1000/1 YEAR _____

Q 2000 GPM H 30.0

MOT. NO. 70368195 DKN KA 16 MN06 - 200

460 V 60 HZ 1161 RPM

PF 0.81 SF 1.15 19.99 HP

FLA 26.8 LRA 169 LIQ. TEMP 104 °F

MAX SUBMERGENCE 100 FT

3. MECHANICAL DATA

Suction Pressure (Dry Pit only) N/A Volute Vented (Dry Pit only)? Yes ☐ No ☐ N/A

Discharge Pressure NOT AVAIL. Flow NOT AVAIL.

Oil level checked? Yes ☐ No ☒ Impeller turn freely by hand? Yes ☒ No ☐

4. ELECTRICAL DATA

Verified Rotation? Yes ☐ No ☐

Starting Method _____

System Voltage (Pump Off) L1/L2 _____ L2/L3 _____ L1/L3 _____

Running Voltage L1/L2 _____ L2/L3 _____ L1/L3 _____

Running Amps L1 _____ L2 _____ L3 _____

5. NOTES

Form completed by _____

P-1

KSB Warranty Department

Appendix 3: PROOF OF ELECTRICAL PROTECTION FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Start-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020
Pump type KRT K 200-316/156XE6-8
Voltage 460 V FLA 26.8

2. CONTROL

Control Manufacturer
Overload Manufacturer
Overload Type Number
Rating according to: NEMA CSA Other (Specify)
Short circuit Protection Manufacturer
Type Rating
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☐ 4X ☐ Other (Specify) 12
Location CONTROL ROOM - SEP. FROM PS.

Electrical connections tighten? Yes ☐ No ☐
Condensation heater installed? Yes ☒ No ☐ Lightning arrester installed? Yes ☐ No ☐
↳ ROOM
Verified monitoring of pump sensors? Yes ☒ No ☐ VERBAL ON RELAYS, MEASURED SENSORS BLUE WIRES 3 & 4 242 Ω @ PUMP CABLE
Motor thermal used Bi-metals 21/22 ☐ PTC's 10/11 ☒
Control response to trip Shutdown ☐ Alarm only ☐
If PTC's, monitoring relay type
Motor Moisture Sensor provided 9/ //? Yes ☒ No ☐ BLUE 5 (#9 FUNC) & G/4
Control response to trip Shutdown ☐ Alarm only ☐
Monitoring relay type ∞ Ω @ PUMP CABLE
Lower Bearing Temp Sensor provided 15/16? Yes ☐ No ☐
Control response to trip Shutdown ☐ Alarm only ☐
Monitoring relay type
Fan Motor operates properly (Vertical dry pit only)? Off bi-metals 20/21 Yes ☐ No ☐ N/A

3. JUNCTION BOX

Electrical connections tighten? Yes ☐ No ☐
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☒ 4X ☐ Other (Specify) EXPLOSION PROOF
Location WALKWAY IN PUMP STATION
Condensation heater installed? Yes ☐ No ☒
Form completed by:

P-2
#0001

KSB Warranty Department

Appendix 2: START UP FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Star-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020

Customer Name MOSSER CONSTRUCTION Owner Name OHIO DEPT. OF TRANS.
Station FORT WASHINGTON WAY PS City/State CINCINNATI, OH

Proof of Electrical Protection Form attached? Yes ☒ No ☐ If "no" state the reason

2. NAMEPLATE DATA

TYPE KRT K 500-634/1308XNG-K
ORD. NO. 997 414 5313/0001 0001 YEAR 2020
Q 15200 GPM H 30.7
MOT. NO. 395866 DKN K28 L08-130
460 V 60 HZ 890 RPM
PF 0.80 SF 1.15 174 HP
FLA 219 LRA 1226 LIQ. TEMP 104 °F
MAX SUBMERGENCE 100 FT

3. MECHANICAL DATA

Suction Pressure (Dry Pit only) N/A Volute Vented (Dry Pit only)? Yes ☐ No ☐ N/A
Discharge Pressure NOT AVAIL Flow NOT AVAIL
Oil level checked? Yes ☒ No ☐ Impeller turn freely by hand? Yes ☒ No ☐
COOLANT ADDED ≃ ½ GALLON

4. ELECTRICAL DATA

Verified Rotation? Yes ☐ No ☐
Starting Method
System Voltage (Pump Off) L1/L2 L2/L3 L1/L3
Running Voltage L1/L2 L2/L3 L1/L3
Running Amps L1 L2 L3

5. NOTES

Form completed by

#0001 P-2

KSB Warranty Department

Appendix 3: PROOF OF ELECTRICAL PROTECTION FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Start-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020
Pump type KRT K 500-634/1308XN6-L
Voltage 460V FLA 219

2. CONTROL

Control Manufacturer
Overload Manufacturer
Overload Type Number
Rating according to: NEMA CSA Other (Specify)
Short circuit Protection Manufacturer
Type Rating
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☐ 4X ☐ Other (Specify) 12
Location CONTROL ROOM - SEP. FROM PS

Electrical connections tighten? Yes ☐ No ☐
Condensation heater installed? Yes ☒ No ☐ Lightning arrester installed? Yes ☐ No ☐
→ ROOM HEATER
Verified monitoring of pump sensors? Yes ☒ No ☐ VERBAL ON RGLAYS, MEASURED SENSORS WIRES 1 & 2 287.3 Ω @ PUMP CABLE

Motor thermal used Bi-metals 21/22 ☐ PTC's 10/11 ☒
Control response to trip Shutdown ☐ Alarm only ☐
If PTC's, monitoring relay type

Motor Moisture Sensor provided 9/ ?? Yes ☒ No ☐ WIRES 9 & 6/4 ∞ Ω @ PUMP CABLE
Control response to trip Shutdown ☐ Alarm only ☐
Monitoring relay type

Lower Bearing Temp Sensor provided 15/16? Yes ☒ No ☐ WIRES 5 & 6 102 Ω @ PUMP CABLE
Control response to trip Shutdown ☐ Alarm only ☐
Monitoring relay type
→ LEAKAGE CHAMBER - WIRES 3/4 - 1.0 Ω @ PUMP CABLE
Fan Motor operates properly (Vertical dry pit only)? Off bi-metals 20/21 Yes ☐ No ☐ N/A

3. JUNCTION BOX

Electrical connections tighten? Yes ☐ No ☐
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☒ 4X ☐ Other (Specify) EXPLOSION PROOF
Location WALKWAY OUTSIDE PUMP STA.
Condensation heater installed? Yes ☐ No ☐
Form completed by:

P-3

#0003

KSB Warranty Department

Appendix 2: START UP FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Star-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020

Customer Name MOSSER CONSTRUCTION Owner Name OHIO DEPT. OF TRANS

Station FORT WASHINGTON WAY PS City/State CINCINNATI, OH

Proof of Electrical Protection Form attached? Yes X No ☐ If "no" state the reason

2. NAMEPLATE DATA

TYPE KRT K 500-634/1308XNG-K

ORD. NO. 9974145313/0001 0003 YEAR 2020

Q 15,200 GPM H 30,70

MOT. NO. 395868 DKN K28 L08-130

460 V 60 HZ 890 RPM

PF 0.80 SF 1.15 174 HP

FLA 219 LRA 1226 LIQ. TEMP 104 °F

MAX SUBMERGENCE 100 FT

3. MECHANICAL DATA

Suction Pressure (Dry Pit only) N/A Volute Vented (Dry Pit only)? Yes ☐ No ☐ N/A

Discharge Pressure NOT AVAIL Flow

~~Oil level~~ COOLANT checked? Yes X No ☐ Added ~ ½ GALLON Impeller turn freely by hand? Yes X No ☐

4. ELECTRICAL DATA

Verified Rotation? Yes ☐ No ☐

Starting Method

System Voltage (Pump Off) L1/L2 L2/L3 L1/L3

Running Voltage L1/L2 L2/L3 L1/L3

Running Amps L1 L2 L3

5. NOTES

Form completed by

P-3 #0003

KSB Warranty Department

Appendix 3: PROOF OF ELECTRICAL PROTECTION FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Start-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020
Pump type KRT K 500-634/1308XN6-K
Voltage 460 FLA 219

2. CONTROL

Control Manufacturer
Overload Manufacturer
Overload Type Number
Rating according to: NEMA CSA Other (Specify)
Short circuit Protection Manufacturer
Type Rating
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☐ 4X ☐ Other (Specify) 12
Location CONTROL RM - SEP FROM PS

Electrical connections tighten? Yes ☐ No ☐
Condensation heater installed? Yes ☒ No ☐ → ROOM HEATER
Lightning arrester installed? Yes ☐ No ☐

Verified monitoring of pump sensors? Yes ☒ No ☐ VERBAL ON RELAY, MEASURED SENSORS WIRES 1 + 2 @ 307.5 Ω AT PUMP CABLE

Motor thermal used Bi-metals 21/22 ☐ PTC's 10/11 ☒
Control response to trip Shutdown ☐ Alarm only ☐
If PTC's, monitoring relay type

Motor Moisture Sensor provided 9/ //? Yes ☒ No ☐ WIRES 9 + G/Y ∞ Ω @ PUMP CABLE
Control response to trip Shutdown ☐ Alarm only ☐
Monitoring relay type

Lower Bearing Temp Sensor provided 15/16? Yes ☒ No ☐ 101.8 Ω @ PUMP CABLE (WIRES 5+6)
Control response to trip Shutdown ☐ Alarm only ☐
Monitoring relay type

NOTE: LEAKAGE CHAMBER WIRES 3/4 : 0.9 Ω @ PUMP CABLE

Fan Motor operates properly (Vertical dry pit only)? Off bi-metals 20/21 Yes ☐ No ☐ NA

3. JUNCTION BOX

Electrical connections tighten? Yes ☐ No ☐
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☒ 4X ☐ Other (Specify) EXPLOSION PROOF
Location WALKWAY WITHIN PS
Condensation heater installed? Yes ☐ No ☒
Form completed by:

P-4

#0002

KSB Warranty Department

Appendix 2: START UP FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Star-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020

Customer Name MOSSER CONSTRUCTION Owner Name OHIO DEPT. OF TRANS.

Station FORT WASHINGTON WAY PS City/State CINCINNATI, OH

Proof of Electrical Protection Form attached? Yes ☒ No ☐ If "no" state the reason ____

2. NAMEPLATE DATA

TYPE KRT K 500-634/1308XNG-K

ORD. NO. 9974145313/00010002 YEAR 2020

Q 15200 GPM H 30.7

MOT. NO. ____ DKN K28 L08-150

460 V 60 HZ 890 RPM

PF 0.80 SF 1.15 174 HP

FLA 219 LRA 1226 LIQ. TEMP 104 °F

MAX SUBMERGENCE 100 FT

3. MECHANICAL DATA

Suction Pressure (Dry Pit only) N/A Volute Vented (Dry Pit only)? Yes ☐ No ☐ N/A

Discharge Pressure NOT AVAIL Flow NOT AVAIL

Oil level checked? Yes ☒ No ☐ Impeller turn freely by hand? Yes ☒ No ☐

COOLANT → ADDED ≈ 1/2 GAL

4. ELECTRICAL DATA

Verified Rotation? Yes ☐ No ☐

Starting Method ____

System Voltage (Pump Off) L1/L2 ____ L2/L3 ____ L1/L3 ____

Running Voltage L1/L2 ____ L2/L3 ____ L1/L3 ____

Running Amps L1 ____ L2 ____ L3 ____

5. NOTES

Form completed by Parker D Bailey

P-4

#0002

KSB Warranty Department

Appendix 3: PROOF OF ELECTRICAL PROTECTION FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Start-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020

Pump type KRT K, 500-634/1308 XNG-E

Voltage 460V FLA 219

2. CONTROL

Control Manufacturer _____

Overload Manufacturer _____

Overload Type _____ Number _____

Rating according to: NEMA _____ CSA _____ Other (Specify) _____

Short circuit Protection Manufacturer _____

Type _____ Rating _____

Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☐ 4X ☐ Other (Specify) 12

Location CONTROL ROOM - SEP. FROM P.S

Electrical connections tighten? Yes ☐ No ☐

Condensation heater installed? Yes ☒ No ☐ Lightning arrester installed? Yes ☐ No ☐

↳ ROOM HEATER

Verified monitoring of pump sensors? Yes ☒ No ☐ VERIFIED ON RELAY, MEASURED SENSORS WIRES 1&2 312Ω @ PUMP CABLE

Motor thermal used Bi-metals 21/22 ☐ PTC's 10/11 ☒

Control response to trip Shutdown ☐ Alarm only ☐

If PTC's, monitoring relay type _____

Motor Moisture Sensor provided 9/~~11~~? Yes ☐ No ☐ WIRES 9+6/4 ∞Ω @ PUMP CABLE

Control response to trip Shutdown ☐ Alarm only ☐

Monitoring relay type _____

Lower Bearing Temp Sensor provided 15/16? Yes ☐ No ☐ WIRES 5&6 101.8Ω @ PUMP CABLE

Control response to trip Shutdown ☐ Alarm only ☐

Monitoring relay type _____

LEAKAGE CHAMBER WIRES 3&4: 1.1Ω @ PUMP CABLE 1.1Ω

Fan Motor operates properly (Vertical dry pit only)? Off bi-metals 20/21 Yes ☐ No ☐ N/A

3. JUNCTION BOX

Electrical connections tighten? Yes ☐ No ☐

Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☒ 4X ☐ Other (Specify) EXPLOSION PROOF

Location WALKWAY WITHIN P.S

Condensation heater installed? Yes ☐ No ☐

Form completed by: _____

Sump Pump

KSB Warranty Department

Appendix 2: START UP FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Star-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020

Customer Name MOSSER CONSTRUCTION Owner Name OHIO DEPT. OF TRANS.

Station FORT WASHINGTON WAY PS City/State CINCINNATI, OH

Proof of Electrical Protection Form attached? Yes ☒ No ☐ If "no" state the reason

2. NAMEPLATE DATA

TYPE KRT F80-217/24 XEG-5' IE3

ORD. NO. 500926443/200/1 YEAR

Q 141.48 GPM H 19.92

MOT. NO. 70348196 DKN KA09MN04-130

460 V 60 HZ 1746 RPM

PF 0.79 SF 1.15 2.00 HP

FLA 2.74 LRA 22 LIQ. TEMP 104 °F

MAX SUBMERGENCE 100 FT

3. MECHANICAL DATA

Suction Pressure (Dry Pit only) N/A Volute Vented (Dry Pit only)? Yes ☐ No ☐ N/A

Discharge Pressure NOT AVAIL Flow NOT AVAIL

Oil level checked? Yes ☐ No ☒ Impeller turn freely by hand? Yes ☒ No ☐

4. ELECTRICAL DATA

Verified Rotation? Yes ☐ No ☐

Starting Method

System Voltage (Pump Off) L1/L2 L2/L3 L1/L3

Running Voltage L1/L2 L2/L3 L1/L3

Running Amps L1 L2 L3

5. NOTES

Form completed by

KSB
Warranty Department

Appendix 3: PROOF OF ELECTRICAL PROTECTION FORM

This form must be completed at initial start-up of each pump, in order to validate warranty coverage. Warranty claim for a pump that does not have a completed Start-up Form on record may be denied, regardless failure.

1. GENERAL INFORMATION

KSB Inc. Sales Order Number 98465 Date of Start-up 2/13/2020
Pump type KRT K F80-2T7/24XEG-S IG 3
Voltage 460 V FLA 2.74

2. CONTROL

Control Manufacturer
Overload Manufacturer
Overload Type Number
Rating according to: NEMA CSA Other (Specify)
Short circuit Protection Manufacturer
Type Rating
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☐ 4X ☐ Other (Specify) 12
Location CONTROL RM - SEP. FROM SENSORS

Electrical connections tighten? Yes ☐ No ☐
Condensation heater installed? Yes ☒ No ☐ Lightning arrester installed? Yes ☐ No ☐
→ ROOM HEATER
Verified monitoring of pump sensors? Yes ☒ No ☐ — VERBAL ON RELAY, MEASURED SENSORS
SENSOR 1 (20/21) SENSOR 2 WIRES 5/6
Motor thermal used ~~Bi-metals 21/22~~ ☐ ~~PTC's 10/11~~ ☒ FUNCTIONAL 21/22
Control response to trip Shutdown ☐ Alarm only ☐
If PTC's, monitoring relay type 1.0 Ω @ PUMP CABLE

Motor Moisture Sensor provided 9/ ~~11~~? Yes ☒ No ☐
Control response to trip Shutdown ☐ Alarm only ☐ WIRE 7 (FUNC. 9) +G/Y
Monitoring relay type ∞ Ω @ PUMP CABLE

Lower Bearing Temp Sensor provided 15/16? Yes ☐ No ☐
Control response to trip Shutdown ☐ Alarm only ☐
Monitoring relay type

Fan Motor operates properly (Vertical dry pit only)? Off bi-metals 20/21 Yes ☐ No ☐

3. JUNCTION BOX

Electrical connections tighten? Yes ☐ No ☐
Enclosure (NEMA) 1 ☐ 3 ☐ 3R ☐ 4 ☒ 4X ☐ Other (Specify) EXPLOSION PROOF
Location WALKWAY IN PUMP STATION
Condensation heater installed? Yes ☐ No ☒
Form completed by:

Pump Cable Termination “Cheat Sheets”