F. WAYNE HILL WATER RESOURCES CENTER
PHASE II, CONTRACT 3
SOLIDS, STORAGE, AWT FACILITIES

VOLUME 1
11530: EGG SHAPED DIGESTERS & APPURTENANCES OPERATION & MAINTENANCE MANUALS
DRAFT TUBE MIXERS 40:DSL-MIX-3 THRU 5

STERLING FLUID SYSTEMS (USA) ORIGINAL SHOP ORDER 23030042

F. WAYNE HILL WATER RESOURCES CENTER
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11530: EGG SHAPED DIGESTERS & APPURTENANCES
CONTRACT DRAWINGS: VOLUMES 9 & 10
RESIDUALS GALLERY 2

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CONTRACTOR

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DRAFT TUBE SLUDGE MIXERS

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Model GMF-B/10/1250/N/0/0/4/0/0/0/0/6/0

- LEAFLET NO. 0009.06.90.GB
- LEAFLET NO. 9002.06.90.GB
- LEAFLET NO. 0005.06.90.GB
- LEAFLET NO. 0006.06.90.GB
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SECTION 1: GENERAL INFORMATION

Gwinnett County Phase II
F. Wayne Hill Water Resources Center
CBI PO 139424/Contract127047

1.0 GENERAL

1.1 EQUIPMENT MANUFACTURER: Sterling Fluid Systems (USA)
Grand Island, N.Y.

1.2 EQUIPMENT MODEL NUMBER MFS-4

1.3 PRELIMINARY REMARKS:

These operating instructions must be available to all personnel entrusted with the operation of the plant. These instructions are not a substitute for thorough training of the operating and maintenance personnel. It is recommended that the operating personnel be employed during the start-up phase.

When working on the machine or operating it, please always ensure optimum safety for all people involved.

In the event of non-compliance with of these instructions

- people or the environment may be put at risk
- the machine could be damaged
- Sterling Fluid Systems (USA) will not accept any responsibility for resulting damage.

If in doubt, or if irregularities occur in the operation of the plant, do not hesitate to contact Sterling Fluid Systems (USA)

The mixer is provided with a nameplate that shows the type designation, Registration Number, and rating. If you have any questions or if irregularities occur, please contact us, indicating this information. In the event of spare part order placements, please also state the designation or number on the sectional drawing and the parts list.

Particular care should be taken that:

- The shaft of the mixer can be rotated manually during standstill. (The motor power supply must be locked out).
- During operation the specified operating voltage is available. Monitoring the current consumption during operation is the best method of ascertaining any irregularities in operation.
- The necessary lubricants are stored in clean closed cans. These lubricants should not be released for general lubrication purposes in the water treatment plant. Claims for damages caused by faulty and improper handling shall not be accepted.

1.4 EQUIPMENT SUMMARY DATA SHEETS:

EQUIPMENT ITEM: DRAFT TUBE SLUDGE MIXER

MANUFACTURER: STERLING FLUID SYSTEMS

COMPONENT INFORMATION: NAMEPLATE DATA	
MODEL/PART: MFS 4	RATED OUTPUT: 6,500 GPM
TYPE: NA	MAX. RPM: 600 RATED RPM: 720
SIZE: NA	OPERATION: REVERSIBLE
CAPACITY: 6,500 GPM +/-10%	SERVICE: CONTINUOUS
PERTINENT DRAWINGS:	QUANTITY:
MiXER ASSEMBLY : L141.5498.51.0238 Rev.3	MFS – 4 Mixers : (3)
MiXER SECTION : L127.5498.26.0172	
PARTS LIST : L127.5498.35.0016 Rev. A	SERIAL NUMBERS:
	359386-011/LU0209845301
	359386-021/LU0209845302
	359386-031/LU0209845303

EQUIPMENT ITEM: MIXER DRIVE MOTOR

MANUFACTURER: GENERAL ELECTRIC

COMPONENT INFORMATION: NAMEPLATE DATA	
MODEL/PART: 5KS364GT501P	FULL LOAD RPM: 705
HORSEPOWER: 20	SF: 1.15 PF: 79.0 EFF: 90.5
ENCLOSURE: TEFC-XP FRAME: I364HP16	PH/FREQ/VOLT: 3/60/460
DESIGN: 36DS5052A TYPE: KS	AMPS (FL): 26
QUANTITY: 3	SERIAL NUMBERS:
	0107336A, 0107336B, 0107336C

1.4 EQUIPMENT SUMMARY DATA SHEETS: (CONTINUED)

EQUIPMENT ITEM: **MIXER GREASE PUMP & MOTOR**

MANUFACTURER: **WOERNER GEASE PUMP & FELTEN & GUILLEAUME MOTOR**

COMPONENT INFORMATION: NAMEPLATE DATA	
GREASE PUMP INFO	**QUANTITIES**
MODEL: GMF-B/10/1250/N/0/0/4/0/0/0/0/6/0	GREASE PUMP: 3
GREASE PUMP MOTOR INFO	PUMP MOTOR: 3
HORSEPOWER (kW): 0.3 (0.21)	
RPM: 1800	
CATALOG NO.:	
FRAME:	
ENCLOSURE: IP 55 EEx e d IICT4 (Explosion-proof))	
FULL LOAD RPM: 1770	
SF: 1.15 PF: 50.0 EFF: 75.5	
PH/FREQ/VOLT: 3/60/460	

1.4 EQUIPMENT SUMMARY DATA SHEETS: (CONTINUED)

EQUIPMENT ITEM: FLEXIBLE COUPLING

MANUFACTURER: FLENDER

COMPONENT INFORMATION: NAMEPLATE DATA	
MODEL/PART: N-EUPEX	QUANTITIY: 3
TYPE: A	
SIZE: 140	

1.5 CONTACTS NAMES:

FOR ALL QUESTIONS CONTACT:

STERLING FLUID SYSTEMS (USA)
ATTN: SERVICE DEPARTMENT
PHONE: 716-773-6450 EXT 216
FAX: 716-773-2330

1.6 EQUIPMENT MANUFACTURERS:

EQUIPMENT TYPE	*MANUFACTURER/ADDRESS*	*PHONE/FAX*
MIXER AND *GREASE PUMP* *GREASE PUMP MOTOR*	*STERLING FLUID SYSTEMS* *3O3 INDUSTRIAL BLVD.* *GRAND ISLAND, NY 14072* *Website: www.sterlingamericas.com*	*716-773-6350* *716-773-2330*
MIXER MOTOR	*GE SUPPLY* *6540 PEACHTREE IND. BLVD.* *NORCROSS, GA 30071* *Website: www.gesupply.com*	*770-840-4160* *770-242-9270*
COUPLING	*FLENDER* *950 TOLGATE RD.* *ELGIN, IL 60123-9397* *Website: www.flenderusa.com*	*800-867-3766* *847-931-0711*

1.7 STERLING FLUID SYSTEMS (USA)

STANDARD WARRANTY FOR DRAFT TUBE SLUDGE MIXERS

LIMITATION OF WARRANTIES, REMEDIES AND DAMAGES

a. **THE WARRANTY STATED BELOW IS IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ARISING OUT OF A COURSE OF DEALING ON USAGE OF TRADE OR OTHERWISE. NO PROMISE, WHETHER ORAL OR WRITTEN, OR AFFIRMATION OF FACT MADE BY SELLER'S AGENTS , EMPLOYEES OR REPRESENTATIVES WILL CONSTITUTE A WARRANTY BY SELLER OR GIVE RISE TO ANY LIABILITY OR OBLIGATION.**

Seller warrants that the goods manufactured by it are free from defects in workmanship and materials under normal use and service for a period of one year from the date of installation, or eighteen months from date of shipment from Seller, whichever comes first, provided the goods are used in accordance with instructions furnished by Seller. Seller makes no warranty with respect to goods or parts manufactured by others and those goods or parts carry only the warranty of their manufacturer.

Seller's obligation under any claim arising from the sale of goods or under this warranty will be limited exclusively to repair or replacement, at Seller's sole discretion, of parts Seller determines to be defective on inspection by an authorized representative of Seller. If not repaired, such parts will be replaced F.O.B. Seller's plant or other points of shipment and will be installed at Buyer's expense.

b. No action against Seller under this Order may be commenced after one year after the date of installation or after 18 months after the date of shipment from Seller.

c. **SELLER SHALL NOT BE LIABLE IN ANY EVENT FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, AS THOSE TERMS ARE DEFINED IN SECTION 2-715 OF THE UNIFORM COMMERCIAL CODE.**

NOTE	EXTENDED WARRANTY APPLIES – CHECK CONTRACT FOR DETAILS

SECTION 2: SAFETY

2.0 GENERAL COMMENTS REGARDING SAFETY:

These operating/fitting manuals contain basic instructions that are to be observed during installation, operation and maintenance.

It is therefore imperative that the fitter and the responsible personnel/user prior to assembly and commissioning read these manuals. It is always to be kept available at the installation site. It is not only the general safety instructions contained under this main heading safety (Sect. 2) that are to be observed but all the specific safety information (e.g. for private use), given in the manuals.

2.1 QUALIFICATION AND TRAINING OF OPERATING PERSONNEL:

The personnel responsible for operation, maintenance, inspection and assembly must be adequately qualified. Scope of responsibility and supervision of the personnel must be exactly defined by the user. If the staff do not have the necessary knowledge, they must be trained and instructed, which may be performed by the manufacturer/supplier on behalf of the user of the machine. Moreover, the user is to make sure that the contents of the operating/fitting manuals are fully understood by the personnel.

2.2 HAZARDS IN THE EVENT OF NON-COMPLIANCE OF THE SAFETY INSTRUCTIONS:

Non-observance of the safety instructions may result in hazards for personnel safety as well as for the environment and the machine. The non-observance of the safety instructions may lead to the loss of all claims for compensation. Non-observance may result in:

- Failure of important functions of the machine/plant
- Failure of specified procedures of maintenance and repair
- Injury by electrical, mechanical and chemical effects
- Environmentally damaging leakage of hazardous substances.

2.3 SAFE WORKING PRACTICES:

The safety instructions contained in these operating/fitting manuals, the existing federal and local regulations for the prevention of accidents and any internal working, operating and safety instructions imposed by the user must be followed.

2.4 SAFETY INSTRUCTIONS TO BE OBSERVED BY THE USER/OPERATOR:

- If hot or cold machine parts present a hazard, it is the customer's responsibility to provide protection against involuntary contact.
- Contact guards for moving parts (e.g. coupling) must not be removed with the machine in operation.
- Hazards caused by electrical power must be eliminated (for details see, for example, the regulations of the local public utilities).

2.5 SAFETY INSTRUCTIONS FOR MAINTENANCE, INSPECTION AND ASSEMBLY WORK:

It shall be the user's responsibility to ensure that all maintenance, inspection and authorized and qualified personnel who have adequately familiarized themselves with the subject matter by studying the operating/fitting manuals perform assembly work. Work on the machine shall only be performed when it is at rest. The procedure for shutting down the machine described in the operating/fitting manuals must be observed. On completion of work all safety and protective devices must be re-installed and made operative again. Prior to restarting the machine, the points listed under *Commissioning* are to be observed.

2.6 UNAUTHORIZED CONVERSIONS AND PRODUCTION OF SPARE PARTS:

Any conversion or alteration work on the machine is subject to the manufacturer's approval. The use of genuine spare parts, accessories, and *recommended mixer grease* authorized by the manufacturer serve to increase safety and equipment life. The use of other parts may render all liability null and void.

2.7 UNAUTHORIZED MODES OF OPERATION

The reliability of the supplied machine is only ensured if the machine is used properly as set out in operating instructions. The limit values given in the data sheet must never be exceeded

SECTION 3: TRANSPORT AND STORAGE

3.0 SAFETY MEASURES:

When carrying out transportation work, all generally established technical rules and regulations for prevention of accidents must be complied with.

Use only permissible and intact ropes and lifting equipment whose minimum load capacity is greater than the weight of the mixer. In addition, the instructions of the lifting equipment manufacturer should be observed.

Mixer Only (Rotor Assembly) – Model MFS 4: 2,725 lbs.

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3.1 DELIVERY:

Transport the mixer in horizontal position. Support the propeller area of the shaft. The equipment must not receive direct impact or shock when loading/unloading and during transport.

Immediately upon receipt, inspect mixer and accessories for damage incurred during shipment. Report any damage to the manufacturer.

3.2 SHORT TERM STORAGE:

The storage of components at the job-site shall be the responsibility of the contractor. The mixer manufacturer is not responsible for touch-up, repainting, or final painting of primed or painted surfaces at the job-site due to the unsuitable storage and handling by others

STORAGE PROCEDURES FOR THREE (3) MONTHS OR LESS

A. MIXERS/GREASE PUMPS/MOTORS/COUPLINGS/SPARE PARTS

- If the packaging and/or components appear damaged, contact Sterling Fluid Systems (USA) – Service Dept. at 716-773-6450.
- All components must remain in the original crating.
- Only personnel from Sterling Fluid Systems (USA) are authorized to ope n and inspect equipment.

3.2 SHORT TERM STORAGE: (CONTINUED)

STORAGE PROCEDURES FOR THREE (3) MONTHS OR LESS

A. MIXERS/GREASE PUMPS/MOTORS/COUPLINGS/SPARE PARTS

- Do not stack the crates.
- It is preferable that the mixing equipment, motors and job boxes are to be installed in a dry, enclosed, protected, heated area. However, the large mixer crates (at least 12foot long), may be temporarily stored outdoors in the original crates.
- Electrical motors are to be stored in a dry, enclosed, protected, heated area.

B. STRAIGHT SECTIONS OF DRAFT TUBE PIPES

- If the draft tubes appear damaged, contact Sterling Fluid Systems (USA) – Service Dept. at 716-773-6450.
- Do not place the pipes (draft tubes) directly on the ground/floor. Place on wooden blocks with a soft surface (i.e. cardboard, rug, etc.) between the block and pipe.
- Pipes may be stacked, but musty have wood blocking between pipes as described above.
- The draft tubes may be left in the outdoors if covered to protect the finish from deterioration caused by sun light.
- The preferred method of lifting the pipe is by soft sling and crane. Two slings should be used, one placed at either end of the pipe, behind the flange.

C. CASTINGS (UPPER AND LOWER)

- If the castings appear damaged, contact Sterling Fluid Systems (USA) – Service Dept. at 716-773-6450
- Do not remove castings from shipping pallets
- Similar castings (same type) may be stacked two high. *Do not stack* dissimilar castings.
- The castings may be left in the outdoors if covered to protect the finish from deterioration caused by sun light.

3.2 SHORT TERM STORAGE: (CONTINUED)

STORAGE PROCEDURES FOR THREE (3) MONTHS OR LESS

D. OTHER MIXER SUB-COMPONENT/MIXER ACCESSORIES – JOB BOXES

- If the equipment and/or job boxes appear damaged, contact Sterling Fluid Systems (USA) – Service Dept. at 716-773-6450
- Miscellaneous steel fabricated components will be crated on wooden pallets. *DO NOT REMOVE* equipment from pallets. Cover with plastic or similiar material.
- Sterling Fluid Systems (USA) job boxes are not to be stacked. *DO NOT* place directly on the ground. Set on wooden blocks. Cover with plastic or similar material.

3.3 LONG TERM STORAGE:

STORAGE PROCEDURES FOR MORE THAN SIX (6) MONTHS

NOTE:
EQUIPMENT IS TO BE STORED UP TO THREE YEARS – A SPECIAL LONG TERM STORAGE PROCEDURE HAS BEEN IMPLEMENTED BETWEEN CBI & STERLING FLUID SYSTEMS

CONTACT: STERLING FLUID SYSTEMS FOR DETAILS

SECTION 4: DESCRIPTION AND WORKING PRINCIPLE

4.0 GENERAL COMMENTS:

Documents, see attachments:

Arrangement drawing:	L141.5498.51.0238 Rev.3
Sectional drawing:	L127.5498.26.0172.
Anchor Parts/Mounting Details:	Z253 Rev.1
List of part numbers:	L127.5498.35.0016 Rev. A

STERLING HALBERG sludge mixer, type MFS, is used as a rotary pump for sludge mixing in a anaerobic digester.
The mixer is installed at the top of the digester dome.

A vertical draft tube with a conical inlet or outlet head on either end is mounted in the digester center.

The MFS mixer mainly consists of the following components:

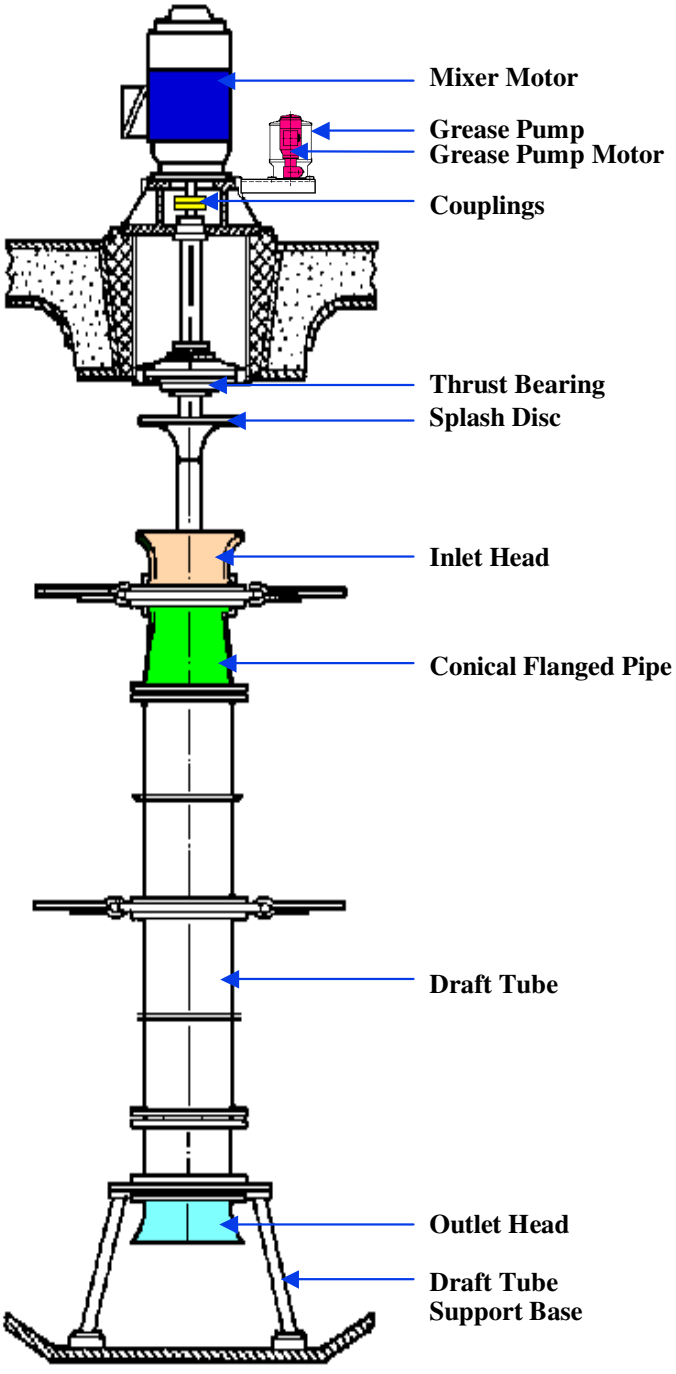
- Seating ring with 2 bearing housings bolted to its upper and lower areas;
- Sealing casing with slinger disc;
- Motor pedestal with electric grease pump and electric motor mounted to it;
- Shaft with one propeller and a deflection disc.

4.1 DESCRIPTION OF EQUIPMENT

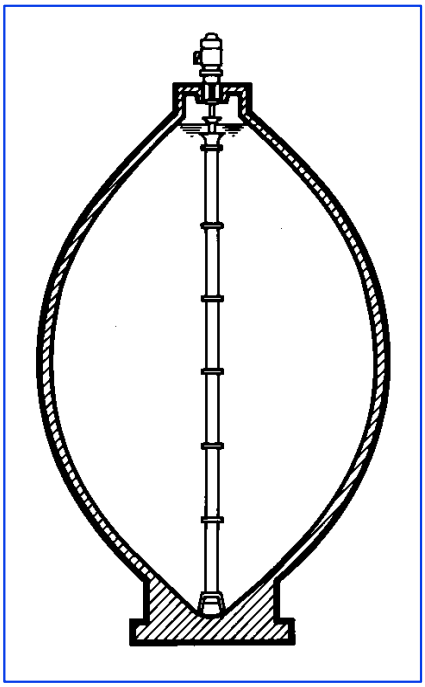
4.1.1 MIXER

The mixer is designed and built in conformance to the following specification to STERLING-Halberg's standard manufacturing and QA/QC procedures for Draft Tube Sludge Mixers.

DESCRIPTION OF EQUIPMENT



Draft tube sludge mixer



Draft tube sludgemixer in egg shaped digester

4.1 DESCRIPTION OF EQUIPMENT (continued):

4.1.1 MIXER (continued)

Quantity of Mixers	(3) Mixers
Mixer Type	Dual Blade Propeller
Mixer Identification Number	MFS - 4
Design Pumping Rate (Minimum)	6,500 USGPM
Mixer Speed (Synchronous)	720 RPM
Rotation	Reversible
Duty	Continuous

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4.1.2 MIXER MOTOR

The mixer is driven by an electric motor direct coupled to the mixer shaft via a flexible coupling.

Rated size of mixer motor	20 HP
Division/Class/Group	Division 1/Class 1/Group D
Type	TEFC - Explosion-proof
Motor Speed (Synchronous)	720 RPM
NEMA Frame Size	L364HP16
Service Factor	1.15 @ 20 HP
Temperature Rating of Motor	40°C
Insulation	Class F
Motor Efficiency at Full Load	*91.0%
Motor Efficiency at ¾ Load	*92.3%
Motor Efficiency at ½ Load	*92.3%
Full load current of motor	Amps *26.6
Locked rotor current of motor	Amps *145

* estimated values - actual data will be available after motor performance test.

Estimated Noise Level of Mixer, Drive Motor, Grease Pump & Motor at one (1) meter	less than 85 db(A)

4.1.3 COUPLING

A flexible coupling connects the shafts of the mixer and the mixer drive motor.

4.1 DESCRIPTION OF EQUIPMENT (continued):

4.1.4 MIXER ROTOR ASSEMBLY

The major components of the mixer rotor assembly are the shaft, propeller, splash disc, shaft sleeve, thrust bearing, guide bearing, bearing lock nuts and lock washer.

4.1.5 MIXER SHAFT

The shaft design is based on many years experience. Deflection of the shaft at the propeller is minimal under unbalanced conditions during normal operation. The generously sized overhung shaft is supported in two anti-friction bearings. The lower anti-friction bearing radially guides the shaft and absorbs the axial thrust of the shaft. The upper anti-friction bearing that is under radial load moves in the casing to compensate for temperature-induced shaft expansion in the axial direction

4.1.6 MIXER BEARINGS

There are two sets of bearings on the mixer assembly, the guide bearings and the thrust bearings.

The mixer guide bearings consist of anti-friction ball bearings. The mixer thrust bearings consist of spherical roller bearings.

The bearings are amply sized for this application and their selection is based on many years of experience. The L10 lives for the upper guide bearing and thrust bearing exceed 100,000 hours. The thrust bearing is designed to accept unbalanced loads caused by rags, or other small solids passing through the propeller during normal operation.

The operating temperature range of the mixer bearings is 70oC with a maximum temperature of 150°C.

4.1.7 IMPELLER

The impeller consists of a hub with two opposite helical, elliptical blades with sharp edges to crush coarse particles.

4.1.8 DEFLECTION DISC

The deflection disc, with concave periphery, is located above the impeller.

4.1 DESCRIPTION OF EQUIPMENT (continued):

4.1.9 SHAFT SEALING

A sealing casing is bolted to the bottom side of the thrust bearing housing in order to seal the shaft where it extends through the lower bearing housing. The shaft seal is a triple lip seal. For lubrication purposes and to assist the sealing, a specially formulated "mixer grease" is supplied during operation at two points between the seals.

In the shaft sealing area, a protective sleeve with a hardened running face is fitted.

To protect the seal in the case of an intermittent, excessive and impermissible sludge level during operation, a slinger disc with one-side Teflon coating is fitted to the shaft, below the sealing casing.

4.1.10 LUBRICATION

During operation, the anti-friction bearings and seals are supplied with grease via an electric grease pump that is mounted on a side of the motor pedestal. When the mixer is operating, the guide bearing, thrust bearing, and lip seals are constantly supplied with grease from an automated grease pump. The automated grease pump, having a capacity of 22 lbs (10 kg) and is driven by a 0.21kW, 1800 rpm, 3 phase, 60 hertz, 460 volt, explosion-proof Division 1, Class 1, Group D motor. The grease used by the mixer bearings is a grease that has been specially formulated for use in the mixer conditions. The grease is a lithium saponified grease containing special additive to improve rust and oxidation protection, adhesive power, and the pressure absorbing capacity of the lubricant film. No other grease is to be used with the mixer so as to avoid early wear or failure of the bearings. Excess grease is relieved into the seat ring and is removed prior to the removal of the mixer from the digester or when the seat ring is full.

4.1.11 MOTOR STAND

The steel motor stand fabrication is mounted to the upper seating flange. Jacking bolts are provided to ease is disassembly. The mixer motor and automated grease pump are mounted on the motor stand.

4.1 DESCRIPTION OF EQUIPMENT (continued):

4.1.12 SEAT RING

The seat ring is permanently installed in the digester. After final alignment of the mixer to the draft tube, the area surrounding the seat ring shall be filled with concrete (grout).

4.1.13 DRAFT TUBE ASSEMBLY

The draft tube is installed upon the completion of the digester. The draft tube is not attached to the mixer. The lower three (3) legged support base is a welded steel structure attached to the flanged joint above the draft tube lower section. The support base is mounted on level consoles.

All assembly hardware is stainless steel. The draft tube upper section is braced in four (4) directions using 316 stainless steel cables. One set of cables is attached to an anchor plate located below the conical flanged pipe. A second set of four (4) 316 stainless steel cables is used to brace the draft tube at a flanged joint near the mid-point of the draft tube. The cables are attached to the digester by wall anchor plates.

4.2 COMPONENT WEIGHTS (APPROXIMATE)

DESCRIPTION		
Mixer Motor	Approx. 1150	lbs.
Sludge Mixer (shaft and propeller)	Approx. 2725	lbs.
Draft Tube Assembly	Approx. 12500	lbs.
Approximate Total Weight	16375	lbs.

4.3 INVENTORY OF SPARE PARTS

4.3.1 SPARE PARTS SUPPLIED

300 KG sterling Halberg mixer grease in 25 kg. pales

4.3.2 RECOMMENDED SPARE PARTS (NOT SPECIFIED)

There are no recommended spare parts other than those specified.

4.4 WORKING PRINCIPLE:

During mixer operation, the impeller propulsion causes the digester sludge to circulate and mix thoroughly throughout the digester. The impeller is located inside the inlet/outlet head at the upper end of the draft tube.

Depending on the mixing requirement, the mixer shaft can rotate in a clockwise or counter-clockwise direction.

If the shaft rotation is *counter-clockwise (when looking down at the mixer motor),* the sludge *flows downwards* through the draft tube. This is the main direction of flow, drawing off and disintegrating coarse floating residue and disbursement. In addition, it counteracts the formation of a foam layer. Also the downward motion of the sludge through the draft tube will disperse any grit accumulation at the digester bottom and force the grit in suspension.

With *clockwise shaft rotation*, the impeller circulates sludge from the *bottom of the digester* up the draft tube to the rotating deflection disc. The deflection disc distributes the sludge over the sludge surface area softening and dispersing any existing supernatant sludge layer.

Exact operating details for the mixer depend on the composition of the sludge and should be established based on plant personnel experience. Therefore, *only general instructions* as to the mode of operation are given.

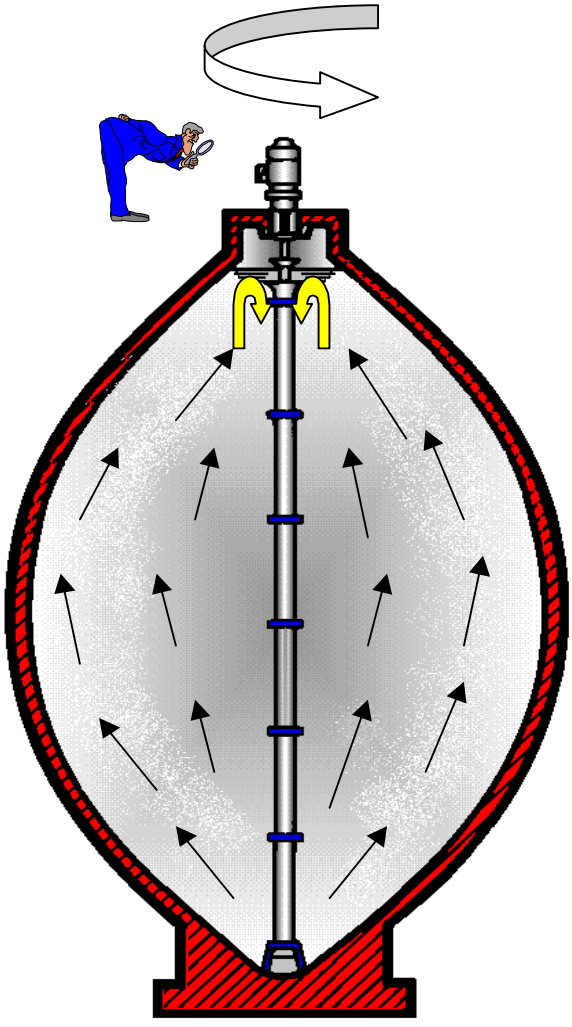
NOTE: REFER ILLUSTRATION ON NEXT PAGE

the sludge over the sludge surface area softening and dispersing any existing supernatant sludge layer.

Exact operating details for the mixer depend on the composition of the sludge and should be established based on plant personnel experience. Therefore, *only general instructions* as to the mode of operation are given.

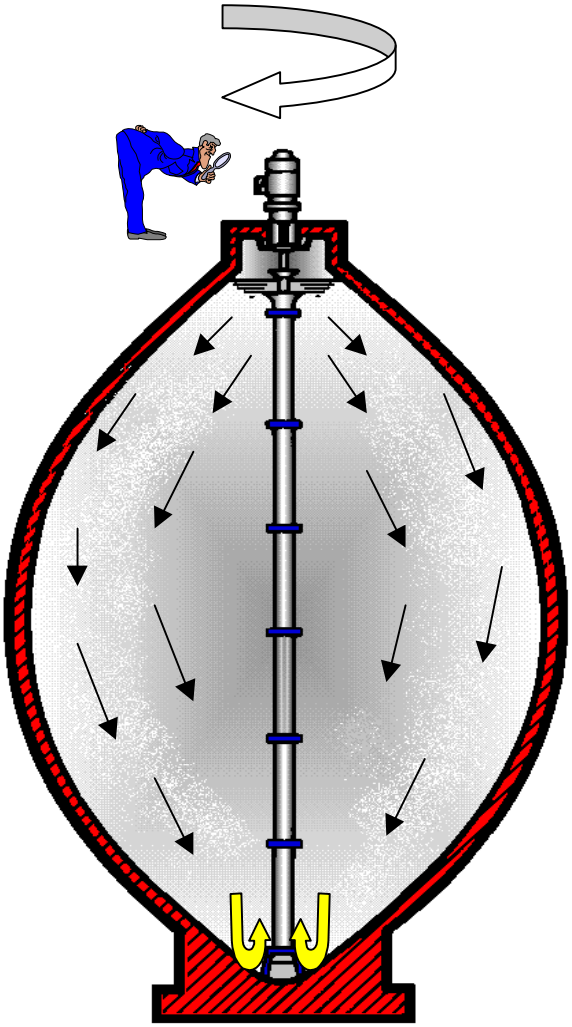
NOTE: REFER ILLUSTRATION ON NEXT PAGE

CCW LOOKING DOWN



MIXING TOP TO BOTTOM

CW LOOKING DOWN



MIXING BOTTOM TO TOP

SECTION 5: INSTALLATION PROCEDURES

5.1 GENERAL INFORMATION

5.2 SCAFFOLDING INSTALLATION

5.3 INSTALLATION LOWER SUPPORT FOOT

5.4 INSTALLING THE DRAFT TUBE

5.5 INSTALLING THE MIXER

REFERENCE DRAWINGS:

L.170.5498.10.0073 REV 4 TENSIONING OF WIRE ROPE

L140.5498.30.6573 SCAFFOLDING DRAWING

(REFER SECTION 9)

L141.5498.51.0238 REV. 3	MIXER ARRANGEMENT DRAWING
L127.5498.26.0172	SECTION DRAWING
Z253 REV. 1	MIXER – ANCHORING PARTS MOUNTING DETAILS

5.1 GENERAL DESCRIPTION

a) The mixing unit consists of the sludge mixer and the draft tube, which is vertically installed in the digester center.

b) The mixer is installed with its seating ring in a conical opening of the digester ceiling.

c) The draft tube is vertically supported in the lower digester area by a three legged support base.

d) The draft tube upper section is braced in four directions using cables.

e) An erecting scaffold should be used for the first erection in the digester.

f) Review the existing customer-provided elevations of the digester and compare them with the required elevations specified on the arrangement drawing. Deviations should be corrected when adjusting the draft tube height.
Moreover, measure and define the adjustment center of the draft tube in relation to the installation opening in the upper digester ceiling.

5.2 SCAFFOLDING INSTALLATION

a) Working platforms shall be installed about five (5) feet below the draft tube flanged joints except at bottom which is to be five (5) feet above the bottom of the digester

b) Outside dimensions of the working platform shall be approximately twenty (20) feet BY (20) feet. The center opening shall be approximately five (5) feet by (5) feet.

c) The scaffolding shall be extended to the wall anchors (73.22 & 73.23) at the anchor plate (89.31) and should be readily accessible right to the wall of the digester (used to install center and upper cables).

d) Wall Anchor mounting plates (73.23) will be supplied by Sterling Fluid Systems to the digester manufacturer, and welded to the digester at the proper locations by others.

e) After installing the mixer the scaffolding must be raised to shutter the seat ring area.

f) Reinforce the scaffold in the lower region at the Inlet Head/Support Foot elevation.

g) Steel Consoles (Drawing Z253) to be supplied by others, and mounted to the digester doubler plates.

5.3 INSTALLING THE LOWER SUPPORT FOOT (18.3)

a) Coat all bolt threads with anti-seize compound prior to assembly.

b) Torque all bolts to grade 5 specification.

c) Lower the three (3) Support Foot Legs (18.3) into the digester separately with a crane. Secure the Support Foot Legs to the scaffolding.

d) Lower the Inlet Head (72.01) into the digester. Place it on the lower scaffold platform.

e) Lower the Support Plate (89.3) into the digester on top of the Inlet Head (72.01). Attach the Inlet Head (72.01) to the Support Plate (89.3) with the FOUR (4)) full thread bolts (*90.114A) from the bottom upwards. Note, for larger size mixers, the Support Plate (89.3) will be in two sections. Torque bolts. **90.114A = 90.114 EXCEPT FULL THREAD*

f) Lift the Support Plate (89.3) and Inlet Head (72.01) off the lower scaffolding platform. Attach the Support Foot Legs (18.3) to the bottom of the Support Plate (89.3) with bolts (90.14) and split washer (93.24). Torque bolts. Position Support Foot Assembly in the digester.

g) Remove the bottom scaffolding platform and lower the support table assembly into position.

h) Accurately align the centricity of the Support Foot Assembly in relation to the Seat Ring opening in the top of the digester with a plumb bob and set at the correct height. Check and compare all dimensions relevant to proper mounting. Make necessary corrections.

i) Check all length dimensions of the Draft Tube (71.1, 71.11 and 71.12) including the Anchor Plate (89.31) and Outlet Head (72.03). Determine overall length. Dimensional deviations (plus or minus) compared to specified dimensions must be compensated for by adjusting the height of the Support Foot Assembly. Re-check level of Support Foot Assembly.

FOR ALL STEEL DIGESTERS - USE THE FOLLOWING PROCEDURE TO COMPLETE THE SUPPORT TABLE ASSEMBLY

k) With Support Table Assembly hanging at the correct location and leveled, clamp angle brace to each support foot, and tack weld to each digester doubler plate to maintain mounting locations.

l) Attach steel console ***templates*** to each foot to determine digester curvature, and console length at each Support Foot (18.3) location.

m) Use the templates to accurately mark the cutting line on each Steel Console and cut to scribed line as closely as possible.

n) Attach cut Steel Console to the appropriate Support Foot (18.3), and precision fit so that the contact between the bottom of the Console and digester will be a minimum of 80% contact area onto the digester doubler plates.

o) If fit is acceptable, assemble precision fitted console to the correct Support Foot (18.3) using bolts (91.7), split washers (93.27) and hex nuts (92.06).

p) Remove angle brace, check concentricity and height of the Support Plate (89.3) in relation to the top of the digester gas dome.

q) ***Tack weld*** fitted console to doubler plate.

r) Use same procedure for two remaining steel console

s) After all consoles have been fitted and tack welded, check concentricity and height of Support Plate (89.3) to bottom of digester before finish welding.

t) After weld have cooled, precision level the top of the Support Plate (89.3) using the level screws in the support feet base, and put shims between foot base and top of the consoles to maintain a tolerance of 0.005 in./ft, and no more than +/- 0.25 in. off center of the plum bob line in a horizontal circle.

u) Remove adjusting screws, and torque all bolts and nuts. Check level, re-shim if necessary.

5.4 ASSEMBLING THE DRAFT TUBE

a) If the crane has sufficient lifting height, assemble two (2) Draft Tube Straight Sections (71.1 and 71.12) on the ground using bolts (90.12), split washers (93.22) and hex nuts (92.02). Torque bolts to specification

b) If the crane lifting height is not sufficient to lift two (2) sections of draft tube, each section must be lifted, lowered and assembled sequentially into the digester.

c) If method b) above is used, install the lowest Draft Tube Section (71.12) onto the Support Plate (89.3) guiding it over the four (4) threaded bolts (90.114A) protruding from the support table (89.3) and secured with split washers (93.22) and hex nuts (92.02). Install remaining bolts (90.114), split washers (93.22) and nuts (92.02). Torque bolts to specification.

d) Continue to install the remaining draft tube. Install and assemble with bolts, split washers and hex nuts described above. Torque bolts to specification

e) After the assembly of lower Draft Tube Sections to the Support Table (89.3), assemble Anchor Plate (89.31) to the top Draft Tube using four (4) full thread bolts (90.115A) inserting from the bottom of the Draft Tube flange holes into the threaded holes of the Anchor Plate (89.31).

f) Assemble and properly torque the combination Wall Anchor/Cable assemblies (73.22 & 59.61) to the Wall Plates (73.23) welded to the sides of the digester, using 5/8 inch bolts (90.17) and split washers (93.27).

g) Coat the spool ends of the Anchor Plate (89.31) with anti-seize compound.

h) Wrap loose ends of Wire Cable around Anchor Plate spools (89.31), mounted to the top draft tube section , and secure the ends with a Cable Clamp (57.21). Mount cable tensioning devices.

i) Tension the Cables in accordance with mounting instruction (L170.5498.10.0073). Accurately align center of the Draft Tube with the center of the digester gas dome using a plumb bob. Observe center alignment and correct tension on cables. Secure cables with Wire Rope Clamps (57.21). Torque clamps as per manufacturer's specifications. Note the cable assemblies, at the digester walls, are factory pre-tensioned.

j) Remove cable tensioning devices from cable

k) Install the remaining upper three Draft Tube Sections onto the previously installed anchor plate (89.31), at top of lower draft tube assembly. Guide bottom part of the upper section over the four (4) threaded bolts (90.115A) protruding up from the Anchor Plate (89.31). Secure with the split washers (93.22) and hex nuts (92.02). Install remaining bolts (90.115), split washers (93.22) and nuts (92.02). Torque bolts.

l) Install Outlet Head (72.03) casting, guiding the lower flange over the draft tube flange. Secure with bolts (90.113), split washers (93.22) and hex nuts (92.02) and torque.

m) Coat the attachments on the Outlet Head (72.03) with anti-seize compound. Wrap Wire Cable around attachments on Outlet Head (72.03). Follow procedures (i) - (j).

5.5 INSTALLING THE MIXER

a) Set the Mixer Assembly complete with the Seat Ring (without electric motor) with the three (3) Set Screws in place (i.e. screwed into the Seat Ring) on the shim plates in the digester. The shim plates are to be placed on top of the seat ring mounting brackets.

b) When aligning the Mixer adjust the distance from the top of the Outlet Head (72.03) to the top of the Splash Disc as shown on the arrangement drawing. Height corrections are to be made with the set screws in the seat ring. Allowable tolerance ± 0.75 inches.

c) Measure horizontal positioning of the mixer with a precision spirit level 0.1 mm/m and a flat precision straight edge set at 90º on the motor seating flange. Corrections are made with the set-screws. The propeller must not contact the Outlet Head (72.03).

d) Using a feeler gauge at least four (4) points at 90º adjust the clearance between the propeller and Outlet Head (72.03). After checking the propeller clearance recheck the horizontal position per paragraph 1.2 c). Permissible off-center deviation is ± 0.118 inches.

e) After adjusting of the mixer, the set-screws are to be welded to the shim plates and the shim plates are to be welded to the steel supports of the digester.

f) To avoid unnecessary forces acting on the seat ring and mixer, the temporary shuttering must not be supported on the seat ring or the mixer shaft.

g) Secure the seating ring with non-shrink, high sulfate resistant grout.

h) Install the motor with the coupling half mounted. Align coupling halves to within 0.002 inches. (Refer to coupling manufacturer's recommendations)

i) Check motor and mixer for easy running by rotating the coupling by hand.

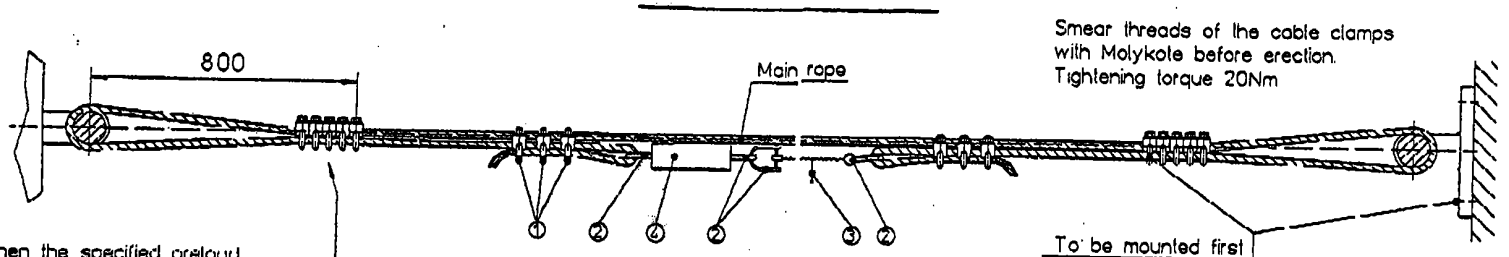
L 100.00.3.004

Datum 23.09.93 | Abt. / Name PKM / Zoskol | Seite | Zeichnungs - Nr. L 170.5498.10.0073 100.0.03 | Rev. 4

Instructions for Mounting Tensioning the Rope

HALBERG SIHI

Mounted condition

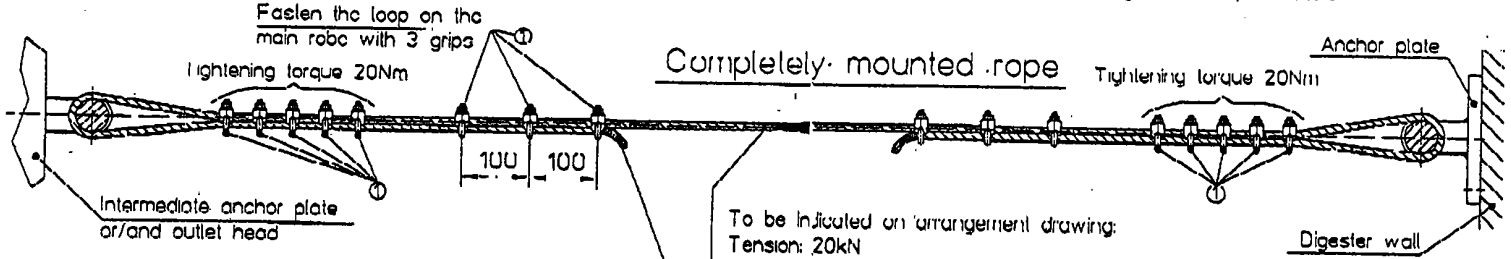


When the specified preload is reached, position the grips (see figure below) and tighten them firmly one after another. After that remove tensioning device. ①bis④

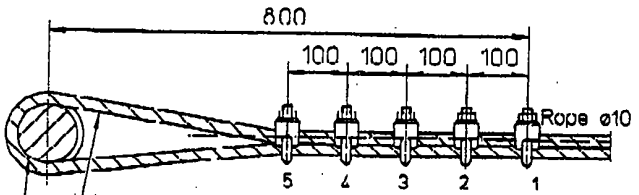
Mounting aids to be furnished by the erecting company

① cable clamps (Niro-steel)
④ shackle
③ tensioning device
④ tension dynamometer

Completely mounted rope

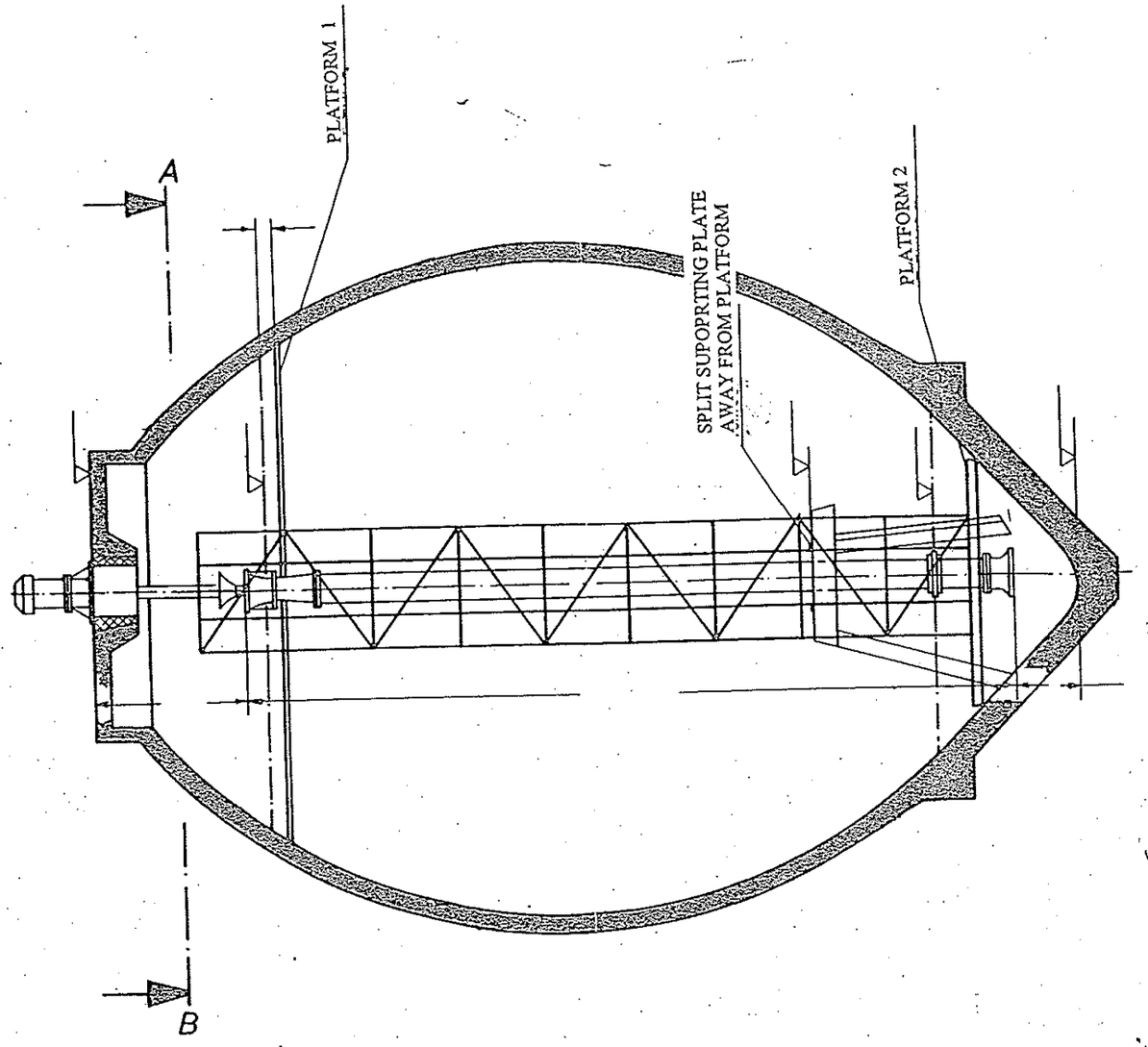


To be wrapped with insulating tape before cutting the rope to length

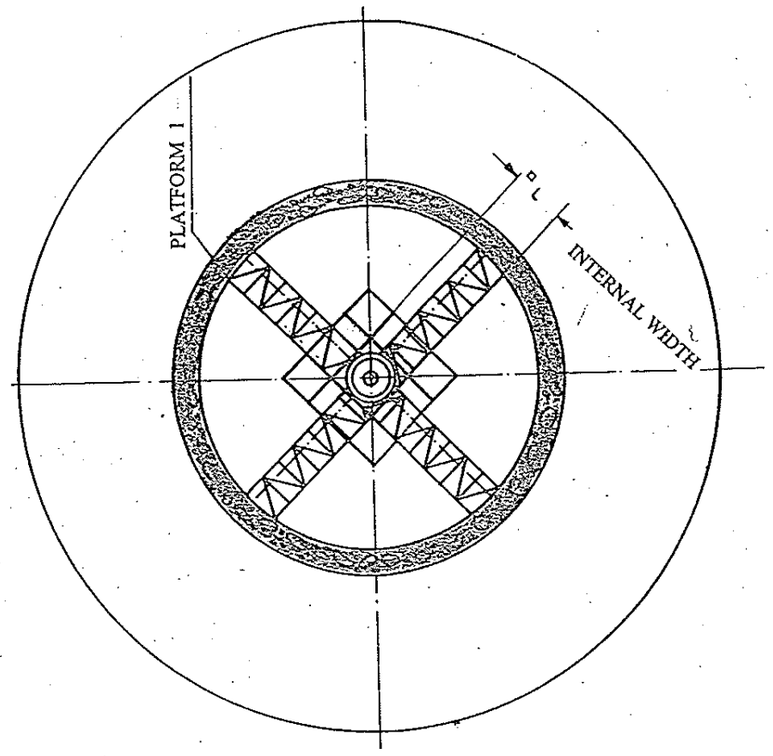


Sequence for tightening the rope grips

Rope pulley and rope to be rubbed in with Molykote



Schnitt A-B



LARGEST FLANGE ϕ + 100 mm

ALIGNMENT OF FEED PIPES ON THE UPPER
WIRING (OR BRACING) AT INSTALLATION OF THE SLUDGE MIXER

REFERENCE ONLY

Ziffer	Ziffer kommt vor	Änderung	Tag	Name

	Tag	Name	
Jahr 1987			HALBERG
Gezeichnet	02.02	Kgl/z	
Geprüft / Gesehen			
Fertigung			Kläranlage:
Normgeprüft			Vorverwendungsbereich:
Maßstab:			

General Layout Steel Tubing for the Installation of the Feed Pipes in the Sludge Container

Zugehörige Zeichnungen
Entstanden aus:
Ersatz für:
Ersetzt durch:
Halbz. oder Werkst.:
Fertig-Gewicht:
Projekt Nr.
Zeichnungs-Nr.
L140549830.6573

SECTION 6: COMMISSIONING & OPERATION PROCEDURES

6.1 COMMISSIONING

6.1.1 MIXER

Prior to commissioning, examine the inside of the digester for loose foreign matter (i.e. construction materials). Foreign matter can get wedged in the space between impeller blade and the draft tube wall, causing the mixer to stall (resulting in possible damage).

The grease unit requires the following measures:

a) Detach grease lines between the pump elements and distributor block at the grease pump casing, with grease pump running, check to ensure that grease is delivered bubble free from the pump element.

b) Prefill grease lines with manual grease gun and reconnect.

c) Detach the grease lines from the outlets of the distributor block and, with grease pump running, check to ensure that grease is delivered bubble free

d) During initial commissioning or after a prolonged shutdown period, the shaft shall be checked for easy running by manually rotating the motor coupling (be sure to lock out motor).

e) Operate automated grease pump for one half hour (½ hr) to ensure the grease delivered to the antifriction bearings and lip seals is bubble free prior to starting the mixer.

f) Ensure that digester sludge is at the proper operational levels as indicated on the arrangement drawing.

g) Care shall be taken to ensure that the mixer first operates from the bottom to top (right-handed operation of the mixer shaft). This sense of rotation must be maintained for at least one half hour (½ hr) before changing the direction of the flow to the top to bottom (left-handed operation of the mixer shaft).

Note: Short term overloading of the motor may occur. In this case switching to the opposite rotation can normally eliminate the overloading.

6.1.2 DRIVE MOTOR

a) Check the insulation resistance of the motor as per the motor manufacturer's recommended testing procedure.

b) Examine the motor for loose objects and debris that may have accumulated, and remove any foreign material.

c) Turn the motor by hand to ensure that it rotates freely (be sure to lock out motor).

d) Check all wiring connections with the connection diagrams. Ensure all accessible factory connections for tightness.

e) De-energize motor space heaters prior to motor operation.

f) Check direction of motor rotation by momentarily applying power to the motor.

g) Start motor and check for abnormal noise, vibration, bearing temperatures, current and voltage balance. Check motor operation for one (1) hour to observe whether any unusual noise or hotspots develop.

h) Check line voltage on all three phases to ensure that there is correct balance and within 10% tolerance of motor rated voltage with motor drawing load current.

i) Check the operating current against the motor nameplate value. Do not exceed the value of the nameplate amperes multiplied by the service factor under steady continuous load. Check that the current in all three lines is balanced.

j) Check motor temperature using motor temperature detectors or temperature gauge.

k) Consult drive motor "Operation & Maintenance" manual for additional information.

6.1.3 GREASE PUMP

a) Check factory prepared connections for tightness.

b) Fill grease lines using manual grease gun with "Sterling-HALBERG Mixer Grease". This is the only acceptable grease for the mixer bearings and seals.

c) Fill grease pot to top level with the same grease.

d) Consult grease pump "Operation & Maintenance" manual for additional information.

6.1.4 GREASE PUMP MOTOR

a) Check the insulation resistance of the motor as per the motor manufacturer's recommended testing procedure.

b) Examine the motor for loose objects and debris that may have accumulated, and remove any foreign material.

c) Turn the motor by hand to ensure that it rotates freely (be sure to lock out motor).

d) Check all wiring connections with the connection diagrams. Ensure all accessible factory connections for tightness.

e) De-energize motor space heaters prior to motor operation.

f) The flowrate of the grease pump does not depend on the direction of rotation of the motor. Therefore, the grease pump motor may be connected in any direction.

The grease pump is to be operated together with the mixer. The rotational direction of the mixer can be reversed without changing the rotational direction of the grease pump.

g) Start motor and check for abnormal noise, vibration, bearing temperatures, current and voltage balance. Check motor operation for one (1) hour to observe whether any unusual noise or hotspots develop.

h) Consult drive motor "Operation & Maintenance" manual for additional information.

6.1.5 DRIVE COUPLING

a) The coupling halves will be installed on the motor and mixer shaft ends prior to first commissioning.

b) The end rings should be supported to allow for access to the hubs.

c) Place coupling sleeve into position, moving mounted hubs toward one another allowing the appropriate gap between them as given in the coupling "Installation and Alignment " instructions.

d) Since the motor is a "C" faced configuration, the face-to-face alignment will be fixed. However, the alignment between the coupling hubs should be limited to +/-0.002" Total Indicated runout using a straight edge across the flange of the coupling hubs.

e) After proper alignment, install the resilient tubular blocks in pairs using a non-metallic hammer.

f) Check final alignment with the straight edge per tolerance above. Re-align if necessary.

g) Consult coupling "Installation and Alignment " instructions for additional information.

6.2 DESCRIPTION OF EQUIPMENT

6.2.1 PROCESS

The Draft Tube Sludge Mixer is mounted on top of the egg shaped digester and extends into the draft tube, which is located in the center of the digester. The mixer circulates the contents of the digester at a specified flow, or turnover rate.

The mixer is reversible and designed for continuous operation. The ability to circulate sludge in either direction for long periods of time fulfills two (2) important process requirements:

6.2.1.1 FLOW FROM BOTTOM TO TOP (CW LOOKING DOWN)

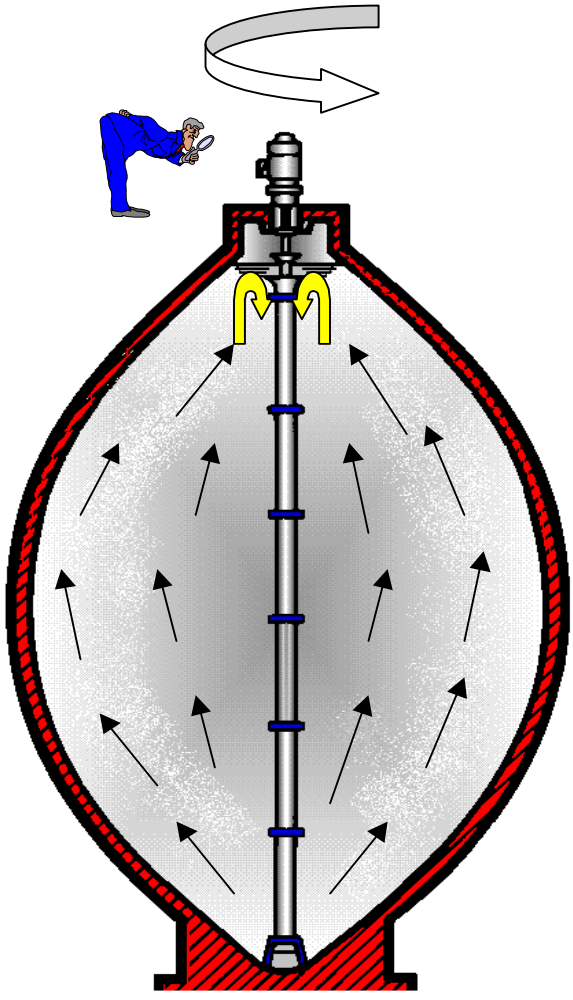
During right hand rotation (as seen from above), the propeller circulates sludge from the bottom of the digester up through the draft tube to the rotating splash disc. The splash disc distributes the sludge over a large sludge surface area softening and dispersing the supernatant sludge layer.

6.2.1.2 FLOW FROM TOP TO BOTTOM (CCW LOOKING DOWN)

During left hand rotation, the propeller forces surface sludge, including coarse floating residue, down the draft tube resulting in an ideal intermixing and blending action that agitates settled sludge in the bottom of the digester. In the event foam forms on the top of the digester, it will be forced down the draft tube and remixed with the digester contents.

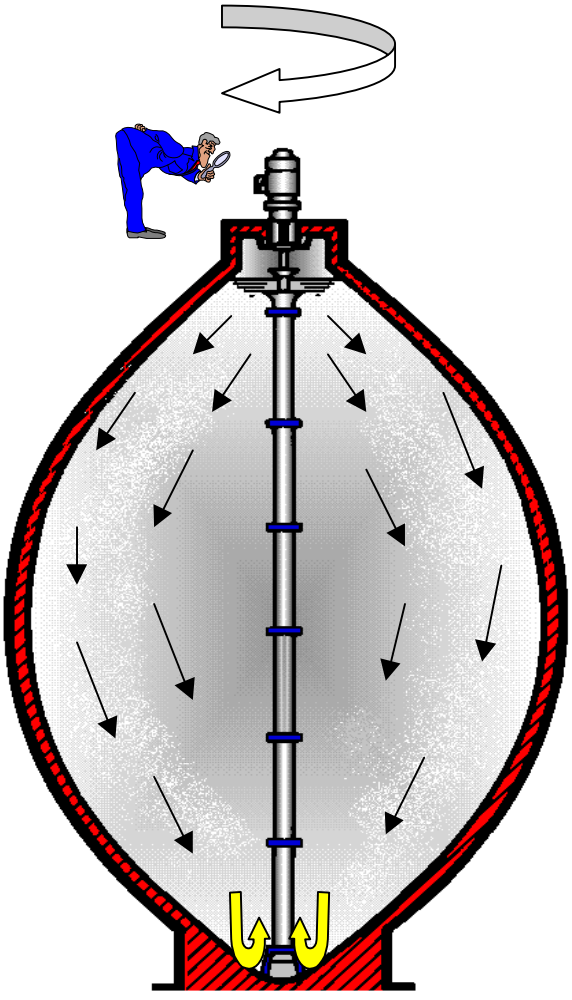
The time period for each flow direction is established based on the plant personnel experience with the digestion process.

CCW LOOKING DOWN



MIXING TOP TO BOTTOM

CW LOOKING DOWN



MIXING BOTTOM TO TOP

6.2.2 DESIGN DATA

6.2.2.1 MIXER

Quantity of Mixers	(3) Mixers
Mixer Type	Dual Blade Propeller
Mixer Identification Number	MFS - 4
Design Pumping Rate (Minimum)	6,500 USGPM
Mixer Speed (Synchronous)	720 RPM
Rotation	Reversible
Duty	Continuous

6.2.2.2 DRIVE MOTOR (GENERAL ELECTRIC)
MOTORS ARE SAME AS FURNISHED ON GWINNETT PHASE I

Rated size of mixer motor	20 HP
Division/Class/Group	Division 1/Class 1/Group D
Type	TEFC - Explosion-proof
Motor Speed (Synchronous)	720 RPM
NEMA Frame Size	L364HP16
Service Factor	1.15 @ 20 HP
Temperature Rating of Motor	40°C
Insulation	Class F
Motor Efficiency at Full Load	*91.0%
Motor Efficiency at ¾ Load	*92.3%
Motor Efficiency at ½ Load	*92.3%
Full load current of motor	Amps *26.6
Locked rotor current of motor	Amps *145

* estimated values - actual data will be available after motor performance test.

Estimated Noise Level of Mixer, Drive Motor, Grease Pump & Motor at one (1) meter	less than 85 db(A)

6.2.2.3 COMPONENT WEIGHTS:

Mixer Motor	Approx.	1150	lbs.
Sludge Mixer (shaft and propeller)	Approx.	2725	lbs.
Draft Tube Assembly	Approx.	12500	lbs.
Approximate Total Weight		16375	lbs.

6.2.3 MIXER ROTOR ASSEMBLY

Major components of the rotor consist of the shaft, propeller splash disc, shaft sleeve, thrust bearing, guide bearing, bearing lock nuts and lockwashers. The rotor is removable with the thrust bearing housing as a complete assembly.

The shaft is guided in an amply dimensioned spherical roller bearing at the bottom of the seat ring. This bearing also supports the axial thrust of the shaft. Moisture from the digester is effectively retained through the use of lip seals.

Another antifriction guide bearing, on the top cover plate of the seat ring, provides radial guidance of the shaft.

6.2.4 SEAT RING

The seat ring is permanently installed in the digester. The area surrounding the seat ring is filled with concrete (grout) after final alignment of the mixer to the draft tube. The seat ring supports the thrust bearing housing and motor stand.

6.2.5 MOTOR STAND

The steel motor stand is mounted to the upper seating flange. Jacking bolts are provided to ease disassembly. The mixer electric motor and automated grease pump are mounted on the motor stand. The upper guide bearing, as well, is fastened to the motor stand.

6.2.6 DRIVE MOTOR

The mixer is driven by a 50 HP, 600 RPM, 3 phase, 60 Hz, 460 V, electric motor. The motor enclosure is Explosion Proof, designed for a Class 1, Division 1, Group D environment, suitable for Class 1, Division 1, Group D (Methane) locations. The motor is installed vertically with the shaft down.

6.2.7 DRIVE ASSEMBLY

A flexible coupling is used to connect the electric motor to the mixer shaft. The entire drive assembly (drive motor, couplings, and motor stand) is removable as a unit without releasing digester gas to the atmosphere.

6.2.8 AUTOMATED LUBRICATION SYSTEM

When the mixer is operating, the guide bearing, thrust bearing, and lip seals are constantly supplied with grease from an automated grease pump. The automated grease pump, having a capacity of 22 lbs (10 kg) and is driven by a 0.21kW, 1800 rpm, 3 phase, 60 hertz, 460 volt, explosion-proof Division 1, Class 1, Group D motor.

The recommended Sterling-HALBERG mixer grease is specially formulated grease. The grease contains additives for improvement of rust and oxidation protection, adhesive power and pressure absorbing capacity of the lubricating film.

Excess grease that accumulates in the seat ring must be removed prior to pulling the rotor assembly from the digester for inspection.

6.2.9 DRAFT TUBE ASSEMBLY

The draft tube is not attached to the mixer. The lower three (3) legged support base is a welded steel structure attached to the flanged joint above the draft tube lower section. The support base is mounted on level consoles.

The draft tube upper section is braced in four (4) directions using 316 stainless steel cables. One set of cables is attached to an anchor plate located below the conical flanged pipe. A second set of four (4) 316 stainless steel cables is used to brace the draft tube at a flanged joint near the mid-point of the draft tube. The cables are attached to wall anchor plates.

6.2.10 SURFACE PREPARATION AND COATING

The draft tube sections and mixer rotor assembly exposed to the digester is externally coated with a coal tar epoxy or customer's specified paint system, and internally glass lined.

6.3 OPERATION

6.3.1 DIGESTER SLUDGE LEVEL - EMERGENCY SHUT DOWN

During filling of the digester tank with the mixer in operation, attention must be paid to the continued steady and smooth operation of the mixer. Should unsteady running occur, stop the mixer and do not restart until the filling procedure has been completed.

NOTE *The sludge level in the digester must not exceed the level given in the arrangement drawing to avoid impairment of the hydraulic operation and the mechanical running behavior of the mixer.*

SLUDGE LEVEL IS AS FOLLOWS:

MIXERS NORMAL SLUDGE LEVEL	*1,120.0 FT ELEVATION +/-6"*
ARRANNGEMENT DRAWING	*L141.5498.51.0238 Rev. 3*

NOTE ***ACTUAL FINAL BUILD SLUDGE LEVELS MUST BE USED FOR OPERATING. VARIANCES OCCUR BECAUSE OF BUILD TOLERANCES INHERENT IN ASSEMBLY OF THE DIGESTERS.***

Furthermore an excessively high sludge level will eventually damage the sealing elements of the lower bearing body which will in turn lead to a failure of the antifriction bearing.

Should digester foaming occur, the mixer must be operated in the left hand sense of rotation with the direction of flow from top to bottom.

Should the digester start to experience unsteady operation and vortexing of the sludge level, immediately stop the mixer. This is commonly caused by having the sludge level too low in the digester. ***Do not restart the mixer*** until the sludge level, in the digester, is at the appropriate level.

6.3.2 OPERATING REQUIREMENTS

NOTE ***The mixer must not be operated unless the automated grease pump is operating***.

An interlock between the grease pump motor and the mixer motor must be provided to prevent the mixer from starting or operating when the grease pump is off.

A timing mechanism must be installed to prevent the mixer motor from starting until the grease pump has already operated for the following appropriate times:

- After a short term shutdown, less than 1one hour .....5 minutes
- After shutdown, less than one month.....15 minutes
- After shutdown, less than one year.....30 minutes

When changing the mixer rotation it is imperative to wait for the mixer shaft to come to a standstill prior changing direction. Failure to do so, can damage or destroy the flexible coupling, mixer, and/or mixer motor.

A timed delay must also be provided to prevent the reversal of the mixer shaft rotation prior to the mixer coming to a complete stop. A five (5) minute delay is recommended.

When the mixer has been shutdown for 60 minutes or longer it must be run in the bottom to top direction (right hand operation) for 30 minutes. After 30 minutes the mixer can be stopped and restarted in the opposite direction.

6.4 CONCLUDING REMARKS

The Operating and Maintenance Instructions have covered the necessary work to be carried out for trouble free operation of the Sterling-HALBERG Draft Tube Sludge Mixer. Due to the special design of the Sterling-HALBERG Mixer, the individual design of each corresponding machine part has been described as far as necessary. However, the description of difficult measures, such as repair work, has not been covered since such work requires consultation with a technical specialist from Sterling Fluid System s (USA).

These instructions are based on typical knowledge of a skilled machine fitter. Therefore, general mechanical rules for operating the machines have not been included. Any claims for damages caused by faulty and improper handling shall not be accepted.

SECTION 7: ROUTINE MAINTENANCE & MIXER REMOVAL

7.1 MAINTENANCE

7.1.1 MAINTENANCE DURING OPERATION

The mixer has been designed such that it will be largely maintenance-free, provided that the following preconditions are met:

a) The drive unit, the grease supply, and the flexible couplings shall be checked every 48 hours during continuous as well as intermittent operation.

b) Current consumption of the electric motor shall be constant (minor short-term variations in current draw are normal). Ammeters should be permanently installed in the control panels.

c) Constant temperature of the upper greased antifriction bearing indicates faultless mechanical functioning of the mixer

d) Uniform discharge of lubrication grease by the automated grease pump (see "Lubrication" section).

e) It is advisable to enter the checks made, as well as the subsequent lubrication and maintenance activities in the machine logbook of the waste water treatment plant.

NOTE:

During mixer operation the sludge level in the digester must be within the maximum and minimum levels indicated on the arrangement drawing(s) and/or levels dictated by tolerances of the digester to avoid impairment of the hydraulic operation, and mechanical running behavior of the mixer. Moreover, an excessively high sludge level can cause untimely wear or may damage the shaft seals which in turn could lead to bearing failure.

Should foaming of the tower contents occur, operate the mixer counter-clockwise, i.e. with downward direction of flow.

7.1.2 MAINTENANCE DURING SHUTDOWN

The grease charges in the antifriction bearing housings are sufficient to ensure preservation of the mixer bearings and seals during normal shutdown periods of the mixer during wastewater treatment operation. If the shutdown period exceeds one (1) month, the mixer shall be started every four (4) weeks to ensure that any condensation that may have accumulated in the housings is removed and that contact corrosion inside the antifriction bearings is prevented by repositioning the grease.

If it is not possible to start the mixer, it must be re-greased manually using a hand grease gun and manually turning the shaft at least one (1) revolution.

If shutdown period exceeds one (1) year, special measures must be taken. In this case, we ask you to please contact Sterling Fluid Systems (USA) for special instructions at 716-773-6450.

7.1.3 PREVENTATIVE MAINTENANCE

7.1.3.1 MIXER GREASE USAGE

Description ➢ Monitor usage at forty-eight (48) hour intervals

Procedure
- ➢ Remove lid of grease pot
- ➢ Observe level - add grease if necessary
- ➢ Document quantity of grease added
- ➢ Capacity of grease pot is 22 pounds (10 kg)
- ➢ Only approved Sterling-Halberg mixer grease should be used

7.1.3.2 CURRENT DRAW OF MIXER MOTOR

Description ➢ Monitor current draw at forty-eight (48) hour intervals

Procedure
- ➢ Record amperage draw of mixer
- ➢ Variations are possible due to different sludge consistencies
- ➢ Long term trends can be plotted and used to determine maintenance schedules

7.1.3.3 MIXER UPPER GUIDE BEARING

Description
- Monitor temperature at forty-eight (48) hour intervals

Tools
- Pyrometer

Procedure
- Record temperature of the Guide Bearing Housing
- Minor changes are normal due to varying sludge consistency

FLEXIBLE COUPLING ELASTOMERS

Description
- Inspect flexible coupling elastomers once each month

Precautions
- De-energize mixer motor
- Lock out power supply and tag power source before proceeding

Tools
- Flashlight

Procedure
- De-energize mixer motor
- Remove end ring
- Visually check conditions of the elastomers in coupling
- If there is any evidence of cracking or splitting, replace

7.1.3.4 MIXER MOTOR BEARINGS

Description
- Lubricate thrust bearings each two thousand (2000) hours of use or each six (6) months, whichever comes first
- Lubricate guide bearings once each year

Precautions
- De-energize mixer motor
- Lock out power supply and tag power source before proceeding

Tools
- Hand grease gun
- Grease - refer to O & M Manual for recommended lubricants
- CAUTION: Mixing non-compatible greases can cause bearing failure

Procedure
- De-energize mixer motor
- Remove grease relief plug, free passage of hardened grease
- Wipe grease fitting clean
- Add grease with hand grease gun until grease moves through relief passage
- Run motor for ten (10) minutes before replacing relief plug

7.2 LUBRICATION

7.2.1 GREASE PUMP ADJUSTMENT

(Refer illustration next page)

The antifriction bearings and the lip seals below the lower bearing has been filled with grease during shop assembly. These quantities will be constantly supplemented during operation of the mixer by the automated grease pump, Woerner GMF-B. Uninterrupted grease supply is essential for the antifriction bearings and lip seals.

The grease pump outlets are marked as follows:

"Bearing Bottom"

"Bearing Top"

"Sealing Grease Bottom"

"Sealing Grease Top"

In order to ensure that the antifriction bearings and lip seals are supplied with the correct amount of grease, adjustment should be made as follows:

a) "Bearing Bottom" & "Bearing Top"

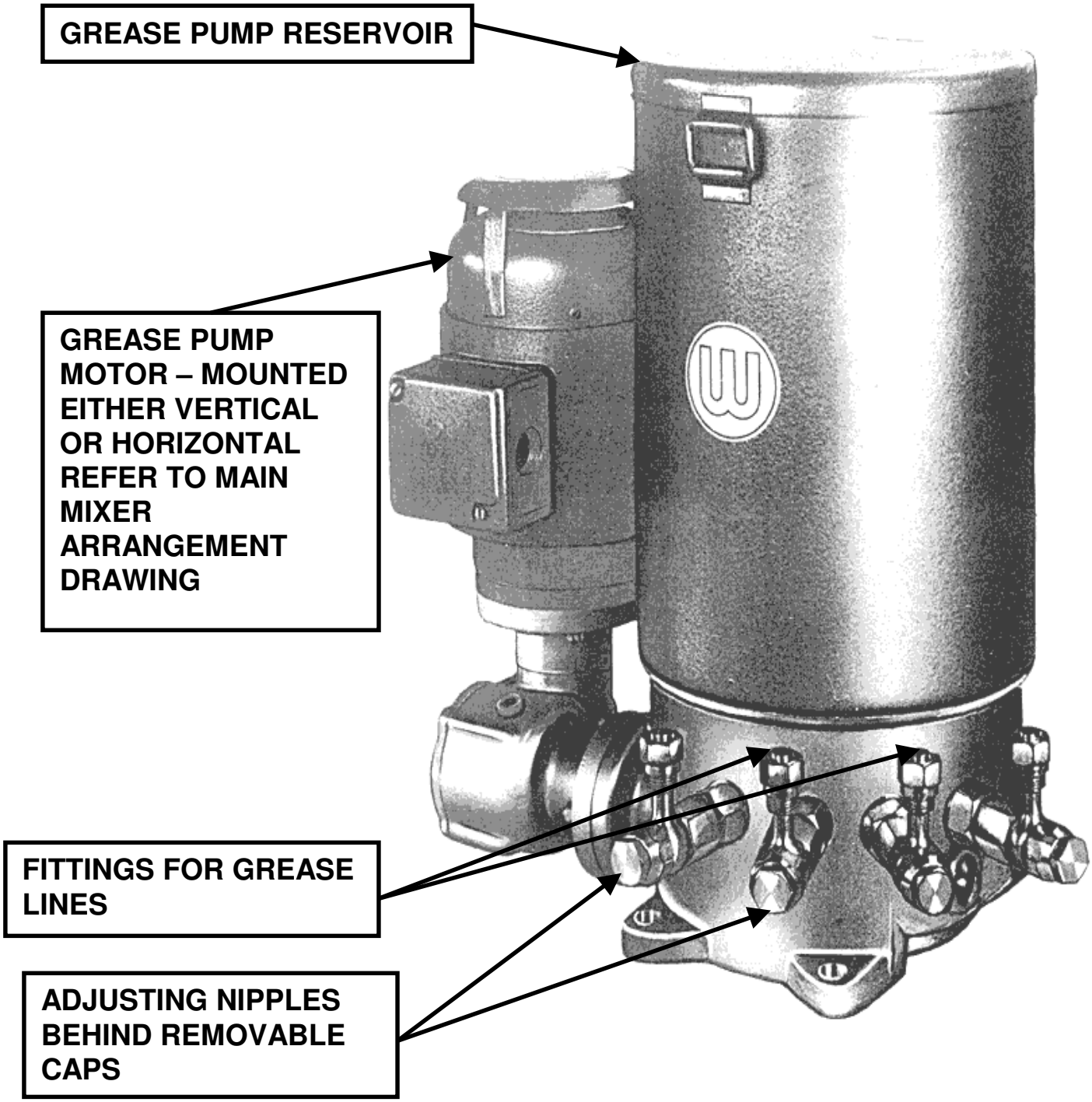
Turn the adjustable nipples on these two (2) outlets with the grease pump wrench from "full stroke", twelve (12) notches to the right corresponding to approximately two (2) revolutions. The discharge amount of these pumping elements will thus be reduced to two (2) grams per hour.

b) "Sealing Grease Bottom" & "Sealing Grease Top"

Turn the adjustable nipples on these two (2) outlets with the grease pump wrenches from "full stroke", six (6) notches to the right corresponding to approximately one (1) revolution. The discharge amount of these pumping elements will thus be reduced to four (4) grams per hour, which is the amount of grease required by the lip seals.

7.2 (CON'T)

WOERNER GREASE PUMP



7.2.2 LUBRICANTS – IMPORTANT!

The lubricant filled during the shop assembly into the grease pump, bearing housing, and lip seal grease chamber is a *specially formulated grease*.

The use of ***STERLING-HALBERG*** mixer grease is a precondition for faultless lubrication of the bearings and lip seals. Excessive grease filling of the antifriction bearings is precluded by means of grease separators in the bottom bearing and a grease overflow unit in the top bearing.

When filling the grease pot of the grease pump or the manual grease gun, cleanliness is a precondition for the life of the bearing.

We strongly advise the user to lock away the grease supplies and filling spatulas and not to release them for general lubrication purposes in the plant.

For lubrication of the drive motor, and grease pump motor please refer to the manufacturers instructions.

7.2.3 GREASE LINE REPAIR

When removing or assembling the grease lines make sure that the free ends are neatly assembled. During commissioning of a newly assembled grease line, it must be expected that due to trapped air, there will be no immediate grease supply.

In order to avoid any damage to the bearings and seals due to lack of lubricant, the grease line shall be filled by a manual grease gun until grease comes out at the separator of the upper bearing or grease overflow of the lower bearing.

For applying grease manually, the 4 threaded holes in the distributor block are each provided with a grease nipple.

Please also refer to the special leaflet instructions for the grease pump.

The grease supply from the grease pump can be checked by unscrewing the nipple plug out of the respective distributor hole, using a wrench, until the inspection hole is exposed and grease comes out.

The grease coming out of the upper and lower bearing housing is collected laterally at the bottom in the seat rings well as on the support lantern casing.

This grease is left in the seat ring during mixer operation and shall only be removed prior to withdrawal of the rotor assembly for inspection purposes.

NOTE: A pipe with a bleeder screw for the seat ring inner space is arranged on the top surface of the mixer seat ring, inside the motor lantern flange.

7.3 FLEXIBLE COUPLING

Transmission of the torque from the electric motor to the mixer shaft is via a resilient Flender N-Eupex size A140

During normal maintenance periods, the flexible coupling blocks should be examined and replaced if there are any signs of excess deterioration or destruction. The flexible inserts can be allowed to wear down to 1/3 of the original thickness before replacement is required.

The electric motor need not be removed to examine or replace the synthetic rubber blocks.

For details see enclosed "Installation and Alignment Instructions “Flender N-Eupex, type A Couplings." In Section 8 of this manual.

7.4 METHOD OF MIXER REMOVAL

The STERLING-HALBERG *Draft Tube Sludge Mixer* will typically provide many years of uninterrupted service. However, when the unit requires a overhaul, *the use of a crane* will be required to lift the mixer from the gas dome of the digester. NOTE: The seat ring, in which the mixer is installed, is grouted into place. Consequently, only the mixer rotor assembly (i.e shaft, bearings, splash disc and impeller) is removed.

The following general steps are to be followed for removal of the components of the mixer assembly for maintenance and repair.

7.4.1 Removal of Mixer Motor (Refer to illustration on next page)

a) Disconnect power source to mixer motor and motor space heater.

b) Remove bolts fastening motor to the motor stand.

c) Lift motor from motor stand using lifting rings on motor.

7.4.2 Removal of Mixer (Refer to illustration on next page)

a) Disconnect power source to automated grease pump,

b) Disconnect grease lines to mixer bearings.

c) Open vent to release any methane accumulation in the seat ring during operation of the mixer.

d) Remove bolts from cover.

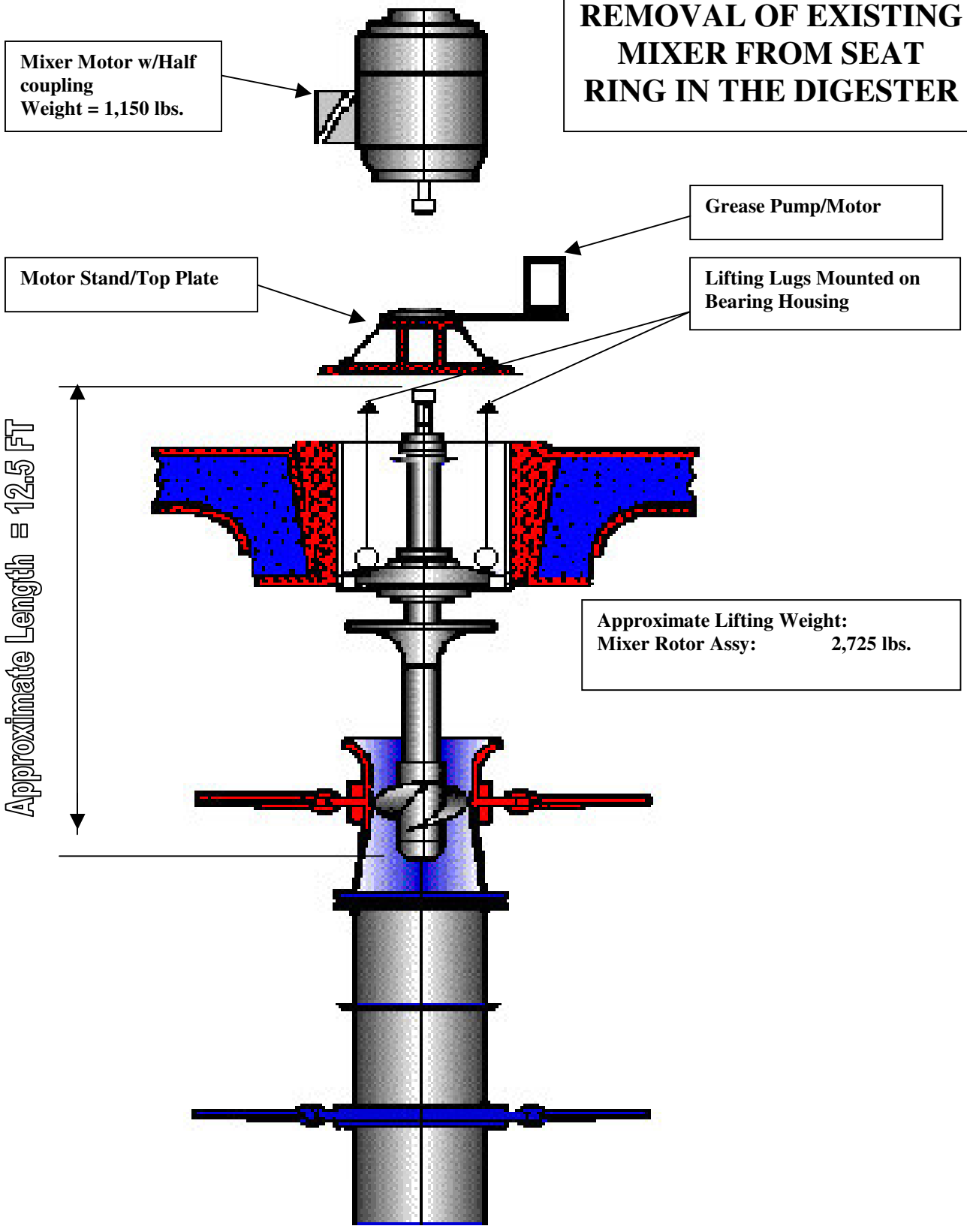
e) Lift cover using the provided lifting rings.

f) Remove and dispose of any accumulated grease in the seat ring.

g) Remove bolts holding bearing housing from seat ring.

h) Lift mixer assembly using lifting rings provided.

REMOVAL OF EXISTING MIXER FROM SEAT RING IN THE DIGESTER



7.5 LUBRICATION SCHEDULE:

MACHINERY	LUBRICANT	FREQUENCY	COMMENTS
MIXER BEARINGS & LIPSEALS	STERLING-HALBERG MIXER GREASE	REFER SECTION 7.1.3.1	NO SUBSTITUTE - WARRANTY VOID IF NOT USED
DRIVE MOTOR - UPPER & LOWER BEARINGS	USE GE "D6A2C5" GREASE OR EQUAL	REFER SECTION 7.1.3.4	ALSO, REFER SECTION 10 OF THIS MANUAL, PAGES 8-9 OF GE MANUAL GEK-95655A,
GREASE PUMP - GEAR HOUSING	13.50 E GEAR OIL AT 50°C	CHECK EVERY 3000 HOURS AND FILL WITH 2.7 OZ. IF REQUIRED	REFER SECTIONS 7.1.3.1 & 7.2
GREASE PUMP LINES	STERLING-HALBERG MIXER GREASE	REFER SECTION 7.1.3.1, AND SECTIONS 7.1.2 & 7.2.3,	NO SUBSTITUTE - WARRANTY VOID IF NOT USED
GREASE PUMP MOTOR	NONE	40,000 HOURS	SEALED BEARINGS
FLEXIBLE COUPLING	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE

NOTE:

The total grease consumption for continuous operation of approximately 8000 h/year per mixer is about 100 kg./year, if the grease pump is adjusted correctly. Of this amount, about 70 kg. are collected in the seating ring. Remove this grease before dismantling of the mixer. ***NOTE:*** *The seat ring will fill with grease after approximately ten (10) years service. Inspection can be made visually by looking through the sight glass installed in the top plate of the mixer motor stand.*

The grease in the grouted in seat ring can be removed by hand or sucked off through the 2" opening in the flange of the motor pedestal, using a vacuum pump.

For the ventilation of the seating ring inside area, a pipe with bleeder screw is installed on the upper side, in the motor pedestal.

FOR ALL QUESTIONS CONTACT: **STERLING FLUID SYSTEMS (USA):**
ATTN: SERVICE DEPARTMENT
Phone: 716-773-6450 EXT 271
Fax: 716-773-2330

STERLING

Lubricant

Product Information Sterling SIHI Mixer grease (special property i.e. methane gas resistant)

Appearance	transparent
Properties	soft, supple, smooth, ropy
composition	mineral oil, soap and additives to improve protection against rust and oxidation, adhesive power and pressure absorbing capacity of the lubricant film
type and quantity of the swelling agent	approx. 3.8% Lithium soap
drop point to DIN 51 801	> +170 °C
incinerated residue as oxide ash to DIN 51 803	< 0.7%
density @ 25°C	*0.95 g/cm^3*
solubility in/ miscibility with water	*insoluble*
water content to DIN 51 852	traces
neutralization number to DIN 51 809	approx. 1.5 mg KOH/g of grease, alkaline

consistency to DIN 51804

unworked	> 450 x 10^{-1} mm
worked 60 strokes	445 - 475 x 10^{-1} mm
behavior to water	resistant
pressure load bearing capacity on four-ball tester to Boerlage	240/260 kp

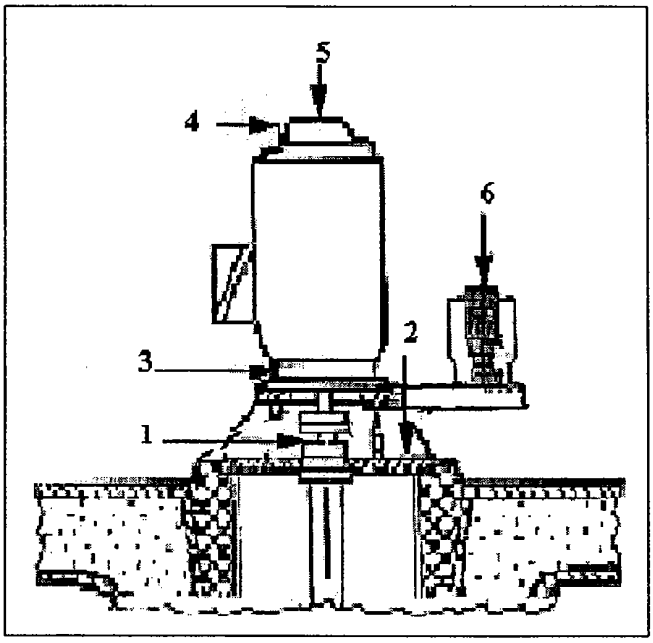
Remarks

The Sterling SIHI Mixer grease is a lithium saponified lubricating grease (fluid grease) of consistency to NLGI 000. It contains additives for the improvement of rust and oxidation protection, adhesive power and pressure absorbing capacity of the lubricant film.

7.6 VIBRATION:

Normal mixer vibration will not exceed 5 mils peak-peak displacement and typically less
Higher vibration levels can occur if the sludge levels are below the recommended minimum
If vibration exceeds the above limit & is not attributable to low sludge levels – vibration readings can be taken as shown below:

EXCESSIVE VIBRATION: (NOT DUE TO LOW SLUDGE LEVELS)



If vibration exceeds limits – vibration measurements can be taken at the locations shown

Probe Location:			
	1. Mixer	Top Bearing	Horizontal
	2. Mixer	Seat Ring	Vertical
	3. Motor	D.E.	Horizontal
	4. Motor	NDE	Horizontal
	5. Motor	Axial	Vertical
	6. Grease Pump Motor		

NOTE: IF VIBRATION LEVELS ARE EXCESSIVE AND CANNOT BE DIAGNOSED BY THE WWTP PERSONNEL, CONTACT STERLING FLUID SYSTEMS IMMEDIATELY

SECTION 8: TROUBLESHOOTING CHART

8.1 TROUBLESHOOTING

8.1 In the event of trouble, locate the problem using the following pages and this chart:

Symptoms	Possible Cause
1. Mixer not pumping	1/4
2. Mixer capacity is reduced	1-4/27/33/38
3. Very noisy	1/3/8-9/12-21
4. Unsteady running of mixer	1/3-5/20-22/26/29-32/39
5. Mixer rotor obstructed in stand still position	3/8-9/12-14/22/26-28/30
6. Mixer is seizing	3/6-20/22/27-28/30/32/38
7. Bearing temperature increased	6/8-9/10-19/26
8. Excessive grease consumption	19
9. Gas escaping from digester	6-7/11/15-19/24
10. Grease pump motor won't start	33/35-38
11. Grease pump motor running hot or burning out	38
12. Mixer motor won't start	28/30/33/36/38
13. Mixer motor difficult to start	3/6/8-9/12-14/26/32-33/35
14. Mixer motor operating hot or burning out	38
15. Motor will not operate at required speed when switching from 'y' to delta	34

POSSIBLE CAUSES OF TROUBLE

1. Impeller damaged
2. Excessive wear of impeller blades
3. Liquid solids concentration higher than design conditions
4. Sludge level to low
5. Sludge level to high
6. Lip seal damaged or little or no lubrication
7. Shaft sleeve worn in the area of the lip seals
8. Bearing worn
9. Insufficient lubrication of bearings
10. Grease lubrication line damaged
11. Grease quality not suitable
12. Rolling contact bearings incorrectly installed
13. Dirty bearings
14. Rolling contact bearings contaminated with rust
15. Grease pump does not deliver
16. Excessive air entrapped in the lubricant
17. Delivery piston of grease pump malfunctioning
18. Check grease level in grease pot
19. Check adjustment of grease pump delivery piston
20. Coupling alignment defective or coupling hub loose
21. Coupling elastic element worn
22. Faulty mixer foundation
23. Synthetic resin not sealed
24. Grouting not sufficiently rammed
25. Studs not sealed with jointing compound

26. Draft tube not aligned with mixer
27. Insufficient clearance between slinger disc and seal housing
28. Guy wire(s) broken
29. Shaft not running true
30. Shaft bent
31. Impeller not sufficiently balanced
32. Impeller rubbing on draft tube
33. Voltage too low/power supply overloaded
34. Change to direct starting
35. Cable cross section too small
36. Grease distributor give alarm (only if automatic monitoring installed)
37. Short circuit in motor
38. Check motor
39. Structure not properly investigated from a statistical and vibrational point of view

SECTION 9 MIXER PARTS LISTS/DRAWINGS/HARDWARE

PARTS LISTS:

- MIXER PARTS LIST- L127.5498.35.0016 Rev. A, Pages 1-6
- SPARE PARTS LIST- L127.5498.35.0016 Rev. A, Page 7

DRAWINGS:

- L141.5498.51.0238 Rev. 3
- SECTION DRAWING L127.5498.26.0172
- MIXER – ANCHORING PARTS Z253 Rev.1

DRAFT TUBE ASSEMBLY HARDWARE REQUIREMENTS:

- DRAFT TUBE BOLTING /WHERE USED

STERLING

DRAFT TUBE SLUDGE MIXERS - PARTS LIST — GWINNETT PHASE II

CBI PO 139424 CONTRACT 127047 TAG: 40:DSL-MIX -3/4/5 STERLING FLUID SYSTEMS SO 23030042

MIXER SIZE: MFS-4

		MATERIAL			
DIN No.	Name of Part	Germany	DIN Norm	USA	SPARES
15.1	Seating Ring (Galvanized)	RSt37-2	17100	A283 Gr.C	
17.1	Deflection Disc	GG-25	1691	A48 C135.40	
21.0	Shaft	CK45N	17200	A576 Gr.1045	
23.0	Impeller	St37-2	17100	A283 Gr.C	
26.0	Impeller Cap	CK45N	17200	A576 Gr.1045	
27.0	Slinger Disc	GG-25/ PTFE	1691	A48 C135, 40	
32.0	Guide (Ball) Bearing - Top	St			
32.1	Thrust Bearing - Bottom	St			
34.1	Motor Pedestal (Galvanized)	St37-2	17100	A283 Gr.C	
35.0	Thrust Bearing Housing	GG-25	1691	A48 C135, 40	
36.01	Bearing Cover	GG-25	1691	A48 C135, 40	
36.02	Bearing Cover	RSt37-2	17100	A283 Gr.C	
40.0	Seal Disc	Teflon			
41.04	Joint Ring	St			
41.1	Seal Ring	Cu			
41.11	Seal Ring	Cu/Isopl 750			
41.21	O-Ring	NBR 70			
41.22	O-Ring	NBR 70			
41.23	O-Ring	NBR 70			
41.24	O-Ring	NBR 70			
41.25	O-Ring	NBR 70			

MIXER SIZE: MFS-4

		MATERIAL			
DIN No.	Name of Part	Germany	DIN Norm	USA	SPARES
41.26	O-Ring	NBR 70			
41.27	O-Ring	NBR 70			
41.28	O-Ring	NBR 70			
42.01	Cap-type Gasket	83 FKM/575			
42.02	Cap-type Gasket	88NBR 101			
42.03	Cap-type Gasket	88NBR 101			
42.2	Felt Ring	Fiz		Felt	
44.1	Seal Housing	RSt37-2	17100	A283 Gr.C	
45.81	Lantern Ring	St37-2	17100	A283 Gr.C	
50.4	Spacer Ring	St37-2	17100	A283 Gr.C	
50.41	Spacer Ring	C45N	17200	A576 Gr.1043	
52.4	Shaft Protection Sleeve	St35/ Metco 15E			
55.0	Seal Disc	C45N	17200	A576 Gr.1045	
55.01	Seal Disc	CK45N	17200	A576 Gr.1045	
56.0	Slotted Spring Pin	Federstahl		Spring Steel	
56.4	Guide Bearing	CK45N	17200	A576 Gr.1045	
57.21	Wire Rope Clamp			316 SST	
59.2	Adjusting Bolt Plate	USt37-1			
59.61	Wire Rope			316 SST	
59.8	Spacer Plate	1.4571	1.4571	A276 Type 316Ti SST	
62.6	Sight Glass	Acrylglas		Acrylic	
63.6	Lubricating Nipple	5.8-A2E			
64.7	Distributor Flange	RSt37-2	17100	A283 Gr.C	

MIXER SIZE: MFS-4

		MATERIAL			
DIN No.	Name of Part	Germany	DIN Norm	USA	SPARES
67.2	Breather	Kunstsloff		Non-metallic	
68.1	Coupling Guard	1.4571			
70.71	Pipe 10 x 1	1.4571	17440	A276 Type 316Ti SST	
71.1	Column Pipe			Ductile Iron Cl 53	
71.11	Column Pipe			Ductile Iron Cl 53	
71.12	Column Pipe			Ductile Iron Cl 53	
71.11	Column Pipe			Ductile Iron Cl 53	
72.01	Inlet Head	GG25		A48 . Cl.35,40	
72.03	Outlet Head	GG25		A48 . Cl.35,40	
73.01	Compression Fitting	1.4571	17440	A276 Type 316Ti SST	
73.02	Pipe Coupling	1.4571	17440	A276 Type 316Ti SST	
73.1	Bite Type Screwed Joint	1.4571	17440	A276 Type 316Ti SST	
73.11	Bulkhead Fitting	1.4571	17440	A276 Type 316Ti SST	
73.22	Cable Anchor Plate			A240 316 SST	
73.23	Wall Anchor Plate			A36	
89.3	Support Plate			A36	
89.31	Draft Tube Anchor Plate			A36	
90.01	Countersunk Head Screw	2.0402		Brass	
90.02	Lifting Eyebolt	C15		A576 Gr. 1015	

MIXER SIZE: MFS-4

		MATERIAL			
DIN No.	Name of Part	Germany	DIN Norm	USA	SPARES
90.11	Hexagon Head Screw	A4-70 (1.4541)	17440	ASTM 193 Gr. B8M	
90.110	Hexagon Head Screw	A2 (1.4301)	17440	ASTM 193 Gr. B8M	
90.111	Hexagon Head Screw	A2 (1.4301)	17440	ASTM 193 Gr. B8M	
90.113	Hexagon Head Screw			ASTM 193 Gr. B8M	
90.114	Hexagon Head Screw			ASTM 193 Gr. B8M	
90.12	Hexagon Head Screw			ASTM 193 Gr. B8M	
90.13	Hexagon Head Screw			ASTM 193 Gr. B8M	
90.14	Hexagon Head Screw			ASTM 193 Gr. B8M	
90.15	Hexagon Head Screw	A4-70 (1.4541)	17440	ASTM 193 Gr. B8M	
90.17	Hexagon Head Screw	A4-70 (1.4541)	17440	ASTM 193 Gr. B8M	
90.18	Hexagon Head Screw	A4-70 (1.4541)	17440	ASTM 193 Gr. B8M	
90.21	Stud				
90.3	Grease Lube Pipe	1.4571	17440	A276 Type 316Ti SST	
90.41	Grub Screw	A4-70 (1.4541)	17440	ASTM 193 Gr. B8M	
90.42	Grub Screw	A4-70 (1.4541)	17440	ASTM 193 Gr. B8M	
90.43	Grub Screw	45H		Steel	
90.8	Grub Screw	45H		Steel	
90.9	Hexagon Head Screw	A4-70 (1.4541)	17440	ASTM 193 Gr. B8M	

MIXER SIZE: MFS-4

		MATERIAL			
DIN No.	Name of Part	Germany	DIN Norm	USA	SPARES
91.41	Hexagon Socket Head Cap Screw	A2 (1.4301)	17440	ASTM 193 Gr. B8	
91.42	Hexagon Socket Head Cap Screw	(1.4057)	17440		
91.43	Hexagon Socket Head Cap Screw	8.8		Steel	
91.44	Hexagon Socket Head Cap Screw	A2 (1.4301)	17440	ASTM 193 Gr. B8	
91.7	Hexagon Head Screw			ASTM 193 Gr. B8M	
92.02	Hexagon Nut			ASTM 194 Gr. 8M	
92.04	Hexagon Nut			ASTM 194 Gr. 8M	
92.06	Hexagon Nut			ASTM 194 Gr. 8M	
92.1	Shaft Nut	CK45N	17200	A576 Gr. 1035	
92.11	Grooved Nut	11H		Steel	
92.12	Grooved Nut	St		Steel	
93.11	Lock Washer	Ust1203		Steel	
93.12	Lock Washer	Ust1203		Steel	
93.2	Spring Lock Washer	1.4310	17440	Type 301	
93.21	Spring Lock Washer	1.4310	17440	Type 301	
93.210	Spring Lock Washer	1.4310	17440	Type 301	
93.22	Spring Lock Washer			ASTM F436 Type 316	
93.23	Spring Lock Washer	1.4310	17440	Type 301	
93.24	Spring Lock Washer			ASTM F436 Type 316	

MIXER SIZE: MFS-4

		MATERIAL			
DIN No.	Name of Part	Germany	DIN Norm	USA	SPARES
93.25	Spring Lock Washer	1.4310	17440	Type 301	
93.26	Spring Lock Washer	1.4310	17440	Type 301	
93.27	Spring Lock Washer			ASTM F436 Type 316	
93.29	Spring Lock Washer	1.4310	17440	Type 301	
93.210	Spring Lock Washer	1.4310	17440	Type 301	
94.01	Key	C45K+N		A576 Gr. 1045	
94.02	Key	C45K+N		A576 Gr.1045	
94.03	Key	C45K+N		A576 Gr.1045	
97.01	Sign: "Mixer Grease"				
97.02	Sign: "Sealing Grease top"	1.4301			
97.03	Sign: "Sealing Grease bottom"	1.4301			
97.04	Sign: "Bearing Top"	1.4301			
97.05	Sign: "Bearing Bottom"	1.4301			
97.07	Nameplate; "Mixer"	1.4301			

MIXER SIZE: MFS-4

OTHER ROTATING MECHANICAL EQUIPMENT TO BE SUPPLIED

	MIXER MOTOR				
63.4	GREASE PUMP/MOTOR				
84.1	COUPLING, N-Eupex A140				

	SPARE PARTS LIST
QTY	Name of Part
12	MIXER GREASE (300 KG) –25 KG PALES

SPECIAL TOOLS NOT REQUIRED

Faulschlammischer/Mixer MFS 4

Volumenstrom Q= 6657 USGPm³(1512m /h)
$P_{Mischer}$ = 9,5 KW

Antriebs-E-Motor

Fabrikat/Manufacturer: General Electric
Frame: 364 HP16
P = 20 HP
n = 720 1/min
U = 460 V/ 60 Hz
Degree of protection: Explosion – Proof
Type of construction: vertical motor

Mischergewicht: 1290 kg
weight of mixer: 2843 lBs
Motorgewicht: 366 kg
weight of motor: 1200 lBS

Fettschmierpumpe/Grease pump

Fabrikat/Manufacturer: Woerner
Type: GMF – B
P = 0,21 KW
U = 460 V/ 60 Hz
Schutzart: IP55 (EExe II T4)
In = 1,0/0,58 A
n = 1800/ 1/min
Type of motor construction: vertical
Fettbehälterinhalt 10 l
Grease Tank 10 l

Bauwerksaussparungen nach Montage vergießen!
Zur Beachtung:
Der in der Zeichnung eingetragene bauliche Teil ist statistisch nicht untersucht und gilt nur als Hinweis für die Baugestaltung.
Die Zeichnung gilt für den Platzbedarf und die erforderlichen Aussparungen für unseren Lieferanteil.
Bauseits ist dafür Sorge zu tragen, daß der Mischer bei Bedarf vom Faulbehälter abgehoben werden kann und Zufahrt sowie Stellplatz für den Autokran vorhanden ist.

Recesses in the structure to be grouted during erection!
Please note:
The civil engineering structure shown on this drawing has not been statically examined and is only meant for guidance in respect of the general layout. The drawing is applicable as regard space requirements and the necessary recesses for our scope of supply.
The owner should ensure that, in case of need, the mixer can be lifted off the tank, and that a driveway and adequate manoeuvring area available for the mobile crane.

The digester steel consoles are to be supplied by contractor and to adapt during erection
Behälterseitige Konsolen sind bauseits beizustellen und bei Montage anzupassen!

Bei Montage:
3 Unterlagsplatten 80x80x8; Lieferung HALBERG.
Je Rohrstütze 1 Einstellschraube BM 24x80 nach DIN 561.
Überstand nach Montage abtrennen!
Stützenbefestigung mit 3x 4 Sechskantschrauben M16x45
Füße mit Unterlegblechen ausrichten (liefert STERLING).

3 shim plates 80x80x8 mm
1 adjusting screw BM24x80, DIN561 per tube support;
Remove projecting length after installation.
Fastening of support feet with 3x 4 hexagon bolts M16x45.
Align feet using shims (STERLING supply).

M 1:100

E–F
Anordnung der Verspannung (ohne Mischerwelle)
Arrangement of bracing in the 1st level (without mixer shaft)

G–H
Anordnung der Verspannung in der 2. Ebene
Arrangement of bracing in the 2st level

C–D
Deckenaussparung
ceiling opening

A–B

J–K

CB & I/GWINNETT COUNTY PHASE II ESD
CONTRACT NO. 127047
PO 139424
STERLING FLUID SYSTEM SO 23030042
DRAFT TUBE SLUDGE MIXERS
TAG: 40:DSL-MIX-3/4/5

Kläranlage GWINNETT COUNTY

HALBERG

Benennung: Aufstellungsplan
Typ: MFS8 4 137561
Zeichnungs-Nr. L141.5498.51.0238

Einstellvorschrift Woerner-Schmierpumpe: GMF-B

Lager unten / Lager oben

Drehe mit dem Fettpumpenschlüssel die Verstellnippel dieser 2 Auslässe von der Stellung "Vollhub" um 12 Rastungen nach rechts.
Das Fördervolumen der so eingestellten Pumpenelemente wird damit auf 1,5 Gramm pro Stunde reduziert.

Sperrfett unten / Sperrfett oben

Drehe mit dem Fettpumpenschlüssel die Verstellnippel dieser 2 Auslässe von der Stellung "Vollhub" um 6 Rastungen nach rechts.
Das Fördervolumen der so eingestellten Pumpenelemente wird damit auf 3,5 Gramm pro Stunde reduziert und entspricht dem Schmierstoffbedarf der Lippendichtungen.

Die Auslässe der Fettpumpe sind wie folgt zu kennzeichnen:

Lager unten	Lager oben	Sperrfett unten	Sperrfett oben

Adjustment Woerner grease pump GMF-B

Bearing bottom / Bearing top

Turn adjustable nipples of these 2 outlets with the grease pump wrench from position "full stroke" by 12 notches to the right.
This discharge amount of the pumping units will thus be reduced to 1,5 grams per hour.

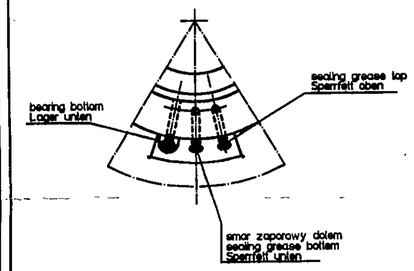
Sealing grease bottom / Sealing grease top

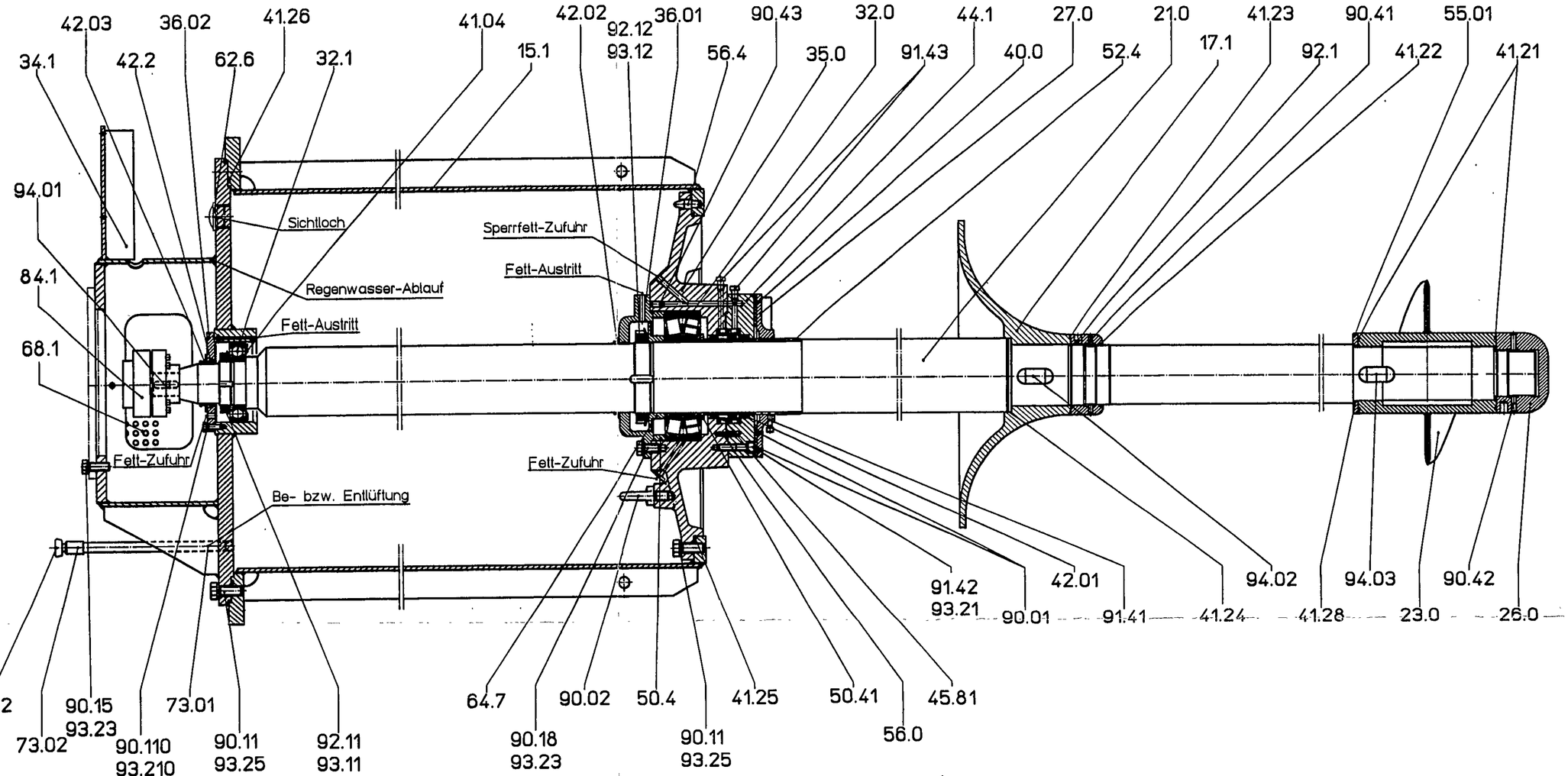
Turn adjustable nipples of these 2 outlets with the grease pump wrench from position "full stroke" by 6 notches to the right.
The discharge amount of the pumping units will thus be reduced to 3,5 grams per hour which is the amount of grease required by the lip seals.

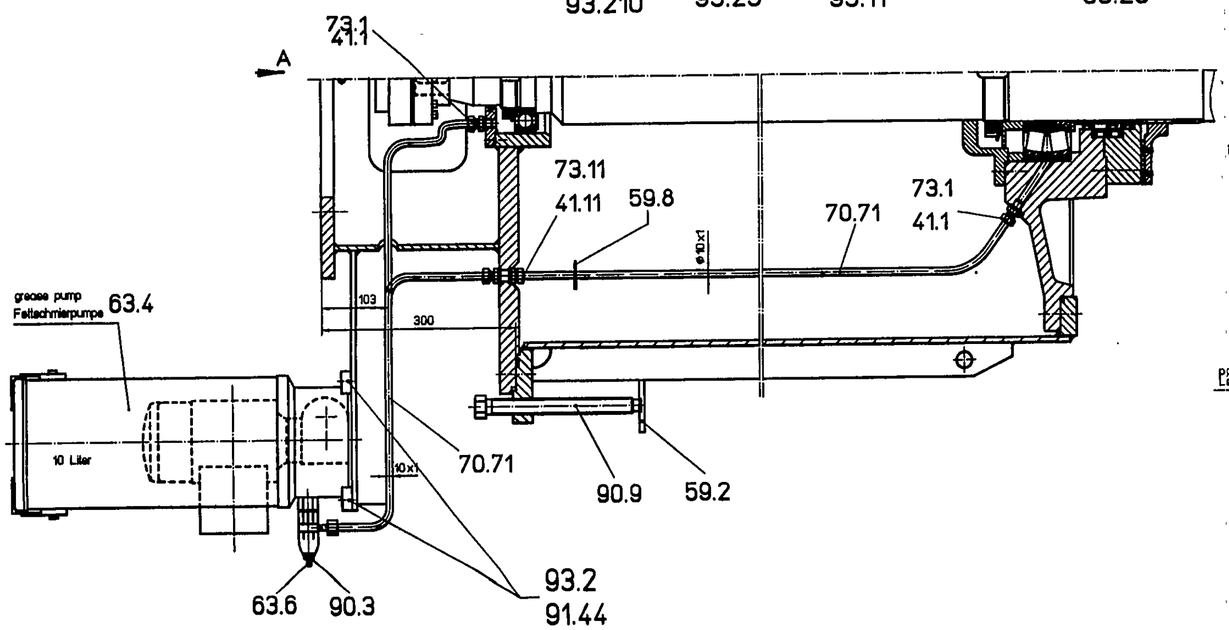
The supply pipes from the grease pump are marked as follows:

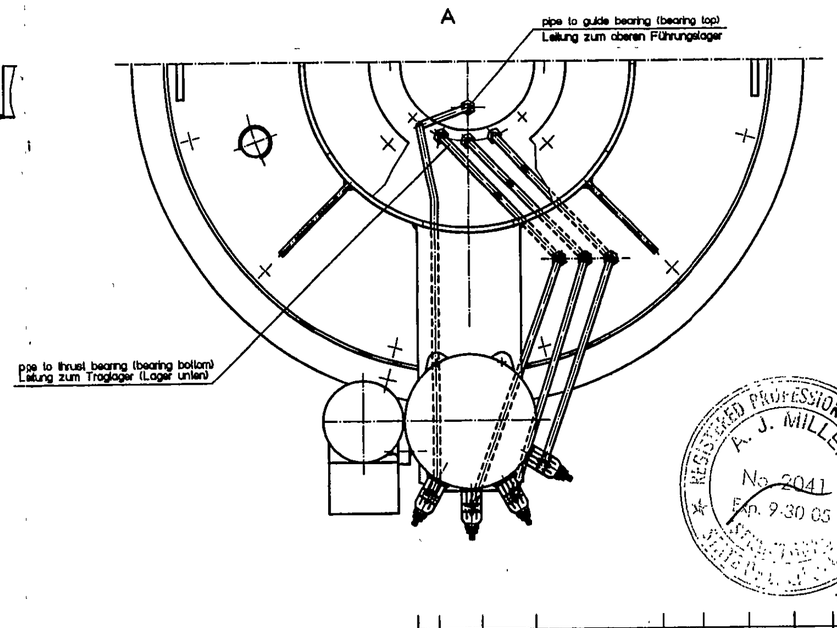
Bearing bottom	Bearing top	Sealing grease bottom	Sealing grease top

Arrangement of the grease lubricating connections (thrust bearing housing)
Anordnung der Fettschmieranschlüsse (Traglagergehäuse)









CB & I/GWINNETT COUNTY PHASE II ESD
CONTRACT NO. 127047
PO 139424
STERLING FLUID SYSTEM SO 23030042
DRAFT TUBE SLUDGE MIXERS
TAG: 40:DSL-MIX-3/4/5

KA Gwinnett County, USA

REGISTERED PROFESSIONAL ENGINEER A. J. MILLER No. 2041 Exp. 9-30 05 3/31/03

Maße ohne Toleranzangabe			
nach DIN 7168 B1 mittel u. B2			
Werkst.	Rev. 0	DIN A0	
Ersetzt für			
Ersetzt durch			
Entst. aus			
Kont.-Zchg.			
Zeichnungs-Nr.	L127.5498.26.0172		
Benennung	Schnittzeichnung Sectional drawing Typ MFB 4		
Maßstab	1:3,33		
Gewicht			

HALBERG

Schutzvermerke nach DIN 34 beachten

Ziffer	Änderungsanlass	Beschreibung	Datum	Name	gepr.	Toleranz	Maß	oberes + unteres Abmaß

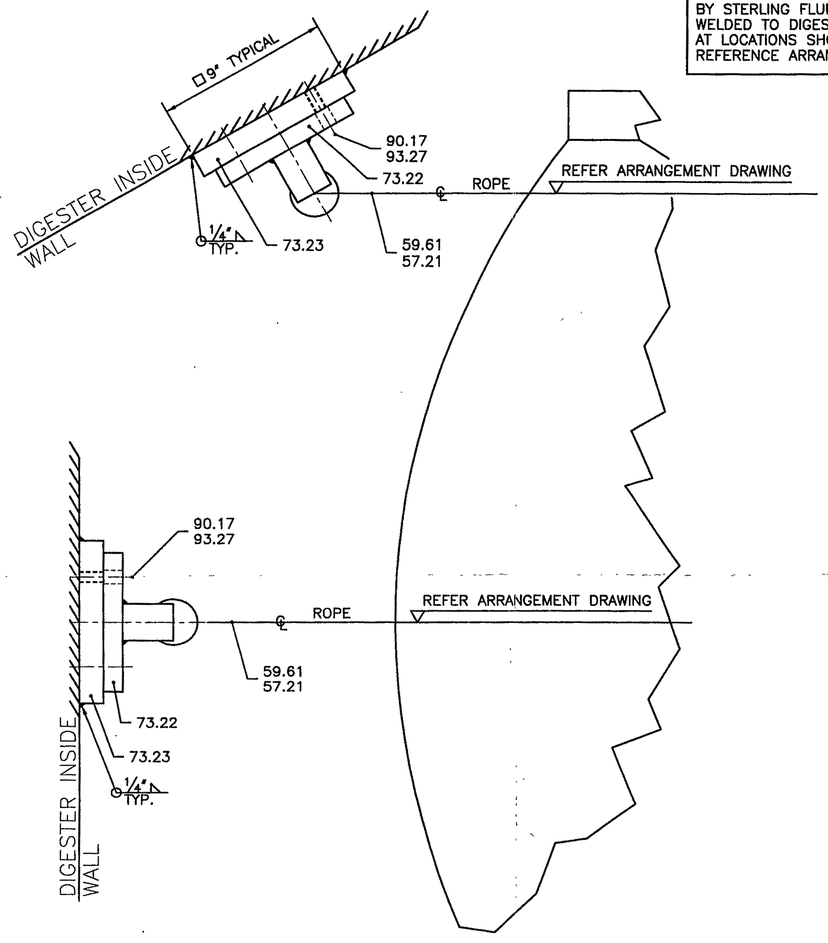
WALL PLATE MOUNTING DETAIL

PART No. 73.23 –
WALL ANCHOR PLATE TO BE FURNISHED BY STERLING FLUID SYSTEMS AND WELDED TO DIGESTER WALL BY OTHERS AT LOCATIONS SHOWN, REFERENCE ARRANGEMENT DRAWING.

PROJECT NAME:

FLOOR CONSOLE TABULATION (INCHES)			
MIXER SIZE		A	REFERENCE ARRANGEMENT DRAWING No.
MFS 4	X	1.25	L141.5498.51.0238 Rev. 3
MFS 6		1.25	
MFS 8		1.625	

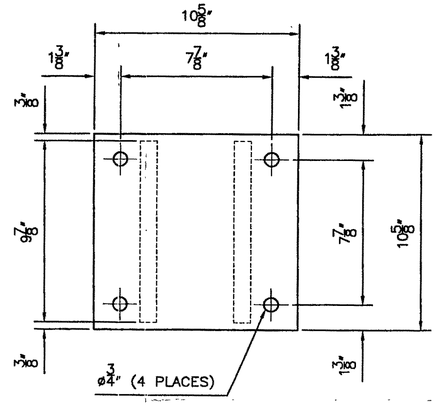
MATERIAL: A36 TO BE COATED PER SPEC BY OTHERS.

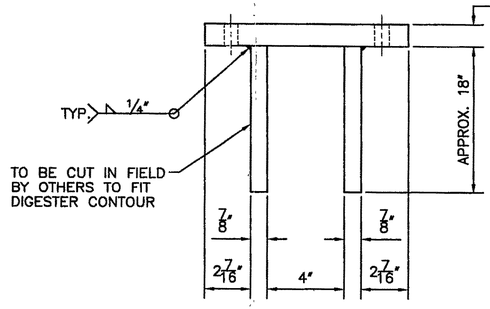


FLOOR CONSOLE – SUPPLIED BY OTHERS

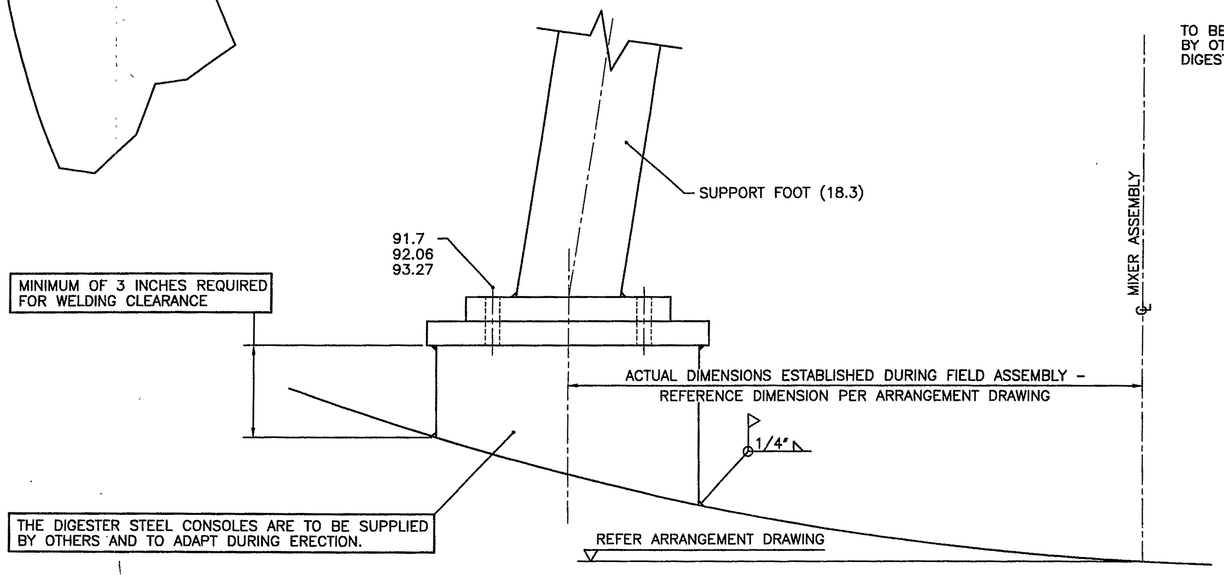
REFERENCE ARRANGMENT DRAWING

IMPORTANT:
1.) SUPPORT FEET, POS. 18.3, TO BE MOUNTED WITH SUPPORT PLATE, POS. 89.3, AND STEEL CONSOLES OF DIGESTER.
2.) HORIZONTAL ADJUSTMENT OF THE SUPPORT PLATE TO THE DIGESTER CENTER.
3.) FINISHING WELDING OF THE STEEL CONSOLES TO THE DIGESTER.





REGISTERED PROFESSIONAL ENGINEER
A. J. MILLER
No. 2041
Exp. 9-30-05
STRUCTURAL
STATE OF CALIFORNIA
3/31/03



REV. NO.	ISSUE DATE	DESCRIPTION	BY	CHKD	APPROVED
1	3/19/99	SEE ECN No. A153/99	JAB	PC	3/8/99
0	1/29/99	STANDARD DRAWING	SCB		

STERLING SIHI
Sterling Fluid Systems (USA)
303 Industrial Boulevard, Grand Island, N.Y. 14072-0460
Telephone: 716-773-6450 Fax: 716-773-2330
An ISO 9001 Registered Company

SCALE	SHOP ORDER	DRAWING NUMBER	REV
1/4" = 1"		Z253	1

CUSTOMER | CUSTOMER P.O.

TITLE
MIXER – ANCHORING PARTS MOUNTING DETAILS

DIMENSIONAL TOLERANCES	
0"–12"	±0.125"
13"–36"	±0.250"
37"–72"	±0.500"
73" AND LARGER	±1.000"

DRAFT TUBE BOLTING REQUIREMENTS

MFS-4

SO **23030042** **(5-STRAIGHT DRAFT TUBE SECTIONS OF EQUAL LENGTH)**

JOB: **Gwinnett Phase II** **QTY:** 3 **DATE:** 3/21/03

BOLTING PARTS LIST:

BOLT NO.	BOLT SIZE
90.12	1-1/8" - 7 UNC x 6.00 IN. LONG STANDARD BOLTS
90.13	1-1/8" - 7 UNC x 7.50 IN. LONG STANDARD BOLTS
90.13A	1-1/8" - 7 UNC x 7.50 IN. LONG FULL THREAD BOLTS
90.14	7/8" - 9 UNC x 3.50 IN. LONG FULL THREAD
90.113	7/8" - 9 UNC x 4.75 IN. LONG STANDARD BOLTS
90.114	7/8" - 9 UNC x 6.00 IN. LONG STANDARD BOLTS
90.114A	7/8" - 9 UNC x 6.00 IN. LONG FULL THREAD BOLTS
90.17	5/8" - 11 UNC x 2.25 IN. LONG FULL THREAD BOLTS
91.7	5/8" - 11 UNC x 5.50 IN.LONG -MIN. 3.5 IN. THRD.
Leveling Screws	SQ. HD. 7/8" - 9 UNF x 5 IN. LONG FULL THREAD BOLTS

		-----QUANTITIES PER MIXER-----'				
DESCRIPTIONS	**BOLT NO.**	**QTY**	**WASHER**	**QTY**	**NUT**	**QTY**
DRAFT TUBE TO DRAFT TUBE - STRAIGHT SECTIONS	90.12	60	93.22	60	92.02	60
DRAFT TUBE TO ANCHOR PLATE TO DRAFT TUBE	90.13	16	93.22	16	92.02	16
DRAFT TUBE TO ANCHOR PLATE TO DRAFT TUBE FULL THREAD	90.13A	4	93.22	4	92.02	4
SUPPORT PLATE TO UPPER SUPPORT FOOT	90.14	9	93.24	9		
DRAFT TUBE TO FLANGE OF UPPER CASTING	90.113	20	93.24	20	92.04	20
AFT TUBE TO SUPPORT PLATE TO LOWER BELL MOUTH	90.114	16	93.24	16	92.04	16
DRAFT TUBE TO SUPPORT PLATE TO LOWER BELL MOUTH-FULL	90.114A	4	93.24	4	92.04	4
ANCHOR PLATE TO WALL ANCHOR	90.17	32	93.27	32		
LOWER SUPPORT FOOT TO CONSOLE	91.7	12	93.27	12	92.06	12
SQ. HD.LEVELING SCREWS IN LOWER FOOT TO CONSOLE	Leveling Screws	3				

PARTS DESCRIPTIONS	**PART NO.**
DRAFT TUBE TO DRAFT TUBE - STRAIGHT SECTIONS	71.1/71.11/71.12
DRAFT TUBE TO ANCHOR PLATE TO DRAFT TUBE	71.1/89.31
SUPPORT PLATE TO UPPER SUPPORT FOOT	89.3/18.3
DRAFT TUBE TO FLANGE OF UPPER CASTING	71.11/72.03
DRAFT TUBE TO SUPPORT PLATE TO LOWER BELL MOUTH	71.12/89.3/72.01
DRAFT TUBE TO SUPPORT PLATE TO LOWER BELL MOUTH-FULL THREAD	71.12/89.3/72.01
ANCHOR PLATE TO WALL ANCHOR	73.22/73.23
LOWER SUPPORT FOOT TO CONSOLE	18.3

SECTION 10 MOTORS – MIXER & GREASE PUMP

10.1 MIXER DRIVE MOTOR

- DRIVE MOTOR DESCRIPTION
- DRIVE MOTOR DRAWING - 225B5360AD (FRAME 364 HP16)
- MOTOR AND ACCESSORY WIRING DIAGRAM
- OPERATING INSTRUCTIONS - VERTICAL INDUCTION MOTORS - GEK 95655A

10.2 GREASE PUMP MOTOR (INTEGRAL WITH GREASE PUMP – REFER ALSO TO SECTION 11 FOR GREASE PUMP)

- DESCRIPTION PAGE (F + G (FELBER - GUILLAUME)
- GREASE PUMP MOTOR WIRING DIAGRAM.
- OPERATING INSTRUCTIONS

10.1 MIXER MOTOR DESCRIPTION -

10.1.1 Mixer Motor - Vertical "P" Flange Explosion-Proof

MOTORS SAME AS PROVIDED FOR GWINNETT PHASE I

• Motor Manufacturer	General Electric
• Division/Class/Group	Division 1, Class 1, Group D
• Rated size of mixer motor	20 HP
• Motor Synchronous Speed	720 RPM
• NEMA Frame Size	364 HP 16
• Service Factor	1.15
• Temperature Rating of Motor	40°C
• Insulation	Class F
• Motor Efficiency at Full Load	91.0% *
• Motor Efficiency at ¾ Load	92.3% *
• Motor Efficiency at ½ Load	92.2% *
• Full load current of motor	26.6 Amps *
• Locked rotor current of motor	145 Amps *

*Estimated values, actual data will be available after motor performance test.

10.1.2 Mixer Motor - Additional Features

- Single phase, 115 VAC, Space Heaters
- Oversize conduit boxes
- Breather Drain
- Auxiliary conduit box for space heater leads placed on *same side* as standard box. Note that in vertical motors of this side, the option of placing the auxiliary terminal box opposite the main box is not offered.
- Ground terminal *inside box only.* UL does not permit external grounding lugs on explosion-proof motors
- Standard manufacturer's paint.

GENERAL ELECTRIC

225B5360AD

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-

APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHINED DIMENSIONS FRACTIONS	DECIMALS	ANGLES
	✓	±	±	±

225B5360AD

TITLE

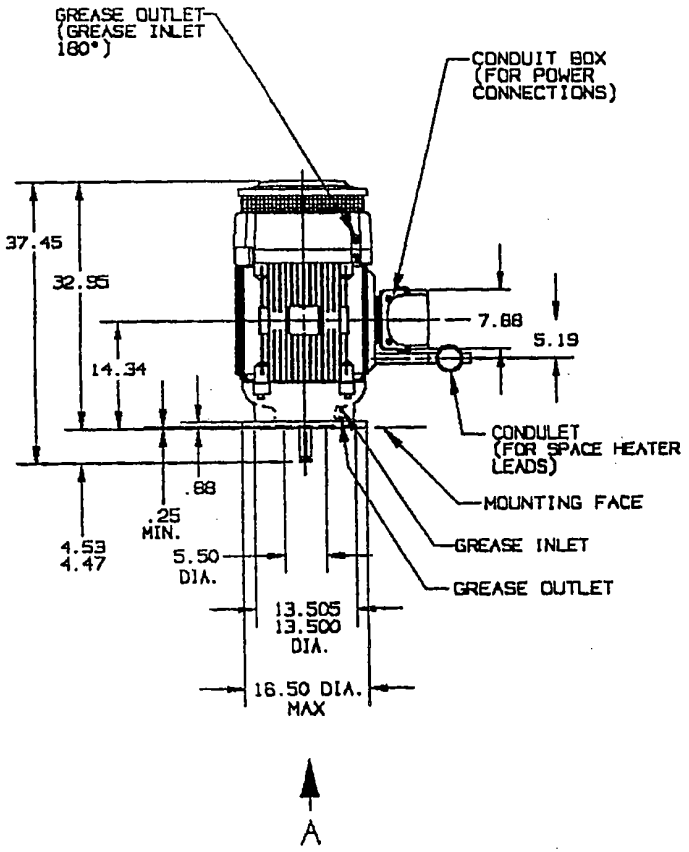
OUTLINE EXPLOSION PROOF

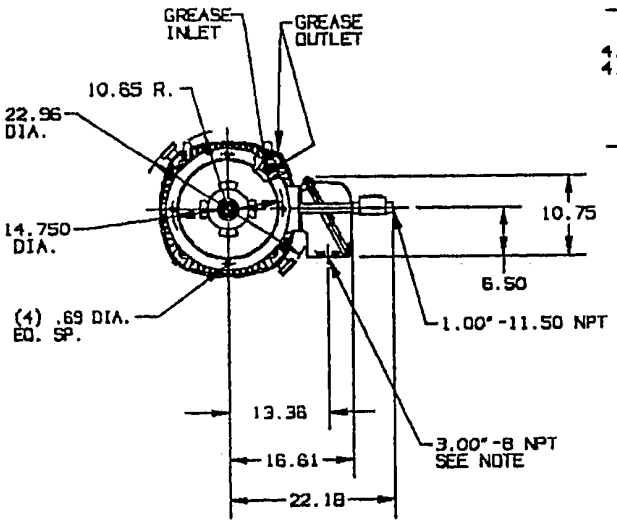
FIRST MADE FOR NEMA 360 CAST IRON FRAME CONSTR.

VERTICAL SOLID SHAFT-NORMAL THRUST-16.00 BD

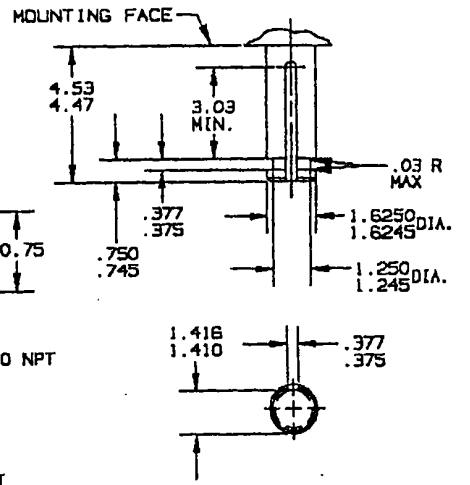
DIMENSIONS IN INCHES
NEMA TYPE P BASE

5KS364GT120P
CONDULET
SPL CONDUIT BOX





VIEW A



ENLARGED VIEW OF SHAFT EXTENSION

PRINTS ARE:
- ☐ FOR APPROVAL
- ☐ APPROVED FOR CONSTRUCTION

CAD NO. F360:225B5360AD PLOT SCALE .0666

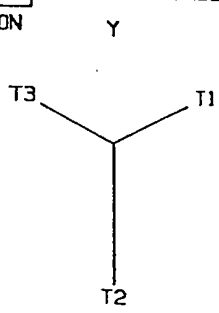
CAD REVISIONS ONLY				PRINTS TO	
1	M.LILLING 8-2-89	REDRAWN ON CAD	.		
2	M.LILLING 7-28-89	850-232			
3	U.SUBHEDLA 03-24-98	RET'D ON CAD			
3	J DUNLAP 10-27-98	RMVD REF TO (2) CNDL			

NOTES:

1. PROVIDED MOUNTING CONDITIONS PERMIT, CONDUIT BOX MAY BE TURNED SO THAT ENTRANCE CAN BE MADE FROM EITHER SIDE.

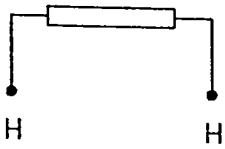
D. WAGER	D.W.	GEICS FORT WAYNE, IN.	225 360AD
2-26-88			

SINGLE VOLTAGE CONNECTION



	VOLTS	L1	L2	L3	TOGETHER
1Y	SINGLE	T1	T2	T3	

FIG. 1
HEATER CONN.



CONTROL	L1	L2
VOLTAGE ONLY	H	H

FIG. 2
THERMOSTAT CONN.

PO= NORM. OPEN	PC= NORM. CLOSED

GE Industrial Systems

Instructions

Vertical Induction Motors

Normal Thrust – Solid-Shaft

Including Aerator and
Sewage Pump Motors

Frames 182-5011 NEMA Type P Base
Weather Protected Type I & II
TEFC & Explosion-Proof

SAFETY PRECAUTIONS

High voltage and rotating parts can cause serious or fatal injuries. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA Publication MG-2, Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators, the National Electrical Code, and sound local practices is recommended.

For equipment covered in this Instruction Book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- Avoid contact with energized circuits or rotating parts.
- Avoid by-passing or rendering inoperative any safeguards or protective devices.
- Avoid use of automatic-reset thermal protection where unexpected starting of equipment might be hazardous to personnel.
- Avoid contact with capacitors until safe discharge procedures have been followed.
- Be sure that the shaft key is fully captive before the motor is energized.
- Avoid extended exposure in close proximity to machinery with high noise levels.
- Use proper care and procedures in handling, lifting, installing, operating, and maintaining the equipment.
- Do not lift anything but the motor with the motor lifting means.

Safe maintenance practices by qualified personnel are imperative. Before starting maintenance procedures, be positive that:

- Equipment connected to the shaft will not cause mechanical rotation.
- Main machine windings and all accessory devices associated with the work area are disconnected from electrical power sources.

If a high-potential insulation test is required, procedure and precautions outlined in NEMA Standards MG-1 and MG-2 should be followed.

Failure to properly ground the frame of this machine can cause serious injury to personnel. Grounding should be in accordance with the National Electrical Code and consistent with sound local practice.

These instructions do not purport to cover all of the details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Table of Contents

VERTICAL INDUCTION MOTORS
NORMAL THRUST – SOLID-SHAFT
INCLUDING AERATOR AND SEWAGE PUMP MOTORS
FRAMES 182-5011 NEMA TYPE P BASE
WEATHER PROTECTED TYPE I & II TEFC & EXPLOSION-PROOF

I. INTRODUCTION

General Electric normal-thrust, aerator and sewage pump vertical motors covered by these instructions are carefully constructed of high-quality materials and are designed to give long and trouble-free service when properly installed and maintained. Normal-thrust motors are generally used to drive pumps but are sometimes used for belt-drive applications.

The enclosure and the bearing lubrication system of these vertical motors are designed specifically for operation with motor mounted vertically with shaft downward. These motors should not be operated in any other position without approval of the General Electric Company.

Normal-thrust, aerator and sewage pump motors generally use grease-lubricated ball bearings at each end of the motor. These motors are intended to carry relatively light axial thrust loads, either up or down. They can also carry some radial load, or a combination of axial and radial loads.

Generally the lower bearing is locked in place in the lower endshield and locked onto the shaft so it carries all thrust loads either up or down. The upper bearing has clearance both above and below its outer ring so it is free to move up and down and keep the bearings from being axially loaded by differential thermal expansion between the shaft and the stationary parts of the motor. The upper bearing then serves only as a guide bearing. See Figures 1 and 2.

Some of the larger normal-thrust motors and all aerator and sewage pump motors use a double-row ball bearing at the lower end to obtain greater capacity. This is shown on the left side of Figures 1 and 2.

Since overloading greatly reduces bearing life, motor bearings should not be loaded beyond their rated capacity.

A. V-Belt Drive

Since belting places relatively high radial loads on the shaft and bearings, motors must be specifically ordered for such service. To limit these loads to reasonable values, adhere to the minimum motor sheave diameter and maximum sheave width specified by the General Electric Company. Belt speed, distance sheave center-lines, and sheave diameter ratio should be within the limits of good belting practice as specified by the belt manufacturer. The belt speeds should not exceed 5,000 feet per minute unless otherwise recommended by the manufacturer of the belt.

This instruction book applies to motors with Weather-Protected I, Weather-Protected II, Totally Enclosed-Fan Cooled (TEFC), or Totally Enclosed-Explosion-Proof enclosures as defined by NEMA (WP-

II enclosure is not available in 440 and smaller frame series).

Weather-Protected I motor construction is shown in Figure 1.

Weather-Protected II motor enclosures are characterized by additional protection at the air inlet and outlet passages and by gaskets, drains, and other features to make it suitable for use outdoors in severe climates. Filters can be supplied for the air-inlet openings. When used, they should be cleaned periodically since clogged filters restrict the amount of cooling air and cause the motor to overheat. Gages are sometimes used to measure the pressure drop across the filter and thus indicate its condition. Filters should be cleaned when the gage reads over 0.4" of water.

TEFC and explosion-proof motor construction is shown in Figure 2. Enclosed motors are characterized by an enclosure and ventilating system that prevents the free exchange of air between the inside and outside of the motor. The air inside the motor is circulated by the rotor fans to carry heat to the enclosing parts while an external fan blows ambient air over the motor to complete the cooling process.

II. RECEIVING, HANDLING, AND STORAGE

Each motor should be carefully examined when received and a claim filed with the carrier for any damage. The nearest office of the General Electric Company may offer guidance.

Warning ***The motor should be lifted by the lugs provided. These lugs are intended for lifting the motor only and must not be used to lift any additional weight. Be careful not to touch overhead power lines with lifting equipment. Failure to observe this warning may result in personal injury or death.***

If the motor is not to be installed immediately, it should be stored in a clean, dry location. Precautions should be taken to prevent the entrance of moisture, dust, or dirt during storage and installation. Precautions are taken by the factory to guard against corrosion. The machined parts are slushed to prevent rust during shipment. Examine the parts carefully for rust and moisture if the equipment is to be stored and re-slush where necessary.

These motors have grease-lubricated bearings which are packed with the proper amount of grease at the factory and do not require regreasing until they have been in service for a time, unless they have been stored for a long time under adverse conditions.

See instructions under MAINTENANCE for lubrication recommendations.

Motors in storage and motors that are to stand idle for a prolonged period and be subjected to moisture from condensation should have the bearing housings filled with grease to minimize corrosion.

To fill bearings completely, add grease until it comes all the way out of the relief passage. When the motor is again started, run it with the relief plug removed for about ten minutes to expel excess grease.

During storage, windings should be protected from excessive moisture absorption by some safe and reliable method of heating. Space heaters, if supplied, may be used for this purpose. The temperature of the windings should always be maintained a few degrees above the temperature of the surrounding air. It is recommended that motors in storage be inspected, the windings meggered, and a log of pertinent data kept. Any significant decrease in insulation resistance should be investigated.

If a motor is to be in storage for over one year, it is recommended that competent technical inspection service be obtained to ensure that the storage has been adequate and that the motor is suitable for service. Contact your nearest General Electric Sales office to arrange for inspection service.

III. UNPACKING

If the machine or machine parts have been exposed to low temperatures, unpack it only after it has reached the temperature of the room in which it will be unpacked or located; otherwise sweating will occur.

IV. INSTALLATION

Warning

Installation should be in accordance with the National Electrical Code and consistent with sound local practices. Coupling guards and belt enclosures should be installed as needed to protect against accidental contact with moving parts. Machines accessible to personnel should be further guarded by screening, guard rails or other suitable enclosure to prevent anyone from coming into contact with the equipment. This is especially important for motors that are remotely or automatically controlled or have automatic re-setting overload relays, since such motors may start unexpectedly. Failure to observe these precautions may result in injury of death to personnel.

A. Location and Mounting

Allow enough space around the motor to permit free flow of ventilating air and to maintain an ambient temperature not over 40° C. Where a choice of locations is possible, install the motor so that it will be subjected to the least amount of dirt, dust, liquids, or other harmful materials. Mount the motor securely on a level, firm foundation, align accurately with the driven equipment, and tighten mounting bolts securely.

For BELT-DRIVE installations, align the sheaves carefully to avoid axial thrust on the bearings and excessive belt wear. Tighten the belts only enough to prevent slipping. Excessive tension will reduce bearing life and may cause the shaft to break.

Warning

All belts should be enclosed to prevent injury from thrown parts in case a belt should break in service.

Weather-Protected Type I motors may be installed in indoor locations with relatively high moisture content or sheltered outdoor locations in dry climates.

Weather-Protected Type II motors may be installed outdoors. Use filters in unclean areas.

Because of their special enclosure features, enclosed motors can be operated out-of-doors and in dirty locations.

Explosion-proof motors suitable for use in hazardous locations bear the Underwriters Laboratories Label and should be applied only in the areas for which they are designed, as specified in the National Electrical Code (See MOTORS FOR HAZARDOUS LOCATIONS).

Warning

If ignitable dust or lint is present around WP-I or WP-II motors, the surface temperature of space heaters, if supplied, should not exceed 80% of the ignition temperature. Refer to space heater nameplate or factory for information on surface temperature. Dust and/or lint should not be allowed to build up around the surface of the space heaters. Failure to observe these precautions may result in damage to equipment, injury to personnel, or both.

Warning

Installation of the machine where hazardous, flammable, or combustible vapors or dusts present a possibility of explosion or fire should be in accordance with the National Electrical Code, Articles 500-503, and consistent with sound local practices. Extreme care is required for all explosion-proof motors and all motors supplied with an explosion-proof or dust-ignition proof accessory device or conduit box since any nicks or burrs in the sealing surfaces during disassembly and reassembly may destroy the explosion-proof or dust-ignition proof features. Failure to observe these precautions may result in damage to the equipment, injury of personnel, or both.

B. Pump and System Precautions

Some precautions are necessary to assure satisfactory operation of motors in pumping service. The packing gland in the pump head should be kept in good condition so that the liquid being pumped will not be forced out along the shaft and enter the motor through the lower bearing housing.

Motors driving pumps in pressure systems where the pressure is maintained after shutdown should be protected from overspeeding by check valves.

The SYSTEM REED CRITICAL FREQUENCY should be 25% above or below motor operating speed in order to avoid excessive vibration.

C. Alignment of Solid Shaft Motors

Accurate mechanical lineup is essential for successful operation. Mechanical vibration and roughness when the motor is running may indicate poor alignment. In general, lineup by straight edge across, and feeler gages between coupling halves is not sufficiently accurate. It is recommended that the lineup be checked with dial indicators. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.

D. Power Supply and Connections

1. Wiring and Grounding

Warning

Motor and control wiring, overload protection, and grounding should be in accordance with the National Electrical Code and consistent with sound local practices. Failure to observe these pre-cautions may result in damage to the equipment, injury to personnel, or both.

2. Allowable Voltage and Frequency

The power supply must agree with the motor nameplate voltage and frequency. Motors will operate (but with charac-

teristics somewhat different from nameplate values) on line voltages within ±10% of nameplate value or frequency within ±5% and a combined variation not to exceed ±10%.

3. Position of the Conduit Box

When mounting conditions permit, the conduit box may be turned so that entrance can be made upward, downward, or from either side.

E. Lubrication

All grease-lubricated bearings are packed with the proper amount of grease at the factory and do not require regreasing initially until they have been in service for a time, unless they have been stored for a long time under adverse conditions.

See instructions under MAINTENANCE for lubrication recommendations.

V. OPERATION

Caution

Before energizing the motor for the first time or after an extended shutdown, it is advisable to check insulation resistance, power supply and mechanical freedom of the motor. If the motor has been stored in a damp location, dry it out thoroughly before operating.

Warning

Be sure that the motor is not running and the power supply is disconnected before working on motor.

A. Steps Prior to Initial Start-Up

1. Check insulation resistance as indicated in the caution above.

Warning

Before measuring insulation resistance, the machine must be at standstill and all windings to be tested must be electrically connected to the frame and to ground for a time sufficient to remove all residual electrostatic charge. Failure to observe these precautions may result in injury to personnel.

In accordance with established standards, the recommended minimum insulation resistance for the stator winding is as follows:

$$R_S = \frac{V_S}{1000} + 1$$

Where R_S is the recommended minimum insulation resistance in megohms at 40°C of the entire stator winding obtained by applying direct potential to the entire winding for one minute, and V_S is rated machine voltage.

NOTE: SEE IEEE RECOMMENDED PRACTICE FOR TESTING INSULATION RESISTANCE OF ROTATING MACHINES PUBLICATION NO. 43 FOR MORE COMPLETE INFORMATION.

If the insulation resistance is lower than this value, it may be wet and it is advisable to eliminate the moisture in one of the following ways

a. Dry the stator in an air circulating oven with the air surrounding the part at 95°C to 115°C. until the stator has been above 90°C for at least four hours. Then the air temperature may be raised to 135°C to 155°C. Continue to heat until the insulation resistance is constant for a one-half hour period.

b. Enclose the motor with canvas or similar covering, leaving a hole at the top for moisture to escape. Insert heating units or lamps and leave them on until the insulation resistance is constant for one-half hour period. Be careful not to get heating units so close to the winding that they cause localized damage.

c. With the rotor locked and using approximately 10% of rated voltage, pass a current through the stator windings. Increase the current gradually until the temperature reaches 90°C. Do not exceed this temperature. Maintain a temperature of 90° C until the insulation resistance becomes constant for a one-half hour period.

2. Whenever possible, examine the interior of the machine for loose objects or debris which may have accumulated and remove any foreign material.

3. If possible, turn the rotor by hand to be sure that it rotates freely.

4. Check all connections with the connection diagram. Check all accessible factory-made connections for tightness to make sure none has become loose during shipment.

5. If possible, leave motor uncoupled (or uncouple it) for initial operation so that motor vibration, noise, current, and bearings can be checked uncoupled before they are masked by the driven equipment.

6. When the driven machine is likely to be damaged by the wrong direction of rotation, it is imperative to uncouple the motor from its load during the initial start and make certain that it rotates in the correct direction. If it is necessary to change rotation, interchange any two line leads. For multispeed motors, check each speed independently.

   Some motors are designed for unidirectional rotation. Rotation of these motors must be in accordance with the rotation indicated on the nameplate and the outline furnished with the equipment.

B. Initial Start

1. After inspecting the machine carefully as outlined above, make the initial start by following the regular sequence of starting operations in the control instructions.

2. Run the motor uncoupled initially, if possible, checking for abnormal noise, vibration, or bearing temperatures and for current and voltage balance. Then check motor operation under load for an initial period of at least one hour to observe whether any unusual noise or hotspots develop.

3. In the event of excessive vibration or unusual noise, remove all power and disconnect the machine from the load and check the mounting and alignment.

4. Space heaters should be deenergized during motor operation.

5. Check line voltage on all three phases to be sure it is balanced and within 10% of motor rated voltage with motor drawing load current.

6. Check the operating current against the nameplate value. Do not exceed the value of nameplate amperes X service factor (if any) under steady continuous load. Also, check to be sure that current in all three lines is balanced.

C. Jogging and Repeat Starts

Warning

Repeated starts and/or jogs of induction motors greatly reduce the life of the winding insulation. The heat produced by each acceleration or job is much more than that dissipated by the motor at full load. If it is necessary to repeatedly start or jog a motor, it is advisable to check the application with the local General Electric sales office.

Check motor heating but do not depend on your hand to determine temperature. Use the temperature detectors furnished in the motor if there are any (e.g., RTD's or thermocouples), or use a thermometer. If there is any doubt about the safe operating temperature, take the temperature of the part in question and confer with the nearest sales office of the General Electric Company. Give full details, including all nameplate information.

Overheating of the motor may be caused by improper ventilation, excessive ambient temperature, dirty conditions, excessive current due to overload, unbalanced AC voltage, or (if a variable speed controller is used) harmonics in power supplied to the motor.

VI. MAINTENANCE

Warning

Before initiating maintenance procedures, disconnect all power sources to the motor and accessories for machines equipped with surge capacitors. Do not handle capacitor until it is discharged by a conductor simultaneously touching all terminals and leads, including ground. This discharge conductor should be insulated for handling.

A. General

Inspect the motor at regular intervals, as determined by service conditions. Keep the motor clean and the ventilation openings clear.

In addition to a daily observation of the overall conditions, it is recommended that a regular inspection routine be set up to check periodically the following items:

1.General Cleanliness

2.Insulation and Windings

3.Lubrication and Bearings

4.Coupling Bolt Tightness

B. Explosion-Proof Motors for Hazardous Locations

Motors which are suitable for use in hazardous locations have special features and are called explosion-proof motors or dust ignition-proof motors. They bear the Underwriters Laboratories label which specifies the particular type of location in which the motor may be operated.

Special features include wide metal-to-metal joints with limited clearances between surfaces; the scaling of leads into the frame; enclosing parts and holding bolts of proper design for strength; fans, seals, and non-reverse couplings of non-sparking metals; the avoidance of removable plugs in the enclosure, etc.

Warning

Motors for hazardous locations require more than ordinary care in their maintenance and repair to as-sure their continued safety. When major repairs are necessary or new parts are required, it is recommended that the motor be sent to an authorized General Electric service shop.

C. General Cleanliness

The interior and exterior of the machine should be kept free from dirt, oil, grease, and conducting dust. Oily vapor, debris, or dust may build up and block off ventilation. Any of these contaminants can lead to early motor failure. Motors should be disassembled and thoroughly cleaned periodically as needed. While TEFC motors can be run in dirty areas, better service may be expected if they are kept reasonably clean.

Motors may be blown out with dry, compressed air of moderate pressure. However, cleaning by suction is preferred because of the possibility of water in the compressed air lines and the danger of blowing metal chips into the insulation with compressed air.

Warning

To prevent injury to eyes and respiratory organs, safety glasses and suitable ventilation or other protective equipment should be used. Operator must not use compressed air to remove dirt or dust from his person or clothing.

D. Relubrication

Motors covered by these instructions employ grease lubrication for both the upper (guide) bearing and the lower (thrust) bearing.

The bearing housings are packed at the factory with sufficient longlife grease for an initial operating period. Since the oil in the grease will ultimately become depleted, it is necessary to regrease at intervals consistent with the service. The following recommendations are offered as a guide in determining the relubrication period.

Guide bearings in vertical motors carry relatively light loads, and, under normal conditions of operation, can be regreased every three to five years. When conditions are more severe (high temperatures, dirty locations, motor running continuously, etc.), regrease every one to two years.

Regrease the thrust bearings of motors with speeds above 1800 rpm every 1000 hours of operation with the interval not to exceed three months. For motors with speeds 1800 rpm and below, regrease every 2000 hours of operation, with the interval not to exceed six months.

Relubrication procedure is as follows: Remove the grease relief plug and free the relief passage of hardened grease. Wipe the grease fitting clean. Or, if no fitting is supplied, replace the 1/8" pipe plug with a standard fitting.

For best results, use GE long-life grease (No. D6A2C5 as specified on motor nameplate). Take care to exclude dirt from the bearing housing and lubricant. With the motor at standstill, add grease, using a hand operated gun, until the grease begins to move in the relief passage. Allow the motor to run about ten minutes before replacing the relief plug, to purge excess grease.

Since the above method tends to purge the bearing housing of used grease, complete removal of all grease should be required only at infrequent intervals. Whenever the motor is disassembled for general cleaning and reconditioning, the housing should be cleaned of old grease, using a suitable cleaning solvent, and dried thoroughly. Refer to the mixture described under INSULATION AND WINDING MAINTENANCE below. Pack the cavity above the bearing with new grease until it is approximately 2/3 full before reassembling.

E. Bearing Replacement

In general, replacement bearings should be of the same type and installed in the same relative position as the other bearings.

When removing bearings, apply steady, even pressure parallel to the shaft center line. Apply this pressure to the inner race whenever possible.

F. Insulation and Winding Maintenance

1. General

For long life and satisfactory operation, insulated windings should be kept clean and free of dirt, oil, metal particles, and other contaminants. A variety of satisfactory and acceptable methods are available for keeping equipment clean. The choice of method will depend greatly on time, availability of equipment, and on the insulation system. However, vacuum and/or compressed air cleaning with nonmetallic hose tips should precede cleaning with water and detergent or with solvents. Tightly adhering dirt may require gently brushing or wiping to get it loose.

Warning	***To prevent injury to eyes and respiratory organs, safety glasses and suitable ventilation or other protective equipment should be used.***

2. Vacuum and Compressed Air Cleaning

Compressed air may be used to remove loose dirt and dust from air passages such as air ducts. Suction should be used to remove dirt and dust particles into the windings and damaging the coils.

Care must be taken to make sure that the air supply is dry and that excessive air pressure is not used. Generally a pressure of not more than 30 psi is recommended.

Operator must not use compressed air to remove dirt or dust from his person or clothing.

3. Cleaning with Water and Detergent

This method is very effective in cleaning windings when used with a low pressure steam jenny (maximum steam flow 30 PSI and 90°C).

To minimize possible damage to varnish and insulation, a fairly neutral, non-conducting type of detergent such as Dubois Flow should be used. A pint of detergent to 20 gallons of water is recommended.

If a steam jenny is not available, the cleaning solution may be applied with warm water by a spray gun. After the cleaning operation, the windings should be rinsed with water or low-pressure steam.

It is advisable to dry the windings. Refer back to Insulation Resistance section for instructions on how to proceed.

4. Cleaning With Solvents

Many cleaning fluids are flammable and/or toxic. To prevent injury to personnel and property, care should be taken to avoid flames, sparks, etc. Safety glasses should be used and contact with the skin should be avoided. The area should be well ventilated or protective equipment should be used.

Although cleaning with water and detergent is the preferred method, solvent cleaning may be used when heat drying facilities are not available.

1,1,1 Trichloroethane is recommended for use as the cleaning solvent. Solvent cleaning of silicone-insulated windings (Class H insulated machines) is not recommended.

While 1,1,1, Trichloroethane is considered to be non-flammable and has a relatively low order of toxicity, it should be used only in a well ventilated area that is free from open flames. Avoid prolonged exposure to its vapor. Failure to observe these precautions may result in injury to personnel.

* One commercial source of 1,1,1 Trichloroethane is Chlorothene NU, which is a trademark of the Dow Chemical Company, Midland, Michigan.

Windings cleaned with solvent should be dried thoroughly by circulation of dry air before voltage is applied.

5. Revarnishing Windings

After several cleanings with water and detergent, it may be necessary to re-varnish the windings. GE 9522 or equivalent varnish treatment is recommended for Class B and Class F systems. This varnish is available from the General Electric Company Insulating Materials Department of GE Service Shops.

All systems treated with varnish No. 9522 or equivalent must be baked until the windings are at 150°C for four hours.

VII. RENEWAL PARTS

When ordering parts, give description and state quantity of parts desired, together with the nameplate rating, model, and serial number of the motor. For couplings, also specify the type, bore, and keyway size.

Requests for additional copies of these instructions or inquiries for specific information should be addressed to the nearest sales office of the General Electric Company.

VIII. TROUBLE SHOOTING CHART

Affected Parts	Difficulty	What to Check
Windings	Overheating	• Calibration of measuring instrument • Excessive load • Unbalanced AC current • Improper or restricted ventilation • Excessive ambient temperature • Short circuited coil or windings • Dirty windings • Unbalanced voltage • Harmonics in power supply (variable frequency control) • Fan broken
Bearings	Overheating	• Calibration of measuring instrument • Worn out or dirty oil • Insufficient oil • Misalignment • Excessive thrust or radial loading • Shaft currents • Insufficient cooling water • Improper end-play • Insufficient down-thrust (on SRB) • Fan broken
Bearing Housing	Oil Leaks	• Incorrect grade of oil (type or viscosity) • Loose fittings • Cracked/porous casting • Over-filled • Water in oil
Motor	Excessive Vibration	• Unbalance • Misalignment • Improper or settled foundation • Non-uniform air gap • Rubbing parts • Bent shaft • Unbalanced stator current • Damaged bearings • Reed critical frequency • Incorrect end-play • Fan broken
Motor	Failure to Start	• Wrong transformer taps • Wrong connections • Open circuit • Excessive line drop (low voltage at motor) • Excessive load • Rotor rubs • Wrong direction of rotation
Insulation	Low Insulation Resistance or Insulation Failure	• Moisture, dirt, metal particles, oil, or other contaminants on the insulated windings • Wrong voltage • Excessive temperature • Voltage surges/lightning • Mechanical damage • Excessive vibration with resultant mechanical damage • Single-phasing

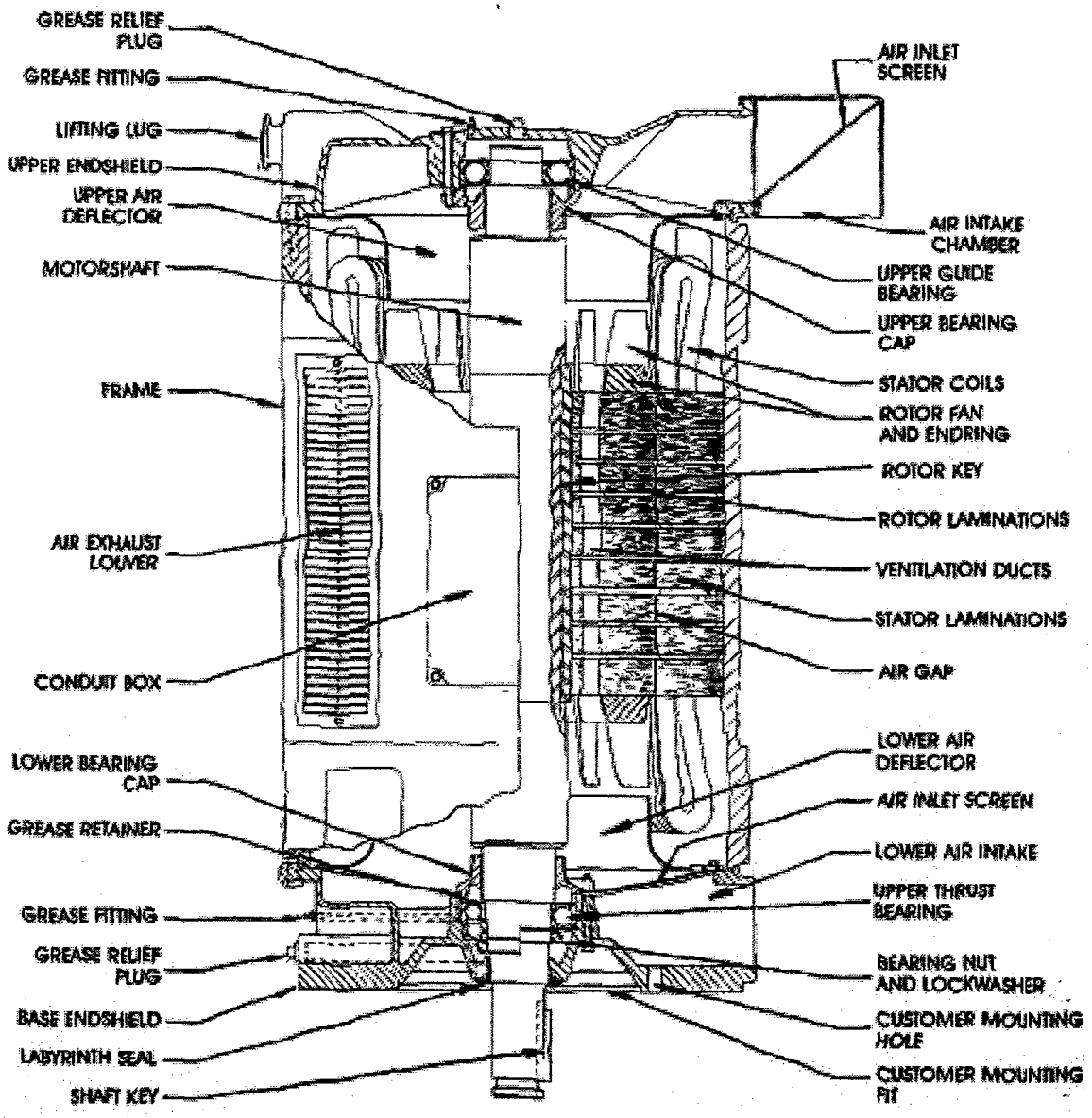


Figure 1

Typical Solid-Shaft Normal-Thrust WP-I Motor With Grease-Lubricated Ball Thrust And Guide Bearings. Double Row Thrust Bearing On Left Is Used In All Sewage And Aerator Motors And In All 5011 Frame Normal-Thrust Motors

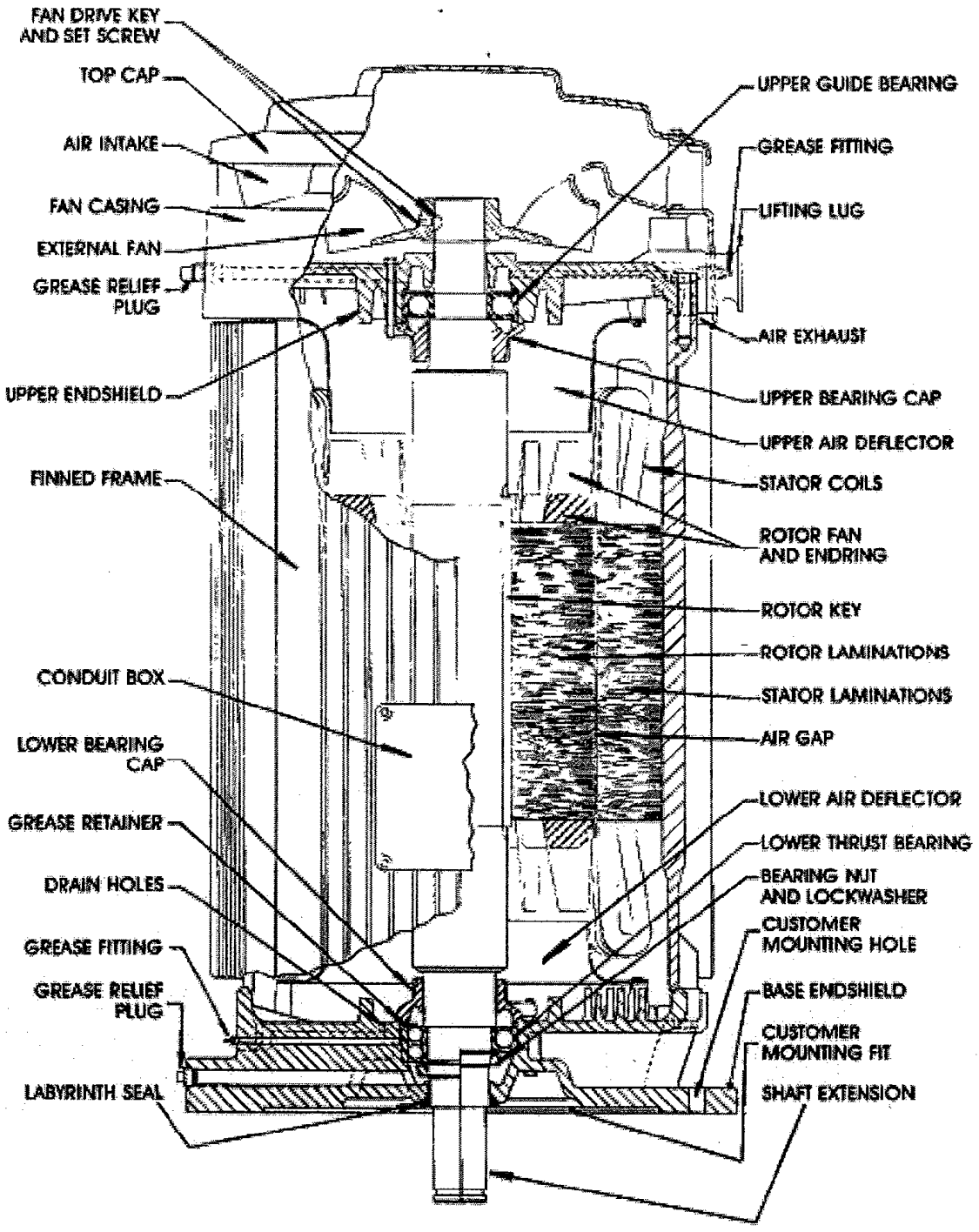


Figure 2

Typical Solid-Shaft Normal-Thrust TEFC Motor With Grease-Lubricated Ball Thrust And Guide Bearings. Double Row Thrust Bearing On Left Is Used In All Sewage And Aerator Motors And In All 5011 Frame Normal-Thrust Motors

Reader Comments

General Electric Company

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Fort Wayne IN 46801-2205
Fax: 1-219-439-3881
(GE Internal DC: 8*380-3881)

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General Rating

	Excellent	*Good*	*Fair*	*Poor*	*Additional Comments*
Contents	O	O	O	O	
Organization	O	O	O	O	
Technical Accuracy	O	O	O	O	
Clarity	O	O	O	O	
Completeness	O	O	O	O	
Drawings / Figures	O	O	O	O	
Tables	O	O	O	O	
Referencing	O	O	O	O	
Readability	O	O	O	O	

Specific Suggestions (Corrections, information that could be expanded on, and such.)

Page No. ***Comments***

Other Comments (What you like, what could be added, how to improve, and such.)

Overall Grade (Compared to publications from other manufacturers of similar products, how do you rate this publication?)

O Superior O Comparable O Inferior O Do not know Comment

Detach and fax or mail to the address noted above.

.....Fold here and close with staple or tape.....

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Stamp
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GE INDUSTRIAL SYSTEMS
INDUSTRIAL ENGINEERING TECHNICAL
PUBLICATIONS EDITOR
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Document Revision History

Rev #	Date	Author	ISAAC #	Description
0	10/13/99	GJG	N/A	Conversion from PageMaker.

10.2 GREASE PUMP MOTOR DESCRIPTION

10.2.1 Grease Pump Motor –Explosion-proof

• Motor Manufacturer	F+G (Felber-Guillaume)
• * Division/Class/Group	IP 55 EEx e d IICT4
• Rated size of mixer motor	0.21 kw
• Motor Synchronous Speed	1800 RPM
• Phase/Frequency/Voltage	3/60 Hz/460 volt
• Temperature Rating of Motor	40°C
• Insulation	Equivalent or greater to Class F

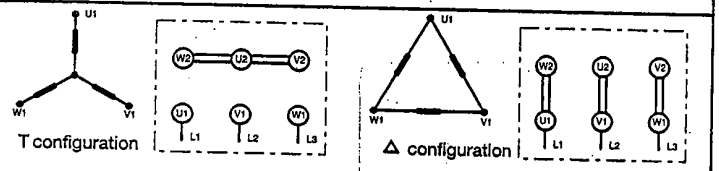
* Conforming to EN60529 (IEC34-5 and VDC0530) with three ptc thermistors.

WHERE:

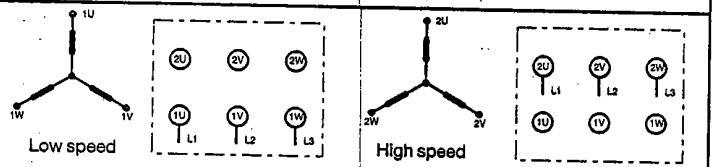
IP 55	Complete protection against contact with live of moving parts inside the enclosure. Protection against harmful deposits of dust. The ingress of dust is not totally prevented, but dust cannot enter in an amount sufficient to interfere with the satisfactory operation of the machine. Water projected by a nozzle against the motor from any direction shall have no harmful effect.
EEX d	Certified Flame-proof motor equivalent to North American Explosion-proof Standard to NEC 500 to 516 Apparatus Group
IIC	Apparatus Group II - All potentially explosive atmospheres other than mines C - Explosive Gas Sub-class A - C, where C is suitable for both classes of explosive gases A & B.
T4	Temperature Category suitable for Methane Gas

REFER TO GREASE PUMP INFORMATION FOR COMBINED DIMENSIONAL INFORMATION

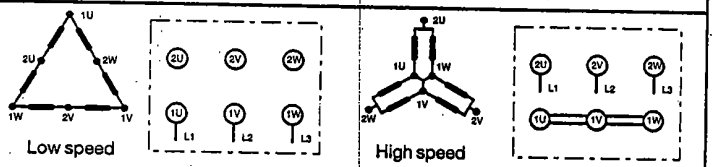
Connection circuit diagram



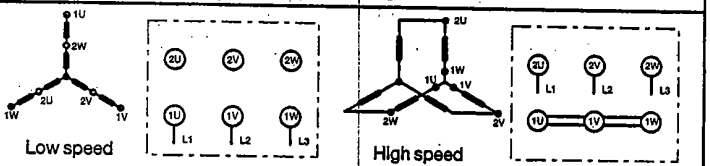
One-phase - one set of poles



Switchable poles



Dahlander - configuration



Dahlander - configuration

10 - 11	PTC thermistor deactivation	PTC thermistor pre-warning	Actuator device with PTB number
12 - 13		PTC thermistor pre-warning	
70 - 71	Standstill heater		
5 - 6	Tachogenerator		
20 21 22 23	PT100 resistance temperature sensor 		**In case of doubt, the configuration diagram located near the motor is decisive.**

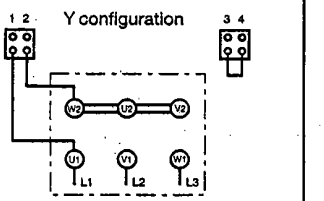
33050060

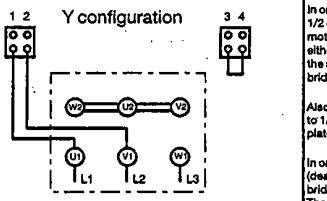
Fig. 8

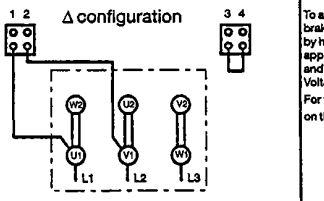
Connection circuit diagram

Brake motor with built-in brake

Connection of the brake via the motor coil







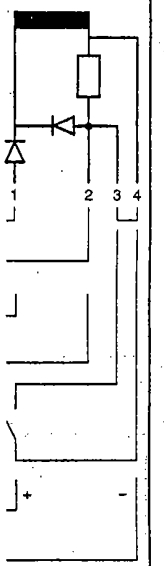
In order to supply power to the brake, 1/2 can be directly connected to the motor terminals. Compare the voltage either with the external cable or with the star point. Terminals 3/4 must be bridged.

Also an external voltage can be applied to 1/2. Observe the data on the rating plate. Terminals 3/4 must be bridged.

In order to rapidly energize the brake (deactivation at the DC side), the 3/4 bridge can be replaced by a contact. The contact must switch simultaneously with the voltage supply of the brake.
5.5

To allow the emergency lifting of the brake (e.g. in order to rotate the motor by hand), a rectified voltage can be applied to 1/4 (first remove other wires and observe the polarity).
Voltage $U_{=} = U_{\sim} \times 0.45$

For voltage $U_{\sim}$ see the brake voltage on the rating plate.



1 - 4	Brake		
10 - 11	PTC thermistor deactivation	PTC thermistor pre-warning	Cold-conductor deactivation
12 - 13		PTC thermistor deactivation	
70 - 71	Standstill heater		
P1 - P2	Temperature control: Microtherm T 10		

3305010

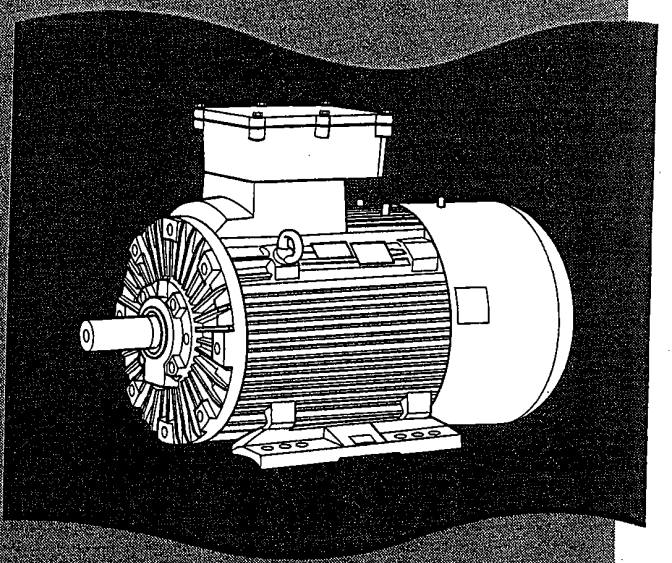
Fig. 9

FELTEN&GUILLEAUME

Explosion-proof 3-phase motors

in EEx d(e) IIC(B) T3-6

OPERATING MANUAL



DRIVE, CONTROL, MOTION

Table of contents

FELTEN & GUILLEAUME
ANTRIEBSTECHNIK GMBH

1 Introduction

This operating manual applies to A/C motors in the series CD..., dCD..., BD..., dBD... and BD...-B.

In addition to the general installation regulations, the guidelines given in this manual must be observed during the installation, commissioning and maintenance of explosion-proof A/C motors of ignition category 'explosion-proof housing', designation ⟨Ex⟩ G, EEx de II. T. or EEx d II. T.

2 Safety

2.1 Intended use

The motor must be operated in acco dance with the nominal data on the rating plate.

2.2 Operational safety

⚠ Electrically conducting and rc ting machines can lead to seri and/or fatal injuries. Installatic commissioning and maintena may be carried out only by qu fied personnel. Observe the re vant VDE stipulations and acc dent prevention regulations fo the installation, commissionin and use of electrical machines

In the case of installations that are sul ject to these guidelines, it is importan take safety measures in order to prote personnel from injury.

Personnel must have been trained:

- To avoid contact with electrically conducting parts.
- To deactivate all energy sources before starting maintenance or repair activities.
- To avoid contact with rotating parts and to ensure that the key is fully covered before the motor is activated.
- To avoid contact with the start and operation condenser in one-phase motors until a secure discharge has occurred.
- To proceed with care and to observe the regulations when transporting, hoisting, installing, commissioning or maintaining the installation. Do not use the lifting eye bolts to lift the motor together with the drive device. Do not use the supplied lifting eye bolts at temperatures below -20 C, in accordance with DIN 580. Lower temperatures could lead to the ring screw breaking and consequent injury to personnel and/or the installation.
- To not put a load on the lifting eye bolts at an angle exceeding 45 from the vertical direction or outside the plane of the ring, in accordance with DIN 580. The use of transverse rods is recommended in this context.
- To take appropriate safety measures against possible faults in the brake installed on the drive, especially in the case of brake motors used in lifting applications.

If high-tension tests are required, follow the procedures and precautionary measures laid down in the accident prevention regulations.

Incorrectly earthed motors can lead to serious injury to personnel or the motor. The earth connection must satisfy VDE stipulations and local installation regulations.

FELTEN & GUILLEAUME
ANTRIEBSTECHNIK GMBH

2.3 Symbols and Directions

Safety Symbol

This symbol indicates all safety directions given in this operating manual which point out dangers to the health and life of persons.

Warning of electric shock

This symbol warns of the danger of electric shock.

Warning!

Warning

This indicates that the operating manual must be specially observed and the guidelines, regulations, directions and correct working procedures are followed so that damage to/destruction of the motor is prevented.

[→...]

This symbol refers to more detailed directions and data given elsewhere in the manual.

3 Liability and Warranty

We cannot be held liable for any damage or operational faults arising from installation errors, non-observance of this operating manual or unprofessional repairs.

F&G original spare parts are specially constructed and tested for **F&G** motors.

It is advisable to purchase spare parts and accessories only from **F&G**. Any spare part or accessory not supplied by us must be approved by **F&G**.

The installation and use of third-party products may have an adverse effect on the properties of the motor and on the safety of people, the motor and other property.

F&G excludes any liability for damage resulting from the use of spare parts or accessories not approved by **F&G**.

Unauthorized conversion of and changes to the motor are disallowed on safety grounds and exclude all liability on the part of **F&G** for any resulting damage.

4 Service

F&G customer service is available for all technical information concerning **F&G** motors.

Should a problem occur, contact us or one of our local branch offices (for addresses, see the last page of this manual).

FELTEN&GUILLEAUME
ANTRIEBSTECHNIK GMBH
Postfach 1220
D-26942 Nordenham
Telephone (+49 47 31) 3 65-0
Telefax (+49 47 31) 3 65-88
E-Mail: fugdrive@fug.com

Spare parts:

When ordering spare parts, in addition to the listed designation of the part required, please indicate the motor type and serial no.

5 Delivery and storage

Upon delivery, check the motor for transport damage. Such damage must be assessed by the transport manager. Any damage must be reported to the transport manager or manufacturer not later than seven days after delivery.

All packaging materials should be disposed of without damage to the environment.

Storage for up to 36 months is possible on the following conditions:
the storage area must be dry and free of dust in order to prevent reduction of the insulation resistance.
The storage temperature must be between +5 °C and +30 °C, with a relative air humidity of <70% and a temperature gradient of a maximum of 10 °C/day.
In order to avoid damage, any occurring vibrations must have a Veff smaller than 0.2 mm/s.
Before storing a motor fitted with a lubrication device, replenish the grease with double the quantity listed on the motor plate while the motor is standing still.
The supplied shut off plugs for the cable entries serve only as transport protection divices and are not approved to outdoor storage. An additional protection from the rain must be applied.

Warning!

If storage conditions differ from the above, take measures in accordance with the separate storage regulations (AR9).

6 Installation

6.1 Mechanical Inspection

Once the transport locking bolt has been removed (see also the indication on the motor), it is possible to rotate the motor shaft by hand. In brake motors, however, the brake must be ventilated during standstill (a max. of 10 min). This is realized by applying voltage in accordance with the switching diagram [→ pages 17 and 18].

Warning!

For further transport, reinstall the transport safeguard in order to prevent damage to the bearings.

6.2 Location

The fully enclosed motors are intended for operation in places where they are exposed to dirt, moisture and the usual outdoor conditions that correspond to their protection class.

The motors must be installed in an easily accessible position with environmental temperatures of -20 °C up to a max. of +40 °C.
At lower temperatures, heaters must be used (in consultation with **F&G**). The air inlet and outlet of the ventilator cover may not be obstructed, otherwise the temperature will exceed the allowed temperature class and the lifespan of coil insulation will be shortened. This applies especially when noise-protection covers are used. In addition, the a paths must be regularly checked and cleaned if much contamination settles on the motor.

Minimum distance (LE) of an obstacle from the air-intake opening (Fig. 1):

Shaft height	LE in mm
up to160	35
180 to 225	85
as from 250	125

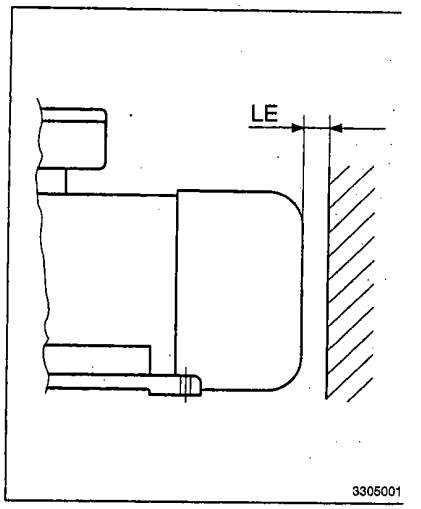


Fig. 1

The motors are intended for use in explosion-risk areas. The rating plate gives their ignition protection class, the explosion group and the temperature class to designate them as explosion-proof.

6.3 Installation activities

The motor feet or flanges are used to install the motors at the location. All motors up to a shaft height of 355 mm can be installed either horizontally or vertically. This also applies to motors that must be attached to ceilings or side walls by their motor feet.

The motors must be aligned in accordance with the requirements of the manufacturer of the coupling or belt pulley.

Warning!

Ensure that the dimensions of the fastening screws are adequate.

Information about the load that the motor will exert on its foundation can be requested from the manufacturer (please supply the serial number). The fastening screws must be tightened and locked in accordance with their layout in order to prevent them from coming loose during operation and damaging the drive [→ Table 1, page 11].

In order to increase the contact surface area, place a large washer underneath each nut or screw head (Fig. 2).

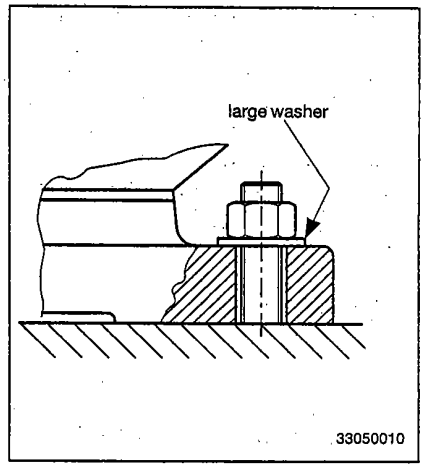


Fig. 2

Directions:

Alternatively, flange nuts or bolts may be used.

In the case of motors installed vertically with the shaft end pointing down or up, protect the working machine or install a suitable cover so as to prevent foreign bodies >= 8 mm from falling into the air-inlet or -outlet openings of the fan cowl.

Warning!

The cover may not reduce the flow of cooling air to the machine [→ 6.2].

The balance condition of the motors is given after the motor serial number on the shaft face and/or the rating plate (H = half, F = full, N = no key).
The version of the coupling must correspond to the balance condition of the motor.

Warning!

In the version with a half key (H), protruding (visible) key parts must be flush with the shaft diameter or be covered by rings with key slots in the positions concerned.

Warning!

Install belt pulleys or couplings only by means of the threaded hole in the shaft end, otherwise the rolling bearings may be damaged (Fig. 3).

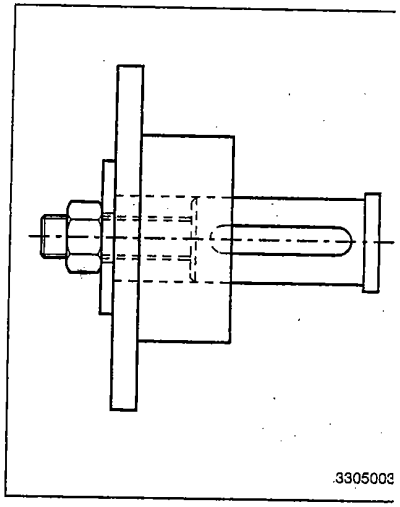


Fig. 3

Screw threaded bolt into the threaded hole. Install the belt pulley or coupling onto the shaft end by screwing onto th threaded bolt a nut with a washer of which the diameter is at least equal to the diameter of the belt-pulley hub or coupling. Before they are installed on the shaft end, the belt pulleys or couplings must be carefully, dynamically balanced. Machines connected with th motor via couplings must be aligned in accordance with the directions of the couplings' manufacturer. Use only flexible couplings!

6.4 Connections

The motors function in accordance with VDE 0530 with a mains voltage fluctuation of up to ± 10% or frequency fluctuations of up to -5% to +3%. The mains data must correspond to the voltage and frequency data on the rating plate. Connect the motor to the supplied original connection parts [→ 6.4.4] in accordance with the connection diagram [→ pages 16, 17, 18].

Warning!

Follow the installation regulations when connecting the motor and the control, the overload-protection and earth circuits.

⚠ Do not use automatically reactivating motor-protection devices if unexpected motor starts can injure personnel.

6.4.1 Mains connection

In addition to the general installation regulations, VDE 0165 must be followed. VDE 0165 prescribes an overload protection by means of a motor-protection switch or an equivalent protection device. Such as, also apply PTC thermistor detectors shown on point [→ 6.4.6 'Directions for motors with temperature control'] in as far as these are given on the rating plate. Further observe any special conditions prescribed on the test certificate; such is indicated by an 'X' after the test certificate number on the rating plate.

6.4.2 Terminal Boxes

In order to change the position of the cable entries, the terminal box can be rotated through 4x90°. For this, the four fastening screws (Fig. 4) or the cap head securing screw (depending on the version) must be loosened (Fig. 5), and the terminal box must be rotated in the desired position.

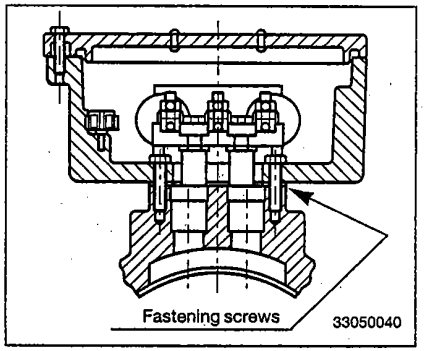


Fig. 4

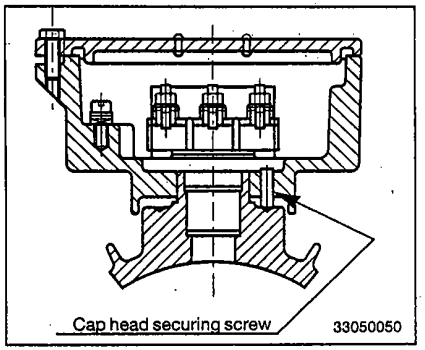


Fig. 5

Next, retighten the terminal bolts using the torque corresponding to the thread size [→ Table 1].

Thread size	Tightening torque
M5	6 Nm
M6	10 Nm
M8	25 Nm
M10	49 Nm
M12	85 Nm
M16	210 Nm
M20	425 Nm

Table 1,
Tightening torque for grade 8.8 screws.

Warning!

Terminal boxes that have been fastened in accordance with Figure 5 may not be rotated back through more than one full turn from the fully screwed down position.

6.4.3 Cable entries

The motors must be connected via cable entries or via a circuit system in accordance with EN 60079-14 and must satisfy the requirements of EN 50019 for terminal boxes in ignition class 'increased safety' (designation on the component EEx e II) or EN 50018 for ignition class 'flame proof enclosure' (designation on the component EEx d II) and be accompanied by specific test certificates.
Unused openings must be closed by means of blanking plugs; these too must be accompanied by corresponding test certificates and the designations referred to. The supplied blanking plugs for the cable entries serve only as transpo protection devices and are not approv shut-offs. The same applies to outdoo storage.
However, additional protection from th rain must be applied. The standardly supplied openings (version 1) serve for the entry of permanently laid cables.

Warning!

Do not use cable entries and blanking plugs that do not satis these requirements. The cable entries must correspond to the clamp range indicated on the opening.

Directions for motors with split termi nal boxes where the mains supply is located between the upper and lowe halves of the terminal box.

In order to maintain protection class EE e II, use only the supplied, original seals Depending on their type (see the designation on the plug), the plugs are suita ble for the following cable diameters [→ Table 2]:

Typ	Cable diameter
RS- 75	31-48 mm
RS-100	48-70 mm

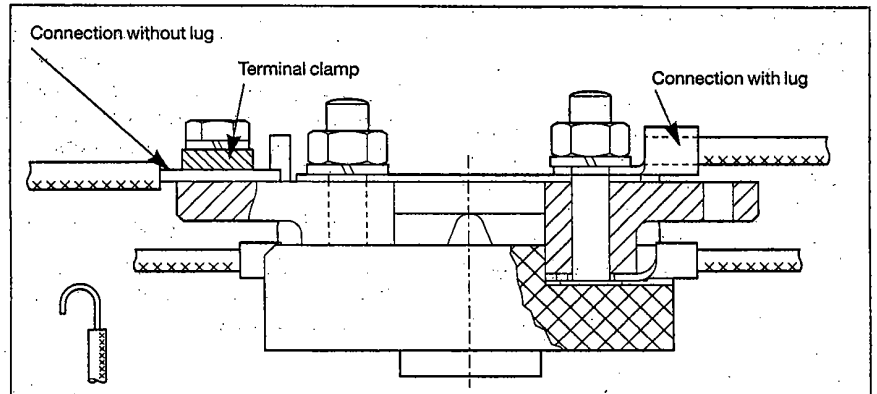
Table 2, Cable diameter

Installation directions:

- After connecting the mains supply, the connection space must be closed by means of the upper part.
- By individually removing the small plates, the plug must be adapted to the cable diameter in such a way that there is a gap <1 mm between the cable and plug. For this, it is allowed to remove one small plate more from one module half than from the other half.
- Grease the cutting edges and the sealing faces of the plug with the supplied grease.
- Push the plug halves over the cable all the way into the passage opening and tighten them with a screwdriver until there is considerable resistance (max. torque 6 Nm).

6.4.4 Connection of the main auxiliary circuit supply cables

The mains cable must be connected in accordance with the included circuit diagram with the relevant connection terminals. The connection of the power cable can be made with or without a lug in versions with a terminal board (Fig. 6) or with individual bolt clamps (Fig. 7) [→ circuit diagrams on pages 16-18].



Bend the conductor end in the form shown for lug-less connections of single-core wires realised by means of a terminal clamp. 33050080

Fig. 6

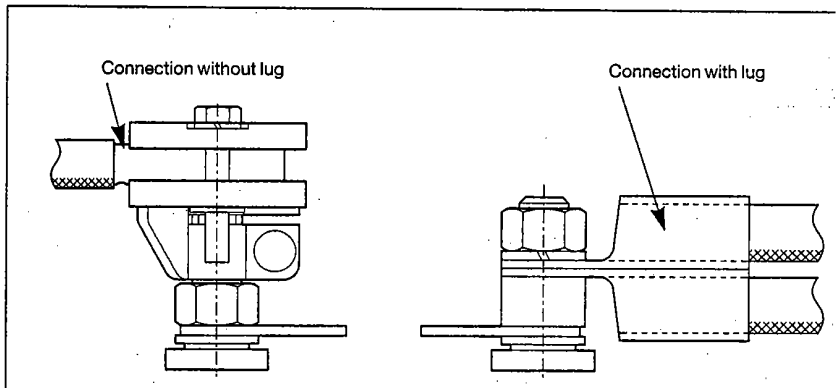


Fig. 7

For terminal boxes of ignition category 'increased safety', pay attention to the air gaps required by EN 50019 [→ Table 3] between conductive parts with different potentials. Screws and nuts on conducting parts must be tightened using the prescribed torque [→ Table 4].

Working tension, U (V)	Min. air gap (mm)
175<U<=275	5
275<U<=420	6
420<U<=550	8
550<U<=750	10
750<U<=1100	14

Table 3, Air gaps

Thread size	Tightening torque (Nr
M4	1,2
M5	2
M6	3
M8	6
M10	10
M12	15,5
M16	30

Table 4, Tightening torque for conducting bol

Depending on the version, additional terminals for e.g. anti condensation he ters are located in either in the main te minal box or auxiliary terminal box a c cuit diagram is included with each motor.

Warning!

The circuit diagram supplied in the terminal box must be kept with the installation's documents.

6.4.5 Directions for motors with external cooling by externally driven fans

The electrical control must ensure that the main motor can only be operated when the motor for external cooling is active.

6.4.6 Directions for motors with temperature control (terminals 10 - 11 or 12 - 13)

These motors are equipped with PTC thermistor in accordance with DIN 44081. [→ temperature indication on the rating plate.] They must be connected to PTC thermistor control box with PTB certificate 3.53 PTC/A.

Warning!

The PTC thermistor operating control box is not explosion-proof. It must therefore be installed outside the explosion-risk area.

PTC certificate 3.53 PTC/A confirms observance of the electrical data at the interface between the temperature sensor circuit and the PTC thermistor operating control box, and allows the application of the PTC thermistor operating control box with PTC thermistor in accordance with DIN 44081 for the thermal monitoring of explosion-proof electric machines.

6.4.7 Directions for motors with anti condensation heater (connection terminals 70 - 71 or U1 - V1)

The nominal data of the anti condensation heater are given on the rating plate or on an additional plate. Depending on the version, the heater can be supplied power via heating belts supplied with power via connection terminals 70 - 71 or via the stator coil under application of alternating current to connection terminals U1 - V1.

Warning!

The electrical control must ensure that motor voltage and heater voltage cannot be applied simultaneously.

6.4.8 Directions for motors concerning operation on frequency convertors

Only motors with temperature control via PTC thermistor may be used for operating frequency convertors. The performance allowable for this operating mode is given on the rating plate or on an additional plate. If no additional plate is fitted information can be found in **F&G** catalogue.

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When operating a frequency convertor, check the electromagnetic compatibility of the drive in accordance with EMU directive 89/336 EEC.

When operating a motor on a frequency convertor with a DC intermediate circuit, ensure that the periodically occurring commutation-voltage peaks do not exceed the allowable voltage peak value of 1000 V (limit value for terminals, air gaps and creeping paths).

If a pulse-width modulated intermediate-circuit voltage convertor (pulse convertor) is used for supplying power, it must be ensured that no high-frequency rush-current events with high voltage peak values can occur. These can arise due to the sharp switching ramps of the voltage pulses (especially in long supply lines between convertor and motor) and will shorten the lifespan of the coil insulation. Avoid voltage peak values exceeding 1000 V. If necessary, make provisions at the convertor output with suitable filters.

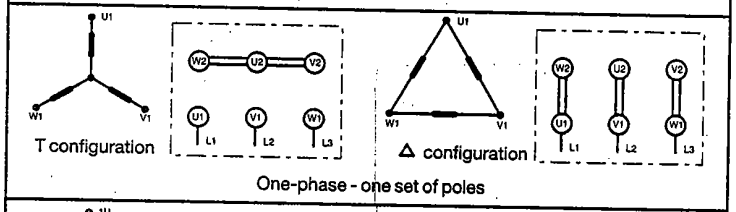
In the case of convertors with a current limiter and a non-galvanically separated power output, one of the following measures must be taken in order to protect the protection cable from overloads under DIN VDE 0160 (Provision of high-voltage current installations with electronic facilities):
(Extract from DIN VDE 0160)

a) The nominal size of the cross-section of the protection cable should exceed the minimum requirements of DIN VDE 0100 part 540, so that the protection cable is protected by the overflow protection device of th external cable. This condition will b satisfied if the load factor of the pro tection cable is more than three times that of the external cable leading from the mains to the electronics facility (BLE).

   Remark: This measure will ensure that no contact-dangerous voltage or any fire hazard can arise, which i turn means that the electronics fac ty (BLE) need not be automatically deactivated.

b) Deactivation of the BLE by means o a suitable device (e.g. via a total-cu rent convertor), thus preventing the protection cable from becoming thermally overloaded.

Connection circuit diagram



10 - 11	PTC thermistor deactivation	PTC thermistor pre-warning	Actuator device with PTB number
12 - 13		PTC thermistor pre-warning	
70 - 71	Standstill heater		
5 - 6	Tachogenerator		
20 21 22 23	PT100 resistance temperature sensor	20 21 22 23	**In case of doubt, the configuration diagram located near the motor is decisive.**

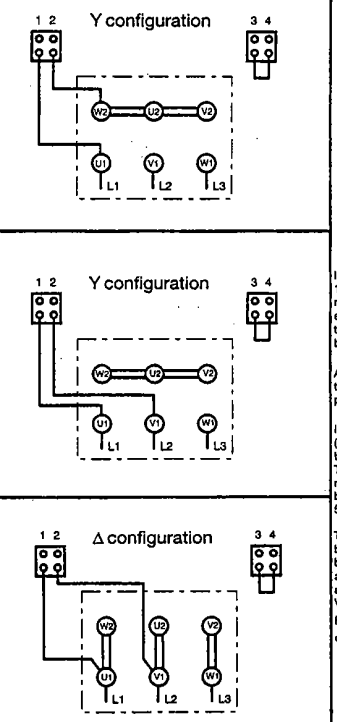
33050060

Fig. 8

Connection circuit diagram

Brake motor with built-in brake

Connection of the brake via the motor coil

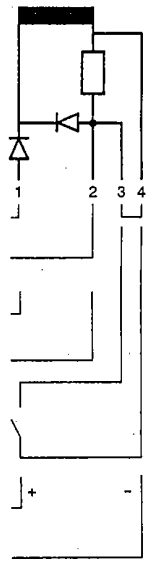


In order to supply power to the brake, 1/2 can be directly connected to the motor terminals. Compare the voltage either with the external cable or with the star point. Terminals 3/4 must be bridged.

Also an external voltage can be applied to 1/2. Observe the data on the rating plate. Terminals 3/4 must be bridged.

In order to rapidly energize the brake (deactivation at the DC side), the 3/4 bridge can be replaced by a contact. The contact must switch almultaneously with the voltage supply of the brake.
5.6

To allow the emergency lifting of the brake (e.g. in order to rotate the motor by hand), a rectified voltage can be applied to 1/4 (first remove other wires and observe the polarity).
Voltage $U_{=} \approx U_{\sim} \times 0.45$
For voltage $U_{\sim}$ see the brake voltage on the rating plate.



1 - 4	Brake		
10 - 11	PTC thermistor deactivation	PTC thermistor pre-warning	Cold-conductor deactivation
12 - 13		PTC thermistor deactivation	
70 - 71	Standstill heater		
P1 - P2	Temperature control: Microtherm T 10		

3305010

Fig. 9

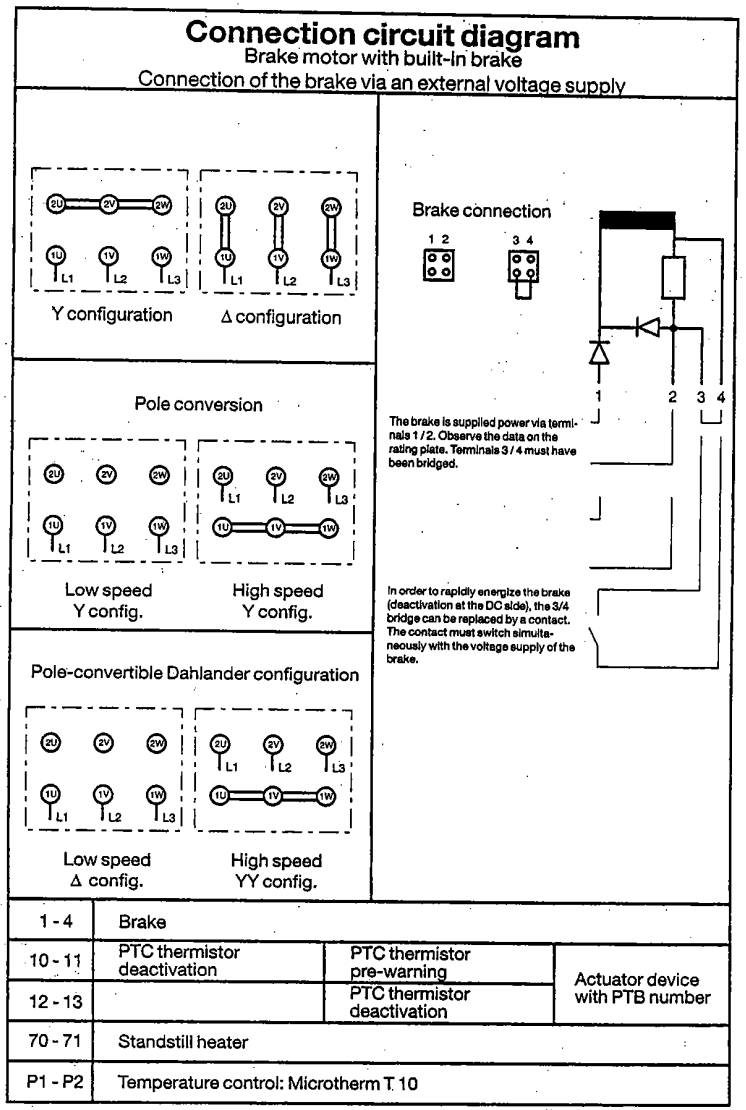


Fig. 10

6.4.9 Directions for motors with brake

In the version with a built-in brake, the mains supply cable is connected inside the terminal box of the motor; in the version with a built-on brake, it is connected inside the separate terminal box of the brake. Observe the connection circuit diagram included with the delivery and the nominal voltage shown on the rating plate. If an AC connection has been realized, the brake coil will be energized via a silicon rectifier, which is accommodated inside the ignition-sealed housing.

The PTC thermistors that have in any case been installed (in both the motor and the brake) must have been connected in accordance with [→ 6.4.6] 'Directions for motors with temperature control'.

7 Operating modes and temperature protection

- In motors with operating mode S1, PTC thermistors (TF) can be used in addition to the motor protection switches required by DIN EN 60079 14, VDE 0165 part 1. Should the protection against disallowable heating in motors with operating mode S1 be realized only using TFs, then a proven combination of TFs and thermistor control box must be applied.
- In motors with operating mode S2, S3 or S6, use TFs in a proven combination of TF and thermistor control box in addition to the motor protection switches required by DIN EN 60079-14, VDE 0165 part 1 or as a sole protective TF.
- In motors with operating mode S4, S5, S7, S8, S9 or S10, use proven combinations of TF and thermistor control box as a protection against disallowable heating.
- Supplying power to motors by means of frequency convertors is only allowed if a proven combination of TFs in the coils and of thermistor control box is used.

The temperature sensors must be connected in accordance with [→ 6.4.6 'Directions for motors with temperature control'.

8 Commissioning

Warning!

Before installation or commissioning, the insulation resistance must be measured by specialized personnel. The resistance must exceed 1 mega ohm. A critical value should be reached at 0.5 mega ohm. If this value is not reached, the motors must be dried out.
Drying is best done in an oven, at a temperature of up to 100 °C. Open the machine in order to allow all moisture/humidity to evaporate. However, first consult with the manufacturer in order to safeguard any warranty claims. These activities must be carried out by specialized personnel. **F&G** will provide directions for maintaining explosion-proofness during reassembly. For installation and removal, see the corresponding **F&G** repair manuals.

- Check the direction of rotation and how the motor is running with no load applied. For external ventilators (axial ventilators) that depend on the direction of rotation, observe the rotation direction notice on the motor. To change the direction of rotation, exchange two mains cores and the ventilator.
- If the motor has been stored and the rolling bearings were provided with an additional quantity of grease, the motor must be run without load for at least 30 minutes in order to ensure that the grease is adequately spread and to prevent the bearing from becoming overheated.
- The operating current must be compared to the current data on the rating plate. The protective devices required by EN 60079-14 must be adjusted in accordance with the nominal motor data on the rating plate. The listed amperage value of the rating plate must not be exceeded under a continuous load.

Warning!

Run the motor for at least an hour under load and observe whether any unusual noises occurs and whether the temperature class is exceeded.

Fluctuations V_{eff} <= 3.5 mm/s (P_N<= 15 kW) or 4.5 mm/s (P_N > 15 kW) in coupled operation is not a problem. In the case of deviations from normal operation (e.g. raised temperatures, noises, fluctuations, vibrations), establish the cause and, if needed, consult **F&G**.

⚠ Never decommission protective devices, even during test runs. In case of doubt, deactivate the machine.

9 Maintenance

9.1 Inspection

- Continuously monitor motors according to the circumstances of their use [→ 6.2].

9.2 Lubrication

Warning!

In order to avoid damage, keep bearings and grease free of contamination.

The ball bearings of motors up to size 280 are sealed for life; the manufacturer of the bearings has provided them with a grease filling that under normal operating conditions (coupling drive) will be adequate for 40,000 operating hours of 4-pole (or more) motors, or for 20,000 operating hours of 2-pole motors.

When the bearings are replaced, the shaft seals must also be replaced. For this, disassemble the motor (which will also provide an opportunity to clean the coils). Disassembly and reassembly must occur in accordance with the repair manual.

Motors as from size 315 and motors with roller bearings are equipped with lubrication nipples. Lubrication of the bearings should occur using a grease gun and via the lubricating nipples installed on the bearing shield or bearing covers, preferably while the motor is running.

The collection space in the bearing cover for spent grease is so large that (given correct lubrication) it can accommodate the old grease for the nominal lifespan of the motor.

The lubrication periods and the grease quantities and grades prescribed for the motor can be derived from the plate installed on the motor housing. The manufacturer normally uses **ESSO Unirex N3**, a lithium-complex soap/mineral-oil grease.

Normal lubrication periods (in hours):

Ambient temp.	Speed up to 1800 min^{-1}	Speed up to 3600 min^{-1}
40 °C	5.000 hours	2.500 hours
50 °C	2.500 hours	1.000 hours

Warning!

In motors with increased power (motor type ...X), under demanding drive conditions (e.g. belt or gear drives with additional bearing loads and in vertical installations), the lubrication periods should be reduced by 50%.

⚠ When lubricating a running motor, make sure there is adequate protection against rotating parts!
Use only resin-free and acid-free roller-bearing grease with a drop point of approx. 200 °C.

10 Explosion-proof enclosure

Designation ⟨Ex⟩ II 2 G, EEx de IIC T4 indicates where the motor may be used and that it was designed, constructed and admitted in accordance with the European standards for operation in explosion-proof conditions.

Warning!

The motor therefore may not be changed to any other form and the operating manual must always be observed.

If the motor is changed or if repair activities must be carried out, these should be completed by a workshop or factory that has the necessary knowledge. Before recommissioning the motor, observance of the regulations must be checked by an appointed agency in accordance with the EC directives (in Germany, by an ElexV specialist) and the result must be confirmed by designating such on the motor or by issuing a test report.

If these stipulations are not observed, the motor will no longer be classified as explosion-proof and the designation referred to must be removed.

10.1 Directions for maintaining explosion-proof enclosure during operation

- All contact screws or nuts of the electrical connections must be well tightened in order to avoid excessive transition resistance, which can lead to excessive heating of the contact spot. For the tightening torques, [→ see Table 4, page 12].
- When connecting the mains cable, proceed with extreme care. Pay attention to creeping paths and air gaps. The sealing parts of the cable openings and connection spaces, and the entry parts provided as pull relief or rotation protection for the mains cable must be used correctly in order to maintain the protection class of the connection spaces [→ 6.4.4].
- Immediately remedy any damage to the ignition short-circuit-proof pipe passages in the connection space or in the seals; use only original spare parts. The correct execution of the activities must be verified by an agency appointed under the EC directives (in Germany, by an ElexV specialist) and be confirmed by designating such on the motor or by issuing a test report.

- The surfaces of flame path must not be sealed with mastic. These surfaces should be maintained as clean metal. As corrosion protection, provide a film of oil or of non-curing grease. This especially concerns the flame paths for the connection-space covers of ignition-protection category 'pressure-proof capsule'.
- Terminal box screws must be tightened using the prescribed torque [→ Table 1, page 11].

11 Repairs

Repairs and changes to explosion-proof machines must be carried out by an appointed agency operating under EC directives (in Germany under ElexV) as well as according to the safety directions and descriptions given in the **F&G** repair manuals. Activities related to explosion protection must be carried out on the premises of **F&G** or by a workshop specializing in electric machines. If such activities are not carried out by **F&G**, they must be approved by a recognized specialist. Before commissioning, a written confirmation under ElexV is required in Germany; elsewhere, observe the applicable national regulations.

SECTION 11 GREASE PUMP & COUPLING

11.1 GREASE PUMP - WOERNER

Model G/PMF-B/10/1250/N/0/0/4/0/0/0/0/6/0

- LEAFLET NO. 0009.06.90.GB
- LEAFLET NO. 9002.06.90.GB
- LEAFLET NO. 0005.06.90.GB
- LEAFLET NO. 0006.06.90.GB
- DRAWING 110.000-15E
- Exploded View
- Gear Pump Parts List
- Installation/Operating Hints for Pumping Elements
- DRAWING 110.031-30

11.2 DRIVE COUPLING – FLENDER N-EUPEX , SIZE A140

- INSTALLATION AND ALIGNMENT INSTRUCTIONS - V 420
- COUPLING DRAWING

WOERNER
CENTRALIZED LUBRICATION EQUIPMENT

Gwinnett County WWTP - Buford, GA
MFS - 4 Draft Tube Sludge Mixer
Grease Pump w/Motor : Timco/Woerner

MODEL: GMF-B/10/1250/N/0/0/4/0/0/0/0/6/0
WITH 0.21 KW, 1800 RPM, 3 PHASE, 60 HZ MOTOR

Order Designation: Pump ○○○○○○○○○○○○○ : ○○ Please state voltage and frequency

type with motor	type without motor	reservoir capacity (l) polyester	reservoir capacity (l) sheet steel	total reduction ratio	type of drive	element 6 with pipe connection ø 6	element 6 ø 8	element 6 ø 10	element 8 with pipe connection ø 6	element 8 ø 8	element 8 ø 10	filling connection	plug number	level switch
see 1)					see 2)	see 3)	3)	3)	see 3)	3)	3)	see 4)	see 5)	see 6)
GMF-A (1 outlet)	PMF-A (1 outlet)	⑤	②	see tables	Ⓥ Ⓜ Ⓝ Ⓞ Ⓨ Ⓢ Ⓗ Ⓚ Ⓡ Ⓤ	number ⓪-①	number ⓪-①	number ⓪-①	number ⓪-①	number ⓪-①	number ⓪-①	without ⓪	without ⓪	⓪ without level switch
GMF-B (10 outlets)	PMF-B (10 outlets)	⑩	④ ⑦			number ⓪-⑩	number ⓪-⑩	number ⓪-⑩	number ⓪-⑩	number ⓪-⑩	number ⓪-⑩	without ⓪ with Ⓑ	⓪ ÷ ⑨ max. 9	Ⓕ without level switch with follow-up piston; grease Ⓚ with level switch and follow-up piston
GMF-C (20 outlets)	PMF-C (20 outlets)	㉚	㉕			number ⓪-⑳	number ⓪-⑳	number ⓪-⑳	number ⓪-⑳	number ⓪-⑳	number ⓪-⑳	Ⓥ	⓪ ÷ ⑲ max. 19	oil Ⓢ for level switch without follow-up piston
						max. 1 element possible								
						max. total 10 elements possible								
						max. total 20 elements possible								

1) Types GMF-A/B/C only possible with drive M or N
2) Sense of drive rotation not specified.
3) If installation of elements in a specific position is required, this should be stated in the ordering example: Pump with six elements: "Install in positions 1–3 and 7–9". Delivery pressure per element 350 bar max. Installation of up to 22 elements by special request.
4) A filling connection can be provided instead of one element.
5) All connection ports without elements must be closed with threaded plugs.
6) Level switch for polyester reservoir only.

lubrication for total transmission ratio	V	M	N	O Y S H K R U
			60	1,33
		97		1,78
		160		2,33
		316		4,25
		625		7,66
		1250		12,7
		2500		25
	3300			50
	4356			66

Ordering Example:
Pump PMF-B, reservoir capacity 10 l, total transmission ratio 1,33 (see tables), type of drive S, 5 elements 6 tube outer dia. 8, 2 elements 8 tube outer dia. 6, filler, connection V, plug number 3, with level switch S.

Order designation:
PMF-B/10/1,33/S/0/5/0/2/0/0/V/3/S

EUGEN WOERNER GmbH & Co. KG
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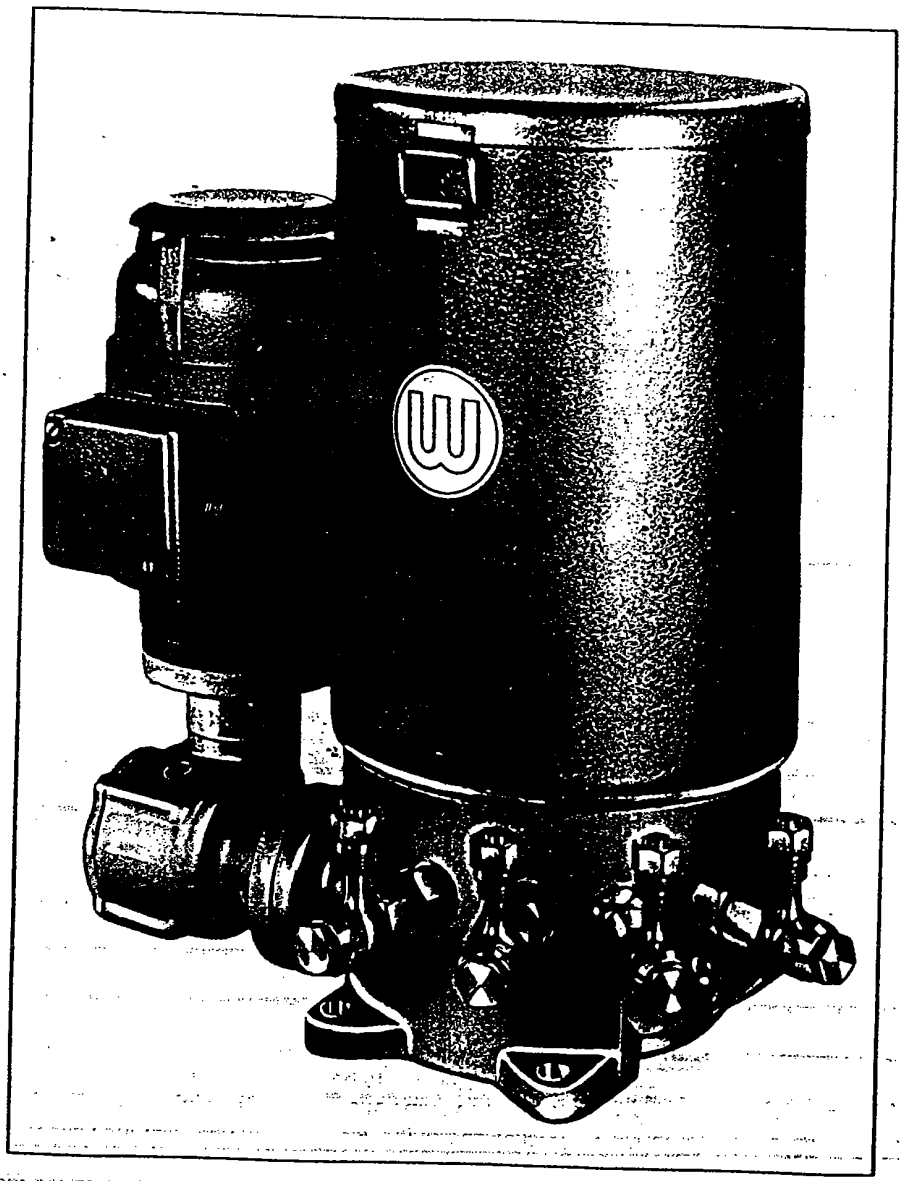
Am Eichamt 8 · D-97877 Wertheim
Telefon (09342) 803-0

Leaflet No. 0009.06.90 GB
Supplements No.
Replaces No. 0009.09.80 GB

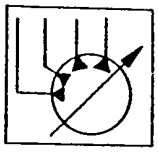
Gwinnett County WWTP Phase II
Grease Pump w/Motor : Timco/Woerner

WOERNER
CENTRALIZED LUBRICATION EQUIPMENT

MODEL: GMF-B/10/1250/N/0/0/4/0/0/0/0/6/0 WITH 0.21 KW, 1800 RPM, 3 PHASE, 60 HZ MOTOR



PMF/GMF (FS)
Lubrication Pump
110.000



Multi-line lubrication pump for a variety of applications

- **Our universal multi-line lubrication pump is designed to meet any requirements**
- **This pump can be provided with different drives. Direction of rotation is optional**
- **With our decades of experience, we can supply the right type of pump for any application**

General Description:
The multi-line pump can accommodate up to 26 pump elements. The maximum delivery volume of each element is 0.08 or 0.15 cm³/stroke and is infinitely variable. Max. operating pressure: 350 bar. The reservoirs are made of sheet steel or transparent polyester with a capacity ranging from 2 to 30 l. The pump can be employed for oil and grease. Level switch and automatic refilling by request.

In order to allow the unit type designation to be readily decoded in our data processing system, we had to alter some order designations. The old designations are shown in ( ).

PMF/GMF (FS)
Lubrication pump

110.000

EUGEN WOERNER GmbH & Co. KG
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Fax (09342) 84717 · Telex 689116

Leaflet No. 9002.06.90 GB
Supplements No.
Replaces No. 9002.09.88 GB

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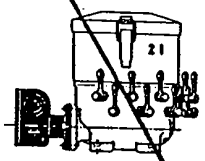
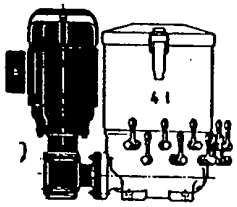
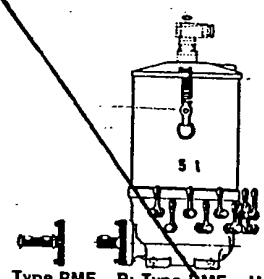
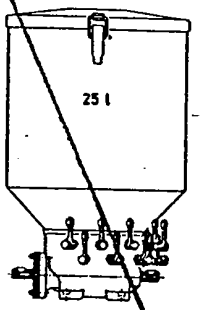
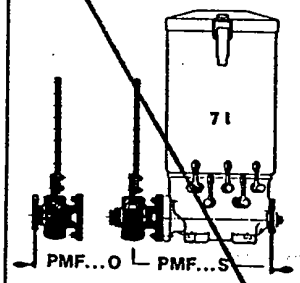
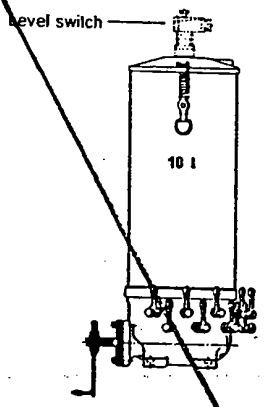
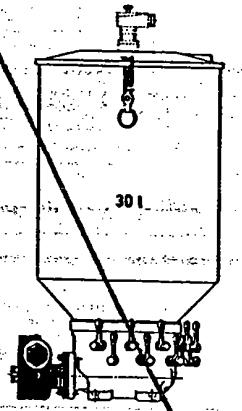
Fax (09342) 84717 · Telex 689116

PMF lubrication pumps
with drives and reservoir sizes for **oil** and **grease**

Sheet Steel Reservoirs		Transparent Polyester Reservoirs
 **Type PMF...V** with worm gear No. 0007.	 **Type GMF...M bzw. GMF...N** with motor worm gear No. 0006.	 **Type PMF...R; Type PMF...U** **Type PMF...R** rotating, for pulley **Type PMF...U** rotating, short (for coupling) No.0006.
 **Type PMF...K** for combining 2 PMF units No. 0006.	 **Type PMF...O** oscillating No. 0007. **Type PMF...S** oscillating with crank (opposite side)	 **Type PMF...U** with crank No. 0007.
Each type of pump can be combined with any of the above reservoirs. When using reservoirs of more than 25 l capacity, the drives of pumps GMF...M, GMF...N are rotated through 90° to the front. **Note:** For pump specifications and order designations please unfold the next to last sheet.		 **Type PMF...Y** hydraulic No. 0007.

Application: As delivery pump in centralized lubrication systems, preferably of the multiple-line type.

Special Version:
A size 63 M (71 N) 3-phase A.C. motor, protection class IP 44, is connected to the PMF multi-line pump with intermediate gear VM. Higher or special protection classes by request.
Two types of explosion-proof motors are available:
a) Motor explosion-proof for increased safety (Ex) e G4
b) Motor explosion-proof, pressurized casing (Ex) d 3 n 65
For the lubrication of the sternpost tube on ships for inland and coastal waters we supply a system including adjusting plate, pulley etc.
Please refer to our dimension drawing 111.100–40.

– Subject to changes without notice –

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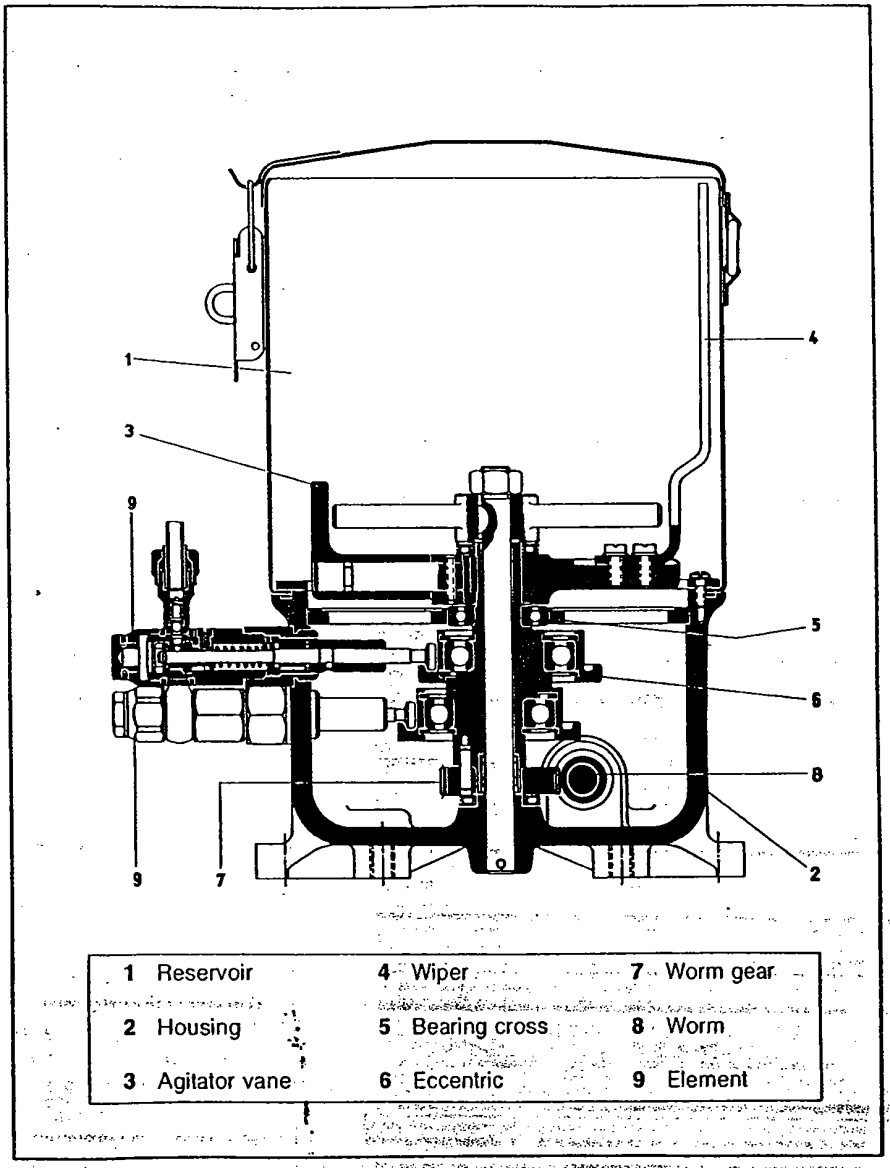
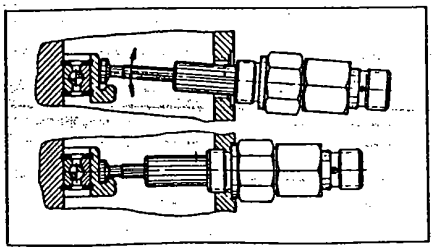


1 Reservoir	4 Wiper	7 Worm gear
2 Housing	5 Bearing cross	8 Worm
3 Agitator vane	6 Eccentric	9 Element

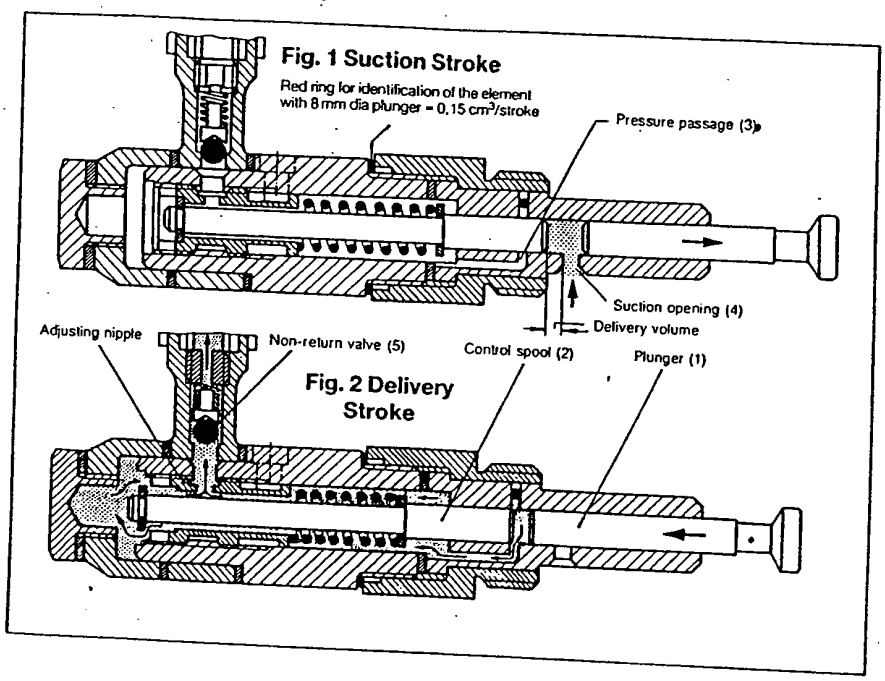
Pump Operation:

The delivery pump comprises the following major components: pump housing, pump elements, internal and external drive and reservoir.
The vertical pump shaft is driven by the external drive via a worm gear. An eccentrically arranged pressure ring rotates with this pump shaft engaging the pump elements. The eccentricity of this pressure ring causes each supply piston to perform one constant pressure and suction stroke per pump shaft rotation (for a more detailed description of the pump elements refer to: »Operation of pump elements«). Connected to the vertical pump shaft is an agitator which forces the lubricant to the intake opening and reduces air bubbles. In the case of the type provided with level switch, a follow-up piston is provided for grease resting on the grease surface thus permitting accurate monitoring of the lubricant level. Where no level switch is provided, a wiper is built in.



Installation of PMF Pump Elements:
If an additional pump element is to be installed in the lubrication pump at a later time, proceed as shown in the drawing on the left. Insert pump element at an upwards inclination into the locating hole with the plunger pulled out about half way. To facilitate installation and putting into operation, fill the bore taking up the plunger with grease. Bring into horizontal position and screw in only after the plunger head abuts the pressure ring and engages in the groove of the pressure ring.

WOERNER
CENTRALIZED LUBRICATION EQUIPMENT



Operating Hints:

For the lubrication pumps only clean oil or grease, up to consistency No. 3 from original containers may be used. If, before putting into operation, the lubricant is not filled through the filling nipple, the pump must be filled up to the vane with gear oil during initial filling to ensure good venting.

The lubrication lines must be clean and free from obstructions. Do not connect them to the lubrication points before the lubricant emerging from the lines is free from air bubbles. Check all connections of the pressure lines for leakages.

Operation of Pump Elements:

During the suction stroke the delivery plunger (1) actuated by the eccentric shaft and the control spool (2) actuated by spring force perform a stroke (in the above drg. to the right). The control spool blocks the pressure passage (3) and stops in a certain position, depending upon the delivery volume selected.
As the supply plunger moves on, a vacuum is created in the metering space and when the suction opening (4) is uncovered by the plunger, lubricant is drawn in from the reservoir.
During the delivery stroke, the plunger actuated by eccentric shaft performs a movement (in the above drawing to the left). The suction opening is blocked and the lubricant contained between plunger and control spool displaces the control spool until it uncovers the pressure passage (3) so that the lubricant is forced to the outlet by the plunger.
The pumps are set for maximum delivery volume, i.e. for full stroke length.
The delivery volume is infinitely variable: the plug above the adjusting nipple is removed and the stroke adjusted by means of the key supplied. By rotating the nipple clockwise, the delivery volume is reduced. The adjusting nipple is provided with a hexagon head loaded radially by a spring-loaded plunger thus preventing inadvertent variation of the delivery volume. This locking feature is also a measure for adjusting the delivery volume. Six notches correspond to one nipple rotation which results in a variation of the delivery stroke by 1 mm. The 3 mm total stroke therefore corresponds to 18 notches. The delivery volume should not be less than 25% of the maximum volume (14 notches less than the full stroke).
The pump element with 8 mm piston dia. (= 0.15 cm³/stroke) is marked with a red ring (see drawing).

Lubrication pump PMF GB 110.000

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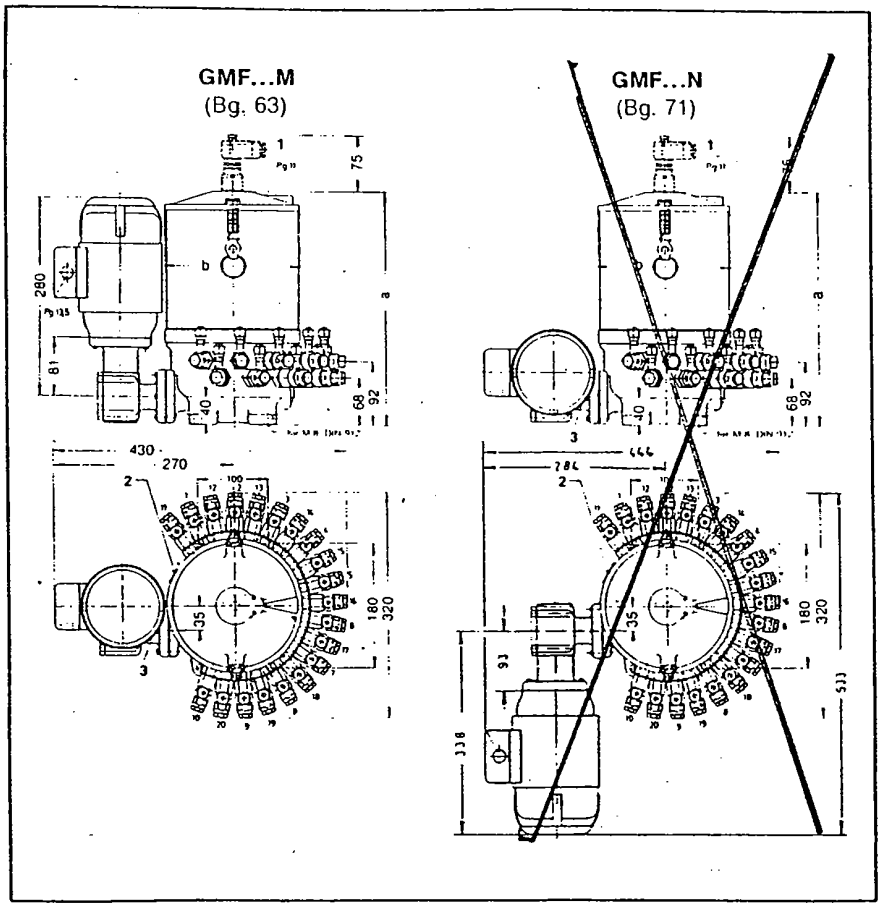
Leaflet No. 0005.06.90 GB
Supplements No.
Replaces No. 0005.12.80 GB

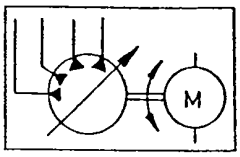
Gwinnett County WWTP Phase II
Grease Pump w/Motor : Timco/Woerner

WOERNER
CENTRALIZED LUBRICATION EQUIPMENT

MODEL: GMF-B/10/1250/N/0/0/4/0/0/0/0/6/0 WITH 0.21 KW, 1800 RPM, 3 PHASE, 60 HZ MOTOR



GMF...M, GMF...N (FSVM) lubrication pump with motor worm gear



Reservoir Dimensions

	reservoir capacity [l]	weight [kg]	dimensions [mm] a	b
polyester	~~5~~	~~1,5~~	~~342~~	~~206~~
	10	1,8	522	200
	~~30~~	~~1,9~~	~~600~~	~~330~~
sheet steel	2	1.0	224	~~185~~
	4	1.4	294	195
	7	2,0	394	195
	25	4,6	490	~~325~~

Item no. 1 level switch
Item no. 2 nameplate
Item no. 3 (type PMF... O/S)
filled with 15 cm³ gear oil, 13.5°E at 50°C, inspect after 3000 operating hours.

Specification								
delivery volume [cm³] per stroke and pump element		piston Ø 6	0,08					
		piston Ø 8	~~0,16~~					
number of plunger strokes		[min⁻¹]	1 to 25, please contact us for different number of strokes					
total transmission ratio			60:1	97:1	160:1	316:1	625:1	1250:1	2500:1*
max. operating pressure [bar] at 20 fitted in elements	GMF...M	piston Ø 6	230	330	350	350	350	350	350
		piston Ø 8	100	170	270	320	350	350	350
	GMF...N	piston Ø 6	350	350	350	350	350	350	350
		piston Ø 8	200	350	350	350	350	350	350
flowrate per element [cm³/min.]		piston Ø 6	1,82	1,12	0,67	0,34	0,17	0,087	0,043
		piston Ø 8	3,4	2,1	1,28	0,64	0,32	0,163	0,0815
temperature range		[°C]	−20 to +40						
lubricant			oil and grease up to consistency class 3						
direction of drive rotation			optional						
installation position			as shown						
weight		[kg]	G = 10,7 + weight of reservoir + 0,25 · number of pump elements						
max. number of elements			20, in special version 24						
electrical specifications (motor)									
supply voltage		[V]	460 ~~220/380~~ special voltage and						
frequency		[Hz]	60 ~~50~~ frequency possible						
synchronous speed, rpm		[min⁻¹]	1800 ~~1500~~						
rating		[kW]	0.21 GMF...M = 0,18 GMF...N = 0,37						
type of protection			IP 54						

for accessories and level switch refer to sheet 0008.

* by request only

GMF...M; GMF...N
PMF...R; PMF...U
PMF...K

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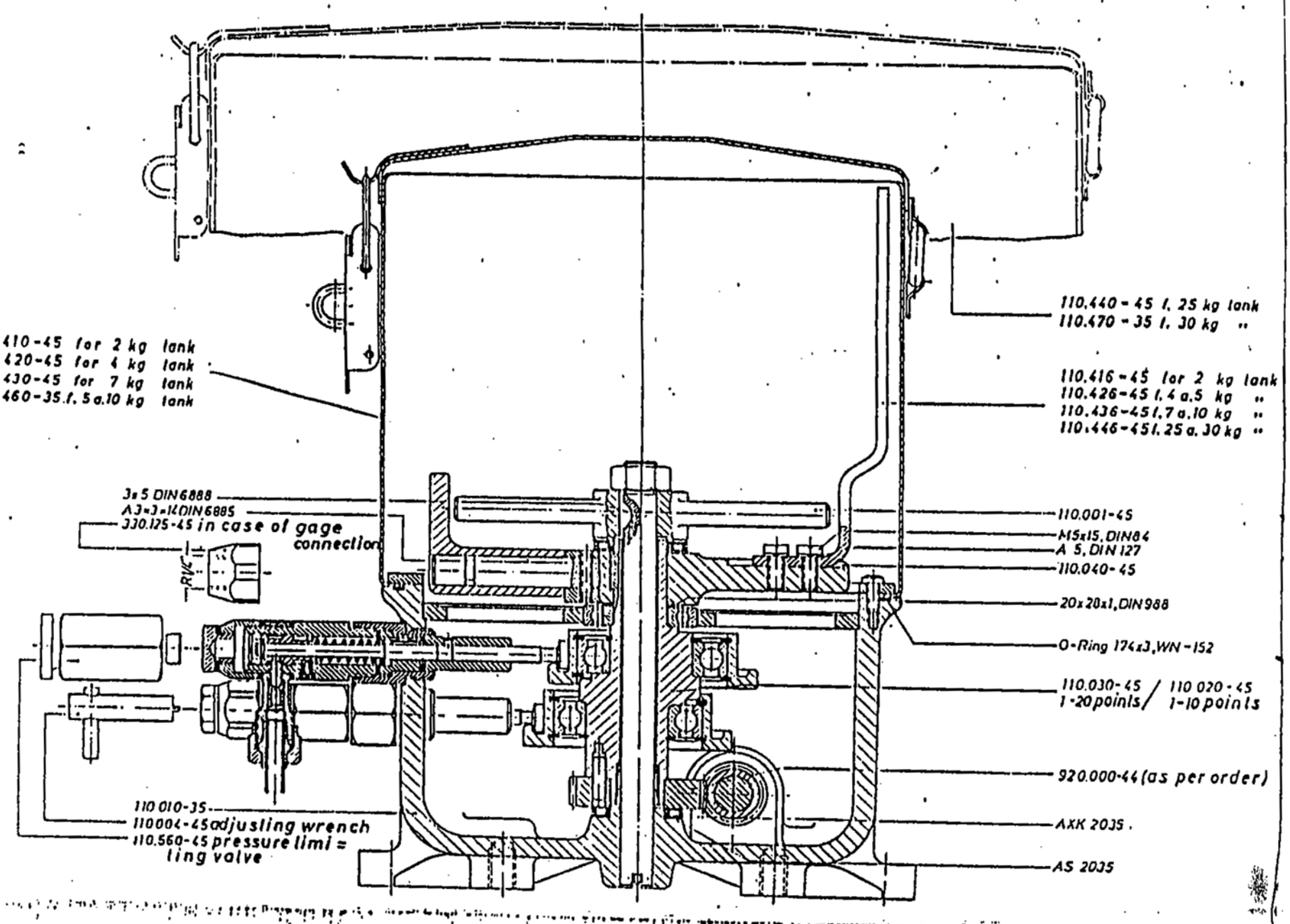
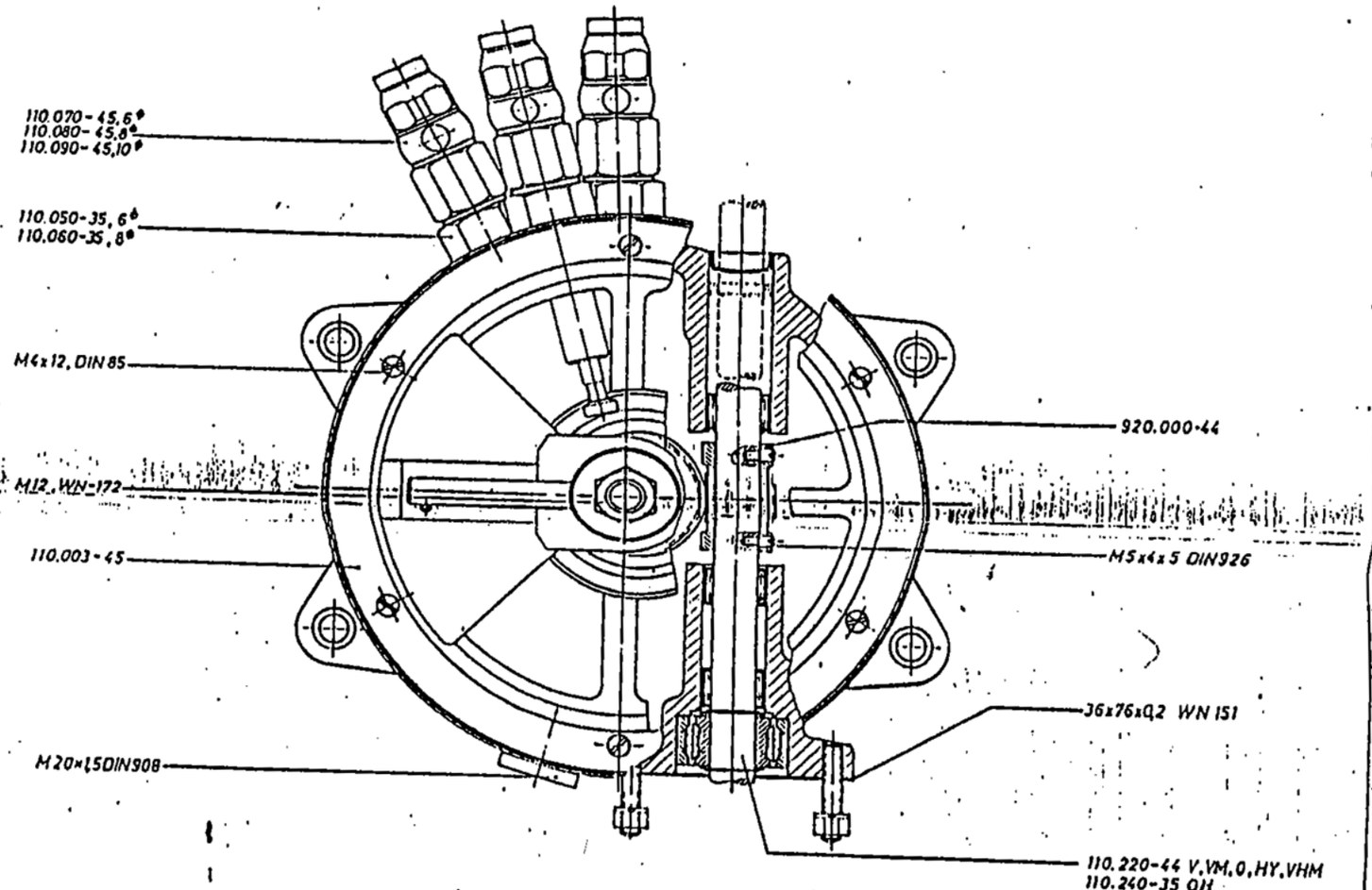
Leaflet No. 0006.06.90 GB
Supplements No.
Replaces No. 0006.03.87 GB



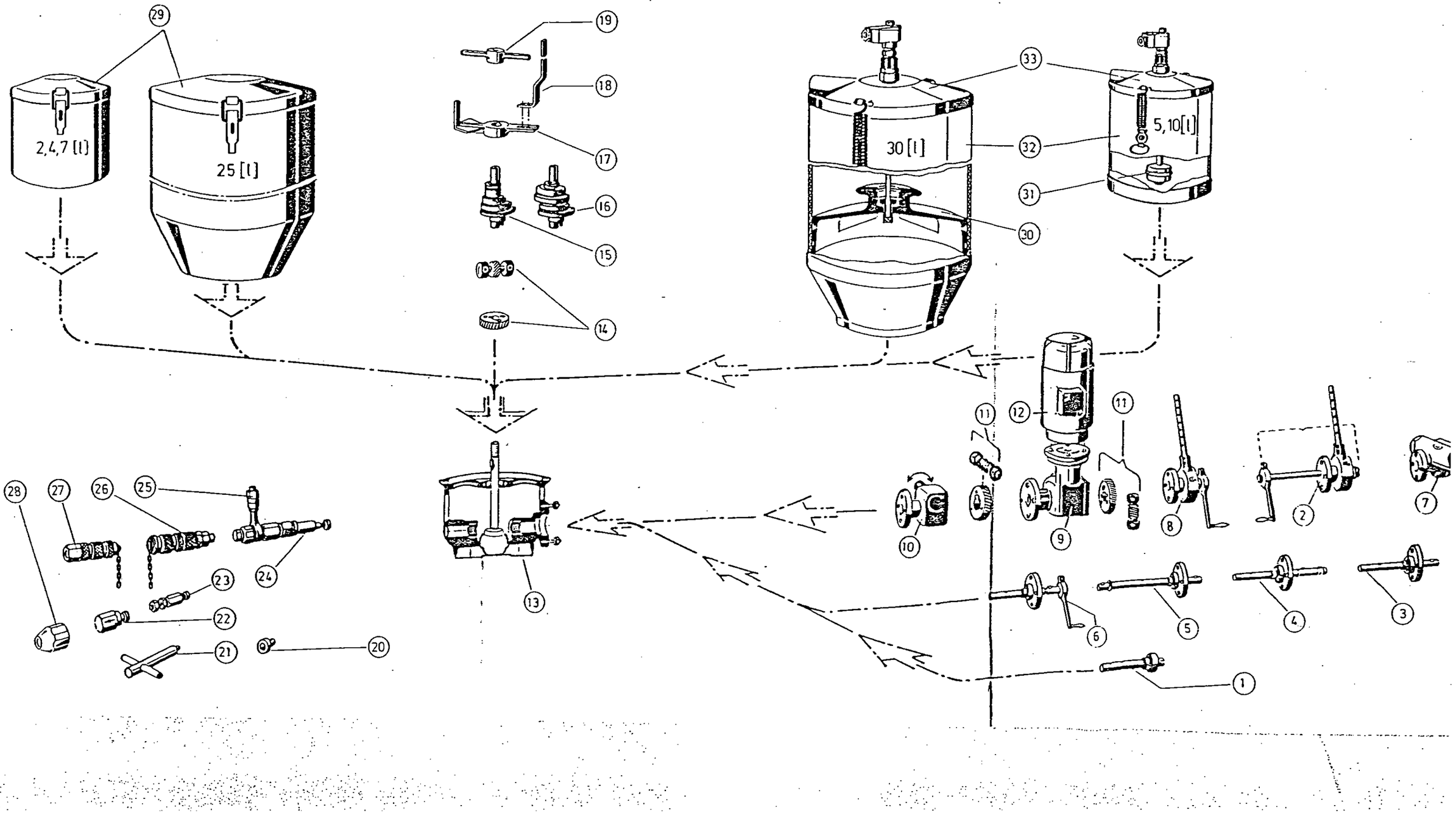


WOERNER

Benennung: Grease Lubricator FS

	Datum	Name
Gezeichnet	1972	
Geprüft	27.6.	Rost

Zeichnungs-Nr.:


29
2,4,7 [l]
25 [l]
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11
11
10
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20

no.	Spare part designation	Order no.
1	Inner drive parts for drive type V, O, Y, M (BG 63), N (BG 71)	110.220-65
2	Inner with outer drive parts for drive type Oscillating Manual S	110.240-65
3	Coupling U	110.275-65
4	Belt pulley R	110.270-65
5	Direct mounted K	110.260-65
6	Manual H	110.250-65
7	External drive for Y	115.600-65
8	O	115.500-65
9	M (VM 63)	115.210-65
	N (VM 71)	115.220-65
10	V	115.110-65
11	for drive type V, M and N in the worm gear total-transmission 50	109.245-65
	97/160	109.246-65
	316/625	109.247-65
	1250/2500	109.248-65
	3300/4356	109.249-65
12	Motor M (VM 63) — 3-phase a. c. motor. 0.18 kW V 18/C 90 1500 BG 63 ☐ V ☐ Hz; Voltage; Frequency	
	Motor N (VM 71) — 3-phase a. c. motor 0.37 kW V 18/C 105 1500 BG 71 ☐ V ☐ Hz; Voltage; Frequency	
13	Housing bottom section — Number of outlet ports for pump elements	
	1–10 lubrication points	110.340-64
	1–20 lubrication points	110.525-64
	1 lubrication point	110.280-64
14	Transmission drive Type O, Y, S, H, K, R u. U — Transmission 1,33	110.141-65
	1,78	110.142-65
	2,33	110.143-65
	4,25	110.144-65
	7,66	110.145-65
	12,7	110.146-65
	25	110.147-65
	50	110.148-65

Item no.	Spare part designation	Order no.
	Transmission 66	110.149-65
14	for drive Type V, M and N housing bottom section 60/97 160/316 625/1250 2500/3300 4356	 110.145-65 110.146-65 110.147-65 110.148-65 110.149-65
15	Eccentric assy. 1–10 lubrication points	110.020-65
16	Eccentric assy. 1–20 lubrication points	110.030-65
17	Vane	110.040-65
18	vertical Stripper for reservoir 2 4 u. 5 7 u. 10 25 u. 30 } 1	110.416-45 110.426-45 110.436-45 110.446-45
19	Stripper	110.001-45
20	Plug	110.076-65
21	Adjusting spanner	110.004-65
22	Pressure relief valve	110.560-65
23	Filler connection U 30	110.550-65
24	Pump element, 6 dia. with outlet element for tube dias ⑥⑧⑩	110.050-65 connection
	Pump element, 8 dia. with outlet element for tube dias. ⑥⑧⑩	110.060-65 connection
25	Outlet element for 6 dia. tube Outlet element for 8 dia. tube Outlet element for 10 dia. tube	110.070-65 110.080-65 110.090-65
	Filler connection	
26	Filler nipple	110.125-65
27	Filler coupling	110.135-65
28	Pressure gauge connection	110.066-45
29	Steel sheet container 2 4 7 25 } 1	110.410-65 110.420-65 110.430-65 110.445-65
30	Cover with level switch „K" 5 follow-up piston 10 30 } 1	110.650-65 110.655-65 110.685-65
31	Cover with level switch „S" 5 net weight 10 30 } 1	110.660-65 110.665-65 110.690-65
32	Polyester container 5 net weight 10 30 } 1	110.610-65 110.615-65 110.475-65
33	Cover (without level switch „O") 5 net weight 10 30 } 1	110.630-65 110.635-65 110.675-65

	Order No.
Set of wear parts[1] for items 1–6	110.235-64
Set of wear parts[1] for items 9 + 10	115.225-64
Set of wear parts[1] for items 7 ÷ 8	115.525-64
Set of wear parts[1] for items 15 ÷ 16	110.035-65
Set of wear parts[1] in the housing bottom section 13	110.005-65

[1] The set of wear parts includes all bearings, feather keys, screws, seals, grub screws and free-wheels which are subject to a certain amount of wear.

Pump operation:

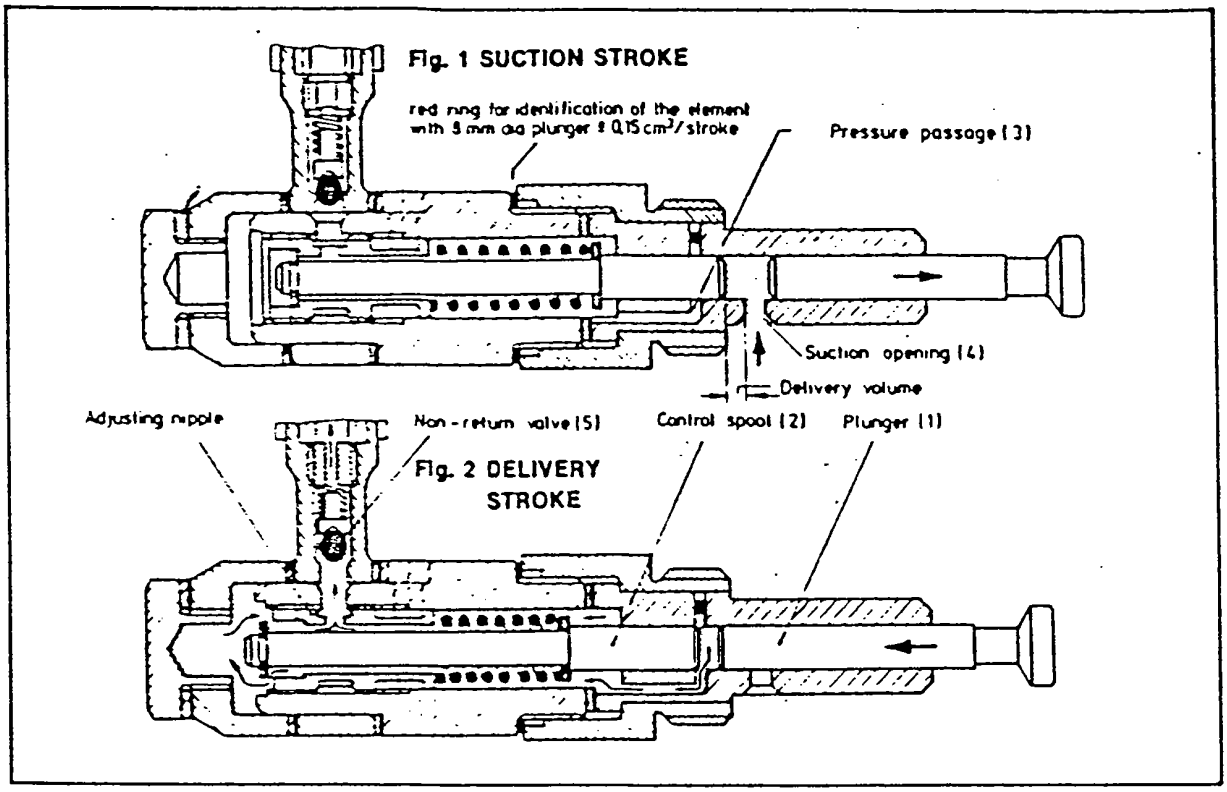
The delivery pump comprises the following major components: pump housing, pump elements, internal and external drive and reservoir.
The vertical pump shaft is driven by the external drive via a worm gear. An eccentrically arranged pressure ring rotates with this pump shaft engaging the pump elements. The eccentricity of this pressure ring causes each supply piston to perform one constant pressure and suction stroke per pump shaft rotation (for a more detailed description of the pump elements refer to: »Operation of pump elements«). Connected to the vertical pump shaft is an agitator which forces the lubricant to the intake opening and reduces air bubbles. In the case of the type provided with level switch, a follow-up piston is provided for grease resting on the grease surface thus permitting accurate monitoring of the lubricant level. Where no level switch is provided, a wiper item no. 17 is built in.

Operation of pump elements:

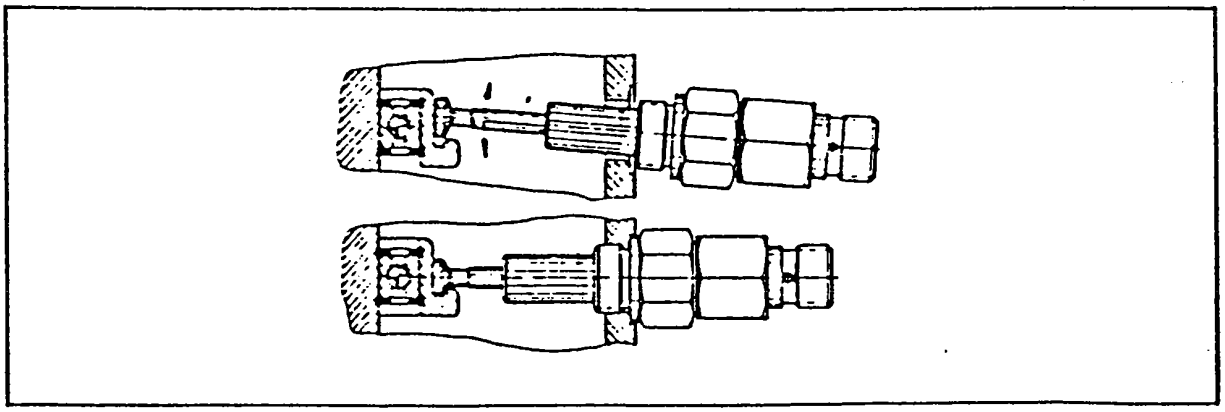
During the suction stroke the delivery plunger (1) actuated by the eccentric shaft and the control spool (2) actuated by spring force perform a stroke (in the above drg. to the right). The control spool blocks the pressure passage (3) and stops in a certain position, depending upon the delivery volume selected. As the supply plunger moves on, a vacuum is created in the metering space and when the suction opening (4) is uncovered by the plunger, lubricant is drawn in from the reservoir.

During the delivery stroke, the plunger actuated by eccentric shaft performs a movement (in the above drawing to the left). The suction opening is blocked and the lubricant contained between plunger and control spool displaces the control spool unit it uncovers the pressure passage (3) so that the lubricant is forced to the outlet by the plunger. The pumps are set for maximum delivery volume, i. e. for full stroke length. The delivery volume is infitely variable: the plug above the adjusting nipple is removed and the stroke adjusted by means of the key supplied. By rotating the nipple clockwise, the delivery volume is reduced. The adjusting nipple is provided with a hexagon head loaded radially by a spring-loaded plunger thus preventing inadvertent variation of the delivery volume. This locking feature is also a measure for adjusting the delivery volume. Six notches correspond to one nipple rotation which results in a variation of the delivery stroke by 1 mm. The 3 mm total stroke therefore correspond to 18 notches. The delivery volume should not be less than 25% of the maximum volume (14 notches less than the full stroke).

The pump element with 8 mm piston dia. (= 0.15 cm^3/stroke) is marked with a red ring (see drawing).



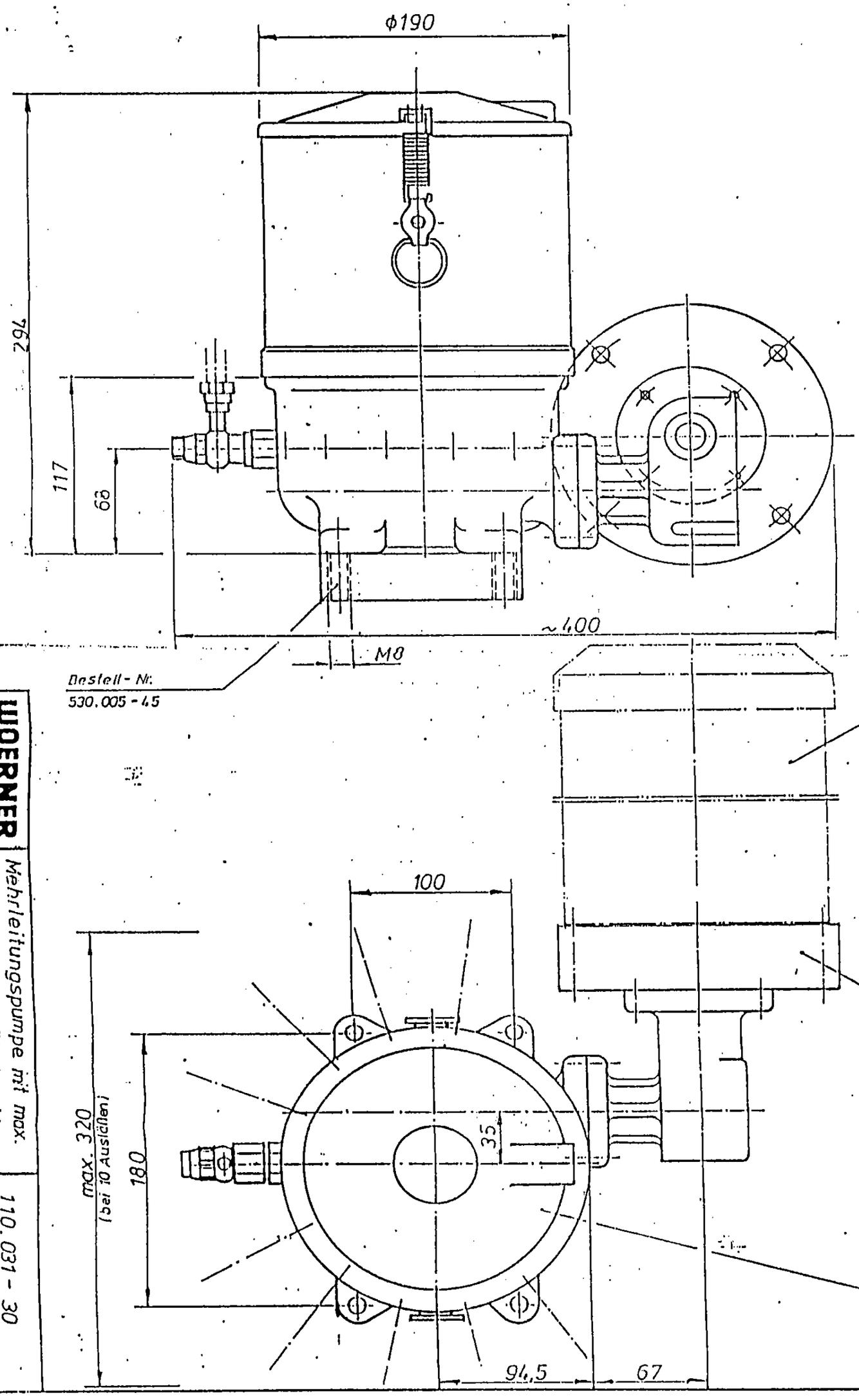
Installation of PMF pump elements:
If an additional pump element is to be installed in the lubrication pump at a later time, proceed as shown in the drawing on the left. Insert pump element at an upwards inclination into the locating hole with the plunger pulled out about half way. To facilitate installation and putting into operation, fill the bore taking up the plunger with grease. Bring into horizontal position and screw in only after the plunger head abuts the pressure ring and engages in the groove of the pressure ring.



Operating hints:
For the lubrication pumps only clean oil or grease, up to consistency No. 3 from original containers may be used. If, before putting into operation, the lubricant is not filled through the filling nipple, the pump must be filled up to the vane with gear oil during initial filling to ensure good venting.
The lubrication lines must be clean and free from obstructions. Do not connect them to the lubrication points before the lubricant emerging from the lines is free from air bubbles. Check all connections of the pressure lines for leakages.

Änderungen vorbehalten!

Freigabe	22.12.10 Skypalla
Ersatz für	
Ausgabe	



WOERNER
ZENTRALSCHMIERANLAGEN

Mehrleitungspumpe mit max. 10 Auslässen. Behälterg. 4l

110.031-30

FLENDER BOCHOLT	Installation and maintenance instructions for N-EUPEX couplings Types A, B, D, E, F, G, H, K, L, M, O und P	V 420 EN 1.88

1. **General information**

1.1 N-EUPEX couplings are suitable for clockwise and counter clockwise rotation as well as for reversing operation.

1.2 Mounting of coupling parts on the shaft ends to be connected is optional.

1.3 A gap remaining between coupling part and shaft collar can be filled by a sleeve; but this is not essential for proper functioning of the coupling.

1.4 To ensure replacement of coupling flexibles without moving connected machines (possible only with types A, D, F and K) dimension P listed in table 4.I, must be taken into account.

1.5 If required, we supply N-EUPEX couplings with finished bores, ready for mounting.

2. **Safety precautions**

2.1 Rotating parts should be guarded to prevent accidents, taking account of applicable local accident prevention regulations.

3. **Finish boring of couplings supplied with rough bores, machining tapped holes for set screws**

3.1 The maximum bore diameters D listed in our catalogue K 420, must not be exceeded.

3.2 When finishing rough bores, the surfaces on page 2 marked with heavy lines (⌐——) should be used as reference faces for correct bore concentricity.

3.3 In a drive type fastening with parallel key we recommend the following bore tolerances for given shaft limits:

Shaft tolerances					recommended bore tolerances
h_6	h_8	k_6	m_6	n_6	
Diameter in mm					
			> 25		H7
		≤ 50			H7
				> 100	H7
≤ 50					K7
> 50					M7
	all				N7

3.4 For extraordinary operating conditions e. g. reversing under load, a tighter fit and keyway width according to ISO P9 tolerances or taper key stress type fastening should be provided.

3.5 Allocation of set screws to bore diameters

Coupling Size	58	68, 80 95, 110	125 140	160	180, 200 225	250, 280 315	350 400	440, 480 520
Thread (set screw)	M5	M6	M8	M10	M12	M16	M20	M24

3.6 For sizes 58, 68, 80, 95 and 110 set screw holes must be located opposite keyway, this is also required for part 9 of sizes 125 and 140.

4. **Mounting**

4.1 Before mounting the hubs, carefully clean shaft ends and coupling parts.

4.2 The coupling hubs should preferably be mounted with the aid of special tools which are available for this purpose; inside hubs to be flush with the shaft ends. Tighten set screw to secure hubs axially.

4.3 Tighten set screws only with hexagon socket wrench according to DIN 911 without extension piece.

A. FRIEDR. FLENDER AG · Postfach 139 · D-4290 Bocholt · Tel. 02871/92-0 · Tx 813841 · Fax 02871922596

4.4 Heating of coupling parts will facilitate mounting, but the flexible elements must be removed first from coupling part 1.

4.5 For type "H", the "O" side of part 6 is marked by a circular groove (0.2 mm deep). This side must be mated with part 5. In addition, supplies with finished bores have been match marked with identical numbers on parts 5, 6 and 7.

4.6 Bring the coupling hubs together, taking care to observe dimension S_1 or S_2 respectively according to table 4.I.

4.7 Check all screw connections with screw tightening torques of table 4.I.

5. Alignment

5.1 N-EUPEX couplings will absorb deviations in the relative position of shafts to be connected (see section 6.).

5.2 When aligning the coupling halves, the angular and parallel offset misalignments of shafts relative to each other should be as small as possible. Alignment to be carried out in two planes as shown in fig. 3.1 with a straight edge (offset misalignment) and spacer bar (angular misalignment). A dial indicator will give greater accuracy.

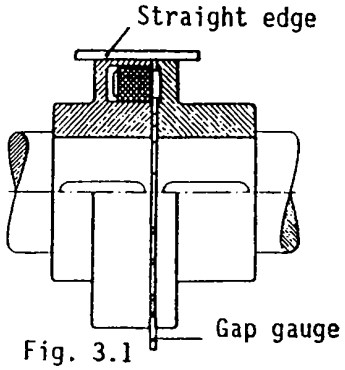
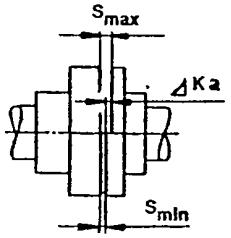


Fig. 3.1

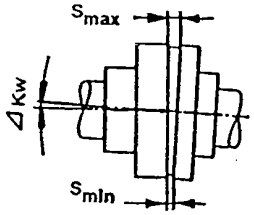
5.3 The gap dimensions S_1 or S_2 respectively must be within the limits listed in table 4.I.

6. Possible misalignment

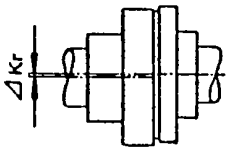
6.1 For all types with the exception of type H, the permissible axial movement ΔKa (fig.3.2) is determined by:
$\Delta Ka = S_{1max.} - S_{1min.}$.
Axial movement ΔKa of type H coupling parts relative to each other, are possible within the permissible limits for dimension S_2 listed in table 4.I.



Axial movement
Fig. 3.2



Angular misalignment
Fig. 3.3



Offset misalignment
Fig. 3.4

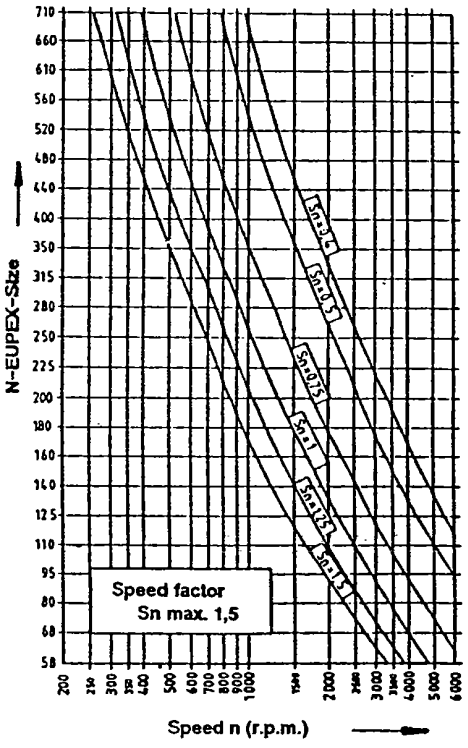


Fig. 3.5

6.2 Angular misalignment ΔK_W (fig. 3.3) is measured as the difference between $S_{max.}$ and $S_{min.}$. Possible values are calculated with values from tabel 4.I and fig. 3.5. The permissible angular misalignment amounts to: $\Delta K_W \times S_n$

6.3 See table 4.I and fig 3.4 for parallel offset misalignment ΔK_r. Permissible parallel offset: $\Delta K_r \times S_n$.

6.4 Angular and parallel offset misalignment can occur at the same time. The sum of both misalignments should not exceed the values for ΔK_r or ΔK_W respectively.

7. Operation

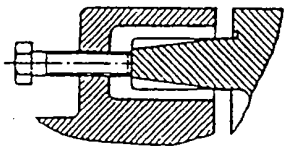
7.1 Before commencing initial operatings check alignment and gap dimension S_1 or S_2 respectively and if necessary make corrections, further check screw connections. For screw tightening torques see table 4.I.

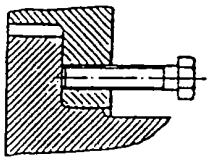
8. Maintenance

8.1 N-EUPEX couplings do not require any regular maintenance except for an occasional check on the torsional play or backlash between the driving and driven halves. When N-EUPEX couplings are used in drives which do not

require a minimum of torsional play or backlash in the coupling, the coupling flexibles can be allowed to wear down to 1/3 of their original thickness before they need replacing.

Size 225 to 400
Fig. 4.1





Size 440 to 710
Fig. 4.2

9. Replacing of flexibles

9.1 Uninterrupted torque transmission and reliability of operation cannot be guaranteed unless original N-EUPEX flexibles are used.

9.2 With the exception of types B, E, L, M and O, the flexibles of other types can be replaced without moving connected shafts or machines.

9.2.1 Types A, D, F, K and P: After loosening screw connection 2/3, part 3 can be moved axially and the flexibles are freely accessible. In order to ease separation of the coupling parts, part 1 of coupling sizes 225 - 400 is provided with tapped holes for forcing screws. From size 440 up these tapped holes are located in coupling part 3 (see figs. 4.1 and 4.2).

9.2.2 Type G: Loosen flange connection part 10/11 and the floating shaft with mounted coupling parts can be removed radially. Using suitable tools, part 10 can be pulled off from the floating bearing side. On the other side, the fixed bearing side, remove first the retaining ring from the floating shaft and after that, part 10 can be dismounted complete with ball and socket joint.

9.2.3 Type H: Loosen screw connection and force parts 5 and 7 out of their centrings with the help of forcing screws in part 6. Push part 7 as far as possible into part 1. Part 6 can now be removed radially. Bring part 7 back out of part 1; the flexibles are freely accessible now.

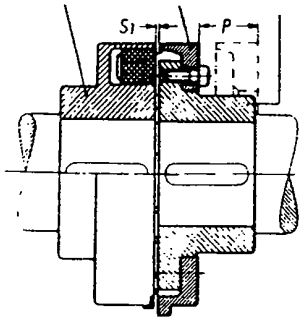
9.3 After fitting new flexibles, reassembly in reverse order. Before starting up take note of sections 4., 5., 6. and 7.

Table 4.I

Coupling size	S_1 mm	S_2 mm	perm. deviation S_2 mm	P mm	Cap screw tightening torque T_A and width between flats S_w for socket head cap screws: Part 2/3 Part 8/10 Part 5/6 Part 10/11 Part 6/7 Part 10/32 Nm	S_w mm	Angular misalignm. ΔK_w $S_{max.}-S_{min.}$ mm	Offset misalignm. ΔK_r mm
58	2... 4						0,10	0,10
68	2... 4						0,11	0,11
80	2... 4	5	+1		13	5	0,13	0,13
95	2... 4	5	+1		13	5	0,15	0,15
110	2... 4	5	+1	33	14	6	0,18	0,18
125	2... 4	5	+1	38	17,5	6	0,21	0,21
140	2... 4	5	+1	43	29	8	0,24	0,24
160	2... 6	6	+1	47	35	8	0,27	0,27
180	2... 6	6	+1	50	44	8	0,30	0,30
200	2... 6	6	+1	53	67,5	10	0,34	0,34
225	2... 6	6	+1	61	89	10	0,38	0,38
250	3... 8	8	+1	69	145	14	0,42	0,42
280	3... 8			73	185	14	0,47	0,47
315	3... 8			78	200	14	0,52	0,52
350	3... 8			83	260	17	0,56	0,56
400	3... 8			88	340	17	0,65	0,65
440	5...10			99	420	17	0,72	0,72
480	5...10			104	550	19	0,78	0,78
520	5...10			115	670	19	0,85	0,85
560	6...12			125	710	19	0,92	0,92
610	6...12			135	1450	22	0,99	0,99
660	6...12			145	1450	22	1,05	1,05
710	6...12			155	1450	22	1,15	1,15

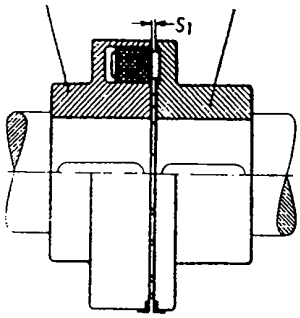
SURVEY OF TYPES

Type A
Sizes 110 to 350

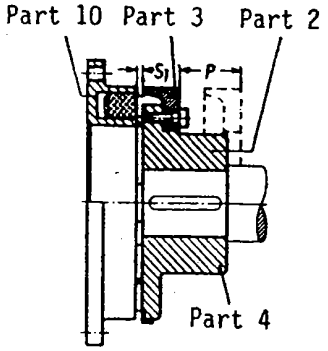


Sizes 400 to 710
Type A

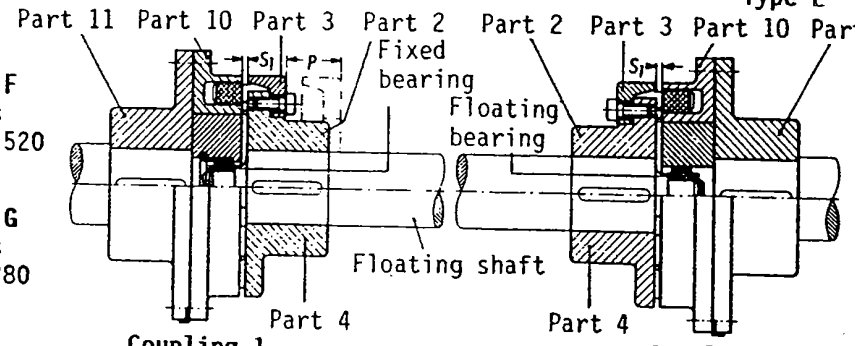
Type B
Sizes 58 to 280



Type D
Sizes 110 to 350
Part 3 from size 400 to 520
see type A

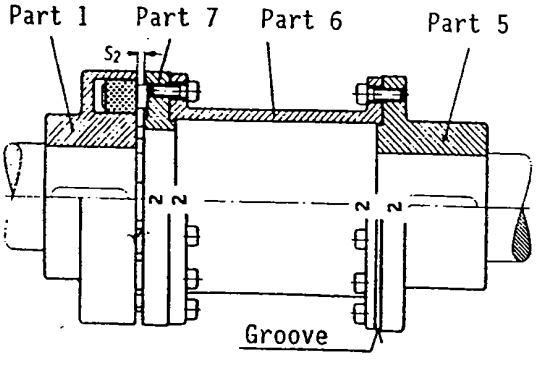


Sizes 68 to 280
Type E

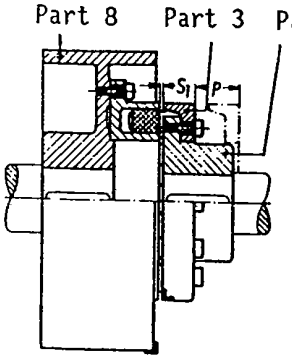


Type F
Sizes
110 to 520

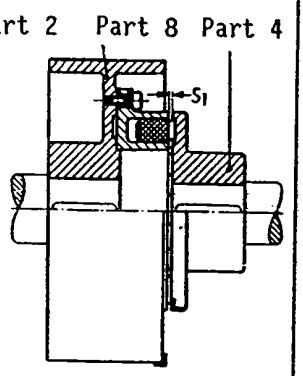
Type G
Sizes
95 to 280



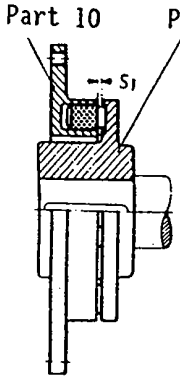
Sizes 80 to 250
Type H



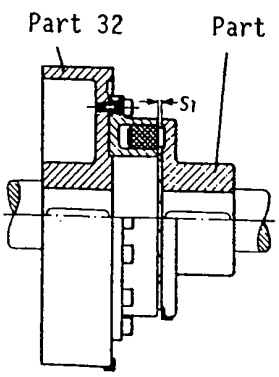
Sizes 125 to 350
Type K



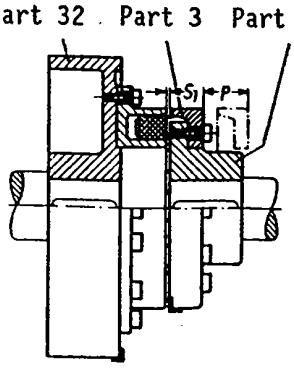
Sizes 125 to 280
Type L



Sizes 68 to 400
Type M



Sizes 125 to 280
Type O



Sizes 125 to 350
Type P

SECTION 12: APPROVED SHOP TESTS

- APPROVED MIXER SHOP TEST REPORT
- APPROVED MIXER MOTOR SHOP TEST REPORT

STERLING

Shop Test Results - Submittal 009

GWINNETT COUNTY WWTP

PHASE II

BUFORD, GA

PO 139424

Contract No. 127047

STERLING - HALBERG MECHANICAL DRAFT TUBE

SLUDGE MIXERS, MFS - 4

SHOP ORDER 23030042

TAG: 40:DSL-MIX-3/4/5

November 13,2003

IINDEX:

Draft Tube Sludge Mixer

STERLING

MIXER SHOP TEST REPORT — **PO 139424**
Gwinett County WWTP, Phase II, Buford, GA — **Contract 127047**
MFS - 4, Draft Tube Sludge Mixer — **Sterling SO # 23030042**

SECTION 1: CONTRACT INFORMATION:

1.1 General Information on Test

Place of Mixer Tests:	Sterling SIHI Gmbh Ludwigshafen, Germany
Date of Mixer Tests:	November 4-6,2003
Inspecting Agent(s): Responsible Halberg Engineer: Tester	 Mr. Uwe Werner Mr. Odermatt

1.2 Information on the Mixer

Type:	Sterling-Halberg MFS – 4 Draft Tube Sludge Mixer
Registration Numbers/WA No.	359386-011/LU0209845301 359386-021/LU0209845302 359386-031/LU0209845303
Job Title:	Gwinnett County Public Utilities F. Wayne Hill Water Resources Center Phase II Expansion
Year of Manufacture:	2003

1.3 Mixer Operational Data

Draft Tube Mixers	6,500 USGPM @ 720 RPM maximum
Mixer Acceptance Test Criteria:	+/-10% Flow

1.4 Motor Data

Manufacturer:	General Electric
Type:	Vertical, Explosion Proof
Horsepower:	20 HP
Speed (Synchronous)/Voltage:	7200 RPM/460 v
Serial Number(s)	0107336A - C

1.5 Test Medium: Clean Water

1.6 Applicable Specification: **Chicago Bridge & Iron PO 139424**

Approved Shop Test Procedure, Sub. #7,

SECTION 2: SUMMARY OF SHOP TEST PROCEDURE:

2.1 Explanation of Test Format

The tests conducted were based on the following:

Frequency

60 Cycle - with frequency inverter

Flow Test Based on Simulating Relative Position of Liquid at Site:

Normal Water Level - 250 mm below top of splash disk

With maximum level at approximately 150 mm above and minimum level at approximately 150 mm below normal level

Tests at normal, high and low water levels, (with flow in upward and downward directions), were conducted for each mixer with the results obtained as shown.

Note:

The test results shown are presented in the original SI units and alternately Imperial (English Units).

2.2 Measuring Instruments Used/Calibration:

Flowrate:	Magnetic Inductive Flowmeter, MID, Auoflux IFS4000 , KROHNE
Time:	Stopwatch
Power Input:	Power Meter, ZES Zimmer Electronic System, Type LMG 450
Speed:	Stroboscope, Dreilo, type Strob 130 ICL
Vibration Velocity:	Vibrometer, t25, SCHENCK
Sound:	Precision Integrating Sound Level Meter Type 2233 Manufacturer: Bruel & Kjaer Octave Filter Set Type 1624 Manufacturer: Bruel & Kjaer

All testing equipment used for the shop test in Germany is calibrated by the testing Germany agency TUV. Calibrations and approvals are performed every two years.

2.3 Measured Parameters Definitions:

Mixer Flow/Power Measurements:

Each mixer is assembled on the test stand with the impeller in the tank and simulated draft tube. A modified draft tube is used in the test bed to accommodate the test bed. This set-up is hydraulically similar to the specified operating conditions. The mixer is tested with the actual drive motor, to be used in the field using plain water as the test medium.

The acceptance criteria are according to DIN standard DIN 1944/III.

The mixer is started and allowed to operate for a few minutes in order to establish a steady state operation. Each unit was tested eight hours *in each* flow direction. The attached reports are the average values over the eight-hour period.

NOTE: Depending on mixer size and speed, vertical repositioning of the outlet head cone may be required as per the tolerances given in the O & M manual.

The following data are taken and recorded in the units indicated:

Mixer Capacity **Q [m3/hr] metric** – ***converted to [gpm] imperial***

Mixer capacity is measured by means of a flow meter.

This unit is located at the middle of the straight tube, and recommended distance from the 90° elbow and entrance pipe to measure flow in both directions

Power Consumption **Pin, Pout [kW]** – ***converted to [hp] imperial***

The mixer is driven with the actual 60 Hz. motor to be used at the jobsite, except requires the interconnection of a frequency converter to change from the normal 50 Hz. frequency to 60 Hz. Power is measured directly using the power meter which also accounts for change in the power factor of the motor. Additionally, values of amps and voltage are recorded as a check against the measured power value.

Shaft Speed **n [rpm]**

The shaft speed is measured by means of a stroboscope.

Vibration **v-eff** [mm/s] velocity – *converted to [mils p-p] displacement*

The vibration measurements are in accordance with the recommendations of VDI 2056, Machine Group M. Five points of measurement are taken and located as shown on the test reports.

Acceptance Level

Test acceptance levels according to DIN 1944/III.

Mixer flow rates, which are not lower than 10% from the specified capacity of 6,500 USGPM, shall be acceptable.

SECTION 3: TEST RESULTS

60 CYCLE MIXER TEST RESULTS – IMPERIAL UNITS: FLOW/POWER/VIBRATION REFER ATTACHMENTS

TOTAL RECORDED TESTING TIMES FOR EACH UNIT:

	MFS 4 MIXER IDENTIFICATION NUMBERS (REGISTRATION/WA)					
	359386-011 /LU0209845301		359386-021 /LU0209845302		359386-031 /LU0209845303	
	TIME (MINUTES)					
*TEST LEVEL	DOWN	UP	DOWN	UP	DOWN	UP
NORMAL 1 (250 MM)	45	70	60	60	80	60
NORMAL 2 (250 MM)	65	60	60	60	65	60
MAX (400 MM)	75	70	60	60	95	75
MIN (100 MM)	60	60	60	60	30	45
TOTAL (MIN) EACH DIRECTION	245	260	240	240	270	240
TOTAL TEST HOURS EACH MIXER	8.4		8.0		8.5	

*DISTANCE MEASURED FROM TOP OF SPLASH DISC DOWN TO WATER LEVEL

Mixer Test Report

STERLING HALBERG

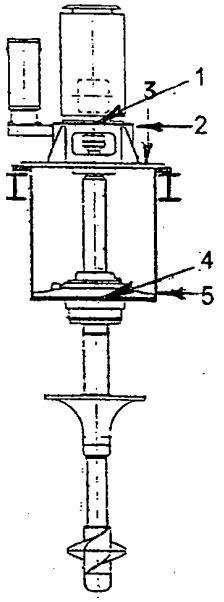
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6715	6261
Power Input	P_{in} [BHP]	9.64	13.22
Current	I_{eff} [A]	13.5	15.4
Voltage	U_{eff} [V]	383	381
Mixer speed	n [rpm]	710	712
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.6	0.5
Point 2	D [mils p-p]	0.3	0.3
Point 3	D [mils p-p]	2.1	1.6
Point 4	D [mils p-p]	1.9	1.7
Point 5	D [mils p-p]	1.6	1.3
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		116.06
	lower bearing [°F]		99.86

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 65 min and upwards 60 min

Test Report No.:	**03/168**	**Tester:**
Register No.:	**359386-011**	
WA No.:	**LU0209845301**	
Customer:	**Sterling Fluid Systems USA**	
Plant:		
Date:	**05.11.2003**	**Ludwigshafen/Rhein**

Mixer Test Report

STERLING
HALBERG

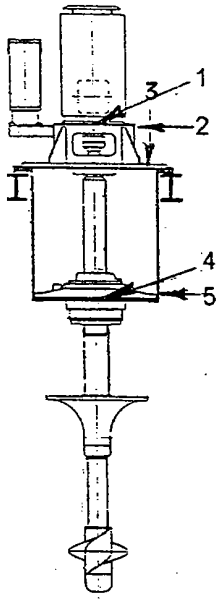
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6635	6261
Power Input	P_{in} [BHP]	9.62	13.22
Current	I_{eff} [A]	13.5	15.4
Voltage	U_{eff} [V]	382	381
Mixer speed	n [rpm]	713	712
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.6	0.5
Point 2	D [mils p-p]	0.3	0.3
Point 3	D [mils p-p]	2.0	1.6
Point 4	D [mils p-p]	1.9	1.7
Point 5	D [mils p-p]	1.6	1.3
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		115.7
	lower bearing [°F]		99.5

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 45 min and upwards 70 min

Test Report No.:	03/168	Tester:
Register No.:	359386-011	
WA No.:	LU0209845301	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	05.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

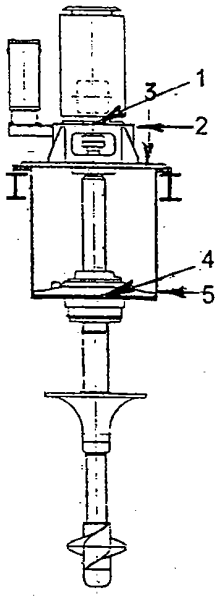
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 400 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6635	6217
Power Input	P_{in} [BHP]	9.62	12.44
Current	I_{eff} [A]	13.5	14.9
Voltage	U_{eff} [V]	382	381
Mixer speed	n [rpm]	712	712
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.6	0.6
Point 2	D [mils p-p]	0.3	0.3
Point 3	D [mils p-p]	2.1	1.6
Point 4	D [mils p-p]	1.9	1.6
Point 5	D [mils p-p]	1.6	1.2
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		115.88
	lower bearing [°F]		98.96

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 75 min and upwards 70 min

Test Report No.:	03/168	Tester:
Register No.:	359386-011	
WA No.:	LU0209845301	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	05.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING
HALBERG

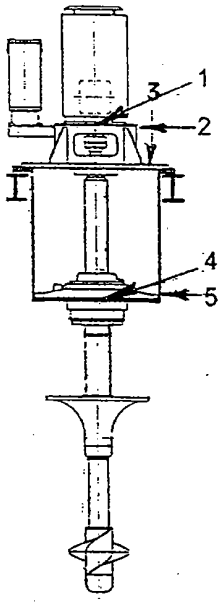
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 100 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6657	6169
Power Input	P_{in} [BHP]	9.7	13.1
Current	I_{eff} [A]	13.5	15.4
Voltage	U_{eff} [V]	382	382
Mixer speed	n [rpm]	713	713
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.7	0.5
Point 2	D [mils p-p]	0.3	0.3
Point 3	D [mils p-p]	2.0	1.6
Point 4	D [mils p-p]	1.9	1.7
Point 5	D [mils p-p]	1.6	1.1
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		116.06
	lower bearing [°F]		99.86

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/168	Tester:
Register No.:	359386-011	
WA No.:	LU0209845301	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	05.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

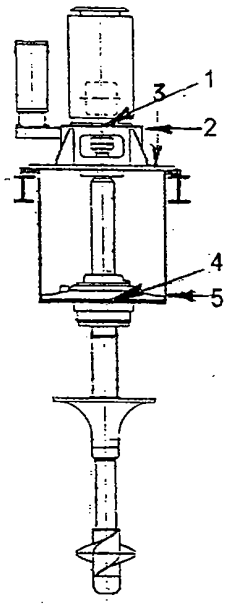
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6930	6204
Power Input	P_{in} [BHP]	8.9	12.88
Current	I_{eff} [A]	13.3	13.9
Voltage	U_{eff} [V]	382	383
Mixer speed	n [rpm]	711	713
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.4	0.3
Point 2	D [mils p-p]	0.2	0.2
Point 3	D [mils p-p]	1.2	1.0
Point 4	D [mils p-p]	1.3	1.3
Point 5	D [mils p-p]	1.2	1.3
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		109.76
	lower bearing [°F]		106.52

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/169	Tester:
Register No.:	359386-021	
WA No.:	LU0209845302	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	06.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

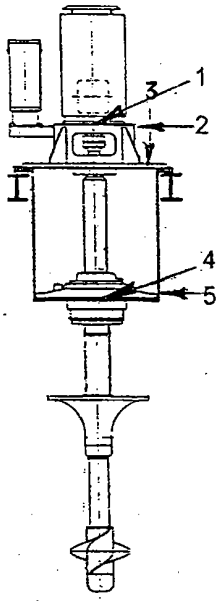
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6930	6204
Power Input	P_{in} [BHP]	8.9	12.94
Current	I_{eff} [A]	13.4	13.9
Voltage	U_{eff} [V]	383	382
Mixer speed	n [rpm]	710	713
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.4	0.3
Point 2	D [mils p-p]	0.2	0.1
Point 3	D [mils p-p]	1.0	0.9
Point 4	D [mils p-p]	1.3	1.3
Point 5	D [mils p-p]	1.3	1.3
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		109.94
	lower bearing [°F]		106.88

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/169	Tester:
Register No.:	359386-021	
WA No.:	LU0209845302	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	06.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

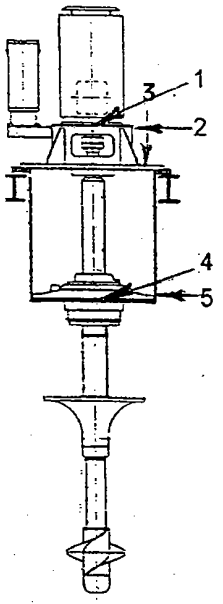
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 400 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6944	6208
Power Input	P_{in} [BHP]	8.8	12.4
Current	I_{eff} [A]	13.4	13.4
Voltage	U_{eff} [V]	382	382
Mixer speed	n [rpm]	710	712
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.4	0.3
Point 2	D [mils p-p]	0.2	0.1
Point 3	D [mils p-p]	1.1	0.9
Point 4	D [mils p-p]	1.2	1.3
Point 5	D [mils p-p]	1.5	1.3
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		110.12
	lower bearing [°F]		106.7

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/169	Tester:
Register No.:	359386-021	
WA No.:	LU0209845302	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	06.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

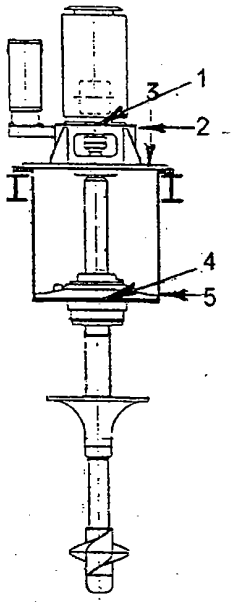
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 100 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	6913	6199
Power Input	P_{in} [BHP]	8.88	12.88
Current	I_{eff} [A]	13.4	13.9
Voltage	U_{eff} [V]	383	383
Mixer speed	n [rpm]	710	712
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.4	0.3
Point 2	D [mils p-p]	0.2	0.1
Point 3	D [mils p-p]	1.1	0.9
Point 4	D [mils p-p]	1.3	1.3
Point 5	D [mils p-p]	1.3	1.3
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		110.3
	lower bearing [°F]		106.52

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/169	Tester:
Register No.:	359386-021	
WA No.:	LU0209845302	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	06.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

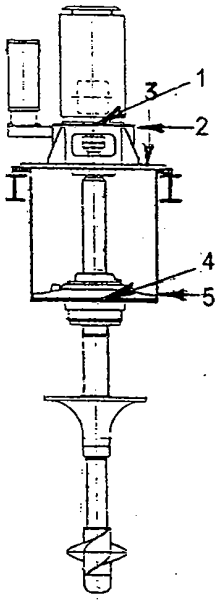
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 100 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	7045	6217
Power Input	P_{in} [BHP]	8.62	13.78
Current	I_{eff} [A]	13.2	16.9
Voltage	U_{eff} [V]	381	380
Mixer speed	n [rpm]	714	710
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.5	0.4
Point 2	D [mils p-p]	0.3	0.3
Point 3	D [mils p-p]	1.3	0.7
Point 4	D [mils p-p]	1.9	1.8
Point 5	D [mils p-p]	1.3	1.2
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		114.62
	lower bearing [°F]		114.08

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 30 min and upwards 45 min

Test Report No.:	**03/165**	**Tester:**
Register No.:	**359386-031**	
WA No.:	**LU0209845303**	
Customer:	**Sterling Fluid Systems USA**	
Plant:		
Date:	**04.11.2003**	**Ludwigshafen/Rhein**

Mixer Test Report

STERLING HALBERG

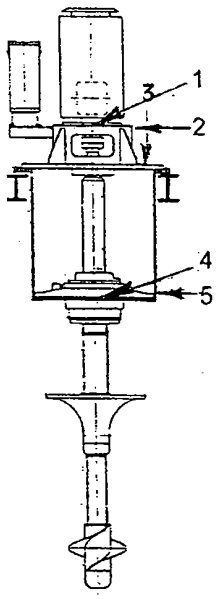
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 400 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	7036	6191
Power Input	P_{in} [BHP]	8.66	12.02
Current	I_{eff} [A]	13.4	16.4
Voltage	U_{eff} [V]	381	380
Mixer speed	n [rpm]	714	710
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.5	0.4
Point 2	D [mils p-p]	0.3	0.3
Point 3	D [mils p-p]	1.3	0.8
Point 4	D [mils p-p]	1.9	1.9
Point 5	D [mils p-p]	1.3	1.2
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		114.8
	lower bearing [°F]		114.26

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 95 min and upwards 75 min

Test Report No.:	03/165	Tester:
Register No.:	359386-031	
WA No.:	LU0209845303	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	04.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

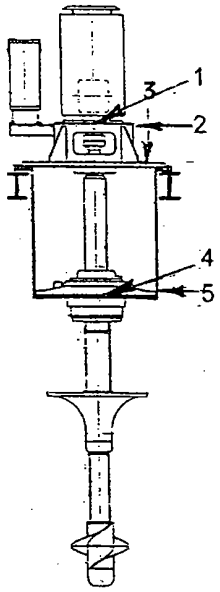
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [gpm]	7076	6191
Power Input	P_{in} [BHP]	8.64	13.76
Current	I_{eff} [A]	13.1	16.9
Voltage	U_{eff} [V]	380	380
Mixer speed	n [rpm]	715	710
VIBRATION		Dmax =	9 MILS P-P
Measurement: VIBROMETER 25			
Point 1	D [mils p-p]	0.5	0.4
Point 2	D [mils p-p]	0.3	0.3
Point 3	D [mils p-p]	1.3	0.8
Point 4	D [mils p-p]	1.9	1.7
Point 5	D [mils p-p]	1.3	1.2
Temparature	Measurements	Tmax =	212 °F
	upper bearing [°F]		114.44
	lower bearing [°F]		113.9

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 65 min and upwards 60 min

Test Report No.:	03/165	Tester:
Register No.:	359386-031	
WA No.:	LU0209845303	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	04.11.2003	Ludwigshafen/Rhein

SECTION 3: TEST RESULTS (continued)

60 CYCLE MIXER TEST RESULTS – METRIC UNITS: FLOW/POWER/VIBRATION REFER ATTACHMENTS

Mixer Test Report

STERLING HALBERG

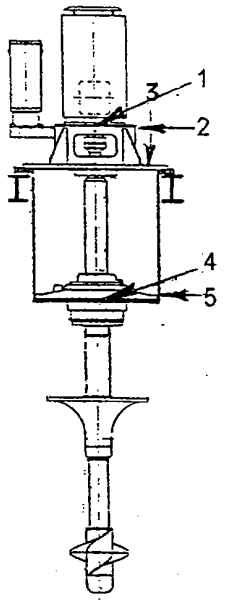
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1507	1422
Power Input	P_{in} [kW]	4,81	6,61
Current	I_{eff} [A]	13,5	15,4
Voltage	U_{eff} [V]	382	381
Mixer speed	n [rpm]	713	712
VIBRATION MEASUREMENTS		Vmax =	7,1 mm/s
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,58	0,45
Point 2	v-eff [mm/s]	0,28	0,28
Point 3	v-eff [mm/s]	1,92	1,50
Point 4	v-eff [mm/s]	1,83	1,62
Point 5	v-eff [mm/s]	1,51	1,19
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		46,5
	lower bearing [°C]		37,5

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 45 min and upwards 70 min

Test Report No.:	03/168	Tester:
Register No.:	359386-011	
WA No.:	LU0209845301	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	05.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

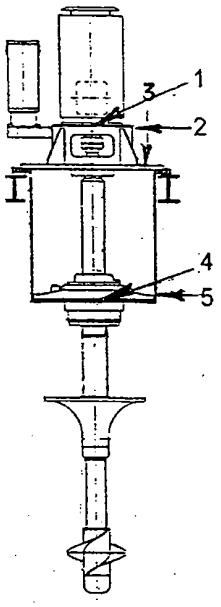
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1525	1422
Power Input	P_{in} [kW]	4,82	6,61
Current	I_{eff} [A]	13,5	15,4
Voltage	U_{eff} [V]	383	381
Mixer speed	n [rpm]	710	712
VIBRATION MEASUREMENTS		**Vmax =**	**7,1 mm/s**
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,60	0,45
Point 2	v-eff [mm/s]	0,27	0,28
Point 3	v-eff [mm/s]	2,01	1,50
Point 4	v-eff [mm/s]	1,84	1,62
Point 5	v-eff [mm/s]	1,55	1,19
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		46,7
	lower bearing [°C]		37,7

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 65 min and upwards 60 min

Test Report No.:	**03/168**	**Tester:**
Register No.:	**359386-011**	
WA No.:	**LU0209845301**	
Customer:	**Sterling Fluid Systems USA**	
Plant:		
Date:	**05.11.2003**	**Ludwigshafen/Rhein**

Mixer Test Report

STERLING HALBERG

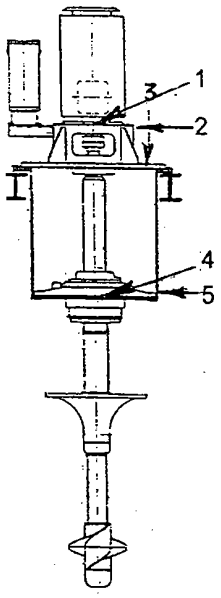
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 400 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1507	1412
Power Input	P_{in} [kW]	4,81	6,22
Current	I_{eff} [A]	13,5	14,9
Voltage	U_{eff} [V]	382	381
Mixer speed	n [rpm]	712	712
VIBRATION MEASUREMENTS		Vmax =	7,1 mm/s
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,60	0,55
Point 2	v-eff [mm/s]	0,25	0,28
Point 3	v-eff [mm/s]	1,95	1,52
Point 4	v-eff [mm/s]	1,84	1,50
Point 5	v-eff [mm/s]	1,51	1,18
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		46,6
	lower bearing [°C]		37,2

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 75 min and upwards 70 min

Test Report No.:	03/168	Tester:
Register No.:	359386-011	
WA No.:	LU0209845301	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	05.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

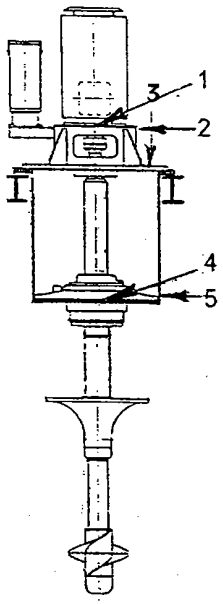
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 100 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1512	1401
Power Input	P_{in} [kW]	4,85	6,55
Current	I_{eff} [A]	13,5	15,4
Voltage	U_{eff} [V]	382	382
Mixer speed	n [rpm]	713	713
VIBRATION MEASUREMENTS		**Vmax =**	**7,1 mm/s**
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,65	0,51
Point 2	v-eff [mm/s]	0,28	0,29
Point 3	v-eff [mm/s]	1,90	1,52
Point 4	v-eff [mm/s]	1,80	1,59
Point 5	v-eff [mm/s]	1,50	1,00
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		46,7
	lower bearing [°C]		37,7

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	**03/168**	**Tester:**
Register No.:	**359386-011**	
WA No.:	**LU0209845301**	
Customer:	**Sterling Fluid Systems USA**	
Plant:		
Date:	**05.11.2003**	**Ludwigshafen/Rhein**

Mixer Test Report

STERLING HALBERG

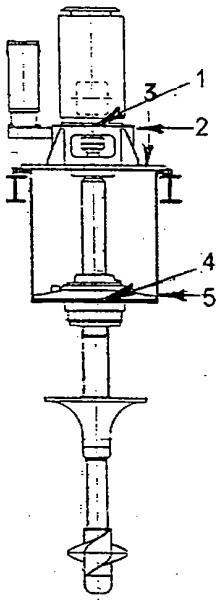
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1574	1409
Power Input	P_{in} [kW]	4,45	6,47
Current	I_{eff} [A]	13,4	13,9
Voltage	U_{eff} [V]	383	382
Mixer speed	n [rpm]	710	713
VIBRATION MEASUREMENTS		Vmax =	7,1 mm/s
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,38	0,32
Point 2	v-eff [mm/s]	0,19	0,10
Point 3	v-eff [mm/s]	0,97	0,89
Point 4	v-eff [mm/s]	1,20	1,20
Point 5	v-eff [mm/s]	1,21	1,25
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		43,3
	lower bearing [°C]		41,6

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/169	Tester:
Register No.:	359386-021	
WA No.:	LU0209845302	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	06.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

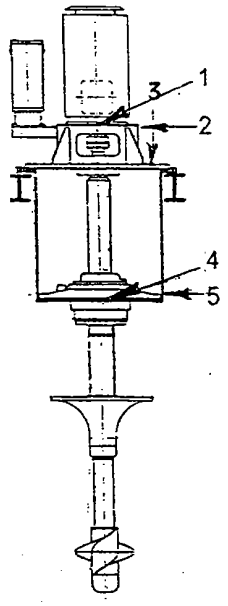
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1574	1409
Power Input	P_{in} [kW]	4,45	6,44
Current	I_{eff} [A]	13,3	13,9
Voltage	U_{eff} [V]	382	383
Mixer speed	n [rpm]	711	713
VIBRATION MEASUREMENTS		**Vmax =**	**7,1 mm/s**
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,39	0,33
Point 2	v-eff [mm/s]	0,22	0,15
Point 3	v-eff [mm/s]	1,09	0,91
Point 4	v-eff [mm/s]	1,22	1,20
Point 5	v-eff [mm/s]	1,15	1,24
Temparature	**Measurements**	**Tmax =**	**100 °C**
	upper bearing [°C]		43,2
	lower bearing [°C]		41,4

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	**03/169**	**Tester:**
Register No.:	**359386-021**	
WA No.:	**LU0209845302**	
Customer:	**Sterling Fluid Systems USA**	
Plant:		
Date:	**06.11.2003**	**Ludwigshafen/Rhein**

Mixer Test Report

STERLING HALBERG

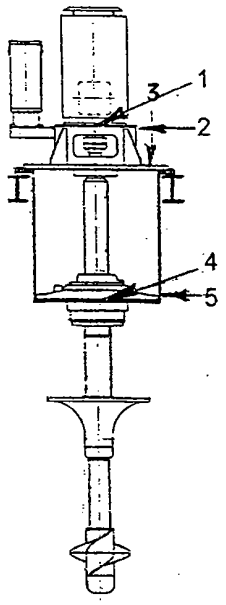
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 400 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1577	1410
Power Input	P_{in} [kW]	4,40	6,20
Current	I_{eff} [A]	13,4	13,4
Voltage	U_{eff} [V]	382	382
Mixer speed	n [rpm]	710	712
VIBRATION MEASUREMENTS		Vmax =	7,1 mm/s
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,38	0,33
Point 2	v-eff [mm/s]	0,15	0,10
Point 3	v-eff [mm/s]	1,00	0,88
Point 4	v-eff [mm/s]	1,17	1,20
Point 5	v-eff [mm/s]	1,40	1,25
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		43,4
	lower bearing [°C]		41,5

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/169	Tester:
Register No.:	359386-021	
WA No.:	LU0209845302	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	06.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

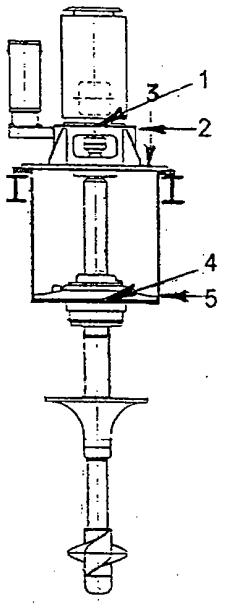
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 100 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1570	1408
Power Input	P_{in} [kW]	4,44	6,44
Current	I_{eff} [A]	13,4	13,9
Voltage	U_{eff} [V]	383	383
Mixer speed	n [rpm]	710	712
VIBRATION MEASUREMENTS		Vmax =	7,1 mm/s
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,38	0,27
Point 2	v-eff [mm/s]	0,19	0,07
Point 3	v-eff [mm/s]	1,05	0,88
Point 4	v-eff [mm/s]	1,21	1,20
Point 5	v-eff [mm/s]	1,21	1,20
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		43,5
	lower bearing [°C]		41,4

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosφ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 60 min and upwards 60 min

Test Report No.:	03/169	Tester:
Register No.:	359386-021	
WA No.:	LU0209845302	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	06.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

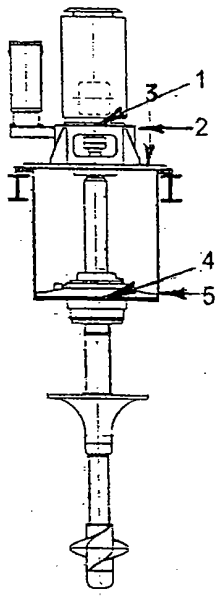
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1609	1407
Power Input	P_{in} [kW]	4,31	6,86
Current	I_{eff} [A]	13	17
Voltage	U_{eff} [V]	381	380
Mixer speed	n [rpm]	714	710
VIBRATION MEASUREMENTS		Vmax =	7,1 mm/s
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,45	0,42
Point 2	v-eff [mm/s]	0,28	0,28
Point 3	v-eff [mm/s]	1,21	0,68
Point 4	v-eff [mm/s]	1,85	1,73
Point 5	v-eff [mm/s]	1,26	1,16
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		46,0
	lower bearing [°C]		45,7

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 80 min and upwards 60 min

Test Report No.:	03/165	Tester:
Register No.:	359386-031	
WA No.:	LU0209845303	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	04.11.2003	Ludwigshafen/Rhein

Mixer Test Report

STERLING HALBERG

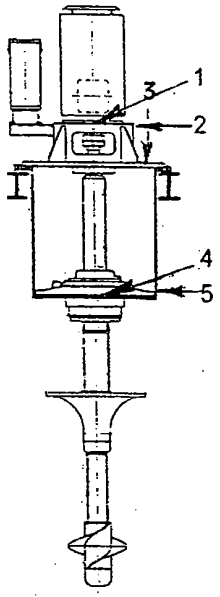
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 250 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1607	1406
Power Input	P_{in} [kW]	4,32	6,88
Current	I_{eff} [A]	13,1	16,9
Voltage	U_{eff} [V]	380	380
Mixer speed	n [rpm]	715	710
VIBRATION MEASUREMENTS		**Vmax =**	**7,1 mm/s**
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,46	0,42
Point 2	v-eff [mm/s]	0,27	0,28
Point 3	v-eff [mm/s]	1,21	0,72
Point 4	v-eff [mm/s]	1,80	1,65
Point 5	v-eff [mm/s]	1,24	1,12
Temparature	**Measurements**	**Tmax =**	**100 °C**
	upper bearing [°C]		45,8
	lower bearing [°C]		45,5

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 65 min and upwards 60 min

Test Report No.:	**03/165**	**Tester:**
Register No.:	**359386-031**	
WA No.:	**LU0209845303**	
Customer:	**Sterling Fluid Systems USA**	
Plant:		
Date:	**04.11.2003**	**Ludwigshafen/Rhein**

Mixer Test Report

STERLING HALBERG

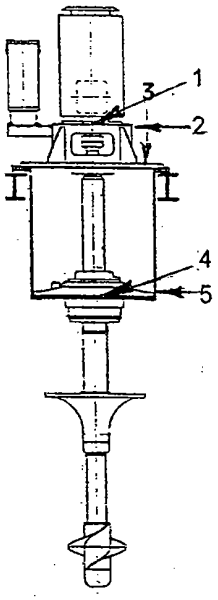
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 400 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1598	1406
Power Input	P_{in} [kW]	4,33	6,01
Current	I_{eff} [A]	13,4	16,4
Voltage	U_{eff} [V]	381	380
Mixer speed	n [rpm]	714	710
VIBRATION MEASUREMENTS		**Vmax =**	**7,1 mm/s**
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,44	0,41
Point 2	v-eff [mm/s]	0,26	0,29
Point 3	v-eff [mm/s]	1,21	0,71
Point 4	v-eff [mm/s]	1,80	1,75
Point 5	v-eff [mm/s]	1,24	1,18
Temparature	**Measurements**	**Tmax =**	**100 °C**
	upper bearing [°C]		46,0
	lower bearing [°C]		45,7

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 95 min and upwards 75 min

Test Report No.:	**03/165**	**Tester:**
Register No.:	**359386-031**	
WA No.:	**LU0209845303**	
Customer:	**Sterling Fluid Systems USA**	
Plant:		
Date:	**04.11.2003**	**Ludwigshafen/Rhein**

Mixer Test Report

STERLING HALBERG

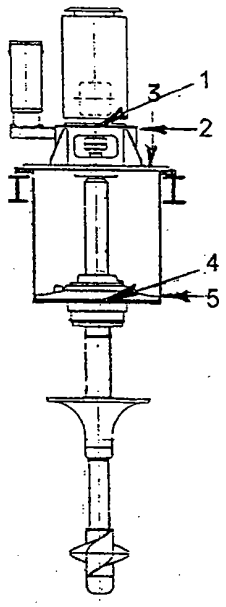
Mixer-Typ: MFSB 4 n= 705 rpm / 60 Hz

Waterlevel based on top of splash disc: 100 mm

Sense of Rotation		left	right
Flow direction		downwards ⇓	upwards ⇑
Hydraulic Measurements			
Flow rate	Q [m^3/h]	1600	1412
Power Input	P_{in} [kW]	4,31	6,89
Current	I_{eff} [A]	13,2	16,9
Voltage	U_{eff} [V]	381	380
Mixer speed	n [rpm]	714	710
VIBRATION MEASUREMENTS		Vmax =	7,1 mm/s
Measurement: VIBROMETER 25			
Point 1	v-eff [mm/s]	0,45	0,42
Point 2	v-eff [mm/s]	0,28	0,28
Point 3	v-eff [mm/s]	1,20	0,69
Point 4	v-eff [mm/s]	1,84	1,70
Point 5	v-eff [mm/s]	1,20	1,16
Temparature	Measurements	Tmax =	100 °C
	upper bearing [°C]		45,9
	lower bearing [°C]		45,6

Motor Data

GE Motors
Type:105 DEG C Rise
Serial No.:TVG07336A
Nom. Output: 20 HP
Nom. Current: 27.1 A
Nom. Voltage: 460 V
cosϕ: 0.76 n = 705 min^{-1}



Sludge mixer type MFSB 4

Running time: downwards 30 min and upwards 45 min

Test Report No.:	03/165	Tester:
Register No.:	359386-031	
WA No.:	LU0209845303	
Customer:	Sterling Fluid Systems USA	
Plant:		
Date:	04.11.2003	Ludwigshafen/Rhein

SECTION 4: CONCLUSION:

The comparison of the specified flow values with the flow test results show that the units are within the specified project and acceptance level specifications.

APPENDIX

A. GE Drive Motor Routine Test Results

B. Acceptance Levels

C. Unit Conversions Used

APPENDIX A

GE Drive Motor Routine Test Results

GE INDUSTRIAL SYSTEMS

REQN #	**WEB1209316**
TYPE OF TEST	**ROUTINE TEST**
DATE	9-10-03
COPIES MAILED TO:	BERNITA.STEVENS@INDSYS.GE.COM PAUL_COSTANZO@SIHI.COM

ROUTINE TEST RESULTS — GENERAL ELECTRIC MOTORS — DATE 09/09/03
MOTOR TECHNOLOGY DEPARTMENT

CUSTOMER: STERLING FLUID

303 INDUSTRIAL BLVD
PO BOX 460
GRAND ISLAND NY 14072

****

CUSTOMER ORDER NO. 108263

G.E. REQUISITION NO. WEB1209316
G.E. ORDER NUMBER. 0107336A

****

ITEM NUMBER	001001	MODEL NUMBER	5KS364GT504P
DESIGN NUMBER	36DS5056A	OUTLINE NUMBER	225B5360AD
TYPE	KS	FRAME	L364HP16
HP	20	RPM-FL	705
PHASE	3	VOLTS	460
HZ	60	SERVICE FACTOR	1.15
TIME RATING	CONT	AMB-MAX	40
INSUL CLASS	F	NEMA DESIGN	B
CODE	G	AMPS-FL	27.1
EFFY NOM	91.0	EFFY GUAR	90.2
MAX KVAR	8.3	POWER FACTOR	76.0
ENCLOSURE	TEFC	CATALOG NUMBER	XX
BEARING-DE	6312ZZC3	BEARING-ODE	6212ZZC3

****

TEST CHARACTERISTICS

SERIAL NUMBER : 0107336A — DATE OF TEST : 07/16/03

NO LOAD 460 VOLTS 3 PHASE 60 HZ
AMPS 13.9
RPM 720

IMPEDENCE TEST 115 VOLTS 1 PHASE 60 HZ
AMPS 15.2

WINDING RESISTANCE OHMS (AMBIENT TEMP 25.0 C)
STATOR .5833

VIBRATION (MILS)
AXIAL 0.100
RADIAL (DE) 0.100
RADIAL (ODE) 0.100

DIELECTRIC TEST
STATOR WINDING WITHSTOOD 2640 VOLTS AC FOR 1 SECOND (YES)

NOTES: DATA ON TEST FROM THIS MOTOR
THE AIR GAP, END PLAY, CONDITION OF BEARINGS
(INCLUDING LUBRICATION), ROTOR BALANCE AND
AIR NOISE HAVE BEEN INSPECTED AND ARE SATISFACTORY.

TESTED BY OWENSBORO MOTOR PLANT

ROUTINE TEST RESULTS

GENERAL ELECTRIC MOTORS
MOTOR TECHNOLOGY DEPARTMENT

DATE 09/09/03

JSTOMER: STERLING FLUID

303 INDUSTRIAL BLVD
PO BOX 460
GRAND ISLAND NY 14072

****

CUSTOMER ORDER NO. 108263

G.E. REQUISITION NO. WEB1209316
G.E. ORDER NUMBER. 0107336B

****

ITEM NUMBER	001001	MODEL NUMBER	5KS364GT504P
DESIGN NUMBER	36DS5056A	OUTLINE NUMBER	225B5360AD
TYPE	KS	FRAME	L364HP16
HP	20	RPM-FL	705
PHASE	3	VOLTS	460
HZ	60	SERVICE FACTOR	1.15
TIME RATING	CONT	AMB-MAX	40
INSUL CLASS	F	NEMA DESIGN	B
CODE	G	AMPS-FL	27.1
EFFY NOM	91.0	EFFY GUAR	90.2
MAX KVAR	8.3	POWER FACTOR	76.0
ENCLOSURE	TEFC	CATALOG NUMBER	XX
BEARING-DE	6312ZZC3	BEARING-ODE	6212ZZC3

****

TEST CHARACTERISTICS

SERIAL NUMBER : 0107336B DATE OF TEST : 08/15/03

NO LOAD 460 VOLTS 3 PHASE 60 HZ
AMPS 11.6
RPM 720

IMPEDENCE TEST 115 VOLTS 1 PHASE 60 HZ
AMPS 15.4

WINDING RESISTANCE OHMS (AMBIENT TEMP 25.0 C)
STATOR .5752

VIBRATION (MILS)
AXIAL 0.250
RADIAL (DE) 0.100
RADIAL (ODE) 0.100

DIELECTRIC TEST
STATOR WINDING WITHSTOOD 2640 VOLTS AC FOR 1 SECOND (YES)

NOTES: DATA ON TEST FROM THIS MOTOR
THE AIR GAP, END PLAY, CONDITION OF BEARINGS
(INCLUDING LUBRICATION), ROTOR BALANCE AND
AIR NOISE HAVE BEEN INSPECTED AND ARE SATISFACTORY.

TESTED BY OWENSBORO MOTOR PLANT

ROUTINE TEST RESULTS | GENERAL ELECTRIC MOTORS
MOTOR TECHNOLOGY DEPARTMENT | DATE 09/09/03

JSTOMER: STERLING FLUID

303 INDUSTRIAL BLVD
PO BOX 460
GRAND ISLAND NY 14072

****

CUSTOMER ORDER NO. 108263

G.E. REQUISITION NO. WEB1209316
G.E. ORDER NUMBER. 0107336C

****

ITEM NUMBER	001001	MODEL NUMBER	5KS364GT504P
DESIGN NUMBER	36DS5056A	OUTLINE NUMBER	225B5360AD
TYPE	KS	FRAME	L364HP16
HP	20	RPM-FL	705
PHASE	3	VOLTS	460
HZ	60	SERVICE FACTOR	1.15
TIME RATING	CONT	AMB-MAX	40
INSUL CLASS	F	NEMA DESIGN	B
CODE	G	AMPS-FL	27.1
EFFY NOM	91.0	EFFY GUAR	90.2
MAX KVAR	8.3	POWER FACTOR	76.0
ENCLOSURE	TEFC	CATALOG NUMBER	XX
BEARING-DE	6312ZZC3	BEARING-ODE	6212ZZC3

****

TEST CHARACTERISTICS
SERIAL NUMBER : 0107336C DATE OF TEST : 07/16/03

NO LOAD 460 VOLTS 3 PHASE 60 HZ
AMPS 12.0
RPM 720

IMPEDENCE TEST 115 VOLTS 1 PHASE 60 HZ
AMPS 16.0

WINDING RESISTANCE OHMS (AMBIENT TEMP 25.0 C)
STATOR .5831

VIBRATION (MILS)
AXIAL 0.100
RADIAL (DE) 0.100
RADIAL (ODE) 0.100

DIELECTRIC TEST
STATOR WINDING WITHSTOOD 2640 VOLTS AC FOR 1 SECOND (YES)

NOTES: DATA ON TEST FROM THIS MOTOR
THE AIR GAP, END PLAY, CONDITION OF BEARINGS
(INCLUDING LUBRICATION), ROTOR BALANCE AND
AIR NOISE HAVE BEEN INSPECTED AND ARE SATISFACTORY.

ESTED BY OWENSBORO MOTOR PLANT

GE Industrial Systems
INDUSTRIAL MOTORS ENGINEERING
2000 TAYLOR STREET
FORT WAYNE, IN 46801-2205

NOISE TEST REPORT

INDUCTION MOTOR

CUSTOMER: STERLING FLUID SYSTEMS
303 INDUSTRIAL BLVD
P O BOX 460
GRAND ISLAND NY

CUSTOMER PART NUMBER:
MARKS:

TEST REQUEST:	2003-OMP-160
REQUISITION / ITEM:	WEB1209316/001
JOB NUMBER:	030603460
CUSTOMER PO:	108263
MODEL NUMBER:	5KS364GT504P
DESIGN NUMBER:	36DS5056A
SERIAL NUMBER:	07336A
DATE OF TEST:	January 29, 2004

NAMEPLATE DATA

POWER OUTPUT:	20 HP	**FRAME:**	L364HP16
SPEED:	705 RPM	**ENCLOSURE:**	TEFC
VOLTAGE:	460 VOLTS	**NEMA DESIGN:**	B
CURRENT:	27.1 AMPS	**SERVICE FACTOR:**	1.15
FREQUENCY:	60 HZ	**NOMINAL FULL-LOAD EFFICIENCY:**	91.0 %
MAX AMBIENT:	40 °C	**MINIMUM GUARANTEED EFFICIENCY:**	90.2 %

SOUND PRESSURE LEVELS

IN DB. RE. 0.0002 MICROBAR, MEASURED AT 3 FEET FROM MAJOR SURFACES

OCTAVE	125	250	500	1000	2000	4000	8000	DB A
AVG READING	59.2	63.2	61.6	58.1	53.8	59.3	62.2	78.3

APPROVED & CERTIFIED BY *Abhishek Tripathy* DATE February 3, 2004
DATA FROM TEST ON THIS MOTOR TESTED AT OWENSBORO MOTOR PLANT

GE Industrial Systems
INDUSTRIAL MOTORS ENGINEERING
2000 TAYLOR STREET
FORT WAYNE, IN 46801-2205

NOISE TEST REPORT

INDUCTION MOTOR

CUSTOMER: STERLING FLUID SYSTEMS
303 INDUSTRIAL BLVD
P O BOX 460
GRAND ISLAND NY

CUSTOMER PART NUMBER:
MARKS:

TEST REQUEST:	2003-OMP-160
REQUISITION / ITEM:	WEB1209316/001
JOB NUMBER:	030603460
CUSTOMER PO:	108263
MODEL NUMBER:	5KS364GT504P
DESIGN NUMBER:	36DS5056A
SERIAL NUMBER:	07336B
DATE OF TEST:	January 29, 2004

NAMEPLATE DATA

POWER OUTPUT:	20 HP	**FRAME:**	L364HP16
SPEED:	705 RPM	**ENCLOSURE:**	TEFC
VOLTAGE:	460 VOLTS	**NEMA DESIGN:**	B
CURRENT:	27.1 AMPS	**SERVICE FACTOR:**	1.15
FREQUENCY:	60 HZ	**NOMINAL FULL-LOAD EFFICIENCY:**	91.0 %
MAX AMBIENT:	40 °C	**MINIMUM GUARANTEED EFFICIENCY:**	90.2 %

SOUND PRESSURE LEVELS

IN DB. RE. 0.0002 MICROBAR, MEASURED AT 3 FEET FROM MAJOR SURFACES

OCTAVE	125	250	500	1000	2000	4000	8000	**DB A**
AVG READING	48.8	56.5	61.2	54.7	53	58.7	61.8	**77.1**

APPROVED & CERTIFIED BY *Abhishek Tripathy* DATE February 4, 2004
DATA FROM TEST ON THIS MOTOR TESTED AT OWENSBORO MOTOR PLANT

GE Industrial Systems
INDUSTRIAL MOTORS ENGINEERING
2000 TAYLOR STREET
FORT WAYNE, IN 46801-2205

NOISE TEST REPORT

INDUCTION MOTOR

CUSTOMER: STERLING FLUID SYSTEMS
303 INDUSTRIAL BLVD PO BOX 460
GRAND ISLAND NY 14072

CUSTOMER PART NUMBER:
MARKS:

TEST REQUEST:	2003-OMP-160
REQUISITION / ITEM:	WEB1209316 / 1
JOB NUMBER:	30603460
CUSTOMER PO:	108263
MODEL NUMBER:	5KS364GT504P
DESIGN NUMBER:	36DS5056A
SERIAL NUMBER:	07336C
DATE OF TEST:	January 22, 2004

NAMEPLATE DATA

POWER OUTPUT:	20 HP	**FRAME:**	L364HP16
SPEED:	705 RPM	**ENCLOSURE:**	TEFC
VOLTAGE:	460 VOLTS	**NEMA DESIGN:**	B
CURRENT:	27.1 AMPS	**SERVICE FACTOR:**	1.15
FREQUENCY:	60 HZ	**NOMINAL FULL-LOAD EFFICIENCY:**	91.0 %
MAX AMBIENT:	40 °C	**MINIMUM GUARANTEED EFFICIENCY:**	90.2 %

SOUND PRESSURE LEVELS

IN DB. RE. 0.0002 MICROBAR, MEASURED AT 3 FEET FROM MAJOR SURFACES

OCTAVE	125	250	500	1000	2000	4000	8000	**DB A**
AVG READING	42.3	51.1	54	51.4	53.2	60.1	63.3	**70.9**

APPROVED & CERTIFIED BY *Biplab Talukdar*
DATA FROM TEST ON THIS MOTOR

DATE January 29, 2004
TESTED AT OWENSBORO MOTOR PLANT

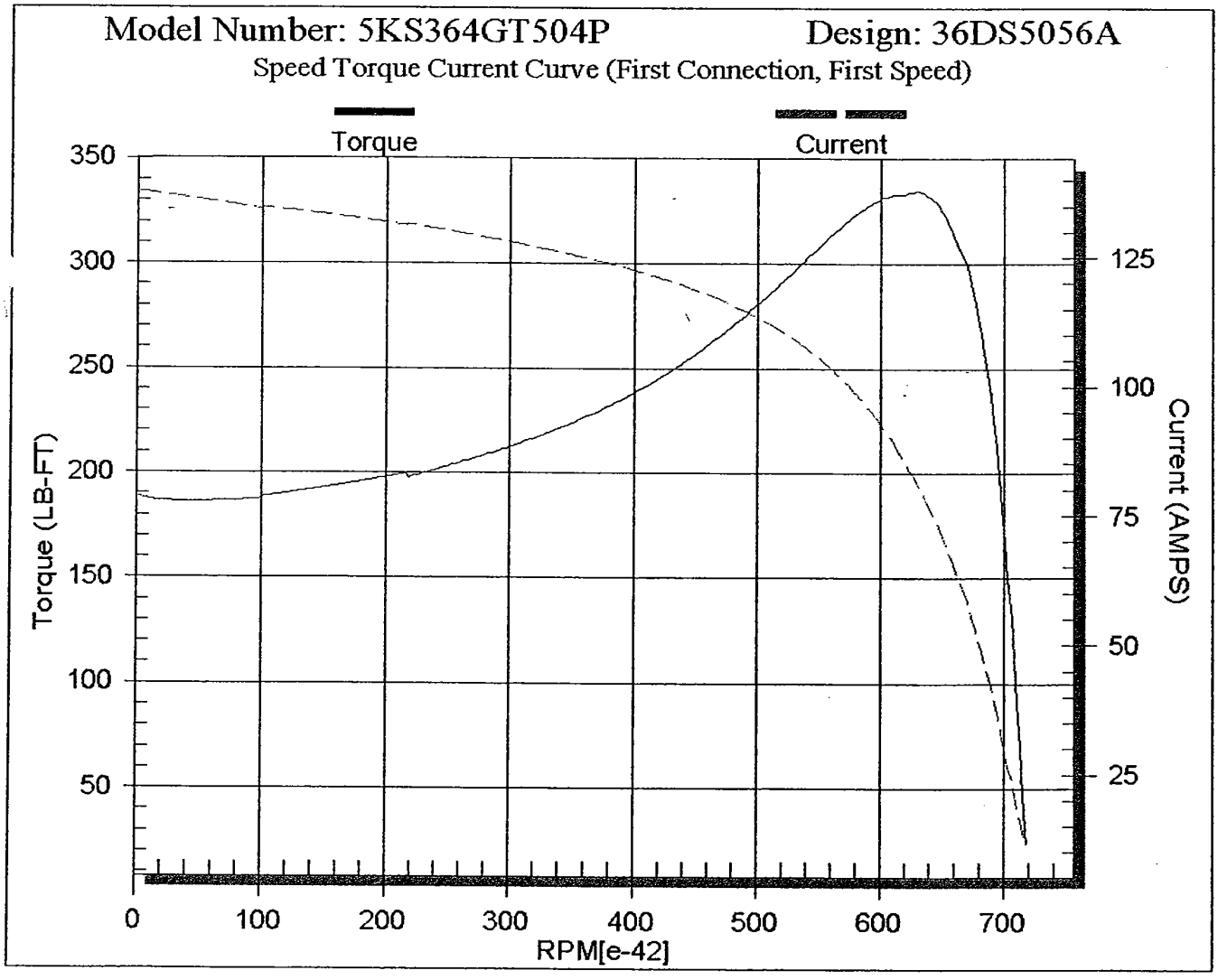
Performance Characteristics 1st Winding 1st Connection Design: 36DS5056A

LOAD %	125.0	115.0	100.0	75.0	50.0	25.0	0.0
% EFF	89.97	90.55	91.00	91.99	91.75	88.34	0.00
% PF	78.12	77.50	76.00	70.56	59.64	38.52	4.37
AMPS	33.29	30.68	27.10	21.63	17.10	13.75	11.53

TORQ(FL)#FT 148.95 **TORQ(LR)%FL** 127.74 **TORQ(BD)%FL** 223.96
AMPS(LR) 137.93 **PF AT START** 0.39

This motor is capable of two cold or one hot start with a maximum connected load inertia of 5189.9 Lb-Ft Sq (218.7 Kgs-Meter Sq) at 100% voltage, where the load torque varies with the square of the speed. Acceleration time with maximum inertia and the above load type is 64 seconds. Safe stall time at 100% voltage is 142 seconds cold, 116 hot. Rotor inertia is 24.23 Lb-Ft Sq (1.021 Kgs-Meter Sq).

Open Circuit A-C: 0.283 **Short Circuit D-C:** 0.014
Short Circuit A-C: 0.022 **X/R Ratio:** 5.278



Mixer Shop Performance Test Procedure
Acceptance Criteria

APPENDIX B:

DIN 1944/III - As Applied to Sterling-Halberg Draft Tube Sludge Mixers

DIN 1944/III - Acceptance Test for Centrifugal Pumps

Din 1944 is the German standard for all centrifugal pumps. The Sterling-Halberg mixer is not a pump. However it has similar characteristics to a centrifugal axial flow pump. The standard in Germany for acceptance criteria for all types of centrifugal pumps is DIN 1944. The part of this specification pertaining to the mixer is accuracy class III, part 32.3.1 (refer to page 5 of specification) where:

$$\frac{Q_N}{H_N} \left| \frac{dH}{dQ} \right| > 0.2$$

The following variations to DIN 1944/III are taken as applicable to draft tube sludge mixers:

- Acceptance and guarantee is for flow only
- +5% Error of Instruments; $0.9<x<1.15$
- Acceptance levels for any mixer are as shown in the tabulation below.
- Mixer performance is not given as a curve, but as tabulated data
- NPSH is not applicable to mixers
- Test setup is as described in Mixer Shop Test Performance Procedure previously sent
- The shop test procedure submitted takes precedence of the DIN 1999 specifications where conflicts exist.

MIXER - MFS-4	**Acceptable (Max. Limits)**	**Average Acceptable Values**
Power Required at Shaft	10.45 Kw (14.1 HP)	9.5 Kw (12.8 HP)
***Vibration (Whichever is less)**	7.1 mm/s or 5 mil p-p	<2 mm/s or 1 mil
Temperature at Mixer Surface	90 deg C (194 deg F)	<50 deg C (122 deg F)

* Test bed vibration levels will be higher than the field levels because the seating ring is not grouted into place, as it will be when installed in the digester.

APPENDIX C

Unit Conversions

Flow:	USgpm	=	M^3/Hr	x	4.4033
Power:	bhp	=	kW	x	1.341

Vibration:

(V) velocity ft/s = mm/s x 1/25.4

(D) displacement = mils (peak to peak)

$$\text{(D) displacement} = \frac{V \times 19100}{RPM}$$